Detecting and Eliminating Illicit Discharges in the Upper and Middle Connecticut River Basin: Final Report

PROJECT NO.

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Cover photo: wastewater from a failed septic system surfacing into a ditch in Concord

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1. Introduction

The goal of the Upper and Middle Connecticut River Basin Illicit Discharge Detection and Elimination Project was to improve water quality by identifying and eliminating contaminated, non-stormwater discharges from entering stormwater drainage systems and discharging to the Connecticut River and its tributaries. The project was funded and administered by the Vermont Department of Environmental Conservation (DEC).

Sixteen towns and villages participated in the project: Bradford, Burke, Canaan, Concord, Danville, East St. Johnsbury, Fairlee, Gilman, Glover, Groton, Lunenburg, Lyndon, Newbury, Norwich, Ryegate, and Wells River. The geographic scope of the project included the entire extents of the municipal closed drainage systems in these towns and villages. Prior to this assessment, DEC prepared stormwater infrastructure mapping for all of the municipalities, which was used to plan the assessment and to guide further investigations in systems with suspected illicit discharges.

From May to December 2015, Stone assessed stormwater outfalls and certain manholes and catchbasins in each participating municipality for the presence of illicit discharges. A total of 250 stormwater drainage systems were assessed. Of the total, 238 systems were assessed at the outfall, while 12 systems were assessed in structures up-pipe from the mapped outfall location because the outfall either could not be located, was inaccessible, or was inundated by the receiving waterbody. Field tests were performed for ammonia, free chlorine, optical brighteners (i.e., fluorescent whitening dyes contained in most laundry detergents), and common anionic detergents [using the methylene blue active substances (MBAS) method]. In addition, Stone measured the specific conductance of each discharge point. Of the 250 systems assessed, 80 were flowing or dripping when inspected.

Among the 250 stormwater drainage systems assessed, contaminants indicating a possible illicit discharge were detected in 26 systems. In 2016, Stone completed its investigations of systems with suspected illicit discharges to confirm the presence of illicit discharges and to attempt to determine their sources. This report presents the assessment data and investigation findings for all of the systems that were suspected of having an illicit discharge. Table 1, below, summarizes the number of systems assessed and the number in which an illicit discharge was suspected in each participating municipality.

Table 1. Summary of Assessments by Town/Village

Town	Systems Assessed	Systems Assessed at Outfall	Systems Flowing or Dripping	Suspected Illicit Discharges	Confirmed Illicit Discharges
Bradford	41	41	11	1	1
Burke	10	9	5	2	1
Canaan	16	15	2	2	0
Concord	11	11	7	6	2
Danville	19	17	9	3	0
East St. Johnsbury	5	5	1	0	0
Fairlee	4	2	0	0	0
Gilman	10	9	9	2	1
Glover	9	9	3	1	0
Groton	11	11	4	1	1
Lunenburg	4	4	2	3	1
Lyndon	62	57	14	3	2
Newbury	1	1	1	0	0
Norwich	27	27	9	2	0
Ryegate	9	9	2	0	0
Wells River	11	11	1	0	0
Total	**250**	**238**	**80**	**26**	**9**

2. Methods

2.1. Preparation for the Assessment

Preparation for the illicit discharge assessment included obtaining and assembling necessary equipment and supplies; preparing a field data form (**Appendix A**), field maps, a Health and Safety Plan, and other documentation; organizing all documents, maps, forms, and plans in a project notebook; and meeting with each of the participating municipalities to gather information and plan the project in detail. Large-format field maps were prepared by overlaying DEC's stormwater infrastructure mapping on the best available orthophotography and were consulted in the kickoff meetings and annotated in the field. The kickoff meeting with each municipality provided an opportunity to collect four key types of information, presented below.

1. Contact information for municipal managers and public works personnel.
2. General schedules of road, wastewater and stormwater collection system projects (to avoid conflict with construction activities).
3. Locations of any known, suspected, or potential cross connections, combined sewer overflows, and sanitary sewer overflows.
4. In-house capabilities of the Public Works or Highway Department to inspect pipelines and perform other advanced investigation techniques.

2.2. Dry Weather Survey

Stormwater drainage systems were assessed during dry weather to minimize dilution from stormwater runoff. Dry weather was defined as negligible rainfall (less than 0.1 inches), beginning at approximately 12:00 p.m. the previous day. Stormwater drainage systems with ten or fewer inlets were typically assessed only at the outfall. Within larger stormwater drainage systems, catchbasins and junction manholes were also assessed to account for any effects of dilution. 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 forms (**Appendix A**).

In order to identify potential illicit discharges from laundry facilities, leaking sanitary sewers, and cross-connections, each dry weather discharge was tested for ammonia, methylene blue active substances (common detergents), and the presence of optical brighteners. 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, odors, or certain deposits.

2.3. 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 American Public Health Association 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, in accordance with Stone Environmental SOP 6.38.0 (**Appendix B**). To test for optical brightener, a cotton pad was placed in the flow stream for a period of 4–10 days, after which the pad was rinsed, dried, and viewed under a long-wave ultraviolet light ("black light"). Florescence of the pad (seen on the pad in Figure 1) indicates the presence of optical brightener. Pads were held in a sleeve of fiberglass window 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, pads were deployed in incoming pipes if possible, but were 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 can 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 optical brightener monitoring pad under fluorescent (left) and UV (right) lamps.

Table 2, below, lists the water quality tests that Stone performed at all discharge points and selected catchbasins and manholes that were flowing at the time of inspection.

Table 2: 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

2.4. Advanced Investigations

Our IDDE experience has provided us an understanding of constituent concentrations likely to indicate the presence of an illicit discharge. These benchmark concentrations are summarized below in Table 3. Stormwater drainage systems were designated for follow-up sampling and/or investigation where these benchmarks were exceeded. In many cases, systems were resampled at a later date if low concentrations (concentrations near the method detection limit) of ammonia, MBAS detergents, or chlorine were measured; and were not designated for intensive investigation unless elevated concentrations reoccurred.

Table 3: Benchmark Levels for Determining Illicit Discharges

Test	Benchmark	Remarks
E. coli	>= 400 *E. coli*/100 mL	Undiluted municipal wastewater can have *E. coli* levels an order of magnitude or more higher than this benchmark. Pet waste and wildlife sources also cause elevated *E. coli* levels.
Ammonia	>= 0.25 mg/L	In the absence of other wastewater indicators, follow-up 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 cause misleading results.
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 additional sampling or investigation.
Optical brightener	presence	Presence usually indicates contamination by sanitary wastewater or washwater. Exposure of the test pad for 4-10 days means that diluted and intermittent discharges can 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 effective method to bracket sources of contamination in storm sewers.
Free chlorine	>=0.10 mg/L	The field test used for free chlorine analyses 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.

Test	Benchmark	Remarks
Specific conductance	>600 µS/cm	Specific conductance is not a reliable indicator of wastewater contamination. Road salt and metals from pipe corrosion often result in levels in the 1,000-10,000 µS/cm range, whereas flows contaminated with wastewater generally have specific conductance in the 600-1,000 µS/cm range. Although infrequent, this measurement has proven most useful in identifying certain industrial discharges.

If a stormwater drainage system was suspected of passing illicit discharges, based on the results of the dry weather survey, additional observations and testing were performed within the system to locate or bracket the origin of the contaminated flow. 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.

To locate or bracket contaminant sources within storm sewer segments, the same testing methods or a subset of methods 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. In several instances, we used optical brightener results to narrow the search area for illicit discharges to a specific structure or to the pipe between two structures. The presence and appearance of dry-weather flows were also useful in isolating sources of contamination within storm sewer segments.

Stone worked with participating municipalities to find specific improper connections, leaks, and other problems contributing to the contaminated flows observed in the stormwater drainage systems. After bracketing the discharge source as closely as possible using the water quality test methods, Stone met with municipal representatives to describe our findings and discuss next steps. Engineering plans were reviewed to identify possible cross-connections between sanitary sewers and stormwater drainage systems, particularly locations where leakage from a sanitary line could be intercepted by the stormwater system. Dye testing was performed in Gilman and Concord to identify specific improper connections. In addition, camera inspections were performed in Gilman, Lunenburg, and Concord.

The following sections present the findings of illicit discharge investigations in each town or village. No suspected illicit discharges were identified in several municipalities; therefore no further investigation occurred. In each of the remaining towns and villages, one or more illicit discharges was investigated. Correction of several illicit discharges occurred in 2016 and additional corrections are planned for 2017.

2.4.1. *E. coli* and Nitrogen

At discharge points where wastewater contamination was suspected (because of a positive optical brightener test, elevated ammonia, and/or septic odor), water samples were collected for *E. coli* and total nitrogen analyses. *E. coli* bacteria levels provide an indication of fecal contamination. Illicit discharges of sanitary wastewater via separated stormwater drainage systems or failed septic systems may contribute *E. coli*. In addition, total nitrogen (TN) was analyzed at all discharge points with suspected wastewater contamination due to concerns over nitrogen in the Connecticut River basin and its impacts on the Long Island Sound. The State of Vermont's VAEL laboratory performed both analyses.

Samples for *E. coli* analysis were collected in sterile, plastic 100-mL bottles and analyzed using Quanti-tray. Samples collected for total nitrogen analysis were collected in 50-mL plastic vials provided by VAEL and analyzed using VAEL's Standard Operating Procedure (SOP) for Determination of Total Nitrogen by Flow

Injection Analysis, 24 7 1-2015 (Persulfate Digestion Method). The method preservation and holding time requirements are provided in Table 4, below.

Table 4. Laboratory Sample Analyses

Parameter	Sample Container	Analytical Method	Sample Preservation	Holding Time
Total N	Plastic vial (50 mL)	4500-N C-modified	Cool (4°C), sulfuric acid	28 days
E. coli	Plastic bottle (100 mL)	SM 9223B (Colilert Quanti-Tray)	Cool (4°C), sodium thiosulfate	6 hours

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

3. Bradford Results

Illicit discharge detection was performed in Bradford in November 2015. Of the 41 systems assessed, 11 were either flowing or dripping during dry weather. Results of the initial assessment in Bradford are included in Appendix C, Table 1. One system was designated for further investigation due to detection of optical brightener. The status of this investigation is described in detail below.

3.1. BD220

The BD220 system drains a portion of North Pleasant Street, Bank Street and Main Street (Appendix D, Map 1). It discharges east of the parking area off KD Welch Service Road, above the Bradford Golf Course. Water quality data for this system are presented in Table 5.

Table 5. Water Analysis Data for Outfall BD220

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
BD220	11/4/15	Flowing	0.0	0.08	0.1	800	Positive	Clear, no odor
	6/15/16	Flowing	0.0	0.00	0.0	778	Positive	Clear, no odor

Findings:

- Optical brightener was detected at the outfall during the initial assessment on a pad retrieved on November 13, 2015. No other contaminants were detected above levels of concern.
- Optical brightener pads were deployed throughout the system on June 15, 2016. Optical brightener was detected at the outfall and in the sumps of catchbasins CB2 and CB7, but not in CB3, CB4, CB5, CB6, CB8, CB9, and CB10 (Appendix D, Map 1).
- The outfall was dry on the *E. coli* sampling date in August, 2016; therefore, no samples were collected.
- Optical brightener pads collected in October 2016 were positive at the outfall, CB1, and CB4. Optical brightener was not detected in CB2, CB3, CB6, CB8, or CB11.
- Examination of engineering plans for the reconstruction of North Pleasant Street (Lamoureux, Stone, and O'Leary, Sheet AS8, 6/19/95) suggests two possible locations where wastewater leaking from the sanitary system could be intercepted by the stormdrain on North Pleasant Street.
  - The 8-inch diameter, "existing" sewer main on North Pleasant Street crosses over the 15-inch diameter stormline connecting catchbasins CB5 and CB4 (CB9 and CB10 on the engineering drawings). There appears to be almost no vertical separation between these pipelines.

    - The sewer lateral (a shared line) serving both 105 and 143 North Pleasant Street appears to cross several feet above the 15-inch diameter stormline connecting CB6 and CB5 (CB11 and CB9 on the engineering drawings)
- Dye testing planned for the late November 2016 timeframe was cancelled due to an early winter storm.

Conclusion: The source of the fluorescence does not appear to be hydrocarbon contamination from the service station on Main Street, as initially suspected based on conversations with the Town of Bradford and inspection of monitoring pads collected in June 2016. Rather, the source appears to be leaking wastewater intercepted by the stormdrain on North Pleasant Street. We do not suspect a cross-connection because stormwater appears clear and not malodorous and there is no indication of wastewater solids in the system. While results of optical brightener monitoring have been somewhat inconsistent, we suspect the contaminant enters the system between catchbasins CB4 and CB5.

Resolution: The source of the wastewater or washwater entering the BD220 stormwater drainage systems was not conclusively identified. It is clear the source is on North Pleasant Street in the vicinity of catchbasins CB4 and CB5. The most likely causes are a leaking sewer lateral serving 105 or 143 North Pleasant Street or a leaking sewer main.

The Town of Bradford is committed to investigating the source of the discharge on North Pleasant Street in the spring of 2017. According to Chief Operator Jon Thornton, the Water and Sewer Commission plans to dye test 105 and 143 North Pleasant Street as well as the sewer main. If necessary, they will also inspect the sewer main with a camera.

4. Burke Results

Illicit discharge detection was performed in Burke during August of 2015. Of the 10 systems assessed 5 were either flowing or dripping during dry weather. Results of the initial assessment in Burke are included in Appendix C, Table 2. Two systems were designated for further investigation due to detection of free chlorine and/or MBAS. Investigations of these systems are described below.

4.1. BU080

The BU080 system drains a portion of Route 114 (Appendix D, Map 2). It discharges west of the intersection of Route 114 and East Darling Hill Road behind the East Burke Garage. The outfall is partially obstructed. It discharges below grade into a small pool. Water quality data for this system are presented in Table 6.

Table 6. Water Analysis Data for Outfall BU080

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
BU080	8/27/15	Wet, no flow	0.25	0.60	0.75	171	Negative	Clear, no odor
	6/2/16	Wet, no flow	0.1	0.21	0.5	248	--	Clear, faint petroleum odor

Findings:

- MBAS detergent was detected in the outfall pool on both sampling dates. A sample collected on June 2, 2016 produced bubbles when shaken.
- There was no flow at the outfall on either sampling date. On June 2, 2016, all drains throughout the system were inspected. Catchbasins CB1 through CB5 were all found to be dry, with the exception of a dribble of flow from the main line (pipe B) to CB3.
- The Kingdom Trails property was inspected and no visible inlets to the system were located.
- The owner of the Northeast Kingdom Country Store, Diane Hasser, confirmed that all interior drains in the store are connected to the building's septic system, which is next to the volleyball court several hundred feet behind the store.

Conclusion: The MBAS detergent present in the outfall pool, the absence of optical brightener, and the lack of flow suggests an intermittent washwater discharge on the two sampling dates. However, no source of washwater could be located. The locations of catchbasins along Main Street would not appear to make them convenient drains in which to dispose of washwater buckets.

Resolution: Not applicable.

4.2. BU090

The BU090 system drains the East Burke Garage property. It discharges into a large pool west of the East Burke Garage that drains to the Passumpsic River. Water quality data for this system are presented in Table 7.

Table 7. Water Analysis Data for Outfall BU090

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
BU090	8/27/15	Trickling	0.25	0.32	0.1	562	--	Iron floc, no odor
	6/2/16	Trickling	0.0	0.00	0.0	444	--	Iron floc and sheen, no odor

Figure 2. Iron floc in pool behind the East Burke Garage.

Findings:

- The outfall was found submerged in a large pool, west of the East Burke Garage, which drains to the Passumpsic River (Figure 2). Heavy deposits of iron floc were present throughout the pool.
- On June 2, 2016, several out of range free chlorine results were recorded due to the high turbidity of the samples. Poor sample quality may have resulted in an inaccurate chlorine measurement on the first assessment date.
- VT ANR's Environmental Research Tool provides one record that is potentially related to the contamination observed. At the East Burke Garage (facility ID #51), two 1,000 gallon gasoline tanks installed in 1961 were removed thirty years later, in 1991. One tank was deemed to be in good condition, while the other was in fair condition.

Conclusion: The extensive iron floc deposit in the pool at the drain outlet behind the East Burke Garage is consistent with contamination by degraded petroleum products. We suspect the problem may stem from a leaking underground storage tank. One of the tanks removed in 1991 was reported to be in fair condition. The petroleum release may well predate the tanks removed in 1991.

Resolution: By this report, the problem is referred to the DEC Hazardous Waste Management Section.

5. Canaan Results

Illicit discharge detection was performed in Canaan in October 2015. Results of the initial assessment in Canaan are included in Appendix C, Table 3. Of the 16 systems assessed, two were flowing during dry weather. Both systems were designated for further investigation due to detection of free chlorine above 0.10 mg/L. The status of these investigations is described below.

5.1. CN090

The CN090 system drains a small portion of Route 253 and discharges to the south of Route 253, midway up the river bank, and into the Connecticut River. Water quality data for this system are presented in Table 8. Catchbasin CB1 was tested because the outfall was dry. The outfall pipe appears to have separated from the stormdrain due to bank failure.

Table 8. Water Analysis Data for Outfall CN090

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
CN090-CB1	10/12/15	Trickling	0.1	0.41	0.0	2170	Negative	Clear, no odor
	7/20/16	Trickling	0.1	0.02	0.0	281	--	Clear, no odor

Findings:

- The elevated free chlorine level measured on October 12, 2015 was not present when the system was reassessed on July 20, 2016.
- No ammonia, MBAS, or optical brightener was detected and the discharge appeared clear and not malodorous on both occasions it was sampled; therefore, wastewater is unlikely to be present.

Conclusion: We found no chronic illicit discharge in this system.

Resolution: Not applicable.

5.2. CN110

The CN110 system drains a small portion of Route 253 and discharges along the abutment of a bridge and into the Connecticut River, south of Route 253. Water quality data for this system are presented in Table 9.

Table 9. Water Analysis Data for Outfall CN110

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
CN110	10/12/15	Trickling	0.25	0.17	0.0	3,480	Negative	Clear, no odor
	7/20/16	Dripping	0.1	0.05	0.15	344	--	Clear, no odor

Findings:

- The elevated free chlorine level measured on October 12, 2015 was not present when the system was reassessed on July 20, 2016.
- The concentrations of ammonia and MBAS were below levels of concern, optical brightener was not detected, and the discharge appeared clear and not malodorous on both occasions it was sampled; therefore, wastewater is unlikely to be present.

Conclusion: We found no chronic illicit discharge in this system.

Resolution: Not applicable.

6. Concord Results

Illicit discharge detection assessments began in Concord in September 2015. Results of the initial assessment in Concord are included in Appendix C, Table 4. Of the nine stormwater drainage systems assessed in 2015, five were flowing during dry weather. Three of these systems were designated for further investigation due to detection of optical brightener. A fourth system (CO060) was designated for further investigation due to elevated levels of ammonia. In June 2016, while investigating these systems, two unmapped outfall pipes (CO090 and CO100) were discovered behind the apartment building at 356 Main Street, immediately east of the fire department building. Both of these outfalls were flowing and were found to contain optical brightener. The status of our investigations to date are summarized below.

6.1. CO015

The CO015 system appears to be an overflow from the water system at the Concord Town Hall (Appendix D, Map 3). It discharges south of Main Street behind the Concord Town Hall. The outfall is a 4-inch diameter PVC pipe. Water quality data for this system are presented in Table 10.

Table 10. Water Analysis Data for Outfall CO015

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
CO015	9/24/15	Flowing	0.0	0.00	0.0	563	Positive	Clear, no odor
	11/23/15	Flowing	0.25	0.06	--	81	Positive	Clear, no odor
	5/18/16	Flowing	0.0	0.02	0.0	69.3	Positive	Clear, no odor

Figure 3. Community spring next to Route 2 in Concord

Findings:

- Optical brightener was detected at the outfall on three separate occasions.
- On August 11, 2016, the toilet in the bathroom of the town hall was dye-tested with fluorescent sewer dye. No dye appeared at outfall CO015.
- Samples were collected on July 26, 2016 for *E. coli* and TN analysis. Concentrations of both constituents were low (Table 30).

- The chairman of the Concord Select Board, George Morehouse, stated that the septic system for the town hall was located and the tank was pumped out in the fall of 2016.
- The sustained, clear flow at the outfall suggests a groundwater source. We suspect the pipe in question is an overflow from the Concord Town Hall's water system, which is reportedly served by a community spring water supply. According to Mr. Morehouse, the community spring water supply—which is not a municipal supply recognized by the State of Vermont—is used by multiple properties: the Town Hall, the Village offices, and the apartment house at 356 Main Street. This spring is considered a non-potable water supply and the water is not consumed.
- According to Mr. Morehouse, the community spring is located next to Route 2 east of the village (Figure 3), approximately 500 feet east of the last house.

Conclusion: The consistent detection of optical brightener at the outfall confirms the presence of wastewater. Given the clear appearance of the discharge and the absence of ammonia and MBAS detergents, the wastewater component of the flow is likely minor and partially renovated. While the low concentration of *E. coli* (10 MPN/100 mL) found at the outfall does not exceed water quality standards, any presence of *E. coli* would be cause for concern if this flow was indeed connected with the community spring water supply. If this flow is from the spring, it will be important to determine whether wastewater is infiltrating the spring or the piping system from the spring.

Resolution: The assumption that the pipe in question is an overflow from the community spring water supply should be confirmed. Investigation of the use and safety of this water source is outside the scope of this project.

6.2. CO040

The CO040 system drains a portion of Shadow Lake Road, Main Street, and High Street (Appendix D, Map 4). It discharges at the bridge south of the Concord Fire and Rescue building. Water quality data for this system are presented in Table 11.

Table 11. Water Analysis Data for Outfall CO040

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
CO040	9/24/15	Flowing	0.0	0.00	0.15	3620	Positive	Clear, no odor
	5/18/16	Flowing	0.0	0.01	0.0	207	Positive	Clear, no odor

Findings:

- Optical brightener was detected at the outfall and in all structures up to a ditch east of 6 High Street. The following structures tested positive for optical brightener: catchbasins CB1 through CB5, the small stream behind 46 High Street, the ditch east of 6 High Street, and the footing drain south of 91 High Street.
- Optical brightener detections led to surfacing wastewater at 6 High Street (Figure 4). Wastewater odors were present in water surfacing into the ditch at the base of the retaining wall.

Figure 4. Surfacing wastewater at 6 High St., Concord, May 18, 2016

- Catchbasin CB5 tested positive for optical brightener, although it is not downstream of the surfacing effluent at 6 High Street.
- Samples were collected at the outfall on July 26, 2016 for *E. coli* and TN analysis (Table 30). The *E. coli* level (31 MPN/100 mL) was surprisingly low. The rate of effluent surfacing at 6 High Street appeared to decline over the dry summer months.
- The DEC Regional Engineer, Richard Wilson, visited the site on August 11, 2016 and confirmed that wastewater from 6 High Street was surfacing into the ditch.

Conclusion: System CO040 was contaminated by surfacing wastewater from a septic system at 6 High Street. It is possible that a second problem also exists, contributing optical brightener to the CB5 branch of the CO040 system.

Resolution: According to Richard Wilson, the DEC Regional Engineer, the owner of 6 High Street contracted with an engineering firm to design upgrades to the septic system on the property. Mr. Wilson reviewed the design. In a follow-up call on January 23, 2017, Mr. Wilson confirmed that the onsite wastewater system was upgraded in November 2016. A pressurized distribution system was installed, the culvert was extended 30-40 feet through the ditch, and the ditch was backfilled with clay to prevent wastewater interception.

We recommend that optical brightener testing be conducted in 2017 at the outfall and at catchbasin CB5, to verify whether additional sources of contamination may exist in this system.

6.3. CO060

The CO060 system drains a portion of Main Street and the parking lot of Barnie's Market (Citgo gas station). It discharges south of Main Street (Appendix D, Map 5). Water quality data for this system are presented in Table 12.

Table 12. Water Analysis Data for Outfall CO060

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
CO060	9/24/15	Flowing	0.3	0.03	0.0	1690	Negative	Clear, no odor
	5/18/16	Flowing	0.0	0.10	0.0	161	Positive (weak)	Clear, no odor

Findings:

- A low concentration of ammonia (0.3 mg/L) was measured when the system was first assessed. No other contaminants were detected.
- Catchbasins CB1, CB2, and CB3 were inspected on May 18, 2016; all appeared clear and no odor was observed.
- Optical brightener was detected on a monitoring pad deployed at the outfall on May 18, 2016, although the fluorescence was weak.
- Low concentrations of *E. coli* and TN were measured at the outfall in samples collected on July 26, 2017 (Table 30).
- Numerous minor oil spills were seen on the asphalt near the gas pumps and in the parking areas at Barnie's Market on August 11, 2016.

Conclusion: We found no chronic illicit discharge in this system. We suspect that the intermittent detection of fluorescence on the monitoring pads placed at the outfall were caused by petroleum contamination rather than optical brightener.

Resolution: Not applicable.

6.4. CO080

The CO080 system drains the driveway and parking lot of the Concord School (Appendix D, Map 6) and discharges below the school on School Street. Water quality data for this system are presented in Table 13.

Table 13. Water Analysis Data for Outfall CO080

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
CO080	9/24/15	Flowing	0.1	0.00	0.05	6650	Indeterminate	Clear, no odor
	5/18/16	Flowing	0.0	0.03	0.0	549	Positive	Clear, no odor

Findings:

- The first test for optical brightener at the outfall (September 24, 2015) was indeterminate. During a second test, optical brightener was detected at the outfall, although the fluorescence was weak. In catchbasin CB1, the optical brightener result was indeterminate, while catchbasins CB2 through CB4 were negative.
- Samples collected at the outfall on July 26, 2016 had very low *E. coli* (20 MPN/100 mL) and total nitrogen concentrations (Table 30).
- The only washing machine on the Concord School property is in the utility room. This washing machine discharges to a slop sink. The slop sink and a floor drain in the utility room were dye tested on August 11, 2016. No dye was observed in either the CO080 stormdrain or in the septic tank.
- On August 31, 2016, Wayne Graham of the Vermont Rural Water Association used a snake and locator to confirm that the slop sink was correctly plumbed to the school's septic system.

Conclusion: We do not have an explanation for the intermittent detection of optical brightener at the outfall. We do not believe there is a direct connection between wastewater piping at the Concord School and the CO080 stormwater system. While the school's leachfield is quite close to the outfall, it is at a slightly lower elevation; therefore infiltration of effluent into the stormdrain appears unlikely. Because negligible *E. coli* were found and the flow rate was very low, we determined that further investigation of the intermittent optical brightener detection was not warranted.

Resolution: N/A

6.5. CO090

CO090 is a 4-inch diameter PVC pipe discharging at the top of the riverbank behind 356 Main Street (Appendix D, Map 7). This pipe is closer to the bridge than CO100. Water quality data for this system are presented in Table 14.

Table 14. Water Analysis Data for Outfall CO090

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
CO090	5/18/16	Flowing	0.8	0.01	0.5	232	Positive	Clear, strong wastewater odor

Figure 5. Septic tank overflow at top of streambank

Findings:

- Optical brightener was detected at the outfall (strong fluorescence) in May 2016. Concentrations of ammonia and MBAS detergent were also elevated.
- A gray growth and black film were seen at the outfall and on the ground surface (Figure 5), and a strong wastewater odor was observed.
- On July 26, 2016, samples were collected for *E. coli* and TN analysis (Table 30). No *E. coli* was detected. The TN concentration (110 mg/L) was extremely high. Unfortunately, no flow measurement was possible.
- The DEC Regional Engineer, Richard Wilson, visited the site on August 11, 2016 and determined that the outfall was a septic tank overflow pipe from the 356 Main Street apartment house.

Conclusion: This discharge was confirmed to be an overflow pipe from a septic tank serving the apartment house at 356 Main Street. The absence of *E. coli* likely resulted from an inimical condition in the septic tank or in the sample container that caused the *E. coli* to die off. Clearly, this discharge consisted of septic tank effluent, and was therefore, highly polluted.

Resolution: According to Mr. Wilson, the owner of 356 Main Street contracted with an engineering firm to design a new onsite wastewater treatment system for the property. In November 2016, the septic tank overflow pipe was eliminated, the tank was pumped, and a running toilet inside the building was repaired.

6.6. CO100

CO100 is a 4-inch diameter PVC pipe discharging at the top of the riverbank behind 356 Main Street (Appendix D, Map 7). This outfall is farther from the bridge than outfall CO090. There are no mapped inlets to this system. Water quality data for this system are presented in Table 15.

Table 15. Water Analysis Data for Outfall CO100

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
CO100	5/18/16	Flowing	0.0	0.04	0.1	456	Positive	Clear, no odor

Findings:

- Optical brightener was detected at the outfall on May 18, 2016. The fluorescence was strong.
- On July 26, 2016, samples were collected for *E. coli* and TN analysis. The *E. coli* concentration was 122 MPN/100 mL, a level that is below water quality standards, although not insignificant.
- The DEC Regional Engineer, Richard Wilson, met with the property owner and determined that the source of the water at outfall CO100 is an overflowing water tank in the basement of the building. This tank is continuously filled by the community spring, previously mentioned by Concord Select Board chair George Morehouse (see description of CO015 system).

Conclusion: Detection of optical brightener and *E. coli* at this overflow point on the community spring water supply requires further examination to determine whether wastewater may be infiltrating the community spring or the piping system from the spring.

Resolution: Investigation of the use and safety of this water source is outside the scope of this project.

7. Danville Results

Illicit discharge detection was performed in Danville in October 2015. Of the 19 systems assessed, nine were either flowing or dripping during dry weather. Results of the initial assessment in Danville are included in Appendix C, Table 5. Three systems were designated for further investigation due to detection of free chlorine, ammonia, and/or MBAS. These investigations are described below.

7.1. DV040

The DV040 system drains the Danville High School property into a stream southeast of the school. Water quality data for this system are presented in Table 16.

Table 16. Water Analysis Data for Outfall DV040

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
DV040	10/22/15	Flowing	0.5	0.10	0.0	71.3	Negative	Clear, no odor

Findings:

- Low concentrations of ammonia (0.5 mg/L) and free chlorine (0.10 mg/L) were measured at the outfall on October 22, 2015.
- The outfall and the next catchbasin up the line were dry when revisited on June 2, 2016

Conclusion: The low concentrations of contaminants detected on the initial assessment date (October 22, 2015) were likely from a transient source. The system was entirely dry when revisited on June 2, 2016. Therefore, we have concluded that no chronic illicit discharge is present in this system.

Resolution: Not applicable.

7.2. DV055

The DV055 system drains a portion of Hill Street and discharges at a cross culvert under Grand View Avenue. Water quality data for this system are presented in Table 17.

Table 17. Water Analysis Data for Outfall for Outfall DV055

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
DV055	10/22/15	Flowing	0.25	0.12	0.1	1170	Negative	Clear, no odor
DV055	6/2/16	Trickle	0.0	0.03	0.10	1014	--	Clear, no odor

Findings:

- Low concentrations of ammonia (0.25 mg/L) and free chlorine (0.12 mg/L) were measured at the outfall on October 22, 2015.
- No contaminants were detected above levels of concern in samples collected on June 2, 2016.

Conclusion: The low concentrations of ammonia and chlorine detected on the initial assessment date (October 22, 2015) were likely from a transient source. No contaminants were detected when the outfall was resampled on June 2, 2016. Therefore, we have concluded that no chronic illicit discharge is present in this system.

Resolution: Not applicable.

7.3. DV140

The DV140 system drains Route 2 through Danville, as well as Park Street, Smith Street, and a portion of Peacham Road. The system discharges to a large stormwater pond east of the village, south of Route 2. Water quality data for this system are presented in Table 18.

Table 18. Water Analysis Data for Outfall DV140

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
DV140	10/22/15	Flowing	0.0	0.44	0.25	1540	Negative	Clear, no odor
	6/2/16	Flowing	0.0	0.00	0.1	1479	--	Clear, no odor

Findings:

- Chlorine and a low concentration of ammonia were measured at the outfall on October 22, 2015.
- There was no indication of any type of contamination when the outfall was revisited on June 2, 2016.

Conclusion: Contaminants detected on the initial assessment date (October 22, 2015) were likely from a transient source. No contaminants were detected when the system was revisited on June 2, 2016. Therefore, we have concluded that no chronic illicit discharge is present in this system.

Resolution: Not applicable.

8. East St. Johnsbury Results

Illicit discharge detection was performed in East St. Johnsbury in September 2015. Of the five systems assessed, only one was flowing during dry weather. Results of the initial assessment in East St. Johnsbury are included in Appendix C, Table 6. No contaminants were detected above levels of concern; therefore, no systems were designated for further investigation.

9. Fairlee Results

Illicit discharge detection was performed in Fairlee in July and August of 2015. None of the four systems assessed were flowing during dry weather. Results of the initial assessments in Fairlee are included in Appendix C, Table 7. No contaminants were detected above levels of concern; therefore, no systems were designated for further investigation.

10. Gilman Results

Illicit discharge detection was performed in Gilman in September 2015. Of the nine systems assessed, seven were flowing during dry weather. Results of the initial assessment in Gilman are included in Appendix C, Table 8. Optical brightener was detected in four systems: GI020, GI060, GI070, and GI090. However, only one system, outfall GI020, required further investigation. The GI090 system was determined to be downstream of the outfall of Gilman's wastewater treatment plant; therefore, after some reconnaissance, it was disregarded. The GI070 outfall was re-sampled on May 19, 2016 and pads were deployed throughout the system; however, no contaminants were detected above levels of concern. The GI060 system is downstream of the GI020 system, which was clearly contaminated. There did not appear to be any dry weather flow entering the GI060 system via structures downstream of GI020, so only the GI020 system was designated for further investigation. The status of this investigation is described in detail below.

10.1. GI020

The GI020 system drains a portion of Commercial Avenue and Jefferson Avenue (Appendix D, Map 8). Note that the old sewer on Jefferson Avenue that was repurposed as a stormdrain when the new sewer main was installed is not shown in Map 8. The GI020 system discharges south of Commercial Avenue, into a small stream that flows through a culvert under the railroad tracks, before flowing into the GI060 system on River Road and subsequently discharging to the Connecticut River. Water quality data for this system are presented in Table 19.

Table 19. Water Analysis Data for Outfall GI020

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
GI020	9/18/15	Flowing	0.4	0.00	0.1	5430	Positive	Clear, no odor
	5/19/16	Flowing	0.0	0.02	0.0	265	Positive	Clear, no odor

Figure 6. Displaced coupling on house sewer lateral on Jefferson Avenue in Gilman

Findings:

- A low concentration of ammonia was detected at the outfall on the initial assessment date, September 18, 2015.
- Optical brightener was detected in a path from manhole MH4 to the outfall: MH4 (pipe A and pipes C/D), MH3 (sump and pipe A), MH2, MH1 (sump and pipe A), and the outfall.
- Optical brightener was not detected in any structures north of MH4 (catchbasin CB1 or the culvert inlet).
- The *E. coli* level measured at the outfall on July 26, 2016 (1,421 MPN/100 mL) was substantially elevated (Table 30).
- Between September and November 2016, a great deal of investigative work was performed on Jefferson Avenue to determine the source of wastewater entering the stormwater system. A push camera was used to inspect sanitary and stormwater mains and house laterals. Toilets and floor drains in several homes were dye tested. Both the sanitary sewer and the storm sewer (the old sewer repurposed as a storm drain) were smoke-tested repeatedly. Wayne Graham of Vermont Rural Water Association and Buddy Ball with the Lunenburg Fire District provided valuable assistance in these investigations.
- Camera inspection of the old sewer, repurposed as a stormdrain, revealed the old house laterals branching off from the sewer main. Water was flowing in these laterals and they appeared intact. When the new sanitary sewer was installed, it appears that the contractor left in place the old house laterals and failed to seal the sections of the sewer laterals still connected to the repurposed old sewer. These branching laterals seem to provide a conduit for wastewater leaking from current house laterals directly to the stormdrain.
- At least two houses on Jefferson Avenue, #40 and #50, have leaking sewer laterals. Dye flushed down the toilet or poured into the floor drain in these houses passed quickly into the sanitary sewer. After a significant delay (~15 minutes), the dye appeared in the stormdrain. Because the dye did not pass from the sanitary main to the stormdrain, the leaks must be in the laterals. Figure 6 shows a misaligned joint in the sewer lateral serving #40 Jefferson Avenue.
- Based on the results of smoke testing, we suspect that #56 Jefferson Avenue may also have a leaking sewer lateral, but we were unable to access the house to confirm this with a dye test. With the smoke blower set up over stormdrain manhole MH4, the sewer lateral serving #56 was seen venting smoke into the sanitary sewer main. The likely explanation for this is that smoke from the stormdrain passed into the sewer lateral through gaps in the pipe before venting into the sanitary main.
- Two additional houses that could potentially have faulty sewer laterals include #53 and #45 Jefferson Avenue. #45 Jefferson Avenue has been unoccupied for three years, so it could not be dye

tested. At the time of these investigations, #53 Jefferson Avenue had no water service and could not be dye tested. The pipe laterals formerly connecting these houses to the repurposed old sewer likely still exist, potentially providing a conduit for leaking wastewater to enter the stormdrain.

Conclusion: Two houses, #40 and #50 Jefferson Avenue, were confirmed to have sewer laterals that leak wastewater into the stormdrain. We expect the same problem exists at #56 Jefferson Avenue, but we were unable to confirm this. Two other houses with potentially faulty (leaking) sewer connections are #53 and #45 Jefferson Avenue; however, neither house could be tested. We believe that the remaining houses on Jefferson Avenue do not have a problem. The sewer main on Jefferson Avenue appears to be in good condition.

Resolution: Between two and five houses on Jefferson Avenue have faulty sewer laterals. Laterals at two of these houses (#40 and #50) were confirmed to leak wastewater into the old, repurposed sewer. One approach for eliminating the discharge is to compel or enable the homeowners to replace their leaking laterals. The three houses with uncertain sewer connections (#56, #53, and #45) should also be dye tested when possible to identify whether any of them are contributing wastewater to the stormdrain. This approach would likely be time consuming for the Town of Lunenburg (or alternatively, DEC) and expensive for the homeowners.

An alternate approach for eliminating the discharge is to plug the old, repurposed sewer line on Jefferson Avenue. There are currently no functional surface inlets to this old sewer line; it does not appear to convey stormwater at all. The old system represents a maintenance liability for the Town of Lunenburg. We expect that if the drain was plugged, wastewater leaks in the laterals would slow, and without a conduit, the town could eliminate wastewater discharges to surface waters.

Plugging the old sewer line on Jefferson Avenue was discussed in a meeting in Gilman on January 10, 2017, where the following people were present:

- Amos Colby, Chair, Lunenburg Select Board
- Don Hallee, Chair, Prudential Committee
- Buddy Ball, Operations Supervisor, Lunenburg Fire District #2
- Richard Dresser, Chief Operator, Lunenburg Fire District #2
- Wayne Graham, Vermont Rural Water Association
- Jim Pease, Vermont DEC
- Dave Braun, Stone Environmental

Attendees discussed a plan to insert inflatable plugs (“Muni-Balls”) in the old sewer in the spring of 2017 and leave them in place for long enough to properly assess whether plugging the line will have any negative consequences. In all of the houses we checked, basement drains were connected to the sanitary system, so we do not expect any basement flooding. If no drainage problems develop over this time, the inflatable plugs will be removed and permanent concrete plugs will be poured in their place. Manhole structures could then be backfilled with stone to prevent collapse. The location of the plugs should be in the incoming lines to manhole MH4 if a dye test at #56 Jefferson Avenue indicates a leaking lateral. However, if #56 Jefferson Avenue does not have a leaking lateral, the plugs could be installed in the next manhole up the line (which may be preferable).

Jim Pease of Vermont DEC confirmed that DEC was amenable to eliminating the wastewater problems on Jefferson Avenue by plugging the non-functioning stormdrain. Mr. Colby, representing the Select Board, and Mr. Hallee, representing the Fire District, appeared to endorse this plan.

11. Glover Results

Illicit discharge detection was performed in Glover in November 2015. Of the nine systems assessed, three were flowing during dry weather. Results of the initial assessment in Glover are included in Appendix C, Table 9. One system (GL040) was designated for further investigation due to detection of free chlorine above 0.10 mg/L. The status of this investigation is described below.

11.1. GL040

The GL040 system drains a portion of Glover Street, First Place, and Lilac Lane, and discharges northwest of the intersection of Glover Street and Bean Hill Road. Water quality data for this system are presented in Table 20.

Table 20. Water Analysis Data for Outfall GL040

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
GL040	11/3/15	Flowing	0.0	0.16	0.0	336	Negative	Clear, no odor
	6/22/16	Trickling	0.0	0.06	0.1	374	--	Clear, no odor
	7/20/16	Dripping	0.0	0.02	0.1	380	--	Clear, no odor

Findings:

- A sample collected at the outfall on November 3, 2015 had an elevated free chlorine concentration (0.16 mg/L). A sample collected on June 22, 2016 had a lower, but still measureable, chlorine concentration.
- On July 20, 2016, samples were taken from all flowing structures in the stormwater system. Chlorine was below detection in every structure, including the outfall. The scientist in the field noted that it was difficult to obtain a clean sample at the outfall. Excessive turbidity in the sample may have resulted in inaccurate chlorine measurements on earlier sampling dates.

Conclusion: Repeated sampling demonstrated that there is no chronic illicit discharge in this system.

Resolution: Not applicable.

12. Groton Results

Illicit discharge detection was performed in Groton in October 2015. Of the 14 systems assessed, seven were flowing during dry weather. Results of the initial assessment in Groton are included in Appendix C, Table 10. One system (GR040) was designated for further investigation due to detection of optical brightener. The status of this investigation is described in detail below.

12.1. GR040

The GR040 system drains a portion of Route 302/Scott Highway (Appendix D, Map 9) and discharges south of Route 302, east of its intersection with Powder Spring Road. Water quality data for this system are presented in Table 21.

Table 21. Water Analysis Data for Outfall GR040

Structure ID	Date Assessed	Dry, Wet/ no flow, Dripping, Flowing?	Ammonia (mg/L)	Free Chlorine (mg/L)	MBAS (mg/L)	Specific Conductance (µs/cm)	OB Result	Observations
GR040	6/15/16	Flowing	0.0	0.02	0.0	240	Positive	clear, no odor
GR040-CB13	6/15/16	Flowing	0.25	0.01	0.1	218	Negative	clear, no odor

Figure 7. Drainage structure behind 1426 Route 302 in Groton

Findings:

- The initial assessment of the GR040 system occurred on October 22, 2015. The outfall was not found during this visit. Ammonia (0.3 mg/L), optical brightener, and a slight septic odor were detected in a catchbasin on Route 302. We assume this catchbasin was the nearest accessible catchbasin to the outfall. However, the specific structure sampled is unclear.
- Optical brightener monitoring pads were deployed throughout the GR040 system on June 15, 2016. Optical brightener was detected in five of the 16 structures. The structures in which OB was detected (CB12, CB11, CB10, CB5, and the outfall) form a consistent path from catchbasin CB12 to the outfall. A definite wastewater odor was observed in CB12.
- In October 2016, additional pads were deployed in catchbasin CB12 and in the next upstream structure, depicted in Figure 7. This drainage structure is located at the end of the

driveway at 1426 Route 302 and collects water draining from a wetland area that is conveyed to a pipe under the driveway. Optical brightener was found in both CB12 and in the drainage structure. A pronounced wastewater odor was present in catchbasin CB12 when the pads were retrieved on October 23, 2016.

- In November 2016, the Groton Town Health Officer, Dan Webster, reported that he found a structure in the wetland area north of the house at 1448 Route 302 that he suspected was the source of the wastewater contamination in GR040. This wetland area is immediately east of the fire department building. Mr. Webster suspected that the structure he found is some type of wastewater seepage pit. A small stream was flowing over the top of the structure and the structure was releasing a discolored effluent. Mr. Webster also noted that the structure was not owned by the Groton Fire Department.
- The Regional Engineer, Richard Wilson, was immediately contacted about this finding and he agreed to visit the site. However, he was unable to find the structure. Mr. Wilson is now planning to inspect the structure together with Mr. Webster in the early spring of 2017.

Conclusion: The most likely source of wastewater contamination in this system is a malfunctioning (apparently inundated) wastewater structure at 1448 Route 302.

Resolution: The Regional Engineer, Richard Wilson, and the Town Health Officer, Dan Webster, plan to inspect the wastewater system at 1448 Route 302 in the spring of 2017 and assist the property owner as needed.

13. Lunenburg Results

Illicit discharge detection was performed in Lunenburg in October 2015. Of the four systems assessed, two were flowing during dry weather. Results of the initial assessment in Lunenburg are included in Appendix C, Table 11. Two systems were designated for further investigation due wastewater odors and ammonia. One system (LU040) was designated due to detection of free chlorine at 0.10 mg/L. The status of these investigations is described below.

13.1. LU010

The LU010 system drains a portion of Route 2/West Main Street (Appendix D, Map 10) and discharges south of the bridge spanning Neal Brook. Water quality data for this system are presented in Table 22.

Table 22. Water Analysis Data for Outfall LU010

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
LU010	10/7/15	Flowing	0.1	0.13	0.1	6,800	Negative	Clear, no odor
	5/19/16	Flowing	0.25	0.00	0.1	510	Negative	Clear, septic odor, suds
	10/7/16	Flowing	0.1	0.02	0.1	728	--	

Findings:

- There was little consistent evidence of contamination in this system across multiple sampling dates. While a slight wastewater odor was observed on May 19 and July 26, 2016, no optical brightener was detected and the *E. coli* (41 MPN/100 mL) and TN concentrations at the outfall were low (Table 30).
- At a January 10, 2017 meeting, the chair of the Lunenburg Select Board, Amos Colby, mentioned a concern regarding recent activities at a house at 190 W. Main Street in Lunenburg (Appendix D, Map 10). Mr. Colby suspects this house may have a seepage pit and that effluent from this pit may recently have been piped directly to nearby Neal Brook. While this concern has not been substantiated, it warrants investigation. If accurate, the discharge would not affect the LU010 system, but it could pose a threat to water quality and public health.

Conclusion: It is possible that diluted, partially renovated septic system effluent infiltrates the LU010 stormline. If this is the case, however, the degree of contamination is sufficiently minor that we lack a wastewater indicator capable of bracketing the source(s).

Resolution: The water quality data collected in the LU010 system do not indicate that significant wastewater contamination is present. We do not believe further investigation of the LU010 system is warranted at this time.

Based on a concern expressed by the Town of Lunenburg Select Board chair Amos Colby regarding a possible direct discharge from the house at 190 W. Main Street to Neal Brook, Stone contacted the DEC Regional Engineer, Richard Wilson, to recommend inspection of the property. Mr. Wilson indicated he would inspect the property's wastewater system in the spring of 2017. This house is proximate to the LU010 system; however, any direct discharge to Neal Brook (were it to exist) would not impact LU010.

13.2. LU020

The LU020 system drains a portion of Route 2/W. Main Street (Appendix D, Map 11) and discharges north of the bridge spanning Neal Brook. Water quality data for this system are presented in Table 23.

Table 23. Water Analysis Data for Outfall LU020

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
LU020	10/7/15	Flowing	0.0	0.12	0.1	4360	Negative	Clear, septic odor
	5/19/16	Flowing	1.0	0.01	0.2	877	--	Clear, slight odor,
	7/26/16	Flowing	--	--	--	--	--	Clear, strong wastewater odor
LU020-CB1	7/20/16	--	0.5	0.01	0.0	741	--	--

Findings:

- A septic odor was noted when the LU020 outfall was first sampled on October 7, 2015. However, the concentrations of ammonia and MBAS were below detection and optical brightener was not present.
- Ammonia was detected in the system on May 19 and July 20, 2016 and wastewater odors were observed on both dates. Wastewater odor and flow were observed as far uphill as catchbasin CB16. CB19 was not flowing.
- Samples were collected for *E. coli* and TN analysis on July 26, 2016. The *E. coli* concentration at the outfall was elevated, 691 MPN/100 mL, which strongly suggests a wastewater contribution.
- On August 11, 2016, Wayne Graham of the Vermont Rural Water Association inspected the drainage system using a tracked camera. In catchbasin CB19 (at the corner of the driveway to 60 W. Main St.), purple sudsy water was present in the basin. There was no flow in the basin. Approximately 10–feet upstream of CB19 the camera was stopped by bricks in the line.
- The chair of the Town of Lunenburg Select Board, Amos Colby, mentioned a history of problems with the septic system at 46 W. Main Street. This is the former Board of Trade building and it now houses two apartments on a small lot. The owners are reportedly Marvin and Jennifer Allen. The septic system is believed to lie in the small space between the building and W. Main Street. Mr. Colby indicated that he may have observed surfacing wastewater on this property as recently as the spring or summer of 2016.

Conclusion: The most likely source of wastewater entering the LU020 system is by interception of poorly treated or surfacing wastewater from the apparently substandard system at 46 W. Main Street. However, another possibility is that poorly treated wastewater enters the stormdrain from 60 W. Main Street, possibly in the vicinity of the bricks in the pipe.

Resolution: Stone contacted the Regional Engineer, Richard Wilson, to recommend inspection of the septic systems at both 46 and 60 W. Main Street during spring conditions to identify any surfacing wastewater or other malfunctions. Mr. Wilson indicated he would contact the property owners in the spring of 2017 to request permission to perform inspections.

13.3. LU040

The LU040 system drains a portion of Route 2 and discharges on the north side of Route 2, east of the town center. Water quality data for this system are presented in Table 24.

Table 24. Water Analysis Data for Outfall for Outfall LU040

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
LU040	10/7/15	Wet, no flow	0.1	0.10	0.0	4450	Negative	Clear, no odor
	5/19/16	Wet, no flow	0.0	0.02	0.0	529	Negative	Clear, no odor

Findings:

- Chlorine detected at the outfall on October 7, 2015 did not reoccur upon repeated sampling.
- An entry error was made, incorrectly assigning a positive optical brightener result at the outfall on October 7, 2015. On May 19, 2016, monitoring pads were placed throughout the LU040 system and no optical brightener was detected. It appears the initial positive result was in error.

Conclusion: Repeated sampling demonstrated that there is no chronic illicit discharge in this system.

Resolution: Not applicable.

14. Lyndon Results

Illicit discharge detection was performed in Lyndon between August-October of 2015. Of the 62 systems assessed, 14 were either flowing or dripping during dry weather. Results of the initial assessment in Lyndon are included in Appendix C, Table 12. One system (LY050) was designated for further investigation due to detection of optical brightener. Two systems were designated for further investigation due to detection of free chlorine above 0.10 mg/L. Two other systems were designated due to elevated levels of ammonia and MBAS. The status of these investigations is described in detail below.

14.1. LY050

The LY050 system drains a portion of Main Street, Grove Street, and Church Street (Appendix D, Map 12) and discharges north of Powers Park. The outfall is fully obstructed, buried beneath sediment. Water quality data for this system are presented in Table 25.

Table 25. Water Analysis Data for Outfall LY050

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
LY050	8/13/15	Wet, no flow	--	--	--	--	--	Clear, no odor
	6/2/16	Dry	--	--	--	--	Negative	Clear, no odor
LY050-CB5	8/13/15	Wet, no flow	--	--	--	--	Positive (weak)	--
	6/2/16	--	--	--	--	--	Negative	--

Findings:

- Assessment of system LY050 was difficult because the outfall is fully obstructed and most of the connected catchbasins are off-line. There was no apparent flow at the outfall when the system was initially assessed on August 13, 2015 and again when it was reassessed on June 2, 2016.
- Optical brightener was detected in catchbasin CB5 on Church Street in August 2015, although fluorescence was weak.
- Due to detection of optical brightener at catchbasin CB5, monitoring pads were placed in multiple structure in June 2016 (CB5, CB2, CB1, and the outfall). No optical brightener was detected in any structure and there was no indication of wastewater contamination in the system.

Conclusion: The initial detection of optical brightener in catchbasin CB5 was weak and it was not detected when the structure was retested. There was no other indication of potential wastewater contamination in this system. Therefore, we have concluded that no chronic illicit discharge is present in this system.

Resolution: Not applicable.

14.2. LY150

The LY150 system drains the receiving and storage area behind the True Value Lyndonville Hardware store, located at 583 Broad Street and discharges into a drainage swale behind the store. Water quality data for this system are presented in Table 26.

Table 26. Water Analysis Data for Outfall LY150

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
LY150	8/28/15	Dry	--	--	--	---	--	Sheen on swale
	6/2/16	Wet, no flow	0.0	0.06	0.1	528	--	No odor, no sheen

Figure 8. Batteries and waste oil in lot behind True Value Hardware

Findings:

- On August 28, 2015, a petroleum sheen was observed below the outfall in a drainage swale behind the True Value Lyndonville Hardware store.
- There was no sheen when the outfall was revisited on June 2, 2016; however, a collection of waste oil pans and batteries was observed behind the store (Figure 8). Stains on the pavement indicated that waste oil had at times washed down from these materials into a drain at the bottom of a loading ramp. This drain appears connected to the outfall.
- The store manager was notified immediately of this problem.

Conclusion: Small quantities of waste oil apparently washed from a collection of oil pans and batteries (depicted in Figure 8) into the swale behind the hardware store.

Resolution: In a subsequent conversation, the store manager, Lori Steward, stated that the materials in question had been moved and no similar materials were being stored outside uncovered. On August 6, 2016, a letter was sent to the owner of the True Value Lyndonville Hardware store, Bradley Gebby, documenting our observations and our understanding of the changes the store had made in storage of these materials.

14.3. LY390

The LY390 system drains a parking area at the athletic facilities at Lyndon State College (Appendix D, Map 13) and discharges to a pond. Water quality data for this system are presented in Table 27.

Table 27. Water Analysis Data for Outfall LY390

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
LY390	9/25/15	Wet, no flow	0.5	0.87	0.1	18	Negative	Iron floc
	6/2/16	Flowing	0.2	0.01	0.1	911	--	Iron staining and petroleum sheen

Findings:

- On September 25, 2015, iron floc was observed at the outfall of system LY390. Chlorine and ammonia were also detected. It is likely that the high chlorine concentration measured resulted from chemical interference or poor sample quality.
- On June 2, 2016, iron staining and a petroleum sheen were observed at the outfall. A faint petroleum odor was observed in catchbasin CB1. Chlorine and ammonia concentrations were below the limits of detection.
- The Agency of Natural Resource's Natural Resources Atlas identifies two hazardous waste sites in the vicinity of the LY390 system. At a location in the parking lot drained by the LY390 system, a 15,000 gallon #2 fuel oil underground storage tank was removed in 2007. 60 cubic yards of soil were removed and no impact to groundwater was reported. This site is #2006-3600. A second petroleum release also occurred near the facility (site #900-489). This site was closed in 2015. An oil sheen was also reported on the pond in 1990.

Conclusion: We suspect that groundwater contaminated by degraded petroleum products resulting from documented releases in this area of Lyndon State College infiltrates the LY390 system.

Resolution: Not applicable.

15. Newbury Results

Illicit discharge detection was performed in Newbury in October 2015. Results of the initial assessment in Newbury are included in Appendix C, Table 13. Only one system was assessed, which was flowing during dry weather. No contaminants were detected above levels of concern; therefore, no systems were designated for further investigation.

16. Norwich Results

Illicit discharge detection was performed in Norwich in October 2015. Of the 24 systems assessed, seven were either flowing or dripping during dry weather. Results of the initial assessment in Norwich are included in Appendix C, Table 14. One system was designated for further investigation due to the detection of optical brightener (NO073), while a second system was designated due to the detection of ammonia (NO198). The status of these investigations is described below.

16.1. NO073

The NO073 outfall is a corroded metal pipe which protrudes at an acute angle from the road bank below Church Street. The system was not mapped correctly; a revised map is included as Appendix D, Map 14. We do not believe there are any connected inlets to this pipe. Water quality data for this system are presented in Table 28.

Table 28. Water Analysis Data for Outfall NO073

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
NO073	11/23/15	Trickling	0.0	0.07	0.05	974	Positive	Clear, no odor

Findings:

- Optical brightener was detected at the outfall in November 2015 and again in June 2016.
- A trickle of flow was sampled at this outfall on November 23, 2015. On numerous subsequent dates (6/16/16, 9/30/16, 10/9/16, and others) the outfall was dry or the flow was insufficient to sample. Any flow from the pipe has appeared clear, with no odor.
- *E. coli* samples were not collected because there was no flow on either sampling date, September 30 or October 9, 2016.

Conclusion: Because there are no apparent inlets to this corroded steel pipe, and given the odd angle it protrudes from the bank, we suspect that it is a relict pipe which intercepts shallow groundwater. The repeated detection of optical brightener in this pipe may indicate that the intercepted groundwater contains partially renovated effluent from septic systems on the opposite side of Church Street.

Resolution: Since there does not appear to be a direct wastewater connection to this pipe and no septic system in the vicinity is surfacing, it would appear there is little recourse to address this discharge.

16.2. NO198

The NO198 system conveys a small stream across the property of the Marion Cross Elementary School. The mapping for this system was inaccurate; a revised map is included as Map 15 in Appendix D. There is one connected catchbasin on the school's property. Water quality data for this system are presented in Table 29.

Table 29. Water Analysis Data for Outfall NO198

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
NO198	6/16/16	Trickling	2.0	0.00	0.75	6290	Negative	Faint wastewater odor, iron staining

Findings:

- Moderate concentrations of ammonia and MBAS detergent were measured at the outfall on June 16, 2016. Optical brightener was not detected at the outfall. A faint wastewater odor and iron staining were also present.
- On multiple, subsequent dates there was no flow or odor at the outfall. *E. coli* samples were not collected because there was no flow on either sampling date, September 30 or October 9, 2016.

Conclusion: It is possible that under high groundwater conditions partially renovated effluent from the elementary school's septic system infiltrates the stormdrain and discharges at NO198.

Resolution: Since there does not appear to be a direct wastewater connection to this pipe and no septic system in the vicinity is surfacing, it would appear there is little recourse to address this discharge.

17. Ryegate Results

Illicit discharge detection was performed in Ryegate in September and October 2015. Of the nine systems assessed, two were flowing during dry weather. Results of the initial assessment in Ryegate are included in Appendix C, Table 15. No contaminants were detected above levels of concern; therefore, no systems were designated for further investigation.

18. Wells River Results

Illicit discharge detection was performed in Wells River in October 2015. Of the 11 systems assessed, only one was flowing during dry weather. Results of the initial assessment in Wells River are included Appendix C, Table 16. No contaminants were detected above levels of concern; therefore, no systems were designated for further investigation.

19. Nitrogen Loading and *E. coli* Concentrations

Samples were collected on July 26, 2016 for *E. coli* and total nitrogen analysis by VAEL. Where feasible, a discharge measurement was made immediately following sampling. Daily total nitrogen loads were calculated from the concentration and discharge data. These data are presented below (Table 30). Note that sample collection for *E. coli* and total nitrogen analyses was attempted at several other outfalls (BD220, GR040, NO073, and NO178), but was not possible because there was no flow on the sampling dates.

Table 30. E. coli and Total Nitrogen Data for Selected Drainage Systems

System	Date	*E. coli* (MPN/100 mL)	TN (mg/L)	Discharge (L/min)	TN loading (g/day)
CO015	7/26/16	10	0.1	0.12	1.0
CO040	7/26/16	31	3.4	0.30	88
CO060	7/26/16	20	0.2	0.008	0.14
CO080	7/26/16	20	1.7	0.007	1.0
CO090	7/26/16	<1	110	No est.	No est.
CO100	7/26/16	122	1.5	0.24	31
GI020	7/26/16	1421	2.2	0.11	21
LU010	7/26/16	41	1.5	0.019	2.5
LU020	7/26/16	691	2.2	0.28	53
LU040	7/26/16	10	1.0	No est.	No est.

E. coli data from the July 26, 2016 sampling date generally reinforce the interpretations made from earlier data and observations. Two of the sampling points with suspected sanitary wastewater contributions (GI020 and LU020) had elevated *E. coli* levels. We suspect the absence of *E. coli* at the CO090 outfall, a highly polluted discharge, was due to die off in the septic tank or in the sample container. The low level of *E. coli* at CO040 may have been due to dilution or to the dry summer conditions reducing the volume of surfacing effluent.

Total nitrogen concentrations were low to moderate (<4 mg/L) at all sampling points except CO090, where the concentration was very high (110 mg/L).

20. Conclusions

A thorough assessment was made of the stormwater drainage systems in 16 towns and villages in the Upper and Middle Connecticut River watersheds in Vermont. A total of 250 systems were assessed. Based on water quality data and our observations during the dry weather surveys, 25 systems were designated as requiring further investigation. Further investigation of these drainage systems confirmed nine illicit discharges. Plans are in place now to correct the majority of the wastewater illicit discharges discovered.

21. References

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

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.

Appendix A. Assessment Data Form

Upper and Middle Connecticut River Basin 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 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

1. 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.
2. 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

1. 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.
2. 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 KCI 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

1. *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.
2. *EPA* the U.S. Environmental Protection Agency.
3. *FIFRA* the Federal Insecticide, Fungicide, and Rodenticide Act as amended.
4. *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.
5. *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:

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.
2. Added instructions about cleaning and re-hydrating the probe to Section 3.1.
3. Added Section 9.0.
4. Reformatted.
5. Minor word editing.

Revision number 2:

1. Changed the title.
2. Removed sections 7.0 (Measurement) and 8.0 (Maintenance/Repairs).
3. Added section called (General and Annual Maintenance).
4. Minor editing.
5. Reformatted.

Revision number 3:

1. Minor wording edits in Section 1.0, Objective.
2. Updated style to match SEI Style Guide – font and text. Reformatted using MS Word
3. 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.
4. Deleted section on logs being given to the QAU.
5. 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

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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

1. 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.
2. 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

1. 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.
2. Care must always be taken when approaching a sampling location. Do not, under any circumstances, place yourself in danger to collect a sample.
3. 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

1. 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 Tables

Table 1: Bradford Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
BD010	BD010	11/4/15	J_S	Outfall pipe	36	corrugated black plastic	wet, no flow	na	partially submerged	na	none	none	none	none	na	na	na	na	na	
BD015	BD015	11/13/15	J_S	Outfall pipe	18	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD020	BD020	11/4/15	J_S	Outfall pipe	18	concrete	dry	na	free flow	na					na	na	na	na	na	Next catchbasin upstream was wet, no flow.
BD030	BD030	11/4/15	J_S	Outfall pipe	unknown	unknown	dry	na	unknown	na	none	none	none	fully obstructed	na	na	na	na	na	No evidence of outfall within detention basin.
BD040	BD040	11/4/15	J_S	Outfall pipe	14	corrugated black plastic	wet, no flow	na	free flow	na	none	sediment	none	partially obstructed	na	na	na	na	na	
BD050	BD050	11/4/15	J_S	Outfall pipe	8	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Downstream swale is being filled with brush, logs, and tires.
BD060	BD060	11/4/15	J_S	Outfall pipe	unknown	unknown	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Next catchbasin upstream is wet, no flow. No evidence of outfall.
BD070	BD070	11/4/15	J_S	Outfall pipe	12	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD075	BD075	11/4/15	J_S	Outfall pipe	12	corrugated black plastic	dry	na	free flow	na	none	sediment	none	partially obstructed	na	na	na	na	na	
BD080	BD080	11/4/15	J_S	Outfall pipe	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	System has not been installed.
BD090	BD090	11/4/15	J_S	Outfall pipe	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	System has not been installed.
BD100	BD100	11/4/15	J_S	Outfall pipe	15	corrugated black plastic	dry	na	free flow	na	none	sediment	none	none	na	na	na	na	na	
BD110	BD110	11/4/15	J_S	Outfall pipe	36	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Next upstream catchbasin is wet, no flow.
BD120	BD120	11/4/15	J_S	Outfall pipe	15	corrugated black plastic	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.05	0.10	760	
BD123	BD123	11/4/15	J_S	Outfall pipe	6	smooth plastic	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.08	0.25	1550	Flow changed by a factor of 4 during inspection; sample collected during high flow.
BD123	BD123	6/15/16	DTC																	Could not locate outfall, only BD120 is visible; no other flow visible.
BD125	BD125	11/4/15	J_S	Outfall pipe	12	corrugated black plastic	trickling	na	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.05	0.10	700	
BD128	BD128	11/4/15	J_S	Outfall pipe	4	smooth plastic	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.05	0.10	925	
BD130	BD130	11/4/15	J_S	Outfall pipe	unknown	unknown	dry	na							na	na	na	na	na	Not found; no apparent outlet.
BD140	BD140	11/4/15	J_S	Outfall pipe	unknown	unknown	dry	na	free flow	na	none	none	none	fully obstructed	na	na	na	na	na	Not found; no apparent outlet; no flow observed on bank.
BD150	BD150	11/4/15	J_S	Outfall pipe	12	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.10	0.05	1107	A spring at base of slope feeds BD150-CB1.
BD150	BD150	6/15/16	DTC	Outfall pipe	12	corrugated metal	flowing	0.25	free flow	clear, no odor	none	none	none	none	na	0.00	0.04	0.00	1220	
BD160	BD160	11/4/15	J_S	Outfall pipe	20	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Next upstream catchbasin is wet, no flow.
BD170	BD170	11/4/15	J_S	Outfall pipe	12	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD180	BD180	11/4/15	J_S	Outfall pipe	48	corrugated metal	flowing	2	free flow	clear, no odor	none	none	none	none	Negative	0.10	0.08	0.00	392	Carries stream from upslope. Pad lost, reset 11/13/15
BD180	BD180	6/15/16	DTC	Outfall pipe	48	corrugated metal	flowing	1	free flow	clear, no odor	none	none	none	none	na	0.00	0.01	0.00	425	Road crew on site beginning repairs on the large culvert under the road.
BD190	BD190	11/4/15	J_S	Outfall pipe	24	concrete	dry	na	free flow	na	none	none	cracking	none	na	na	na	na	na	
BD195	BD195	11/4/15	J_S	Outfall pipe	8	iron	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD200	BD200	11/4/15	J_S	Outfall pipe	unknown	smooth plastic	dry	na	free flow	na	none	none	end of pipe lost	fully obstructed	na	na	na	na	na	Shards of large, white PVC pipe noted, but end buried in river bank.
BD210	BD210	11/4/15	J_S	Outfall pipe	12	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD220	BD220	11/4/15	J_S	Outfall pipe	24	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	Positive	0.00	0.08	0.10	800	
BD220	BD220	6/15/16	DTC	Outfall pipe	24	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	Positive	0.00	0.00	0.00	778	Padded the system extensively. See assessment sheet for details.
BD225	BD225	11/4/15	J_S	Outfall pipe	16	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.10	0.25	1443	
BD225	BD225	6/15/16	DTC	Outfall pipe	16	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	na	0.00	0.01	0.10	1245	
BD228	BD228	11/4/15	J_S	Outfall pipe	4	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD230	BD230	11/4/15	J_S	Outfall pipe	12	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	corrosion	none	Negative	0.25	0.09	0.15	1109	Next upstream catchbasin is wet, no flow, next above that is flowing.
BD230	BD230	6/15/16	DTC	Outfall pipe	12	corrugated metal	flowing	0.25	free flow	clear, no odor	none	none	corrosion	none	na	0.00	0.05	0.00	727	
BD240	BD240	11/4/15	J_S	Outfall pipe	21	corrugated black plastic	flowing	1	partially submerged	clear, no odor	none	none	none	none	Negative	0.25	0.11	0.00	765	
BD240	BD240	6/15/16	DTC	Outfall pipe	21	corrugated black plastic	flowing	0.5	partially submerged	clear, no odor	none	none	none	none	na	0.10	0.02	0.00	996	Pipe is partially surcharged by wetland it discharges into.
BD245	BD245	11/4/15	J_S	Outfall pipe	18	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Next two upstream catchbasins are dry.
BD250	BD250	11/4/15	J_S	Outfall pipe	18	concrete	dripping	na	free flow	clear, no odor	none	none	cracking	none	na	na	na	na	na	Bottom of pipe is gone.
BD260	BD260	11/4/15	J_S	Outfall pipe	18	concrete	dry	na	free flow	na	none	none	cracking	none	na	na	na	na	na	Bottom of pipe is gone.
BD270	BD270	11/4/15	J_S	Outfall pipe	18	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD280	BD280	11/4/15	J_S	Outfall pipe	18	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD290	BD290	11/4/15	J_S	Outfall pipe	18	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD295	BD295	11/4/15	J_S	Outfall pipe	unknown	unknown	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Buried beneath hay bales, inside a locked fence. No flow below pipe, basin dry.
BD300	BD300	11/4/15	J_S	Outfall pipe	24	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
BD310	BD310	11/4/15	J_S	Outfall pipe	15	corrugated metal	dry	na	free flow	na	none	sediment	none	partially obstructed	na	na	na	na	na	

Table 2: Burke Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
BU010	BU010	8/27/15	J_S		Outfall pipe	8	corrugated black plastic	trickling	na	free flow	clear, no odor	none	none	none	none	na	na	na	na	na	Flow is flow stream at head.
BU020	CB3	8/27/15	J_S		Catchbasin	na	na	wet, no flow	na	na	clear, no odor	none	none	none	none	na	na	na	na	na	System under construction; observed at last available point.
BU030	BU030	8/27/15	J_S		Outfall pipe	12	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Newly constructed.
BU040	CB1	8/28/15	J_S		Outfall pipe	12	corrugated black plastic	trickling	na	free flow	clear, no odor	none	none	none	none	Negative	0.10	0.00	0.20	460	Sampled at CB1, rather than at outfall, to avoid surface water dilution. Not as depicted on map; building erected at basin.
BU050	BU050	8/27/15	J_S		Outfall pipe	12	corrugated metal	dry	na	free flow	na	none	sediment	none	none	na	na	na	na	na	
BU060	BU060	8/27/15	J_S		Outfall pipe	12	corrugated metal	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.10	0.00	0.00	516	Flow appears to be from headwater stream.
BU070	BU070	8/27/15	J_S		Outfall pipe	16	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Location different than depicted on plan. Two previous catchbasins wet, no flow.
BU080	BU080	8/27/15	J_S		Outfall pipe	unknown	unknown	wet, no flow	12	submerged	silty, no odor, stagnant	none	sediment	unknown	partially obstructed	Negative	0.25	0.60	0.75	171	Pool is about 1 ft above river level.
BU080	BU080	6/2/16	DTC	DCB	Outfall pipe	12 (est.)	corrugated metal	no flow	na	submerged	faint petroleum odor in pool	none	sediment	unknown	partially obstructed	na	0.10	0.21	0.50	248	Bubbles when shaken. CB1-CB5 dry, except dribble via main line (pipe b) to CB3. No visible inlets around Kingdom Trails.
BU090	BU090	8/27/15	J_S		Seep	na	na	trickling	1	submerged	clear, no odor, heavy iron floc	??	FeOH floc	none	none	na	0.25	0.32	0.10	562	Groundwater seep drained by a channel. Behind East Burke Garage.
BU090	BU090	6/2/16	DTC	DCB	Outfall pipe	4	corrugated black plastic	trickling	1	submerged	Heavy Fe floc/ sheen	??	FeOH floc	none	none	na	0.00	0.00	0.00	444	Flow bubbling from submerged outfall. No petroleum odor, but appears to drain garage. Several out of range Cl2 tests due to turbidity.
BU100	BU100	8/28/15	J_S		Outfall pipe	4	smooth plastic	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.00	0.00	555	Outfall appears to be the outlet of a foundation drain for the new building.

Table 3: Canaan Assessment Table

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (μs/cm)	Comments
CN010	CN010	10/12/15	J_S	Outfall	12	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Observed from outside perimeter fence. Basin is dry as well.
CN020	CN020	10/12/15	J_S	Outfall	12	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Observed from outside perimeter fence. Basin is dry as well.
CN030	CN030	10/12/15	J_S	Outfall	unknown	unknown	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Buried beneath riprap or the bank. No evidence of flow at location or next catchbasin upstream.
CN040	CN040	10/12/15	J_S	Outfall	unknown	unknown	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Buried beneath construction debris fill. No evidence of flow at location or next catchbasin upstream.
CN050	CN050	10/12/15	J_S	Outfall	18	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
CN060	CN060	10/12/15	J_S	Outfall	unknown	unknown	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Buried beneath yard waste. Inlet dry on east side of house; no apparent flow.
CN070	CN070	10/12/15	J_S	Outfall	12	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Previous 2 catchbasins wet, no flow.
CN080	CN080	10/12/15	J_S	Outfall	12	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
CN083	CN083	10/12/15	J_S	Outfall	4	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Apparent roof drain.
CN085	CN085	10/12/15	J_S	Outfall	4	smooth plastic	wet, no flow	na	free flow	na	none	none	crushed	none	na	na	na	na	na	Partly crushed by silver maple roots.
CN090	CN090-CB1	10/12/15	J_S	Outfall	12	corrugated metal	trickling		free flow	clear, no odor	none	none	disconnected	fully obstructed	Negative	0.10	0.41	0.0	2170	Outfall appears to have been behind restaurant. Sampled at next CB upstream at flowing side pipe.
CN090	CN090-CB1	7/20/16	DTC	Catchbasin	na	na	trickling	na	na	clear, no odor	none	none	na	na	na	0.10	0.02	0.0	281	Outfall was dry. Sampled CB1. Pipe A trickling in CB1.
CN100	CN100	10/12/15	J_S	Outfall	unknown	unknown	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Not found; previous catchbasin is dry.
CN110	CN110	10/12/15	J_S	Outfall	12	concrete	trickling	na	free flow	clear, no odor	suds	none	disconnected	none	Negative	0.25	0.17	0.0	3480	
CN110	CN110	7/20/16	DTC	Outfall	12	concrete	dripping	na	free flow	clear, no odor	none	none	disconnected	none	na	0.10	0.05	0.15	344	
CN120	CN120	10/12/15	J_S	Outfall	12	corrugated metal	dry	na	free flow	na	none	none	corrosion	none	na	na	na	na	na	Next catchbasin upstream is wet, no flow.
CN130	CN130	10/12/15	J_S	Outfall	15	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
CN140	CN140	10/12/15	J_S	Outfall	unknown	unknown	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Buried beneath recent fill and soil dumping. Previous catchbasin is dry.

Table 4: Concord Assessment Table

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
CO010	CO010-CB1	9/24/15	J_S		Catchbasin	na	na	wet, no flow	na	na	na	na	na	na	na	Negative	na	na	na	na	Outfall buried beneath channel bank, evaluated at next upstream catchbasin.
CO010	CO010	9/24/15	J_S		Outfall pipe	unknown	unknown	unknown	na	free flow	na	na	na	na	na	Negative	na	na	na	na	
CO010	CO010	5/18/16	DTC	DCB	Outfall pipe	16	corrugated metal	dry	na	buried	na	na	na	crushed	buried	na	na	na	na	na	Potentially found this pipe in the vicinity. Unclear.
CO015	CO015	9/24/15	J_S		Outfall pipe	4	smooth plastic	flowing	0.5	free flow	clear, no odor	none	none	none	none	P (strong), P (strong), P (strong)	0.00	0.00	0.00	563	Apparent foundation drain from Town Hall.
CO015	CO015	5/18/16	DTC	DCB	Outfall pipe	4	smooth plastic	flowing	0.5	free flow	clear, no odor	none	none	none	none	P (strong)	0.00	0.02	0.00	69	
CO020	CO020	9/24/15	J_S		Outfall pipe	18	corrugated metal	dry	na	free flow	na	na	na	na	na	na	na	na	na	na	
CO030	CO030	9/24/15	J_S		Outfall pipe	18	corrugated metal	dry	na	free flow	na	na	na	na	na	na	na	na	na	na	
CO040	CO040	9/24/15	J_S		Outfall pipe	24	corrugated metal	flowing	1	free flow	clear, no odor	none	none	none	none	Positive	0.00	0.00	0.15	3620	
CO040	CO040	5/18/16	DTC	DCB	Outfall pipe	24	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	Positive (most strong)	0.00	0.01	0.00	207 (?)	Padded upline structures. All positive, many strongly positive. See assessment sheet.
CO050	CO050	9/24/15	J_S		Outfall pipe	18	corrugated metal	dry	na	free flow	na	na	na	na	na	na	na	na	na	na	
CO060	CO060	9/24/15	J_S		Outfall pipe	18	corrugated metal	flowing	1	free flow	clear, no odor, FeOHx floc	none	iron staining	none	none	Negative	0.30	0.03	0.00	1690	
CO060	CO060	5/18/16	DTC	DCB	Outfall pipe	18	corrugated metal	flowing	1	free flow	clear, no odor, FeOHx floc	none	iron staining	none	none	positive (weak)	0.00	0.10	0.00	161	inlets to CB1-CB3 all clear/ no odor
CO070	CO070	9/24/15	J_S		Outfall pipe	24	concrete	flowing	1	free flow	clear, no odor	none	sediment	none	partially obstructed	Negative	0.05	0.10	0.05	2900	
CO070	CO070	5/18/16	DTC	DCB	Outfall pipe	24	concrete	flowing	1	free flow	clear, no odor	none	sediment	none	partially obstructed	Negative	0.00	0.02	0.00	364	
CO080	CO080	9/24/15	J_S		Outfall pipe	12	corrugated metal	trickling	na	free flow	clear, no odor	none	none	partly crushed	partially obstructed	Indeterminate	0.10	0.00	0.05	6650	
CO080	CO080	5/18/16	DTC	DCB	Outfall pipe	12	corrugated metal	trickling	na	free flow	clear, no odor	none	none	partly crushed	partially obstructed	positive (weak), Indeterminate, negative	0.00	0.03	0.00	549	Padded outfall, CB1-CB4. OB results: outfall = + (weak), CB1 = indeterminate, CB2-CB4 = neg.
CO090	CO090	5/18/16	DTC	DCB	Outfall pipe	4	smooth plastic	flowing	unknown	free flow	strong wastewater odor	none	gray growth	none	partially obstructed	positive (strong)	0.80	0.01	0.50	232	Was buried in bank, cleared outfall to expose pipe.
CO100	CO100	5/18/16	DTC	DCB	Outfall pipe	4	smooth plastic	trickling	na	free flow	clear, no odor	none	none	none	none	positive (strong)	0.00	0.04	0.10	456	

Table 5: Danville Assessment Table

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
DV010	DV010	10/22/15	J_S		Outfall pipe	unknown	unknown	dry	na	free flow	na	None	Sediment	None	partially obstructed	na	na	na	na	na	Outfall buried beneath channel bank, flows upward to get out.
DV020	DV020	10/22/15	J_S		Outfall pipe	18	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
DV030	DV030	10/22/15	J_S		Outfall pipe	18	corrugated black plastic	wet, no flow	na	free flow	na	None	Sediment	None	None	na	na	na	na	na	
DV040	DV040	10/22/15	J_S		Outfall pipe	18	corrugated metal	flowing	0.5	free flow	clear, no odor	None	None	None	None	Negative	0.50	0.10	0.00	71	Likely rainfall drainage.
DV040	DV040	6/2/16	DTC	DCB	Outfall pipe	18	corrugated metal	dry	na	free flow	clear, no odor	None	None	None	None	na	na	na	na	na	CB1 also dry.
DV045	DV045	10/22/15	J_S		Outfall pipe	24	corrugated black plastic	trickling	na	free flow	clear, no odor	None	Sediment	None	partially obstructed	Negative	0.00	0.25	0.00	343	75% sedimented in.
DV045	DV045	6/2/16	DTC	DCB	Outfall pipe	24	corrugated black plastic	trickling	na	free flow	clear, no odor	None	Sediment	None	partially obstructed	na	0.00	0.02	0.00	292	Pipe surcharged.
DV050	DV050	10/22/15	J_S		Outfall pipe	12	corrugated metal	dry	na	free flow	na	None	Sediment	None	partially obstructed	na	na	na	na	na	
DV055	DV055	10/22/15	J_S		Outfall pipe	unknown	unknown	flowing	1	free flow	clear, no odor	None	None	None	partially obstructed	Negative	0.25	0.12	0.10	1170	Buried beneath riprap.
DV055	DV055	6/2/16	DTC	DCB	Culvert	unknown	unknown	trickling	na	na	clear, no odor	none	none	na	na	na	0.00	0.03	0.10	1014	Couldn't locate outfall. Sampled from end of cross culvert.
DV060	DV060	10/22/15	J_S		Outfall pipe	30	corrugated black plastic	flowing	3	partially submerged	clear, no odor	None	None	None	None	Negative	0.10	0.09	0.10	486	
DV060	DV060	6/2/16	DTC	DCB	Outfall pipe	30	corrugated black plastic	flowing	substantial	partially submerged	clear, no odor	None	None	None	None	na	0.00	0.03	0.00	511	
DV070	DV070	10/22/15	J_S		Outfall pipe	unknown	unknown	dry	na	free flow	na	None	None	None	partially obstructed	na	na	na	na	na	Buried within bank.
DV080	DV080	10/22/15	J_S		Outfall pipe	15	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
DV090	DV090	10/22/15	J_S		Outfall pipe	24	corrugated black plastic	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
DV100	DV100	10/22/15	J_S		Outfall pipe	48	corrugated metal	flowing	6	partially submerged	clear, no odor	None	None	None	None	Negative	0.00	0.41	0.25	1690	Pad set at DV100-CB4, to avoid surcharge from stream.
DV100	DV100	6/2/16	DTC	DCB	Culvert	unknown	unknown	flowing	unknown	partially submerged	clear, no odor	None	None	None	None	na	0.00	0.03	0.00	564	Sampled at cross culvert outlet, appears to be the same flow JS sampled on 10/22/15. Storm drain crosses under this and discharges at DV140 (DV100=DV140)
DV110	DV110	10/22/15	J_S		Outfall pipe	18	corrugated black plastic	dry	na	free flow	na	None	Sediment	None	partially obstructed	na	na	na	na	na	Only the top inch of the outfall is exposed above accumulated sediment.
DV120	DV120	10/22/15	J_S		Outfall pipe	6	smooth plastic	flowing	0.5	free flow	clear, no odor	None	None	None	None	Negative	0.00	0.08	0.10	319	Two adjacent, 4-inch smooth green plastic pipes are dry.
DV120	DV120	6/2/16	DTC	DCB	Outfall pipe	6	smooth plastic	flowing	0.25	free flow	clear, no odor	None	None	None	None	na	0.00	0.00	0.00	292	
DV140	DV140	10/22/15	J_S		Outfall pipe	36	corrugated black plastic	wet, no flow	na	partially submerged	clear, no odor	None	None	None	None	Negative	0.00	0.44	0.25	1540	Sampled at next upstream manhole DV140-MH1.
DV140	DV140 MH1	6/2/16	DTC	DCB	Manhole	na	na	flowing	unknown	na	clear, no odor	None	None	None	None	na	0.00	0.00	0.10	1479	
DV150	DV150	10/22/15	J_S		Outfall pipe	32	corrugated metal	flowing	1	free flow	clear, no odor	None	None	None	None	Negative	0.00	0.08	0.20	1362	
DV150	DV150	6/2/16	DTC	DCB	Outfall pipe	32	corrugated metal	flowing	0.5	free flow	clear, no odor	None	None	None	None	na	0.00	0.05	0.10	1698	
DV160	DV160	10/22/15	J_S		Outfall pipe	10	smooth plastic	wet, no flow	na	partially submerged	clear, no odor	None	None	None	None	na	na	na	na	na	Former 18-inch corrugated metal pipe discarded nearby.
DV170	DV170	10/22/15	J_S		Outfall pipe	24	corrugated metal	dry	na	free flow	na	None	Sediment	None	partially obstructed	na	na	na	na	na	
DV180	DV180	10/22/15	J_S		Outfall pipe	unknown	unknown	flowing	na	free flow	clear, slight septic odo	None	None	None	fully obstructed	na	na	na	na	na	Outfall located downgradient of a cow holding pen, seeping out through the bank.

Table 6: East St. Johnsbury Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
EJ010	EJ010	9/24/15	J_S	Outfall pipe	18	corrugated black plastic	dry	na	free flow	na	na	na	na	na	na	na	na	na	na	
EJ020	EJ020	9/24/15	J_S	Outfall pipe	Unknown	corrugated black plastic	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.25	0.08	0.0	869	
EJ020	EJ020	6/22/16	DTC	Outfall pipe	30	corrugated black plastic	Flowing	0.5	free flow	brownish-yellow, no odor	none	none	none	none	na	0.25	na	1.0	182	Began raining very hard, lots of pollen in water. Could not obtain valid Cl2 reading.
EJ020	EJ020	7/20/16	DTC	Outfall pipe	30	corrugated black plastic	Flowing	0.25	free flow	clear, no odor	none	none	none	none	na	0.00	0.01	0.0	116	
EJ030	EJ030	9/24/15	J_S	Outfall pipe	16	corrugated metal	dry	na	free flow	na	na	na	corrosion	na	na	na	na	na	na	Entire bottom of pipe is corroded, and pipe bedding is washing away.
EJ040	EJ040	9/24/15	J_S	Outfall pipe	18	corrugated black plastic	dry	na	free flow	na	na	na	na	na	na	na	na	na	na	
EJ050	EJ050	9/24/15	J_S	Outfall pipe	18	corrugated black plastic	dry	na	free flow	na	na	na	na	na	na	na	na	na	na	

Table 7: Fairlee Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
FL010	Outfall	7/22/15	DCB	J_S	Outfall pipe	na	corrugated metal	dry	na	submerged	na	unknown	unknown	pipe flattened and submerged beneath 1	fully obstructed	na	0.3	na	0.5	195	Tested next upstream catchbasin.
FL010	CB1	7/31/16	DCB		Catchbasin	na	na	wet (no flow)	na	na	na	none	none	na	na	na	na	na	na	na	Checked next upstream catchbasin.
FL020	Outfall	7/22/15	DCB	J_S	Outfall pipe	8	corrugated metal	unknown	na	submerged	na	none	none	holes on bottom of inlet	fully obstructed	na	0.3	na	0.5	195	Tested next upstream catchbasin.
FL020	CB1	7/31/16	DCB		Catchbasin	na	na	wet (no flow)	na	na	na	none	none	na	na	na	na	na	na	na	Checked next upstream catchbasin.
FL030	FL030	8/27/15	J_S		Outfall pipe	18	concrete	dry	na	partially submerged	na	none	none	none	none	na	na	na	na	na	Two next upstream catchbasins were wet, no flow.
FL040	FL040	8/27/15	J_S		Outfall pipe	24	cast iron	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	

Table 8: Gilman Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
GI010	GI010	9/18/15	J_S		Outfall pipe	24	corrugated black plastic	flowing	3	free flow	clear, no odor; FeOHx floc	floc	iron staining	none	none	Negative	3.00	0.33	0.10	8,650	
GI010	GI010	5/19/16	DTC	DCB	Outfall pipe	24	corrugated black plastic	flowing	3	free flow	clear, no odor; FeOHx floc; metallic sheen	floc	iron staining	none	none	na	0.20	0.02	0.10	859	All flow enters CB1 via pipe B. This flow has Fe floc and staining. Pipes A and C are dry.
GI020	GI020	9/18/15	J_S		Outfall pipe	16	smooth plastic	flowing	1	free flow	clear, no odor	none	sediment	none	none	Positive	0.40	0.00	0.10	5,430	
GI020	GI020	5/19/16	DTC	DCB	Outfall pipe	16	smooth plastic	flowing	1	free flow	clear, no odor	none	sediment	none	none	Many Positive	0.00	0.02	0.00	265	Padded system extensively. See assessment sheet/ results from reading for details.
GI030	GI030-CB1	9/18/15	J_S		Catchbasin	na	na	wet, no flow	na	free flow	na	none	none	none	fully obstructed	na	na	na	na	na	Outfall buried beneath rubble; evaluated at next upstream catchbasin, wet, no flow.
GI040	GI040	9/18/15	J_S		Outfall pipe	24	corrugated black plastic	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.10	0.05	0.10	5,830	Passes beneath home at 127 Riverside.
GI050	GI050	9/18/15	J_S		Outfall pipe	18	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.00	0.00	8,720	
GI060	GI060	9/18/15	J_S		Outfall pipe	36	corrugated metal	flowing	1	free flow	clear, no odor	none	none	none	none	Positive	0.10	0.00	0.10	5,440	Flow is irregular; comes in pulses.
GI060	GI060	5/18/16	DTC	DCB	Outfall pipe	36	corrugated metal	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.03	0.00	156	Padded outfall, CB2, culvert inlet.
GI070	GI070	9/18/15	J_S		Outfall pipe	16	iron	trickling	na	free flow	clear, no odor	none	none	none	none	Positive	0.35	0.00	0.15	14,300	
GI070	GI070	5/19/16	DTC	DCB	Outfall pipe	16	iron	trickling	na	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.04	0.10	999	Padded outfall, MH1 pipes A, B, C (all trickling), CB1, CB2.
GI080	GI080	9/18/15	J_S		Outfall pipe	16	concrete	dry	na	free flow	na	none	none	pipe separated	none	na	na	na	na	na	
GI090	GI090	9/18/15	J_S		Outfall pipe	46	corrugated metal	flowing	4	free flow	few suds, clear, no odor	suds	none	none	none	Positive (strong)	3.00	0.07	0.15	5,370	John Chessman 802-892-1166 granted access.
GI090	GI090	5/19/16	DTC	DCB	Outfall pipe	46	corrugated metal	flowing	4	free flow	wastewater odor	none	none	none	none	Negative	0.50	0.00	0.00	183	Padded outlet of culverts 1 and 2. Couldn't find WWTP outfall.
GI095	GI095	5/19/16	DTC	DCB	Rubber hose	2	rubber	strong flow	na	free flow	clear, no odor	none	none	none	none	na	0.00	0.00	0.00	264	Hose coming from mill window. Likely draining the basement.

Table 9: Glover Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
GL010	GL010	11/3/15	J_S	Outfall pipe	12	corrugated black plastic	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	
GL020	GL020	11/3/15	J_S	Outfall pipe	15	corrugated black plastic	wet, no flow	na	free flow	na	none	sediment	none	partially obstructed	na	na	na	na	na	half blocked with sediment
GL024	GL024	11/3/15	J_S	Outfall pipe	12	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	half blocked with sediment
GL026	GL026	11/3/15	J_S	Outfall pipe	14	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	half blocked with sediment
GL030	GL030	11/3/15	J_S	Outfall pipe	18	concrete	wet, no flow	na	partially submerged	na	none	sediment	none	partially obstructed	na	na	na	na	na	
GL040	GL040	11/3/15	J_S	Outfall pipe	18	concrete	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.16	0.00	336	next manhole upstream is also flowing
GL040	GL040	6/22/16	DTC	Outfall pipe	18	concrete	trickling	na	free flow	clear, no odor	none	none	none	none	na	0.00	0.06	0.10	374	
GL040	GL040	7/20/16	DTC	Outfall pipe	18	concrete	dripping	na	free flow	clear, no odor	none	none	none	none	na	0.00	0.02	0.10	380	Sampled outfall twice (1 time high Cl2, 1 time low Cl2), CB1, CB3, CB5 all low Cl2.
GL050	GL050	11/3/15	J_S	Outfall pipe	18	corrugated black plastic	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.06	0.00	483	
GL060	GL060	11/3/15	J_S	Outfall pipe	unknown	unknown	dry	na	na	na	none	none	none	fully obstructed	na	na	na	na	na	no evidence of outfall
GL070	GL070	11/3/15	J_S	Outfall pipe	18	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.06	0.10	570	

Table 10: Groton Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
GR010	GR010	10/23/15	J_S	Outfall pipe	unknown	unknown	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	No evidence of outfall. Next manhole upstream was dry.
GR020	GR020	10/23/15	J_S	Outfall pipe	12	concrete	flowing	0.5	free flow	clear, no odor	None	None	None	None	Negative	0.25	0.04	0.05	212	
GR040	GR040-CB7	10/23/15	J_S	Catchbasin	na	na	flowing	1	free flow	clear, no odor	None	None	None	None	Negative	0.00	0.10	0.00	137	Flow from u.s. Highway Comm. reports a Community Building drain formerly discharged here.
GR040	GR040	6/15/16	DTC	Outfall pipe	16	concrete	flowing	0.5	free flow	clear, no odor	None	None	None	None	Positive	0.00	0.02	0.00	240	Deployed many pads--see notes. JS labeled GR040, GR045, GR047 separately, but all one system
GR040	GR040-CB13	6/15/16	DTC	Catchbasin	na	na	flowing	na	na	clear, no odor	None	None	None	None	Negative	0.25	0.01	0.10	218	See assessment sheet for system details.
GR040	GR040-CB4	10/23/15	J_S	Catchbasin	na	na	flowing	1	free flow	clear, slight septic odor	None	iron staining	None	None	Pos. (strong)	0.30	0.07	0.10	255	
GR041	GR045-CB5	10/23/15	J_S	Catchbasin	na	na	flowing	0.5	free flow	clear, no odor	None	None	None	None	Negative	0.00	0.09	0.05	269	
GR042	GR047-CB2	10/23/15	J_S	Catchbasin	na	na	flowing	0.5	free flow	clear, no odor	None	None	None	None	Negative	0.20	0.07	0.10	325	
GR050	GR050	10/23/15	J_S	Outfall pipe	15	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
GR060	GR060	10/23/15	J_S	Outfall pipe	unknown	unknown	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	Could not locate beneath loose bank material and knotweed. Upstream CB dry.
GR070	GR070	10/23/15	J_S	Outfall pipe	15	concrete	flowing	0.5	free flow	clear, no odor	None	None	None	None	Negative	0.00	0.08	0.00	449	Flow entering at GR070-CB1 from 4-inch green plastic pipe; GR070-CB2 is dry.
GR080	GR080	10/23/15	J_S	Outfall pipe	12	corrugated metal	dry	na	free flow	na	None	None	exposed, bent	None	na	na	na	na	na	
GR090	GR090	10/23/15	J_S	Outfall pipe	15	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
GR100	GR100	10/23/15	J_S	Outfall pipe	unknown	unknown	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
GR110	GR110	10/23/15	J_S	Outfall pipe	12	corrugated black plastic	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
GR120	GR120	10/23/15	J_S	Outfall pipe	12	corrugated black plastic	trickling	0	free flow	clear, no odor	None	None	None	None	Negative	0.00	0.07	0.15	428	

Table 11: Lunenburg Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
LU010	LU010	10/7/15	J_S		Outfall pipe	24	corrugated metal	flowing	1	free flow	clear, no odor	suds	none	none	none	Negative	0.10	0.13	0.10	6800	
LU010	LU010	5/19/16	DTC	DCB	Outfall pipe	24	corrugated metal	flowing	1	free flow	slight septic odor, suds.	suds	none	none	none	Negative/ I	0.25	0.00	0.10	510	Padded outfall (neg.), CB1 (indeterminate), CB2 (pad lost), 4" drain outlet (neg.). See 7/20 notes
LU020	LU020	10/7/15	J_S		Outfall pipe	24	concrete	flowing	2	free flow	clear, slight septic odor	none	none	none	none	Negative	0.00	0.12	0.10	4360	
LU020	LU020	5/19/16	DTC	DCB	Outfall pipe	24	concrete	flowing	2	free flow	clear, slight odor, Fe stain	none	Fe staining	none	none	na	1.00	0.01	0.20	877	See additional assessment sheet for 7/20 bracket sampling
LU030	LU030	10/7/15	J_S		Outfall pipe	12	concrete	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	
LU040	LU040	10/7/15	J_S		Outfall pipe	12	concrete	wet, no flow	na	free flow	clear, no odor	none	none	none	partially obstructed	Negative	0.10	0.10	0.00	4450	
LU040	LU040	5/19/16	DTC	DCB	Outfall pipe	12	concrete	wet, no flow	na	free flow	clear, no odor	none	none	none	partially obstructed	Negative	0.00	0.02	0.00	529	Flow uncertain, sampled standing water in pipe. Padded outfall, culvert inlet, CB1: all negative.

Table 12: Lyndon Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
LY010	LY010	8/13/15	DCB	J_S	Outfall pipe	15	corrugated metal	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	Intersection of Routes 5 and 114.
LY020	LY020-CB1	8/13/15	DCB	J_S	Catchbasin	na	na	wet, no flow	na	na	FeOH sheen	none	na	na	na	na	na	na	na	na	W. side of Rte 5, S. of triple culvert. Outfall likely buried. Splash pool near mapped location. Assessed at u.s. CB.
LY030	LY030-CB1	8/13/15	DCB	J_S	Catchbasin	na	corrugated metal	wet, no flow	na	na	FeOH sheen	none	na	na	na	na	na	na	na	na	E. side of Rte 5, S. of triple culvert. Could not find outfall, likely buried. Assessed at 1st u.s. CB, below car wash. CB1 outlet surcharged.
LY040	LY040	8/13/15	DCB	J_S	Outfall pipe	12	corrugated black plastic	wet, no flow	na	free flow	stagnant pool, clear, no odor	none	none	none	none	na	na	na	na	na	At edge of field, behind apartment complex, Lyndonville Partnership
LY050	LY050	8/13/15	DCB	J_S	Outfall pipe	na	unknown	wet, no flow	na	free flow	clear, no odor	none	none	unknown	fully obstructed	na	na	na	na	na	NE of park. Planned to examine next point upstream, but MH-1 not found. Assessed at CB5.
LY050	LY050-CB5	8/13/15	DCB	J_S	Catchbasin	na	na	wet, no flow	na	na	clear, no odor	none	none	none	none	Pos. (weak)	na	na	na	na	Intersection of Church and Grove Street.
LY050	LY050	6/2/16	DTC	DCB	Outfall pipe	na	na	no flow	na	na	na	na	na	na	fully obstructed	Negative	na	na	na	na	Padded outfall, CB1, CB2, CB5. All pads are negative.
LY060	LY060-MH1	8/13/15	DCB	J_S	Manhole	na	na	flowing	3	na	clear, no odor	none	none	none	none	Neg., Neg.	0.00	0.06	0.20	590	No evidence of outfall at stream bank. Assessed at first manhole upstream.
LY060	LY060-CB5	8/13/15	DCB	J_S	Catchbasin	na	na	wet, no flow	na	na	na	none	na	na	na	I, Neg.	na	na	na	na	In front of Lyndonville Methodist Church.
LY070	LY070	8/13/15	DCB	J_S	Outfall pipe	na	smooth plastic	flowing	4	free flow	clear, no odor	none	none	none	partially obstructed	Negative	0.10	0.03	0.15	1868	Checked next u.s. CB, intersection of Main and Maple; wet, no flow, surrounded by fresh pavement, no sample.
LY080	LY080	8/28/15	J_S		Outfall pipe	unknown	unknown	dry	na	free flow	na	none	none	none	fully obstructed	na	na	na	na	na	Checked next two CBs upstream: wet, no flow.
LY090	LY090	8/28/15	J_S		Outfall pipe	24	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Recently rebuilt; outfall 40 ft N. of previous location. Beginning to wash out. Checked next four CBs upstream: wet, no flow
LY100	LY100	8/28/15	J_S		Outfall pipe	36	corrugated metal	dripping	na	free flow	clear, no odor	none	none	none	none	na	na	na	na	na	Checked next two CBs upstream: dry, no flow.
LY110	LY110	8/28/15	J_S		Outfall pipe	16	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Checked next CB upstream: wet, no flow.
LY120	LY120	8/28/15	J_S		Outfall pipe	unknown	unknown	dry	na	unknown	na	none	none	none	none	na	na	na	na	na	Checked all upstream CBs: either dry or wet, no flow.
LY130	LY130	8/28/15	J_S		Outfall pipe	unknown	unknown	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	Checked upstream CBs on both legs of system: wet, no flow.
LY140	LY140	8/28/15	J_S		Outfall pipe	unknown	unknown	dry	na	submerged	na	none	none	none	fully obstructed	na	na	na	na	na	Checked next CB upstream: wet, no flow.
LY150	LY150	8/28/15	J_S		Outfall pipe	12	smooth plastic	dry	na	free flow	na	none	sheen	none	none	na	na	na	na	na	
LY150	LY150	6/2/16	DTC	DCB	Outfall pipe	12	smooth plastic	wet, no flow	na	submerged	clear, no odor	none	none	none	none	na	0.00	0.06	0.00	528	Behind True Value. Staining from oil washing down from pallet with oil pan/bucket into grate at bottom of loading dock.
LY160	LY160	8/28/15	J_S		Headwall	36	concrete	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.00	0.00	1	
LY170	LY170	8/28/15	J_S		Outfall pipe	unknown	unknown	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	
LY180	LY180	8/28/15	J_S		Outfall pipe	unknown	unknown	dry	na	free flow	na	none	none	none	unknown	na	na	na	na	na	Checked next CB upstream: wet, no flow. Under thick brush.
LY190	LY190	8/28/15	J_S		Outfall pipe	unknown	unknown	dry	na	free flow	na	none	none	none	unknown	na	na	na	na	na	Checked next CB upstream: dry, no flow. Under thick brush.
LY200	LY200	8/28/15	J_S		Outfall pipe	24	concrete	dry	na	partially submerged	na	none	sediment	none	partially obstructed	na	na	na	na	na	Checked next two CBs upstream: dry, no flow.
LY210	LY210	8/28/15	J_S		Outfall pipe	unknown	unknown	wet, no flow	na	submerged	clear, no odor	none	sediment	none	fully obstructed	na	na	na	na	na	
LY220	LY220	8/28/15	J_S		Outfall pipe	24	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Checked two upstream CBs: either dry or wet, no flow.
LY230	LY230	8/28/15	J_S		Outfall pipe	24	corrugated black plastic	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	Checked next CB upstream: dry, no flow.
LY240	LY240	8/28/15	J_S		Outfall pipe	unknown	unknown	dry	na	unknown	na	none	none	none	fully obstructed	na	na	na	na	na	Checked next CB upstream: wet, no flow. Located beneath piles of yard waste; only splash pool observed.
LY250	LY250	10/7/15	J_S		Outfall pipe	36	concrete	flowing	2	free flow	clear, no odor	none	sediment	none	none	Negative	0.10	0.12	0.00	6480	Access through dense honeysuckle
LY250	LY250	6/2/16	DTC	DCB	Outfall pipe	36	concrete	flowing	1	free flow	clear, no odor	none	sediment	none	none	na	0.10	0.05	0.00	671	Access through dense honeysuckle
LY260	LY260	9/17/15	J_S		Headwall	12	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Paired, matching outfalls.
LY270	LY270	9/17/15	J_S		Outfall pipe	24	corrugated black plastic	trickling	na	free flow	clear, no odor	none	none	none	none	Indeterminate	0.00	0.00	0.00	4,850	
LY280	LY280	9/18/15	J_S		Outfall pipe	6	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Southern outfall is mislocated on VTDEC datalayer. Both are the same.
LY290	LY290	9/18/15	J_S		Outfall pipe	18	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY300	LY300	9/18/15	J_S		Outfall pipe	18	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY310	LY310	9/18/15	J_S		Outfall pipe	unknown	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Outfall channel recently reconstructed; outfall buried beneath rip rap.
LY320	LY320	9/18/15	J_S		Outfall pipe	unknown	unknown	wet, no flow	na	free flow	na	none	none	none	none	na	na	na	na	na	Mapped location is a 4-inch PVC foundation drain (dry). Outfall could not be located; evaluated at next upstream catchbasin.
LY330	LY330	9/18/15	J_S		Outfall pipe	12	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	A 6-inch perforated PVC pipe (apparent foundation drain, dry) is located above and north of outfall.
LY340	LY340	9/25/15	J_S		Outfall pipe	16	corrugated black plastic	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.10	0.00	0.15	>19,999	Located in middle of tunnel under Back Center Road
LY350	LY350	9/25/15	J_S		Outfall pipe	12	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY360	LY360	9/25/15	J_S		Outfall pipe	8	smooth plastic	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	
LY370	LY370	9/25/15	J_S		Outfall pipe	8	smooth plastic	dry	na	free flow	na	none	sediment	none	partially obstructed	na	na	na	na	na	
LY380	LY380	9/25/15	J_S		Outfall pipe	12	corrugated metal	flowing	0.5	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.00	0.20	>19,999	
LY390	LY390	9/25/15	J_S		Outfall pipe	32	corrugated metal	wet, no flow	na	partially submerged	FeOHx floc	suds	sediment	none	none	Negative	0.50	0.87	0.10	18	
LY390	LY390	6/2/16	DTC	DCB	Outfall pipe	32	corrugated metal	flowing	0.25	free flow	Fe staining, petroleum sheen	none	sediment	none	none	na	0.20	0.01	0.10	911	Faint petroleum odor at CB1.
LY400	LY400	9/25/15	J_S		Outfall pipe	24	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY410	LY410	9/25/15	J_S		Outfall pipe	8	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY420	LY420	9/25/15	J_S		Outfall pipe	18	concrete	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY430	LY430	9/25/15	J_S		Outfall pipe	8	smooth plastic	flowing	0.5	free flow	clear, no odor	none	sediment, FeOHx stair	none	none	Negative	6.00	0.09	1.00	>19,999	
LY430	LY430	6/2/16	DTC	DCB	Outfall pipe	8	smooth plastic	flowing	0.5	free flow	clear, no odor	none	none	none	none	na	0.30	0.09	0.70	5.9 mS	Strong Fe staining and floc in CBs by Crevecour dorm.
LY440	LY440	9/25/15	J_S		Outfall pipe	15	corrugated metal	trickling	na	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.10	0.25	>19,999	
LY440	LY440	6/2/16	DTC	DCB	Outfall pipe	15	corrugated metal	trickling	na	free flow	clear, no odor	none	none	none	none	na	0.10	0.06	0.25	3.32 mS	
LY450	LY450A	9/25/15	J_S		Outfall pipe	36	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY460	LY460	9/25/15	J_S		Outfall pipe	8	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY470	LY470	9/25/15	J_S		Outfall pipe	6	vitrified clay	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY480	LY480	9/25/15	J_S		Outfall pipe	10	vitrified clay	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	Slightly mislocated on VTDEC map, located farther south.
LY490	LY490	9/25/15	J_S		Outfall pipe	15	corrugated white plastic	wet, no flow	na	partially submerged, surch	na	none	none	none	none	na	na	na	na	na	
LY500	LY500	9/25/15	J_S		Outfall pipe	15	corrugated white plastic	wet, no flow	na	submerged	na	none	none	none	none	na	na	na	na	na	
LY510	LY510	9/25/15	J_S		Outfall pipe	32	concrete	wet, no flow	na	partially submerged	na	none	none	none	none	na	na	na	na	na	
LY520	LY520	9/25/15	J_S		Outfall pipe	12	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY525	LY525	9/25/15	J_S		Outfall pipe	8	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY530	LY530	10/12/15	J_S		Outfall pipe	24	corrugated black plastic	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.20	0.09	0.00	2150	
LY540	LY540	10/12/15	J_S		Outfall pipe	15	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY550	LY550	10/12/15	J_S		Outfall pipe	24	corrugated metal	flowing	2	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.09	0.10	9450	Certainly carrying the stream mapped above it.
LY560	LY560	10/12/15	J_S		Outfall pipe		corrugated metal	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.20	0.10	0.10	12	
LY570	LY570	10/12/15	J_S		Outfall pipe	32	concrete	flowing	2	free flow	clear, no odor	none	none	none	none	Negative	0.00	0.11	0.00	8000	Certainly carrying the stream mapped above it.
LY580	LY580	10/12/15	J_S		Outfall pipe	15	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY583	LY583	10/12/15	J_S		Outfall pipe	4	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
LY585	LY585	10/12/15	J_S		Outfall pipe	14	corrugated black plastic	dry	na	free flow	na	none	sediment	none	none	na	na	na	na	na	
LY588	LY588	10/12/15	J_S		Outfall pipe	24	corrugated black plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	

Table 13: Newbury Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
NB010	NB010	10/23/15	J_S	Outfall	16	corrugated metal	Flowing	0.5	free flow	na	None	None	None	None	Negative	0.0	0.06	0.15	460	The most upstream catchbasin is dry.

Table 14: Norwich Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
NO010	NO010	11/23/15	J_S	Outfall	15	corrugated metal	dripping	na	free flow	clear, no odor	None	None	None	None	na	na	na	na	na	Three upstream catchbasins were wet, no flow
NO020	NO020	11/23/15	J_S	Outfall	18	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO030	NO030	11/23/15	J_S	Outfall	18	corrugated black plastic	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO040	NO040	11/23/15	J_S	Outfall	16	corrugated black plastic	dry	na	free flow	na	None	sediment	None	None	na	na	na	na	na	
NO050	NO050	11/23/15	J_S	Outfall	16	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO060	NO060	11/23/15	J_S	Outfall	12	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO070	NO070	11/23/15	J_S	Outfall	24	corrugated metal	trickling	na	free flow	clear, no odor	None	None	None	None	Negative	0.0	0.07	0.10	894	
NO073	NO073	11/23/15	J_S	Outfall	10	corrugated metal	trickling	na	free flow	clear, no odor	suds	None	corrosion	None	Pos. (strong)	0.0	0.07	0.05	974	
NO073	NO073	6/16/16	DCB	Outfall	10	corrugated metal	trickling	na	free flow	clear, no odor	none	none	none	none	Positive	na	na	na	na	Padded system, only outfall downstream was positive. See sketch.
NO075	NO075	11/23/15	J_S	Outfall	18	corrugated metal	trickling	na	free flow	na	None	None	None	None	na	na	na	na	na	The culverts upstream contain standing groundwater
NO078	NO078	11/23/15	J_S	Outfall	18	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO080	NO080	11/23/15	J_S	Outfall	24	corrugated metal	trickling	na	partially submerged	clear, no odor	None	None	None	None	Negative	0.2	0.07	0.05	946	
NO090	NO090	11/23/15	J_S	Outfall	unknown	unknown	dry	na	free flow	na	None	None	None	fully obstructed	na	na	na	na	na	Buried beneath landscaping debris
NO100	NO100	11/23/15	J_S	Outfall	12	corrugated black plastic	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO110	NO110	11/23/15	J_S	Outfall	12	corrugated black plastic	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO115	NO115	11/23/15	J_S	Outfall	18	corrugated black plastic	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO120	NO120	11/23/15	J_S	Outfall	12	corrugated black plastic	trickling	na	free flow	clear, no odor	None	None	None	None	Negative	0.0	0.08	0.10	1700	
NO130	NO130	11/23/15	J_S	Outfall	60	corrugated metal	flowing	1.0	free flow	clear, no odor	None	None	None	None	Negative	0.0	0.06	0.00	580	Carries a stream from upstream. Upstream catchbasins have flow.
NO135	NO135	11/23/15	J_S	Outfall	18	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO140	NO140	11/23/15	J_S	Outfall	unknown	unknown	unknown	na	unknown	na	None	None	None	None	na	na	na	na	na	Not found, perhaps submerged in basin. Next upstream CB is wet, no flow.
NO145	NO145	11/23/15	J_S	Outfall	14	smooth plastic	unknown	na	partially submerged	clear, no odor	None	None	None	None	na	na	na	na	na	Surcharged, no evidence of flow. Next two upstream CBs are wet, no flow.
NO150	NO150	11/23/15	J_S	Outfall	16	corrugated metal	unknown	na	partially submerged	clear, no odor	None	None	None	None	na	na	na	na	na	No evidence found
NO160	NO160	11/23/15	J_S	Outfall	12	smooth plastic	dry	na	free flow	na	None	sediment	None	None	na	na	na	na	na	4-inch PVC pipe immediately north is also dry.
NO170	NO170	11/23/15	J_S	Outfall	24	corrugated black plastic	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO180	NO180	11/23/15	J_S	Outfall	na	na	na	na	na	na	None	None	None	None	na	na	na	na	na	Facility Manager stated that the outfall was eliminated, and routed to NO130.
NO190	NO190	6/16/16	DCB	Outfall	8	smooth plastic	flowing	1	free flow	clear, no odor	None	None	None	None	Negative	0.0	0.02	0.20	1104	flow increased suddenly during
NO194	NO194	6/16/16	DCB	Outfall	12	smooth plastic	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
NO198	NO198	6/16/16	DCB	Outfall	24	smooth plastic	trickling	na	free flow	faint WW odor	None	Iron staining	None	None	Negative	2.0	0.00	0.75	6290	pad is negative, but odor and high ammonia suggests an issue.
NO198	NO198	7/31/16	DCB	Outfall	24	smooth plastic	trickling	na	free flow	faint WW odor, gray color	None	Less iron staining	None	None	na	0.0	na	na	na	odor, black (reduced) sediment, and white floating particles suggest a WW contribution.

Table 15: Ryegate Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
RY010	RY010	9/25/15	J_S		Outfall pipe	36	concrete	flowing	1	free flow	clear, no odor	none	sediment	none	partially obstructed	Negative	0.1	0.01	0.1	3960	
RY010	RY010-CB3	9/25/15	J_S		Catchbasin	na	na	trickling	na	partially submerged, not surcharged	clear, no odor	none	none	none	none	Negative	0.0	0.00	0.0	2700	
RY020	RY020	9/25/15	J_S		Outfall pipe	16	corrugated metal	flowing	1	free flow	clear, no odor	none	none	none	none	Negative	0.1	0.00	0.0	3150	
RY030	na	9/25/15	J_S		na	na	na	na	na	na	na	none	none	none	none	na	na	na	na	na	No evidence of outfall or either mapped CB.
RY040	RY040	9/25/15	J_S		Outfall pipe	18	corrugated metal	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
RY050	RY050	9/25/15	J_S		Outfall pipe	4	smooth plastic	dry	na	free flow	na	none	none	none	none	na	na	na	na	na	
RY090	RY090	10/6/15	J_S		Outfall pipe	12	iron	dry	na	free flow	na	none	none	corrosion	none	na	na	na	na	na	
RY100	RY100	10/6/15	J_S		Outfall pipe	18	corrugated metal	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	
RY110	RY110	10/6/15	J_S		Outfall pipe	18	corrugated metal	dry	na	free flow	na	none	none	none	partially obstructed	na	na	na	na	na	
RY120	RY120	10/6/15	J_S		Outfall pipe	24	corrugated metal	dry	na	free flow	na	none	none	crushed	none	na	na	na	na	na	

Table 16: Wells River Assessment Data

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	Damage	Obstructions	OB Result	Ammonia (mg/L)	Chlorine (mg/L)	MBAS detergents (mg/L)	Sp. conductance (µs/cm)	Comments
WR010	WR010	10/6/15	J_S	Outfall pipe	16	corrugated metal	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
WR015	WR015	10/6/15	J_S	Outfall pipe	unknown	unknown	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	Not found; buried beneath dense vegetation; no flow coming from vegetation.
WR020	WR020	10/6/15	J_S	Outfall pipe	48	concrete	flowing	1	free flow	clear, no odor	None	None	None	None	Negative	0.00	0.11	0.10	3170	
WR020	WR020	6/15/16	DTC	Outfall pipe	48	concrete	flowing	1	free flow	clear, no odor	None	None	None	None	na	0.00	0.00	0.00	422	Road work (paving and shoulder work primarily) in progress.
WR030	WR030	10/6/15	J_S	Outfall pipe	8	iron	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
WR040	WR040	10/6/15	J_S	Outfall pipe	12	corrugated metal	dry	na	free flow	na	None	None	corrosion	None	na	na	na	na	na	
WR050	WR050	10/6/15	J_S	Outfall pipe	unknown	unknown	dry	na	unknown	na	None	None	None	None	na	na	na	na	na	Not found; several pieces of 6-inch VC pipe were along bank. No apparent flow anywhere.
WR060	WR060	10/6/15	J_S	Outfall pipe	unknown	unknown	dry	na	unknown	na	None	None	None	None	na	na	na	na	na	Not found, possibly behind or beneath retaining wall. Next two CBs upstream are dry.
WR070	WR070	10/6/15	J_S	Outfall pipe	12	concrete	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	Edges painted pink.
WR080	WR080	10/6/15	J_S	Outfall pipe	10	vitrified clay	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	
WR090	WR090	10/6/15	J_S	Outfall pipe	unknown	unknown	dry	na	free flow	na	None	None	None	None	na	na	na	na	na	Buried beneath riprap and knotweed; no evidence of flow; next two u.s. CBs are wet, no flow.
WR100	WR100	10/6/15	J_S	Outfall pipe	16	iron	wet, no flow	na	partially submerged	na	None	Sediment	None	partially obstructed	na	na	na	na	na	

Appendix D. Maps

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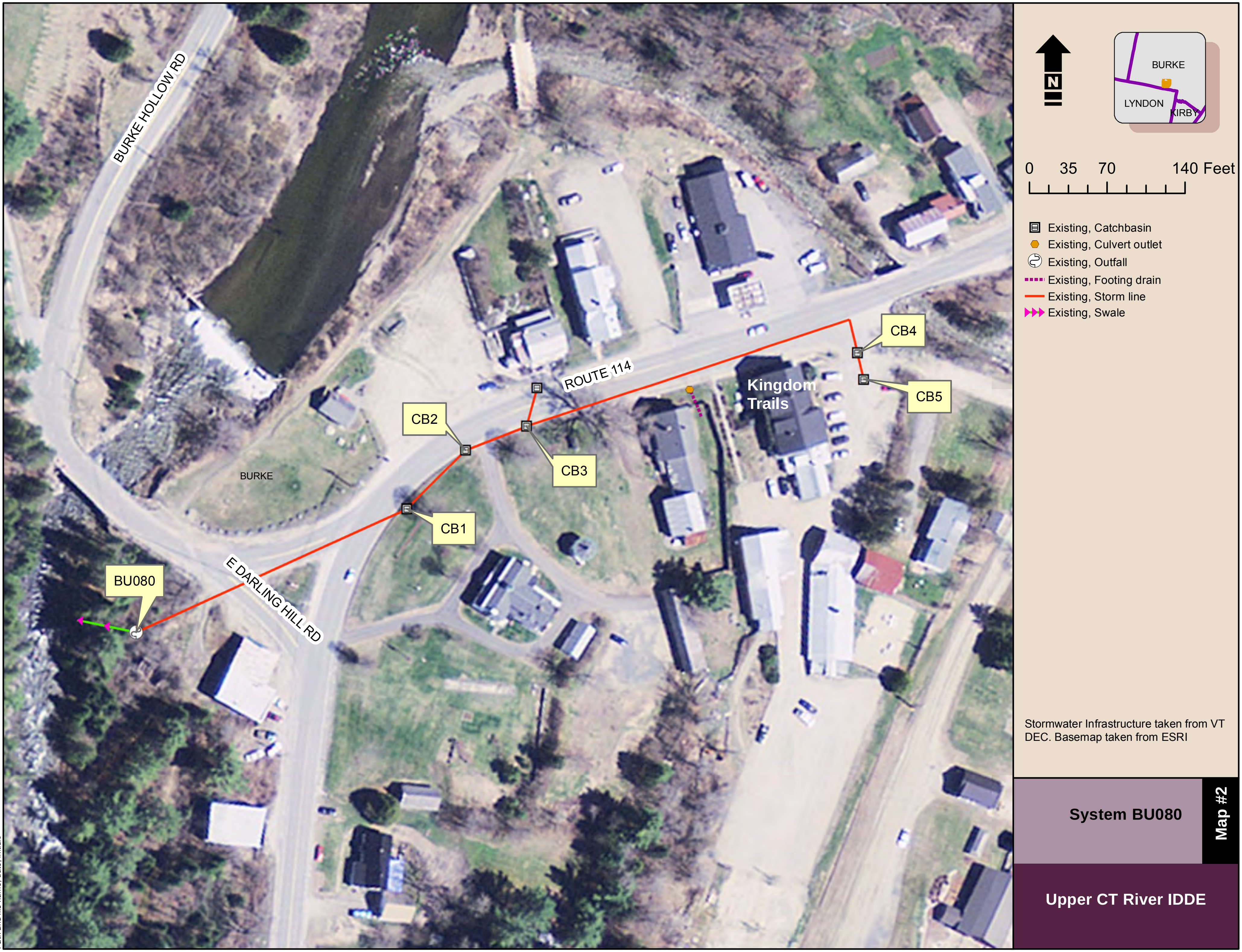
Path and file name, date, initials



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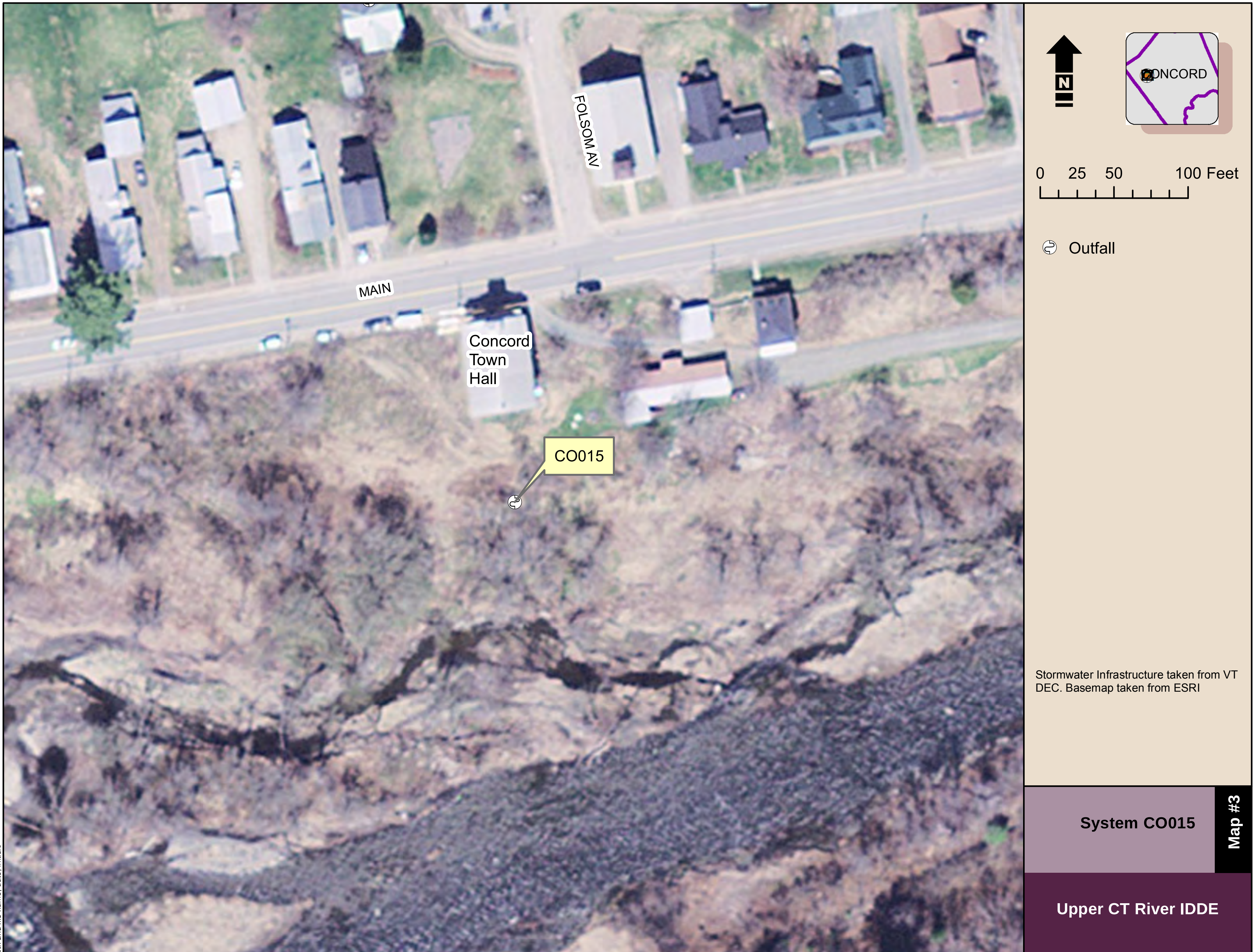


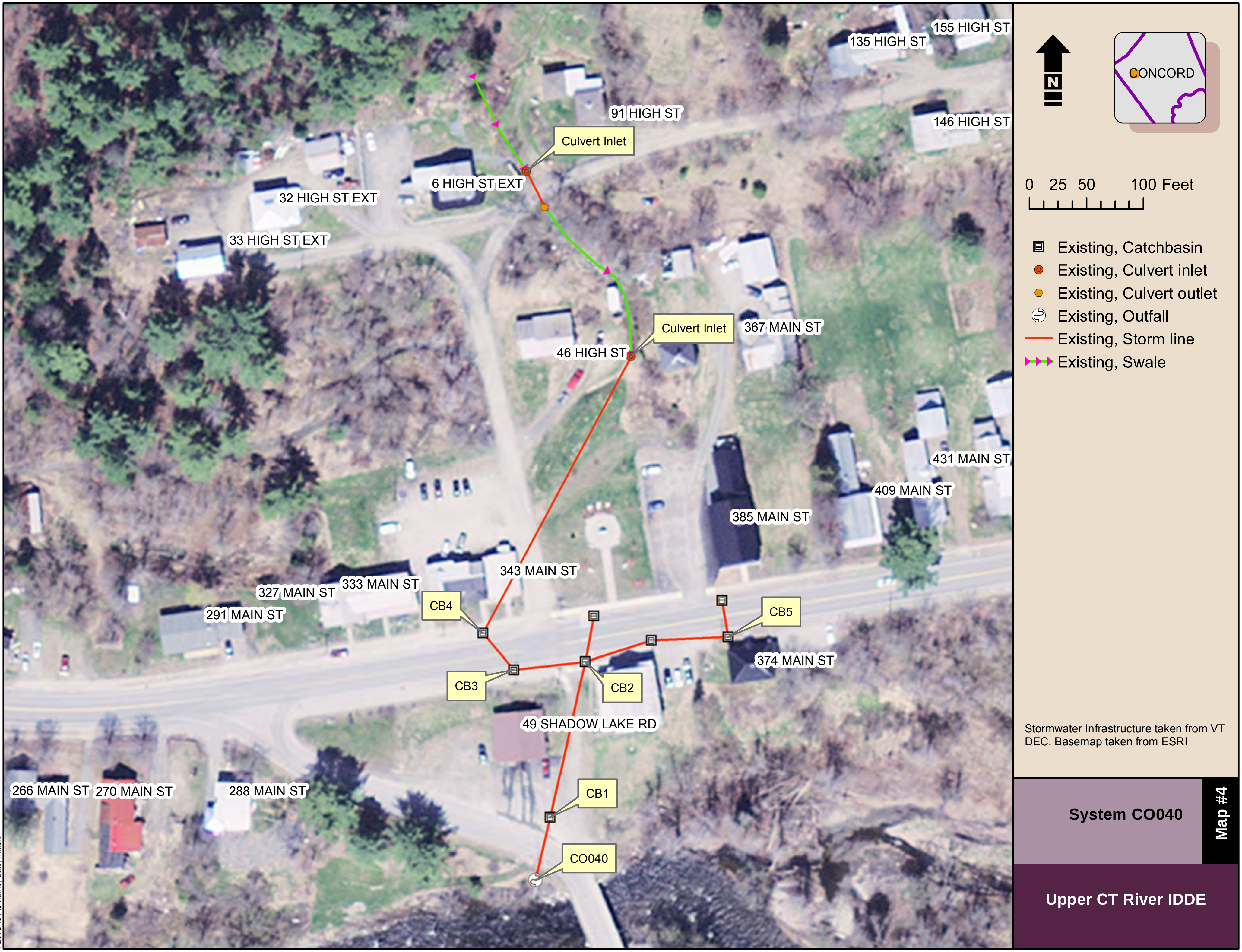
Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

System CO015

Map #3

Upper CT River IDDE

Path and file name, date, initials



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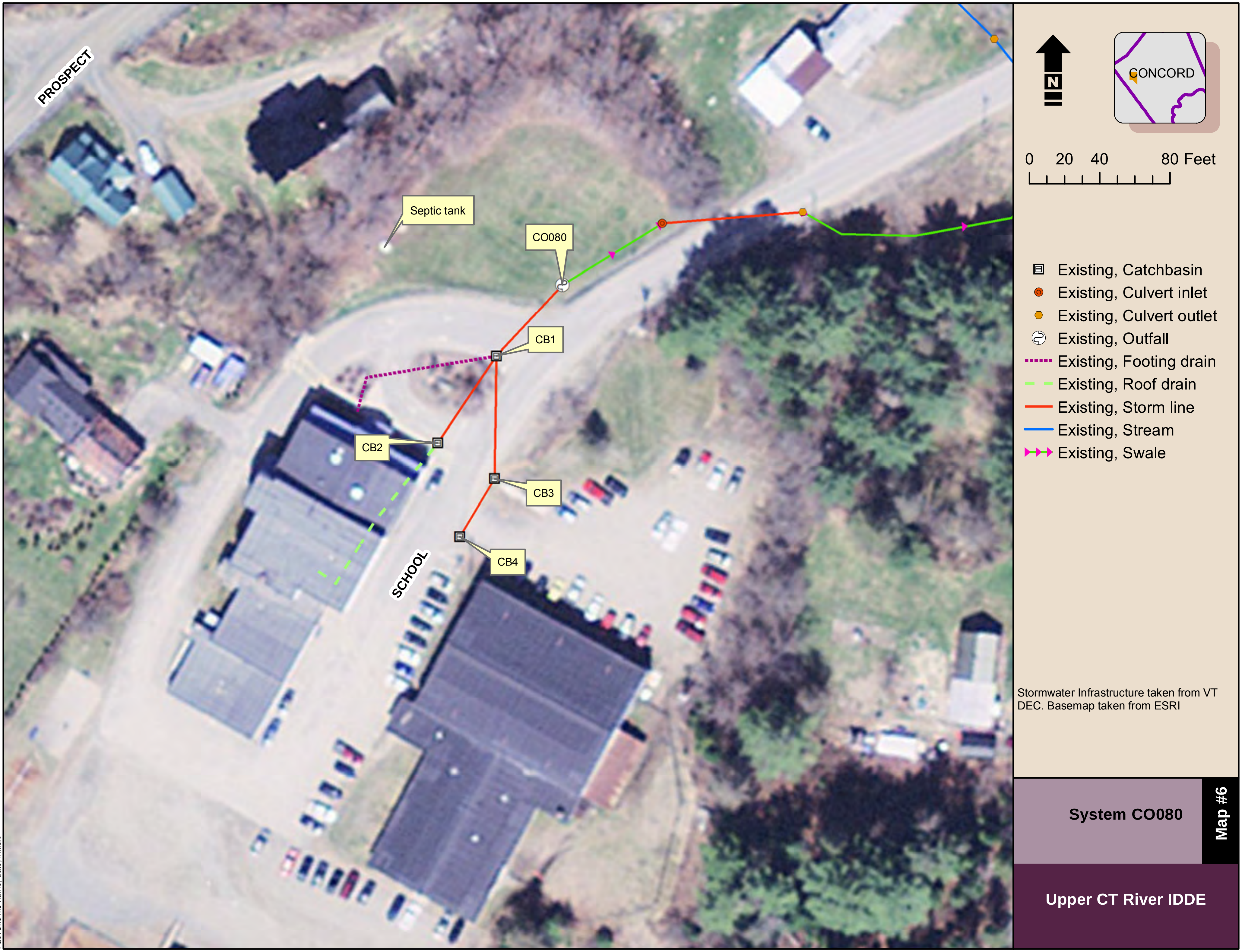

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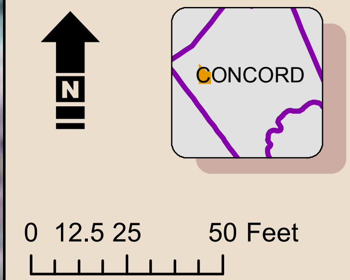


Outfall
Storm line

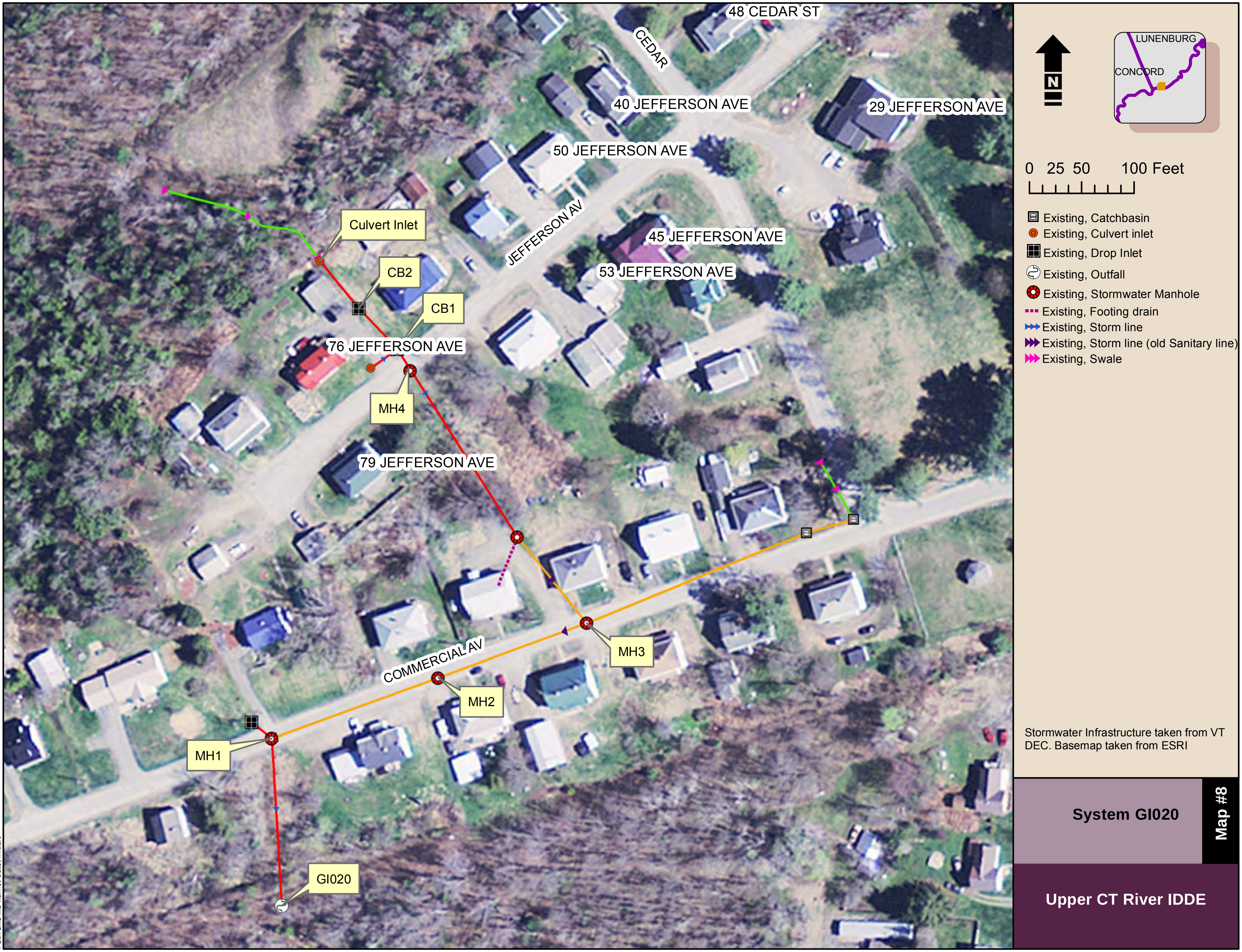
Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

Systems CO090 & CO100

Map #7

Upper CT River IDDE

Path and file name, date, initials



Path and file name, date, initials

N

PEACHAM
GROTON
TOPSHAM

0 25 50 100 Feet

VT_E911_Site_Locations_buildin
Existing, Catchbasin
Existing, Culvert inlet
Existing, Information Point
Existing, Outfall
Existing, Stormwater Manhole
E911_Roads
Existing, Footing drain
Existing, Storm line
Existing, Stream
Existing, Trench drain
Existing, Under drain

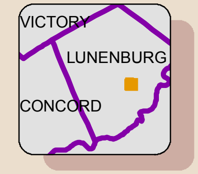
Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

System GR040

Map #9

Upper CT River IDDE

Path and file name, date, initials



N

0 30 60 120 Feet

- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Outfall
- Existing, Storm line
- Existing, Stream
- Existing, Swale

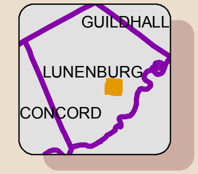
Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

System LU010

Map #10

Upper CT River IDDE

Path and file name, date, initials



0 55 110 220 Feet

- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Outfall
- E911_Roads
- Abandoned, Storm line (old Sanitary line)
- Existing, Footing drain
- Existing, Storm line
- Existing, Stream
- Existing, Swale

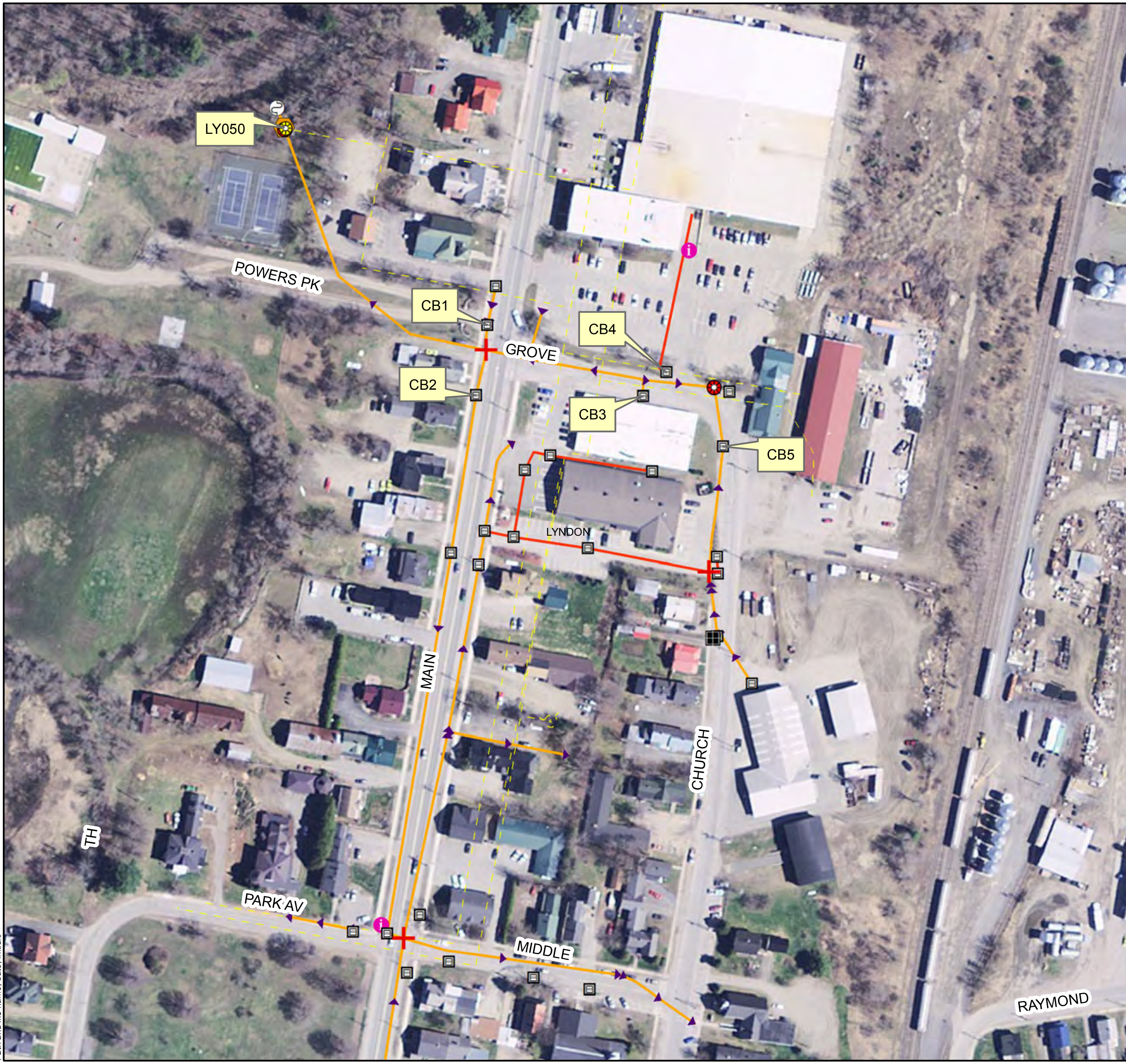
Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

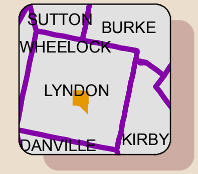
System LU020

Map #11

Upper CT River IDDE

Path and file name, date, initials





0 60 120 240 Feet

- Abandoned, Junction Box
- Existing, Catchbasin
- Existing, Drop Inlet
- Existing, Information Point
- Existing, Outfall
- Existing, Pipe Cross (not connected)
- Existing, Sanitary Manhole
- Existing, Stormwater Manhole
- Existing, Sanitary line
- Existing, Storm line
- Existing, Storm line (old Sanitary line)

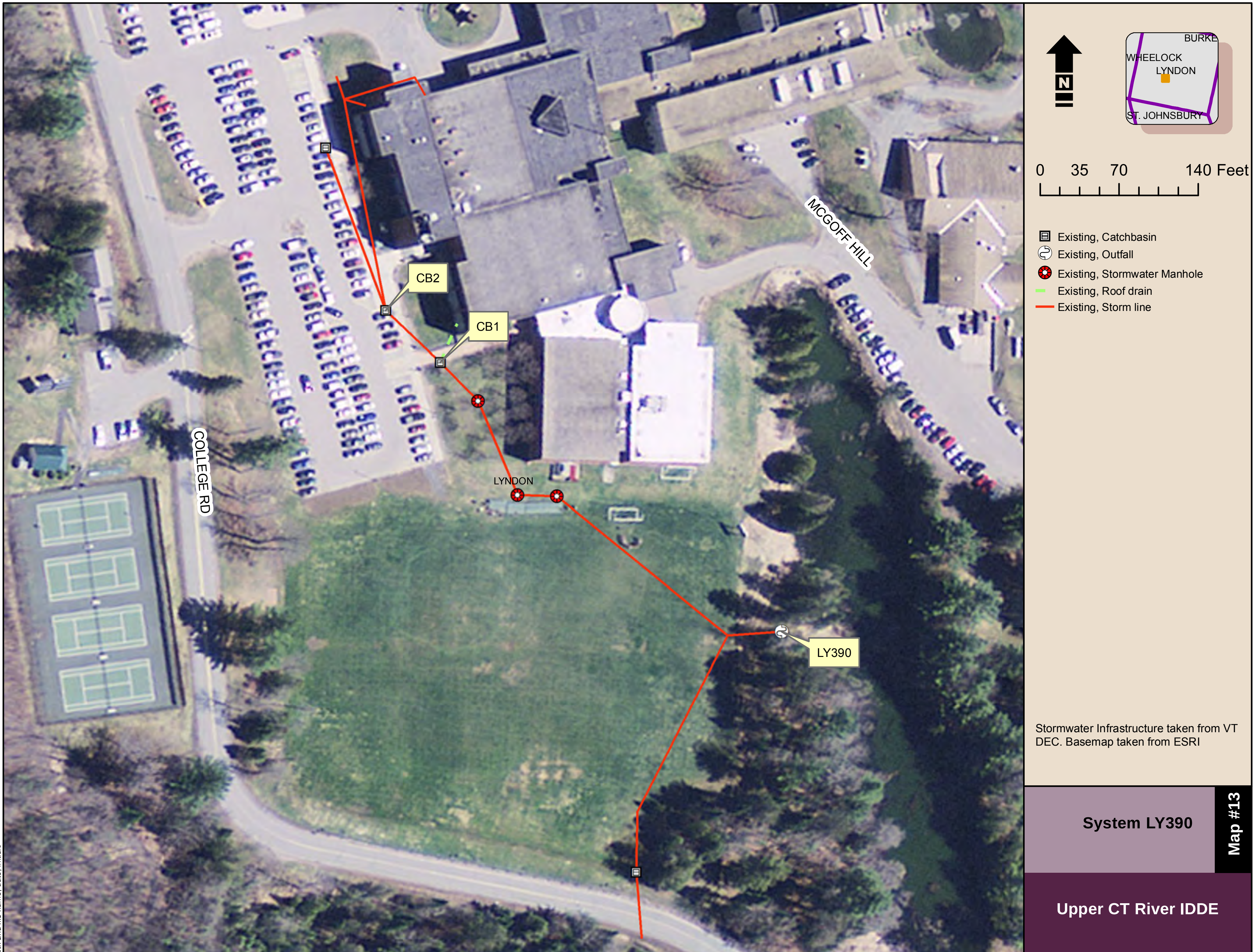
Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

System LY050

Map #12

Upper CT River IDDE

Path and file name, date, initials



Existing, Catchbasin
Existing, Outfall
Existing, Stormwater Manhole
Existing, Roof drain
Existing, Storm line

Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

System LY390

Map #13

Upper CT River IDDE

Path and file name, date, initials

N

0 12.5 25 50 Feet

- Drop Inlet
- Existing, Culvert inlet
- Existing, Culvert outlet
- Existing, Outfall
- Existing, Storm line
- Existing, Swale

Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

System NO073

Map #14

Upper CT River IDDE

Path and file name, date, initials

N

0 20 40 80 Feet

- Existing, Catchbasin
- Existing, Culvert inlet
- Existing, Culvert outlet
- Existing, Outfall
- Existing, Storm line
- Existing, Swale

Stormwater Infrastructure taken from VT DEC. Basemap taken from ESRI

System NO198

Map #15

Upper CT River IDDE

Path and file name, date, initials