



# Final Report: Contract #35956 Statewide IDDE

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## Contents

1. Introduction .....	6
2. Methods .....	8
2.1 Field Work Preparation .....	8
2.2 Outfall Reconnaissance Inventory – Dry Weather Survey .....	8
2.3 Water Quality Analysis Methods .....	9
2.4 Water Quality Analysis Methods .....	10
3. Results .....	13
3.1 Barnard Results .....	14
3.2 Barton Results .....	15
3.3 Berkshire Results .....	17
3.4 Bloomfield Results .....	18
3.5 Cambridge Results .....	18
3.6 Charleston Results .....	21
3.7 Corinth Results .....	22
3.8 Derby Town Results .....	22
3.9 Guildhall Results .....	26
3.10 Gilman Results .....	26
3.11 Lincoln Results .....	27
3.12 Lunenburg Results .....	27
3.13 Newport City Results .....	29
3.14 North Montpelier Results .....	38
3.15 North Troy Results .....	38
3.16 Plainfield Results .....	40
3.17 Reading Results .....	41
3.18 Roxbury Results .....	42
3.19 Saint Johnsbury Results .....	42
3.20 Sheffield Results .....	50
3.21 Sheldon Results .....	50
3.22 Strafford Results .....	51
3.23 Thetford Results .....	52
3.24 Topsham Results .....	54
3.25 Vershire Results .....	54



3.26	Waterbury Results .....	54
3.27	Waterville Results .....	54
3.28	Wheelock Results .....	54
3.29	Woodbury Results .....	55
4.	Recommendations for Future Action .....	55
4.1	Barnard – Future Action Recommendations .....	55
4.2	Barton – Future Action Recommendations .....	55
4.3	Berkshire – Future Action Recommendations .....	55
4.4	Bloomfield – Future Action Recommendations .....	55
4.5	Cambridge – Future Action Recommendations .....	55
4.6	Charleston – Future Action Recommendations .....	56
4.7	Corinth – Future Action Recommendations .....	56
4.8	Derby – Future Action Recommendations .....	56
4.9	Gilman – Future Action Recommendations .....	56
4.10	Guildhall – Future Action Recommendations .....	56
4.11	Lincoln – Future Action Recommendations .....	56
4.12	Lunenburg – Future Action Recommendations .....	56
4.13	Newport City – Future Action Recommendations .....	56
4.14	North Montpelier – Future Action Recommendations .....	56
4.15	North Troy – Future Action Recommendations .....	56
4.16	Plainfield – Future Action Recommendations .....	56
4.17	Reading – Future Action Recommendations .....	56
4.18	Roxbury – Future Action Recommendations .....	56
4.19	St. Johnsbury – Future Action Recommendations .....	56
4.20	Sheffield – Future Action Recommendations .....	56
4.21	Sheldon – Future Action Recommendations .....	57
4.22	Strafford – Future Action Recommendations .....	57
4.23	Thetford – Future Action Recommendations .....	57
4.24	Topsham – Future Action Recommendations .....	57
4.25	Vershire – Future Action Recommendations .....	57
4.26	Waterbury – Future Action Recommendations .....	57
4.27	Waterville – Future Action Recommendations .....	57
4.28	Wheelock – Future Action Recommendations .....	57



4.29	Woodbury – Future Action Recommendations.....	57
5.	Phosphorus and <i>E. coli</i> Loading .....	57
6.	Conclusions .....	58
7.	References.....	59

## List of Tables

Table 1.	Summary of ORI Assessments by Municipality. ....	7
Table 2.	Summary of Advanced Investigations by Municipality.....	8
Table 3.	Water Quality Threshold Values for Determining Possibility and Nature of Illicit Discharges. ....	11
Table 4.	Summary of ORI and AI Assessments by Municipality. ....	13
Table 5.	Water Quality Analysis Data for BRN_OF_17.....	14
Table 6.	Water analysis data for outfall BA020. ....	15
Table 7.	Water Quality Analysis Data for BA020.....	16
Table 8.	Water Quality Analysis Data for OF_BERK_3. ....	17
Table 9.	Water Quality Analysis Data for OF_CAMB_6.....	18
Table 10.	Water Quality Analysis Data for OF_CAMB_7.....	19
Table 11.	Water Quality Analysis Data for OF_CAMB_10.....	20
Table 12.	Water Quality Analysis Data for OF_CHRL_5. ....	22
Table 13.	Water Quality Analysis Data for OF_CHRL_7. ....	22
Table 14.	Water analysis data for outfall DT020. ....	23
Table 15.	Water analysis data for outfall DT030. ....	24
Table 16.	Water Quality Analysis Data for DT020.....	25
Table 17.	Water Quality Analysis Data for DT030.....	26
Table 18.	Water analysis data for outfall LU020.....	27
Table 19.	Water Quality Analysis Data for LU020.....	28
Table 20.	Water analysis data for outfall NC360. ....	29
Table 21.	Water Quality Analysis Data for NC360. ....	31
Table 22.	Water analysis data for outfall NC680. ....	32
Table 23.	Water Quality Analysis Data for NC680. ....	35
Table 24.	Water analysis data for outfall NC1050. ....	36
Table 25.	Water Quality Analysis Data for NC1050. ....	37
Table 26.	Water Quality Results for P_CB_100. ....	41
Table 27.	Water analysis data for outfall SJ440.....	42
Table 28.	Water analysis data for outfall SJ950.....	45
Table 29.	Water Quality Analysis Data for SJ440.....	47
Table 30.	Water Quality Analysis Data for SJ950.....	49
Table 31.	Water Quality Results for SHLD_33_Bridge. ....	50
Table 32.	Water Quality Analysis Data for SHLD_90_Church. ....	51
Table 33.	Water Quality Analysis Data for OF_THTF_2. ....	52
Table 34.	Water Quality Analysis Data for OF_THTF_4. ....	52
Table 35.	Water Quality Analysis Data for OF_THTF_7. ....	53
Table 36.	Phosphorus and <i>E. coli</i> Loading Calculations. ....	58



# List of Figures

Figure 1. Photo from Camera Scoping..... 19

Figure 2. Map depicting location of push camera. .... 20

Figure 3. Oil Sheen at Underdrain Outfall..... 21

Figure 4. DT030 outfall ..... 24

Figure 5. Outfall GI020 with OB pad between 2 rocks and covered with debris. .... 26

Figure 6. Visual Inspection of NC360\_MH1. .... 32

Figure 7. NC1050 Dye Testing. .... 38

Figure 8. Manholes with OB pads attached to the metal ladders and the outfall with pad attached, under leaves.  
..... 48

Figure 9. Optical Brightener presence analysis under black light. .... 48

Figure 10. OB Pad analysis for CB 9A and 9 (top) and the outfall and CB 6 (bottom)..... 49

Figure 11. 90 Church Street View..... 51

Figure 12. Outfall pipe THTF\_4 with no flow and a standing pool right below the outfall. .... 53

Figure 13. THTF\_7 Dye Testing. .... 53

# Appendices

- Appendix 1 – All Results Summary Table
- Appendix 2 – Town by Town Results Summary Table
- Appendix 3 – Advanced Investigation Maps



## 1. Introduction

In April 2018, Watershed Consulting Associates, LLC (Watershed) was awarded an Ecosystem Restoration Program grant (#35956) by the Vermont Department of Environmental Conservation to perform an Illicit Discharge Detection and Elimination (IDDE) study for 29 towns throughout Vermont. Participating towns include:

■ Barnard	■ Lincoln	■ Sheldon
■ Barton	■ Lunenburg	■ Strafford
■ Berkshire	■ Newport City	■ Thetford
■ Bloomfield	■ North Montpelier	■ Topsham
■ Cambridge	■ North Troy	■ Vershire
■ Charleston	■ Plainfield	■ Waterbury
■ Corinth	■ Reading	■ Waterville
■ Derby Town	■ Roxbury	■ Wheelock
■ Gilman	■ Saint Johnsbury	■ Woodbury
■ Guildhall	■ Sheffield	

The goal of this study was to find any potential non-stormwater discharges, usually waters related to sanitary sewage, entering the stormwater sewer system, trace them back to their source, and eliminate them. Doing so improves the aquatic ecosystem health of the rivers and streams in those communities and eliminates any potential public health hazards that could be associated with non-stormwater discharges that enter untreated into natural ecosystems.

An extensive project by both volume and range, the geographic scope of work included 29 towns or other designated areas. With over 80 outfalls, twenty-seven are in Cambridge, nine are in Thetford, seven are in Berkshire, and six are in Strafford. All other municipalities contain five outfalls or fewer. Many of them are in watersheds that drain to Lake Champlain or Lake Memphremagog, although some are in the Connecticut and Hudson River watersheds. From developed urban downtowns to rural backroad drainage systems, the project encompassed a wide variety of land uses.

The dry weather assessment, also referred to as the Outfall Reconnaissance Inventory (ORI), was conducted during dry weather (defined as <0.1" in the past 24 hours to the maximum extent practicable), with field tests performed on any flowing water found at the system's pipe outlet. These tests included quantitative tests for ammonia, temperature, pH, and conductivity; qualitative tests for odor, turbidity, color, and floatables; and non-flow-based indicators such as outfall damage, deposits or stains, abnormal vegetation, poor pool quality, and pipe benthic growth. Where any of these indicators suggested a possible illicit discharge, a sample was taken for later analysis for methylene blue active substances (MBAS, a proxy test for detergent). Additional samples were also obtained, where indicated by the results of other analyses, for *E. coli*, total phosphorus (TP), or total nitrogen (TN). Optical brighteners were tested by placing unbleached cotton pads in an outfall for a period of 4-10 days. If any optical brighteners (substances typically associated with laundry detergent) were present, the pads would fluoresce under UV light.

To identify discharges normally associated with human sewage, Watershed partnered with Environmental Canine Services (ECS) to conduct canine scent detection procedures. Following ECS quality control protocol,



Watershed staff collected, packaged, and shipped samples of concern to the ECS headquarters in Otisfield, Maine. Two canines tested each of the shipped samples, negative control and positive control scenting containers, and their responses were recorded. Of the 89 outfalls tested, 29 were flowing when investigated and 10 were suspected of possible illicit discharge during the ORI, or 11% of all outfalls (Table 1). During the Advanced Investigation (AI) portion of the study, 6 of the 10 outfalls were confirmed to have some sort of illicit discharge (Table 2).

**Table 1. Summary of ORI Assessments by Municipality.**

Town	Systems in Contract	Systems Assessed	Systems with Flow	Suspected Illicit Discharge	Confirmed Illicit Discharge
Berkshire	7	6	2	1	1
Bloomfield	4	4	2	0	0
Cambridge	27	27	9	2	2
Charleston	2	7	4	2	0
Corinth	2	2	1	0	0
Guildhall	1	1	1	0	0
Lincoln	3	3	0	0	0
North Montpelier	1	1	0	0	0
Reading	1	1	0	0	0
Roxbury	1	1	0	0	0
Sheffield	3	3	0	0	0
Sheldon	2	5	0	3	2
Strafford	6	6	2	0	0
Thetford	9	9	4	2	1
Topsham	1	1	0	0	0
Vershire	1	1	1	0	0
Waterbury	5	5	1	0	0
Waterville	2	2	1	0	0
Wheelock	1	1	1	0	0
Woodbury	3	3	0	0	0
Total	82	89	29	10	6



**Table 2. Summary of Advanced Investigations by Municipality.**

Town	Advanced Investigations in Contract	Systems Assessed	Systems with Flow	Suspected Illicit Discharge	Confirmed Illicit Discharge
Barnard	1	1	1	1	0
Barton	1	1	1	1	1
Derby Town	2	2	1	2	0
Gilman	0	1	1	0	0
Lunenburg	1	1	1	0	0
Newport City	3	3	3	0	2
North Troy	1	1	0	1	0
Plainfield	1	1	1	1	0
St. Johnsbury	2	2	0	2	1
Total	12	13	9	8	4

## 2. Methods

Our general methodology for this study follows the protocols and recommendations established by the Center for Watershed Protection (CWP), as well as additional guidelines developed over the course of several other studies by the State of Vermont.

### 2.1 Field Work Preparation

Initial preparation for the study involved obtaining the necessary field supplies for sample collection and analysis, creating a digital smartphone-based application for ORI and AI data collection in the field based on the CWP's ORI field and laboratory forms, and creating storm and sanitary sewer digital base layers to use within the smartphone app based on the most recent mapping performed by the VT DEC under the Stormwater Infrastructure Mapping Program.

Towns were individually contacted using the contact information provided by the VT DEC following its stormwater infrastructure mapping project in each of these towns, or from previous IDDE study work. Towns were made aware of the scope of work related to IDDE, the methods to be used, the regulatory issues involved, and the follow-up process should an illicit discharge be discovered. Public notifications were provided for each town to use in its outreach process (local papers, websites, social media, etc.).

### 2.2 Outfall Reconnaissance Inventory – Dry Weather Survey

Stormwater systems were assessed during dry weather to minimize dilution by large volumes of runoff. Dry weather was defined as <0.1" precipitation in the previous 24 hours to the maximum extent practicable. There were times during the study when outfalls were assessed when precipitation had marginally exceeded this amount – this was noted on the Outfall Reconnaissance Inventory reports. Surveys during these times were





avoided whenever possible. Only outfalls specified by VT DEC as part of the scope of work were assessed – other outfalls were not assessed. Outfalls in the public right of way or along a water body were accessed via public land. Where portions of the stormwater system were on private land, permission was obtained prior to investigating the system. If access to property was denied, infrastructure within the public right of way was assessed. Where no publicly accessible infrastructure existed access denial was noted, and the system was not analyzed.

Watershed developed a digital smartphone-based application to use for the collection, storage, analysis, and reporting of survey data. This application, developed using a third-party software platform, is based on the CWP field and laboratory forms merged into one overall interface and accessed in the field using a smartphone or tablet device. An integral part of the creation of this application was the import of all stormwater and sanitary sewer infrastructure points from the VT DEC's mapping program. Each of these features was assigned a unique alphanumeric code and color-based symbol. This enabled field staff to quickly find each outfall or other infrastructure point using the phone's built-in GPS. Using these previously mapped points also ensured the accuracy of each point's geo-location as built-in phone GPS units are only accurate to 3-5 meters where most of the VT DEC data is sub-meter accurate.

Wherever unmapped points were found, they were either mapped using a sub-meter horizontal accuracy Trimble GeoXH GPS unit, or were recorded using the phone's built-in GPS and later corrected using high-resolution aerial photos. This process was also particularly useful for unmapped points found under bridges or in a narrow urban stream reaches between taller buildings where satellite reception is poor.

At every outfall point, the basic procedure was to search for the presence or absence of flow. If there was no flow during dry weather, it was generally assumed that there was no chronic illicit discharge present unless other non-flow-based indicators such as outfall damage, deposits or stains, abnormal vegetation, poor pool quality, or pipe benthic growth were noted. If none of these indicators was present, basic time/date information was entered into the application, along with a 'No' indicator for flow and non-flow based indicators and the outfall was assigned an overall characterization of 'Unlikely'.

If flow was present, immediate analysis for temperature, pH, specific conductance, ammonia, and methylene blue active substances (MBAS, a detergent indicator) was conducted in the field. Other indicators, such as color, odor, turbidity, and floatables were noted as well. If any indicators were above the established thresholds (Table 3), a sample was taken for analysis of total chlorine (if applicable depending on municipality).

In cases where other non-flow based indicators (listed above) were present, or a sample was not otherwise able to be obtained from a flow or pool, a cotton pad was placed in the line of assumed flow to capture intermittent discharges and analyze them for the presence of optical brighteners.

Additionally, Watershed noted any non-IDDE issues at the outfall or structure such as erosion, structure damage, headwall collapses, etc.

## **2.3 Water Quality Analysis Methods**

*Temperature/pH/Specific Conductance:* The Hanna Instruments HI98129 Combo pH and EC meter was used for all three parameters. Fresh pH and conductivity buffers were ordered at the beginning of the study from Endyne Labs in Williston, VT to ensure accuracy using standard solutions at known specific conductivity ranges.

*Ammonia:* Ammonia was measured immediately in the field using the LaMotte Colorimeter 1500 (Model 3680-01). This unit uses Nessler's reagent for the detection of ammonia using a color reaction that is then measured by the colorimeter. The range and sensitivity are 0-5ppm and 0.05ppm NH<sub>3</sub>-N.



*Methylene Blue Active Substances (MBAS):* The presence of detergents was determined using the Chemetrics R-9400 Detergents test which used a methylene blue active substances (MBAS) test, a method consistent with APHA Standard Methods, 21st ed., Method 5540 C (2005).

*Total Chlorine:* Total chlorine was measured using the Hach Model CN66 Chlorine – Free and Total Color Disk Kit with a 0-3.5 mg/L range. This kit uses a powdered DPD reagent method and visual color wheel to determine total chlorine concentration in samples quickly and accurately.

*Optical Brighteners:* Where indicated, Watershed used cotton pads placed either in the flow path of water at the outfall or in the sump of a catchbasin where flow was anticipated. These pads sat for a period of 4-10 days encased in a plastic-coated wire mesh pouch. After this period, pads were retrieved, rinsed, and dried, then exposed to a UV (black) light. In the presence of detergents, the pad will fluoresce to varying degrees. Watershed did not attempt to make measurements of the relative amount of fluorescence – this test was only for presence or absence. However, fouling with other debris and dirt often made reading results difficult. In most cases where there was generally reliable flow or pooled water in the catchbasin sump, the MBAS test was used.

## **2.4 Water Quality Analysis Methods**

Using water quality thresholds established by the CWP and used by the US EPA in their Illicit Discharge Detection and Elimination guidance, as well as thresholds referenced in other IDDE studies performed throughout Vermont (Table 3), outfalls were designated for follow-up investigation based on exceedance of these thresholds. In addition to these chemical benchmarks, other criteria such as outfall damage, deposits or stains, abnormal vegetation, poor pool quality, or pipe benthic growth, as well as water color, odor, turbidity, or the presence of floatables were used to supplement assessments.

Follow-up investigation consists primarily of following any observed flow up a stormline to pinpoint its source, then testing that source using the aforementioned thresholds. If multiple sources were observed coming into a main line, those sources were tested as well to attempt to bracket possible pollution inputs. Where possible, a section of a stormline was isolated as possibly containing the origin point of pollution. This section was then designated for follow-up to confirm or deny an issue's presence. Watershed communicated directly with each municipality to discuss the findings and to plan for follow-up investigation. These investigations are described below.

**Table 3. Water Quality Threshold Values for Determining Possibility and Nature of Illicit Discharges.**

Test	Threshold (US EPA)	Threshold (VT Specific Studies)	Notes
<i>E. coli</i> (MPN/100ml)	235	400	Wastewater (undiluted) will have levels far exceeding 400 MPN. However <i>E. coli</i> can occur due to animal waste entering the storm system through open catch basins. Additionally, there is some evidence which indicates that <i>E. coli</i> populations can survive in anaerobic sediment conditions found in streams, ponds, or other similar environments. <i>E. coli</i> is a difficult indicator to use in IDDE for these reasons.
Ammonia (mg/L)	0.1	0.25	Ammonia is an indicator of decomposition of organic matter. Decomposing landscaping vegetation within catch basins under anoxic conditions can cause elevated ammonia in water. This can cause misleading results. The threshold of 0.25 mg/L is only used when other indicators are present. Otherwise a value of 0.5 mg/L is the trigger for additional investigation.
MBAS (mg/L)	0.25	0.2	Anionic detergents are fairly commonly found at outfalls in low-flow conditions found during dry weather as they correlate with various outdoor washing practices (of cars, house siding, windows, and also windshield washing fluid). Higher levels (typically 0.5-0.75 mg/L or greater) can sometimes indicate wastewater discharges.
Optical Brightener	N/A	Presence	Presence of optical brighteners can indicate washwater or wastewater contaminants as brighteners are contained in some hair conditioners, bleached paper products, and laundry detergents. Petroleum products will also cause fluorescence. Some studies indicate that a relatively high concentration of OB must be present for detection. We only use this test when other indicators are strongly present.
Chlorine (mg/L)	N/A	0.06	This test is used only in municipalities where municipal water is provided and chlorinated. This test was used very sparingly during this study as few of the towns chlorinated their water. As it degrades in the presence of organic materials, it's not a good wastewater indicator.
Specific Conductance (uS/cm)	>2000	600	Specific conductance can be elevated by road deicing materials, or metals from corrosion. It can help in determining some industrial discharges but is primarily used in conjunction with other strong indicators.



#### ***2.4.1 Televising Sanitary and Stormlines***

An additional method to identify illicit discharges is to use either a push or track camera, depending on pipe type and size, to obtain video of pipe cross connections, leaks, or other means by which non-stormwater discharges may be entering storm pipes. This method is most effective when combined with line flushing using dyed water. We did not use this method extensively during this study, however, as only Newport City possessed the necessary equipment. In the past, we have worked with the Vermont Rural Water Association to perform this work. However, we favored using liquid smoke testing over camera investigation during this study due to its efficiency and positivity in identifying or ruling out illicit discharge connections.

#### ***2.4.2 Smoke Testing with Vermont Rural Water Association***

Smoke testing using non-toxic liquid smoke was used in many of the municipalities in this study. Smoke is blown into a manhole or catchbasin structure (storm) and visual observations are made of surrounding sanitary infrastructure. Manholes are opened adjacent to the storm infrastructure, building sewer gas vent stacks are scrutinized for smoke escaping, and at times buildings are entered, with permission, to check for smoke in basements or other areas. The reverse test is also often done where smoke is blown into sanitary infrastructure and the storm system is inspected, via manholes and catchbasins, for smoke intrusion. Watershed has found that this is one of the most efficient, reliable means of identifying possible illicit discharges, especially when infrastructure is poorly mapped or understood.

#### ***2.4.3 Environmental Canine Services (ECS) Alerts***

Environmental Canine Services (ECS) uses specially trained canines to detect the presence or absence of sanitary sewage. Watershed has used this method before in the Towns of Bennington and Pawlet with success. There are two primary methods to use with ECS. The first method is the 'ship and sniff' method where a sample is collected in a sterile 12 oz plastic bottle. The outside of the bottle is rinsed in distilled water and double-bagged in a resealable plastic bag. These samples are then shipped to ECS in Maine where they are evaluated by the canines and their handlers. A report is prepared of the results. If a dog alerts on a sample, that outfall is then flagged for additional follow-up investigation. This method provides a good screening of outfalls that, based on previous water quality parameters, may be receiving illicit discharges. The second method involves bringing a canine and handler to a storm sewer system and doing on-site field investigations of structures. Field investigation was never utilized during this study.



### 3. Results

The overall results for all towns can be seen below. These results are the combination of Table 1 and Table 2.

**Table 4. Summary of ORI and AI Assessments by Municipality.**

Town	Systems in Contract	Systems Assessed	Systems with Flow	Suspected Illicit Discharge	Confirmed Illicit Discharge
Barnard	1	1	1	1	0
Barton	1	1	1	1	1
Berkshire	7	6	2	1	1
Bloomfield	4	4	2	0	0
Cambridge	27	27	9	2	2
Charleston	2	7	4	2	0
Corinth	2	2	1	0	0
Derby Town	2	2	1	2	0
Gilman	0	1	1	0	0
Guildhall	1	1	1	0	0
Lincoln	3	3	0	0	0
Lunenburg	1	1	1	0	0
Newport City	3	3	3	0	2
North Montpelier	1	1	0	0	0
North Troy	1	1	0	1	0
Plainfield	1	1	1	1	0
Reading	1	1	0	0	0
Roxbury	1	1	0	0	0
Sheffield	3	3	0	0	0
Sheldon	2	5	0	3	2
St. Johnsbury	2	2	0	2	1
Strafford	6	6	2	0	0
Thetford	9	9	4	2	1
Topsham	1	1	0	0	0
Vershire	1	1	1	0	0
Waterbury	5	5	1	0	0
Waterville	2	2	1	0	0
Wheelock	1	1	1	0	0
Woodbury	3	3	0	0	0
Total	94	102	38	18	10



For a more complete overview table showing all results from both the Outfall Reconnaissance Inventory and Advanced Investigation combined, please see Appendix 1: Smaller Towns IDDE – Results Summary Table.

### 3.1 Barnard Results

#### 3.1.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on April 25th, 2016 Watershed surveyed 17 different outfalls. Of the 17 outfalls visited, five were flowing and three had discharge that warranted further investigation.

#### 3.1.2 Advanced Investigation (AI)

Of the five systems assessed, none were found to have an illicit discharge that was confirmed. While other outfalls were deemed unsuspecting during studies in August 2017, it remained unclear if BRN-OF-17 was associated with an illicit discharge. Final follow up was conducted in April 2019, what follows is a summary of the outfall and its drainage system. Water quality data is presented for all dates visited in Table 5. Fields left blank in the table represent water quality parameters that were not tested.

##### 3.1.2.1 BRN\_OF\_17

**Table 5. Water Quality Analysis Data for BRN\_OF\_17.**

Infrastructure ID	Date	Flow	Notes	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)	TKN (mg/L)
BRN_OF_17	4/25/2016	yes	No physical indicators present	8.06	445	0.05	trace	-	-	-
BRN_OF_17	8/24/2017	yes	No physical indicators present	7.81	720	0.63	0.25	-	-	-
BRN_OF_17	4/17/2019	yes	No physical indicators present	8.2	267	0.35	0	1	<.05	0.4
BRN_CB_23A	4/17/2019	yes	No physical indicators present	7.86	1217	0	0.25	<1.0	-	-
BRN_CB_23B	4/17/2019	yes	No physical indicators present	8.32	693	0.05	0.25	<1.0	-	-
BRN_CB_23C	4/17/2019	yes	No physical indicators present	8.02	729	0.25	0.25	<1.0	-	-
BRN_POT_1	4/17/2019	yes	No physical indicators present	8.68	120	0.29	0	<1.0	-	-
BRN_CB_43	4/17/2019	yes	No physical indicators present	8.32	265	0.15	0	<1.0	-	-

Initial outfall testing at BRN-OF-17 revealed water quality results largely below threshold parameters. However, reddish staining of the pipe outlet led the team to flag it for follow-up. Access to the site proved to be difficult as the property is a private resort. A return trip was conducted on 8-24-17, primarily to sample for Environmental Canine Services Ship and Sniff testing. Please note that the ammonia water quality results from 8-24-17 are believed to be erroneously high as a field blank tested that day returned a result of 0.27 mg/L, suggesting contaminated reagent. However, upon assessment by Environmental Canine Services Ship and Sniff testing, both canines alerted. The owners of the property were alerted to this result and smoke testing was tentatively scheduled for April 2018. However, the work was not performed during this period as a suitable time could not be found. Watershed returned to Twin Farms to conduct follow up water quality analysis and smoke test the storm/sewer lines in April 2019.

In order to best bracket all possible sources of contamination, Watershed sampled six different locations upstream of the outfall. Standard water quality parameters were taken at each location as well as *E. coli*. Once water quality testing was complete, the system was smoke tested. Smoke was injected into the storm system at multiple locations. No smoke was observed flowing from sewer vent stacks on building roofs or from any adjacent sewer manhole structures. Once the storm system was cleared of smoke, the smoke machine was placed on two different sewer manholes and the system was again tested for crossover. No smoke was observed in the storm system. No direct connections were found during the smoke testing and all water quality parameters were under threshold, therefore no illicit discharge is suspected at this outfall, despite the positive alert by ECS canines.



We can conclusively state that there is no direct illicit connection associated with the sewer drainage system owned and operated by Twin Farms Resort to the system draining to outfall BRN\_OF\_17. Please note that there is a pond which drains to the outfall as well, which appears to be the source of most flow to this location. While it may be possible that the canines were alerting on substances associated with water coming from that pond or the outfall leading to it, BRN-OF-15 was found to be clear of potential illicit discharges. We cannot, therefore, conclusively say why the canines alerted on the previous sample, nor what may have been the cause. We can say that we do not believe there to be illicit discharges associated with either BRN-OF-17 or BRN-OF-15.

### 3.2 Barton Results

#### 3.2.1 Outfall Reconnaissance Inventory (ORI)

Watershed was contracted to perform advanced investigation on one system in Barton. What follows is the initial ORI and previous AI findings that were published by the VT DEC and Stone Environmental, Inc. on February 21, 2016 in a report entitled *Lake Memphremagog Basin Additional Advanced Investigation*.

##### 3.2.1.1 BA020

*"The BA020 system drains a portion of Lake Street and a few underdrains located on two residential properties (Map BA-1). It discharges just south of 501 Lake Street.*

**Table 6. Water analysis data for outfall BA020.**

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
BA020	7/22/14 9/4/14	Flowing Flowing	0.10 --	0.03 --	0.10 --	386 --	Positive Positive	Clear, no odor --
BA020 CB1	9/4/14	Flowing	--	--	--	--	Positive	Strong sewage odor
BA020 CB1 Pipe A	10/9/14	Flowing	0.10	--	--	--	--	Clear, no odor
BA020 CB1 Pipe B	10/9/14 5/14/15	Flowing Flowing	3.0 --	-- --	-- --	-- --	-- --	Strong wastewater odor Strong wastewater odor
BA020 CB2 Sump	9/4/14	Trickling	--	--	--	--	Negative	--
BA020 CB2 Pipe B	9/4/14	Trickling	--	--	--	--	Negative	--

#### Findings:

- Optical brightener was detected at the outfall and in the sump of catchbasin CB1, but not in CB2.





- On September 4, 2014, a strong sewage odor was observed at the outfall and catchbasin CB1, but not at CB2.
- A neighbor commented that the septic system at 530 Lake Street is frequently pumped.
- On October 9, 2014, a high ammonia concentration (3.0 mg/L) was measured from Pipe B in catchbasin CB1; ammonia was below detection in flow from CB1 Pipe A. Catchbasin CB1 Pipe B connects to a drop inlet located on the property of 530 Lake Street. A shallow ditch along the driveway was flowing to the drop inlet. This flow appeared to be wastewater.
- Pipe B in catchbasin CB1 was sampled for *E. coli* and total phosphorus analysis on May 14, 2015 (Table 79). The *E. coli* concentration (40 MPN/100 mL) was surprisingly low while the TP concentration was moderately high (339 µg/L). The sample had a wastewater odor.

**Conclusion:** Based on the optical brightener and ammonia test results and wastewater odor observations, we conclude that there is a malfunctioning septic system at 530 Lake Street that discharges to catchbasin CB1.

**Resolution:** This matter was referred to the town health officer, Joyce Croteau, on October 10, 2014 by Nathan Sicard, a member of the Barton Village Board of Trustees. The DEC Regional Engineer, Steve Rebillard, was also made aware of this problem. The DEC project manager referred the problem to enforcement on July 15, 2015.” (VT DEC & Stone Environmental, Inc., 2015)

### 3.2.2 Advanced Investigation (AI)

#### 3.2.2.1 BA020

**Table 7. Water Quality Analysis Data for BA020.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
BA020	8/1/2019	-	yes	7.55	379	-	0.25	Yes	31	-
BA020_CB1	8/1/2019	-	yes	7.18	467	-	0.25	Yes	1400	-
BA020_CB2	8/1/2019	-	yes	7.91	256	-	0	Yes	<1	-

The water quality data strongly supports the previous conclusion that the septic leachate from 530 Lake Street is being intercepted by catchbasin CB1. Specifically, the *E. coli* concentration in CB1 clearly suggests the presence of wastewater coming from a source other than CB2. The only other pipe entering CB1 comes from a drop inlet located on the property of 530 Lake Street. The *E. coli* concentration in CB2 was negligible, so the drop inlet on 530 Lake Street is the only possible source of *E. coli* to CB1. Smoke testing was conducted from CB1, but no crossover was observed with the private septic system at 530 Lake Street. Dye testing was not able to be conducted because the homeowner would not cooperate. The water quality data collected in conjunction with data from the previous study clearly identify an illicit discharge happening due to septic leachate at 530 Lake Street. However, because the definition of a failed septic system is surfacing septic, the homeowners cannot be forced to perform any maintenance at this point.



### 3.3 Berkshire Results

#### 3.3.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on 8/27/2018 and again on 6/24/2019, six outfalls were assessed. Of the six outfalls assessed, two outfalls were flowing at a trickle, and one outfall was marked as a possible illicit discharge. The outfall had a small amount of flow during both dry weather assessments and preliminary analysis revealed that *E. coli* was above US EPA and VT thresholds, and TP concentrations were elevated on both dates the outfall was visited; this suggests a chronic illicit discharge. The outfall was flagged for further investigation and was revisited on 8/21/2019. Results of the initial assessment in Berkshire are included in Appendix 1 – All Results Summary Table.

#### 3.3.2 Advanced Investigation (AI)

Of the six systems assessed, one was suspected of having a possible illicit discharge. What follows is a summary of the outfall (or other infrastructure within an outfall's drainage system) suspected of possible illicit discharge. Water quality data is presented for all states visited. Fields left blank in the table represent water quality parameters that were not tested.

##### 3.3.2.1 OF\_BERK\_3

**Table 8. Water Quality Analysis Data for OF\_BERK\_3.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_BERK_3	8/27/2018	-	yes	-	-	-	-	-	2400	0.19
OF_BERK_3	6/24/2019	Outlet either covered with rockfall or collapsed. Sample take from pool in ditch that has sediment suspended from flow. This could elevate ammonia and phosphorus levels.	yes	8.35	562	0	0.25	Yes	1600	1
OF_BERK_3_CB_41	8/21/2019	Ammonia was overrange, lots of dead bugs in the catchbasin. Perforation holes are on the non-septic side of the catchbasin. Smoke tested from the catchbasin, no crossover observed. Flushed green dye down the gas station toilet, purple dye in the bathroom sink, and orange dye in the utility sink; no dye was observed in any storm infrastructure.	no	8.1	179	5	2	N/A	N/A	N/A
OF_BERK_3_CB_39	8/21/2019	Same as CB_41	no	7.5	199	5	2	N/A	N/A	N/A

After analyzing the water quality data from the first two site visits, the system was identified as needing further advanced investigation. The septic system for the gas station is located directly to the west of the outfall and associated catchbasins, so advanced investigations were focused on identifying any crossover that may be occurring from the septic system to the storm system. On 8/21/2019, the system was smoke tested from CB\_41. No smoke was observed emanating from any infrastructure associated with the septic system. After smoke testing, dye was flushed down the toilet, bathroom sink, and utility sink of the gas station; no dye was observed in any storm infrastructure. Ammonia and MBAS were analyzed for both catchbasins; ammonia was overrange (>5 ppm) for both catchbasins, and the MBAS concentration was 2 ppm for both catchbasins. A two-inch diameter PVC pipe was noted entering CB\_41; the pipe was determined to be a refrigerant drain from the walk-in fridge in the gas station. The refrigerant effluent was analyzed for ammonia and MBAS; Ammonia was overrange (>5 ppm), and MBAS concentration was 0 ppm. Both catchbasins were also dry wells. Septic leachate could potentially be intercepted by these perforations, and this could explain the high levels of MBAS and *E. coli* in the system. However, because no septic leachate is surfacing, the system is considered functioning properly, despite water quality implications.



### 3.4 Bloomfield Results

#### 3.4.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on 5/31/2019, four outfalls were assessed. Of the four outfalls visited two outfalls were flowing at a trickle, but none were marked as a possible illicit discharge based upon their visual inspections and water quality data. Results of the initial assessment in Bloomfield are included in Appendix 1 – All Results Summary Table.

#### 3.4.2 Advanced Investigation (AI)

No contaminants were detected above thresholds; therefore, no systems were designated for further investigation.

### 3.5 Cambridge Results

#### 3.5.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted from 7/30/2018 to 7/31/2018, 27 outfalls were assessed. Of the 27 outfalls visited, nine were flowing, and two had discharge that warranted further investigation. The outfalls in question were reexamined on 9/10/2019 with advanced investigation techniques such as smoke testing and dye testing, in addition to further water quality analyses to determine the nature and source of any possible illicit discharge. Results of the initial assessment in Cambridge are included in Appendix 1 – All Results Summary Table.

#### 3.5.2 Advanced Investigation (AI)

Of the 27 systems assessed, two were suspected of having an illicit discharge. What follows is a summary of the outfall (or other infrastructure within an outfall's drainage system) suspected of possible illicit discharge. Water quality data is presented for all dates visited. Fields left blank in the table represent water quality parameters that were not tested.

##### 3.5.2.1 OF\_CAMB\_6

**Table 9. Water Quality Analysis Data for OF\_CAMB\_6.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_CAMB_6	7/31/2018	-	yes	7.98	2316	0.02	-	-	-	0.45
OF_CAMB_6	9/10/2019	-	yes	7.42	473	0	0.175	-	6.3	0.01
OF_CAMB_6_CB_88	9/10/2019	-	yes	-	-	-	-	-	8.6	-

Upon reviewing water quality data, this system was flagged for a revisit due to lack of parameters tested. The data from the retesting showed that no illicit discharge was occurring in this system.



### 3.5.1.1 OF\_CAMB\_7

**Table 10. Water Quality Analysis Data for OF\_CAMB\_7.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_CAMB_7	7/31/2018	-	yes	7.5	406	1.22	0.25	-	10	0.018
OF_CAMB_7	9/10/2019	-	yes	7.42	485	2.04	0.175	-	290	0.1
OF_CAMB_7_CB_89	9/10/2019	-	no	-	-	-	-	-	51	-
OF_CAMB_7_CB_89	10/21/2019	Smoke testing was conducted. Some diffuse smoke was seen coming from the nearby sewer manhole, although the results were largely inconclusive because the smoke emanating from the sewer manhole was difficult to see, and the results couldn't be recreated when smoking the sewer system.	no	N/A	N/A	N/A	N/A	N/A	N/A	N/A

After analyzing the initial water quality data, it was clear that there was some source of *E. coli* to the OF\_CAMB\_7 system in between CB\_89 and the outfall. Based on paper maps provided by Dan Maxon of Smuggler's Notch, the sewer line crosses in between this outfall and CB\_89. Smoke was blown into CB\_89, and some very diffuse smoke was seen emanating from the nearby sewer manhole, but it was difficult to see. The storm system was then cleared, and smoke was blown into the sanitary sewer; the crossover results could not be recreated. After discussing the results with Dan Maxon, he said that the system would be inspected for any potential connections in this location using a camera at the next possible date.

Watershed followed up on this work and on August 20, 2020, a televised survey of the sewer system was completed to further evaluate CAMB\_7. A push camera was installed into the sewer manhole as indicated on the plan in Figure 2. The camera was extended through the sewer line beyond the crossing with the subject stormwater line to the next sewer manhole structure as seen in Figure 1. The pipe was observed to be in good condition with no evidence of bends or cracks. The outfall was observed to be dry at the time of the inspection with no visual evidence of contamination.



**Figure 1. Photo from Camera Scoping.**

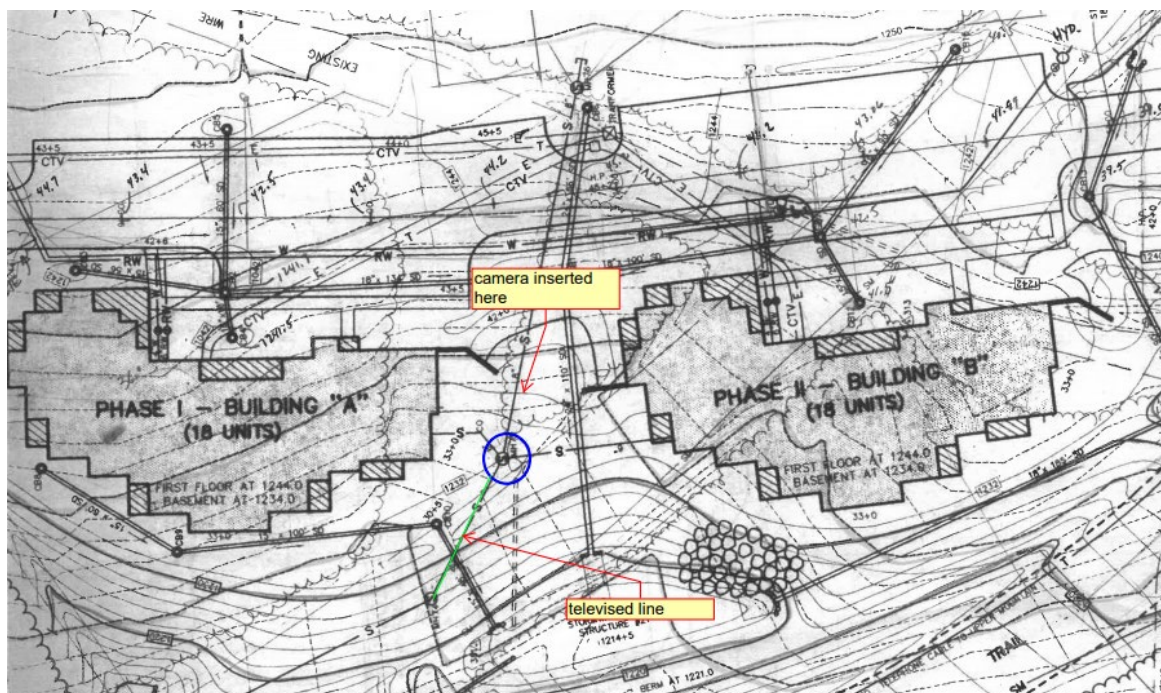


Figure 2. Map depicting location of push camera.

### 3.5.1.2 OF\_CAMB\_10

Table 11. Water Quality Analysis Data for OF\_CAMB\_10.

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_CAMB_10	7/30/2018	-	yes	7.3	2080	0.31	0.25	-	10	0.03
OF_CAMB_10	9/10/2019	-	yes	7.31	805	0.61	0.175	-	3.1	0.01
OF_CAMB_10_CB_185	9/10/2019	-	no	-	-	-	-	-	520	-
OF_CAMB_10_CB_185	10/21/2019	Smoke testing performed at CAMB 10 CB 185, which only receives surface runoff. No sewer infrastructure visible from testing location, so building sewer gas vents were observed and no smoke seen. Smoke testing was inconclusive. Dye testing was then performed. Dye flushed down first floor toilet. None observed at stormwater outlet. Near main base area intersection.	no	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Upon reviewing water quality data, the CAMB\_10 system was flagged for advanced investigation due to the high *E. coli* concentration at CB\_185 on 9/10/2019. The system was smoke tested from CB\_185, and the sanitary vents on all nearby buildings were observed, as there is no nearby sanitary sewer infrastructure; no crossover was observed. Dye was flushed down the toilet of room 002 of the nearby building, and no crossover was observed. Based on the advanced investigation results, no chronic illicit discharge is occurring in the CAMB\_10 system. It is possible that the high *E. coli* on 9/10/2019 was from an external source, such as animal feces.





## 3.6 Charleston Results

### 3.6.1 Outfall Reconnaissance Inventory (ORI)

During the ORI conducted on 06/17/2019, Watershed surveyed seven different outfalls. Of the two outfalls visited, four were flowing, and two had discharge and/or visual indicators that warranted further investigation. The two outfalls in question were reexamined on 10/29/2019 with advanced investigation techniques such as smoke testing and/or dye testing to determine the nature and source of any possible illicit discharge. Results of the initial assessment in Charleston are included in Appendix 1 – All Results Summary Table.

### 3.6.2 Advanced Investigation (AI)

Of the seven systems assessed, two were suspected of having an illicit discharge. What follows is a summary of the outfalls (or other infrastructure within an outfall's drainage system) suspected of possible illicit discharge. Water quality data is presented for all dates visited. Fields left blank in the table represent water quality parameters that were not tested.

#### 3.6.2.1 OF\_CHRL\_5

Upon review of water quality data, CHRL\_5 was flagged for advanced investigation due to high phosphorus, ammonia, and specific conductivity values. The system was smoke tested on 10/29/2019 and no crossover was observed. During the October site visit, it was observed that the outfall had been buried during the previous site visit, and the “outfall” that had been sampled prior was an underdrain for the nearby garage. The actual outfall was not flowing during the site visit. Due to this misidentification, the lack of flow, and the lack of crossover during smoke testing, it is our conclusion that no chronic illicit discharge is occurring in this system. However, it does appear that the underdrain from the nearby maintenance garage may be polluting the stream it discharges to. The pool at the underdrain outfall had very poor quality, high ammonia and total phosphorus, and a visible oil sheen (Figure 3).



Figure 3. Oil Sheen at Underdrain Outfall.

**Table 12. Water Quality Analysis Data for OF\_CHRL\_5.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_CHRL_5	6/17/2019	Pool of orange algae filled water at pipe outfall. It seems like pollutant source is from garage/rubbish removal business adjacent to outfall.	yes	7.03	1024	3.46	0.175	Yes	4.1	0.44
OF_CHRL_5	10/29/2019	Smoke testing performed, no crossover observed. Outfall misidentified from last visit, because it was buried during last visit. Previously identified outfall is an underdrain for maintenance garage.	no	-	-	-	-	-	-	-

### 3.6.2.2 OF\_CHRL\_7

CHRL\_7 was flagged for advanced investigation due to excessive algal growth at the outfall. The system was smoke tested on 10/29/2019, and no crossover was observed. During smoke testing, it was discovered that the outfall had been misidentified previously due to clogging of the outfall and overgrowth of vegetation. The data suggest that no illicit discharge is occurring in this system.

**Table 13. Water Quality Analysis Data for OF\_CHRL\_7.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_CHRL_7	6/17/2019	Lots of orange algal growth	no	-	-	-	-	-	-	-
OF_CHRL_7	10/29/2019	Outfall misidentified during last visit due to clogging and overgrowth of vegetation. Smoke testing performed from the immediate upsystem catchbasin, no crossover observed.	no	-	-	-	-	-	-	-

## 3.7 Corinth Results

### 3.7.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on 8/20/2018, two outfalls were surveyed. Of the two outfalls visited, one was flowing, but none were marked as a possible illicit discharge based upon their visual inspections and water quality data. Results of the initial assessment in Corinth are included in Appendix 1 – All Results Summary Table.

### 3.7.2 Advanced Investigation (AI)

No contaminants were detected above thresholds; therefore, no systems were designated for further investigation.

## 3.8 Derby Town Results

### Outfall Reconnaissance Inventory (ORI)

Watershed was contracted to perform advanced investigation on two systems in Derby. What follows is the initial ORI and previous AI findings that were published by the VT DEC and Stone Environmental, Inc. on August 14, 2015 in a report entitled *Detecting and Eliminating Illicit Discharges to Improve Water Quality in the Lake Memphremagog Basin*.





## DT020

*“The DT020 system drains a portion of Hinman Settler Road and discharges to the Clyde River at the bottom of Hinman Settler Road (Map DT-1).”*

**Table 14. Water analysis data for outfall DT020.**

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
DT020	7/30/14	Flowing	0.10	0.10	0.00	435	Positive	Clear, slightly foamy, no odor
	9/4/14	Flowing	0.10	0.06	0.10	405	Positive	Clear, no odor
	5/14/15	Flowing	--	--	--	--	--	Clear, no odor
DT020 CB1	9/4/14	Flowing	--	--	--	--	Positive	--
DT020 CB3	9/4/14	Flowing	--	--	--	--	Positive	--
DT020 Culvert 1	9/4/14	Flowing	--	--	--	--	Positive	--
DT020 Culvert 2	9/4/14	Dripping	--	--	--	--	Positive	Strong OB signal
	10/9/14	Trickling	3.0	--	--	--	--	Strong wastewater odor

**Findings:**

- Optical brightener was detected throughout the DT020 system.
- On September 4, 2014, optical brightener monitoring pads were deployed throughout the drainage system and several structures were inspected. Optical brightener was present throughout the flowing portion of the drainage system. The strongest signal was detected at the outlet of culvert #2 (Map DT-1), which drains the property at 110 Hinman Settler Road.
- On October 9, 2014, wastewater effluent was observed seeping from the ground into the road ditch at 110 Hinman Settler Road and a high concentration of ammonia (3.0 mg/L) was measured in this seepage (Table 14). The discharge rate was 179 L/min, which likely means that any wastewater was substantially diluted.

**Conclusion:** We conclude that there is a malfunctioning septic system at 110 Hinman Settler Road that is discharging wastewater into the DT020 system.



**Resolution:** A letter detailing these findings was sent on October 14, 2014 to the DEC Regional Engineer, Steve Rebillard. On July 15, 2015, the problem was referred to enforcement by the DEC project manager.” (VT DEC & Stone Environmental, Inc., 2015)



**Figure 4. DT030 outfall**

#### DT030

*“The DT030 system drains a small portion of Hinman Settler Road and discharges to the Clyde River at the bottom of Hinman Settler Road (Map DT-1, Figure 4)*

**Table 15. Water analysis data for outfall DT030.**

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
DT030	7/17/14	Trickling	0.10	0.15	0.20	509	Positive	Clear, no odor
	9/4/14	Trickling	0.25	0.07	0.10	528	Positive	Clear, no odor
	5/14/15	Trickling	--	--	--	--	--	Wastewater odor
DT030 CB1	9/4/14	Trickling	--	--	--	--	Positive	Sewer odor

#### Findings:

- Optical brightener was detected at the outfall and in catchbasin CB1. Low



concentrations of ammonia, MBAS, and chlorine have also been detected at the outfall.

- A steady flow of water was observed seeping from the yard on the northern end of the property at 31 Hinman Settler Road and discharging into CB1. This water has a wastewater odor.

***E. coli and total phosphorus concentrations in samples collected at the outfall on May 14, 2015 were surprisingly low considering that a wastewater odor was observed (Table 15.).***

***Conclusion:*** Based on repeated testing and observations, we conclude that the house at 31 Hinman Settler Road has a malfunctioning septic system that is discharging into the DT030 system.

***Resolution:*** A letter detailing these findings was sent on October 14, 2014 to the DEC Regional Engineer, Steve Rebillard. The problem was then referred to enforcement by the DEC project manager on July 15, 2015.” (VT DEC & Stone Environmental, Inc., 2015)

### 3.8.1 Advanced Investigation (AI)

#### 3.8.1.1 DT020

**Table 16. Water Quality Analysis Data for DT020.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
DT020	8/1/2019	No OB fluorescence	yes	7.69	835	-	-	Yes	52	-

The DT020 system is comprised of only ditches and culverts, so no smoke testing could be conducted. The previous issue was identified as seeping septic from 110 Hinman Settler Rd. No seepage was observed during the visit. However, a perimeter drain that comes from the lawn and discharges directly into the town ditch was noted; the pipe could provide an unrestricted flow path for partially treated leachate from the septic system at 110 Hinman Settler Rd. No discharge from this pipe was observed during multiple visits to the site. Water quality parameters were measured at the outfall, and the only parameter that was above threshold was specific conductivity. An OB pad was left in culvert 2, which crosses the road from the ditch adjacent to 110 Hinman Settler Rd. No OB fluorescence was observed in this system. Additionally, the site was inspected for seepage when the OB pad was collected, and once again the site was dry. Based on our findings, no illicit discharge is occurring in the DT020 system.



### 3.8.1.2 DT030

**Table 17. Water Quality Analysis Data for DT030.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
DT030	8/1/2019	Left OB pad, performed visual inspection of outfall and house that had the supposed sewer issue contributing to the illicit discharge. No OB fluorescence.	no	-	-	-	-	-	-	-

The DT030 system consists of one catchbasin, located in the lawn of 31 Hinman Settler Rd, piped directly to an outfall. The system was totally dry so no water quality analysis could be performed, but an OB pad was left at CB1. The previous issue was identified as surfacing effluent from the septic system at 31 Hinman Settler Rd. No surfacing septic was observed upon the initial visit and when the OB pad was collected. No optical brightener presence was found in the DT030 system. Based on our findings, no illicit discharge is occurring in this system.

## 3.9 Guildhall Results

### 3.9.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on 5/31/2019, two different outfalls were surveyed. Of the two outfalls visited, one was flowing, but none were marked as a possible illicit discharge based upon their visual inspections and water quality data. Results of the initial assessment in Guildhall are included in Appendix 1 – All Results Summary Table.

### 3.9.2 Advanced Investigation (AI)

No contaminants were detected above thresholds; therefore, no systems were designated for further investigation.

## 3.10 Gilman Results



**Figure 5. Outfall GI020 with OB pad between 2 rocks and covered with debris.**

### 3.10.1 Outfall Reconnaissance Inventory (ORI)

Watershed was contracted to perform a recheck of a fix performed on the GI020 system. Work was completed in September 2020. This work is summarized in Advanced Investigations below.

### 3.10.2 Advanced Investigation (AI)

An optical brightener pad was deployed at the outfall GI020 September 28, 2020. The pipe was damp but contained no flow. After one week, the pad was collected. Water was present at the outfall since it has rained 0.47" the week before. The pad was analyzed for the presence of optical brightener under black light. There was no evidence detected.



### 3.11 Lincoln Results

#### 3.11.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on 7/30/2018, three different outfalls were surveyed. Of the three outfalls visited, none were flowing, and none were marked as a possible illicit discharge based upon their visual inspections and water quality data. Results of the initial assessment in Lincoln are included in Appendix 1 – All Results Summary Table.

#### 3.11.2 Advanced Investigation (AI)

No contaminants were detected above thresholds; therefore, no systems were designated for further investigation.

### 3.12 Lunenburg Results

#### 3.12.1 Outfall Reconnaissance Inventory (ORI)

Watershed was contracted to perform advanced investigation on one system in Lunenburg. What follows is the initial ORI and previous AI that were published by the VT DEC and Stone Environmental, Inc. in January 2017 in a report entitled *Detecting and Eliminating Illicit Discharges in the Upper and Middle Connecticut River Basin*.

#### 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 18.*

**Table 18. 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 storm drain 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.” (VT DEC & Stone Environmental, Inc., 2017)

### 3.12.2 Advanced Investigation (AI)

Advanced investigation was conducted in Lunenburg on 8/1/2019. Based upon the previous findings laid out above, advanced investigation efforts were focused on the portion of LU020 near 46 and 60 West Main Street. What follows is a summary of the outfall (or other infrastructure within an outfall’s drainage system) suspected of possible illicit discharge. Water quality data is presented for all dates visited. Fields left blank in the table represent water quality parameters that were not tested.

#### 3.12.2.1 LU020

**Table 19. Water Quality Analysis Data for LU020.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
LU020_CB3	8/1/2019	Small amount of flow in catchbasin.	yes	7.87	660	-	0.175	No	2	-





During the advanced investigation, a visual inspection was performed at every catchbasin in the system. There was no flow from CB13 up. The outfall was inaccessible due to vegetation, but water quality analysis was performed at CB3, the next structure upstream in the system. The specific conductivity was very slightly elevated, but no other parameters indicated chronic illicit discharge. Smoke testing was conducted from CB20, right outside 46 West Main Street, and no smoke was seen emanating from any roof vents. Tenants were seen leaving the house during smoke testing, so dye testing was not possible. A couple was doing yard maintenance at 60 West Main Street, and Watershed asked permission to dye test from the house. They said the house had belonged to their deceased mother, and the house was vacated, and the water was shut off. Additionally, CB 20, which is located directly across from 46 W. Main, was completely dry during the visit, and the house was occupied at the time. The data suggest that no chronic illicit discharge is occurring in this system.

### 3.13 Newport City Results

#### 3.13.1 Outfall Reconnaissance Inventory (ORI)

Watershed was contracted to perform advanced investigation on three systems in Newport City. What follows is the initial ORI and previous AI findings that were published by the VT DEC and Stone Environmental, Inc. on February 21, 2016 in a report entitled *Lake Memphremagog Basin Additional Advanced Investigations*.

##### 3.13.1.1 NC360

*“The NC360 system drains a portion of Main Street before discharging to Lake Memphremagog northeast of 70 Main Street (Map 4). The first structure up-pipe from the outfall (catchbasin CB1) was assessed because the outfall extends into the lake.”*

**Table 20. Water analysis data for outfall NC360.**

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
NC360 CB1	6/17/2014	Trickling	0.1	0.13	1	9,500	Negative	Strong sewer odor
	10/13/2014	Dry	--	--	--	--	--	No sewer odor
	11/25/2014	Trickling	--	0.01	0.3	2,180	--	No odor
	5/7/2015	Stagnant pool	0.5	0.1	0.3	340	--	No odor





<i>Structure ID</i>	<i>Date assessed</i>	<i>Dry, Wet/no flow, Dripping, or Flowing?</i>	<i>Ammonia (mg/L)</i>	<i>Free Chlorine (mg/L)</i>	<i>MBAS (mg/L)</i>	<i>Specific Conductance (<math>\mu</math>S/cm)</i>	<i>OB Result</i>	<i>Observations</i>
	12/16/2015	Wet, no flow	--	--	--	--	--	--
NC360 MH1 Pipe A	6/17/2014	Flowing	--	--	--	--	--	--
	11/25/2014	Dry	--	--	--	--	--	--
	6/16/2015	Trickling	0.25	--	--	--	--	Wastewater odor
	12/16/2015	Wet, no flow	--	--	--	--	--	--
NC360 MH1 Pipe B	6/17/2014	Flowing	--	--	--	--	--	--
	11/25/2014	Wet, no flow	--	--	--	--	--	--
	5/7/2015	Wet, no flow	--	--	--	--	--	Wastewater odor
	6/16/2015	Trickling	0.25	--	--	--	--	Wastewater odor
	12/16/2015	Wet, no flow	--	--	--	--	--	--
NC360 MH1 Pipe C	6/17/2014	Dry	--	--	--	--	--	--
	11/25/2014	Wet, no flow	--	--	--	--	--	--
	5/7/2015	Wet, no flow	--	--	--	--	--	Wastewater odor
	6/16/2015	Trickling	0.25	--	--	--	--	Wastewater odor
	12/16/2015	Wet, no flow	--	--	--	--	--	--

**Findings:**

- On June 17, 2014, moderate concentrations of chlorine (0.13 mg/L) and MBAS (1.0 mg/L) and exceedingly high specific conductivity (9,500  $\mu$ g/L) were measured in



catchbasin CB1. A strong wastewater odor was emanating from CB1. There was no wastewater odor in the next up-pipe structure, MH1.

- No flow or wastewater odor was observed in CB1 on October 13, 2014.
- On November 25, 2014, CB1 was trickling, and no flow was observed in manhole MH1. Specific conductance was dramatically lower though still elevated.
- On May 7, 2015, none of the three pipes entering manhole MH1 were flowing, but a slight wastewater odor was observed. Although catchbasin CB1 was not flowing, samples were collected from the sump for *E. coli* and total phosphorus analysis (Table 20). The *E. coli* concentration was elevated (540 MPN/100 mL) and the total phosphorus concentration was moderate (97 µg/L).
- A definite wastewater odor was observed in manhole MH1 on June 16, 2015. The flow was insufficient to collect any samples except ammonia, the concentration of which was low in all three pipes.
- On December 16, 2015, a push camera was used to view manhole MH1 and the pipes entering and exiting the structure. The nearby sanitary manhole was also inspected. The inspection revealed that a grout plug on a cross connection between the sanitary manhole and stormwater manhole MH1 was not properly sealing the pipe. A gap was visible at the top of the pipe opening (the grout apparently settled). This gap in the plug was believed to be the source of the wastewater odor in MH1. Under surcharged conditions in the sanitary sewer, this gap would have allowed wastewater to flow into manhole MH1.

**Conclusion:** A direct connection between the sanitary sewer and stormwater manhole MH1 was identified. A faulty plug on a cross connecting line appears to have been responsible for wastewater odors in manhole MH1. When the sanitary sewer was surcharged this may have caused wastewater to enter MH1. Conversely, at high flows MH1 may have been a source of inflow to the sanitary sewer.

**Resolution:** The Newport City Public Works Department sealed the cross-connection pipe in early February 2016.” (VT DEC & Stone Environmental, Inc., 2016)

## NC360 MH

**Table 21. Water Quality Analysis Data for NC360.**

Infrastructure ID	Date	Notes	Flow	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
NC360_MH1	6/14/2019	There was a leak in a cement pipe connected to sewer, but it was plugged on site.	yes	3999	0.28	0.5	yes	5.3	0.096



The advanced investigation of NC360 revealed very elevated specific conductivity levels, elevated detergents concentration, slightly elevated ammonia concentration. After testing water quality parameters, both the storm and sanitary systems were smoke tested, but the results were inconclusive. However, upon further visual inspection it was determined that the same cross connection pipe that was sealed because of the previous Lake Memphremagog study (VT DEC & Stone Environmental, Inc., 2016) was once again discharging to the storm system. The pipe was sealed again onsite. It is recommended that Newport City keep a watch on this as it has leaked twice in three years.



**Figure 6. Visual Inspection of NC360\_MH1.**

### 3.13.1.2 NC680

*“The NC680 system drains portions of Glen Road, Weaver Street, and Fern Street before discharging to Lake Memphremagog across from 20 Fern Street (Map 6).”*

**Table 22. Water analysis data for outfall NC680.**

<i>Structure ID</i>	<i>Date assessed</i>	<i>Dry, Wet/no flow, Dripping , or Flowing ?</i>	<i>Ammonia (mg/L)</i>	<i>Free Chlorine (mg/L)</i>	<i>MBAS  (mg/L)</i>	<i>Specific Conductance (<math>\mu</math>S/cm)</i>	<i>OB Result</i>	<i>Observations</i>
NC680	6/23/2014	Trickling	0.5	0	0.3	1890	Indeterminate	Orange, slight oil odor
	7/23/2013	Trickling	--	--	--	--	Negative	--
	10/13/2014	Trickling	0.75	0.01	0.1	1190	--	Cloudy, no odor



<i>Structure ID</i>	<i>Date assessed</i>	<i>Dry, Wet/no flow, Dripping, or Flowing?</i>	<i>Ammonia (mg/L)</i>	<i>Free Chlorine (mg/L)</i>	<i>MBA S  (mg/ L)</i>	<i>Specific Conductance (μs/cm)</i>	<i>OB Result</i>	<i>Observations</i>
	11/25/2014	Trickling	0.5	0	0.2	1300	Negative	Minor suds, no odor
NC680 CB2	10/13/2014	Trickling	0.1	--	--	--	--	--
NC680 CB3	10/13/2014	Trickling	1	--	--	--	--	--
NC680 CB5	10/13/2014	Dry	--	--	--	--	--	--
NC680 CB4  Pipe A	10/13/2014	Trickling	1.5	--	0.1	513	--	Cloudy, orange, strong odor
	11/25/2014	Trickling	--	--	--	--	--	Iron staining, no odor
	5/7/2015	Trickling	--	--	--	--	--	--
	6/16/2015	--	1.5	--	--	--	--	--
NC680 CB4  Pipe B	10/13/2014	Trickling	0.5	--	--	440	--	Clear, slight odor
	11/25/2014	Trickling	--	--	--	--	--	Iron staining, no odor
	5/7/2015	Trickling	--	--	--	--	--	--
	6/16/2015	--	0.25	--	--	--	--	--
NC680 MH2	10/13/2014	Dripping	0.1	--	--	--	--	Clear, no odor

**Findings:**

- On June 23, 2014, a moderate ammonia concentration (0.50 mg/L) and low MBAS concentration (0.30 mg/L) were both measured at the outfall. An indeterminate optical brightener result was recorded. Resampling for optical brightener on July 23, 2014 yielded a negative result.
- Bracket sampling for ammonia on October 13, 2014 isolated the ammonia source to catchbasin CB4. Two pipes enter this structure. A four-inch diameter drain ("Pipe A") enters from the main stormline ("Pipe B") enters from south. The ammonia concentration in Pipe A was higher than in Pipe B (1.5 mg/L versus 0.75 mg/L).
- On November 25, 2014, a low concentration of ammonia (0.50 mg/L) was measured at the outfall. Some suds were observed.
- On May 7, 2015, concentrations of *E. coli* (<1 MPN/100 mL) and total phosphorus (42 µg/L) measured at the outfall were very low (Table 22).
- On June 16, 2015, the ammonia concentration at CB4 Pipe A was in the same moderately high range as on October 13, 2014.
- A dye test was performed on June 16, 2015 of the four-unit apartment building at 20 Fern Street. The two apartments on the north side of the building were unoccupied at the time. Only the second-floor apartment on the south side of the building could be tested. No dye was seen in catchbasin CB4 shortly after the test or several hours later when CB4 was rechecked.
- The Director of Public Works, Tom Bernier, visited the property in late summer 2015 and observed wastewater solids in catchbasin CB4. Apparently, an excavator working on the septic system tied the building sewer for the two apartments on the north side of the building into the perimeter drain which discharges to CB4. Mr. Bernier required the building owner to make a proper connection to the municipal sewer on Fern Street. This repair was made in the fall of 2015.

**Conclusion:** Although some of the details are unclear, it appears that Pipe A in catchbasin CB4 is a perimeter drain that conveyed partially renovated wastewater from a saturated septic system leachfield to CB4. Over the summer of 2015 a contractor tied a sewer line serving two units into this drain, resulting in discharge of raw wastewater to CB4.

**Resolution:** The Newport City Public Works Department required the owner of the apartment building at 20 Fern Street to connect the building to the municipal sewer on Fern Street." (VT DEC & Stone Environmental, Inc., 2016)



## NC680

**Table 23. Water Quality Analysis Data for NC680.**

Infrastructure ID	Date	Notes	Flow	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
NC 680	6/14/2019	Oily residue on top of pool of water that the outfall discharges to.	yes	2150	0.73	0.5	No	22	0.075
NC 680 - CB 4	6/14/2019	Water in the catchbasin sump is orange and turbid.	yes	540	0.56	0.25	Yes	2	0.089
NC680-CB5	6/14/2019	Canine alert not definitive	yes	-	-	-	No	230	0.55
NC680_SS MH-2	10/29/2019	Smoke testing performed on sewer manhole at intersection of Fern and Richard. No connection seen.	no	-	-	-	-	-	-
NC680_CB-7	10/29/2019	Smoke testing performed. Sewer manholes up and downhill check for connection. No smoke observed.	no	-	-	-	-	-	-

The advanced investigation of NC680 showed some elevated levels of various pollutants throughout the system, however, all samples were taken from catchbasin sumps or the pool of water that the outfall discharges to; this could elevate the pollutant concentrations. The previous study concluded that a perimeter drain that discharged to CB4 was conveying partially treated wastewater from a saturated leach field. They indicated that the apartment building at 20 Fern St. would be required to connect to the municipal sewer system. Smoke testing was conducted in both the storm and sanitary systems, no crossover was noted. When smoking the sanitary system, smoke was observed coming out of the sanitary smokestack of 20 Fern St., so the connection to the municipal system was completed. Additionally, dye was flushed from three of the four units in 20 Fern St., and none was observed in the storm system. While 20 Fern St. has been connected to the municipal sewer system, certain pollutants remain at elevated levels. Therefore, Watershed revisited the system on 10/29/2019 to smoke test further up the storm sewer and sanitary sewer line. Smoke testing did not show any crossover between the sanitary and storm system; therefore, it is our conclusion that no chronic illicit discharge is occurring in this system.

**3.13.1.3 NC1050**

*“The NC1050 system is downstream of the NC1010 outfall and drains a portion of Sias Avenue and the Newport City Elementary School property (Map 8).”*

**Table 24. Water analysis data for outfall NC1050.**

<i>Structure ID</i>	<i>Date assessed</i>	<i>Dry, Wet/no flow, Dripping, or Flowing?</i>	<i>Ammonia (mg/L)</i>	<i>Free Chlorine (mg/L)</i>	<i>MBAS (mg/L)</i>	<i>Specific Conductan ce (µs/cm)</i>	<i>OB Result</i>	<i>Observations</i>
NC1050	6/30/14	Flowing	0.10	0.04	0.20	580	Negative	Clear, no odor
NC1050 CB1 Pipe A	6/30/14	Flowing	0.10	0.00	0.20	533	Positive	Clear, no odor
NC1050 CB2 Pipe A	5/7/15	Flowing	0.0	0.04	0.10	525	--	--
NC1050 CB2 Pipe B	5/7/15	Flowing	1.0	0.5	0.02	1232	--	Wastewater odor, toilet paper in sump.

**Findings:**

- On June 30, 2014, optical brightener was detected in Pipe A entering the first catchbasin above the NC1050 outfall (CB1). CB1 Pipe A drains the elementary school property, as well as an underdrain behind 110 Sias Avenue.
- On May 7, 2015, samples were collected from the two pipes entering the second catchbasin above the outfall (CB2). No *E. coli* or ammonia were detected in flow from Pipe A, which drains the north side of the school property, and the total phosphorus (23 µg/L), MBAS, and free chlorine concentrations were below levels of concern. However, flow from Pipe B, which drains the south side of the school, had elevated ammonia, MBAS, and total phosphorus (416 µg/L) concentrations, exceedingly high *E. coli* levels (17,320 MPN/100 mL), and a distinct wastewater odor.
- On June 16, 2015, the storm drainage system around the school was inspected and mapped connections were verified or corrected. Toilet paper and feces were observed in a manhole (labelled CB3 on Map 8) south of the school building (see cover photo). An unmapped vitrified clay pipe discharges to this manhole. From its appearance, location, and alignment, we suspected the vitrified clay pipe was the source of wastewater entering the system and that it originates in the old wing of the elementary school. Dye testing was therefore performed in every lavatory in the old





wing of the school. The toilet in one classroom (Room 108) was found to be connected via a cross connection to a roof leader. Dye added to the toilet quickly appeared in the unmapped vitrified clay pipe discharging to the manhole. We do not believe there are any other connected toilets. The sink in the lavatory and a project sink in the classroom were presumed to be connected incorrectly also, as there appeared to be a single pipe connection to the roof leader.

- The Director of Public Works, Tom Bernier, revisited the site with a plumber the following day to develop a plan to correct the cross connection.

**Conclusion:** A direct connection was identified from a toilet and two sinks in a classroom in the Newport City Elementary School to the municipal storm drain.

**Resolution:** The school discontinued use of the bathroom until the inappropriate sewer connection was eliminated. Over the summer, the problem was corrected by cutting through the concrete floor and connecting the toilet and sinks into the building sanitary sewer. This classroom is used by 25 children per day during the school year, and the problem had likely existed for many years. Therefore, correction of the cross connection resulted in a meaningful water quality improvement.” (VT DEC & Stone Environmental, Inc., 2016).

### 3.13.2 Advanced Investigation (AI)

Advanced investigation was conducted in Newport City on 6/14/2019. Based upon the previous findings laid out above, advanced investigation efforts were focused on NC360 MH1, the NC680 system, and NC1050. What follows is a summary of the outfalls (or other infrastructure within an outfall’s drainage system) suspected of possible illicit discharge. Water quality data is presented for all dates visited. Fields left blank in the table represent water quality parameters that were not tested.

#### 3.13.2.1 NC1050

**Table 25. Water Quality Analysis Data for NC1050.**

Infrastructure ID	Date	Notes	Flow	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
NC1050_CB3_pipe C	6/14/2019	Sewage and TP observed flowing in pipe.	yes	1702	1.9	0.5	Yes	2400	0.46
NC1050_CB3_pipe C	8/23/2019	Dye tested from school bathrooms. Used a camera to inspect pipe. Flushed fluorescent green dye down room 131 toilet and observed dye in pipe C. Dye tested from every other bathroom in the old wing of the school, no other connections were found.	yes	-	-	-	-	-	-
NC1050_CB3_pipe C	10/29/2019	Performed a wq check to make sure fix has been made. No flow was present, indicating the issue has been resolved.	no	-	-	-	-	-	-
NC 1050_CB3_pipe D	6/14/2019		yes	1307	0.23	0.25	No	0	0.014



The advanced investigation of NC1050 identified a clear illicit discharge occurring in NC1050\_CB3\_pipe C. Specific conductivity, ammonia, detergents, *E. coli*, and TP were all significantly elevated. Additionally, while sampling from pipe C, floatables including feminine hygiene products and toilet paper was observed flowing down the pipe.

Smoke testing was conducted from CB3, and dye testing was conducted from the toilet identified as the previous source of illicit discharge, but no suspect smoke or dye were observed.

The site was visited again on 8/23/2019, and dye testing was conducted from all school bathrooms in the old wing of the school. A camera was used to inspect CB3 during dye testing with help from Tom Bernier and Newport Public Works. A direct connection between the toilet in room 131 and CB3\_pipe\_C was found. Newport City Public Works and the Newport City Elementary School were notified of the connection, and the toilet was immediately stopped from being used.

The site was revisited on 10/29/2019 and pipe C was dry, indicating that stopping use of the room 131 toilet was effective and there are no further illicit discharges. As of March 2021, the School and the Public Works Department are in negotiations with a neighboring property owner over a right-of-way to connect the School's sewer line into the adjacent line. W



**Figure 7. NC1050 Dye Testing.**

### **3.14 North Montpelier Results**

#### **3.14.1 Outfall Reconnaissance Inventory (ORI)**

Illicit discharge detection was performed in North Montpelier on 8/20/2018. Only one outfall was flagged for assessment during this project, which was not flowing during dry weather. No contaminants were detected above threshold; therefore, no systems were designated for further investigation. Results of the initial assessment in North Montpelier are included in Appendix 1 – All Results Summary Table.

#### **3.14.2 Advanced Investigation (AI)**

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

### **3.15 North Troy Results**

#### **3.15.1 Outfall Reconnaissance Inventory (ORI)**

Watershed was contracted to perform advanced investigation on one system in North Troy. What follows is the initial ORI and previous AI findings that were published by the VT DEC and Aldrich & Elliot, PC in October 2014 in a report entitled *Missisquoi River Basin Advanced IDDE Study*.

##### **3.15.1.1 NT060**

*“System NT060 drains a portion of Main Street and all of School Street. As a result of the 2009 assessment, a washing machine connection to system*



*NT060 from #129 Main Street was reportedly eliminated. Since the 2009 assessment, the outfall of this system has been eliminated and flow has been routed to a pipe crossing under the railroad tracks to the north. An approximate map of the reconfigured outlet is presented in Map 5.*

*In 2013, we expected to confirm that correction of the washing machine connection at #129 Main Street had eliminated optical brightener from the system. However, samples collected on August 14 and August 15, 2013 indicated both presence of optical brightener and very high *E. coli* levels (17,329 MPN/100 mL) in this system. In contrast, the sample collected in 2009 had low *E. coli* (140 MPN/100 mL). Note that the August 2013 samples were collected in CB-A due to the reconfigured outlet. Optical brightener was also detected in CB-G.*

*On September 5, 2013, an unmapped pipe entering CB-X was observed discharging sanitary wastewater to the catchbasin. A dye test confirmed that the sewer lateral from a house at #69 School Street was directly connected to NT060 system. Upon learning of the connection, Marcel Mayhew quickly arranged to have the building sewer disconnected from the stormwater drainage system and reconnected to the sanitary sewer. The correction was completed on September 16, 2013. This misconnection existed before the 2009 IDDE assessment and was evidently missed. It is possible the home was not occupied at the time of the first assessment.*

*Follow up sampling was conducted on January 21, 2014 to confirm that the *E. coli* concentration had declined as expected. The *E. coli* concentration measured at CB-A was low (173 MPN/100 mL), which indicates that sanitary wastewater is no longer present in the system.*

*The detection of optical brightener in CB-G suggests that a home on Main Street also has an improper wastewater or wash water connection. On August 25, 2014, Mr. Mayhew reiterated his plan to dye test the three properties that could conceivably be responsible; progress has been slow because one of these homes is currently vacant and another is owned by a man who lives abroad most of the year.*

*Therefore, we consider one problem to have been corrected and there is a plan in place for the Village to identify and correct a possible second problem.” (VT DEC, 2014)*



### 3.15.2 Advanced Investigation (AI)

Based on the results of the previous study, advanced investigation was focused on identifying the source of optical brightener in CB-G. However, since the previous study, CB-G had been removed and paved over. On 7/19/2019 and 8/19/2019, the entire system was dry, so water quality analyses were not possible. OB pads were left at CB-A, CB-F, and CB-H on 7/19/2019, and none of them fluoresced. No homeowners were present on 7/19/2019, so dye testing was not conducted. On 8/19/2019, Watershed was denied access by the homeowner to 141 Main Street for dye testing. Based upon the lack of OB presence throughout the system, the lack of flow during dry weather on two occasions, and the removal of the previously suspect catchbasin, it is our conclusion that there is no chronic illicit discharge occurring in the NT060 system.

## 3.16 Plainfield Results

### 3.16.1 Outfall Reconnaissance Inventory (ORI)

Watershed was contracted to perform advanced investigation on one system in Plainfield. What follows is the initial ORI and previous AI findings that were published by the VT DEC and Stone Environmental, Inc. in April 2018 in a report entitled *Upper Winooski River Basin IDDE Project: Final Report*.

#### 3.16.1.1 P\_O\_90

*"Catchbasin P-CB-100 is located at the southeast corner of the intersection of Martin Meadow Road and Towne Avenue (Map PL-1). This is a deep structure immediately up the stormline from outfall P-O-090, which is difficult to access. Optical brightener was first detected in this system on August 23, 2013. Optical brightener has been detected consistently in the sump. On October 9 and 29, 2013 a laundry odor was observed. On October 9, 2013, optical brightener was detected in an unmapped pipe entering P-CB-100. It was not detected in the main stormline entering P-CB-100, from CB2.*

#### Findings:

- *In May 2016, monitoring pads were set in the P-CB-100 system. The pad set in CB1 was positive (strong) while the pad in the next catchbasin up the stormline, CB2, was negative.*
- *On October 19, 2016, Dave Braun, Wayne Graham (VRWA), and Greg Chamberlin (Chief Operator of the Plainfield wastewater treatment facility) smoke tested the sanitary sewer on Towne Avenue. Smoke was observed emanating from roof vents throughout the neighborhood except for #237 and #223 High Street. A camera was inserted into the unmapped pipe entering P-CB-100. Within about 50 feet of the outlet, the camera hit an obstruction and was unable to continue.*
- *Mr. Chamberlin related that #237 and #223 High Street share a private sewer line that runs between the properties. According to Mr. Chamberlin, there have been problems with this line in past. It has needed repeated cleaning due to root penetration. The private sewer line is believed to discharge to the municipal sewer in the vicinity of the Towne Ave. and Martin Meadow Road intersection.*



**Conclusion:** *We suspect that the private sewer line shared by #237 and #223 High Street, or the connection of this line to the municipal sanitary sewer, is leaking wastewater that is intercepted by the deep, unmapped pipe entering P-CB-100. This conclusion is supported by the smoke testing results and the location and maintenance history of this sewer line.*

**Resolution:** *Mr. Chamberlin indicated he would request that the homeowners have their private sewer line inspected with a camera the next time it was cleaned, to ascertain the location of any break(s). We are unaware whether this has occurred. This system was designated for additional advanced investigation in a recently released contract through which this longstanding problem should finally be resolved.” (VT DEC & Stone Environmental, Inc., 2017)*

### 3.16.2 Advanced Investigation (AI)

Advanced investigation was conducted in Plainfield on 6/26/2019. Based upon the previous findings laid out above, advanced investigation efforts were focused on P\_CB\_100, and the infrastructure immediately surrounding it. What follows is a summary of the outfalls (or other infrastructure within an outfall’s drainage system) suspected of possible illicit discharge. Water quality data is presented for all dates visited. Fields left blank in the table represent water quality parameters that were not tested.

#### 3.16.2.1 P\_CB\_100

**Table 26. Water Quality Results for P\_CB\_100.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
P_CB_100_pipe_1	6/26/2019	Smoke tested here, no crossover observed. Reverse smoke tested from an unmapped sanitary manhole, smoke was observed coming from the sanitary vents of all houses in the area, indicating that they are all connected to the municipal sewer system.	yes	7.14	983	0.06	0.175	Yes	5.1	0.013
P_O_90	6/26/2019	Canine alert not definitive	yes	7.32	541	0	0.175	No	46	0.032
P_O_90_CB_2	6/26/2019	Suds on top of water in catchbasin sump	yes	7.66	244	0	0.175	Yes	79	0.048

The advanced investigation in Plainfield confirmed there was no longer illicit discharge occurring to P\_CB\_100. Sampling at three locations in the system found that *E. coli*, TP, and ammonia concentrations were all low. Additionally, the previous study identified the issue as a discharge from a private sewer between 223 and 237 High Street, and they did not see smoke emanating from these two sanitary roof vents when the system was smoke tested. Smoke testing was conducted from P\_CB\_100 during Watershed’s advanced investigation on 6/26/2019, and smoke was seen coming from the sanitary roof vents of all surrounding houses, including 223 and 237 High Street. The presence of emanating smoke from these roof vents provides further evidence that the illicit discharge to P\_CB\_100 has been eliminated.

## 3.17 Reading Results

### 3.17.1 Outfall Reconnaissance Inventory (ORI)

Illicit discharge detection was performed in Reading on 7/16/2018. Only one outfall was flagged for assessment during this project, which was not flowing during dry weather. No contaminants were detected above



threshold; therefore, no systems were designated for further investigation. Results of the initial assessment in Reading are included in Appendix 1 – All Results Summary Table.

### 3.17.2 Advanced Investigation (AI)

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

## 3.18 Roxbury Results

### 3.18.1 Outfall Reconnaissance Inventory (ORI)

Illicit discharge detection was performed in Roxbury on 7/30/2018. Only one outfall was flagged for assessment during this project, which was not flowing during dry weather. No contaminants were detected above threshold and there were no visual indicators that suggested a chronic illicit discharge; therefore, no systems were designated for further investigation. Results of the initial assessment in Roxbury are included in Appendix 1 – All Results Summary Table.

### 3.18.2 Advanced Investigation (AI)

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

## 3.19 Saint Johnsbury Results

### 3.19.1 Outfall Reconnaissance Inventory (ORI)

Watershed was contracted to perform advanced investigation on two systems in Saint Johnsbury. What follows is the initial ORI and previous AI findings that were published by the VT DEC and Stone Environmental, Inc. in August 2015 in a report entitled *Detecting and Eliminating Illicit Discharges in St. Johnsbury to Improve Water Quality*.

#### 3.19.1.1 SJ440

***“The SJ440 system drains Concord Avenue from approximately 550 Concord Avenue to the intersection of Concord Avenue and Elm Street (Map SJ-8). It discharges to the Moose River west of the intersection of Concord Avenue and Elm Street.***

**Table 27. Water analysis data for outfall SJ440.**

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
SJ440	5/19/2014	Dripping	2	0.04	0.75	859	Positive	Clear, strong sewage odor in outfall.
	8/21/2014	Wet, no flow	--	--	--	--	Positive	--



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
SJ440 CB1	8/26/2014	Wet, flow	no	--	--	--	--	--	--
	8/27/2014	Wet, flow	no	--	--	--	--	--	--
	10/30/14	Dry		--	--	--	--	--	--
	11/12/14*	--		0.5	--	--	--	--	--
	5/14/2015	Dry		--	--	--	--	--	--
	6/25/15	Dry		--	--	--	--	--	--
	8/21/2014	--		0.25	--	--	--	Positive	--
	11/12/14*	--		--	--	--	--	--	--
SJ440 CB2	6/25/2015	Dry			--	--	--	--	--
	8/21/2014	--		--	--	--	--	Indeterminate	--
SJ440 CB3	8/21/2014							Negative	--
	11/12/14*							--	*Sampled during rainstorm
		--		0.25	--	--	--		
SJ440 CB3A	8/21/2014							Negative	
SJ440 CB4	8/21/2014	--		--	--	--	--	Indeterminate	--
SJ440 CB5	8/21/2014							Negative	
SJ440 CB5A	8/21/2014	--		--	--	--	--	Indeterminate	--
SJ440 CB6	8/21/2014							Negative	
SJ440 CB6A	8/21/2014							Negative	
SJ440 CB7	8/21/2014							Negative	
SJ440 CB8	8/21/2014	--		--	--	--	--	Indeterminate	--

### Findings:

- Optical brightener and a strong sewage odor were detected at the outfall on May 19, 2014. The ammonia concentration was high (2.0 mg/L) and MBAS was moderate (0.5 mg/L). These data provide clear evidence of a wastewater or combined sewage discharge.



- *The outfall was inspected on eight subsequent dates and was never again observed flowing during dry weather.*
- *Optical brightener monitoring pads were deployed throughout the system on August 21, 2014 and collected on August 27. The results were largely inconclusive for use in bracket sampling, as an unusual number of pads were indeterminate. Optical brightener was detected at the outfall and catchbasins CB1.*
- *There are no documented combined sewer overflow structures in this location. The section of Concord Avenue from the bridge over the Moose River east to the railroad crossing was reportedly separated in 1991 (Dufresne Group Consulting Engineers, 2014).*
- *Options for advanced investigation were limited because, with the exception of the May 19, 2014, dry weather flow was not observed in this system. Sanitary wastewater discharges to the system clearly do not occur during dry weather; therefore, dye testing home plumbing fixtures would be pointless.*
- *There are (at least) two possible explanations for the sanitary wastewater discharge observed on May 19, 2014: 1) sanitary wastewater overflows the sewer main, discharges to the street, and is intercepted by the storm drain, and/or 2) a sewage backup into a basement enters the stormwater system via a connected floor drain.*
- *Homes on Concord Avenue between Harrison Avenue and the Moose River bridge were visited on June 24-25, 2015 to assess whether sewage backups into basement could be the source of the wastewater discharged at the SJ440 outfall. The following summarizes information recorded from the homeowners:*

Address	Notes
220 Elm St.	Homeowner reported no backup problems or odors but stated that backups were a longstanding problem in some houses on the north side of Concord Avenue, including #391 and #411.
375 Concord Ave.	Not home. Recently
sold. 391 Concord Ave.	Not home.
411 Concord Ave.	Unoccupied. Homeowner recently deceased.
427 Concord Ave.	Owner reported a backup in 2014 that caused a small amount of wastewater to leak from the threads on a backflow preventer installed on the house sewer line. He since sealed the valve housing. There is no basement floor drain.
433 Concord Ave.	On septic system
447 Concord Ave.	Homeowner reports no sewage backup problems or odors.

- *Information is lacking for the houses at 375, 391, and 411 Concord Avenue, which are perhaps the likeliest homes to experience backups and to contribute wastewater to system SJ440 based on their low elevation and proximity to the outfall. However, the information from homeowners at 220 Elm Street and 427 Concord Avenue demonstrates that the sanitary sewer does become surcharged in this area, suggesting that either of the above explanations is plausible.*



**Conclusion:** Based on clear evidence of a wastewater discharge during monitoring at the outfall on May 14, 2014 and homeowner statements indicating that the sanitary sewer on Concord Avenue becomes surcharged close to the Moose River bridge, we conclude sanitary wastewater can discharge to the separate stormwater system during wet weather. Two possible routes of entry are by discharge to the street followed by drainage to a catchbasin and/or by sewage backing up in a house and flowing to a connected floor drain.

**Resolution:** These observations should inform future investigations in St. Johnsbury's long term control plan to reduce combined sewer overflows. Specifically, in St. Johnsbury's Combined Sewer Overflow Abatement Inventory Report & 3-Year Plan, Dufresne Group (2014) recommended that smoke testing be performed for this section of Concord Avenue. This recommendation and additional door to door surveys should be prioritized given our findings at the SJ440 outfall." (VT DEC & Stone Environmental, Inc., 2015)

### 3.19.1.2 SJ950

*"The SJ950 system consists of a long culvert which conveys runoff under the bike path and High Street and discharges over a low bank to the Sleepers River. The outfall is at the bottom of a concrete wall in the location indicated in Map SJ-16. Note that the stream segment shown on Map SJ-16 now flows through the culvert under the bike path."*

**Table 28. Water analysis data for outfall SJ950.**

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
SJ950 outfall	5/21/14	Flowing	0.1	0.01	0.2	609	Indeterminate	Suds where flow enters river.
	7/17/14	Flowing	--	--	--	--	Positive	--
	8/27/14	Flowing	0.25	0.10	0.1	706	--	--
	11/18/14	Flowing	--	--	--	--	Positive	Suds where flow enters river.
SJ950 culvert inlet	11/18/14	Flowing	--	--	--	--	Negative	--

#### **Findings:**

- Detection of optical brightener at the outfall and a concentration of suds observed



at the edge of the Sleepers River where this system discharges indicate the presence of a wastewater or wash water source.

- On November 19, 2014, monitoring pads were placed at the culvert inlet and at the outfall. Optical brightener was detected at the outfall but not at the inlet, indicating a source between the inlet and outfall. The only structure between these points is a house at 240 High Street.
- On June 24, 2015, samples were collected at the outfall for *E. coli* and total nitrogen analysis. The levels of both constituents were very low (see Section 4).
- 240 High Street has a septic system which appears to be located in a raised lawn between the house and the garage, proximate to the culvert running beneath the property.

**Conclusion:** The only possible source of optical brightener to this system is the house at 240 High Street. Based on repeated detection of optical brightener, suds repeatedly seen below the outfall, and the position of the culvert beneath the property, we suspect partially renovated effluent is infiltrating the culvert from the septic system at 240 High Street.

By design, septic systems reintroduce treated wastewater to the environment. The septic system serving the house at 240 High Street appears to function adequately to discharge wastewater without surfacing and to reduce odor and bacteria. However, more mobile, and persistent constituents, including detergents and optical brightener, pass into the underlying storm drain. Apparently, by DEC's operating definition, this septic system has not failed.

**Resolution:** Because the system has not failed per DEC's definition, it appears that neither the Town of St. Johnsbury nor DEC could compel the property owner to replace the system." (VT DEC & Stone Environmental, Inc., 2015)

### 3.19.2 Advanced Investigation (AI)

Advanced investigation was conducted in Saint Johnsbury on 6/26/2019. Based upon the previous findings laid out above, advanced investigation efforts were focused on SJ440 and SJ950, and the infrastructure immediately surrounding it. What follows is a summary of the outfalls (or other infrastructure within an outfall's drainage system) suspected of possible illicit discharge. Water quality data is presented for all dates visited. Fields left blank in the table represent water quality parameters that were not tested.



### 3.19.2.1 SJ440

**Table 29. Water Quality Analysis Data for SJ440.**

Infrastructure ID	Date	Investigator	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
SJ440	6/26/2019	Harrison Myers	No flow in upstream catch basins. Some water in sumps from rain storm. No flow at outfall.	no	-	-	-	-	no	-	-
SJ440 - MH-1	6/26/2019	Dana Allen	Damage to manhole structure. Clearly can and does overflow.	no	-	-	-	-	no	-	-
SJ440 - CB1	8/5/2020	Sebastian Strong	No flow in outlet or upstream catch basins. Water in sump from 0.5" rain event prior day. Sample taken from CB1 sump.	no	-	-	0.17	0.25-0.50	no	>2400	-

Following the recommendations of the previous study, smoke testing was conducted at SJ440\_CB1 and SJ440\_CB9; no crossover was observed when smoke testing the storm system. After the storm system had been thoroughly smoke tested, the system was cleared, and the sanitary system was then smoke tested. Again, no crossover was observed from the sanitary to the storm system. No homeowners complained of smoke entering their house, which could be explained by their absence at the time of testing, but it does suggest a lower probability that the source of discharge in wet weather is through a connected floor drain. The entire SJ440 system was dry, so no water quality sampling was done. No crossover or suspicious smoke was observed during testing; therefore, it can be assumed that no illicit discharge is occurring in SJ440. Upon visual inspection of the system, the sanitary manhole immediately south of SJ440 was observed to have a hole in the manhole structure that had evidence of overflow. This was reported to Saint Johnsbury public works and should be addressed to prevent any future overflows.

A wet weather grab sample was performed at CB1 after 0.50" of rain on August 5, 2020. Water quality indicators showed suspect ammonia and MBAS values. Lab results for *E. coli* showed extremely high amounts of bacteria in the sump of CB1. It should be noted that reports of dog waste have been documented in the green space near CB9 and is likely to contribute to the *E. coli* levels measured at CB1.

Optical brighteners pads were deployed at SJ 440 outfall and 3 manholes (MH 2-4) on Concord Ave on September 28, 2020. These were collected a week later on October 5, 2020. The pads were left on the top stair step. All pads were knocked off the step because of high flow during that week. Within that week, there was a 1.82" rainstorm. MH 2 has a golf ball flow gauge under the rim but was not triggered because of high flow. Pads were analyzed for presence of optical brighteners under black light. Results were inconclusive.



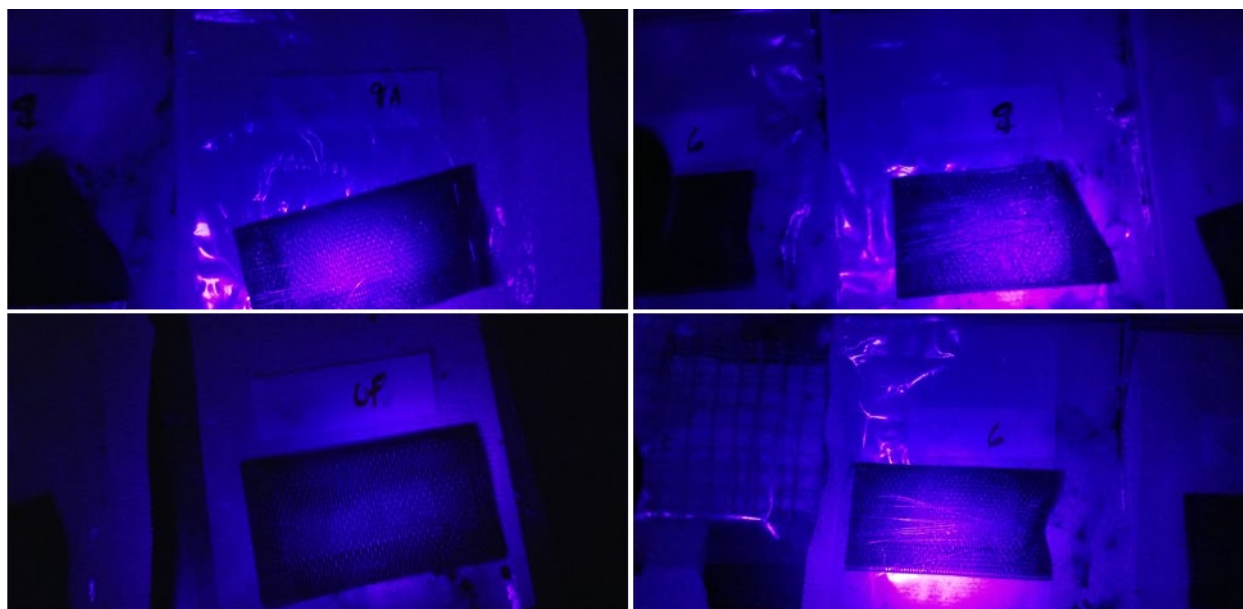
**Figure 8. Manholes with OB pads attached to the metal ladders and the outfall with pad attached, under leaves.**



**Figure 9. Optical Brightener presence analysis under black light.**

Again, OB pads were placed in CB 6, CB 9, CB 9A and the outfall in December 2020. Pads were analyzed and presence of optical brighteners was not detected as no pad exhibited any noticeable fluorescence.





**Figure 10. OB Pad analysis for CB 9A and 9 (top) and the outfall and CB 6 (bottom).**

A liquid smoke survey was done December 22, 2020 in the vicinity of Concord Ave and Elm Street and Portland Street. Liquid smoke was injected from CB #1, CB #9A, and from the sewer manhole. A crew monitored houses from the ground level, looking for any smoke from houses during the smoking of the stormlines. Catchbasins and houses were also monitored during smoke testing of the sewer, looking for any unexpected crossover. A drone was used to document aerial video of the process. Footage was reviewed to cross-check observations from the ground. No definitive results were drawn from the smoke testing, but there was one discrepancy for the house, 27 W Cottage St, near the corner of Concord Ave and W Cottage St. There may have been a few houses that showed some potential crossover in this area – depending on which houses were supposed to be tied to the combined sewer or not. This suggested possible storm/sewer system crossovers in this portion of the study area. Therefore, Watershed has recommended to the Town of St. Johnsbury to complete camera work down the stormlines in the vicinity of Concord Ave and West Cottage Street. Camera work could potentially occur at the same time as additional smoke testing.

### 3.19.2.2 SJ950

**Table 30. Water Quality Analysis Data for SJ950.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
SJ950	6/26/2019	System is totally dry.	no	-	-	-	-	-	-	-

Smoke testing was conducted at SJ950 from the catchbasin immediately up the system from SJ950. Smoke was observed coming from the outfall, but there was no crossover to the private sewer. The entire system was dry, therefore no water quality sampling was conducted. It is possible that the slightly elevated MBAS concentration seen in the previous study came from the septic system at 240 High Street. It is recommended that wet weather testing be completed as this data suggests a leaking septic.





### 3.20 Sheffield Results

#### 3.20.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on 5/31/2018, three outfalls were surveyed. Of the three outfalls visited, none were flowing, and none were marked as a possible illicit discharge based upon their visual inspections and water quality data. Results of the initial assessment in Sheffield are included in Appendix 1 – All Results Summary Table.

#### 3.20.2 Advanced Investigation (AI)

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

### 3.21 Sheldon Results

#### 3.21.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on 8/27/2018, two outfalls were surveyed. Of the two outfalls visited, neither were flowing or contained discharge that warranted advanced investigation. After the initial ORI, Watershed was contacted by Jim Pease and asked to investigate three additional private septic systems. Two out of the three systems were flowing, and two out of the three were obviously surfacing septic. No advanced investigation was warranted, because the results clearly indicated an illicit discharge via the two faulty septic systems. Results of the initial assessment in Sheldon are included in Appendix 1 – All Results Summary Table.

#### 3.21.2 Advanced Investigation (AI)

Of the three systems assessed, two were confirmed to have an illicit discharge. What follows is a summary of the outfalls (or other infrastructure within an outfall's drainage system) suspected of illicit discharge. Water quality data is presented for all dates visited. Fields left blank in the table represent water quality parameters that were not tested.

##### 3.21.2.1 SHLD\_33\_Bridge

**Table 31. Water Quality Results for SHLD\_33\_Bridge.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
SHLD-33-Bridge	7/10/2019	Water is seeping from mound in front of house. Neighbors have confirmed leaking septic.	yes	7.88	810	-	0.5	Yes	21	0.18

At 33 Bridge Street, all surrounding stormwater infrastructure was dry, but water was observed seeping from multiple locations with the source being a mound in the front lawn that was assumed to be the septic system. The neighbors of 33 Bridge Street confirmed that the septic system has had chronic issues with surfacing effluent. While the *E. coli* concentration was relatively low at 20 MPN/100 mL, TP, specific conductivity, and detergents were all elevated. The water quality data in conjunction with the visual observations and neighbor's confirmation is enough evidence to confirm that there is chronic illicit discharge occurring from the septic system at 33 Bridge Street. This was submitted as an enforcement action and there was follow up from the engineer on a correction project.

### 3.3.2.1 SHLD\_90\_Church

**Table 32. Water Quality Analysis Data for SHLD\_90\_Church.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
SHLD-90-Church	7/10/2019	Purplish blue color to water, looks like detergent. Muck accumulation at culvert inlet.	yes	6.65	750	-	3	Yes	2400	2.9

At 90 Church Street, there was a pool of purple/blue tinted water at the inlet to a culvert immediately adjacent to the front lawn. The pool of water not only looked like it was heavily polluted with detergents, but it also had a strong wastewater odor, and an accumulation of what appeared to be partially treated feces at the bottom of the pool (Figure 11). All water quality analysis parameters support the visual observations made. Therefore, it is confirmed that there is chronic illicit discharge occurring from the septic system at 90 Church Street. The culvert that receives the partially treated sewage is hydrologically connected to Black Creek, so it is of utmost importance that the illicit discharge is corrected as soon as possible. The issue was reported to Jim Pease at the Vermont DEC and was referred to enforcement.



**Figure 11. 90 Church Street View.**

## 3.22 Strafford Results

### 3.22.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted on 8/7/2018, six outfalls were surveyed. Of the six outfalls visited, two were flowing and none had discharge that warranted further investigation. Results of the initial assessment in Strafford are included in Appendix 1 – All Results Summary Table.



### 3.22.2 Advanced Investigation (AI)

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

## 3.23 Thetford Results

### 3.23.1 Outfall Reconnaissance Inventory (ORI)

During the ORI, which was conducted between 8/6/2018 to 8/20/2018, nine outfalls were surveyed. Of the nine outfalls visited, three were flowing and three had discharge that warranted further investigation. We focused on these three outfalls during our Advanced Investigation in Thetford. Results of the initial assessment in Thetford are included in Appendix 1 – All Results Summary Table.

### 3.23.2 Advanced Investigation (AI)

Of the nine systems assessed, three were suspected of having an illicit discharge. What follows is a summary of the outfall (or other infrastructure within an outfall's drainage system) suspected of possible illicit discharge. Water quality data is presented for all dates visited. Fields left blank in the table represent water quality parameters that were not tested.

#### 3.23.2.1 OF\_THTF\_2

**Table 33. Water Quality Analysis Data for OF\_THTF\_2.**

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_THTF_2	8/6/2018		yes	7.66	2220	0.25	0			
OF_THTF_2	9/5/2019	Outfall is extremely overgrown with Japanese knotweed.	yes	8.22	594	0.03	0.175	N/A	6.3	0.03

The system was revisited due to a lack of data from the first visit. Resampling of the system indicates that no chronic illicit discharge is present.

#### 3.23.2.2 OF\_THTF\_4

**Table 34. Water Quality Analysis Data for OF\_THTF\_4.**

Infrastructure ID	Date	Notes	Flow	Temp (°C)	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Investigation Performed?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_THTF_4	8/6/2018	-	yes	23.1	8.11	2485	0.13		no		
OF_THTF_4	9/5/2019	-	yes	19.2	7.71	3625	0.24	0.5	no	6.3	0.02
OF_THTF_4	8/20/2020	no odors, no flow	no	18.3	7.26	2210	0.13	0.25	no		

The system was revisited due to lack of data from the first visit. Resampling of the system indicates that there is a source of detergents to the system. On August 20, 2020, a liquid smoke survey was completed at Thetford Academy to further evaluate THTF\_4. Liquid smoke was injected at the lowest catchbasin along the collection line above the outfall. With Academy maintenance staff, the entire collection system drainage area was monitored during the smoking process including sewer manholes, building vents, and interior floor drains, bathrooms, and sinks. Smoke was observed in stormwater catchbasins throughout the drainage area. No visual evidence of cross contamination was observed during the smoking process. The outfall was observed, and field tested following the smoke survey. Only a trickle of flow was observed with no visual indicators present.





Figure 12. Outfall pipe THTF\_4 with no flow and a standing pool right below the outfall.

### 3.23.2.3 OF\_THTF\_7

Table 35. Water Quality Analysis Data for OF\_THTF\_7.

Infrastructure ID	Date	Notes	Flow	pH	Specific Conductivity (uS/cm)	Ammonia (mg/L)	Detergents (ppm)	Canine Alert?	E. Coli (MPN/100 mL)	Total Phosphorus (mg/L)
OF_THTF_7	8/6/2018	Suds present	yes	7.97	1167	3.61	0.75	-	39	0.31
OF_THTF_7	8/20/2018	Blueish color clearly visible in the outfall; MBAS much greater than 3. Dye tested from school utility sink, and observed dye in the outfall.	yes	8.55	513	-	3	-	-	-

The water quality data from the 8/6/2018 field visit, specifically the ammonia, detergents, and TP concentrations, triggered an advanced investigation of this system. The system was revisited on 8/20/2018, and dye tested from the Thetford Elementary School utility sink; dye was observed coming from the THTF\_7 outfall (Figure 13). The school was notified of the issue, and their facilities staff has placed the utility sink out of order. The School plans to tie the offending drain into their septic system as part of a larger renovation, but budget constraints due to their COVID-19 response has delayed the project until Summer 2021. As of March 2021, a restroom renovation project is currently out for bid. This will include a new utility sink tied to the wastewater system.



Figure 13. THTF\_7 Dye Testing.



### **3.24 Topsham Results**

#### **3.24.1 Outfall Reconnaissance Inventory (ORI)**

Illicit discharge detection was performed in Topsham on 8/7/2018. Only one outfall was flagged for assessment during this project, which was not flowing during dry weather. No contaminants were detected above threshold; therefore, no systems were designated for further investigation. Results of the initial assessment in Topsham are included in Appendix 1 – All Results Summary Table.

#### **3.24.2 Advanced Investigation (AI)**

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

### **3.25 Vershire Results**

#### **3.25.1 Outfall Reconnaissance Inventory (ORI)**

During the ORI, which was conducted on 8/7/2018, Watershed surveyed one outfall, which was not flowing during dry weather. No contaminants were detected above threshold; therefore, no systems were designated for further investigation. Results of the initial assessment in Vershire are included in Appendix 1 – All Results Summary Table.

#### **3.25.2 Advanced Investigation (AI)**

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

### **3.26 Waterbury Results**

#### **3.26.1 Outfall Reconnaissance Inventory (ORI)**

During the ORI, which was conducted in July 2018, Watershed surveyed five different outfalls. Of the five outfalls visited, one was flowing, and none had discharge that warranted further investigation. Results of the initial assessment in Waterbury are included in Appendix 1 – All Results Summary Table.

#### **3.26.2 Advanced Investigation (AI)**

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

### **3.27 Waterville Results**

#### **3.27.1 Outfall Reconnaissance Inventory (ORI)**

During the ORI, which was conducted on 8/27/2018 and 6/24/2019, Watershed surveyed two different outfalls. Of the two outfalls visited, one was flowing, and none had discharge that warranted further investigation. Results of the initial assessment in Waterville are included in Appendix 1 – All Results Summary Table.

#### **3.27.2 Advanced Investigation (AI)**

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

### **3.28 Wheelock Results**

#### **3.28.1 Outfall Reconnaissance Inventory (ORI)**

Illicit discharge detection was performed in Wheelock on 5/31/2019. Only one outfall was flagged for assessment during this project, which was not flowing during dry weather. No contaminants were detected above threshold; therefore, no systems were designated for further investigation. Results of the initial assessment in Wheelock are included in Appendix 1 – All Results Summary Table.



### ***3.28.2 Advanced Investigation (AI)***

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

## ***3.29 Woodbury Results***

### ***3.29.1 Outfall Reconnaissance Inventory (ORI)***

During the ORI, which was conducted on 8/13/2018, nine outfalls were surveyed. Of the nine outfalls visited, none were flowing, and none were marked as a possible illicit discharge based upon their visual inspections and water quality data. Results of the initial assessment in Woodbury are included in Appendix 1 – All Results Summary Table.

### ***3.29.2 Advanced Investigation (AI)***

No contaminants were detected above threshold; therefore, no systems were designated for further investigation.

## **4. Recommendations for Future Action**

### ***4.1 Barnard – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Barnard. No further action required.

### ***4.2 Barton – Future Action Recommendations***

- BA020 – The BA020 system was previously studied and thought to be intercepting septic leachate from the septic system at 530 Lake Street. The water quality sampling conducted in this study eliminated CB2 as a source of *E. coli* to the system, leaving the only other possible source to be an underdrain coming from the 530 Lake Street property. It is highly likely that this underdrain is intercepting septic leachate, thus polluting the stormwater system, and presenting a public health concern. However, because the septic is not surfacing, the system is considered to be functioning properly, and no further action can be taken at this time.

### ***4.3 Berkshire – Future Action Recommendations***

- OF\_BERK\_3 – The dry well catchbasins that drain to OF\_BERK\_3 behind the Jolly gas station are suspected of intercepting septic leachate from the nearby septic system. However, no septic is surfacing so the system is functioning in accordance with state guidelines. The water quality concerns in OF\_BERK\_3 should be documented and stored for future action if the rules around failing septic systems change in the future.
- No other chronic illicit discharges were found or are suspected in Berkshire. No further action required.

### ***4.4 Bloomfield – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Bloomfield. No further action required.

### ***4.5 Cambridge – Future Action Recommendations***

- OF\_CAMB\_7 – Sampling showed elevated *E. coli* at the outfall, and although smoke testing was inconclusive. The system was inspected with a camera in the Fall of 2020. Nothing of concern was seen, however, it is recommended that this system is watched and retested.
- OF\_CAMB\_10 – Sampling showed elevated *E. coli* in catchbasin 185. The system was smoke tested, and dye testing was conducted from room 002 of the nearby building, but no connection to sanitary infrastructure was found. No chronic illicit discharge present in this system. However, watching and retesting is recommended for this system.



#### ***4.6 Charleston – Future Action Recommendations***

- OF\_CHRL\_5 – An illicit discharge was suspected in this system but was eliminated as a possibility through water quality testing and smoke testing. No further action required with the stormwater system, but potential follow up may be required with the maintenance garage underdrain.
- OF\_CHRL\_7 – An illicit discharge was suspected in this system but was eliminated as a possibility through water quality testing and smoke testing. No further action required.

#### ***4.7 Corinth – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Corinth. No further action required.

#### ***4.8 Derby – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Derby. No further action required.

#### ***4.9 Gilman – Future Action Recommendations***

- GI020 was rechecked in September 2020 with no chronic illicit discharges found or suspected. A recheck using *E. coli* testing is recommended.

#### ***4.10 Guildhall – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Guildhall. No further action required.

#### ***4.11 Lincoln – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Lincoln. No further action required.

#### ***4.12 Lunenburg – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Lunenburg. No further action required.

#### ***4.13 Newport City – Future Action Recommendations***

- NC\_360 – A connection to the sanitary sewer that had been identified in a previous study was found to have become unsealed. The issue was fixed onsite, but retesting should occur.
- NC\_1050 – A direct connection to the Newport City Elementary School room 131 toilet was found, and the toilet has since been retired from use. As of March 2021, the issue has been resolved. Retesting should be done to confirm it has been resolved.

#### ***4.14 North Montpelier – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in North Montpelier. No further action required.

#### ***4.15 North Troy – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in North Troy. No further action required.

#### ***4.16 Plainfield – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Plainfield. No further action required.

#### ***4.17 Reading – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Reading. No further action required.

#### ***4.18 Roxbury – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Roxbury. No further action required.

#### ***4.19 St. Johnsbury – Future Action Recommendations***

- After illicit discharge detection testing was done using optical brightener pads and liquid smoke detection with visual inspection and drone footage, it is recommended to the town of St. Johnsbury to complete stormline camera work in the vicinity of Concord Ave and West Cottage Street. This could be done at the same time as additional smoke testing.

#### ***4.20 Sheffield – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Sheffield. No further action required.





#### ***4.21 Sheldon – Future Action Recommendations***

- SHLD\_33\_Bridge – A failed septic system was identified at 33 Bridge St, Sheldon, VT. The issue was sent to Jim Pease at the Vermont DEC and he forwarded the information along to regional enforcement. The septic system should be maintained/replaced at the soonest opportunity.
- SHLD\_90\_Church – A failed septic system was identified at 90 Church St, Sheldon, VT. The issue was sent to Jim Pease at the Vermont DEC and he forwarded the information along to regional enforcement. The septic system should be maintained/replaced at the soonest opportunity.
- No other chronic illicit discharges were found or are suspected in Sheldon. No further action required.

#### ***4.22 Strafford – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Strafford. No further action required.

#### ***4.23 Thetford – Future Action Recommendations***

- THTF\_4 – The system is suspected of having a chronic illicit discharge due to detergent concentrations in outfall samples. In August 2020, a liquid smoke survey was completed to further investigate this. Smoke was observed in stormwater catchbasins throughout the drainage area. No visual evidence of cross contamination was observed during the smoking process. The outfall was observed, and field tested following the smoke survey. Only a trickle of flow was observed with no visual indicators present. No further action required.
- THTF\_7 – The system was found to be directly connected to a school utility sink. The school was notified and indicated they would fix the connection immediately. The School plans to tie the offending drain into their septic system as part of a larger renovation, but budget constraints due to their COVID-19 response has delayed the project until Summer 2021. As of March 2021, a new utility sink, tied to the wastewater system, is part of a restroom restoration project out for bid.
- No other chronic illicit discharges were found or are suspected in Thetford. No further action required.

#### ***4.24 Topsham – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Topsham. No further action required.

#### ***4.25 Vershire – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Vershire. No further action required.

#### ***4.26 Waterbury – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Waterbury. No further action required.

#### ***4.27 Waterville – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Waterville. No further action required.

#### ***4.28 Wheelock – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Wheelock. No further action required.

#### ***4.29 Woodbury – Future Action Recommendations***

- No chronic illicit discharges were found or are suspected in Woodbury. No further action required.

## **5. Phosphorus and *E. coli* Loading**

Where possible, flow was measured at the time of phosphorus and *E. coli* sampling. Annual totals for phosphorus were calculated using measured flows in cubic feet per second and total phosphorus concentration in mg/L. Not all illicit discharges were sampled due to flow issues or other factors which prevented samples from being obtained.

**Table 36. Phosphorus and *E. coli* Loading Calculations.**

Infrastructure Code (Outfall)	Illicit Discharge	CFS	TP Concentration (mg/L)	TP Load (lbs / year)	<i>E. coli</i> (MPN / 100 mL)
BA020	Septic Leachate	0.001	NT	Unk	1400
OF_BERK_3	Septic Leachate	0*	0.6**	Unk	2000**
OF_CAMB_7	Potential Sanitary Sewage	0*	0.1	Unk	290
NC360-MH1	Sanitary Sewage	0*	0.096	Unk	5.3
NC1050	Sanitary Sewage	0*	0.46	Unk	2400
SHLD_33_Bridge	Failed Septic	0*	0.18	Unk	21
SHLD_90_Church	Failed Septic	0*	2.9	Unk	2400
OF_THTF_7	Septic Connection	NT	0.31	Unk	39
Total TP Load (lbs.)					Unknown
* - flow too intermittent or sparse to measure      ** - based on an average of two values NT - Not Tested      Unk - Unknown					

## 6. Conclusions

A thorough assessment of stormwater drainage systems in each study town was conducted in an attempt to find any non-stormwater discharges to the stormwater system that could then possibly enter natural water bodies in these communities. This work was conducted during the spring, summer, and fall of 2018 through 2020 on all mapped stormwater outfalls provided to the project team as part of the scope of work. This resulted in a total of 102 systems (or other points) visited. Of these, 38, or 37.3% were flowing. Further analysis of these flowing outfalls led to the designation of 18, or 17.6% of the total study outfalls, as suspected illicit discharges. 10 confirmed illicit discharges, or approximately 9.8% of the total study outfalls, were found for all study towns.



## 7. References

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