Detecting and Eliminating Illicit Discharges in the Stevens Branch Watershed and Stowe

Final Report

February 19, 2016

Dye (and wastewater) flowing from a leaking sewer main into a catchbasin on Hill Street in Barre, November 24, 2015. Two leaking sections of the sewer main were replaced in December, 2015.

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Table of Contents

List of Tables

List of Figures

INTRODUCTION

Five municipalities participated in the Stevens Branch and Stowe Illicit Discharge Detection and Elimination (IDDE) project: Barre City, Barre Town, Berlin, Stowe, and Williamstown. The goal of the project was to improve water quality by identifying and eliminating contaminated, non-stormwater discharges (illicit discharges) entering stormwater drainage systems and discharging to surface waters in the participating municipalities.

Illicit discharges contribute to the degradation of local receiving waters and can pose a public health risk. Among the many types of illicit discharges that have been identified in Vermont, sanitary wastewater is generally considered as having the greatest impact. Wastewater flowing to storm drains from directly connected municipal sewers or building sewer pipe connections can result in significant nutrient and microbial pollution. Sanitary wastewater can also enter storm drains through indirect connections, leaking from sanitary sewers, sewer service laterals, and malfunctioning septic systems into stormwater pipes and structures. Other types of illicit discharges encountered in previous studies include graywater connections (washwater from laundry machines, sinks, dishwashers, etc.), mop water and oil dumping via floor drains and catchbasins, pet waste and trash dumping, vehicle washing runoff, and (infrequently) industrial discharges. Municipal water leaks are also discovered in the course of IDDE studies.

Without special study many illicit discharges can go undetected for years, even decades. Diluted wastewater flows may appear clean and may travel a circuitous path to the storm drain outfall. Other discharges, such as illegal dumping to catchbasins, are intermittent; hence difficult to catch. Without exception, our experience has been that municipalities and private owners on whose properties we have discovered an illicit discharge were previously unaware the discharge was occurring. Through the sustained efforts of DEC, municipalities, organizations, and private contractors the prevalence of illicit discharges has been declining over the last decade. However; it must also be recognized that new illicit discharges arise every year as aging infrastructure fails and plumbing mistakes are inevitably made.

The project was conducted by the Friends of the Winooski River (FWR) and their subcontractor Stone Environmental (Stone) under a grant from the Vermont Department of Environmental Conservation (DEC). The geographic scope of the project included the entire extents of the municipal closed drainage systems in the participating municipalities. Prior to this assessment, the Vermont Department of Environmental Conservation prepared stormwater infrastructure maps. This infrastructure mapping was used to plan the assessment and to guide further investigations in certain systems with suspected illicit discharges.

In Barre City and Berlin, the results of earlier illicit discharge studies conducted by FWR and Stone were reviewed prior to this project to select stormwater drainage systems to assess or reassess. The scopes of the three previous studies were more limited than the present study and they were completed without the benefit of DEC's stormwater infrastructure mapping. These studies are summarized as follows:

1. 2003 Barre City project by FWR, funded by a Section 319 Water Quality Grant administered by DEC: Primarily a visual survey conducted by volunteers of the major outfalls to the Stevens Branch.
2. 2006 Barre City project by FWR and Stone, funded by Barre City as a Supplemental Environmental Project (in lieu of a state fine for an ammonia release to the Stevens Branch): An assessment of 78 outfalls to the Stevens Branch and its major tributaries with advanced investigations (primarily camera inspection) of approximately 12 stormwater drainage systems with suspected illicit discharges.
3. 2009 Mid-Winooski project by FWR and Stone, funded by a DEC Clean and Clear water quality grant: Outfalls were assessed in Berlin, Montpelier, and Northfield. In Berlin, 60 outfalls to the Stevens Branch were assessed.

The locations of the outfalls assessed in the second and third studies were compared with the more recent infrastructure mapping by DEC to identify which outfalls in Barre City and Berlin had been previously assessed. The 2003 study was not considered in this comparison because, while it provided some relevant information, it was not sufficiently rigorous for these purposes. This comparison was made in GIS using the proximity of the assessed outfalls to outfalls mapped in DEC's infrastructure geodatabase. All systems that were not previously assessed at the outfall were designated for assessment in this project with the exception of highway drainage systems along Route 62, which were considered to have minimal potential for illicit discharges. Previously assessed systems were then grouped in the following categories:

I. Small and medium sized systems where contaminants were not detected at the outfall.
II. Large systems with no indication of contamination, but for which outfall assessment alone may not have been sufficient.
III. Systems where contaminants were detected and further investigation did not locate a specific pollutant source.
IV. Systems where contaminants were detected, a specific pollutant source was identified, and a correction was either implemented or planned.

Together with the unassessed systems, the previously assessed systems in Barre City and Berlin in categories II, III, and IV above were reassessed.

In total, FWR and Stone assessed 595 stormwater drainage systems in the participating municipalities (Table 1). 147 of these systems were flowing or dripping when assessed. Systems with 10 or fewer inlets were typically assessed only at the outfall, while larger systems were also assessed at selected junction manholes and catchbasins to account for possible dilution and degradation of contaminants within the system. The distribution of the assessed systems by municipality and the time periods the assessments were completed are as follows:

Table 1. Systems assessed and period of assessment in each municipality

Municipality	Total Number	Organization	Timeframe
Barre City	227	Stone/FWR	July–October, 2014
Barre Town	193	Stone/FWR	June–July, 2014
Berlin	73	FWR	July–September, 2015
Stowe	72	Stone	July–September, 2015
Williamstown	30	Stone	October–November, 2015

Among the 595 systems assessed, contaminants and/or observations indicating a possible illicit discharge were detected in 93 systems. In September 2015, Stone began investigating certain priority systems to confirm the presence of illicit discharges and to attempt to determine their sources. The project contract allowed for advanced investigation of a maximum of 14 systems. Systems were prioritized for investigation based on their potential water quality impact as well as certain operational considerations. In cooperation with the municipalities, five systems were investigated in Barre City, five in Barre Town, and four in Williamstown. The results of these 14 advanced investigations are described in this report.

The 79 remaining systems in which contaminants were detected will require reassessment to confirm whether or not a chronic illicit discharge is present. This follow-on work is outside the scope of the present project. DEC may elect to pursue this additional assessment and investigation work under a separate contract.

Based on past experience, we expect that upon repeated testing many of these systems will prove not to be contaminated, especially where contaminants measured during the initial assessment were at concentrations near the analytical limits of detection. Where presence of an inappropriate discharge is confirmed, advanced investigation will be necessary to determine the source and plan for correction. In Table 2, we attempted to place the 79 systems for which further work is required into two categories—reassessment or advanced investigation—based on the level of effort we assume will be required to address them. All systems where optical brightener was detected were placed in the advanced investigation category, because a chronic illicit discharge necessitating considerable investigation is more likely in these systems than in systems without optical brightener. Two additional systems (BE100 and ST370) were added to the advanced investigation category because we believe the evidence for contamination is strong and considerable dye testing will likely be required to find the contaminant source.

Table 2. Stormwater systems designated for reassessment or advanced investigation

Barre City		Barre Town		Berlin		Stowe	
Reassessment	Advanced Investigation	Reassessment	Advanced Investigation	Reassessment	Advanced Investigation	Reassessment	Advanced Investigation
BC020	BC130	BT100		BE080	BE100	ST010	ST170
BC110	BC290	BT390		BE160		ST030	ST250
BC120	BC410	BT550		BE210		ST040	ST350
BC170	BC450	BT570		BE420		ST420	ST370
BC180	BC520	BT660		BE430			ST700
BC560	BC550	BT670		BE440			
BC790	BC570	BT680		BE480			
BC1310	BC800	BT690		BE500			
BC1320	BC830	BT950					
BC1420	BC990	BT1010					
BC1490	BC1290	BT1050					
BC1510	BC1300	BT1090					
BC1710	BC1620	BT2000					
BCF020	BCF170	BT2050					
BCF040	BCF470	BT2120					
BCF050		BT2260					
BCF070		BT2370					
BCF140		BT2420					
BCF180		BT2440					
		BT2470					
		BT2480					
		BT2510					
		BT2590					
		BT2650					
		BT2670					
		BT2740					
		BT2820					
19	**15**	**27**	**0**	**8**	**1**	**4**	**5**

1. METHODS

1.1 Preparing for the assessment

Preparation for the illicit discharge assessment included obtaining and assembling necessary equipment and supplies; preparing field maps, a Health and Safety Plan, and other documents and organizing these in a project notebook; and meeting with municipal managers and/or public works personnel to plan the project in detail. Large-format field maps were prepared by overlaying DEC's stormwater infrastructure mapping on the best available orthophotography. These maps were consulted in the kickoff meetings and were annotated in the field. The kickoff meetings were an opportunity to collect information regarding:

- General schedules of road and wastewater and stormwater collection system projects (to avoid conflict with construction activities).
- Locations of any known, suspected, or potential cross connections, combined sewer overflows, and sanitary sewer overflows.
- In-house capabilities of the town or city to inspect pipelines and perform other advanced investigation techniques.

1.2 Dry weather survey

Stormwater drainage systems were assessed during dry weather to minimize dilution by stormwater runoff. Dry weather was defined as negligible rainfall (less than 0.1 inches) since approximately 12:00 p.m. on the previous day. Stormwater drainage systems with 10 or fewer inlets were typically assessed only at the outfall. Within larger stormwater drainage systems, the effects of dilution must be considered; therefore, selected catchbasins and junction manholes were also assessed. Stormwater structures were accessed along the public right-of-way or from the receiving waterbody, as appropriate. Where access permission was obtained, stormwater structures located on private property were also assessed, particularly if these structures were connected to a municipal drainage system.

Every outfall or other stormwater structure assessed was assigned a unique identifying code. A visual inspection was made of the condition of each discharge point and the area immediately below each discharge point. If present, dry-weather flows were observed for color, odor, turbidity, and floatable matter. Obvious deficiencies in the structure, such as severe corrosion, were noted. Dry weather flows were sampled by hand or using a telescoping pole. At catchbasins and manholes located at junctions in the storm sewer, samples were collected independently from each in-flowing pipe, when possible. Field data were entered on printed assessment data forms (Appendix A).

Each dry weather discharge was tested for ammonia, methylene blue active substances (common detergents), and the presence of optical brightener to identify potential illicit discharges from laundry facilities, leaking sanitary sewers, and cross-connections. Optical brighteners are fluorescent dyes contained in most laundry detergents. Specific conductance was measured as an indication of the

dissolved solids content. To detect treated municipal water leakage, samples were also analyzed for free chlorine concentration.

With few exceptions, structures that were not flowing at the time of the initial inspection were assumed not to have illicit connections and no further assessment of these structures was performed. Our general procedure is to provide additional assessment of non-flowing structures only if there is associated evidence of contamination, such as suds, offensive odors, or certain deposits.

1.3 Water analysis methods

The ammonia concentration was tested using Aquacheck ammonia test strips. Samples were tested for methylene blue active substances using CHEMetrics test kit K-9400, a method consistent with APHA Standard Methods, 21st ed., Method 5540 C (2005). Free chlorine analysis was conducted with powdered DPD reagent (Hach Method 8167, equivalent to USEPA method 330.5) and a portable Hach DR/900 colorimeter. Specific conductance was measured using an Oakton model conductivity meter, according to Stone Environmental Standard Operating Procedure (SOP) 5.23.3 (Appendix B).

Optical brightener monitoring was performed at outfalls and selected catchbasins and manholes that were flowing at the time of inspection, according to Stone Environmental SOP 6.38.0 (Appendix B). To test for optical brighteners, a cotton pad is placed in the flow stream for a period of 4-10 days, after which the pad is rinsed, dried, and viewed under a long-wave ultraviolet light ("black light"). Florescence of the pad (seen on the right pad in Figure 1) indicates the presence of optical brightener. OB pads are held in a sleeve of plastic screen, clipped to the rim of the outfall pipe or secured with fishing line to a rock or other anchor. At catchbasins and manholes located at junctions in the storm sewer, OB pads are deployed in incoming pipes if possible, but are more often hung from the catchbasin grate or manhole rung into the sump. An advantage of optical brightener monitoring is that some intermittent or dilute wastewater discharges may be detected due to the multiple-day exposure of the pad, whereas the contaminant may not be detected in tests performed on grab samples.

Figure 1. Positive OB monitoring pad under fluorescent lamp (left) and UV lamp (right)

Table 3 identifies water quality tests that FWR and Stone performed at all discharge points and selected catchbasins and manholes that were flowing at the time of inspection.

Table 3. Water quality tests performed at flowing structures

Parameter	Sample Container	Analytical Method
Ammonia	Plastic vial	Aquacheck ammonia test strips
MBAS detergents (anionic surfactants)	Plastic vial	APHA Standard Methods, 21st ed., Method 5540 C (2005)
Free chlorine	Glass jar	By DPD, Hach Method 8167 (EPA 330.5)
Specific conductance	Glass jar	Stone SOP 5.23.3
Optical brightener	Cotton test pads	Stone SOP 6.38.0

1.4 Advanced investigations

Results of the initial assessments (Appendix C) were reviewed to determine which systems warranted further assessment or investigation. A total of 93 systems were designated for further work. Stormwater drainage systems were designated for follow-up sampling and/or investigation where benchmarks summarized in Table 4 were exceeded. Note that in this study samples were collected for *E. coli* analysis during the advanced investigation phase only; *E. coli* data were not used to identify which systems warranted advanced investigation. In addition to constituent concentrations, observations made at the outfall or within the drainage system were considered in designating systems for further investigation.

Table 4. Benchmark concentrations for determination of illicit discharges

Test	Benchmark	Remarks
E. coli	>= 400 E. coli/100 mL	Undiluted municipal wastewater will generally have *E. coli* levels at least an order of magnitude higher than this benchmark. Pet waste and wildlife sources can also cause elevated *E. coli* levels.
Ammonia	>= 0.25 mg/L	In the absence of other wastewater indicators, investigation is performed when the ammonia concentration is 0.5 mg/L or higher. If other wastewater indicators are present, then the 0.25 mg/L benchmark is used. Decomposing vegetation under anoxic conditions can release ammonia to water, which can be misleading.
Anionic detergents (methylene blue active substances)	> 0.2 mg/L	Detection of low concentrations (0.1-0.3 mg/L) of anionic detergents is common at stormwater outfalls. Most detections are not correlated with other wastewater indicators and do not lead to a definite source. These detections may be attributable to outdoor washing. However, concentrations as low as 0.2 mg/L have occasionally led us to significant wastewater sources that might otherwise have been missed; therefore this is a useful test to trigger further sampling or investigation.
Optical brightener	presence	Presence usually indicates contamination by sanitary wastewater or washwater. Exposure of the OB test pad for 4-10 days enables diluted and intermittent discharges to be detected. Unfortunately, petroleum fluoresces at the same wavelength as optical brighteners. Optical brightener testing in catchbasins and manholes has proven to be our most reliable method of bracketing sources of contamination within storm sewers.
Free chlorine	> 0.10 mg/L	The field test used for free chlorine analysis is sufficiently sensitive to detect municipal tapwater sources diluted by groundwater or runoff approximately 3 to 10 fold, depending on the strength of the tapwater chlorine residual. Chlorine is a good indicator of tapwater leaks and graywater sources. Chlorine is degraded in the presence of organic materials; therefore it is not a good wastewater indicator.

In September 2015, Stone began investigating certain priority systems to confirm the presence of illicit discharges and to attempt to determine their sources. The project contract allowed for advanced investigation of a maximum of 14 systems. Because more than 14 systems are suspected of receiving illicit discharges, systems were prioritized for investigation based on their potential water quality impact as well as certain operational considerations. In cooperation with the municipalities, investigations were begun of five systems in Barre City, five in Barre Town, and four in Williamstown. As described in the Introduction section, the remaining systems in which contaminants were detected may be reassessed and investigated in a subsequent project.

In the 14 systems where investigations were begun, additional sampling was performed within the drainage system to locate or bracket the origin of the contaminated flow, if present. The goal was to bracket the contaminant source between adjacent structures, such as a stormline connecting a catchbasin to a down-pipe manhole. DEC's stormwater infrastructure mapping was used to guide this effort. Annotated maps of the 14 systems are presented in Appendix D.

To locate or bracket contaminant sources within storm sewer segments, the same testing methods or a subset were used as in the dry weather survey. The most reliable method to bracket sources of wastewater contamination is usually optical brightener monitoring throughout the drainage system. The presence and appearance of dry-weather flows were also useful in isolating sources of contamination within storm sewer segments.

After bracketing the discharge sources as closely as possible, Stone communicated results to our municipal contacts and began dye testing in certain systems. The City of Barre also began inspection of stormwater lines using both tracked and push cameras.

1.4.1 *E. coli* and phosphorus

In the 14 stormwater drainage systems investigated under this contract, water samples were collected for total phosphorus and *E. coli* analyses at outfalls where wastewater contamination was suspected (because of a positive optical brightener test, elevated ammonia, and/or wastewater odor). The State of Vermont Agriculture and Environmental Laboratory performed both analyses. Phosphorus was analyzed because of its impact on the ecology and use of Lake Champlain. *E. coli* bacteria levels provide an indication of fecal contamination; due to human health concerns, *E. coli* enumeration is recommended for all fresh waters used for contact recreation or for water supply.

Samples for *E. coli* analysis were collected in sterile, plastic 100-mL bottles and analyzed using Quanti-tray. Total phosphorus was analyzed by DEC's Standard Operating Procedure (SOP) for Determination of Phosphorus by Flow Injection, Revision 6. The preservation and holding time requirements are given in Table 5.

Table 5. Laboratory sample analyses

Parameter	Sample Container	Analytical Method	Sample Preservation	Holding Time
Total P	Glass vial (50 mL)	DEC SOP, Revision 6	Cool (4°C)	28 days
E. coli	Plastic (100 mL)	SM 9223B (Colilert Quanti-Tray)	Cool (4°C), sodium thiosulfate	6 hours

At the same time that water samples were collected for *E. coli* and total phosphorus analyses, flow measurements were made to enable calculation of total phosphorus mass loading. Flow was measured by timing the filling of a container of known volume or using the float method.

2. BARRE CITY RESULTS

Appendix C.1 presents water quality data for stormwater drainage systems assessed in Barre City. Of the 227 systems assessed in Barre City, 39 were designated for further investigation due to detection of one or more contaminants and/or observations indicating probable contamination. Investigations were initiated for five of these systems (BC140, BC240, BC1100, BC1120, and BC1630), all of which were suspected of receiving sanitary wastewater flows based on detection of optical brightener and other contaminants. The City of Barre Department of Public Works led these investigations, with guidance and assistance from Stone. The investigations of these systems are described individually below. The remaining 34 systems designated for future work (Table 2) may be reassessed and/or further investigated in a follow-on study. Not including the five investigations completed or in progress, 15 systems in Barre City were designated for advanced investigation in a future study due to detection of optical brightener, a strong indication that an illicit wastewater or washwater connection is present.

On January 19, 2016, a final project meeting was held with the City of Barre to discuss the assessment results, the status of ongoing investigations, and plans for infrastructure improvements. The attendees were Steve Micheli (Director of Public Works), Everett Hoyt (Barre Public Works), Jim Pease (DEC), Dave Braun (Stone), Ann Smith (FWR), and Shawn White (FWR). Mr. Micheli was provided with a set of maps of outfall locations where contaminants were detected. Information gathered during this meeting regarding infrastructure improvements is discussed in the following sections, where applicable.

2.1 BC140

The BC140 system drains the northern end of Westwood Parkway and Palmisano Plaza, as well as Arioli Avenue. It discharges via a 24-inch diameter corrugated metal pipe to an unnamed tributary of the Stevens Branch at the intersection of Westwood Parkway and Prospect Street (Map BC-1).

Table 6. Water analysis data for outfall BC140

Structure ID	Date	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Cond. (µs/cm)	OB Result	Observations
BC140	7/31/14	Flowing	0.1	0.00	0.1	1617	Pos. (strong)	Foul odor in stream channel
	9/22/15	Flowing (0.066 L/s)	0.1	0.10	0.2	1354	--	Clear, no odor. Dog waste bags in receiving stream channel
	9/23/15	Flowing	--	--	--	--	Pos. (strong)	Dog waste bags in catchbasins along Westwood. Oil residue on catchbasin grate near 31 Palmisano Plaza.

Findings:

- Optical brightener was detected at the outfall on July 31, 2014. A foul order was observed in the receiving stream channel.
- On September 22, 2015, samples were collected at the outfall for *E. coli* and total phosphorus analysis (Table 20). The phosphorus concentration was very low, 12 µg/L. The *E. coli* concentration (170 MPN/100 mL) was lower than expected given the presence of bags of dog waste in catchbasins in this system. The stream channel upstream and downstream of the outfall was also littered with bags of dog waste.
- On September 23, 2015, monitoring pads were set in all the flowing catchbasins throughout the system. Optical brightener was detected in all structures from the outfall up-pipe to catchbasin CB15 on Palmisano Plaza (Map BC-1). Optical brightener was not detected in basins on Westwood Parkway above its intersection with Arioli Avenue.
- Dog waste bags were noted in several catchbasins on Westwood Parkway on September 23, 2015. Disposal of dog waste in catchbasins in this neighborhood is the likely source of the foul odors observed during the 2014 assessment.
- On September 23, 2015, a petroleum odor was observed in catchbasin CB12 and oily residue was observed in catchbasin CB13 on Palmisano Plaza (Map BC-1). Note that CB13 is not mapped accurately; it is located in front of 31 Palmisano Plaza. The catchbasin grate had an oily appearance, indicating waste oil was recently dumped into the drain. A dumpster was located next to this catchbasin in front of 31 Palmisano Plaza (Figure 2).
- In mid-November, Everett Hoyt (City of Barre) TV'd the storm sewer from CB14 to CB15. There was clear flow the length of the pipe. There were pipe penetrations at 57 ft. (Figure 3), 87 ft., and 160 ft. and clear flow from the pipes at 57 and 160 ft.

Figure 2. Oil on catchbasin grate

Figure 3. Flowing pipe 57 feet down storm sewer from CB14

Figure 4. Path to 31 Palmisano Plaza; material apparently spread to absorb waste oil

- On November 24, 2015, Dave Braun (Stone) and Everett Hoyt (City of Barre) inspected catchbasins on Palmisano Plaza. At 31 Palmisano Plaza, a material had been spread on the side path and around the dumpster, apparently to absorb spilled waste oil (Figure 4).
- Shortly after November 24, 2015 Steve Micheli, Public Works Director, visited 31 Palmisano Plaza to advise the owners to dump no waste in the drain. Mr. Micheli stated he would also require them to move the dumpster away from catchbasin CB13.

Conclusion: Three apparently unrelated problems were identified in this system. Disposal of dog waste in catchbasins on Westwood Parkway presents both water quality and human health concerns. Disposal of waste oil in catchbasin CB13 on Palmisano Plaza is illegal. Finally, there appears to be washwater or sanitary wastewater entering the system above catchbasin CB15 on Palmisano Plaza (Map BC-1). The exact source is not known. The most likely explanation is a leaking sewer lateral at a house located between catchbasins CB14 and CB15, possibly discharging to the storm sewer via one of the three pipe connections observed in this section. Another explanation is that the observed petroleum contamination caused false positive optical brightener readings on the Palmisano Plaza line, although the absence of optical brightener in CB12, CB13, and CB14 is counter to this theory.

Resolution:

- Mr. Micheli has spoken to the homeowners of 31 Palmisano Plaza advising them that discharging petroleum products or any other wastes to catchbasins is illegal. In our January 19, 2016 meeting, Mr. Micheli stated he would check on the issue periodically. If any further petroleum spill or dumping to the municipal drainage system occurs, Mr. Micheli will refer the matter to DEC enforcement.
- Stone recommends the City of Barre install placards on catchbasins on Westwood Parkway or a sign near the intersection of Westwood Parkway and Prospect Street advising residents not to dump wastes in catchbasins.
- Stone recommends dye testing of houses between catchbasins CB14 and CB15 to identify any possible graywater connections or leaking sewer laterals. Specifically, we recommend dye testing houses 8, 12, 16, and 20 Palmisano Plaza.

2.2 BC240

The BC240 system drains a short section of Route 302 east of the Berlin town line. It passes under Route 302 and the railroad tracks and discharges to the Stevens Branch immediately west of the North End pump station (Map BC-2).

Table 7. Water analysis data for outfall BC240

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BC240	8/28/14	Trickling	0.1	0.03	0.0	333	--	Pump station noise audible inside pipe. Sewage odor observed in pipe.
	9/2/14	--	--	--	--	--	Positive (strong)	Stronger sewage odor. Waste deposits around outfall.
	9/25/14	Dripping	--	--	--	--	--	Sewage odor in pipe.
	9/22/15	Wet, no flow	--	--	--	--	--	Strong wastewater odor.
	9/23/15	Flowing (0.12 l/s)	0.1	0.00	0.0	364	Positive (strong)	Strong wastewater odor in pipe. Pump station noise audible inside pipe. Water in splash pool is grayish. Water in up-pipe drop inlet clear, with no wastewater odor.

Findings:

- Wastewater odor and pump sounds were consistently observed at the outfall. Optical brightener was detected at the outfall on both occasions it was monitored.
- There was no flow on September 22, 2015, the day *E. coli* samples were collected in Barre.
- On December 11, 2015, a sanitary manhole located directly west of the North End pump station was accessed. A pipe was found apparently connecting the sanitary manhole to the stormline, with an invert a few inches above the floor of the manhole (Figure 5). Dye poured into the pipe opening quickly flowed to the outfall (Figure 6).
- The Barre Department of Public Works determined that a valve intended to restrict sewer overflow from the pipe to the storm sewer was not working properly.

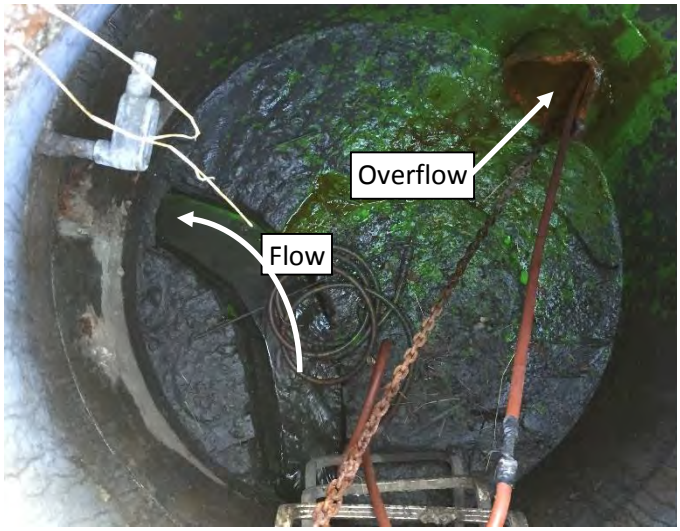


Figure 5. Sanitary manhole near North End pump station; sewer overflow pipe marked by dye

Figure 6. Dye poured into the sanitary sewer overflow pipe is visible at the outfall

Conclusion: Based on wastewater odors and pump sounds repeatedly observed at the outfall, the gray appearance of water in the splash pool below the outfall, and the presence of optical brightener, a direct connection between the sanitary sewer and the stormwater system was suspected. A direct connection via a sewer overflow pipe was confirmed on December 11, 2015.

Resolution: In December, 2015 the Department of Public Works installed a permanent cap on the sanitary sewer overflow pipe. The frequency of overflows occurring prior to this correction is unknown.

2.3 BC1100

The BC1100 system drains portions of Maple Grove Street, Tremont Street, and Hersey Drive. It discharges to Potash Brook at the corner of the box culvert closest to 3 Maple Grove Street (Map BC-3). The outfall is typically partially submerged by Potash Brook; therefore the first up-pipe catchbasin was the most appropriate assessment point.

Table 8. Water analysis data for outfall BC1100

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BC1100 CB1	9/18/14	Trickling	1.0	--	0.70	1285	Positive	CB1 pipe A trickling; pipe B dry.
	10/10/14	Trickling	--	--	--	--	Positive	--
	9/22/15	Trickling	--	--	--	--	--	Clear, no odor. Raccoon moving through storm sewer.
	9/23/15	Trickling	--	--	--	--	Positive	Slight laundry odor in CB7, in the driveway of 17 Hersey Drive.

Findings:

- On September 18, 2014, elevated ammonia and MBAS detergent concentrations were measured at catchbasin CB1, the first basin up the line from the surcharged outfall.
- Optical brightener was detected consistently in catchbasin CB1.

- A sample collected at CB1 on September 22, 2015 had an elevated *E. coli* concentration of 1,110 MPN/100 mL. Considering the presence of optical brightener, the likely source of *E. coli* is sanitary wastewater. However, a wildlife contribution is also possible.
- Monitoring pads deployed on September 23, 2015 indicate that the source of the optical brightener is on Hersey Drive. Optical brightener was detected in catchbasins CB1, CB2, CB3, and CB6. Catchbasin CB6 is near the top of Hersey Drive. Optical brightener was not detected at CB7 and CB8. Catchbasin CB8 is at the top of Hersey Drive line.
- In November, 2015, the Department of Public Works dye tested the house (toilet) at 17 Hersey Drive. Dye did not show at catchbasin CB7. Catchbasin CB6 was not inspected. No one was home at the time at 10 Hersey Drive.

Conclusion: We suspect diluted sanitary wastewater is discharging to the Hersey Drive storm sewer in the vicinity of catchbasin CB6. The most likely explanation is that a leaking sewer lateral serving 10 Hersey Drive is infiltrating the storm sewer at or immediately up-pipe of catchbasin CB6 (between CB6 and CB8 or between CB6 and CB7).

Resolution: In our January 19, 2016 meeting, the City of Barre Department of Public Works confirmed they plan to dye test the house at 10 Hersey Drive. Given some uncertainty regarding optical brightener testing at catchbasin CB7 and dye testing of 17 Hersey Drive, we also recommend the City retest 17 Hersey Drive, watching for dye at catchbasin CB6.

2.4 BC1120

The BC1120 system drains Center Street and its side streets, Oswald, Howard, and George Streets. It discharges to the Stevens Branch behind the Nativi Playground (Map BC-4). In the previous IDDE study, the system was identified as SB-O-13.

Table 9. Water analysis data for outfall BC1120

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BC1120	9/25/14	Flowing	0.1	0.02	0.0	1155	Positive	Clear, no odor
	9/22/15	Flowing (0.22 L/s)	0.0	--	0.1	1188	lost	
BC1120 CB1	9/25/14	Flowing	--	--	--	--	Positive	Sewage odor. Catchbasin very warm.
	9/22/15	Flowing	--	--	--	--	Positive	Wastewater odor.
BC1120 MH3	9/25/14	Flowing	--	--	--	--	Positive	Pipes A and B flowing. Pipe C dry. No odor.

Findings:

- Optical brightener was detected at the outfall in a monitoring pad deployed on September 25, 2014. Optical brightener was also detected at catchbasin CB1 and manhole MH3 (Map BC-4). A strong wastewater odor was observed at CB1.
- An elevated *E. coli* concentration of 660 MPN/100 mL was measured at the outfall on September 22, 2015.
- On October 5, 2015, optical brightener monitoring pads were deployed in many locations in the drainage system. Optical brightener was detected at catchbasin CB1, manhole MH3, and catchbasin CB6 on Howard Street near its intersection with Center Street. The fluorescence of the pad was markedly greater at CB1 than at MH3 or CB6. Optical brightener was not detected at catchbasins CB5, CB7, or CB8, indicating that the source is not on George, Oswald, or upper Center Street.
- On October 13, 2015, additional monitoring pads were deployed at structures above CB6 on Howard Street (CB9, CB10, CB11, and CB12) to bracket the source of optical brightener entering this line. Optical brightener was detected at catchbasins CB6 and CB9 on Howard Street, but not in catchbasins CB10 or CB11 or in the stream inlet at the intersection of Pike and George Streets (Map BC-4).

Figure 7. Stormwater manhole MH1 with concrete sewer main running through it

- The concrete sewer main flowing through stormwater manhole MH1 (Figure 7) has reportedly been repaired multiple times in the last decade. This pipe was found to be leaking badly when FWR and Stone performed the first Barre City IDDE project in 2006. According to the Department of Public Works, it was repaired in 2006 and again more recently. In a November 24, 2015 meeting, Everett Hoyt indicated he had recently inspected the pipe section and it was not leaking. Mr. Hoyt also explained that he had found and cleared a major obstruction in the sewer main in the sanitary manhole immediately below this section of pipe. The obstruction has caused wastewater to surcharge but not overflow the sanitary manhole.
- A monitoring pad placed in catchbasin CB1 on November 24, 2015 indicated presence of optical brightener (though fluorescence was weak). There was no odor or elevated temperature in this structure, in contrast to previous inspections.

- In November, 2015, the Department of Public Works reportedly cleaned the storm line on Howard Street in preparation for inspecting it with a closed circuit TV camera. A camera malfunction delayed the work. Oil stains were observed on the catchbasin CB9 grate.

Conclusions: We suspect there are (or were) two sources of optical brightener—and wastewater—entering this system. One source is (or was) in the area where the sanitary sewer crosses the storm sewer (in or near catchbasin CB1, manhole MH1, or the storm line connecting the two structures). Water pressure in the sewer main resulting from obstruction in the sanitary manhole likely caused wastewater and sewer odors to infiltrate the underlying storm drain, either via an unknown direct connection or through gaps and cracks in the walls of the structures. Cleaning the sewer main appears to have eliminated or reduced this source. Because optical brightener was detected on the main line up to catchbasin CB9 on Howard Street, potentially masking sources lower in the system, we cannot say conclusively that the source near CB1 and MH1 was eliminated by cleaning the sanitary sewer.

We suspect a second source of optical brightener on Howard Street, but have been unable to confirm this to date through camera inspection or dye testing. The Department of Public Works plans to conduct camera inspection on Howard Street when conditions allow. However, another explanation is that oil dumping or leaking from a vehicle into catchbasin CB9 (oil was observed on the grate) could have caused false positive OB detections.

Resolution: It appears that cleaning the sanitary sewer eliminated or reduced wastewater inflow to the stormwater system in the vicinity of catchbasin CB1 and manhole MH1. However, we cannot regard this as a permanent solution because the problem will reoccur if the sewer main becomes obstructed. We strongly support the City of Barre's plans to reconfigure the sanitary and storm sewer lines in the vicinity of Nativi Playground. The City is committed to upgrading this problematic infrastructure within the next two years. Options discussed in the January 19, 2016 meeting included rerouting the stormline and filling manhole MH1 with concrete (thereby encasing the unsupported bend in the sewer main) and sealing the walls of the sanitary manhole adjacent to catchbasin CB1 with concrete. Slip lining the sewer main would be another possibility.

Regarding Howard Street, further investigation is warranted, as discussed above.

2.5 BC1630

The BC1630 system drains portions of Camp Street and Hill Street and several connecting streets. The system discharges to Edgewood Brook off Camp Street north of the Elmwood Cemetery (Map BC-5). In the previous IDDE study, the system was identified as EB-O-3.

Table 10. Water analysis data for outfall BC1630

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BC1630	10/31/14	Flowing	0.6	0.02	0.1	850	Positive	Clear
	9/22/15	Flowing (0.30 L/s)	--	--	--	--	--	Distinct laundry odor, gray growth on outfall

Findings:

- Optical brightener and a low concentration of ammonia (0.6 mg/L) were detected at the outfall on October 31, 2014.
- Samples collected at the outfall on September 22, 2015 had a moderate total phosphorus concentration (798 µg/L) and, surprisingly, no detectable *E. coli* (Table 20). A definite laundry odor and gray (possibly fungal) growth was observed at the outfall.
- On September 23, 2015, manholes MH11 and MH12 on Hill Street (Map BC-5) had a pronounced wastewater odor and flow was observed through the main storm line. There was no flow in manholes MH13 and MH14; however a wastewater odor was present, possibly venting up the pipe. The flow and wastewater odor appeared strongest at MH11.
- Monitoring pads deployed on September 23, 2015 indicated that the source of optical brightener is located on Hill Street between Nelson Street and Woodland Drive. Optical brightener was detected at the outfall and at all manholes on Hill Street except MH14 (at the intersection of Hill Street and Woodland Drive). No optical brightener was detected at MH5 on Berkeley Street.

Figure 8. Inspection of Hill Street storm sewer, November 24, 2015

- On November 24, 2015, Everett Hoyt (Barre Public Works) and Dave Braun (Stone) dye tested a toilet at 204 Hill Street and the Hill Street sanitary sewer main below Woodland Drive (by flushing dye at 2 Woodland Drive). In both tests, dye was observed in the storm sewer at manhole MH11. Using the City's tracked camera (Figure 8), we determined that dye (and wastewater) were crossing into the storm sewer at a pipe joint 231 feet below MH12.
- In early December, 2015, the Department of Public Works performed camera inspection of the 6-inch sewer main on Hill Street to identify possible leaks. Substantial root penetration was observed in the first 30 feet of pipe below the sanitary manhole nearest 204 Hill Street. Roots were cut out of the line. A

section of broken pipe and a possible broken pipe bell were observed within the first 30 feet of pipe. Ultimately, two dilapidated sections of pipe on Hill Street between Nelson Street and Woodland Drive were excavated and replaced by Public Works. It is unclear whether the sewer service for 204 Hill Street was found. The connection may have been in a dilapidated section of pipe or the house sewer may in fact be directly connected to the storm line. The Department of Public Works has arranged with the owner of 204 Hill Street to have the sewer lateral replaced when conditions permit in the spring.

Conclusions: Wastewater was leaking into the storm drain from the sewer main on Hill Street between Woodland Drive and Nelson Street. Questions remain about the sewer connection for the house at 204 Hill Street.

Resolution: Two sections of dilapidated sewer pipe were excavated and replaced to eliminate flow of wastewater to the storm drain. When conditions permit in the spring, the City has committed to working with the homeowner at 204 Hill Street to ensure a proper house sewer connection is constructed.

3. BARRE TOWN RESULTS

Appendix C.2 presents water quality data for stormwater drainage systems assessed in Barre Town. Of the 193 systems assessed in Barre Town, 32 were designated for further investigation due to detection of one or more contaminants and/or observation indicating probable contamination. Investigations were initiated of five of these systems (BT700, BT2230, BT2240, BT2640, and BT2790), all of which were suspected of receiving sanitary wastewater or washwater flows, based on detection of optical brightener or ammonia. The investigations of these systems are discussed individually below. The remaining 27 systems designated for future work (Table 2) may be reassessed and/or further investigated in a follow-on study. Of these systems, most fall in one of four categories: 1) systems with detectable (low) concentrations of ammonia (eight systems); 2) systems with high (>2500 µS/cm) specific conductivity (five systems); 3) systems with elevated chlorine (5 systems), either due to a water leak or outdoor washing; or 4) systems with wastewater or petroleum odors or suds (seven systems).

On January 19, 2016, a final project meeting was held with Barre Town to discuss the assessment results and the status of ongoing investigations. The attendees were Carl Rogers (Town Manager), Harry Hinrichsen (Town Engineer), Jim Pease (DEC), Dave Braun (Stone), Ann Smith (FWR), and Shawn White (FWR). During the final project meeting the town staff provided insight and past history into potential causes of suspected illicit discharges, particularly in the cases of systems BT700 and BT2640. For system BT700, the Town Engineer agreed to continue working with the property owner to identify the contaminant source and resolve the problem. Dye testing and plumbing inspection are planned. Information gathered during this meeting is discussed in the following sections, where applicable.

3.1 BT700

The outfall of the BT700 system is a 4-inch diameter pipe which discharges to a small stream on the south side of Websterville Road (Map BT-1). The system is not connected to a municipal stormwater drainage system.

Table 11. Water analysis data for outfall BT700

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BT700	7/7/14	Dry	--	--	--	--	Positive	Iron staining
	9/22/15	Dry	--	--	--	--	Positive	--
	10/1/15	Trickle	--	--	--	--	--	--

Findings:

- Monitoring pads deployed at the outfall on July 7, 2014 and September 22, 2015 indicated presence of optical brightener.
- A trickle of flow was observed from the outfall on October 1, 2015; otherwise the pipe has been dry.
- The alignment of the outfall pipe suggests it is connected to a round concrete structure (Figure 9) in the side yard of the house at 140 Websterville Road. This structure may be some type of graywater system.
- According to the Town Engineer, Harry Hinrichsen, 140 Websterville Road was unoccupied in recent months. New residents moved in to the house in early January, 2016. Mr. Hinrichsen has been in contact with the property owner, who agreed to work with the Town to determine if there is a pipe connection from the house to the concrete structure in the yard (or directly to the outfall).
- During the January 19, 2016 meeting, Mr. Hinrichsen stated that town staff would attempt to dye test a toilet in the house and inspect plumbing connections to ensure that all fixtures and appliances discharge to the municipal sewer.

Figure 9. Concrete structure in side yard of 140 Websterville Road

Conclusion: We suspect there is a plumbing connection from the house at 140 Websterville Road to the outfall.

Resolution: The Town of Barre intends to determine whether or not there is a plumbing connection from the house and, if found, will work with the property owner to correct the problem.

3.2 BT2230

The BT2230 system drains a portion of Philbrook Street and Strawberry Lane. It discharges into a ditch west of 12 Philbrook Street (Map BT-2).

Table 12. Water analysis data for outfall BT2230

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BT2230	7/11/14	Wet/no flow	4.5	0.04	N/A	564	Negative	Anaerobic/wastewater odor; suds formed in the MBAS test vial
	9/22/15	Dry	--	--	--	--	Negative	No odor. Water in sump of CB1, CB2 dry.
	10/1/15	Dry	--	---	--	--	--	--
BT2230 CB1	7/11/14	Wet/no flow	--	--	--	--	--	--
	9/22/15	Wet/no flow	--	--	--	--	Negative	--
BT2230 CB2	7/11/14	Dry	--	--	--	--	--	--
	9/22/15	Dry	--	--	--	--	--	--

Findings:

- On July 11, 2014 a very high ammonia concentration was measured in stagnant water at the outfall. The water had a wastewater odor. Suds formed in the MBAS test vial, likely indicating presence of detergents. There was water in the sump of catchbasin CB1 while CB2 was dry.
- On repeated visits in 2015, there was no flow in the system, no water pooled at the outfall, and no odors or other indications of contamination.
- There do not appear to be any drains entering the system other than those mapped.

Conclusion: The high concentration of ammonia measured on the initial sampling date, the absence of optical brightener, and the fact that contamination did not reoccur during subsequent visits suggests that washwater may have been dumped into a catchbasin on or shortly before July 11, 2014.

Resolution: Stone will draft a letter to the Town of Barre explaining the 2014 findings. The Town of Barre will refer to these findings in a notice to residents in the Philbrook Street neighborhood not to discharge wastes to catchbasins.

3.3 BT2240

The BT2240 system drains West Cobble Hill Road from the intersection with Philbrook Street to the intersection with Meadowcrest Lane. It discharges immediately past Meadowcrest Lane (Map BT-2).

Table 13. Water analysis data for outfall BT2240

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BT2240	7/11/14	Flowing	0.0	0.01	0.0	704	Negative	Clear, no odor
	9/22/15	Flowing (0.37 L/s)	0.1	--	0.1	616	Positive (weak)	Clear, no odor
BT2240 CB1	7/11/14	Flowing	--	--	--	--	Positive	
BT2240 CB6	7/11/14	Flowing	--	--	--	--	Indeterminate	
BT2240 CB9 Pipe A	7/11/14	Flowing	0.0	0.03	--	456	Negative	Flushing sound heard
BT2240 CB9 Pipe B	7/11/14	Flowing	0.0	0.02	0.25	971	Negative	Flushing sound heard

Findings:

- On July 11, 2014, ammonia, chlorine, and MBAS concentrations were all below detection at the outfall.
- Optical brightener was detected inconsistently in this system. It was detected at catchbasin CB1 on July 11, 2014, but not at the outfall. On September 22, 2015, it was detected at the outfall, though the fluorescence was weak. On November 21, 2015, pads were deployed in 15 structures throughout the system and no optical brightener was detected. An indeterminate result was obtained at CB6 on Willow Street.
- Concentration of *E. coli* (120 MPN/100 mL) and total phosphorus (13 µg/L) were low in samples collected on September 22, 2015 (Table 20).

Conclusion: We do not believe there is a chronic illicit discharge in this system. The intermittent nature of the optical brightener results suggests transitory sources such as direct dumping to a catchbasin occur in this large residential drainage area.

Resolution: NA

3.4 BT2640

The BT2640 system drains Beckley Hill Road from Lemay Drive down to Green Street, as well as Buena Vista Circle. The system discharges to a stream at the end of Green Street (Map BT-3).

Table 14. Water analysis data for outfall BT2640

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BT2640	7/25/14	Flowing	0.2	0.03	0.3	973	Positive	No odor
	9/22/15	Flowing (0.15 L/s)	--	--	--	--	Positive	--
	10/30/15	Flowing					Indeterminate	Clear, no odor
	12/21/15	Flowing					Positive	Clear, no odor

Findings:

- Optical brightener was detected at the BT2640 outfall on multiple occasions. Several attempts were made to bracket the source of optical brightener. Pads deployed on September 23, 2015 indicated optical brightener was present from the outfall up the main storm line to catchbasin CB13 at the intersection of Beckley Hill Road and Buena Vista Circle. No optical brightener was detected in CB14 at the entrance to Washington County Mental Health. Pads deployed October 30 indicated optical brightener was present at catchbasin CB13 but not in catchbasins BVCB1 and BVCB2 on Buena Vista Circle nor in catchbasins CB14 through CB19 on Beckley Hill Road. Oddly, fluorescence, though weak, was recorded for pads in CB20 and CB21. On December 11, 2015, pads were deployed within catchbasin CB13 to identify which of the two inflowing pipes was contaminated. Strong fluorescence was seen on the pad placed in Pipe A, which drains Buena Vista Circle. On December 21, 2015, pads were placed in catchbasin CB13, BVCB1, and BVCB2 and near the end of a swale discharging to catchbasin BVCB1. The results demonstrated that the swale is the source of optical brightener in the system.
- Concentrations of *E. coli* (10 MPN/100 mL) and total P (12 µg/L) were very low in samples collected at the outfall on September 22, 2015 (Table 20).
- On December 11, 2015 dye was flushed into the sewer at 324 Beckley Hill Road (near the intersection with Lemay Drive). Dye was also poured directly into the sanitary main on Buena Vista Circle. Lastly, dye was flushed at 276 Beckley Hill Road at the intersection of Beckley Hill Road and Buena Vista. No dye appeared in the storm drain after any of these tests, either at CB13 or at the outfall.

Conclusion: After several rounds of testing, the source of optical brightener was determined to be a swale discharging to catchbasin BVCB1 on Buena Vista Circle. Winter conditions did not permit testing along the swale. According to the Town Engineer, there is only one property abutting the swale that is not connected to municipal sanitary sewer, 24 Lemay Drive.

Resolution: When conditions permit, we recommend bracket sampling for optical brightener at points along the swale. If results suggest 24 Lemay Drive as the likely source, we recommend dye testing this house.

3.5 BT2790

The BT2790 system drains from 182 Richardson Road to 52 Spring Hollow Road. It discharges into a ditch on the south side of Spring Hollow Road (Map BT-4).

Table 15. Water analysis data for outfall BT2790

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
BT2790	7/30/14	Flowing	0.0	0.01	0.0	1365	Positive (weak)	No odor
	9/22/15	Flowing (0.88 L/s)	--	--	--	--	--	Clear, no odor
	9/23/15	Flowing	--	--	--	--	Negative	Clear, no odor

Findings:

- Optical brightener was detected at the outfall on September 30, 2014. No other contaminants were detected.
- Concentrations of *E. coli* (10 MPN/100 mL) and total P (12 µg/L) were very low in samples collected at the outfall on September 22, 2015 (Table 20).
- On September 23, 2015, monitoring pads were placed throughout the system. No optical brightener was detected at the outfall or in any catchbasin (CB1 through CB8).

Conclusion: We do not believe there is a chronic illicit discharge in this system. Optical brightener did no reoccur and no other contaminants were detected.

Resolution: NA

4. BERLIN RESULTS

Appendix C.3 presents water quality data for stormwater drainage systems assessed in Berlin. Of the 73 systems assessed in Berlin, nine were designated for further investigation due to detection of one or more contaminants. No investigations of these systems were initiated. Four of these nine systems are located in a cluster near Woodridge Nursing Home and the Central Vermont Hospital; these had exceedingly high specific conductivity (2,500–6,100 µS/cm). It is likely that shallow groundwater contaminated with chloride is infiltrating each of these drainage systems. The remaining five systems were designated for follow-up assessment or investigation due to detection of MBAS detergent and/or observation of suds or offensive odors. Systems in which contaminants were detected may be reassessed and/or further investigated in a follow-on study, if requested by DEC.

On January 5, 2016, a final project meeting was held with Berlin to discuss the assessment results. The attendees were Dana Hadley (Town Administrator), Jim Pease (DEC), Dave Braun (Stone), and Shawn White (FWR). Mr. Hadley was informed that further work was likely to be performed on the nine

systems designated for reassessment or investigation. With the concurrence of Mr. Hadley, FWR agreed to write a letter to the Central Vermont Hospital informing them of the high specific conductivity readings measured in dry weather flows at four outfalls around the hospital property.

5. STOWE RESULTS

Appendix C.4 presents water quality data for stormwater drainage systems assessed in Stowe. Stowe Mountain Resort was included in the assessment. Of the 72 systems assessed in Stowe, nine were designated for further investigation due to detection of one or more contaminants. None of these nine systems were at the Stowe Mountain Resort.

Optical brightener was detected at the outfall of three systems (ST170, ST250, and ST700), a strong indication of the presence of sanitary wastewater of washwater. Moderate free chlorine (0.23 and 0.21 mg/L) and ammonia (1.0 mg/L) concentrations were detected at the ST350 and ST420 outfalls, suggesting a water leak. Ammonia was also detected in ST010, ST030, ST040, and ST370. In ST010, ST030, and ST040, we suspect the ammonia is naturally occurring; however, in system ST370 high concentrations of both ammonia (4.0 mg/L) and MBAS detergent (0.7 mg/L) at a junction in the stormwater system likely indicate an illegal connection to the stormwater system. No investigations of these systems have been initiated. Systems in which contaminants were detected may be reassessed and/or further investigated in a follow-on study, if requested by DEC.

On January 13, 2016, a final project meeting was held with Stowe to discuss the assessment results. The attendees were Harry Shepard (Public Works Director), Chris Jolly (Assistant Town Engineer), Jim Pease (DEC), Dave Braun (Stone), and Ann Smith (FWR). Mr. Shepard was informed that further work was likely to be performed on the nine systems designated for reassessment or investigation. During the final project meeting the town staff provided insight and past history into potential causes of the suspected illicit discharges.

6. WILLIAMSTOWN RESULTS

Appendix C.5 presents water quality data for stormwater drainage systems assessed in Williamstown. Of the 30 systems assessed in Williamstown, four were designated for further investigation Two systems (WT040 and WT070) were designated because MBAS was detected and two (WT140 and WT320) because ammonia was detected. The findings of investigations of these four systems are presented below.

On January 5, 2016, a final project meeting was held with Williamstown to discuss the assessment results. The attendees were Jacqueline Higgins (Town Manager) and Dave Braun (Stone). The town was thanked for their participation. One issue highlighted was dumping of tires and appliances into a wetland area south of Depot Street near the WT070 outfall. Ms. Higgins indicated she would look into this issue. We do not anticipate the need for further work in Williamstown.

6.1 WT040

The WT040 system drains Pleasant Street and a portion of Main Street (Route 14) and discharges to the Stevens Branch south of the post office on Main Street on the west side of the Route 14 bridge (Map WT-1).

Table 16. Water analysis data for outfall WT040

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
WT040	10/22/15	Flowing	0.1	0.00	0.3	410	Negative	Clear, slight musty odor
WT040	12/9/15	Flowing	0.0	0.02	0.1	963	--	Clear, no odor
WT040	12/14/15	Flowing	--	--	--	--	--	Clear, no odor

Findings:

- On October 22, 2015, a low concentration of MBAS detergent (0.3 mg/L) was detected at the WT040 outfall. Ammonia and chlorine concentrations were below detection and optical brightener was not detected.
- No contaminants were detected in samples collected at the outfall on December 9, 2015. Catchbasins throughout the system were inspected for presence of dry weather flow. A substantial dry weather flow enters catchbasin CB8 on Pleasant Street from pipe B (the main stormline). The flow was clear, with no odor. Catchbasin CB8 pipes A and C were not flowing. No flow was present in any catchbasin or stormwater manhole up-pipe from CB8. Judging from the topographic setting, the origin of the flow entering CB8 via pipe B is likely a spring intercepted by the stormline. It appears this flow entering CB8 via pipe B represents nearly all the dry weather flow in the WT040 drainage system. No flow was observed in catchbasin CB10 or in any pipe discharging to catchbasins on Main Street (other than the main line).
- On December 14, 2015, Dave Braun met with Brian Palmer of the Williamstown Highway Department to inspect a pipe entering the WT040 system at catchbasin CB5 from the direction of Burrell's Roofing. The pipe was dry but the origin of the pipe was unknown. Given its uncertain connection, Mr. Palmer spoke with the owner of Burrell's Roofing, Kevin (Jake) Burrell, about the pipe. Mr. Burrell reported that there is a catchbasin in the backyard of the facility that is connected with this system.

Conclusion: Based on repeated sampling and inspection of the WT040 system, we do not believe a chronic illicit discharge is present.

Resolution: NA

6.2 WT070

The WT070 system drains Depot Street and Beckett Street and discharges into a swale on the south side of Depot Street (Map WT-2).

Table 17. Water analysis data for outfall WT070

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
WT070	10/22/15	Wet, no flow	0.2	0.01	0.5	538	Negative	Turbid, no odor
WT070-MH1	12/9/15	Wet, no flow	0.2	0.02	0.2	1,760	--	Clear, no odor
WT070-CB1	12/9/15	Wet, no flow	--	--	--	--	--	Turbid, no odor
WT070-CB1	12/14/15	Wet, no flow	--	--	--	--	--	Turbid, no odor

Findings:

- On October 22, 2015, a low concentration of MBAS detergent (0.5 mg/L) was detected at the WT070 outfall. Ammonia and chlorine concentrations were below detection and optical brightener was not detected.
- On December 9, 2015, the outfall was surcharged by the receiving swale. No flow was observed in the next up-pipe manhole (MH1) or in catchbasin CB1. In CB1, pipe A was dry and pipes B and C appeared wet but not flowing. Pipe B is a 2-inch diameter PVC pipe entering the catchbasin from the direction of the Catholic Church; pipes A and C are branches of the municipal stormwater drainage system. The next up-pipe catchbasin (CB2) on the pipe C branch was dry.
- No contaminants were measured above limits of detection in a sample collected from the manhole MH1 sump on December 9, 2015.
- On December 14, 2015, Dave Braun met with Brian Palmer of the Williamstown Highway Department to examine a 2-inch diameter PVC pipe entering CB1 from the direction of the Catholic Church. Mr. Palmer then contacted an engineer who is an official at the church about this pipe. Apparently this pipe is the outlet for a groundwater collection system on the church property. Perforated pipes collect groundwater and convey it to a tank, which is pumped up to catchbasin CB1.

Conclusion: Based on repeated sampling and inspection of the WT070 system, we do not believe a chronic illicit discharge is present.

Resolution: NA

6.3 WT140

The WT140 system discharges to a small stream east of the Williamstown Elementary School on Brush Hill Road (Map WT-3). It appears to be a subsurface drain with no surface inlets. The outfall is a 4-inch diameter PVC pipe.

Table 18. Water analysis data for outfall WT140

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
WT140	10/22/15	Trickling	1.0	NA	NA	558	Negative	Heavy iron staining
WT140	12/9/15	Wet, no flow	--	--	--	--	--	Iron staining/sheen, no odor

Findings:

- On October 22, 2015 a trickle of flow with pronounced iron staining was observed at the outfall. The ammonia concentration was 1.0 mg/L. Due to the orange color and turbidity of the sample, chlorine and MBAS detergent analyses were not performed.
- On December 9, 2015 no flow was observed at the WT140 outfall. The outfall was partially obstructed. Water pooled within the pipe had pronounced iron staining and a metal oxide sheen, but no odor. Samples were not collected because there was no flow and iron floc may have invalidated the results.
- ANR's Natural Resources Atlas indicates that the Williamstown Elementary School is a closed hazardous waste release site (SMS Site #97-2226). In 1997 a leaking underground fuel oil tank was removed. A linked letter dated January 26, 2016 from Matt Moran of DEC's Waste Management and Prevention Division to Chris Locarno of the Orange North Supervisory Union presents the history of the site. Site management activities are considered completed.
- Immediately north of the Williamstown Elementary School property is the former Unifirst property, a significant hazardous waste site (SMS Site #77-0087).

Conclusion: Based on repeated sampling and inspection, we do not believe a chronic illicit discharge is present. We expect that iron staining observed at the outfall is a result of degradation of fuel oil that entered groundwater at the former tank location. It is also possible that it results from contaminated groundwater migrating from the former Unifirst site, although systems are in operation to collect and treat groundwater at the site.

Resolution: NA

6.4 WT320

The WT320 system discharges to a tributary of the Stevens Branch on the east side of the Williamstown Wastewater Treatment plant (Map WT-4). The system is apparently an overflow for an abandoned municipal well (wellhead #1) located east of Brockway Hill Road and south of Vesper Road. The connecting pipe is not shown on map WT-4. This well was reportedly abandoned due to groundwater contamination. There is a mapped surface inlet in the trailer park on Railroad Street; however, there is uncertainty regarding the connection from this inlet to the well overflow line.

Table 19. Water analysis data for outfall WT320

Structure ID	Date Assessed	Dry, Wet/no flow, Dripping, or Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
WT320	11/3/15	Flowing	1.0	0.02	0.1	673	--	Clear, no odor
WT320	12/9/15	Flowing	0.25	0.02	0.0	113	--	Clear, no odor

Findings:

- There was substantial flow at the outfall on both the November 3 and December 9, 2015 sampling dates.
- On November 3, 2015 an elevated ammonia concentration of 1.0 mg/L was measured at the outfall. No other contaminants were detected. Aquatic moss was observed in the channel below the outfall.
- The outfall was resampled on December 9, 2015 and the ammonia concentration was at the limit of detection, 0.25 mg/L. Substantial attached algae was present in the channel below the outfall.

Conclusion: Based on repeated sampling, we do not believe a chronic illicit discharge is present. The ammonia detected on the two sampling dates may result from the same groundwater contamination that caused the well to be abandoned. While the ammonia concentration measured on November 3, 2015 was certainly elevated, it was below levels considered toxic to aquatic life (USEPA 2013).

Resolution: NA

7. PHOSPHORUS AND *E. COLI* CONCENTRATIONS

Samples were collected on September 22, 2015 for *E. coli* and total phosphorus analyses by the Vermont DEC laboratory. If feasible, a discharge measurement was made immediately following sampling. Daily loading of total phosphorus was calculated from the concentration and discharge data. These data are presented below (Table 20).

Table 20. E. coli and total phosphorus data for selected drainage systems

System	Date	*E. coli* (MPN/100 mL)	TP (µg/L)	Discharge (L/s)	TP loading (g/day)
BC140	9/22/15	170	12	0.066	0.07
BC1100	9/22/15	1100	386	Could not measure	--
BC1120	9/22/15	660	35	0.22	0.67
BC1630	9/22/15	<1	798	0.30	21
BT2240	9/22/15	120	14	0.37	0.45
BT2640	9/22/15	10	12	0.15	0.16
BT2790	9/22/15	<1	17	0.088	0.13

8. REFERENCES

American Public Health Association. 2005. Standard Methods for the Examination of Water and Wastewater, 21th edition, Washington D.C.

Hach Company. Hach Method #8167. Loveland, CO.

Stone Environmental, Inc. SEI SOP 5.23.3: Maintenance and Calibration of the pH/Con 10 Meter. February 24, 2003.

Stone Environmental, Inc. SEI SOP 6.38.0: Optical Brightener Testing. September 11, 2008.

USEPA. 2013. *Aquatic Life Ambient Water Quality Criteria for Ammonia - Freshwater (2013).* 820-F-13-013. Accessed January 27, 2016 at: *http://www.epa.gov/sites/production/files/2015-08/documents/fact_sheet_aquatic-life-ambient-water-quality-criteria-for-ammonia-freshwater-2013.pdf.*

APPENDIX A: ASSESSMENT DATA FORM

Stevens Branch plus Stowe IDDE Project

IDDE ID: _____						
Date: _____	Time: _____			Inspector: _____		
Structure type: _____				Inner diameter (outfall only): _____(in.)		
Material (outfall only):	corrugated metal	concrete	corrugated black plastic	smooth plastic	vitrified clay	other (describe): _____
Flow depth (outfall only):	dry	wet (no flow)	dripping	trickling	Flowing Depth: _____(in.)	
Outfall position:	free flow	partially submerged	submerged	If partially submerged, surcharged? YES NO		
Erosion at outfall:	none	If present, describe: _____				
Discharge characteristics (observations on color, turbidity, and odor of flow):						
Floatables:	none	sheen	sewage	suds	other _____	
Deposits or staining:	none	sediment	oily	iron staining	other_____	
Structural damage:	none	cracking, spalling	corrosion	crushed	other_____	
Obstructions:	none	partially obstructed	fully obstructed	other_____		
Ammonia _____ mg/L			Date OB pad set: _____ NA			
Chlorine _____ mg/L Free or Total			Date OB pad retrieved: _____ NA			
MBAS _____ mg/L						
Specific conductance _____µS/cm						
Sample collected for *E. coli* analysis: YES NO NA			Date: _____ Time: _____			
Sample collected for TN analysis: YES NO NA			Date: _____ Time: _____			
Flow measurement (if *E. coli* and/or nutrients sample collected):						
Comments:						

APPENDIX B: STONE ENVIRONMENTAL INC. SOPS

STANDARD OPERATING PROCEDURE

SEI-5.23.3

MAINTENANCE AND CALIBRATION OF THE pH/CON 10 METER

SOP Number: SEI-5.23.3 Date Issued: 05/14/99

Revision Number: 3 Date of Revision: 02/24/03

1.0 OBJECTIVE

This standard operating procedure (SOP) explains the calibration and maintenance of the Oakton pH/Con 10 meter and the Cole-Parmer pH/Con 10 meter. The meters are identical except for the distributor's names. The meter is manufactured by Cole-Parmer and distributed by Cole-Parmer and Oakton. The operator's manual should be referred to for the applicable procedures described below. The pH/Con 10 meter is used for measuring the pH, conductivity, and temperature of water. The pH/conductivity meters generate and measure data, and thus must meet the requirements of 40 CFR part 160 subpart D.

2.0 POLICIES

According to 40 CFR Part 160, Subpart D, Section 160.61, Equipment used in the generation, measurement, or assessment of data and equipment used for facility environmental control shall be of appropriate design and adequate capacity to function according to the protocol and shall be suitable located for operation, inspection, cleaning, and maintenance.

Personnel will legibly record data and observations in the field to enable others to reconstruct project events and provide sufficient evidence of activities conducted.

3.0 SAFETY ISSUES

If necessary and appropriate, a site-specific health and safety plan shall be created for each study site. A template for creating a proper health and safety plan is provided on the SEI network.

If necessary and appropriate, all chemicals are required to be received with Material Safety Data Sheets (MSDS) or appropriate application label. These labels or MSDS shall be made available to all personnel involved in the sampling and testing.

4.0 PROCEDURES

4.1 Equipment and Materials

1. The pH/Con 10 meter, pH/conductivity/ temperature probe. The probe cable has a notched 6-pin connector to attach to probe meter.
2. If necessary and appropriate, standard solutions (e.g., standard pH 4.0 and 7.0, conductivity standards)
3. Clean beakers or other appropriate containers
4. Log or other appropriate medium to record calibration.

4.2 Meter Set-up and Conditioning

1. The pH/Con 10 meter uses a combination pH/conductivity/temperature probe. The probe cable has a notched 6-pin connector to attach the probe meter. Keep connector dry and clean.
2. To connect the probe, line up the notches and 6-pins on the probe connector with the holes in the connector located on the top of the meter. Push down and the probe connector will lock into place.
3. To remove probe, slide up the metal sleeve on the probe connector. While holding onto metal sleeve, pull probe away from the meter. Do not pull on the probe cord or the probe wires might disconnect.
4. Be sure to decontaminate the probe prior to use. The probe shall be tripled rinsed with distilled or deionized water. Further decontamination and cleaning procedures may be called for in special situations or outlined in approved protocols or work plans. This will be documented in field notes or in an appropriate logbook.
5. Be sure to remove the protective rubber cap of the probe before conditioning, calibration, or measurement. If the probe is clean, free of corrosion, and the pH bulb has not become dehydrated, simply soak the probe in tap water for ten minutes before calibrating or taking readings to saturate the pH electrode surface to minimize drift. Wash the probe as necessary in a mild detergent solution. If corrosion appears on the steel pins in the conductivity cell, use a swab soaked in isopropyl alcohol to clean the pins. Do not wipe the probe; this causes a build-up of electrostatic charge on the glass surface. If the pH electrode has dehydrated, soak it for 30 minutes in a 2M-4M KCl boot solution prior to soaking in tap water.
6. Wash the probe in deionized water after use and store in pH 4.0 standard solution or an approved boot solution (per the manufacturer’s instruction).

4.3 pH Calibration

1. The meter is capable of up to 3-point pH calibration to ensure accuracy across the entire pH range of the meter. At the beginning of each day of use, perform a 2 or 3-point calibration with standard pH buffers 4.00, 7.00, and 10.00. Calibration standards that bracket the expected sample range should be used. Never reuse buffer solutions; contaminants in the solution can affect the calibration.
2. Press the MODE key to select pH mode. The pH indicator appears in the upper right corner of the display.
3. Dip the probe into the calibration buffer. The end of the probe must be completely immersed into the buffer. Stir the probe gently to create a homogeneous buffer solution. Tap probe to remove any air bubbles.
4. Press CAL/MEAS to enter pH calibration mode. The primary display will show the measured reading while the smaller secondary display will indicate the pH standard buffer solution.
5. Press or keys to scroll up or down until the secondary display value is the same as the pH buffer value (pH 4.00, 7.00 or 10.00).
6. Wait for the measured pH value to stabilize. The READY indicator will display when the reading stabilizes. After the READY indicator turns on, press ENTER to confirm calibration. A confirming indicator (CON) flashes and disappears. The meter is now calibrated at the buffer indicated in the secondary display.
7. Repeat steps 3, 5, and 6 using a second or third pH standard
8. Press CAL/MEAS to return to pH measurement mode.

4.4 Conductivity Calibration

1. Select a conductivity standard with a value near the sample value expected. The meter should be calibrated by the user(s) at the beginning of each day of use.
2. Pour out two separate portions of your calibration standard and one of deionized water into separate clean containers.
3. Press MODE key to select Conductivity. The ΦS or mS indicator will appear on the right side of the display.
4. Rinse the probe with deionized water, and then rinse the probe in one of the portions of calibration standard Record the calibration standard on the per-use maintenance form or other appropriate medium.
5. Immerse the probe into the second portion of calibration standard. The meter's auto-ranging function selects the appropriate conductivity range (four ranges are possible).

Be sure to tap the probe to remove air bubbles. Air bubbles will cause errors in calibration.

6. Wait for the reading to stabilize. The READY indicator lights when the reading is stable. Press the CAL/MEAS key. The CAL indicator appears above the primary display. The primary display shows the measured reading and the secondary display shows the temperature. Record the initial calibration standard on the per-use maintenance form or other appropriate medium.
7. Press the or keys to scroll to the value of your conductivity standard Press and hold the or keys to scroll faster. The meter automatically compensates for temperature differences using a factor of 2.00% per BC.
8. Press ENTER key to confirm calibration. Upon confirmation, the CON indicator appears briefly. The meter automatically switches back into Measurement mode. The display now shows the calibrated, temperature compensated conductivity value. However, if the calibration value input into the meter is different from the initial value displayed by more than 20% , the ERR annunciator appears in the lower left corner of the display

4.5 Temperature Calibration/Verification

1. The built-in temperature sensor is factory calibrated. Therefore, no additional calibration is necessary. However, the temperature may be verified against another working thermometer. However, if errors in temperature readings are suspected or if a replacement probe is used. Refer to the operating instructions if temperature calibration is necessary.

4.6 General and Annual Maintenance

Individual users are responsible for the calibration, cleaning, repair, and maintenance of the instrument.

Routine inspection and maintenance schedules vary from each piece of equipment. Typically there are minor maintenance needs each piece of equipment will need to undergo prior to use in the field (such as cleaning or conditioning). Always consult the manufacturer=s instructions for general maintenance.

Specific per use maintenance needs for the pH /Con 10 meter include but are not limited to:

1. Inspect probe for physical damage and debris
2. Inspect meter for physical damage and debris
3. Clean probe w/ mild detergent
4. Rinse probe in distilled water
5. Clean conductivity pins with isopropyl alcohol (if necessary)
6. Condition probe
7. Calibrated to pH 7.0
8. Calibrated to pH 4.0
9. Calibrated to pH 10.0

The pH /con 10 meter shall be stored in a clean dry place, usually the padded box that it came in. Care should be given to keep the instrument from dust and contamination.

Wash the probe in distilled water after use, and store in pH 4 solution.

All maintenance, repairs, and calibrations are to be documented on an equipment maintenance log or other appropriate medium. Follow the checklist provided on the equipment maintenance log for regular use maintenance needs. Any maintenance must include documentation of whether the maintenance was routine and followed the SOP or not.

Equipment logs shall be brought to the field for documenting use and calibration. The logs will be returned to the office after each field use and filed in the equipment records filing cabinet.

In the event of failure due to breakage or loss of parts, an attempt will be made to repair or replace the necessary parts by the field personnel who discover the malfunction. All repairs will be documented in field notes and/or on a non-routine maintenance log. If the instrument is rendered “out of service” or “broken”, it should be tagged as such. If further repair is necessary, return the instrument to the manufacturer following proper shipping procedures.

Non-routine repairs must include documentation of the nature of the defect, how and when the defect was discovered, and any remedial action taken in response to the defect.

5.0 RESPONSIBILITIES

1. All personnel will legibly record data and observations (including phone conversations) in accordance with this SOP to enable others to reconstruct project events and provide sufficient evidence of activities conducted.
2. Prior to use and after use, all equipment will be appropriately cleaned, decontaminated, calibrated (if necessary) and stored in accordance with the manufacturer’s instructions and this SOP.

6.0 DEFINITIONS

Decontamination – Procedures followed to ensure cross contamination does not occur between sampling points or that potential contamination of equipment does not pose a hazard to sampling personnel.

EPA the U.S. Environmental Protection Agency.

FIFRA the Federal Insecticide, Fungicide, and Rodenticide Act as amended.

Maintenance – Actions performed on equipment to standardize and/or correct the accuracy and precision of a piece of equipment to ensure that the equipment is operating within the manufacturer’s specifications and standard values.

Study means any experiment at one or more test sites, in which a test substance is studied in a test system under laboratory conditions or in the environment to determine or help predict its effects, metabolism, product performance (pesticide efficacy studies only as required by 40 CFR 158.640)

environmental and chemical fate, persistence, or residue, or other characteristics in humans, other living organisms, or media. The term “study” does not include basic exploratory studies carried out to determine whether a test substance or a test method has any potential utility.

7.0 REFERENCES

40 CFR Part 160 Good Laboratory Practice Standards, August, 1989.

8.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

None

9.0 AUTHORIZATION

Revised by: _____ Date: _____

Michael Nuss, Staff Scientist

Approved by: _____ Date: _____

Christopher T. Stone, President

10.0 REVISION HISTORY

Revision number 1:

Changed title and references to Oakton in Sections 1.0 and 2.0 to enable this standard operating procedure to apply to both the Oakton pH/Con 10 meter and the Cole-Parmer pH/Con 10 meter, as these are identical meters.

Added instructions about cleaning and re-hydrating the probe to Section 3.1.

Added Section 9.0.

Reformatted.

Minor word editing.

Revision number 2:

Changed the title.

Removed sections 7.0 (Measurement) and 8.0 (Maintenance/Repairs).

Added section called (General and Annual Maintenance).

Minor editing.

Reformatted.

Revision number 3:

Minor wording edits in Section 1.0, Objective.

Updated style to match SEI Style Guide – font and text. Reformatted using MS Word

Added standardized section headers: 2.0 Policies, 3.0 Safety, 5.0 Responsibilities, 6.0 Definitions, 7.0 References, 8.0 Tables, Diagrams, Flowcharts and Validation data. Authorization moved to Section 9.0, andSection10.0 Revision History.

Deleted section on logs being given to the QAU.

Other minor wording edits.

STANDARD OPERATING PROCEDURE

SEI-6.38.1

OPTICAL BRIGHTENER TESTING

SOP Number: SEI-6.38.1 Date Issued: 09/11/08

Revision Number: 1 Date of Revision: 03/18/13

1.0 OBJECTIVE

Optical brighteners are a class of fluorescent dyes used in almost all laundry detergents. Many paper products also contain optical brighteners. When optical brightener is applied to cotton fabrics, they will absorb ultraviolet (UV) rays in sunlight and release them as blue rays. These blue rays interact with the natural yellowish color of cottons to give the garment the appearance of being “whiter than white”. Optical brightener dyes are generally found in domestic wastewaters that have a laundry effluent component. Because optical brighteners absorb UV light and fluoresce in the blue region of the visible spectrum, they can be detected using a long wave UV light (a “black” light).

Optical brightener monitoring can be used to indicate the presence of wastewater in stormwater drainage systems, streams, and other water bodies. Since optical brighteners are removed by adsorption onto soil and organic materials as effluent passes through soil and aquifer media, optical brightener monitoring may also be used to identify incompletely renovated wastewater effluent in groundwater at wastewater dispersal sites.

To test for optical brightener, a cotton pad is placed in a flow stream for a period of 4-10 days, after which the pad is rinsed, air dried, and viewed under a long range UV light. Florescence indicates the presence of optical brightener. Optical brighteners may be monitored in a wide range of structures and flow streams. For example, monitoring pads may be placed in stormwater outfall pipes, within catchbasins and manholes, or in any other man-made or natural water conveyance. Optical brightener pads may be placed in dry pipes or other dry structures to monitor possible intermittent flow streams. However, the more common application is to monitor discharge points that are flowing under dry weather conditions.

2.0 POLICIES

According to Stone’s Corporate Quality Management Plan, Stone shall have standard operating procedures in writing setting forth study methods that management is satisfied are adequate to ensure the quality and integrity of the data generated in the course of a study.

Personnel will legibly record data and observations in the field to enable others to reconstruct project events and provide sufficient evidence of activities conducted.

3.0 SAFETY ISSUES

If necessary and appropriate, a site-specific health and safety plan shall be created for each study site. A template for creating a proper health and safety plan is provided on the SEI network.

Care must always be taken when approaching a sampling location. Do not, under any circumstances, place yourself in danger to collect a sample.

If necessary and appropriate, all chemicals are required to be received with Material Safety Data Sheets (MSDS) or appropriate application labels. These labels or MSDS shall be made available to all personnel involved in the sampling and testing.

4.0 PROCEDURES

4.1 Equipment and Materials

1. Untreated cotton pad measuring approximately 10 cm by 10 cm (e.g., VWR cat no. 21902-985 or equivalent).
2. Fiberglass or nylon screen to enclose the cotton pad (sewn or stapled).
3. Monofilament fishing line (approximately 20 to 50 lb. test).
4. Binder clips of various sizes.
5. Field notebook, sample collection form, or other acceptable medium for recording field data.
6. Protective gloves if contamination is suspected in the water to be sampled, or if cold weather may be hazardous with wet hands.

4.2 Sampling Procedure and Sample Handling

4.2.1 Optical Brightener Pad Assembly

To assemble an optical brightener monitoring pad, place an untreated cotton pad measuring approximately 10 cm by 10 cm (e.g., VWR cat no. 21902-985) in an envelope made of a screen material. A light fiberglass screen is preferred. The pad may be folded in half to double its thickness. Sew, staple, or otherwise secure all open sides of the screen envelope to enclose the pad.

4.2.2 Optical Brightener Pad Placement

1. Secure the pad at the monitoring point using high test nylon fishing line (20 - 50 lb. test), a binder clip, or both. The pad may be attached to any convenient anchor, provided the pad is as well exposed to the flow stream as possible and the anchor point appears stable enough

to resist the force of high flow events. When sampling culverts or stormwater outfall pipes, the pad may be clipped directly to the inner rim of the outfall. The pad should lie flat against the bottom surface of the pipe. The pad may also be hung from a catchbasin grate or manhole rung.

2. If a suitable anchor is not present, a heavy object may be placed in the flow stream or channel to anchor the pad. For example, a pad may be anchored in a stream by tying it to a concrete block.
3. Two or more optical brightener monitoring pads may be placed at monitoring points if appropriate. If more than a single pad is used, the pads should be anchored so that they do not become entangled.
4. Record the date each pad is deployed and any other relevant information in a field logbook or on a specified sample collection form.

4.2.3 Optical Brightener Pad Retrieval and Handling

1. After a 4-10 day period of exposure, optical brightener pads should be collected. The collection of each pad should be recorded in a field logbook or on a specified sample collection form.
2. Any object inserted in a pipe or other structure to anchor the pad should be removed.
3. Pads should be placed in individually labeled, re-sealable plastic bags. The sample label should indicate the monitoring point identification.
4. The pad should be removed from the screen envelope using scissors to cut open the envelope. The pad should be gently rinsed using cold tap water. Lightly squeeze out excess water with a clean hand. Do not wring out the pad. When processing the pads be aware that you may spread dye from one pad to another with your hands. Wear disposable gloves.
5. The pad should then be returned immediately to the labeled bag.
6. Pads should be air dried. The pad may be hung on a line to dry within the labeled bag. If a re-sealable plastic bag is used, cut the bottom corners of the bag to allow airflow to the pad.

4.3 Optical Brightener Analysis

1. When the pad is dry, expose the pad under a high quality long range UV light in a room that is completely dark. A non-exposed and an exposed pad are used as controls and compared to each test pad as it is exposed to the UV light.
2. There are three qualitative results: Positive, Negative, and Indeterminate. A pad will very definitely glow (fluoresce) if it is positive. If it is negative it will be noticeably drab and similar to the control pad. All other tests are indeterminate. Pads may be sorted into the basic categories: positive test, negative test, and indeterminate. Further, for positive tests,

the pads may be sorted into categories by the relative strength of the fluorescence. A pad that is fluoresces brightly over most or all of its surface may be considered a strongly positive test, whereas a pad on which fluorescence appears patchy or faint may be considered a weakly positive test. Indeterminate results generally dictate that the test be repeated.

3. In some instances, only a portion of the pad or simply the outer edge will fluoresce after being exposed to optical brightener. This can be caused by many factors but is usually the result of an uneven exposure to the dye in the flow stream due to sedimentation or the way the pad was positioned in the water. Regardless, as long as a portion of the pad fluoresces, it should be considered positive.
4. Since paper and cotton dust is so pervasive, it is common to see fluorescent fibers or specks on the test or control pads. These should be ignored and not used to indicate a positive result.
5. With the lights back on, record the identification number and the test result for each pad.
6. It is advisable to have a second reader perform the pad observations independently. The results are then compared. Any conflicting interpretations may be resolved though repeated observation of the pad in question, or a by a third observer.

5.0 RESPONSIBILITIES

1. All personnel will legibly record data and observations (including phone conversations) in accordance with this SOP to enable others to reconstruct project events and provide sufficient evidence of activities conducted.

6.0 DEFINITIONS

Study means any experiment at one or more test sites, in which a test substance is studied in a test system under laboratory conditions or in the environment to determine or help predict its effects, metabolism, product performance (pesticide efficacy studies only as required by 40 CFR 158.640) environmental and chemical fate, persistence, or residue, or other characteristics in humans, other living organisms, or media. The term “study” does not include basic exploratory studies carried out to determine whether a test substance or a test method has any potential utility.

7.0 REFERENCES

40 CFR Part 160 Good Laboratory Practice Standards, August, 1989.

MASS Bay Program. 1998. An Optical Brightener Handbook.
http://www.thecompass.org/8TB/pages/SamplingContents.html

8.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

None

9.0 AUTHORIZATION

Revised by: _____ Date: _____

Dave Braun, Project Scientist/Water Quality Specialist

Approved by: _____ Date: _____

Christopher T. Stone, President

10.0 REVISION HISTORY

Revision number 1:

1. Minor clarifications and rewording throughout.
2. Changed 4-8 day pad exposure period to 4-10 day exposure period.
3. Changed description of indeterminate results.
4. Added use of binder clips to secure pads.
5. Updated procedure for processing exposed pads.

APPENDIX C: ASSESSMENT DATA

C.1. Barre City assessment data

Flag	System ID	Structure ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Cross reference	Comments
	BC010	BC010	7/30/14	KNB	AD	outfall	12	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
NH3, high conductivity, sulfur odor, sheen	BC020	BC020	7/30/14	KNB	AD	outfall	15	smooth plastic	trickling	na	free flow	sulfur odor	sheen	none	none	N	0.3	0.00	0.1	2270		Some suds observed at the stream pipe next to the outfall
	BC030	BC030	7/30/14	KNB	AD	outfall	8	vitrified clay	wet (no flow)	na	free flow	na	none	sediment	fully obstructed	na	na	na	na	na		Sediment from river has almost completely buried outfall. Data from outlet pipe in CB1 (no flow)
	BC040	BC040	7/30/14	KNB	AD	outfall	10	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC050	BC050	7/30/14	KNB	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Outfall appears buried. There is a trickle from base of hill at river bank, could not find source.
	BC060	BC060	7/30/14	KNB	AD	outfall	8	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC070	BC070	7/30/14	KNB	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Unable to locate outfall. May be submerged in river. There are no catchbasins according to map
	BC080	BC080	7/30/14	KNB	AD	outfall	8	unknown	unknown	unknown	submerged	unknown	none	unknown	unknown	na	na	na	na	na		Pipe seen from bridge, submerged in river. CB1 not flowing, stagnant
	BC090	BC090	7/30/14	KNB	AD	outfall	48	black corrugated plastic	flowing	1.5	free flow	clear, no odor	none	none	none	N	0.2	0.01	0.0	926	SB-O-28	
	BC100	BC100	7/30/14	KNB	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Could not locate outfall. Assessed at CB1
	BC100	CB1	7/30/14	KNB	AD	catchbasin	na	na	flowing	na	na	na	none	sediment	fully obstructed	N	0.1	0.00	0.2	989		Could not get a good view of CB, but appears fully blocked with sediment. MBAS test cloudy
	BC110	BC110	7/31/14	KNB	na	outfall	14	smooth plastic	flowing	1.5	free flow	na	none	none	none	N	0.2	0.02	0.1	1720		
high conductivity	BC110	CB9A	7/31/14	KNB	na	catchbasin	na	na	flowing	na	na	na	none	none	none	N	0.1	0.01	0.1	2160		
MBAS, high conductivity	BC110	CB13A	7/31/14	KNB	na	catchbasin	na	na	flowing	na	na	na	none	none	none	I	0.2	0.02	1.9	2170		
MBAS, sheen	BC120	BC120	7/31/14	KNB	na	outfall	16	concrete	trickling	na	partially submerged	clear, no odor	sheen	sediment	partially obstructed	na	0.2	0.01	0.2	212		90% obstructed, stagnant pool formed with some trickling flow. Could not locate flow source
OB, NH3, suds	BC130	BC130	7/31/14	KNB	na	outfall	36	corrugated metal	flowing	1	free flow	clear, no odor	suds	none	none	P	0.3	0.00	0.1	1186		
OB	BC140	BC140	7/31/14	KNB	na	outfall	24	corrugated metal	flowing	na	free flow	clear, no odor	none	none	none	P	0.1	0.00	0.1	1617		Lots of trash. Receiving creek smells bad. BC 110, 130 and 140 all outfall here. OB strongly positive.
	BC150	BC150	7/31/14	KNB	na	outfall	6	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		Lots of trash. Receiving creek smells bad
	BC160	BC160	7/31/14	KNB	na	outfall	6	cast iron?	dry	na	free flow	na	none	none	none	na	na	na	na	na		
NH3, Cl2, high conductivity	BC170	BC170	7/31/14	KNB	na	outfall	16	corrugated metal	trickling	na	free flow	clear, no odor	none	none	none	N	0.3	0.10	0.1	2950		The outfall is difficult to access. Lots of erosion, with deep gully along creek bed.
foul odor	BC180	BC180	7/31/14	KNB	na	outfall	4	smooth plastic	dry	na	free flow	foul odor, similar to feces	none	none	none	N	na	na	na	na		Small underdrain from house
	BC190	BC190	7/31/14	KNB	na	outfall	4	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC200	BC200	8/28/14	RES	na	outfall	10	corrugated black plastic	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na		
	BC210	BC210	8/28/14	RES	na	outfall	18	concrete	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na		Assessed at separation in pipe. Outfall buried.
	BC220	Culvert-1	8/28/14	RES	na	culvert	12	steel	trickling	na	free flow	clear, no odor	none	none	none	N	0.1	0.09	0.0	279		Outfall not found. CB1 not safe to access.
	BC230	BC230	8/28/14	RES	na	outfall	18	corrugated metal	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na		
OB, wastewater odor, waste deposits, pump sound	BC240	BC240	8/28/14	RES	na	outfall	14	steel	trickling	na	free flow	floating particles, no odor	none	none	none	P (strong)	0.1	0.03	0.0	333		Pump station sounds and sewer odor inside pipe. 9/2/14: waste deposits and strong sewage odor
	BC250	CB1	8/28/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Could not find outfall
	BC260	BC260	8/28/14	RES	na	outfall	12	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC270	BC270	8/28/14	RES	na	outfall	4	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC280	BC280	8/28/14	RES	na	outfall	33	corrugated black plastic	flowing	0.2	free flow	clear, no odor	none	none	none	N	0.1	0.02	0.0	818		
OB	BC290	CB1	8/28/14	RES	na	catchbasin	na	na	trickling	na	free flow	clear, no odor	none	none	none	P	0.1	0.05	0.0	780		Outfall inaccessible, empties to buried stream. Unmapped Pipe A trickling. Carwash runoff to CB.
	BC300	BC300	8/28/14	RES	na	outfall	22	corrugated black plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC310	BC310	8/28/14	RES	na	outfall	16	corrugated black plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC320	BC320	8/28/14	RES	na	outfall	10	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC330	BC330	8/28/14	RES	na	outfall	16	corrugated black plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC340	BC340	8/28/14	RES	na	outfall	16	corrugated black plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC350	BC350	8/28/14	RES	na	outfall	14	corrugated black plastic	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na		
	BC360	BC360	8/28/14	RES	na	outfall	na	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Could not find outfall. The mapped manhole MH1 is sewer.
	BC370	CB1	8/28/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Could not find outfall. Assessed at CB1.
	BC380	BC380	9/2/14	RES	na	outfall	8	steel	dry	na	free flow	na	none	none	none	na	na	na	na	na		To the left (facing up-pipe) of BC390
	BC390	BC390	9/2/14	RES	na	outfall	8	steel	dry	na	free flow	na	none	none	none	na	na	na	na	na		To the right (facing up-pipe) of BC380
	BC400	BC400	9/2/14	RES	na	outfall	10	steel	dry	na	free flow	na	none	none	none	na	na	na	na	na		
OB, NH3, sheen	BC410	BC410	9/2/14	RES	na	outfall	14	steel	wet (no flow)	na	free flow	clear, no odor	sheen	iron staining	none	P	0.25	0.01	0.0	665	SB-O-31	Water dripping out around the pipe; difficult to tell if it is groundwater or from the pipe (sampled).
	BC420	BC420	9/2/14	RES	na	outfall	14	corrugated metal	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na		
	BC430	BC430	9/2/14	RES	na	outfall	12	vitrified clay	trickling	na	submerged	clear, no odor	none	none	partially obstructed	N	0.1	0.02	0.1	620		Sampled CB1 Padded outfall.
	BC440	BC440	9/2/14	RES	na	outfall	16	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
OB, high conductivity	BC450	BC450	9/2/14	RES	na	outfall	14	corrugated metal	dripping	na	free flow	na	none	none	partially obstructed	P	0.1	0.03	0.0	3480		
	BC460	CB1	9/2/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Could not find outfall. Assessed at CB1.
	BC470	BC470	9/2/14	RES	na	outfall	12	corrugated metal	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na		
	BC480	CB1	9/2/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	fully obstructed	na	na	na	na	na		Outfall buried under rubble. CB1 is an open culvert with no grate. Severe erosion around culvert.
	BC490	CB1	9/2/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na		Outfall covered by debris and soil, but has scoured a hole out through the ground. Assessed at CB1.
	BC500	CB1	9/2/14	RES	na	catchbasin	na	na	dripping	na	free flow	na	none	none	partially obstructed	N	na	na	na	na		Outfall buried by brush. Surface pipe dripping into CB1. Padded CB1. Dripping too slowly to sample.
	BC510	CB1	9/2/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na		Outfall buried under brush. Assessed at CB1.
OB	BC520	BC520	9/2/14	RES	na	outfall	16	vitrified clay	trickling	na	free flow	clear, no odor	none	none	none	P	0.1	0.01	0.0	570		
	BC530	BC530	9/2/14	RES	na	outfall	10	smooth plastic	trickling	na	free flow	na	none	none	none	N	0.1	0.03	0.0	554		
	BC540	BC540	9/2/14	RES	na	outfall	4	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
Wastewater odor, OB=I	BC550	BC550	9/2/14	RES	na	outfall	22	corrugated metal	trickling	na	partially submerged	clear, no odor	none	none	none	I	0.1	0.03	0.0	1236	GB-O-05	Padded CB1 because outfall surcharged. Slight sewage odor in pipe--related to sewer main repair?
NH3	BC560	BC560	9/2/14	RES	na	outfall	18	corrugated metal	trickling	na	free flow	clear, no odor	none	none	none	N	0.25	0.05	0.1	728	GB-O-04	Padded CB1. Outfall very corroded.
OB	BC570	BC570	9/2/14	RES	na	outfall	12	vitrified clay	flowing	0.1	free flow	clear, no odor	none	none	none	P	0.1	0.02	0.0	1532		Outfall discharges less than an inch above a channelized stream.
	BC580	BC580	9/2/14	RES	na	outfall	4	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC590	BC590	9/2/14	RES	na	outfall	10	steel	dry	na	free flow	na	none	none	none	na	na	na	na	na		Above BC600
	BC600	BC600	9/2/14	RES	na	outfall	12	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na		Below BC590
	BC610	BC610	9/2/14	RES	na	outfall	12	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC620	BC620	9/2/14	RES	na	outfall	10	vitrified clay	dry	na	submerged	na	none	none	none	na	na	na	na	na		Surcharged into CB1. CB2 and CB3 both dry.
	BC630	CB1	9/2/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Could not find outfall. Assessed at CB1.
	BC640	BC640	9/2/14	RES	na	outfall	12	smooth plastic	dry	na	partially submerged	na	none	none	none	na	na	na	na	na		CB1 dry
	BC650	BC650	9/2/14	RES	na	outfall	10	vitrified clay	dry	na	partially submerged	na	none	none	none	na	na	na	na	na	GB-O-03	CB1 dry
	BC660	BC660	9/12/14	RES	na	outfall	unknown	concrete	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na		Difficult to determine size of outfall.
	BC670	BC670	9/12/14	RES	na	outfall	10	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC680	BC680	9/12/14	RES	na	outfall	12	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC690	BC690	9/12/14	RES	na	outfall	24	concrete	dry	na	free flow	na	none	sediment	none	na	na	na	na	na		Outfall is recessed in a box culvert.
	BC700	BC700	9/12/14	RES	na	outfall	8	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC710	BC710	9/12/14	RES	na	outfall	8	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		

Flag	System ID	Structure ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Cross reference	Comments
	BC720	BC720	9/12/14	RES	na	outfall	8	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC730	BC730	9/12/14	RES	na	outfall	8	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC740	BC740	9/12/14	RES	na	outfall	8	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC750	BC750	9/12/14	RES	na	outfall	38	corrugated black plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC760	BC760	9/12/14	RES	na	outfall	30	concrete	dry	na	free flow	na	none	sediment	none	na	na	na	na	na	SB-O-14	
	BC770	BC770	9/12/14	RES	na	outfall	16	corrugated black plastic	flowing	3	free flow	clear, strong rotting odor	none	sediment	partially obstructed	N	0.1	0.01	0.1	1178		Strong rotting odor in and around outfall. Drains a retention pond. Outfall about 6 inches above river.
	BC780	BC780	9/12/14	RES	na	outfall	16	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
MBAS, high conductivity	BC790	BC790	9/12/14	RES	na	outfall	6	smooth plastic	trickling	na	free flow	na	none	none	none	N	0.0	0.02	0.4	4680		
	BC800	BC800	9/12/14	RES	na	outfall	12	smooth plastic	flowing	na	free flow	na	none	none	none	na	na	na	na	na		Outfall discharges 50 ft. up inside culvert. Culvert too small to climb up.
OB, high conductivity	BC800	MH1	9/18/14	RES	na	manhole	na	na	trickling	na	free flow	clear, no odor	none	none	none	P	0.1	0.02	0.0	2790		
	BC810	CB1	9/12/14	RES	na	catchbasin	na	na	flowing	na	na	clear, no odor	none	none	fully obstructed	N	0.0	0.04	0.0	1441		Outfall buried - possibly drains into a subsurface infiltration strip. Assessed at CB1.
	BC820	BC820	9/12/14	RES	na	outfall	12	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
OB	BC830	BC830	9/12/14	RES	na	outfall	38	concrete	flowing	1	free flow	clear, no odor	none	none	none	P	0.1	0.01	0.0	885		
	BC840	CB1	9/12/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Could not find outfall. Assessed at CB1.
	BC850	CB1	9/18/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall buried under dead trees. Assessed at CB1.
	BC860	BC860	9/18/14	RES	na	outfall	10	smooth plastic	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na		
	BC870	BC870	9/18/14	RES	na	outfall	unknown	unknown	Unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Could not find outfall. No other structures to assess (underdrain).
	BC880	BC880	9/18/14	RES	na	outfall	4	steel	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC890	BC890	9/18/14	RES	na	outfall	4	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC900	BC900	9/18/14	RES	na	outfall	12	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	PB-O-02A	
	BC910	BC910	9/18/14	RES	na	outfall	14	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC920	CB1	9/18/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall buried. Assessed at CB1.
	BC930	CB1	9/18/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall buried. Assessed at CB1.
	BC940	BC940	9/18/14	RES	na	outfall	10	vitrified clay	flowing	0.1	free flow	clear, no odor	none	none	none	N	0.1	0.04	0.1	1810	EB-O-02	
	BC950	BC950	9/18/14	RES	na	outfall	12	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC960	BC960	9/18/14	RES	na	outfall	4	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC970	BC970	9/18/14	RES	na	outfall	12	corrugated metal	flowing	0.1	free flow	clear, no odor	none	none	none	N	0.1	0.01	0.0	1009	PB-O-05	
	BC980	BC980	9/18/14	RES	na	outfall	10	corrugated metal	dripping	na	free flow	clear, no odor	none	none	none	N	0.1	0.02	0.0	1281		
OB	BC990	BC990	9/18/14	RES	na	outfall	12	smooth plastic	flowing	0.1	free flow	clear, no odor	none	none	none	P	0.1	0.02	0.0	1158		Small flow pulses.
	BC1000	BC1000	9/18/14	RES	na	outfall	6	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1010	BC1010	9/18/14	RES	na	outfall	6	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1020	BC1020	9/18/14	RES	na	outfall	10	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1030	BC1030	9/18/14	RES	na	outfall	24	corrugated metal	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1040	BC1040	9/18/14	RES	na	outfall	24	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1050	BC1050	9/18/14	RES	na	outfall	10	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1060	BC1060	9/18/14	RES	na	outfall	8	steel	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1070	BC1070	9/18/14	RES	na	outfall	12	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1080	BC1080	9/18/14	RES	na	outfall	10	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1090	BC1090	9/18/14	RES	na	outfall	12	corrugated black plastic	dry	na	partially submerged	na	none	none	none	na	na	na	na	na		Drains southwest side of Maple Grove St. Assessed flow at CB1.
	BC1100	BC1100	9/18/14	RES	na	outfall	12	smooth plastic	trickling	na	partially submerged	clear, no odor	none	none	none	na	na	na	na	na		Assessed flow, took sample at CB1, and padded CB1. CB1: Pipe A trickling, Pipe B dry.
																P	1.0	na	0.7	1285		
OB, NH3, MBAS	BC1100	CB1	9/18/14	RES	na	catchbasin	na	na	trickling	na	free flow	na	none	none	none	P						Ran out of free chloride reagent. Pipe A trickling, pipe B dry.
OB	BC1100	CB2	9/18/14	RES	na	catchbasin	na	na	trickling	na	free flow	na	none	none	none	P	na	na	na	na		
	BC1110	BC1110	9/25/14	RES	na	outfall	34	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na	SB-O-29	
OB	BC1120	BC1120	9/25/14	RES	na	outfall	12	smooth plastic	flowing	0.1	free flow	clear, no odor	none	none	none	P	0.1	0.02	0.0	1155	SB-O-13	Red fibrous algae growing below outfall
OB	BC1120	CB1	9/25/14	RES	na	catchbasin	na	na	flowing	na	na	na	none	none	none	P	na	na	na	na		Sewer odor in catchbasin. Very warm in catchbasin.
OB	BC1120	MH3	9/25/14	RES	na	manhole	na	na	flowing	na	na	na	none	none	none	P	na	na	na	na		Pipes A and B flowing. Pipe C dry. No odor in catchbasin.
	BC1130	BC1130	9/25/14	RES	na	outfall	16	corrugated metal	flowing	0.2	free flow	clear, no odor	none	none	none	N	0.1	0.02	0.0	1173		
	BC1140	BC1140	9/25/14	RES	na	outfall	12	vitrified clay	dry	na	submerged	na	none	none	none	na	na	na	na	na		Flow assessed at MH1.
	BC1150	BC1150	9/30/14	RES	SW	outfall	12	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na	SB-O-03	
	BC1160	BC1160	9/30/14	RES	SW	outfall	10	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1170	BC1170	9/30/14	RES	SW	outfall	10	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1180	BC1180	9/30/14	RES	SW	outfall	8	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1190	BC1190	9/30/14	RES	SW	outfall	7	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1200	BC1200	9/30/14	RES	SW	outfall	4	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1210	BC1210	9/30/14	RES	SW	outfall	10	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1220	BC1220	9/30/14	RES	SW	outfall	24	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na	SB-O-04	
	BC1230	BC1230	9/30/14	RES	SW	outfall	6	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1240	BC1240	9/30/14	RES	SW	outfall	8	corrugated metal	wet (no flow)	na	free flow	na	none	sediment	none	na	na	na	na	na		1 in. above river
	BC1250	BC1250	9/30/14	RES	SW	outfall	10	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1260	BC1260	9/30/14	RES	SW	outfall	3	smooth plastic	flowing	na	free flow	na	none	none	none	na	na	na	na	na		Highly variable flow into a detention pond behind a manufacturing building
	BC1270	BC1270	9/30/14	RES	SW	outfall	8	smooth plastic	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1280	BC1280	9/30/14	RES	SW	overflow	na	na	flowing	na	free flow	cloudy gray, no odor	none	none	none	na	0.1	0.05	0.1	460		Overflow from factory detention pond
OB, petroleum and sewage odor, sheen	BC1290	BC1290	9/30/14	RES	SW	outfall	8	corrugated metal	dry	na	free flow	strong oil odor, sewer odor	sheen	none	none	P	na	na	na	na	SB-O-06	OB detection may result from river surcharge (outfall is 4 inches above river level)
OB	BC1300	BC1300	9/30/14	RES	SW	outfall	18	corrugated black plastic	flowing	0.25	free flow	clear, no odor	none	none	none	P	0.0	0.00	0.0	1412	SB-O-07	
Cl2, high conductivity	BC1310	BC1310	9/30/14	RES	SW	outfall	9	vitrified clay	dripping	na	free flow	clear, no odor	none	slime	none	N	0.0	0.37	0.1	5850		
high conductivity	BC1320	BC1320	9/30/14	RES	SW	outfall	15	smooth plastic	trickling	na	free flow	clear, no odor	none	algae	none	N	0.0	0.02	0.1	4050		
	BC1330	BC1330	9/30/14	RES	SW	outfall	17	corrugated black plastic	flowing	na	free flow	clear, no odor	none	none	none	N	0.0	0.07	0.0	1738	SB-O-11	
	BC1330	CB1	10/31/14	RES	na	catchbasin	na	na	flowing	na	na	na	none	none	none	N	na	na	na	na		
	BC1340	CB1	9/30/14	RES	SW	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Could not find outfall. Assessed at CB1
	BC1350	BC1350	9/30/14	RES	SW	outfall	12	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		Several 4-in. PVC pipes on other side of river (appear to be water withdrawal).
	BC1360	BC1360	9/30/14	RES	SW	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Revisit to assess at CB1.
	BC1370	BC1370	9/30/14	RES	SW	outfall	16	corrugated black plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall has flexible rubber flap over it
	BC1380	BC1380	9/30/14	RES	SW	outfall	15	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na	SB-O-23	

Flag	System ID	Structure ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Cross reference	Comments
	BC1390	BC1390	10/10/14	RES	na	outfall	16	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1400	BC1400	10/10/14	RES	na	outfall	24	corrugated black plastic	flowing	0.1	free flow	na	none	none	none	N	0.0	0.00	0.0	821		
	BC1405	BC1405	10/10/14	RES	na	outfall	18	corrugated metal	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na		To the right (facing up pipe) of BC1400
	BC1410	BC1410	10/10/14	RES	na	outfall	4	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
Cl2	BC1420	BC1420	10/10/14	RES	na	outfall	12	smooth plastic	trickling	na	partially submerged	cloudy brown, floating particles	none	none	partially obstructed	N	0.1	0.11	0.0	930		Outfall marked for clearing by public works.
	BC1430	CB1	10/10/14	RES	na	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall buried. Assessed at CB1.
	BC1440	BC1440	10/10/14	RES	na	outfall	48	corrugated black plastic	flowing	0.2	free flow	clear, no odor	none	none	none	N	0.1	0.00	0.0	925		CB1 is inaccessible. CB2 is dry. CB4 flows to CB1. Padded outfall, CB1, and culvert inlet.
	BC1440	CB1	10/31/14	RES	na	catchbasin	na	na	flowing	na	na	na	none	none	none	N	na	na	na	na		
	BC1450	BC1450	10/31/14	RES	SW	outfall	10	steel	unknown	na	free flow	na	none	none	fully obstructed	na	na	na	na	na	JB-O-03	Outfall buried. Other structures unsafe to access without traffic control
	BC1460	BC1460	10/31/14	RES	SW	outfall	12	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na	JB-O-02	Two 3" pipes in outfall. One 1" pipe in outfall.
	BC1470	BC1470	10/31/14	RES	SW	outfall	12	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na	JB-O-01	Three 2-3" pipes inside outfall.
	BC1480	BC1480	10/31/14	RES	SW	outfall	12	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na	SB-O-01	
faint chemical odor	BC1490	BC1490	10/31/14	RES	SW	outfall	12	smooth plastic	flowing	0.5	partially submerged	clear, faint chemical odor	none	none	none	na	0.0	0.03	0.0	951	JB-O-08	Padded CB1.
	BC1490	CB1	10/31/14	RES	SW	catchbasin	na	na	flowing	na	na	na	none	none	none	N	na	na	na	na		
	BC1500	BC1500	10/31/14	RES	SW	outfall	14	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
Cloudy water (vehicle washwater likely)	BC1510	BC1510	10/31/14	RES	SW	outfall	14	corrugated metal	flowing	1	free flow	cloudy white, no odor	none	none	none	N	0.0	0.04	0.0	777	JB-O-12	12-in vitrified clay pipe below outfall is dry. Car wash up-system.
	BC1520	BC1520	10/31/14	RES	SW	outfall	8	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1530	BC1530	10/31/14	RES	SW	outfall	14	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1540	BC1540	10/31/14	RES	SW	outfall	15	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		Iron stained groundwater seepage downhill from outfall.
	BC1550	BC1550	10/31/14	RES	SW	outfall	10	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1560	BC1560	10/31/14	RES	SW	outfall	10	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		Long (~30 ft.) section of pipe broken away from outfall.
	BC1570	BC1570	10/31/14	RES	SW	outfall	14	smooth plastic	flowing	0.1	free flow	clear, no odor	none	none	none	N	0.0	0.00	0.1	1123		
	BC1580	BC1580	10/31/14	RES	SW	culvert	na	na	flowing	na	free flow	clear, no odor	none	none	none	N	0.0	0.01	0.1	1450		Outfall is a stone box culvert. Culvert entrance across the street is dry. CB1 buried and CB2 dry.
	BC1590	BC1590	10/31/14	RES	SW	outfall	10	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1600	BC1600	10/31/14	RES	SW	outfall	12	smooth plastic	dripping	na	free flow	clear, no odor	none	none	none	N	0.0	0.03	0.0	300		Padded CB1. Outfall discharges into culvert from CB1 positioned above an opening in culvert pipe.
	BC1610	BC1610	10/31/14	RES	SW	outfall	8	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1620	BC1620	10/31/14	RES	SW	outfall	20	concrete	flowing	0.5	free flow	clear, no odor	none	none	none	na	0.1	0.00	0.0	1002	EB-O-04	Padded CB1. Outfall is inside culvert.
OB	BC1620	CB1	10/31/14	RES	SW	catchbasin	na	na	flowing	na	free flow	na	none	none	none	P	na	na	na	na		
OB, NH3	BC1630	BC1630	10/31/14	RES	SW	outfall	20	corrugated black plastic	flowing	0.1	free flow	clear, no odor	none	none	none	P	0.6	0.02	0.1	850	EB-O-03	Shawn noted that this outfall has had high *E. coli* levels in the past.
	BC1640	BC1640	10/31/14	RES	SW	outfall	12	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1650	BC1650	10/31/14	RES	SW	outfall	10	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1660	BC1660	10/31/14	RES	SW	outfall	12	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1670	BC1670	10/31/14	RES	SW	outfall	10	concrete	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na	SB-O-17	
	BC1680	BC1680	10/31/14	RES	SW	outfall	10	smooth plastic	dripping	na	free flow	na	none	none	none	na	na	na	na	na		Dripping too slowly to sample.
	BC1690	BC1690	10/31/14	RES	SW	outfall	10	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	SB-O-19	
	BC1700	BC1700	10/31/14	RES	SW	outfall	6	steel	dry	na	free flow	na	none	none	none	na	na	na	na	na		
NH3, Cl2	BC1710	BC1710	10/31/14	RES	SW	outfall	unknown	unknown	trickling	na	free flow	na	none	none	none	Lost	0.75	0.06	0.1	406	SB-O-20	Outfall buried under granite debris.
	BC1720	BC1720	10/31/14	RES	SW	outfall	12	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BC1730	BC1730	10/31/14	RES	SW	outfall	24	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BCF010	BCF010	8/28/14	SW	AS	outfall	18	corrugated black plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		Minor longitudinal crack--grate has been placed in front
NH3, low MBAS	BCF020	BCF020	8/28/14	SW	AS	outfall	15	smooth plastic	dripping	na	free flow	no odor	small bits of br	sediment?	none	N	0.25	0.02	0.2	946		9/5/14: still dripping. Observed small particles of brownish-tan organic matter. 21 Fecteau Circle
	BCF030	BCF030	8/28/14	SW	AS	outfall	5	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		Very close to house at the bottom of the stairs to the back door.
NH3, Cl2	BCF040	BCF040	8/28/14	SW	AS	outfall	15	corrugated black plastic	dripping	na	free flow	no odor	none	none	none	N	0.25	0.08	not done	not done		Slow drip. Insufficient sample for complete chemistry. Distinct pink color in chlorine test. Pool above 9/5/14: reset pad, still dripping. 9/12/14: wet. 16 Fecteau Circle
	BCF045	BCF045	8/28/14	SW	AS	outfall	6	smooth plastic	trickling	na	free flow	no odor	none	sediment/slime	partially obstructed	N	na	na	na	na		1/2 full of sediment/slime. Could not obtain sample. Outfall not mapped; located next to BCF040. Possible pool drain? Shawn's photos: 45a &b.
NH3, MBAS, suds	BCF050	BCF050	8/28/14	SW	AS	outfall	12	corrugated black plastic	trickling	na	free flow	no odor, suds on 9/5/14	suds	algal growth?	none	N	0.25	0.05	0.2	1183		9/5/14: still trickling steadily. Suds. Catchbasin had water in sump, but not enough to flow to outlet.
	BCF060	CB1	8/28/14	SW	AS	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall not found. Assessed at CB1.
NH3, low MBAS, suds	BCF070	BCF070	8/28/14	SW	AS	outfall	15	corrugated metal	flowing	0.5	free flow	no odor, suds on 9/5/14	suds	calcareous deposit (crunchy)	none	N	0.25	0.00	0.2	521		Gully below but not at outfall, 50 Basset
	BCF080	CB1	8/28/14	SW	AS	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Unable to access outfall. Assessed at CB1.
	BCF090	BCF090	8/28/14	SW	AS	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Outfall not found.
	BCF100	BCF100	8/28/14	SW	AS	outfall	9	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		Observed outfall from the top of the slope. CB upstream is dry.
	BCF110	BCF110	8/28/14	SW	AS	outfall	18	concrete	dripping	na	free flow	na	none	none	fully obstructed	na	na	na	na	na		Last CB is dry; line goes under driveway; completely sedimented in on outflow side of driveway.
	BCF120	BCF120	8/28/14	SW	AS	outfall	18	smooth plastic	dry	na	free flow	na	none	sediment	none	na	na	na	na	na		
	BCF130	BCF130	8/28/14	SW	AS	outfall	12	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na		
NH3	BCF140	BCF140	8/28/14	SW	AS	outfall	18	corrugated metal	flowing	0.25	free flow	no odor	none	calcareous deposit (crunchy)	none	N	0.25	0.00	0.1	1539		
	BCF150	BCF150	9/5/14	SW		outfall	na	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		Riprapped below with small stones
	BCF160	BCF160	9/5/14	SW		outfall	4	smooth plastic	dry	na	submerged	na	none	none	partially obstructed	na	na	na	na	na		End of pipe is almost buried. Flow seems to be via holes in pipe where there is standing water.
OB, NH3, MBAS, suds	BCF170	BCF170	9/12/14	SW	AD	outfall	36	corrugated metal	flowing	1	free flow	musty odor w/some suds	suds?	iron staining/algae	none	P	0.4	0.01	0.2	693		Lots of trash, CB was dry, most of the flow seems to be coming from stream. 9/23/14: significant suds
MBAs, suds	BCF180	BCF180	9/12/14	SW	AD	outfall	18	corrugated black plastic	trickling	na	free flow	clear, no odor	suds	none	none	N	0.1	0.02	0.7	900		
	BCF190	BCF190	9/12/14	SW	AD	outfall	5	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		Underdrain
	BCF200	CB1	9/12/14	SW	AD	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Unable to find outfall. CB1 above is dry but full of trash/sediment/grass.
	BCF210	CB1	9/12/14	SW	AD	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Unable to find outfall. CB1 sump has lots of sediment that appears to be covering outlet pipe. Dry.
	BCF220	BCF220	9/12/14	SW	AD	outfall	10	corrugated metal	dry	na	free flow	na	none	sediment	none	na	na	na	na	na		1st CB is nearly full of sediment that covers outlet pipe completely.
	BCF230	BCF230	9/12/14	SW	AD	outfall	4	vitrified clay	dry	na	free flow	na	none	rocks and sediment	partially obstructed	na	na	na	na	na		2/3rds full of sediment, other broken pieces of pipe nearby.
	BCF240	BCF240	9/12/14	SW	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Could not find outfall. Glenwood/Elmwood.
	BCF250	BCF250	9/12/14	SW	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Could not find outfall. Neighbor says it is buried and not functional. Claims runoff problem above property.
	BCF260	BCF260	9/12/14	SW	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Could not find outfall. Lots of debris, grout. Additional CB (wet) not on map.
	BCF270	BCF270	9/12/14	SW	AD	outfall	3	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		This outfall appears to be a suspended PVC pipe from the upper floor of concrete cutting shed.
	BCF280	BCF280	9/12/14	SW	AD	outfall	6	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BCF290	BCF290	9/12/14	SW	AD	outfall	6	smooth plastic	dry	na	free flow	na	none	iron staining	none	na	na	na	na	na		2 outfalls side by side. Manhole symbol on map incorrect.
	BCF300	BCF300	9/12/14	SW	AD	outfall	42	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na		CB is at a higher grade than the street. Water is bypassing the CB and eroding the top of the bank.
	BCF310	BCF310	9/12/14	SW	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Outfall not found. Major stormwater issues described by owner, Charlie Dindo: 479-1410 (O), 476-7067 (H)
	BCF320	BCF320	9/12/14	SW	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Outfall not found.
	BCF330	BCF330	9/23/14	SW	AD	outfall	10	smooth plastic	wet (no flow)	na	free flow	clear, no odor	none	none	none	N	na	na	na	na		CB is full of sediment; stormwater may be bypassing outfall

Flag	System ID	Structure ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Cross reference	Comments
	BCF340	BCF340	9/23/14	SW	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Could not find outfall. Brush and grout on slope.
	BCF350	CB1	9/23/14	SW	AD	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Can see pipe in CB1. Silt deposit with pooling at suspected outfall location.
	BCF360	CB1	9/23/14	SW	AD	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall possibly incorrectly mapped. It may be an outlet for an underdrain that is connected to a CB.
	BCF370	BCF370	9/23/14	SW	AD	outfall	8	smooth plastic	dry	na	free flow	na	none	sediment	fully obstructed	na	na	na	na	na		See notes for BCF360 about CB.
	BCF380	BCF380	9/23/14	SW	AD	outfall	8	vitrified clay	dry	na	free flow	na	none	none	none	na	na	na	na	na		End is cracked but still functional
	BCF390	BCF390	9/23/14	SW	AD	outfall	9	corrugated metal	dry	na	free flow	na	none	sediment	none	na	na	na	na	na		Rusted out. Last 8 feet of pipe has broken off.
	BCF400	BCF400	9/23/14	SW	AD	outfall	6	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		Riprap on slope below outfall. CB above has significant sediment plus unmapped inlet
	BCF410	BCF410	9/23/14	SW	AD	outfall	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall covered in asphalt/rock debris on bank. Incision at site where outfall should be.
	BCF420	CB1	9/23/14	SW	AD	catchbasin	na	na	dry	na	free flow	na	none	none	none	na	na	na	na	na		Outfall not found. No sign of outfall pipe in CB either.
	BCF430	BCF430	9/23/14	SW	AD	outfall	8	smooth plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na		
	BCF440	BCF440	9/23/14	SW	AD	outfall	36	corrugated metal	flowing	1	free flow	clear, no odor	none	algae	none	N	0.1	0.01	0.1	319		
	BCF450	BCF450	9/23/14	SW	AD	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Outfall not found. Sections of crushed corrugated metal abound. Water seeping under pile of fencing.
	BCF460	BCF460	9/25/14	SW	AS	outfall	12	smooth plastic	dry	na	free flow	na	none	sediment	none	na	na	na	na	na		
OB	BCF470	BCF470	9/25/14	SW	AS	outfall	18	smooth plastic	flowing	0.125	free flow	clear	none	algae-like stuff	none	P	0.13	0.00	0.1	776		
	BCF480	BCF480	9/25/14	SW	AS	outfall	5	smooth plastic	flowing	0.5	submerged	clear, no odor	none	sediment/slime	partially obstructed	na	na	na	na	na		Outfall too submerged to set pad or take sample, short drain that drains swale.
	BCF490	BCF490	9/25/14	SW	AS	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		In tunnel under Wash. St. Could see header but not outfall pipe. Could not reach.
	BCF500	BCF500	9/25/14	SW	AS	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na		Also in tunnel under Wash St. Property owner (Jerry Dudley's auto) mentioned a second pipe that "nobody knows where is comes from or where it goes". Complained about water runoff from Barre town.
	BCF510	BCF510	9/25/14	SW	AS	outfall	13	vitrified clay	flowing	0.25	free flow	clear, no odor	none	none	none	N	0.13	0.00	0.1	460		Colorimeter battery is dying
	BCF520	BCF520	9/25/14	SW	AS	outfall	15	concrete	flowing	0.5	free flow	no odor	none	none	none	N	0.13	0.00	0.1	457		Colorimeter battery is dying

C.2. Barre Town Assessment Data

Flag	System ID	Structure ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Discharge characteristics	Floatables	Deposits/ Stains	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
	BT010	BT010	6/18/14	DCB	KNB	outfall	18	black corrugated plastic	dripping		clear, no odor	none	none	na	na	na	na	na	Re-assessed on 6/20/14: dry
	BT020	BT020	6/18/14	DCB	KNB	outfall	12	corrugated metal	trickling		clear, no odor	none	none	N	0.0	0.04	0.7	134.2	MBAS test possibly invalid due to oil cross contamination. Re-assessed on 6/20/14: dry
	BT030	BT030	6/18/14	DCB	KNB	outfall	10	smooth plastic	wet, no flow		no odor	none	none	na	na	na	na	na	Outfall located under bridge on downstream side, west bank (downstream of mapped location)
	BT040	BT040	6/18/14	DCB	KNB	outfall	12	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT050	BT050	6/18/14	DCB	KNB	outfall	12	black corrugated plastic	dripping		clear, no odor	none	none	N	0.0	na	0.5	622	MBAS test possibly invalid due to oil cross contamination. Reassessed 6/20/14: dry
	BT060	BT060	6/18/14	DCB	KNB	outfall	18	black corrugated plastic	dripping		clear, no odor	suds	none	N	0.0	na	1.0 (0.75)	160	Reassessed 6/20/14: wet, no flow.
	BT070	BT070	6/20/14	DCB	KNB	outfall	unknown	unknown	dry		na	none	unknown	na	na	na	na	na	Fully obstructed, no flow
	BT080	BT080	6/20/14	DCB	KNB	outfall	18	black corrugated plastic	dry		na	none	none	na	na	na	na	na	
	BT080-Seep	Seep	6/20/14	DCB	KNB	seep	na	na	dripping		iron sheen, staining, suds	suds	iron staining	na	0.25	0.03	invalid	277	Seep with iron staining and suds emerging from rock wall beneath BT080 outfall.
	BT090	BT090	6/20/14	DCB	KNB	outfall	18	black corrugated plastic	dry		na	none	none	na	na	na	na	na	
NH3	BT100	BT100	6/20/14	DCB	KNB	outfall	30	corrugated metal	trickling		no odor	none	none	N	0.5	0.00	0.2	173.5	Across from Hannaford.
	BT110	BT110	6/20/14	DCB	KNB	outfall	18	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	Not as mapped
	BT120	BT120	6/20/14	DCB	KNB	outfall	24	corrugated metal	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT130	BT130	6/20/14	DCB	KNB	outfall	24	black corrugated plastic	dry		na	none	none	na	na	na	na	na	
	BT140	BT140	6/20/14	DCB	KNB	outfall	12	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT150	BT150	6/20/14	DCB	KNB	outfall	18	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	2 outfalls at this location (BT140, BT150), mapped as 1 outfall
	BT160	BT160	6/20/14	DCB	KNB	outfall	18	black corrugated plastic	wet, no flow		ponding, backed up	none	sediment	na	na	na	na	na	Water backed up, sedimented in
	BT170	BT170	6/20/14	DCB	KNB	infiltration basin	4	smooth plastic	dry		na	none	none	na	na	na	na	na	Outfall not found, infiltration basin inlet?
	BT180	BT180	6/20/14	DCB	KNB	outfall	unknown	unknown	unknown		unknown	unknown	unknown	na	na	na	na	na	Outfall buried; rock lined ditch and trash at presumed outfall (dry).
	BT190	CB1	6/20/14	DCB	KNB	catchbasin	na	na	dry		na	na	na	na	na	na	na	na	Outfall not found, assessed at first up-pipe CB
	BT200	CB1	6/20/14	DCB	KNB	catchbasin	na	na	dry		na	na	na	na	na	na	na	na	parking lot - dry
	BT210	BT210	6/20/14	DCB	KNB	outfall	18	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT220	BT220	6/20/14	DCB	KNB	outfall	28X40 Oval	corrugated metal	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT230	BT230	6/20/14	DCB	KNB	outfall	12	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT240	BT240	6/20/14	DCB	KNB	outfall	6	smooth plastic	dry		no odor	none	none	na	na	na	na	na	
	BT250	BT250	6/24/14	KNB	AS	outfall	18	black corrugated plastic	dry		no odor	none	sediment	na	na	na	na	na	
	BT260	BT260	6/24/14	KNB	AS	outfall	8	smooth plastic	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT270	CB1	6/24/14	KNB	AS	catchbasin	na	na	flowing		clear, no odor	none	none	N	0.0	0.05	0.0	844	
	BT280	BT280	6/24/14	KNB	AS	outfall	12	corrugated metal	dry		no odor	none	none	na	na	na	na	na	Erosion around pipe, pipe extends 4+ ft. over river.
	BT290	BT290	6/24/14	KNB	AS	outfall	15	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT300	BT300	6/24/14	KNB	AS	outfall	14	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT310	BT310	6/24/14	KNB	AS	outfall	14	smooth plastic	wet, no flow	4	no odor	none	none	na	na	na	na	na	Ponding at outfalls
	BT320	BT320	6/24/14	KNB	AS	outfall	14	smooth plastic	wet, no flow	4	no odor	none	none	na	na	na	na	na	Ponding at outfalls
	BT330	BT330	6/24/14	KNB	AS	outfall	15	black corrugated plastic	wet, no flow		no odor	none	none	N	na	na	na	na	
	BT340	BT340	6/24/14	KNB	AS	outfall	14	corrugated metal	dry		na	none	sediment	na	na	na	na	na	Assessed at first CB up-pipe: no inflow. Filled 1/2 way with sediment and blocked by wooden stakes
	BT350	BT350	6/24/14	KNB	AS	outfall	15	corrugated metal	dry		na	none	sediment	na	na	na	na	na	Filled 1/3 way with sediment
	BT360	BT360	6/24/14	KNB	AS	outfall	15	black corrugated plastic	wet, no flow		none	none	sediment	N	na	na	na	na	
	BT370	BT370	6/24/14	KNB	AS	outfall	14	black corrugated plastic	dry		na	none	none	na	na	na	na	na	
	BT380	BT380	6/24/14	KNB	AS	outfall	12	black corrugated plastic	wet, no flow		none	none	none	N	na	na	na	na	
Cl2	BT390	BT390	6/24/14	KNB	AS	outfall	14	black corrugated plastic	dripping		clear, no odor	none	none	N	0.0	0.10	0.0	414	
	BT400	BT400	6/24/14	KNB	AS	outfall	12	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT410	BT410	6/24/14	KNB	AS	outfall	8	smooth plastic	dry		na	none	staining	na	na	na	na	na	
	BT420	BT420	6/24/14	KNB	AS	outfall	4	smooth plastic	dry		na	none	none	na	na	na	na	na	Footing drain
	BT430	BT430	6/24/14	KNB	AS	outfall	60	corrugated metal	stream culvert		unknown	none	none	na	na	na	na	na	Too steep to access
	BT440	BT440	6/24/14	KNB	AS	outfall	24	black corrugated plastic	dry		na	none	none	na	na	na	na	na	
	BT450	BT450	6/24/14	KNB	AS	outfall	8	smooth plastic	dry		sediment	none	sediment	na	na	na	na	na	
	BT460	BT460	6/24/14	KNB	AS	outfall	15	concrete	flowing	0.25	clear, no odor	none	sediment	N	0.0	0.03	0.2	504	
	BT470	BT470	6/24/14	KNB	AS	outfall	24	corrugated metal	dry		no odor	none	none	na	na	na	na	na	
	BT480	BT480	6/24/14	KNB	AS	outfall	18	corrugated metal	dry		no odor	none	none	na	na	na	na	na	
	BT490	BT490	6/24/14	KNB	AS	outfall	14	corrugated metal	dry		no odor	none	sediment	na	na	na	na	na	
	BT500	BT500	6/24/14	KNB	AS	outfall	14	corrugated metal	dry		no odor	none	sediment	na	na	na	na	na	
	BT510	BT510	6/24/14	KNB	AS	outfall	15	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT520	BT520	7/1/14	KNB	AD	outfall	12	corrugated metal	wet, no flow		no odor	none	sediment	na	na	na	na	na	Two pipes come together to form this outfall
	BT530	BT530	7/1/14	KNB	AD	outfall	12	corrugated metal	dripping		no odor	none	iron staining	N	0.25	0.03	0.1	1958	Duplicate conductivity measurement = 1613 µs/cm
	BT540	BT540	7/1/14	KNB	AD	outfall	12	corrugated metal	wet, no flow		no odor	none	sediment	N	na	na	na	na	
petroleum odor	BT550	BT550	7/1/14	KNB	AD	outfall	4	smooth plastic	trickling		petroleum odor	sheen	iron staining	N	0.0	0.00	0.2	1182	New construction/swale outside of Vermont Butter & Cheese. Pipe recently installed. Iron sheen.
	BT560	BT560	7/1/14	KNB	AD	outfall	6	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	

Flag	System ID	Structure ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Discharge characteristics	Floatables	Deposits/ Stains	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
suds	BT570	BT570	7/1/14	KNB	AD	outfall	18	black corrugated plastic	dripping		no odor	suds	none	na	na	na	na	na	..\Photos\2014\070114\BT570.JPG
	BT580	BT580	7/1/14	KNB	AD	outfall	18	corrugated metal	dry		sheen in receiving pond	sheen	none	na	na	na	na	na	
	BT590	BT590	7/1/14	KNB	AD	outfall	24	corrugated metal	flowing	0.75	no odor	none	none	N	0.25	0.00	0.16	1300	Outfall in granite dump and trash along railroad
	BT600	BT600	7/1/14	KNB	AD	outfall	12	corrugated metal	trickling		pool ~8 in. deep, no odor	none	sediment	na	0.25	0.04	0.21	600	At Northern Power
	BT610	BT610	7/1/14	KNB	AD	outfall	24	corrugated metal	wet, no flow		pool ~5 in. deep, no odor	none	sediment	na	na	na	na	na	At Northern Power
	BT620	BT620	7/1/14	KNB	AD	outfall	18	black corrugated plastic	trickling		minty odor	none	none	N	0.25	0.02	0.2	98.8	
	BT630	BT630	7/1/14	KNB	AD	outfall	24	black corrugated plastic	wet, no flow		minty odor	none	none	na	na	na	na	na	
	BT640	BT640	7/1/14	KNB	AD	outfall	unknown	unknown	unknown		unknown	unknown	unknown	na	na	na	na	na	Too steep, outfall not found; inlet structures not found either
	BT650	BT650	7/1/14	KNB	AD	outfall	unknown	unknown	flowing		unknown	unknown	unknown	na	na	na	na	na	Outfall beyond barbed wire fence in field with steer. Assessed at first CB
	BT650	CB1	7/1/14	KNB	AD	catchbasin	na	na	flowing		clear, no odor	none	none	N	0.0	0.01	0.20	819	
high conductivity, MBAS, suds	BT660	BT660	7/1/14	KNB	AD	outfall	16	corrugated metal	flowing	0.5	no odor	suds	iron staining	N	0.2	0.02	0.2-0.3	5000	
high conductivity, MBAS	BT670	BT670	7/1/14	KNB	AD	outfall	4	smooth plastic	flowing	0.5		none	none	N	0.0	0.01	0.29	6600	Underdrain from house and drop inlet for swale at this location, flows to outfall BT660. Iron staining in swale traced to BT680
Cl2, NH3, petroleum odor	BT680	BT680	7/1/14	KNB	AD	outfall	2	smooth plastic	flowing		petroleum odor	sheen	iron staining	N	0.3	0.07	0.14	1660	Unmapped outfall; it may be connected to the apartment building across the street
high conductivity, MBAS	BT690	BT690	7/1/14	KNB	AD	outfall	4	smooth plastic	flowing	0.25	no odor	none	none	N	0.0	0.02	0.28	6780	Unmapped outfall discharging to the swale below BT680, above BT670 and BT660
OB	BT700	BT700	7/1/14	KNB	AD	outfall	4	smooth plastic	dripping		no odor	none	iron staining	P	na	na	na	na	
	BT710	BT710	7/1/14	KNB	AD	outfall	12	corrugated metal	trickling		no odor	none	sediment	N	0.0	0.02	0.2	1208	
	BT720	BT720	7/1/14	KNB	AD	outfall	14	smooth plastic	trickling		no odor	none	none	N	0.0	0.01	0.0	248	
	BT730	BT730	7/2/14	KNB	AD	outfall	16	corrugated metal	dripping		no odor	none	none	na	0.25	0.02	0.2	102	
	BT740	BT740	7/2/14	KNB	SW	outfall	unknown	unknown	unknown		unknown	unknown	unknown	na	na	na	na	na	Could not find outfall, may be buried. CB directly up-pipe (in parking lot) is bricked over
	BT750	BT750	7/2/14	KNB	SW	outfall	24	corrugated metal	flowing	0.5	no odor	none	none	na	0.0	0.01	0.0	160	
	BT760	BT760	7/2/14	KNB	SW	outfall	24	corrugated metal	flowing	0.25	clear, no odor	none	none	na	na	na	na	na	Sampled at upstream outfall BT770 because this was the only source of flow in the system
	BT770	BT770	7/2/14	KNB	SW	outfall	4	smooth plastic	flowing	0.25	clear, no odor	none	none	N	0.0	0.01	0.0	184	Sediment at CB probably due to erosion below this outfall, and also road runoff
	BT780	BT780	7/2/14	KNB	SW	outfall	30	concrete	flowing		clear, no odor	none	sediment	na	0.0	0.00	0.0	190	Conductivity meter flashing
	BT790	BT790	7/2/14	KNB	SW	outfall	18	corrugated metal	dry		no odor	none	sediment	na	na	na	na	na	
	BT800	BT800	7/2/14	KNB	SW	outfall	16	corrugated metal	wet, no flow		no odor	none	none	na	na	na	na	na	Ponding
	BT810	BT810	7/2/14	KNB	SW	outfall	unknown	unknown	unknown		unknown	unknown	unknown	na	na	na	na	na	Could not find an outfall or CB
	BT820	BT820	7/2/14	KNB	SW	outfall	18	corrugated metal	wet, no flow		no odor	none	sediment	na	na	na	na	na	
	BT830	BT830	7/2/14	KNB	SW	outfall	4	smooth plastic	dripping		clear, no odor	none	none	N	na	na	na	na	
	BT840	BT840	7/2/14	KNB	SW	outfall	12	smooth plastic	trickling		no odor	none	sediment	N	0.3	0.01	0.0	194	Steady flow into CB directly upstream
	BT850	BT850	7/2/14	KNB	SW	outfall	unknown	unknown	unknown		unknown	unknown	unknown	na	na	na	na	na	Could not find outfall
	BT860	BT860	7/2/14	KNB	SW	outfall	4	smooth plastic	flowing	0.25	clear, no odor	none	none	na	0.0	0.01	invalid	181	Discharge from 4-inch pipe flows into a gutter, then to kiddie pool, then into a swale. MBAS test invalid
	BT870	BT870	7/2/14	KNB	SW	outfall	16	corrugated metal	dripping		clear, no odor	none	none	na	na	na	na	na	Top of Holden Rd.
	BT880	BT880	7/2/14	KNB	SW	outfall	16	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT890	BT890	7/2/14	KNB	SW	outfall	20	black corrugated plastic	dripping		no odor	none	none	na	na	na	na	na	
	BT900	BT900	7/2/14	KNB	SW	outfall	18	black corrugated plastic	wet, no flow		no odor	none	sediment	na	na	na	na	na	
	BT910	BT910	7/2/14	KNB	SW	outfall	12	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT920	BT920	7/2/14	KNB	SW	outfall	12	black corrugated plastic	dripping		no odor	none	none	na	na	na	na	na	
	BT1000	BT1000	7/7/14	KNB	AD	outfall	16	corrugated metal	wet, no flow		no odor	none	sediment	na	na	na	na	na	
Cl2, high conductivity	BT1010	BT1010	7/7/14	KNB	AD	outfall	27	corrugated metal	flowing	1	no odor	none	none	N	0.0	0.07	0.1	2520	
	BT1010	CB5	7/7/14	KNB	AD	catchbasin	na	na	flowing			none	none	na	0.0	0.05	0.2	1489	Sampled at CB5, could not open CB6 grate, three pipes discharge to CB6, all three were trickling
	BT930	BT930	7/7/14	KNB	AD	outfall	unknown	concrete	wet, no flow		clear, no odor	none	sediment	na	0.25	0.02	0.2	1172	Checked up-pipe CBs: none reachable, CB3 fully obstructed by sediment
	BT940	BT940	7/7/14	KNB	AD	outfall	20	smooth plastic	flowing	5	clear, no odor	none	sediment	N	0.0	0.05	0.0	940	
wastewater odor	BT950	BT950	7/7/14	KNB	AD	outfall	12	smooth plastic	wet, no flow		wastewater odor	none	sediment	N	na	na	na	na	
wastewater odor	BT950	CB1	7/7/14	KNB	AD	catchbasin	na	na	trickling		wastewater odor, yellowish	none	none	na	0.25	0.00	0.2	356	
	BT960	BT960	7/7/14	KNB	AD	outfall	4	smooth plastic	trickling		clear, no odor	none	none	na	0.0	0.00	0.0	424	trickling/flowing
	BT970	BT970	7/7/14	KNB	AD	outfall	oval 48x40	corrugated metal	flowing	1.5		sheen	iron staining	N	0.0	0.00	0.0	592	Outfall is at stream culvert. Pad set at CB4, not at outfall
	BT970	CB1	7/7/14	KNB	AD	catchbasin	na	na	flowing		clear, no odor	none	none	na	0.0	0.03	0.0	367	
	BT980	BT980	7/7/14	KNB	AD	outfall	10	corrugated metal	dry		na	none	sediment	na	na	na	na	na	
	BT990	BT990	7/7/14	KNB	AD	outfall	6	smooth plastic	flowing	0.25		none	none	N	0.0	0.04	0.1	1684	
	BT1020	BT1020	7/10/14	KNB		outfall	4	smooth plastic	dry		no odor	none	none	na	na	na	na	na	
	BT1030	BT1030	7/10/14	KNB		outfall	24	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT1040	BT1040	7/10/14	KNB		outfall	16	black corrugated plastic	wet, no flow		no odor	none	sediment	na	na	na	na	na	Almost totally submerged, stagnant
high conductivity, NH3	BT1050	BT1050	7/10/14	KNB		outfall	36	black corrugated plastic	flowing	0.25	clear, no odor	none	none	N	0.3	0.01	0.1	3470	
	BT1060	BT1060	7/10/14	KNB		outfall	60	concrete	flowing	6	clear, no odor	none	none	na	na	na	na	na	This is the stream tunnel outfall. Assessed at first street catchbasin: dry
	BT1070	BT1070	7/10/14	KNB		outfall	16	black corrugated plastic	wet, no flow		no odor	none	sediment	na	na	na	na	na	This outfall looks abandoned, replaced by BT1080
	BT1080	BT1080	7/10/14	KNB		outfall	20	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	Stagnant

Flag	System ID	Structure ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Discharge characteristics	Floatables	Deposits/ Stains	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
NH3	BT1090	BT1090	7/10/14	KNB		outfall	12	black corrugated plastic	trickling		clear, no odor	none	none	N	0.3	0.03	0.2	1771	
	BT1090	CB10	7/10/14	KNB		catchbasin	na	na	flowing		clear, no odor	none	none	na	0.0	0.05	0.0	414	
Cl2	BT2000	BT2000	7/10/14	KNB		outfall	15	corrugated metal	trickling		clear, no odor	none	sediment	N	0.2	0.53	0.1	1884	
	BT2010	BT2010	7/10/14	KNB		outfall	16	corrugated metal	wet, no flow		slight odor	none	none	na	na	na	na	na	
	BT2020	BT2020	7/10/14	KNB		outfall	16	concrete	dry		no odor	none	sediment	na	na	na	na	na	
	BT2030	BT2030	7/10/14	KNB		outfall	8	smooth plastic	wet, no flow		no odor	none	sediment	na	na	na	na	na	
	BT2040	BT2040	7/10/14	KNB		outfall	8	smooth plastic	dry		no odor	none	none	na	na	na	na	na	
Cl2, NH3	BT2050	BT2050	7/10/14	KNB		outfall	16	corrugated metal	trickling		turbid	sheen	sediment	N	0.3	0.30	0.0	587	
	BT2060	BT2060	7/10/14	KNB		outfall	18	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT2070	BT2070	7/10/14	KNB		outfall	18	corrugated metal	dry		no odor	none	sediment	na	na	na	na	na	
	BT2080	BT2080	7/10/14	KNB		outfall	8	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT2090	BT2090	7/10/14	KNB		outfall	12	black corrugated plastic	trickling	0.25	no odor	none	none	N	0.2	0.01	0.1	1546	
	BT2100	BT2100	7/10/14	KNB		outfall	18	black corrugated plastic	dry		no odor	none	sediment	na	na	na	na	na	
	BT2110	BT2110	7/10/14	KNB		outfall	18	black corrugated plastic	wet, no flow		clear, no odor	none	sediment	na	na	na	na	na	
suds	BT2120	BT2120	7/10/14	KNB		outfall	18	black corrugated plastic	flowing	0.25	clear, no odor	suds	none	N	0.0	0.02	0.1	1293	Not as mapped
	BT2130	BT2130	7/10/14	KNB		outfall	14	corrugated metal	dry		no odor	none	none	na	na	na	na	na	
	BT2140	BT2140	7/10/14	KNB		outfall	16	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	Lots of algae
	BT2150	BT2150	7/10/14	KNB		outfall	18	black corrugated plastic	wet, no flow		no odor	none	sediment	na	na	na	na	na	Stagnant
	BT2160	BT2160	7/10/14	KNB		outfall	18	black corrugated plastic	flowing		clear, no odor	sheen	none	N	0.0	0.02	0.0	833	
	BT2170	CB1	7/11/14	KNB	AD	catchbasin	na	na	dry		na	none	none	na	na	na	na	na	Outfall listed as buried, assessed at first CB, no flow
	BT2180	BT2180	7/11/14	KNB	AD	outfall	12	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT2190	BT2190	7/11/14	KNB	AD	outfall	18	corrugated metal	wet, no flow		no odor	sheen	sediment	na	na	na	na	na	Stagnant
	BT2200	BT2200	7/11/14	KNB	AD	outfall	15	black corrugated plastic	dry		sulfur odor	none	sediment	na	na	na	na	na	CB dry
	BT2210	BT2210	7/11/14	KNB	AD	outfall	12	smooth plastic	dry		no odor	none	none	na	na	na	na	na	
	BT2220	BT2220	7/11/14	KNB	AD	outfall	19	smooth plastic	dry		no odor	none	sediment	na	na	na	na	na	
NH3, wastewater odor	BT2230	BT2230	7/11/14	KNB	AD	outfall	16	black corrugated plastic	wet, no flow		anaerobic wastewater odor	none	sediment	N	4.5	0.04	invalid	564	Turbid sample. Suds/bubbles formed during MBAS test. CB1: water in sump; CB2: dry
OB	BT2240	BT2240	7/11/14	KNB	AD	outfall	48	black corrugated plastic	flowing	3	clear, no odor	none	none	P	0.0	0.01	0.0	704	Also set pad at CB1 (positive)
	BT2250	BT2250	7/11/14	KNB	AD	outfall	18	corrugated metal	dry		no odor	none	none	na	na	na	na	na	
Cl2	BT2260	BT2260	7/11/14	KNB	AD	outfall	18	concrete	flowing		clear, no odor	none	sediment	N	0.0	0.12	0.1	900	CB1 and CB2 had heavy flow
	BT2260	CB6A	7/11/14	KNB	AD	catchbasin	na	black corrugated plastic	flowing		clear, no odor	none	none	na	0.0	0.02	0.1	705	
	BT2260	CB6B	7/11/14	KNB	AD	catchbasin	na	na	flowing		clear, no odor	none	none	na	0.0	0.02	0.0	814	
	BT2270	BT2270	7/11/14	KNB	AD	outfall	20	black corrugated plastic	flowing	0.5	clear, no odor	none	none	N	0.0	0.00	0.1	1285	Underdrain also at this location. Set pad in underdrain as well
	BT2270	U1	7/11/14	KNB	AD	underdrain	6	smooth plastic	dry		no odor	none	none	N	na	na	na	na	
	BT2280	BT2280	7/11/14	KNB	AD	outfall	12	black corrugated plastic	wet, no flow		no odor	none	none	N	na	na	na	na	
	BT2290	BT2290	7/11/14	KNB	AD	outfall	12	smooth plastic	trickling		no odor	none	sediment	N	0.0	0.01	0.0	740	CB1 also trickling
	BT2300	BT2300	7/11/14	KNB	AD	outfall	15	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT2310	BT2310	7/11/14	KNB	AD	outfall	12	corrugated metal	dry		no odor	none	none	na	na	na	na	na	Stream culvert also at this location
	BT2310	S1	7/11/14	KNB	AD	stream culvert	36	corrugated metal	flowing		no odor	suds	iron staining	N	0.1	0.01	0.2	814	Sampled and padded stream culvert
	BT2320	BT2320	7/11/14	KNB	AD	outfall	24	corrugated metal	wet, no flow		no odor	none	none	na	na	na	na	na	
	BT2330	BT2330	7/11/14	KNB	AD	outfall	12	black corrugated plastic	flowing		no odor	none	none	N	0.0	0.01	0.0	771	Flow assumed to be groundwater from uphill
	BT2240	CB6	7/16/14	KNB	AD	catchbasin	na	na	flowing		no odor	none	none	I	na	na	na	na	
	BT2240	CB9A	7/16/14	KNB	AD	catchbasin	na	na	flowing		no odor	none	none	I	0.0	0.03	cloudy	456	into 10A, 11A, 12A or 13A
	BT2240	CB9B	7/16/14	KNB	AD	catchbasin	na	na	flowing		no odor	none	none	N	0.0	0.02	0.2	971	CB10B was flowing but 11B was dry
	BT2340	BT2340	7/16/14	KNB	AD	outfall	unknown	unknown	unknown		unknown	unknown	unknown	na	na	na	na	na	Could not find outfall--very dense vegetation here and no indication of a flow path, used GPS
	BT2350	BT2350	7/16/14	KNB	AD	outfall	unknown	unknown	unknown		unknown	unknown	unknown	na	na	na	na	na	Property owner denied us access due to dispute with town. Very little flow going into CB1.
	BT2360	BT2360	7/16/14	KNB	AD	outfall	12	black corrugated plastic	trickling		clear, no odor	none	none	N	0.0	0.01	0.2	650	
OB=I	BT2370	BT2370	7/16/14	KNB	AD	outfall	12	black corrugated plastic	wet, no flow		no odor	none	none	I	na	na	na	na	
	BT2380	BT2380	7/16/14	KNB	AD	outfall	12	black corrugated plastic	dry		no odor	none	sediment	na	na	na	na	na	
	BT2390	BT2390	7/16/14	KNB	AD	outfall	15	smooth plastic	dry		no odor	none	sediment	na	na	na	na	na	
	BT2400	BT2400	7/16/14	KNB	AD	outfall	15	smooth plastic	dry		no odor	none	sediment	na	na	na	na	na	
	BT2410	BT2410	7/16/14	KNB	AD	outfall	15	smooth plastic	wet, no flow		no odor	none	sediment	na	na	na	na	na	
NH3, low NH3, odor, suds	BT2420	BT2420	7/16/14	KNB	AD	outfall	17	smooth plastic	flowing		bad odor, iron staining	suds	iron staining	N	0.5	0.00	0.0	389	
	BT2430	BT2430	7/16/14	KNB	AD	outfall	18	black corrugated plastic	flowing		unknown	unknown	unknown	na	na	na	na	na	Could not locate outfall. CB1 assessed: flowing
	BT2430	CB1	7/16/14	KNB	AD	catchbasin	na	na	flowing		no odor	none	none	na	0.2	0.02	0.2	187	
suds	BT2440	BT2440	7/16/14	KNB	AD	outfall	12	black corrugated plastic	flowing		no odor	suds	none	N	0.2	0.02	0.2	564	
	BT2450	BT2450	7/16/14	KNB	AD	outfall	12	black corrugated plastic	wet, no flow		no odor	none	none	na	na	na	na	na	Two underdrains next to outfall, both wet with no flow
	BT2460	BT2460	7/17/14	KNB		outfall	12	smooth plastic	wet, no flow		no odor	none	none	na	na	na	na	na	

Flag	System ID	Structure ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Discharge characteristics	Floatables	Deposits/ Stains	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
OB=I	BT2470	BT2470	7/17/14	KNB		outfall	12	smooth plastic	flowing	0.25	clear, no odor	none	none	I	0.0	0.02	0.2	667	
low NH3	BT2480	BT2480	7/17/14	KNB		outfall	10	smooth plastic	wet, no flow		no odor	none	sediment	N	0.3	0.03	0.1	901	
	BT2480	CB1	7/17/14	KNB		catchbasin	na	na	flowing		no odor	none	none	na	0.2	0.01	0.1	1723	
	BT2490	BT2490	7/17/14	KNB		outfall	16	black corrugated plastic	flowing		no odor	none	sediment	N	0.2	0.00	0.0	461	
	BT2500	BT2500	7/17/14	KNB		outfall	6	smooth plastic	dry		no odor	none	none	na	na	na	na	na	
suds	BT2510	BT2510	7/17/14	KNB		outfall	12	smooth plastic	flowing		no odor	suds	none	N	0.0	0.01	0.0	870	
	BT2520	BT2520	7/17/14	KNB		outfall	16	smooth plastic	unknown		unknown	unknown	unknown	na	na	na	na	na	Outfall buried, assessed at CB1
	BT2520	CB1	7/17/14	KNB		catchbasin	na	na	dry		na	none	none	na	na	na	na	na	
	BT2530	BT2530	7/17/14	KNB		outfall	12	smooth plastic	flowing	1	clear, no odor	none	none	N	0.0	0.02	0.0	347	3 OB pads lost
	BT2540	BT2540	7/17/14	KNB		outfall	12	smooth plastic	dry		no odor	none	sediment	na	na	na	na	na	Not as mapped. CB1 also dry
	BT2550	BT2550	7/17/14	KNB		outfall	12	smooth plastic	trickling		clear, no odor	none	none	N	0.0	0.00	0.0	391	
	BT2560	BT2560	7/17/14	KNB		outfall	12	black corrugated plastic	dry		no odor	none	sediment	na	na	na	na	na	
	BT2570	BT2570	7/17/14	KNB		outfall	12	corrugated metal	dry		no odor	none	none	na	na	na	na	na	
	BT2580	BT2580	7/17/14	KNB		outfall	12	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
	BT2590	BT2590	7/17/14	KNB		outfall	12	black corrugated plastic	flowing		clear, no odor	none	none	na	na	na	na	na	Could not access outfall or CB1. Sampled at CB2
NH3	BT2590	CB2	7/17/14	KNB		catchbasin	na	na	flowing		clear, no odor	none	none	N	0.3	0.02	0.1	447	
	BT2600	BT2600	7/25/14	SW	AD	outfall	unknown	unknown	dry		unknown	unknown	unknown	na	na	na	na	na	flowing
	BT2610	BT2610	7/25/14	SW	AD	outfall	22	concrete	wet, no flow		no odor	none	sediment	na	na	na	na	na	
	BT2620	BT2620	7/25/14	SW	AD	outfall	18	corrugated metal	wet, no flow		no odor	none	sediment	na	na	na	na	na	
	BT2630	BT2630	7/25/14	SW	AD	outfall	15	black corrugated plastic	wet, no flow		musty	none	none	N	na	na	na	na	Outfall at culvert outlet symbol on map
OB	BT2640	BT2640	7/25/14	SW	AD	outfall	18	corrugated metal	flowing	1	no odor	none	none	P	0.2	0.03	0.2	973	
NH3	BT2640	CB13A	7/25/14	SW	AD	catchbasin	na	na	flowing		na	none	none	N	0.3	0.07	0.1	736	Water sample taken from sump, pads placed at inflow lines A and B
Cl2, NH3	BT2640	CB13B	7/25/14	SW	AD	catchbasin	na	na	flowing		na	none	none	N	0.3	0.07	0.1	736	Water sample taken from sump, pads placed at inflow lines A and B
	BT2640	CB7	7/25/14	SW	AD	catchbasin	na	na	flowing		na	none	none	P	0.2	0.02	0.0	696	
OB=I	BT2650	BT2650	7/30/14	KNB	AD	outfall	16	corrugated metal	flowing	0.25	clear, no odor	none	sediment	I	0.2	0.02	0.1	1142	
	BT2660	BT2660	7/30/14	KNB	AD	outfall	12	smooth plastic	flowing	0.25	clear, no odor	none	sediment	N	0.2	0.02	0.1	884	
Cl2	BT2670	BT2670	7/30/14	KNB	AD	outfall	unknown	corrugated metal	flowing		no odor	none	sediment	N	0.2	0.17	0.2	1884	Outfall buried, had to dig it out to find it and sample
	BT2680	BT2680	7/30/14	KNB	AD	outfall	unknown	unknown	unknown		unknown	unknown	unknown	na	na	na	na	na	Outfall buried, could not locate
	BT2690	BT2690	7/30/14	KNB	AD	outfall	15	black corrugated plastic	flowing	0.5	algae, thick biofilm	none	none	N	0.2	0.01	0.0	774	
	BT2700	BT2700	7/30/14	KNB	AD	outfall	16	black corrugated plastic	wet, no flow		tea color, leaves, no odor	none	sediment	na	0.2	0.02	0.2	647	
	BT2710	BT2710	7/30/14	KNB	AD	outfall	12	smooth plastic	dry		no odor	none	none	na	na	na	na	na	
	BT2720	BT2720	7/30/14	KNB	AD	outfall	12	smooth plastic	wet, no flow		no odor	none	sediment	na	na	na	na	na	
	BT2730	BT2730	7/30/14	KNB	AD	outfall	12	smooth plastic	dry		no odor	none	none	na	na	na	na	na	
OB=I	BT2740	BT2740	7/30/14	KNB	AD	outfall	12	smooth plastic	flowing	0.5	no odor	none	none	I	0.1	0.02	0.0	590	
	BT2750	BT2750	7/30/14	KNB	AD	outfall	12	black corrugated plastic	flowing	0.5	clear, no odor	none	none	N	0.1	0.02	0.1	1416	
	BT2760	BT2760	7/30/14	KNB	AD	outfall	18	corrugated metal	wet, no flow		no odor	none	sediment	na	na	na	na	na	
	BT2770	BT2770	7/30/14	KNB	AD	outfall	16	corrugated metal	trickling		no odor	none	none	N	0.1	0.01	0.1	1086	
	BT2780	BT2780	7/30/14	KNB	AD	outfall	16	black corrugated plastic	dry		no odor	none	none	na	na	na	na	na	
OB	BT2790	BT2790	7/30/14	KNB	AD	outfall	15	green corrugated plastic	flowing	4	no odor	none	none	P	0.0	0.01	0.0	1365	
	BT2800	BT2800	7/30/14	KNB	AD	outfall	12	smooth plastic	dripping		no odor	none	none	N	na	na	na	na	
	BT2810	BT2810	7/30/14	KNB	AD	outfall	22	corrugated metal	trickling		no odor	none	sediment	N	0.1	0.01	0.1	843	
MBAS, suds	BT2820	BT2820	7/30/14	KNB	AD	outfall	36	corrugated metal	flowing	1	no odor	suds	sediment	N	0.1	0.01	0.3	1145	MBAS test cloudy

C.3. Berlin Assessment Data

Flag	System ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Erosion	Erosion description	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
	Be010	7/23/15	SW	AD	outfall	12	corrugated black plastic	flowing	1	free flow	Y	gully below	clear, no odor	none	none	none	N	0.00	0.03	0.2	116.6	
	Be020	7/23/15	SW	AD	outfall	12	corrugated black plastic	wet	na	free flow	Y	gully below	na	na	none	none	na	na	na	na	na	gully below connects to gully from Be010; standing water in outfall and skirt below
	Be030	7/23/15	SW	AD	outfall	18	corrugated black plastic	dripping	na	free flow	N	see comments	clear	none	none	none	N	0.00	0.01	0.2	400	
	Be040	7/23/15	SW	AD	outfall	18	concrete	dry?	na	free flow	N	see comments	na	na	sediment	fully obstructed	na	na	na	na	na	VTrans property. Erosion from runoff above pipe. Many small gullies forming to the Stevens Branch
	Be050	7/23/15	SW	AD	outfall	16	corrugated metal	dry	na	free flow	N	na	na	na	none	none	N	0.25	0.06	0.2	70	
	Be060	7/23/15	SW	AD	outfall	12	clay	wet	na	free flow	N	na	na	none	none	fully obstructed	na	na	na	na	na	
	Be070	7/23/15	SW	AD	outfall	17	concrete	wet	na	partially submerged	N	na	na	none	none	none	na	na	na	na	na	
Cl2, suds	Be080	7/23/15	SW	AD	outfall	28	concrete	flowing	0.5	free flow	N	na	musty odor, some suds	suds	none	partially obstructed	N	0.00	0.10	0.2	62.7	sediment in outfall seems to be simply the bed of a diverted stream
	Be090	7/23/15	SW	AD	outfall	16	corrugated metal	drippling	0.25	free flow	N	na	clear, no odor	none	sediment	none	N	na	na	na	na	very slow drip - no sample taken; OB pad may have had a slight fluorescence
MBAS	Be100	7/23/15	SW	AD	outfall	16	corrugated metal	flowing	0.5	free flow	Y	deep incision above	clear, no odor	suds in bottle	none	none	N	0.00	0.03	0.5	134.8	marked "reassess" on map; oily sheen on water in pipe noted when retrieving OB pad
	Be110	7/23/15	SW	AD	outfall	14	corrugated metal	?	na	partially submerged	Y	around and above OF	unknown	suds?	none	none	na	na	na	na	na	end of pipe was in the Stevens Branch - could not see whether there was flow, deposits, obstruction, etc
	Be120	7/23/15	SW	AD	outfall	14	corrugated metal	?	na	partially submerged	Y	around and above OF	unknown	suds?	unknown	unknown	na	na	na	na	na	end of pipe was in the Stevens Branch - could not see whether there was flow, deposits, obstruction, etc
	Be130	7/23/15	SW	AD	outfall	14	corrugated metal	dry	na	free flow	N	na	na	na	none	none	na	na	na	na	na	has backflow prevention (?) valve on the end of the pipe
	Be140	7/23/15	SW	AD	outfall	16	corrugated metal	dripping	0.25	free flow	N	riprapped below	clear, no odor	none	sediment	none	N	na	na	na	na	very slow flow, no sample taken; grey sheen inside surface of outfall pipe
	Be150	7/23/15	SW	AD	outfall	16	corrugated black plastic	wet	na	submerged	N	na	clear	grass	sediment	none	na	na	na	na	na	
Odor	Be160	7/23/15	SW	AD	outfall	18	corrugated black plastic	flowing	0.3	free flow	N	na	pee odor?	none	none	none	N	0.00	0.05	0.2	332	flow in pulsing, weird odor
	Be170	7/23/15	SW	AD	outfall																	could not locate
	Be180	7/23/15	SW	AD	outfall																	could not locate; may be beneath steel girders/concrete slabs or big brush pile
	Be190	7/23/15	SW	AD	outfall	10	smooth plastic	dripping		free flow	N	na	clear, no odor	none	sediment	none	N	0.00	0.02	0.0	4700	lots of sediment deposition under pipe; pipe seems to have been cleaned out recently; near FWR site with high chloride levels (Macs10 site)
	Be200	7/23/15	SW	AD	outfall	10	smooth plastic	dripping		free flow	N	na	clear, no odor	none	iron staining	none	N	0.25	0.06	0.2	564	
petroleum odor	Be210	7/23/15	SW	AD	outfall	12	corrugated black plastic	wet	na	free flow	N	riprapped	petroleum odor	oily sheen	sediment	partially obstructed	N	na	na	na	na	entire bank has been riprapped
	Be220	7/23/15	SW	AD	outfall	12	corrugated black plastic	wet	na	free flow	N	riprapped	clear, no odor	oily sheen	sediment	partially obstructed	N	na	na	na	na	entire bank has been riprapped
	Be230	7/23/15	SW	AD	outfall	10	corrugated metal	dry	na	free flow	N	na	na	na	none	none	na	na	na	na	na	
	Be240	7/30/15	SW	AD	outfall	24	concrete	flowing	0.5	free flow	N	riprapped	clear, no odor	none	none	none	N	0.0	0.03	0.0	237	
	Be250	7/30/15	SW	AD	outfall	18	concrete	flowing	0.25	free flow	N	na	clear, no odor	none	none	none	N	na	na	na	na	unable to take sample due to pipe damage
	Be260	7/30/15	SW	AD	outfall	30	corrugated metal	flowing	1	free flow	Y	above and around pipe	clear, no odor	none	none	none	N	0.00	0.01	0.0	539	a "reassess" from 2008, smelled like petroleum on 8/10/15
	Be270	7/30/15	SW	AD	outfall	30	corrugated metal	flowing	1	free flow	N	riprapped below	musty odor	none	sediment, Fe+ staining	partially obstructed	N	0.25	0.02	0.1	317	crew was seen cleaning the line on 8/6/15; on 8/19 observed lots of iron staining and suds
	Be280	7/30/15	SW	AD	outfall	36	corrugated metal	flowing	1.5	free flow	Y	small scour pool	no odor	none	no odor	none	N	0.25	0.03	0.1	385	perpendicular to this outfall there is an unmapped 6" perforated corrugated metal pipe with erosion around it; see Be290
	Be290	7/30/15	SW	AD	outfall	6	corrugated metal	wet	na	free flow	Y	around pipe	no odor	none	sediment	none	N	na	na	na	na	no sample taken; unmapped pipe
	Be300	7/30/15	SW	AD	outfall																	unable to assess due to construction - looks like storm drain line is being replaced here
	Be310	7/30/15	SW	AD	outfall																	unable to locate outfall; may be buried; CB above it wet but not flowing
	Be320	7/30/15	SW	AD	outfall	24	corrugated metal	flowing	0.25	free flow	Y	small scour pool	no odor	none	no odor	none	N	0.25	0.01	0.0	283	
	Be330	7/30/15	SW	AD	outfall	30	corrugated metal	wet	na	free flow	N	na	na	none	na	none	na	na	na	na	na	
	Be340	7/30/15	SW	AD	outfall	58	metal	flowing		free flow	N	na	clear, no odor	none	stream substrate on bott	none	N	0.25	0.00	0.0	405	
	Be350	7/30/15	SW	AD	outfall	15	corrugated black plastic	flowing	0.25	partially submerged	N	na	clear, no odor	none	sediment	1/3 full of sediment	N	na	na	na	na	unable to collect sample due to low flow and sediment in pipe
	Be360	7/30/15	SW	AD	outfall	12	corrugated metal	flowing	0.25	free flow	N	riprapped	clear, no odor	none	sediment	1/4 full of sediment	N	na	na	na	na	
	Be370	7/30/15	SW	AD	outfall	36?	corrugated metal	flowing	3	partially submerged	N	na	clear, no odor	none	sediment	none	N	0.00	0.03	0.2	190	
	Be380	7/30/15	SW	AD	outfall	12	smooth plastic	flowing	0.5	free flow	N	riprapped	clear, no odor	none	none	none	N	0.25	0.00	0.0	209	
	Be390	8/10/15	SW	AS	outfall	18	corrugated metal	flowing	0.25	free flow	Y	small scour pool	clear, no odor	none	none	none	N	0.00	0.02	0.1	601	
	Be400	8/10/15	SW	AS	outfall	12	corrugated metal	flowing	0.125	free flow	N	na	clear, no odor	none	rust	none	N	0.00	0.04	0.0	218	OB pad may have had a very slight fluorescence
	Be410	8/10/15	SW	AS	outfall	36	corrugated metal	flowing	1	free flow	N	riprapped	clear, no odor	none	none	none	N	0.25	0.04	0.1	978	
High conducti	Be420	8/10/15	SW	AS	outfall	24	smooth plastic	dripping	na	free flow	Y	large scour pool	clear	none	none	none	N	0.25	0.09	0.4	5440	
High conducti	Be430	8/10/15	SW	AS	outfall	12	corrugated black plastic	dripping	na	free flow	Y	incision		none	algae	none	N	0.25	0.14	0.2	4790	riprap below outfall is not in good shape
High conducti	Be440	8/10/15	SW	AS	outfall	18	corrugated black plastic	flowing	0.125	free flow	N	na	clear, slightly musty, sour odor	none	algae	none	N	0.00	0.17	0.3	6140	trash at the base of the outfall (including a used diaper)
	Be450	9/18/15	SW	LS	outfall	10	vitrified clay	wet	na	submerged, surcharg	N	na	clear, no odor	none	sediment	none	na	na	na	na	na	not sure if this is the mapped outfall. There is another just upstream. Stormwater system in this area has been recontructed: new swale
	Be460	9/18/15	SW	LS	outfall	16	corrugated metal	dry	na	free flow	N	na	na	none	none	none	na	na	na	na	na	iron staining close to pipe, seeping from slope. Stream appears to circumvent the pipe, or seep out above the end. At junction box above, flow is coming in from stormdrain system and entering long culvert - but disappears somewhere further down. Catchbasin above has five inlet pipes (not all mapped).
	Be470	9/18/15	SW	LS	outfall	24	corrugated metal	flowing	0.5	partially submerged	N	na	clear, algae, Fe+ staining	none	algae	none	na	na	na	na	na	no sample taken since the pipe was partially submerged
High conducti	Be480	9/18/15	SW	LS	outfall	18	corrugated metal	trickling	na	free flow	N	na	clear, musty odor	none	sediment	partially obstructed	N	0.25	0.07	0.3	2510	plants growing in pipe
	Be490	9/18/15	SW	LS	outfall	30	corrugated metal	trickling	na	partially submerged	N	na	Fe+ staining, algae	oily sheen	algae, oily	none	na	na	na	na	na	partially submerged; could not take sample or leave pad.
MBAS	Be500	9/18/15	SW	LS	outfall	12	corrugated black plastic	flowing	0.125	free flow	N	na	clear, no odor	algae	none	none	N	0.25	0.00	0.6	28.1	Blue Cross Blue Shield; returned to verify conductivity reading, but there was no flow that day
	Be510	9/18/15	SW	LS	outfall	18	corrugated metal	wet	na	free flow	N	na	na	none	sediment	none	na	na	na	na	na	
	Be520	9/18/15	SW	LS	outfall	12	corrugated metal	wet	na	free flow	N	na	na	none	none	none	na	na	na	na	na	holding pond below
	Be530	9/18/15	SW	LS	outfall	24	concrete	wet	na	partially submerged	Y	incision, minor cut	film on surface	sheen	sediment	fully obstructed	na	na	na	na	na	Pike Industries was washing trucks this day. Sediment from trucks flowed into the catchbasin above
	Be540	9/18/15	SW	LS	outfall	15	corrugated black plastic	wet	na	partially submerged	N	na	na	none	none	none	na	na	na	na	na	only outfall outside the fence around detention pond behind Berlin Mal
	Be550	9/18/15	SW	LS	outfall	24	corrugated black plastic	flowing	0.5	free flow	N	na		suds	iron staining	none	na	na	na	na	na	Inside the fence around the detention pond. Could not reach to take sample. Flows into pond (which drains via Be540)
	Be560	9/18/15	SW	LS	outfall	18	corrugated black plastic	trickling	na	free flow	N	na		?	?	none	na	na	na	na	na	Inside the fence around the detention pond. Could not reach to take sample. Flows into pond (which drains via Be540). One other (unmapped) outfall nearby
	Be570	9/18/15	SW	LS	outfall	15	corrugated black plastic	dripping	na	free flow	N	na		none	sediment, algae	none	N	0.00	0.05	0.1	862	
	Be580	9/18/15	SW	LS	outfall	18	corrugated black plastic	dry	na	free flow	N	riprapped below	na	none	none	none	na	na	na	na	na	
	Be590	9/18/15	SW	LS	outfall	15	corrugated black plastic	trickling	na	free flow	N	riprapped below		none	algae	none	N	0.25	0.00	0.0	801	Vermont National Guard
	Be600	9/18/15	SW	LS	outfall	15	corrugated black plastic	dry	na	free flow	Y	moderate incision below	na	none	none	none	na	na	na	na	na	
	Be610	9/18/15	SW	LS	outfall	15?	corrugated black plastic	wet	na	free flow	N	riprapped below		none	none	none	N	na	na	na	na	residence on Paine Turnpike
	Be620	10/6/15	SW	LS	outfall	15	corrugated black plastic	dry	na	free flow	N	na	na	na	sediment	none	na	na	na	na	na	sock filter in the skirt below the outfall
	Be630	10/6/15	SW	LS	outfall	15	corrugated black plastic	dry	na	partially submerged	N	na	na	na	leaf debris	none	na	na	na	na	na	
	Be640	10/6/15	SW	LS	outfall	6	smooth plastic	dry	na	partially submerged	N	na	na	na	sediment	none	na	na	na	na	na	
	Be650	10/6/15	SW	LS	outfall	18	corrugated black plastic	wet	na	free flow	N	na	na	na	none	none	na	na	na	na	na	
	Be660	10/6/15	SW	LS	outfall	18	corrugated black plastic	dry	na	free flow	N	na	na	na	none	none	na	na	na	na	na	riprap
	Be670	10/6/15	SW	LS	outfall	15	corrugated black plastic	dry	na	free flow	N	na	na	na	none	none	na	na	na	na	na	riprap

Flag	System ID	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Erosion	Erosion description	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
	Be680	10/6/15	SW	LS	outfall	12	corrugated black plastic	dry	na	free flow	N	na	na	na	none	none	na	na	na	na	na	
	Be690	10/6/15	SW	LS	outfall																	behind the VTrans Materials Research bldg. - could not finc
	Be700	10/6/15	SW	LS	outfall	14	corrugated black plastic	dry	na	free flow	N	na	na	na	none	none	na	na	na	na	na	riprap
	Be710	10/6/15	SW	LS	outfall	18	corrugated black plastic	dry	na	free flow	Y	active cut above	na	na	none	none	na	na	na	na	na	Another unmapped outfall nearby - smooth green plastic, completely full of sediment & almost buried. Active erosion above from overland flow from parking lot.
	Be720	10/6/15	SW	LS	outfall	30?	concrete	flowing	0.5	partially submerged	Y	some above and below	turbid, no odor	none	sediment, Fe+ staining	partially obstructed	na	na	na	na	na	Nearby culvert outlet is blocked with sediment. Construction going on in this area
	Be730	10/6/15	SW	LS	outfall	36	corrugated black plastic	flowing	?	partially submerged	N	na	clear, no odor, algae	na	none	none						
	Be1	9/22/15	TH		outfall	18	concrete	na	na	free flow	N	na	na	na	none	none	na	na	na	na	na	
	Be2	9/22/15	TH		outfall	30	smooth plastic	flowing	5	partially submerged	N	na		none	none	none	na	na	na	na	na	standing water in pipe, very low flow
	Be3	9/22/15	TH		outfall	24	concrete	wet	na	free flow	N	na		na	none	none	na	na	na	na	na	outlet in pond. No flow.
	Be4	9/22/15	TH		outfall	24	smooth plastic	dry	na	free flow	N	na	na	na	none	none	na	na	na	na	na	

C.4. Stowe Assessment Data

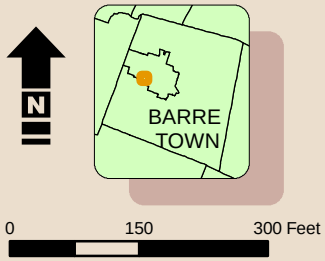
Flag	System ID	Structure ID	VTRans cross reference	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
NH3, suds	ST010	ST010		7/6/15	BHB	DB	outfall	28	black corrugated plastic	flowing	0.25	free flow	clear, no odor	suds	iron staining	none	N	0.5	0.00	0.0	893	A second pad was placed on 8/6 and collected on 8/26
	ST020	ST020		7/6/15	BHB	DB	outfall	15	black corrugated plastic	wet (no flow)	na	free flow	na	none	none	none	na	na	na	na	na	
NH3	ST030	CB1		7/6/15	BHB	DB	catchbasin	unknown	unknown	unknown	unknown	submerged	clear, no odor	sheen	iron staining	fully obstructed	N	1.0	0.06	0.0	1315	
NH3	ST040	CB1		7/6/15	BHB	DB	catchbasin	unknown	unknown	unknown	unknown	submerged	slight yellow color, metalic/sulfur odor	sheen	none	fully obstructed	N	1.0	0.00	0.1	2370	A second pad was placed on 8/6 that was collected on 8/26
	ST110	ST110		8/6/15	BHB	DB	outfall	24	black corrugated plastic	dry	na	free flow	na	na	none	none	na	na	na	na	na	
	ST120	ST120		8/6/15	BHB	DB	outfall	36	corrugated metal	flowing	0.25	free flow	clear, no odor	none	iron staining	none	N	0.0	0.00	0.0	149.9	
	ST130	ST130		8/6/15	BHB	DB	outfall	24	black corrugated plastic	dry	na	free flow	na	na	minor iron staining	none	N	0.0	0.01	0.1	523	Samples taken from CB1
	ST140	ST140		8/6/15	BHB	DB	outfall	15	corrugated metal	dry	na	free flow	na	na	na	partially obstructed	na	na	na	na	na	
	ST150	ST150		8/6/15	BHB	DB	outfall	4	green pvc	dry	na	free flow	na	na	na	none	na	na	na	na	na	
	ST160	ST160		8/6/15	BHB	DB	outfall	18	green pvc	flowing	16	free flow	clear, no odor	none	none	none	N	0.0	0.07	0.0	1095	
OB	ST170	ST170		8/6/15	BHB	DB	outfall	15	black corrugated plastic	wet (no flow)	na	free flow	na	na	none	none	P	na	na	na	na	No water sample able to be collected
	ST180	ST180		8/6/15	BHB	DB	outfall	8'x4'	cement	flowing	2	free flow	clear, petroleum/sewer odor	none	iron staining	none	N	0.0	0.00	0.0	611	Long box culvert through village; receives runoff from catchbasins above
	ST190	ST190		8/6/15	BHB	DB	outfall	15	black corrugated plastic	dry	na	free flow	na	na	none	none	na	na	na	na	na	Discharges to stream that runs through ST180
	ST200	ST200		8/6/15	BHB	na	outfall	6	pvc	dry	na	free flow	na	na	none	none	na	na	na	na	na	Drains new ice rink
	ST210	ST210		8/6/15	BHB	na	outfall	18	black corrugated plastic	dry	na	free flow	na	na	none	none	na	na	na	na	na	Small system, two CBs, one on either side of road to rink
	ST220	ST220		8/6/15	BHB	na	outfall	18	black corrugated plastic	flowing	0.25	free flow	clear, no odor	none	none	none	N	0.0	0.02	0.1	210	New construction - redone when new bridge was constructed
	ST230	ST230		8/6/15	BHB	na	outfall	18?	corrugated metal	wet (no flow)	na	free flow	no odor	none	none	partially obstructed	N	0.0	0.00	0.2	1191	Water samples/pad taken from CB1
	ST240	ST240		8/28/15	BHB	na	outfall	24	black corrugated plastic	dry	na	free flow	na	na	none	none	na	na	na	na	na	ST240 was dry
OB, NH3, odor, foam	ST250	ST250		8/28/15	BHB	na	outfall	15	black corrugated plastic	flowing	0.25	free flow	manure, sulfur odor	yellow foam	none	none	P	3.0	0.03	0.2	1131	ST250 outfall is downpipe of ST240 with one CB in between. Pad replaced on 9/10
	ST260	ST260		8/28/15	BHB	na	outfall	15	corrugated metal	trickling	0.125	free flow	slightly cloudy, no odor	none	some iron staining	none	N	0.1	0.01	0.0	925	
	ST270	ST270		8/28/15	BHB	na	outfall	18	corrugated metal	wet (no flow)	na	free flow	na	na	none	none	N	na	na	na	na	Outfalls ST270 and ST275 empty to a swale which immediately enters a road culvert
	ST275	ST275		8/28/15	BHB	na	outfall	30	corrugated metal	wet (no flow)	na	free flow	na	na	none	none	N	na	na	na	na	Outfalls ST270 and ST275 empty to a swale which immediately enters a road culvert
	ST280	ST280		8/28/15	BHB	na	outfall	15	black corrugated plastic	wet (no flow)	na	free flow	na	na	none	none	N	na	na	na	na	
	ST290	ST290		8/28/15	BHB	na	outfall	unknown	unknown	dry	na	unknown	na	na	unknown	fully obstructed	na	na	na	na	na	One and only CB was dry. Large compost pile was covering the outfall
	ST300	ST300		8/28/15	BHB	na	outfall	12	black corrugated plastic	dry	na	free flow	na	na	none	none	na	na	na	na	na	
	ST310	ST310		8/28/15	BHB	na	outfall	18	black corrugated plastic	dry	na	free flow	na	na	none	partially obstructed	na	na	na	na	na	
	ST320	ST320		8/28/15	BHB	na	outfall	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown	fully obstructed	na	na	na	na	na	First up-pipe CB was dry.
	ST330	ST330		8/28/15	BHB	na	outfall	18	black corrugated plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST340	ST340		8/28/15	BHB	na	outfall	18	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na	
OB=I, NH3, Cl2	ST350	ST350		8/28/15	BHB	na	outfall	18	corrugated metal	wet (no flow)	na	free flow	clear, no odor	none	none	partially obstructed	I	1.0	0.23	0.2	80.5	Cl_2 test turned pink immediately. Water pooled about 3 inches due to obstruction
	ST360	ST360		8/28/15	BHB	na	outfall	18	black corrugated plastic	dry	na	free flow	na	na	none	partially obstructed	na	na	na	na	na	Earth obstructing ~50% about 2 feet back into the pipe
NH3, Cl2, suds	ST370	ST370		9/16/15	BHB	na	outfall	60	corrugated metal	flowing	3	free flow	slightly cloudy, slight marshy odor	suds	iron staining	none	N	0.75	0.14	0.0	520	
NH3, MBAS	ST370	JCT 1		9/16/15	BHB	na	stormline junction	12	black corrugated plastic	dripping	na	free flow	slightly cloudy, slight odor	none	sediment	none	N	4.0	0.03	0.7	124.3	All junction data taken by walking through the pipes
	ST370	JCT 2		9/16/15	BHB	na	stormline junction	30	corrugated metal	wet (no flow)	na	partially submerged	na	none	sediment	partially obstructed	N	0.0	0.06	0.0	1216	Outfall 1/3 full of sediment; all junction data taken by walking through the pipes
	ST370	JCT 8		9/16/15	BHB	na	stormline junction	18	corrugated metal	wet (no flow)	na	free flow	na	none	iron staining	none	N	na	na	na	na	
	ST370	CB		9/16/15	BHB	na	catchbasin	unknown	unknown	trickling	unknown	free flow	na	unknown	unknown	unknown	na	0.1	0.09	0.0	1057	Pipe is destroyed; able to get water sample, but could not place pad
	ST380	ST380		9/10/15	BHB	na	outfall	15	green pvc	dry	na	free flow	na	none	sediment	none	na	na	na	na	na	
	ST390	ST390		9/10/15	BHB	na	outfall	12	green pvc	wet (no flow)	na	free flow	na	none	sediment	none	N	na	na	na	na	Pad washed away, was replaced on 9/16/15
	ST400	ST400		9/10/15	BHB	na	outfall	18	black corrugated plastic	wet (no flow)	na	free flow	na	none	sediment	none	N	na	na	na	na	
	ST410	ST410		9/10/15	BHB	na	outfall	18	black corrugated plastic	wet (no flow)	na	free flow	na	none	sediment	none	N	na	na	na	na	
NH3, Cl2	ST420	ST420		9/10/15	BHB	na	outfall	24	black corrugated plastic	flowing	0.25	free flow	murky, no odor	none	sediment	partially obstructed	N	1.0	0.21	0.0	1235	
	ST430	ST430		9/10/15	BHB	na	outfall	12	black corrugated plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST440	ST440		9/10/15	BHB	na	outfall	18	corrugated metal	wet (no flow)	na	free flow	na	none	none	partially obstructed	N	na	na	na	na	
	ST450	ST450		9/10/15	BHB	na	outfall	18	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na	This outfall does not appear to be in use anymore; it has deteriorated
	ST460	ST460		9/10/15	BHB	na	outfall	24	corrugated metal	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na	Only drains a swale on the other side of the road
	ST470	ST470		9/10/15	BHB	na	outfall	18	corrugated metal	flowing	0.75	free flow	clear, no odor	none	iron staining	none	N	0.0	0.02	0.0	193.1	
	ST480	ST480		9/10/15	BHB	na	outfall	12	black corrugated plastic	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	
	ST490	ST490		9/10/15	BHB	na	outfall	18	green pvc	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na	
	ST500	ST500		9/16/15	BHB	na	outfall	18	metal (smooth)	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST510	ST510		9/16/15	BHB	na	outfall	18	metal (smooth)	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	
	ST520	ST520		9/16/15	BHB	na	outfall	4	green pvc	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST530	CB		9/16/15	BHB	na	catchbasin	unknown	unknown	dry	na	uknown	na	na	unknown	unknown	na	na	na	na	na	
	ST540	ST540		9/16/15	BHB	na	outfall	18	metal (smooth)	dry	na	free flow	na	none	iron staining	none	na	na	na	na	na	
	ST550	ST550		9/16/15	BHB	na	outfall	15	black corrugated plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST560	ST560		9/16/15	BHB	na	outfall	18	concrete	flowing	0.25	free flow	very clear, no odor, very cold	none	none	none	N	0.1	0.03	0.0	1818	
	ST570	ST570		9/25/15	BHB	na	outfall	6	green pvc	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST580	ST580		9/25/15	BHB	na	outfall	4	smooth plastic	dripping	unknown	free flow	murky, no odor	none	none	none	N	0.0	0.05	0.0	446	Four 4" footing drains entering a drop inlet, one was dripping
	ST590	ST590		9/25/15	BHB	na	outfall	18	corrugated metal	flowing	0.125	free flow	clear, no odor	none	none	none	N	0.0	0.03	0.1	579	Pad rest 10/22/15
	ST600	CB2		9/25/15	BHB	na	catchbasin	18	black corrugated plastic	submerged	unknown	submerged	clear, no odor	none	unknown	partially obstructed	N	0.25	0.02	0.0	953	Outfall was burried and submerged, sample and pad collected at CB2
	ST610	ST610		9/25/15	BHB	na	outfall	36	corrugated metal	dry	na	free flow	na	none	iron staining	none	na	na	na	na	na	
	ST620	CB1		9/25/15	BHB	na	catchbasin	unknown	corrugated metal	dry	unknown	unknown	unknown	unknown	unknown	unknown	na	na	na	na	na	Outfall was in major construction site, CB1 was tested
	ST630	CB1		9/25/15	BHB	na	catchbasin	unknown	black corrugated plastic	flowing	unknown	unknown	clear, no odor	unknown	unknown	unknown	N	0.1	0.11	0.1	556	Outfall in major construction site, CB1 tested; flow passes through Vortechnique units
	ST640	ST640		9/25/15	BHB	na	outfall	36	black corrugated plastic	flowing	1	free flow	clear, no odor	none	major iron staining	none	N	0.2	0.00	0.1	188.7	
	ST650	ST650		9/25/15	BHB	na	outfall	15	black corrugated plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST660	ST660		9/25/15	BHB	na	outfall	18	concrete	flowing	4	partially submerged	clearish, pond water odor	none	iron staining	none	N	0.2	0.00	0.1	487	
	ST670	ST670		9/28/15	BHB	na	outfall	18	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST680	ST680		9/28/15	BHB	na	outfall	15	corrugated metal	dry	na	free flow	na	none	none	partially obstructed (	na	na	na	na	na	
	ST690	CB		9/28/15	BHB	na	catchbasin	unknown	concrete (exiting CB)	dry	na	unknown	na	na	unknown	unknown	na	na	na	na	na	Outfall could not be located
OB	ST700	ST700		9/28/15	BHB	na	outfall	18	corrugated metal	flowing	0.25	free flow	clear, no odor	none	none	none	I, P (wea	0.1	0.02	0.0	534	
	ST710	ST710		9/28/15	BHB	na	outfall	18	black corrugated plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST720	ST720		9/28/15	BHB	na	outfall	12	black corrugated plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST730	ST730		9/28/15	BHB	na	outfall	24	black corrugated plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	

Flag	System ID	Structure ID	VTRans cross reference	Date assessed	Inspector 1	Inspector 2	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
	ST740	ST740		9/28/15	BHB	na	outfall	24	black corrugated plastic	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	ST750	ST750		9/28/15	BHB	na	outfall	12	black corrugated plastic	dry	na	free flow	na	none	none	partial obstruction (n	na	na	na	na	na	
	ST760	ST760		9/28/15	BHB	na	drop inlet	unknown	concrete	dry	na	unknown	na	unknown	unknown	unknown	na	na	na	na	na	
	ST770	ST770		9/28/15	BHB	na	outfall	unknown	unknown	flowing	0.5	submerged	clear, no odor	none	iron staining	fully obstructed	N	0.25	0.02	0.0	641	Pad left in CB1, CB1 receives runoff from car wash. Outfall submerged

C.5. Williamstown Assessment Data

Flag	System ID	Structure ID	Date assessed	Inspector 1	Structure	Pipe diam. (in.)	Pipe material	Dry, wet (no flow), dripping, or flowing?	Flow depth (in.)	Pipe position	Discharge characteristics	Floatables	Deposits/ Stains	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS corrected (mg/L)	Sp. conductance (µs/cm)	Comments
	WT010	WT010	10/22/15	BHB	outfall	15	corrugated black plastic	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na	
	WT020	WT020	10/22/15	BHB	outfall	12	smooth plastic	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	
	WT030	WT030	10/22/15	BHB	outfall	18	corrugated metal	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na	
MBAS	WT040	WT040	10/22/15	BHB	outfall	24	concrete	flowing	0.125	free flow	clear, slight musty odor	none	sediment, slime, sludge	none	Negative	0.1	0.00	0.3	410	
	WT040	CB8	10/22/15	BHB	CB	na	na	flowing	unknown	na	clear, no odor	none	unknown	none	Negative	0.0	0.01	0.0	973	Pad labelled WT050
	WT040	CB10	10/22/15	BHB	CB	na	na	dry	na	na	na	none	none	none	na	na	na	na	na	
MBAS	WT070	WT070	10/22/15	BHB	outfall	18	corrugated black plastic	wet, no flow	na	partially submerged	murky, no odor	none	sediment	none	Negative	0.2	0.01	0.5	538	
	WT080	WT080	10/22/15	BHB	outfall	18	corrugated metal	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	WT090	WT090	10/22/15	BHB	outfall	12	concrete	wet, no flow	na	free flow	na	none	none	none	Negative	na	na	na	na	
	WT100	WT100	10/22/15	BHB	outfall	12	smooth metal	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na	Partially filled with stones, sediment, debris.
	WT110	WT110	10/22/15	BHB	outfall	18	corrugated black plastic	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na	Pipe is almost fully obstructed ~80%
	WT120	WT120	10/22/15	BHB	outfall	15	corrugated metal	dry	na	free flow	na	none	iron staining	none	na	na	na	na	na	
	WT130	WT130	10/22/15	BHB	outfall	18	corrugated black plastic	dry	na	free flow	na	none	sediment	minor sediment	na	na	na	na	na	
NH3	WT140	WT140	10/22/15	BHB	outfall	4	smooth plastic	minor trickle	na	free flow	heavy iron content, sludgy	none	iron staining	partially obstructed	Negative	1.0	na	na	558	No other tests were possible because of the sludge
	WT150	WT150	11/3/15	BHB	outfall	15	corrugated black plastic	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	
	WT160	WT160	11/3/15	BHB	outfall	12	corrugated black plastic	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	
	WT170	WT170	11/3/15	BHB	outfall	18	corrugated metal	dry	na	free flow	na	none	sediment	none	na	na	na	na	na	
	WT180	WT180	11/3/15	BHB	outfall	12	smooth metal	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	Merges with WT190
	WT190	WT190	11/3/15	BHB	outfall		smooth metal	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	
	WT200	WT200	11/3/15	BHB	outfall	18	corrugated metal	dry	na	free flow	na	none	sediment	none	na	na	na	na	na	
	WT210	WT210	11/3/15	BHB	outfall	18	corrugated metal	dry	na	free flow	na	none	rust	none	na	na	na	na	na	
	WT220	CB1	11/3/15	BHB	CB	na	na	dry	na	na	na	none	none	none	na	na	na	na	na	Could not locate outfall, single CB in system is dry
	WT230	WT230	11/3/15	BHB	outfall	18	concrete	dry	na	free flow	na	none	none	none	na	na	na	na	na	
	WT240	WT240	11/3/15	BHB	outfall	24	corrugated metal	dry	na	free flow	na	none	rust	none	na	na	na	na	na	
	WT250	WT250	11/3/15	BHB	outfall	18	corrugated metal	dry	na	free flow	na	none	rust	none	na	na	na	na	na	
	WT260	WT260	11/3/15	BHB	outfall	12	corrugated metal	dry	na	free flow	na	none	rust	none	na	na	na	na	na	Second outfall, not marked on map
	WT270	WT270	11/3/15	BHB	CB	na	corrugated metal	dry	na	na	na	na	na	na	na	na	na	na	na	No water, did not notice funny odor as indicated on map
	WT280	WT280	11/3/15	BHB	outfall	12	smooth plastic	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	
	WT290	WT290	11/3/15	BHB	outfall	18	concrete	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na	
	WT300	WT300	11/3/15	BHB	outfall	15	corrugated black plastic	dry	na	free flow	na	none	none	partially obstructed	na	na	na	na	na	Eroded channel (dry)
	WT310	WT310	11/3/15	BHB	outfall	18	corrugated black plastic	dry	na	free flow	na	none	sediment	partially obstructed	na	na	na	na	na	
NH3	WT320	WT320	11/3/15	BHB	outfall	18	corrugated metal	flowing	2	free flow	clear, no odor	none	bright green moss	partially obstructed	na	1.0	0.02	0.1	673	Not marked on map, heavy flow

APPENDIX D: SYSTEM MAPS



Legend

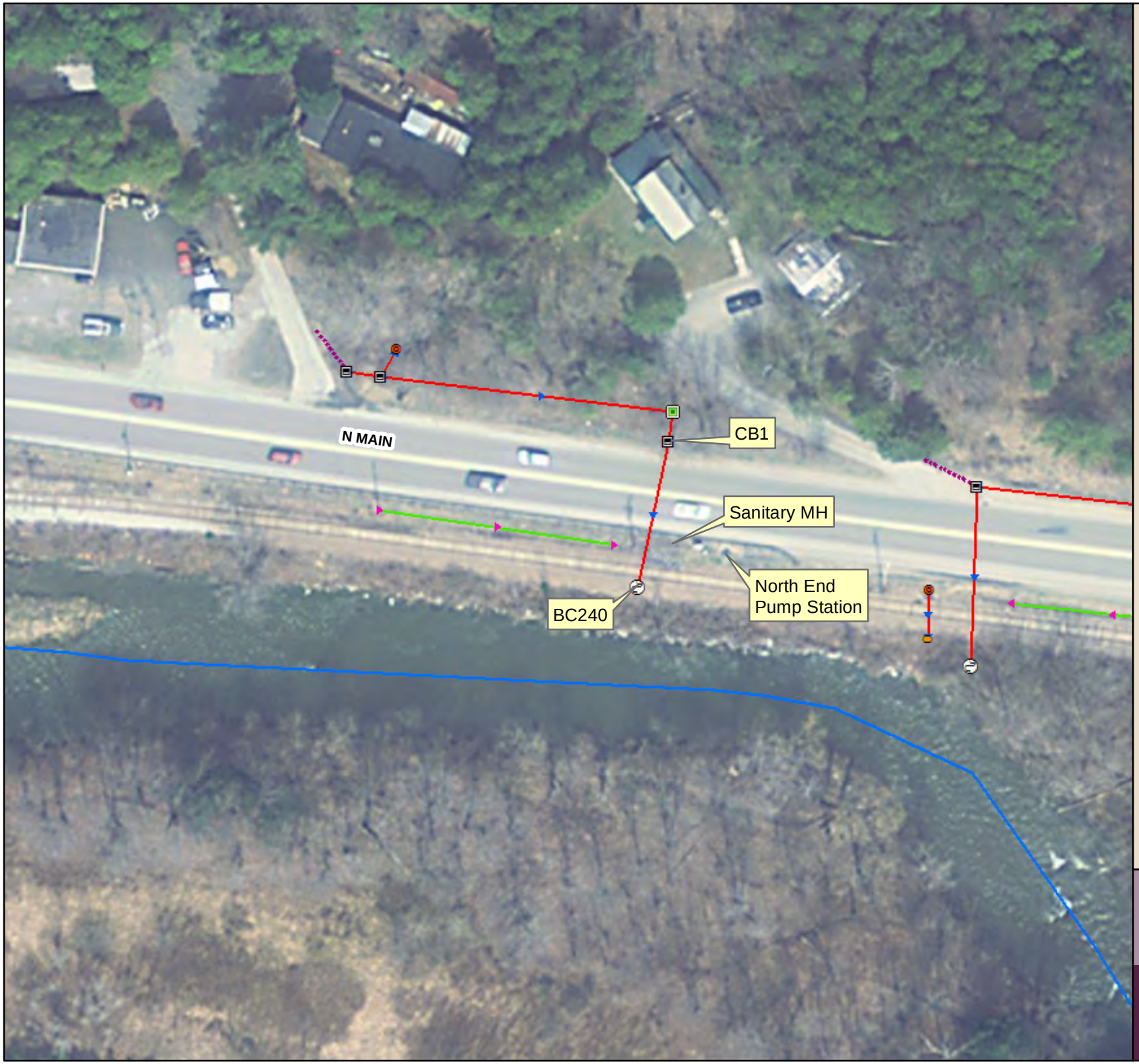
- Outfall
- Catchbasin
- Stormwater Manhole
- Footing drain
- Overland flow
- Storm line
- Swale

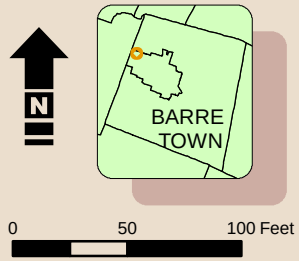
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BC-1
System BC140
Barre City, VT

Stevens + Stowe IDDE





Legend

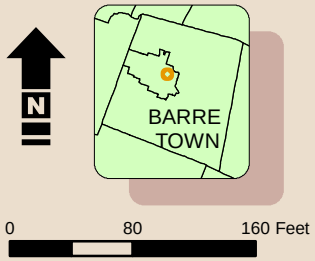
- Outfall
- Catchbasin
- Culvert inlet
- Culvert outlet
- Junction Box
- Footing drain
- Storm line
- Stream
- Swale

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BC-2
System BC240
Barre City, VT

Stevens + Stowe IDDE



Legend

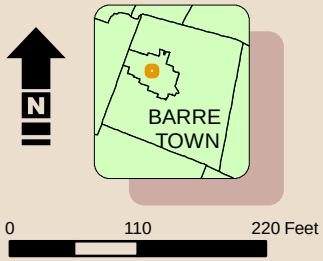
- Existing, Outfall
- Catchbasin
- Culvert outlet
- Drop Inlet
- Stormwater Manhole
- Storm line
- Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BC-3
System BC1100
Barre City, VT

Stevens + Stowe IDDE



Legend

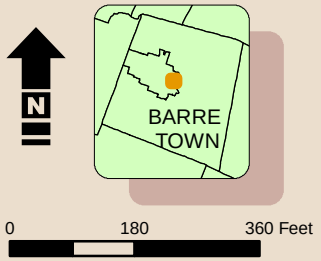
- Outfall
- Catchbasin
- Culvert inlet
- Drop Inlet
- Information Point
- Stormwater Manhole
- Treatment feature
- Overland flow
- Storm line
- Swale
- Under drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BC-4
System BC1120
Barre City, VT

Stevens + Stowe IDDE



Legend

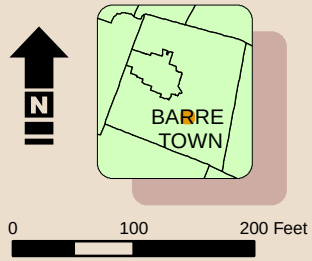
- Outfall
- Stormwater Manhole
- Catchbasin
- Stormwater Manhole
- Overland flow
- Storm line
- Stream
- Under drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BC-5
System BC1630
Barre City, VT

Stevens + Stowe IDDE



Legend

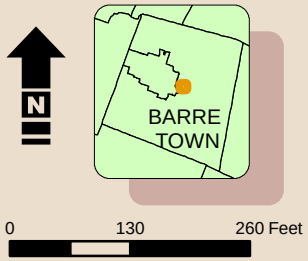
- Outfall
- Catchbasin
- Culvert inlet
- Culvert outlet
- Drop Inlet
- Sanitary Manhole
- Stormwater Manhole
- Footing drain
- Overland flow
- Sanitary line
- Storm line
- Stream
- Swale

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BT-1
System BT700
Barre Town, VT

Stevens + Stowe IDDE



Legend

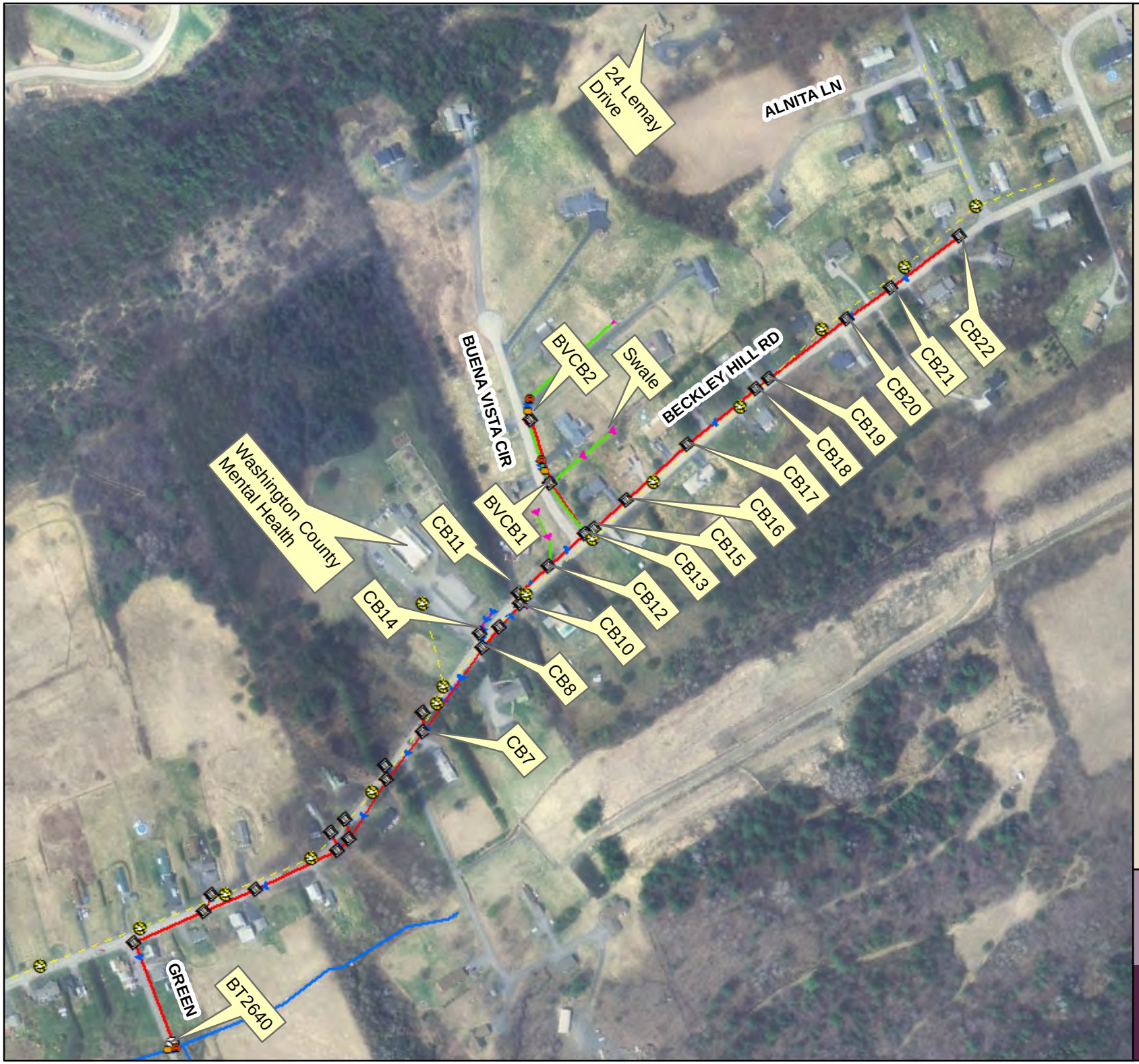
- Outfall
- Catchbasin
- Culvert inlet
- Culvert outlet
- Drop Inlet
- Dry Well
- Sanitary Manhole
- Overland flow
- Roof drain
- Sanitary line
- Storm line
- Stream
- Swale

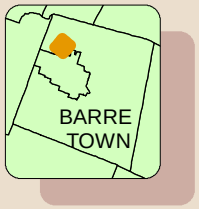
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BT-2
Systems BT2230 and BT2240
Barre Town, VT

Stevens + Stowe IDDE





0 320 640 Feet

N

Legend

- Outfall
- Catchbasin
- Culvert inlet
- Culvert outlet
- Sanitary Manhole
- Footing drain
- Sanitary line
- Storm line
- Stream
- Swale
- Proposed, Storm line

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BT-3
System BT2640
Barre Town, VT

Stevens + Stowe IDDE

N

BARRE TOWN

0 100 200 Feet

Legend

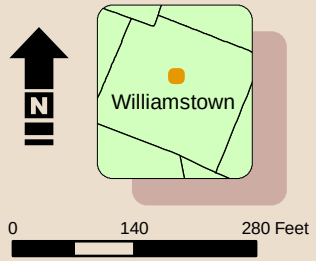
- Outfall
- Catchbasin
- Culvert inlet
- Culvert outlet
- Information Point
- Sanitary Manhole
- Proposed, Culvert inlet
- Proposed, Culvert outlet
- Overland flow
- Roof drain
- Sanitary line
- Storm line
- Stream
- Swale
- Proposed, Storm line

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map BT-4
System BT2790
Barre Town, VT

Stevens + Stowe IDDE



Legend

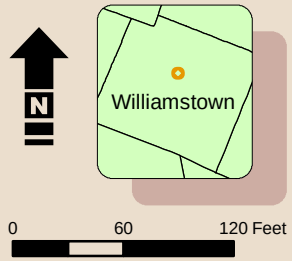
- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Drop Inlet
- Existing, Information Point
- Existing, Outfall
- Existing, Stormwater Manhole
- Existing, Footing drain
- Existing, Overland flow
- Existing, Storm line
- Existing, Stream
- Existing, Swale

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map WT-1
System WT040
Williamstown, VT

Stevens + Stowe IDDE



Legend

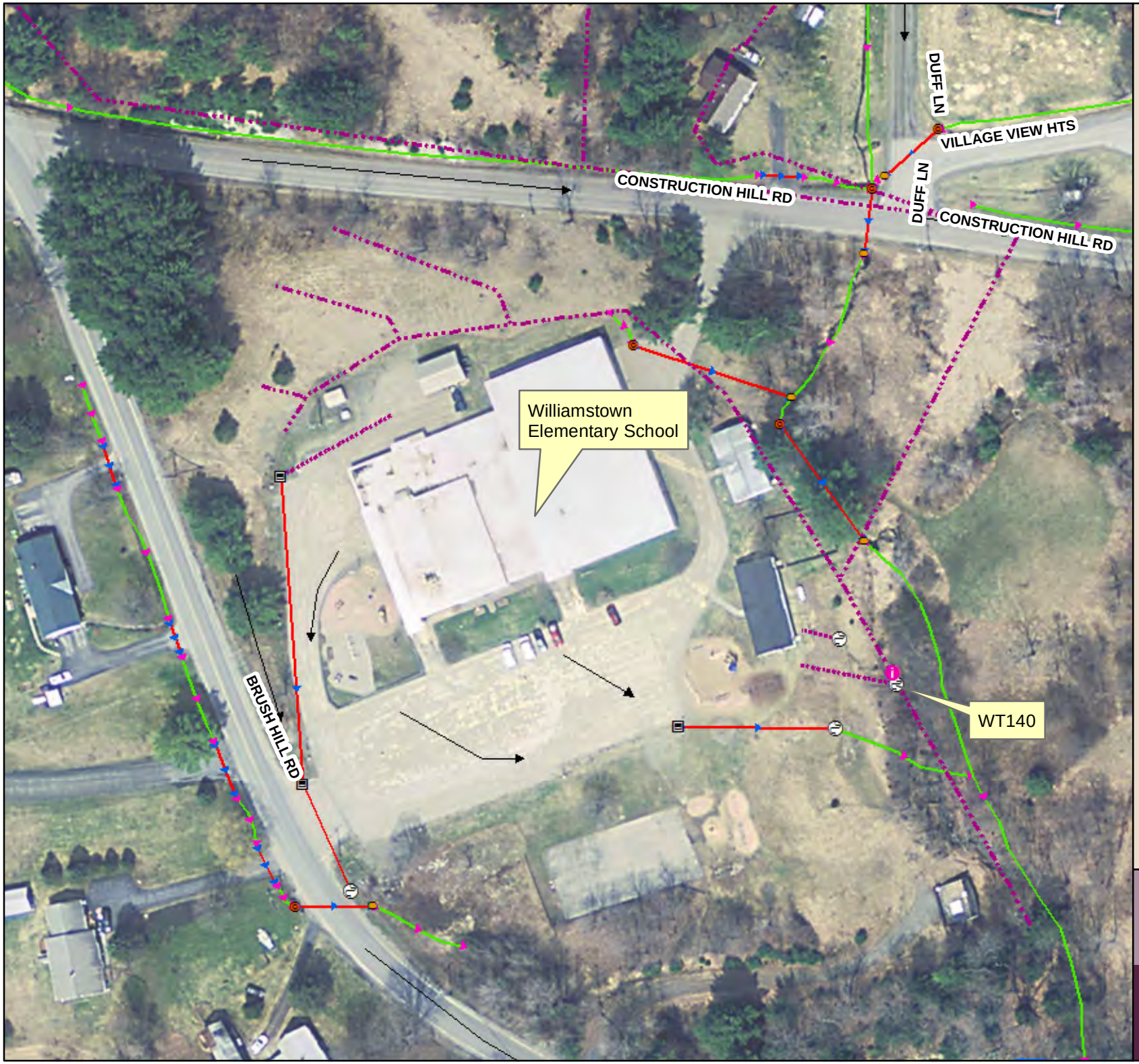
- Existing, Catchbasin
- Existing, Outfall
- Existing, Footing drain
- Existing, Overland flow
- Existing, Storm line
- Existing, Swale

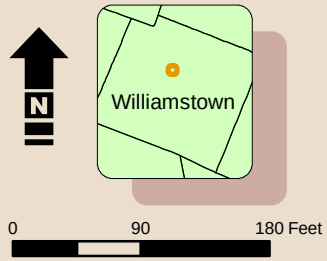
Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map WT-2
System WT070
Williamstown, VT

Stevens + Stowe IDDE





Legend

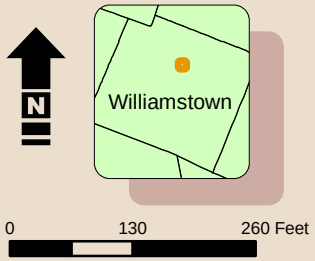
- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Culvert outlet
- Existing, Information Point
- Existing, Outfall
- Existing, Footing drain
- Existing, Overland flow
- Existing, Storm line
- Existing, Stream
- Existing, Swale
- Existing, Under drain

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map WT-3
System WT140
Williamstown, VT

Stevens + Stowe IDDE



Legend

- Existing, Catchbasin
- Existing, Information Point
- Existing, Outfall
- Existing, Footing drain
- Existing, Overland flow
- Existing, Storm line
- Existing, Stream

Sources: Stormwater infrastructure: VT ANR; Imagery: esri.

STONE ENVIRONMENTAL INC

Map WT-4
System WT320
Williamstown, VT

Stevens + Stowe IDDE