FINAL REPORT – BENNINGTON AND PAWLET IDDE STUDY

BENNINGTON AND PAWLET, VERMONT

DRAFT FINAL REPORT
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WATERSHED
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1 INTRODUCTION

In March 2016, Watershed Consulting Associates, LLC (WCA) was awarded an Ecosystem Restoration Program grant (#28665) by the Vermont Department of Environmental Conservation to perform an Illicit Discharge Detection and Elimination (IDDE) study for the towns of Bennington and Pawlet.

The goal of this study was to find any potential non-stormwater contaminated 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. Additionally, the reach of the Flower Brook that flows through the heart of downtown Pawlet has been listed as impaired on the State's 303(d) list for *E. coli*. By conducting an IDDE study for this area, it was hoped that many sources of that impairment could be eliminated.

The geographic scope of this work included all of downtown Bennington's municipal stormwater system, as well as systems in Old Bennington, North Bennington, one commingled outfall in Shaftsbury, the Southwestern Vermont Medical Center, Southern Vermont College and Bennington College campuses, as well as the new Visitor's Center on VT Route 279 (Bennington Bypass). In Bennington a total of 348 outfalls were surveyed during the initial Outfall Reconnaissance Inventory (ORI). Of these 348, 112 were previously unmapped and unknown. These new outfalls were found during field work while walking the more urbanized portions of Bennington's rivers and streams. The majority of these were found in downtown Bennington, due in large part to its heritage as an old industrial mill town. Many old factory buildings are built directly on the banks of the Walloomsac River which runs through the heart of Bennington and used to have non-stormwater discharges directly into the river system.

In Pawlet, the scope included all of the closed catchbasin drainage systems in downtown Pawlet, as well as a few smaller closed stormwater systems in West Pawlet. In Pawlet, 34 mapped outfalls were surveyed during the ORI. Two additional unmapped outfalls were located during a stream walk of the more developed areas of the Flower Brook (where accessible – a small reach below Mill Pond in Pawlet is an inaccessible bedrock gorge).

During the ORI, conducted during dry weather (defined as <0.1" in the past 24 hours to the maximum extent practicable), field tests were performed on any flowing water found. These tests included chemical tests for ammonia, temperature, pH, and conductance, qualitative tests for odor, turbidity, color, and floatables, as well as 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 total chlorine (except in Pawlet where there is no municipal water system and thus no chlorination), potassium, and methylene blue active substances (MBAS, which are detergent-related). Additional samples were also obtained, where indicated by the results of other analyses, for *E. coli* and total phosphorus. Occasionally optical brighteners were tested for using unbleached cotton pads placed in an outfall and allowed to sit for 3-10 days. If any optical brighteners (substances typically associated with laundry detergent) were present, the pads would fluoresce under UV (black) light.

During this study, WCA partnered with the Center for Watershed Protection (CWP) and Environmental Canine Services (ECS) to conduct a week-long field study using canines specially trained to sniff out

discharges normally associated with human sewage. This week long study consisted of one day of targeted sampling of outfalls and associated infrastructure that had previously been seen flowing during dry weather and had been suspected of illicit discharges. These samples were then brought back to the canines for them to evaluate. If the canines alerted on the sample, additional field visits were conducted to each system. Obtaining samples from a wide geographic range allowed the team to more effectively evaluate a larger number of samples and more precisely target field work during the week. Three full days of field work with the canines were conducted – one in Pawlet and two in Bennington. The fifth day consisted largely of conducting follow-up visits to outfalls or associated infrastructure that had been identified by the canines as particularly suspect to obtain *E. coli* and total phosphorus samples. It is important to note that the canines can often detect 'residual' sewage smells – sewage contaminated water does not have to be present for them to detect it. This trait actually led to the identification of sites that would not have been noticed otherwise as flows were negligible.

Of the outfalls tested in Bennington, 34 were suspected for some possible illicit discharge during the ORI or roughly 10% of the overall system. In Pawlet 6 outfalls were suspected, comprising about 17% of all outfalls. During the Advanced Investigation (AI) portion of the study, 6 of the 34 outfalls in Bennington were confirmed to have some sort of illicit discharge. In Pawlet, 1 of the 6 were found to have confirmed illicit discharges.

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 CWP's ORI field and laboratory forms, creating laminated large-scale field maps of mapped stormwater infrastructure in each of the areas to be investigated overlaid on recent aerial photos, and meeting with project stakeholders in each of the communities. Kick-off meetings were held in Bennington and Pawlet where WCA discussed field methods, requested access letters from town offices, discussed follow-up procedures for any illicit discharges found and how they would be enforced or otherwise resolved, and discussed municipal capacity and cooperation as far as the potential for televising storm or sanitary lines, dye testing, and determined if lab facilities could be used to water quality analyses. Known problem areas were also discussed during this time in an effort to further target the study.

In the case of Pawlet, WCA coordinated with the Poultney-Mettowee Natural Resources Conservation District (PMNRCD) on a septic system survey that the PMNRCD was conducting during the summer of 2015. In Pawlet, there is no municipal sanitary system – residents and businesses rely on private septic systems. System type and age were assessed by the PMNRCD's study on a parcel-by-parcel basis using owner knowledge or permit documents. This study generated a map of systems that might have an effect on illicit discharges directly from the septic system to the Flower Brook, or that might somehow cross over into the stormwater system.

2.2 Outfall Reconnaissance Inventory – Dry Weather Survey

Stormwater systems were assessed during dry weather so as 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 kept to a bare minimum and avoided whenever possible. Only systems with two or more catchbasins or other structures were analyzed – single catchbasin systems were left out due to their low likelihood possible connections that could result in illicit discharges. 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.

Additionally, WCA conducted a stream walk through the more densely developed portion of Bennington and Pawlet (the historic downtown centers). Any unmapped outfalls were geo-located using high-accuracy GPS and marked on field maps.

WCA 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 essentially 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. 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 accurate 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 reach between taller buildings where satellite reception is poor.

At an 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, and ammonia was conducted in the field. Other indicators, such as color, odor, turbidity, and floatables were noted as well. If any indicators were above established thresholds (see Table 1), a further sample was taken for analysis later that day for total chlorine, methylene blue active substances (MBAS, a detergent indicator), and potassium.

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. WCA used this technique sparingly, as most outfalls, or other infrastructure, had adequate flow or a pool to sample from and the water could be analyzed for MBAS.

Additionally, WCA 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:
Given the geographic scope of the study area, WCA employed two field teams. Because of this, three different meters were used to test an outfall for temperature, pH, and specific conductance. The Hannah Instruments HI98129 Combo pH and EC meter was used for all three parameters, while the second field team employed the YSI EcoSense pH 10a Pen Tester for pH and the Eutech ECTestr 11 Dual Range for specific conductance. These meters were tested side-by-side in advance to assess variation in measurement. Though measurements were slightly different, the difference was less than 1% in all cases. Fresh pH 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.

Table 1: Common Water Quality Thresholds for IDDE.

Key water quality thresholds for initial screening of illicit discharges used by the Center for Watershed Protection and used by the US EPA and other IDDE studies in Vermont.

Common Water Quality Thresholds for IDDE	US EPA	VT Specific Studies
E. coli (MPN/100ml)	235	400
Ammonia (mg/L)	0.1	0.25
MBAS (mg/L)	0.25	0.2
Optical Brighteners	N/A	Presence
Chlorine (mg/L)	N/A	0.06
Potassium (ppm)	6	N/A
Specific Conductivity (uS/cm)	>2000	N/A
Ammonia/Potassium Ratio	>1.0	N/A

Ammonia:
Ammonia was measured immediately in the field using the LaMotte Colorimeter 1200 (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 is 0-5ppm/0.05ppm NH_3-N. Fresh reagents were maintained throughout the course of the study.

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 quickly and accurately determine total chlorine concentration in samples.

Potassium:
Potassium was analyzed using the Horiba Cardy-C Compact Ion Meter C-131 which uses a selective flat ion electrode that is unreceptive to other ions. This meter can measure down to 1ppm at the low range, though 'guaranteed' range is between 39 – 3,900ppm. This unit was calibrated according to Horiba's 2-point calibration method for the greatest degree of accuracy.

Optical Brighteners:
Where indicated WCA used cotton pads placed either in the potential flow path of water at the outfall or in the sump of a catchbasin where flow was anticipated. These pads were allowed to sit for a period of 3-

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. WCA 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 a result difficult. In most cases where there was generally reliable flow or pooled water in the catchbasin sump, the MBAS test was used. Some studies have indicated that it takes a relatively high concentration of optical brighteners to cause a pad to fluoresce under UV light (up to 50 mg/L), while the MBAS test is reliable ranging from 0 – 3 ppm. For this reason we tended to use it more frequently.

2.4 Advanced Investigation Methods

Using water quality thresholds established by the Center for Watershed Protection and used by the US EPA in their Illicit Discharge Detection and Elimination guidance, as well as thresholds referenced in other studies performed throughout Vermont on IDDE (Table 1), 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 pin-point 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. WCA communicated directly with each Town to discuss the findings and to plan for follow-up investigation. These investigations are described below.

2.4.1 Televising Sanitary and Stormlines:

The Town of Bennington possesses their own push and track cameras, as well as a line-jet to wash out sanitary and stormlines. On two occasions WCA Staff worked in coordination with the Town's Water Department to conduct camera investigation of several sanitary and stormlines to look for leaks, failed caps, or possible connections that were highlighted through Advanced Investigation methods.

2.4.2 Smoke Testing with Vermont Rural Water Association:

Smoke testing using non-toxic liquid smoked was used in Pawlet on one main stormline (PWL-19) and several smaller, more isolated catchbasin systems. Traditional IDDE Advanced Investigation methods had not yielded any specific suspicious locations, nor had investigations with Environmental Canine Services discovered anything. As the main stormline in question was commonly believed by town residents and officials to be a possible source of chronic illicit discharge, WCA Staff wanted to absolutely exhaust all potential options aimed at finding connections or other issues.

2.4.3 Dye-Testing using Optical Brightener Pads:

Several locations in both Bennington and Pawlet were investigated using high-strength dye. Dye was flushed down toilets or down sinks (or both) at the suspected point of origin of illicit discharge. Prior to flushing, a cotton pad free of optical brighteners was placed at the outfall or other point of analysis to ensure that the dye would stain the pad in case visual confirmation was not possible due to time-lag. WCA Staff would then attempt to visually confirm a connection in the 10-15 minutes that followed dye flushing.

If no dye was observed, the pad was left in place for a period of 3-10 preferably rain-free days in order to test for both the flushed dye as well as any possible optical brightener discharge within the system.

After retrieving the pads, they were rinsed in distilled water and immediately checked for florescence (the dye used would fluoresce as well, though not in the same way as optical brighteners used in laundry detergents). If no fluorescence was observed, the pads were left to dry in a dark room for 1-3 days, then checked again.

2.4.4 Environmental Canine Services (ECS) Alerts:

WCA, in partnership with the Center for Watershed Protection and Environmental Canine Services, conducted a week-long study using two canines specially trained in detecting sanitary sewage related discharges in stormwater systems.

The first step in this process involved visiting all the outfalls designated as Suspect or Possible in the initial dry-weather survey. If there was flow to sample, a sample was obtained in a sterile Whirl-Pak sample bag and put on ice for transport and storage. Once all samples had been collected, the canine's handlers placed the samples in small plastic containers spread out over a large area so as to not cross contaminate one sample's smell with another. The handler's then led the canines independently to each sample while WCA and CWP Staff noted any 'alerts' which indicate the potential presence of sewage in the sample. Samples where both canines alerted were designated as priority samples. Samples where only one canine alerted were placed in the second tier for possible follow-up.

Using these results, ECS, WCA, and CWP Staff then went into the field using printed maps of the VT DEC stormwater infrastructure, as well as the smartphone application developed by WCA with all infrastructure located and named in it. Sites with priority samples were then walked from the outfall up the line in an attempt to bracket the source of contamination. Alerts were noted using the smartphone application. These results were then used later to determine areas where additional follow-up was necessary if a pollution source wasn't immediately identifiable. In many cases the canines were able to alert on residual sewage smells, leading investigators to sources where flow was not visible in downstream structures. This aspect of ECS' service, combined with the relative speed of sample-targeted field work, was a boon to the investigation.

In Pawlet, additional samples were also taken directly from Flower Brook above the Mill Pond to attempt to ascertain the presence of sewage in the water body using the same 'sample and sniff' protocol described above.

3 RESULTS

The overall results for both Bennington and Pawlet can be seen in the table below. In Bennington of the combined 382 existing and newly-found outfalls assessed, 58 were found with some dry-weather flow on at least one occasion. 33 of these were flagged for later follow-up. Of these 33, 6 had confirmed illicit discharges. In Pawlet, a total of 34 existing and newly-found outfalls were assessed. 9 were found with some dry-weather flow on at least one occasion. 8 of these were flagged for later follow-up. Of these 8, 1 was found to be a confirmed illicit discharge.

Table 2: Summary Results for Bennington and Pawlet

Town	Outfalls Assessed:	New Outfalls Found:	Number Flowing:	Suspect or Possible Illicit Discharge:	Confirmed Illicit Discharge:
Bennington	382	114	58	33	6
Pawlet	34	2	9	8	1

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

3.1 Bennington Results

3.1.1 Outfall Reconnaissance Inventory (ORI):

During the ORI, which was conducted between April 1 and July 15, 2015, WCA surveyed 382 different outfalls, 114 of which were new (found primarily during the stream walk of downtown Bennington). Many of these new structures were very small pipes (<4" diameter) and very few of them were suspect in any way. During the ORI we did not visit approximately 25 mapped outfalls as those outfalls are primarily located along VT Routes 9 and 279. These roads are divided highways with little, if any, infrastructure near them and have all been installed in the last 10 years. In our opinion we don't believe that these areas are of any great concern.

Of the 382 outfalls visited, 58 were flowing and 33 had discharge that warranted further investigation. We focused on these 33 outfalls during our Advanced Investigation.

3.1.2 Advanced Investigation (AI):

AI work began after finishing the ORI on July 15, 2015 and was primarily conducted during the months of August and September, though follow-up work was also conducted in October and November.

Of the 33 systems assessed, 6 were found to have an illicit discharge that was confirmed. These discharges have either already been eliminated or are slated to be eliminated as soon as possible by the town of Bennington where discharges are related to the municipal system, or by the private property owner where the outfall or system is located.

What follows is a summary, site by site, of each 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.

3.1.2.1 *BTN-9:*

BTN-9 – Mapbook Page 1

Table 3: Water Analysis Data for BTN-9

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-12-15	Yes	605	1.45		0	2	0.75				
7-3-15	No										

The initial visit was on 6-12-15 - sampled from pooled water at culvert outlet in what appears to be small infiltration basin. Note – 0.16" precipitation in past 48 hours. Return visit in 7-15 found no pooled runoff. It is likely that the detergents results are linked to car washing in residential building parking lot. The likelihood for an illicit discharge to this outfall are low – this is a single catchbasin outfall. It was initially believed there was more infrastructure at this outfall, but that is not the case. Do not suspect chronic illicit discharge.

3.1.2.2 *BTN-11:*

BTN-11 is a 78"x40" concrete box culvert outlet that for part of its length carries an unnamed tributary stream that originates near the intersection of Prospect and South Streets from a small wetland complex. The piped drainage network that ultimately drains to BTN-11 comprises much of the southern section of downtown Bennington.

BTN-11 – Mapbook Page 2

Table 4: Water Analysis Data for BTN-11

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-25-15	Yes	700	0.09		0	0	0	>2400	0.012		
9-2-15	Yes										1x

Despite the low water quality values for other parameters, a lab sample for *E. coli* was taken and processed. The high bacteria count, while not necessarily indicative of an illicit discharge, prompted a more complete survey of the system. It was decided to use time with Environmental Canine Services to accomplish this survey.

The outfall was subsequently re-visited on 9-2-15 with staff and canines from ECS. One of the canines alerted at the outfall while the other did not. Catchbasins that did not have stream flow present were evaluated in an attempt to eliminate or bracket certain sources. Alternating catchbasins with stream flow were investigated using the canines to confirm that a possible illicit discharge was still present. Additionally, the stream itself was evaluated by the canines prior to its entrance into the underground box culvert – neither canine alerted. Therefore, it was concluded that no further investigation was necessary on upstream systems (i.e. systems that enter the stream upstream of its entrance to the underground box culvert).

Dana Allen, WCA, obtains a sample from BTN-11.

3.1.2.3 *BTN-11 – CB-1081:*

BTN-11 – CB-1081 – Mapbook Page 3

Table 5: Water Analysis Data for BTN-11 – CB-1081

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-2-15	Yes		2.77				0.75	199			X2

Team from ECS led the investigation to a small amount of pooled water in the catchbasin sump. WCA sampled from sump for lab analysis and found high detergent and a moderate level of bacteria. WCA returned with the Town of Bennington on 9-22-15 to conduct camera work. No suspect connections were found leading to or from the catchbasin sump. High ammonia levels were likely due to decomposing organic matter (grass clippings and leaves present). Detergent results were possibly due to car washing in residential neighborhood or fertilizers from lawns. This catchbasin collects a relatively large drainage area. Based on these results, WCA did not suspect a chronic illicit discharge.

3.1.2.4 *BTN-11 – CB-1384:*

BTN-11 – CB-1384 – Mapbook Page 4

Table 6: Water Analysis Data for BTN-11 – CB-1384

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-2-15	Yes	280	1.56				0.75	>2400			X1

WCA and ECS found pooled water in the catchbasin sump on 9-2-15. WCA sampled for lab (results above). WCA returned with Town of Bennington staff on 9-22-15 to televise pipes and found no suspect connections. Town of Bennington staff drained the sump and began monitoring over the following 5-6 days. The sump remained dry. WCA suspects that the high bacteria result was due to breeding in anaerobic conditions and temperature conditions in the sump. The high ammonia reading was likely due to decomposing organics. Detergents results were likely a result of road washoff. WCA does not suspect a chronic illicit discharge.

3.1.2.5 *BTN-11 – SMH-1386:*

BTN-11 – SMH-1386 – Mapbook Page 5

Table 7: Water Analysis Data for BTN-11 – SMH-1386

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-2-15	Yes	435					0.25	5			X2

WCA and ECS followed the stormline to this point on 9-3-15 and opened stormwater manhole. Pooled water was found during dry weather. One canine alerted, but it is suspected that canine alerted on a residual smell from SMH-1450 (higher up in same line). As both bacteria and detergent test results were low, there was no strong indication of an illicit discharge. WCA returned on 9-22-15 with the Town of Bennington staff to conduct camera and dye testing. Televising the lines indicated no potential illicit connections. Dye testing was conducted from all adjacent buildings and no dye appeared in the stormline. Additionally, to test the integrity of the sanitary line caps, each sanitary line was jetted with high-pressure water. No water was observed leaking into the stormwater line. WCA does not suspect a chronic illicit discharge.

3.1.2.6 *BTN-11 – SMH-1450:*

BTN-11 - SMH-1450 – Mapbook Page 6

Table 8: Water Analysis Data for BTN-11 – SMH-1450

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-2-15	Yes	615	*				2	>2400			X2

*Beyond Detection Limit - >5mg/L with no dilutions run.

WCA and ECS investigated up the stormline to this sanitary manhole and the adjacent storm catchbasins on 9-2-15. Both canines alerted on the catchbasin downstream of the sanitary manhole and on the nearby stormwater manhole sump. A small amount of water was observed in the sump of the stormwater manhole. WCA opened the sanitary manholes to observe conditions. The piping in each sump was different, indicating an incomplete slip-lining at some point in the past. Water sampled from the stormwater manhole seemed to confirm that some leaking from the sanitary line was taking place (results above). As there was no flow, no total phosphorus sample was taken.

Town of Bennington Water Dept. crew uses a camera to identify a leak in the line near SMH-1450. Cracks in the pipe are visible in the photo.

WCA returned on 9-22-15 with the Town of Bennington staff to televise the pipe. Cracks were found in the sanitary manhole sump, confirmed by televising the stormline while jetting the sanitary line with dyed water. A clear increase in flow was noted as soon as the jet was introduced. Dye was observed in the stormline. The Town of Bennington staff returned and added concrete to the sanitary manhole sump and re-tested using the camera and water jet. No discharges were found after the fix. The issue is considered resolved.

3.1.2.7 *BTN-18*

BTN-18 – Mapbook Page 7

Table 9: Water Analysis Data for BTN-18

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-12-15	Yes	625	0.41		0	0	0				
9-3-15	Yes										X1

An initial visit on 6-12-15 found a large concrete box culvert flowing with what appeared to be an underground stream. The initial sample indicated a weak chance of illicit discharge as any illicit discharge would likely be diluted by stream flow. Further investigation of stormwater infrastructure confirmed that this box culvert outlet does carry an unnamed tributary to the Walloomsac River under the Main St and Depot St intersection. Many stormwater systems outfall underground in this culvert, making identifying them separately somewhat problematic. Mapped infrastructure has been updated to reflect the suspected connections and approximate locations. For ease of use, BTN-18 has been retained as the overall system ID for sub-infrastructure.

3.1.2.8 *BTN-18 – CB-42:*

BTN-18 – CB-42 – Mapbook Page 8

Table 10: Water Analysis Data for BTN-18 – CB-42

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-2-15	No										X2

WCA and ECS followed this stormline. Both canines alerted at CB-42, but the catchbasin was dry so water sampling was not possible. WCA returned on 9-22-15 to televise pipes and dye-test with the Town of Bennington staff. Testing showed no suspect connections. The catchbasin was dry on 9-22-15 as well. There were no alerts by ECS on catchbasins upstream of this point, and no water was flowing or pooled. WCA does not suspect a chronic illicit discharge. ECS is not certain what could have caused alerts. This location may be good for follow-up using smoke testing in the future.

3.1.2.9 *BTN-18 – CB-72*

BTN-18 – CB-72 – Mapbook Page 9

Table 11: Water Analysis Data for BTN-18 – CB-72:

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-3-15	Yes	44	1.68				0.25				X2
11-17-15	Yes										

WCA and ECS followed canine alerts into the parking lot behind Madison Brewing Company on 9-2-15. One canine alerted. Two small pipes outfalling to this catchbasin were located; one was flowing intermittently and the other was dry. Moderate-high ammonia (1.68mg/L) and low detergents (0.25ppm) were detected. Bacteria was not measured as there seemed to be few indicators for possible sanitary sewage discharge. WCA returned to televise this line with the Town of Bennington staff on 11-17-15. One pipe was confirmed to be a roof drain. The intermittently flowing pipe was confirmed as a sump pump as the town crew remembered the installation. WCA was unable to televise this line as too much water was flowing. WCA does not suspect a chronic illicit discharge.

3.1.2.10 *BTN-18 – CB-86*

BTN-18 – CB-86 – Mapbook Page 10

Table 12: Water Analysis Data for BTN-18 – CB-86:

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-3-15	Pool		0.42				0.75	63			X2

WCA and ECS followed canine alerts to this catchbasin. Both canines alerted on pooled water. Moderate ammonia (0.42mg/L), detergents (0.75ppm), and low bacteria (63MPN) were found. WCA televised this line with the Town of Bennington staff on 11-17-15; no possible connections were found. Stormline pipes do tip slightly back toward the catchbasin, allowing water to pool in the catchbasin and pipe. This may be the source of ammonia and detergents, which may have concentrated over time. This catchbasin is also in a busy area of town, and it is possible that substances that could cause an alert by the canines have been dumped there over time. Investigation with the camera unit did not show any possible sources up- or down-stream. WCA does not suspect a chronic illicit discharge.

3.1.2.11 *BTN-18 – CB-199:*

BTN-18 – CB-199 – Mapbook Page 11

Table 13: Water Analysis Data for BTN-18 – CB-199

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-3-15	Yes	3999	2.6				>3				X2

On 9-3-15 WCA and ECA observed staining on the parking lot from the door of TJ's Fish Fry restaurant to the catchbasin. WCA suspected dumping of mop bucket wash water. The Town of Bennington indicated that the site has on-going sanitary sewer failure issue. The issue was initially referred to the Town of Bennington's Water Department and Health Office. The town declined jurisdiction over the issue and referred follow-up to the State of VT Wastewater Management Division. The State followed up with the restaurant and was assured that this was a one-time issue and would not occur again in the future. The issue is considered resolved.

3.1.2.12 *BTN-18 – SMH-114:*

BTN-18 – SMH-114 – Mapbook Page 12

Table 14: Water Analysis Data for BTN-18 – SMH-114:

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
9-3-15	No										X2
11-17-15	No										

WCA and ECS followed canine alerts to this manhole which was dry on 9-3-15. WCA televised the manhole with the Town of Bennington on 11-17-15 and found no possible illicit connections. WCA does not suspect a chronic illicit discharge.

3.1.2.13 *BTN-20 – CB-244/243*

BTN-20 – CB-244/243 – Mapbook Page 13

Table 15: Water Analysis Data for BTN-20 – CB-244/243:

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-25-15	Yes	216	2.3		0	1	0				
9-3-15	Yes	222	0.0				0				0X

Note: Data from 6-25-15 was for BTN-20 outfall location only. Data from 9-3-15 was from CB-243 (upstream of BTN-20) only.

Initial results from 6-25-15 marked this outfall for follow-up based primarily on a high ammonia reading. However, lab notes indicate that ammonia results were somewhat suspect due to a questionable batch of

reagents shipped around that time. This outfall is the outlet of Morgan Springs and the flow is primarily (during dry periods) the overflow from that spring. Ammonia results from 9-3-15 seem to support this.

Canines did alert on the adjacent catchbasin (CB-244). They did not alert on any catchbasins along Gage Street, which also drain to this junction. They did alert at two locations above this junction – one at stormwater manhole SMH-129 and once in the stream before it goes underground. However, these results were out of 4 and 6 separate tests, respectively. This does not give a high level of confidence in these results.

Televising the line on 11-17-15 from CB-244 to CB-243 revealed no suspect connection. No chronic illicit discharges are suspected along this line.

3.1.2.14 BTN-33:

BTN-33 – Mapbook Page 14

Table 16: Water Analysis Data for BTN-33

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	1560	0.25		Trace	2	0.25				
9-1-15	No										
9-3-15	No										X1
10-19-15	No			No Florescence						No	

At the initial visit on 7-2-15 there had been 0.39" rain in past 24 hours. Moderate ammonia and low detergents prompted flagging this outfall as of possible concern. However, the 'flow' was a combination of a pool of water as well as trickle flow from the pipe. Reddish staining and a sheen on the water indicated a possible discharge, but these were due to a small 4" pipe adjacent to the outfall. The sheen broke up when agitated, indicating bacteria rather than hydrocarbons. On the return visit on 9-1-15 there had been no rain for the past 24 hours and there was no flow. One canine alerted, but it was not clear if it was on this outfall or on the adjacent outfall. Neither canine alerted on the upstream catchbasins. No optical brighteners were present in the outflow. It is unlikely that there is a chronic illicit discharge at this outfall.

3.1.2.15 BTN-54

BTN-54– Mapbook Page 15

Table 17: Water Analysis Data for BTN-54

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
5-19-15	Yes	970	0.31		0	6	0.1				
8-6-15	Trickle	1133	0.75	CB-666	0	3	0.25	<1			
8-6-15	Trickle	840	0.55	CB-684	0	2	0.25	32			
9-1-15	Trickle			CB-666							X0

WCA conducted initial testing on 5-19-15. There had been 0.2" of rain in the previous 24 hours. Note – the first row of the above data table represents results for outfall BTN-54 only. Subsequent lines are for two different pipes in the catchbasin CB-666. WCA returned on 8-6-15 for follow-up. CB-666 was the only catchbasin accessible (CB-684 was paved closed). WCA sampled the trickle flow from a small pipe seemingly coming from the adjacent residence. WCA also sampled the larger pipe coming from CB-684 as a proxy for the trickle flow observed coming from a small pipe seemingly coming from the adjacent residence.

Moderate ammonia levels, low detergents, very low bacteria, and a trace of potassium seem to indicate that these pipes sampled are underdrains conveying groundwater that potentially had traces of fertilizers in it. Detergents results could be due to those fertilizers or to road washoff from this residential area. WCA returned again on 9-1-15 to obtain a sample for follow-up with ECS. Neither canine alerted on the sample. We do not suspect that there is a chronic illicit discharge here.

3.1.2.16 *BTN-64*

BTN-64 – Mapbook Page 16

Table 18: Water Analysis Data for BTN-64

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	885	0.19								
9-1-15	No										

Initial testing was conducted on 7-2-15. There had been 0.39" of rain in the previous 24 hours. The ammonia level prompted the follow-up, despite it being fairly low. Other parameters were not tested for at that time as this area is under development and there were no buildings built at the time of investigation. The probability of illicit discharge seemed quite low. WCA returned on 9-1-15 to obtain a sample for ECS, but there was no flow at that time. WCA does not suspect a chronic illicit discharge at this time.

3.1.2.17 *BTN-86– CB-996:*

BTN-86 – CB-996 – Mapbook Page 17

Table 19: Water Analysis Data for BTN-86– CB-996

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
8-5-15	Yes	2160	0.56		0	3	0.25	<1			

There is a small pipe outfalling into the catchbasin from uphill. It appears to be an underdrain. No infrastructure was located uphill from the catchbasin. High conductivity is likely related to de-icing activities on hospital campus. Moderate ammonia levels, low detergents, and low (at/below detection limit) bacteria do not indicate a high probability of illicit discharge from this pipe. WCA does not suspect a chronic illicit discharge at this catchbasin.

3.1.2.18 *BTN-86– CB-New 001:*

BTN-86 – CB-New-001 – Mapbook Page 17

Table 20: Water Analysis Data for BTN-86– CB-New 001

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
8-5-15	Yes	3300	0.5		0	14	0.25	<1			

This 'catchbasin' is actually a ~3' tall circular stone structure at grade with a pipe discharging into the sump near ground level. There was high conductivity, which at first was suspected to be due to de-icing on the hospital campus. This is still potentially part of the cause, but it could also be due to the illicit discharge from a hospital utility (paint) sink found at outfall BTN-105. We suspect that the high potassium is possibly related to utility sink discharges at BTN-105.

3.1.2.19 *BTN-92*

BTN-92 – Mapbook Page 18

Table 21: Water Analysis Data for BTN-92

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	1325	0.11		0.1	2	0				
9-1-15	Trickle										X0

WCA conducted an initial visit on 7-2-15. There had been 0.39" rain in the previous 24 hours. Ammonia levels, though low, prompted a follow-up visit. WCA conducted the follow-up visit on 9-1-15 to sample for ECS. In walking upstream, WCA discovered that the source of the flow is a small seep. It was previously thought that a larger closed drainage system, originating in Old Bennington, flowed all the way down and eventually to this outfall. That is not the case. The stormwater infrastructure has been updated accordingly. ECS tested and neither canine alerted. We suspect flow is due to primarily to the seep and also to saturated groundwater flow above the outfall. During mapping, WCA staff saw many instances where saturated groundwater flow from the hill of Old Bennington daylighted into small ditches, etc. WCA does not suspect a chronic illicit discharge at this outfall.

3.1.2.20 *BTN-100:*

BTN-100 – Mapbook Page 19

Table 22: Water Analysis Data for BTN-100

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-24-15	Yes	1520	0.44		0	1	0.15				
9-27-15	Yes	1400	0.8		0	1	0.25	5			

WCA initially visited this site on 6-24-15. There had been 0.48" of rain in the past 24 hours. Somewhat elevated ammonia and a trace of detergents (barely detectable) indicated the possibility of an illicit discharge. WCA did not sample or visit this outfall with ECS as the single catchbasin outfall did not indicate the need. WCA conducted a return visit on 9-27-15. There had been no rain past 48 hours. WCA observed a small trickle flow at that time and collected a sample for lab tests. While ammonia was still somewhat elevated, detergents did not support the possibility of a chronic illicit discharge. The source of flow was likely a small underdrain pipe coming into the upstream catchbasin.

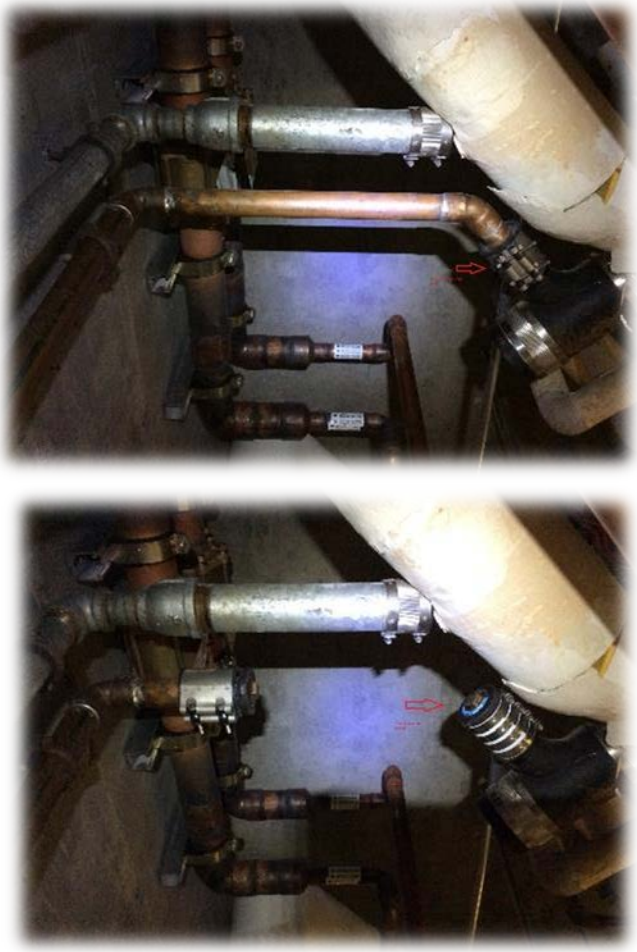
3.1.2.21 *BTN-105:*

BTN-105 – Mapbook Page 20

Table 23: Water Analysis Data for BTN-105

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	3350	0.27		0.2	3	0.5				
9-3-15	Yes	8	0.36				0				X1

WCA initially noticed this issue on 7-2-15 where there was a moderate flow of turbid, cloudy water coming from an older concrete pipe. Conductivity was very high, but ammonia and detergents were moderate. The presence of chlorine caused this outfall to be flagged as suspect. On a return visit on 9-4-15, water was visibly cleaner – the cloudiness and turbidity was gone and the conductivity and detergents were normal. WCA did not test for chlorine at this time as the visit's purpose was primarily sampling for ECS. One canine alerted on this sample. WCA then conducted a follow-up visit on 9-22-15, and spoke with Willy Hall, facilities engineer. WCA pointed out the issue and the highest visible source, which was a small pipe entering the first upstream catchbasin. Mr. Hall followed up with his plumbing staff and found an improperly connected paint sink. Mr. Hall communicated via e-mail to WCA on 10-13-15 that the sink had been disconnected from the stormline. WCA followed up on 11-22-15 and found no water flowing at the outfall or into the catchbasin. WCA considers the issue resolved. Because of the responsiveness of the hospital staff, neither the Town nor the State of Vermont was formally notified at the time of discovery.



Before (top) and after (bottom) photo of the improperly connected sink at the hospital.

3.1.2.22 *BTN-106:*

BTN-112 – Mapbook Page 21

Table 24: Water Analysis Data for BTN-106

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-25-15	Flooded										
11-17-15	Flooded										

WCA flagged this outfall, an old concrete pipe, as the infrastructure draining to it was not well understood from the mapping process. The outfall was flooded on both visits. The outfall was not tested by ECS as the presence of the stream could have confused the canines (i.e. the possibility of other discharge scents carried by the stream water could have led to false results). The three catchbasins that were potentially thought to drain to this outfall were always dry on inspection. WCA conducted camera and dye testing with the Town of Bennington staff at these catchbasins on the corner of Elm and Washington St. Dye testing confirms that these catchbasins do not drain to BTN-106 but rather drain to BTN-11. WCA does not suspect a chronic illicit discharge at this outfall. Revised infrastructure data has been sent to the VT DEC.

3.1.2.23 *BTN-112*

BTN-112 – Mapbook Page 22

Table 25: Water Analysis Data for BTN-112

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-5-15	Yes	121	0.09								
9-3-15	Yes										X1
9-27-15	Yes										

WCA conducted an initial visit on 6-5-15. Reddish-brownish stains were noted at the outfall. Ammonia was technically lower than follow-up criteria, but flow indicated the possibility that illicit discharges could be present. WCA conducted a follow-up on 9-1-15 to sample for ECS – the flow was still consistent. One canine alerted, but this weak level of suspicion did not merit a field visit with ECS. WCA conducted a final follow-up on 9-27-15. WCA determined that the flow is clearly from a small stream flowing through this area. WCA suspects that the reddish-brownish stains are due to iron-philic bacteria and does not suspect a chronic illicit discharge.

3.1.2.24 *BTN-113:*

BTN-113 – Mapbook Page 23

Table 26: Water Analysis Data for BTN-113

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-5-15	Yes	191	0.36		0	0	<0.25	10	<0.005		
9-3-15											X0

WCA conducted an initial visit on 6-5-15. There was some staining and a sheen on the surface of the water, believed to be due to iron bacteria. The sheen broke into clumps when agitated. Moderate ammonia, low detergent (trace), and low bacteria do not indicate the likelihood of an illicit discharge. It should be noted that this area is largely marshy and seems to be a fragmented wetland area; groundwater daylighting is common according to communications held with area tenants during infrastructure mapping.

3.1.2.25 *BTN-116*

BTN-116 – Mapbook Page 24

Table 27: Water Analysis Data for BTN-116

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-11-15	Yes	390	0.22		0	0	0				

Initial visit to this site on 6-11-15 found moderate ammonia with no other indicators. This outfall was flagged for follow-up but access was denied to the site for a follow-up visit. Despite inability to investigate, WCA does not suspect this site for chronic illicit discharge; results are not strongly indicative. It is likely that the elevated ammonia is due to high groundwater in this area.

3.1.2.26 *BTN-120:*

BTN-120 – Mapbook Page 25

Table 28: Water Analysis Data for BTN-120

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-11-15	Yes	648	0.14		0	2	0				
9-3-15											X0

WCA conducted an initial visit on 6-11-15. Slightly elevated ammonia levels prompted additional testing, but no results were strongly indicative of an illicit discharge. WCA returned on 9-1-15 to sample for ECS. Flow was followed up the entirety of the catchbasin system to the most upstream catchbasin. A trickle flow of water was observed at that location entering from an underdrain pipe. The flow at this location was substantially reduced from the flow at the outfall. WCA suspects that the flow observed is from groundwater intrusion into catchbasins and pipes. This entire area is low-lying and bounded by Furnace Brook to the north and the Walloomsac River to the south. ECS canines did not alert on the sample collected. The evidence does not indicate a chronic illicit discharge.

3.1.2.27 *BTN-128– CB-1406:*

BTN-128 – Mapbook Page 26

Table 29: Water Analysis Data for BTN-128– CB-1406

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
8-6-15	Yes	1640	0.12		0	0	0				
9-3-15	Trickle	1701	0.55		0	3	0.25				X0

WCA conducted an initial visit on 8-6-15 and found a small trickle flow at the outfall. Moderate ammonia levels at the outfall prompted a follow-up visit. Note – the second row of results are from small underdrain pipe coming from the direction of the adjacent Catamount Motel. The follow-up visit was conducted on 9-3-15. Though slightly higher ammonia and some detergents and potassium were found, neither canine alerted on the sample. It appears that this pipe is a parking lot underdrain for the motel. We do not suspect a chronic illicit discharge.

3.1.2.28 *BTN-130:*

BTN-130 – Mapbook Page 27

Table 30: Water Analysis Data for BTN-130

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-12-15	Yes	790	7.8			10					
7-27-15	Yes							>2400	3.9		

WCA conducted an initial visit on 6-12-15 and found very high ammonia. Water was too turbid to test for detergents. WCA returned on 7-27-15 to obtain an *E. coli* and phosphorus sample as the ammonia level and odor from the first visit made this outfall a likely target. We suspected an illicit discharge on 7-27-15. We opened a sanitary manhole and saw similar water running through the sanitary lines. We immediately called the Town of Bennington to report the suspected discharge. They investigated the sanitary line on 8-10-15 using the water jet and camera equipment, finding a significant sag in the sanitary line approximately where it crossed the stormline. On investigation of the stormline they found that it had sagged, allowing the sanitary line to sag, allowing leaking from the joints into the stormline. On 8-12-15 they dug it up and repaired the stormline, using 14' of new PVC sanitary pipe to replace the sagging section. The Town of Bennington also contacted contractors to slip-line approximately 1000' of sanitary pipe in this area. Jim

Pease of the VT DEC Stormwater Management Division was notified via e-mail of this issue and the repair on 8-19-15.

A return visit on 9-1-15 showed no flow from the outfall. The issue is considered resolved.

3.1.2.29 *BTN-160– CB-3586:*

BTN-160 – CB-3586 – Mapbook Page 28

Table 31: Water Analysis Data for BTN-160– CB-3586

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-3-15	Yes	2498	0.13		0	1	0				
9-1-15	Trickle										X0

WCA conducted an initial visit on 7-3-15 and found a trickle flow. Slightly elevated ammonia and a trace of potassium led to flagging this for follow-up. Conductivity was likely related to de-icing on campus. The follow-up visit occurred on 9-1-15 to obtain a sample for ECS. WCA also sampled water from CB-3586. Neither canine alerted on these samples. WCA does not suspect a chronic illicit discharge.

3.1.2.30 *BTN-209– CB-Multiple*

BTN-209 – CB-Multiple – Mapbook Page 29

Table 32: Water Analysis Data for BTN-209– CB-Multiple

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	750	0.78		0.2	6	0.25	5			
9-1-15	Yes										X2
9-1-15	No			CB-4671							X1
9-1-15	Trace			CB-4674							X2
9-1-15	No			CB-4665							X1
9-1-15	No			CB-5148							X2
9-1-15	No			CB-4663							X0
9-1-15	No			CB-4666							X0
9-1-15	No			CB-4944							X0

WCA conducted an initial visit on 7-2-15. There had been 0.39" of rain in the past 24 hours. WCA found a small trickle flow on the return visit on 9-1-15 when WCA sampled for ECS. Both canines alerted on BTN-209, with mixed results on several catchbasins leading to BTN-209. WCA performed dye tests from the Visitor's Center building and left optical brightener pads at the outfall; all tests were negative.

While water quality parameter testing and dye/OB tests do not indicate an illicit discharge, the canine alerts suggest that there could be some intermittent or random illicit discharges occurring in the parking lot and making their way to the detention pond BMP. Communication with the VTrans Facility Manager indicated that there was one diesel spill in the parking lot on 4-23-15. Additionally, ECS notes that there could be illicit dumping of truck or RV sanitary systems in catchbasins that could cause the canines to alert on the residual smells. The VTrans Facilities manager was notified of these results, as well as the possibility of illicit dumping by trucks and RVs. They will monitor the situation.

At this time WCA does not believe there is a chronic illicit discharge issue at the site. Our communication with the VTrans Facility Manager constitutes notice to them to be on watch for any potential illicit dumping.

3.1.2.31 *BTN-214*

BTN-214 – Mapbook Page 29

Table 33: Water Analysis Data for BTN-214

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	480	0.64		0.1	6	0				
9-1-15	Yes										X0

The initial visit was conducted on 7-2-15. There had been 0.39" of rain in the past 24 hours. There was a small trickle flow at the outfall. Slightly elevated ammonia, some potassium, and low chlorine indicated the possibility of an illicit discharge. WCA returned on 9-1-15 to obtain a sample for ECS. Neither canine alerted on the sample. With weak evidence supporting the possibility of an illicit discharge, and the fact that the Visitor's Center is newly constructed and is unlikely to have broken or improperly connected infrastructure, WCA does not believe that there is a chronic illicit discharge at this location.

3.1.2.32 *BTN-228:*

BTN-228 – Mapbook Page 30

Table 34: Water Analysis Data for BTN-228

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	1260	0.83		0.2	4	0.5				
9-1-15	No										

The initial results are from 7-2-15. There had been 0.39" of rain in the past 24 hours. The site was flagged for follow-up because of the moderate ammonia, along with the moderate detergents and low chlorine and potassium. WCA returned on 9-1-15 to sample for ECS when there had been no rain in the previous 24 hours. There was no flow at that time. As this system is on a highway exit, there is no sanitary infrastructure near the site. Detergents are likely due to windshield fluid. Potassium could be related to the same, or other washoff from the road. Only the chlorine is somewhat questionable, but infrastructure data does not indicate the presence of any other water or sanitary sewer pipes in the area, nor are there any houses or other buildings nearby. Therefore, WCA does not suspect a chronic illicit discharge.

3.1.2.33 *BTN-235:*

BTN-235 – Mapbook Page 31

Table 35: Water Analysis Data for BTN-235

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	1210	0.78		0	1	0				
9-1-15	No										

The initial results are from 7-2-15. There had been 0.39" of rain in the past 24 hours. The site was flagged for follow-up based on the ammonia levels. No other parameter was suspect at that time. WCA returned on 9-1-15 to sample for ECS. There had been no rain in the previous 24 hours. There was no flow at that time. This outfall is a two catchbasin system located on a newer part of VT Route 279. There are no sanitary

lines nearby, nor are there any residences or other structures. Therefore, we do not suspect chronic illicit discharge.

3.1.2.34 *BTN-New 8*

BTN-New-8 – Mapbook Page 32

Table 36: Water Analysis Data for BTN-New 8

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-12-15	Yes	386	0.36		0	1	0.25				
9-3-15											X0

We suspect this outfall carries an underground small stream or a diversion from the Walloomsac River that runs through the basement of part of the Bennington VA Clinic. As this building appears to be an old mill building of some sort, this could have been an old hydro-power diversion. Because the routing was not completely understood, WCA traced the line with ECS. One canine was alerting on residual scents in dry catchbasins until the team found a catchbasin being used as 'toilet' by the local homeless population. WCA contacted the Bennington VA Hospital administrative staff and alerted them to the issue. They communicated that problem to the building's owners. As this is a random, intermittent issue, WCA does not consider this to be a chronic illicit discharge. Notification of the building's owners constitutes the best possible solution for this issue at this time.

3.1.2.35 *BTN-New 9:*

BTN-New-9 – Mapbook Page 33

Table 37: Water Analysis Data for BTN-New 9

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-12-15	No									No	
9-3-15	No										X0

BTN-New-9 is an outfall found during the stream walk. It appears to be old and in poor condition. It is not known what system drains to this outfall as much of the infrastructure in this area seemingly outfalls underground to the large concrete box culvert that has BTN-18 as its outfall. WCA was not able to obtain flow results on any visits. An optical brightener pad was set and there was evidence of flow as the pad was covered in dirt. However, after rinsing and drying, there was no optical brightener on the pad. WCA did not visit BTN-new-9 with ECS canines due to the proximity of other outfalls with known alerts (proximity negates results at outfall).

It is possible that this outfall is connected to catchbasins along Depot Street and Main Street. WCA and ECS inspected those catchbasins along those streets - any potential issues would have been determined by that investigation. Other than the intermittent dumping discovered at BTN-18 – CB-199 (TJ's Fish Fry) there were no other issues found during the investigation. WCA does not suspect a chronic illicit discharge to this outfall at this time.

3.1.2.36 *BTN-New 32*

BTN-New-32 – Mapbook Page 34

Table 38: Water Analysis Data for BTN-New 32

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-24-15	Yes	>2400	0.14		0	0	0.25			No	
8-26-15	Yes							1	0.033		

WCA conducted an initial visit on 6-24-15. There had been 0.48" of rain in the past 24 hours. WCA observed intermittent flow – like a pumped flow. However, ammonia and detergents were relatively low, though conductivity was very high. A follow-up was conducted on 8-26-15 to obtain a bacteria and total phosphorus sample. Both results were very low – bacteria was essentially a non-detect. WCA sampled for ECS on 9-1-15. Neither canine alerted. WCA returned on 9-27-15 and obtained access to the building. We observed sump pump arrangement in the basement of the business. The water in the sump was sampled, and results were consistent with water at the outfall. We believe this outfall to be solely the effluent from the basement sump pump of the adjacent business. WCA does not consider this to be a chronic illicit discharge.

3.1.2.37 *BTN-New 53-54:*

BTN-New-53-54 – Mapbook Page 35

Table 39: Water Analysis Data for BTN-New 53-54:

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-24-15	Yes	57	0.2		0.6	0	0	<1			

During the stream walk, WCA found water discharging from small pressure relief pipes in the concrete bridge abutment. Water samples had the highest chlorine values seen to date. Other parameters did not suggest a sanitary leak – WCA believed this to be a broken water main. Neither canine alerted on the sample obtained on 9-1-15 – this is consistent with their training. WCA expressed our belief that this discharge was related to a broken water main. The Town of Bennington confirmed that this was the case via e-mail and noted that they had found the issue in their line sometime in July, 2015. As of a follow-up visit on 11-20-15 a complete repair of the line was underway. Though we were not able to observe that the problem was completely repaired by the work underway on 11-20-15, WCA believes that this issue should be considered resolved.

3.1.2.38 *BTN-New 107:*

BTN-New-107 – Mapbook Page 36

Table 40: Water Analysis Data for BTN-New 107

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
6-25-15	Yes	970	0.33		0	0	0				

WCA conducted an initial visit on 6-25-15 during the stream walk. There had been 0.48" of rain in the past 48 hours. We observed a trickle flow from a 6" concrete pipe. Elevated ammonia indicated a follow-up, but no other parameters indicated an illicit discharge. We believe this to be an underdrain pipe; this area has a large dammed pond and likely experiences high groundwater, necessitating an underdrain for the lawn area. Anaerobic conditions in groundwater would explain the relatively low ammonia levels seen. WCA re-visited on 9-27-15 and observed a small trickle flow. We were unable to conduct a dye test as the residence is low-use and no one was home during either visit. A business card was left with a number to call at that

time. We have not heard from the resident. WCA does not suspect a chronic illicit discharge based on water quality results.

3.1.2.39 *BTN-New 201– CB-1028:*

BTN-New-201 – CB-1028 – Mapbook Page 37

Table 41: Water Analysis Data for BTN-New 201– CB-1028

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	1876	0.13		0.2	4	0.25				0X

During the initial visit on 7-2-15, a trickle-to-moderate flow was observed from a 12" pipe that outlets under the road to the small tributary stream. Low ammonia, detergents, chlorine, and potassium indicated the possible need to follow-up.

During a subsequent follow-up in late August, the infrastructure was slightly revised. There is a large closed drainage system that runs along most of Main Street towards Old Bennington that outlets to a large swale where a majority of the runoff infiltrates. What doesn't infiltrate can make it to a small culvert and swale before entering the second of two catchbasins that drain to BTN-New-201. As there was 0.39" of rain in the 24 hours before the first visit on 7-2-15, the results (and flow) are likely related to the leftover runoff from this large piped drainage system.

When WCA returned on 9-1-15 to sample for ECS there was only a small trickle from one underdrain pipe coming into CB-1028 – definitely not enough flow to account for what was seen on 7-2-15. Neither canine alerted on the sample from CB-1028. WCA does not suspect that this pipe experiences a chronic illicit discharge.

3.1.2.40 *BTN-New 202:*

BTN-New-202 – Mapbook Page 14

Table 42: Water Analysis Data for BTN-New 202

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-2-15	Yes	1820	1.15		0.1	5	0.25				
9-1-15	No										
9-3-15	No									No	X1

Note – the map for this outfall, with explanatory text, is combined with the map for BTN-33 as the two are located next to each other.

WCA conducted an initial visit on 7-2-15. There had been 0.39" of rain in the past 24 hours. On our return visit on 9-1-15 to sample for ECS there was no flow. WCA and ECS visited the site on 9-3-15 – one canine alerted, but with another outfall in proximity it was not clear which outfall was possibly causing the alert.

We placed an OB pad on 9-4-15 and left it for ~10 days. Though the pad was stained reddish, after rinsing and drying there was no florescence. The reddish stains and sheen are likely iron-philic bacteria as the sheen breaks into chunks when agitated. We suspect this is underdrain pipe outlet from Rescue Squad parking lot. WCA does not suspect that there is a chronic illicit discharge at this location.

3.2 Pawlet Results:

3.2.1 Outfall Reconnaissance Inventory:

During the ORI which was conducted between April 1 and July 15, 2015, WCA surveyed 34 different outfalls, 2 of which were new (found primarily during the stream walk of the urbanized portions of Pawlet). One of these structures was actually a culvert outlet from a ditch that conveys a small farm pond to the larger Mill Pond. There is also a spring that drains into it. The other new outfall was an old rusted metal pipe that was not flowing during investigation. During the ORI we visited all mapped outfalls for both Pawlet and West Pawlet.

Of the 34 outfalls visited, 9 were flowing and 8 had discharge that warranted further investigation. We focused on these 8 outfalls during our Advanced Investigation.

3.2.2 Advanced Investigation:

Advanced Investigation (AI) work began after finishing the ORI on July 15, 2015 and was primarily conducted during the months of August and September, though follow-up work was also conducted in October and November.

Of the 8 systems assessed, 1 was found to have an illicit discharge that was able to be confirmed. This discharge, from a residence with on-site septic, is currently undergoing engineering design for a proper repair.

3.2.2.1 *PWL-3*

PWL-3 – Mapbook Page 38

Table 43: Water Analysis Data for PWL-3

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	Yes	390	0.45		0	3	0				
8-10-15	No										

Initial visit on 7-9-15 revealed moderate ammonia (0.45mg/L), and low potassium (3ppm). Our follow-up visit on 8-10-15 revealed no flow at the outfall or in either catchbasin. We suspect the ammonia level is due to the presence of an undefined underdrain pipe above CB-121616. WCA does not suspect a chronic illicit discharge.

3.2.2.2 *PWL-11*

PWL-11 – Mapbook Page 39

Table 44: Water Analysis Data for PWL-11

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	No										
9-1-15	No										

No flow was observed on WCA's initial visit on 7-9-15. During the investigation with ECS one canine alerted at this outfall on 9-1-15. WCA dye tested from adjacent business on 10-26-15 and left an OB pad from 10-26-15 to 10-30-15. No dye or optical brightener was found at the outfall. WCA does not suspect a chronic illicit discharge.

3.2.2.3 *PWL-12*

PWL-12 – Mapbook Page 40

Table 45: Water Analysis Data for PWL-12

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	No										
9-1-15	No										1X

No flow was observed on initial visit on 7-9-15. During our investigation with ECS, one canine did alert at the outfall and the lone upstream catchbasin. WCA dye and optical brightener tested from the adjacent residence to the upstream CB 10-26-15 to 10-30-15 in a 4" PVC pipe with no results.

However, in addition to the 4" PVC pipe, the catchbasin has a 24" pipe that extends 5-6' uphill and into an old stone sluiceway. No one at the Town of Pawlet is certain where that sluiceway comes from. It is likely that it used to run underground down the hill behind the residence, but now that there has been new drainage installed along VT Route 30, what used to run in that drainage is now being intercepted by the stormline along VT Route 30. WCA did not initially test this larger pipe as there was no flow observed.

WCA then conducted smoke testing with VT Rural Water Association from the catchbasin on 11-16-15. Smoke was observed from sanitary vents at 75 School Street. A dye test and further investigation in the catchbasin inlet pipe revealed the presence of dye. WCA and VT Rural Water Association confirmed this is an illicit discharge on 11-16-15. It was reported to the Town of Pawlet's Health Officer, VT DEC, and the building's residents.

They contacted their district Waste Management Division on 11-17-15 to discuss repair options. At this time WCA considers this illicit discharge confirmed, but not fully repaired though plans are underway to resolve the issue in a timely fashion.

3.2.2.4 PWL-15

PWL-15 – Mapbook Page 41

Table 46: Water Analysis Data for PWL-15

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	Yes	795	0.42			6	0.25	82			
9-1-15	Yes										0X

Note – refer to the map for this outfall for infrastructure revisions. The outfall is farther uphill than shown. Additional adjustments were made to pipes routed to catchbasin.

On our initial visit on 7-9-15, staff sampled from what is now know to be small PVC lawn underdrain pipe. There is a spring that runs through the basement of the house uphill and outlets into a small round metal basin. This then overflows, resulting in the need for the underdrain. Staff sampled from the underdrain thinking this was the catchbasin outfall, but this is not the case.

WCA did conduct a follow-up on 9-1-15 with ECS. Neither canine alerted at the outfall. Additionally, neither canine alerted at the round metal 'Bird Bath' basin, nor did they alert on the catchbasin. Additional smoke testing was conducted on 11-17-15 with VT Rural Water Association – no smoke was observed from any sanitary vents in the area. We do not believe that there is a chronic illicit discharge in this area.

'Bird Bath' structure with OB pad placed at outlet of the feeder pipe.

3.2.2.5 PWL-18

PWL-18 – Mapbook Page 42

Table 47: Water Analysis Data for PWL-18

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	Yes	349	0.59			1	0				
8-14-15	No										
9-1-15	No										0X

WCA found a moderate trickle flow on 7-9-15. Moderate ammonia (0.59mg/L) with no other indicators led to the decision to conduct a follow-up visit on 8-14-15. Follow-up on 8-14-15 revealed no flow. There were no canine alerts on 9-1-15. WCA does not suspect a chronic illicit discharge at this location.

3.2.2.6 PWL-19

PWL-19 – Mapbook Page 43

Table 48: Water Analysis Data for PWL-19

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	Yes										
8-14-15	Yes	482	0	CB-124717		3	0	58			
8-14-15	Yes	532	0	CB-124726		1	0	38			

PWL-19 is the largest closed pipe drainage system in Pawlet. According to communications with town residents and officials, many believed that this outfall is potentially a source for illicit discharges in the Town of Pawlet. Because of this widely held belief, WCA conducted a more thorough search of this system than was initially warranted by water quality parameters and observations.

On 7-9-15 during the Outfall Reconnaissance Inventory WCA was not able to sample the outfall as it was approximately 15' down from the edge of the road coming out of a concrete bridge abutment into a bedrock gorge. We did not have a crowbar to open the catchbasin grate. There was an observed trickle flow in the catchbasin sump.

On 8-14-15 WCA returned and were able to trace the flow up the line to CB-124717 where there was a noticeable trickle flow coming from a small pipe out of the basement of a house. The results for that are listed above. The owner of the house, Eric Mach, let WCA in and showed us the small spring that runs through the basement of the house and into the catchbasin. WCA tested this spring water – results are consistent with results obtained from the trickling small pipe.

Also on 8-14-15, WCA was able to trace a small amount of flow farther upstream to CB-124726. Water quality results for this are listed above. Results do not indicate an illicit discharge.

On 9-1-15 WCA investigated the entire line with ECS. Only one canine alerted on CB-124758 and CB-124693. This alert was later linked to the septic tank vent pipe associated with the residence on the corner of VT Route 30 and Church Street. Otherwise, there were no alerts at any catchbasin along this line.

On 11-3-15 WCA placed OB pads in all catchbasins along this line. There were no positive results after they had been left for four days.

Finally, on 11-17-15 WCA and VT Rural Water Association conducted smoke testing of this line from the outfall up to the top of the line. No smoke was observed coming from any sanitary pipes in any residence.

The results of all these tests do not indicate the presence of any chronic illicit discharge at PWL-19.

Note – residents of Pawlet have frequently said, and investigators noted several times during the course of the study, the strong presence of a sewage smell at the corner of VT Route 30 and Church Street. It is WCA's suspicion that this smell is due largely to the

Smoke testing PWL-19 in Pawlet.

septic tank vent pipe on that corner. The contents of the tank are pumped uphill to a leach field. It is our suspicion that this is the cause of the odor.

3.2.2.7 *PWL-22*

PWL-22 – Mapbook Page 44

Table 49: Water Analysis Data for PWL-22

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	Yes	525	0.71			2	0				
8-10-15	No										
9-1-15	No										0X

WCA observed a moderate trickle flow on 7-9-15. Moderate ammonia (0.71mg/L) and low potassium (2ppm) indicated need for a follow-up. No flow was observed on 8-10-15 follow-up. No flow was observed on 9-1-15 canine investigation - no ECS canine alerts. WCA does not suspect a chronic illicit discharge.

3.2.2.8 *PWL-25*

PWL-25 – Mapbook Page 45

Table 50: Water Analysis Data for PWL-25

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	Yes	525	0.71			2	0				
9-1-15	No			CB-124754							1X
9-1-15	Yes	440	0	CB124753		14	0	16			2X

Observed a trickle flow on 7-9-15. Moderate ammonia (0.6mg/L) and low potassium (2ppm) indicated the need for a follow-up. One canine alerted at CB-124754 on 9-1-15. WCA and ECS investigated the line; both canines alerted on two 4" PVC underdrains that outlet into the adjacent catchbasin (CB-124753 - see map). WCA tested the flow – there was no ammonia, no detergents, some potassium (14ppm), and low bacteria (16MPN). WCA tested for optical brighteners 11-3-15 to 11-7-15 - no florescence was seen. WCA and VT Rural Water Association were unable to smoke test (pipes too small).
WCA has spoken with the owner who asserts that pipes are underdrains. The on-site septic was installed in the last 20 years. WCA suspects that the canines may have been alerting on neighbor's septic vent pipe which is directly adjacent to small pipes. Despite the double alert by the canines on 9-1-15, WCA does not suspect that there is a chronic illicit discharge at this site.

3.2.2.9 *PWL-New-100*

PWL-New-100 – Mapbook Page 46

Table 51: Water Analysis Data for PWL-New-100

Date	Flow?	Conductivity (uS/cm)	NH_3 (mg/L)	Observations	Cl (mg/L)	K^+ (ppm)	MBAS (ppm)	*E. coli* (MPN)	T.P. (mg/L)	OB?	Canine Alert?
7-9-15	Yes	510	0.94			10	0.25	120			
9-1-15	Yes			Edie's Pond			0.25				1X
9-1-15	Yes	613	0	Edie's Lower Spring			0.5	2	0.01		2X

This outfall is actually the end of a culvert conveying runoff from small pond and a spring through a channel into the Mill Pond. Initial results from 7-9-15 with moderate-high ammonia (0.94mg/L), potassium (10ppm), low detergents (0.25ppm), and low bacteria (120MPN) are likely due to influence of decaying organic matter in pond, lawn fertilizer inputs, and animal feces.

Follow-up investigations on 9-1-15 with canines show no alert on 'Upper Spring' (see map) but both canines alerted on 'Lower Spring'. This 'Lower Spring' is actually the overflow from a cistern in the basement of the adjacent residence. The cistern is fed by the 'Upper Spring'. Moderate-low detergents (0.5ppm) in Lower Spring and very low bacteria (<2MPN) were found. It was theorized initially that the line conveying the spring overflow might cross the line to the septic tank. However, dye testing of the Lower Spring from the basement of adjacent house revealed no dye or optical brighteners.

ECS is uncertain what may have caused the alert at the spring outlet – it is possible that it could be the sanitary vent pipe on the roof of the house. The smell will often fall around the footing of the house and linger in the area. We do not suspect a chronic illicit discharge here.

3.2.2.10 *Flower Brook – Stream Sampling*

Flower Brook – Stream Sampling – Mapbook Page 47

As Flower Brook has demonstrated chronic issues with bacteria impairment, WCA wanted to attempt to rule out all possible potential sources of onsite wastewater treatment system discharges. In our stream walk of the Flower Brook, WCA only uncovered two additional unmapped pipe outfalls neither of which proved to have a confirmed illicit discharge. While working with ECS, WCA attempted to bracket potential sources of bacterial contamination in Flower Brook above the Mill Pond up to VT Route 133 bridge by conducting targeted sampling for analysis by the canines. Starting below the Fire Department, WCA walked upstream, sampling in-stream between houses in an attempt to determine if a particular residence's septic system might be discharging inappropriately.

Samples were stored in sterile Whirl-Pak bags and brought to the canines. Each canine analyzed each sample twice, as well as a field blank.

The results were highly variable. On only one sample during one round of testing was there an alert by both canines – the sample taken above the fire department (Above FD – see map). Canines did not agree on the second round of analysis.

On other samples there were instances of agreement sample from Below FD (both rounds), sample from FB3 (both rounds), sample from FB5 (both rounds), but only one canine alerted. Given the nature of the sample (in-stream water with a high degree of mixing), it is difficult to determine if one canine alerting bears any significance.

Because of the highly variable nature of the data, it is difficult to make a concrete recommendation for future investigation or reparative action. The one conclusion that can be drawn from this investigation is that there is some evidence that demonstrates the presence of sanitary sewage in the reach of Flower Brook above the Mill Pond. WCA recommends that the Town of Pawlet use and build on the work performed in the summer of 2015 by the Poultney-Mettowee Natural Resources Conservation District to classify the type and condition of all onsite wastewater treatment systems located along the Flower Brook to determine if there are failed, or failing, septic systems that can be replaced or repaired.

3.2.2.11 *Mill Pond – E. coli Sampling*

Mill Pond– *E. coli* Sampling – Mapbook Page 48

WCA performed one round of *E. coli* bacteria sampling on 7-9-15 focused on bracketing the potential effects the Mill Pond in Pawlet might have on downstream reaches. As there was only one round of sampling, the results must be viewed as very preliminary, however the data trend does show a slight increase in *E. coli* levels from upstream to downstream (see map).

This could potentially indicate that the sediment in the Mill Pond harbors an indigenous population of *E. coli* bacteria that was established in the past due to stormwater runoff chemistry (i.e. the presence of mammalian fecal matter) or due to illicit discharges from malfunctioning or failed septic systems. This round of *E. coli* sampling was conducted prior the pond dredging, which occurred around 9-1-15. While this conclusion is somewhat supported in the literature[1], this study does not constitute definitive proof that this is the case for Flower Brook and the Mill Pond. Rather it is just one possible explanation for the higher *E. coli* levels seen downstream of the Pond.

[1] Hartel, et. al., 2005; Brinkmeyer, et. al., 2015, Byappanahalli, et. al., 2003

4 RECOMMENDATIONS FOR FUTURE ACTION

4.1 Bennington – Future Action Recommendations:

- BTN-11 – CB-1081: Town of Bennington should continue to monitor this catchbasin. Consider educating local residents regarding proper car washing activities, etc.
- BTN-86 – CB-996 and CB-New-001: Recommend conducting outreach to Southern Vermont Medical Center regarding developing de-icing plan (salt reduction) as conductivity levels (often linked to salt application for deicing) are very high in this area.
- BTN-160: Recommend working with Bennington College to develop deicing plan (salt reduction) to reduce conductivity (salt) levels at outfall.
- BTN-209: Recommend monitoring for illicit dumping of RV or truck sanitary tanks at Bennington Visitor's Center.
- BTN-New-8 – CB-52: Recommend that owners of the building housing the Bennington VA Clinic work to discourage usage of stormwater infrastructure as a clandestine toilet facility.
- BTN-New-9: Recommend that Town of Bennington work to ascertain the location and type of piped drainage system that outlets at this location. Doing this work is outside the scope of this study.
- General Recommendation 1: Recommend installing 'No Dumping' badges on all municipally managed catchbasins to prevent intermittent illicit discharges from occurring.
- General Recommendation 2: Recommend using the newly-created VT DEC stormwater infrastructure map cross-referenced with existing sanitary sewer line mapping to determine where all sanitary / storm sewer intersection points are located. It should be noted that for the VT DEC stormwater infrastructure layer, pipe locations are approximate – the Town of Bennington should work with the local Regional Planning Commission to continue to update the stormwater infrastructure data. Once intersection points are determined, camera investigations can be made to determine if there are cracks or sags in any of the piping that may allow for cross-contamination. This is often the most effective way of discovering intermittent or small-scale illicit discharges, as well as infrastructure on the brink of failure.

4.2 Pawlet – Future Action Recommendations:

- PWL-12: Ensure that the septic system is fixed according to VT State regulations. The Town should also contact the Vermont Rural Water Association to televise the old stone sluiceway extending uphill from this single catchbasin in front of 75 School Street to determine connections and provenance. Doing this work was outside the scope of this study.
- General Recommendation 1: The Town of Pawlet should continue to support the work of the Poultney-Mettowee NRCD in cataloging the type and condition of residential septic systems in the town center, as well as surrounding areas in Pawlet as failed, or failing, systems could be a substantial contributor to bacteria in Flower Brook.
- General Recommendation 2: The Town of Pawlet may want to consider conducting bacteria sampling in association with the Poultney-Mettowee NRCD to determine, on a more regular basis, when the Flower Brook is safe to swim in. Additionally, creating outreach materials regarding this issue may be prudent. An example of a good outreach program in Vermont is the work done by the Friends of the Mad River in Waitsfield (http://www.friendsofthemadriver.org/).
- General Recommendation 3: A stormwater master planning study is currently underway for the Flower Brook watershed – this may help reduce bacteria loading associated with rural upland non-human sources (i.e. animals, including livestock). It is recommended that Pawlet use the outcome of this study to help reduce bacteria loading seen in Flower Brook.

5 PHOSPHORUS LOADING ESTIMATES

5.1 Bennington Load Reductions:

Table 52– Bennington Phosphorus Load Reductions:

Infrastructure Code	Illicit Discharge	Potential P Reduction
BTN-11 – SMH-1450	Cracked sanitary sewer manhole sump serving ~2-3 residences	Assuming occupancy of each residence = 4, potential P reduction from eliminating this discharge is: 2 g / P / capita / day X 12 residents X 365 days **= 8.76 kg P / year[2][3]**
BTN-18 – CB-199	Wash water dumping from restaurant	Intermittent dumping only – related to malfunctioning sanitary sewer at seasonal restaurant. Assume 1 floor wash / day 4 gallons wash water / wash 6 mg / L P for washwater[1] 3 months operation / year (~90 days) **= 2.04 kg / year**
BTN-105	Utility sink (paint-related) from hospital building	Did not obtain TP sample prior to issue being resolved. Not estimated.
BTN-130	Failed stormwater line allowing sanitary waste to leak from joints into stormline.	Measured flow – 0.008 L / second Measured T.P. – 3.9 mg/L Flow measured at 8:40AM – typically a higher flow time. Assume ~690 L / day **= 0.98 kg P / year**
BTN-209	Possible intermittent sanitary tank dumping from RVs or trucks	Not Estimated.
BTN-New-8 – CB-52	Catchbasin area being used as 'toilet' by homeless population	Not Estimated. Occurrence of events are too random.
BTN-New-53-54	Broken water main @ 200gpm.	P reductions from eliminating this connection is assumed to be negligible, if existent at all.

[2] P loading estimate derived from U.S. EPA, 2002, Onsite Wastewater Treatment Systems Manual, US Environmental Protection Agency, Office of Water, February, 2002, EPA/625/R-00/008.

[3] This number may overestimate the total amount entering the stormwater system as the discharge was a leak, not a direct connection – therefore it is difficult to accurately gauge the amount of P entering the stormwater system.

5.2 Pawlet Load Reductions

Table 53– Pawlet Phosphorus Load Reductions

Infrastructure Code	Illicit Discharge	Potential P Reduction
PWL-12	Improperly plumbed sanitary pipes not connected to septic tank from an apartment building with 1 occupant (at time of discharge discovery).	Assuming occupancy has been 1 for past year, potential P reduction from eliminating this discharge is: 2 g / P / capita / day X 1 resident X 365 days = 0.73 kg P / year[1]

Total phosphorus load reductions as a result of this project are estimate at approximately 12.51 kg / year.

6 CONCLUSIONS

A thorough assessment of stormwater drainage systems in Bennington and Pawlet was conducted in an attempt to find any non-stormwater illicit discharges to the stormwater system that could then possibly enter natural water bodies in either of those communities. This work was conducted during the spring, summer, and fall of 2015 on all mapped stormwater outfalls known at that time. Additionally, the natural water ways in the more urbanized portions of each municipality were walked to identify possible additional outfalls that had not been mapped. This resulted in a total of 382 systems in Bennington and 34 in Pawlet visited. 114 new outfalls in Bennington and 2 new outfalls were found in Pawlet. Of these, 58 in Bennington and 9 in Pawlet were flowing. Further analysis of these flowing outfalls led to the designation of 33 in Bennington and 8 in Pawlet as suspected illicit discharge. 6 confirmed illicit discharges were found in Bennington while 1 was found in Pawlet.

These confirmed illicit discharges are:

Bennington:

- BTN-11 – SMH-1450: A cracked sanitary sewer manhole sump was identified with assistance from Environmental Canine Services and later confirmed with camera assistance from the Town of Bennington. The sump was repaired with concrete and tested by the Town of Bennington. The issue was resolved. A phosphorus reduction of 8.76 kg / year is estimated.
- BTN-18 – CB-199: Intermittent wash water dumping from a restaurant with a malfunctioning sanitary system was discovered with assistance from Environmental Canine Services. The issue was pursued by the State of Vermont Wastewater Division – a resolution is not known at this time. Approximately 2.04 kg phosphorus could be eliminated annually if this issue is resolved.
- BTN-105: A utility sink from the Southern Vermont Medical Center was found draining to this outfall. Hospital staff were notified of the issue and the sink was disconnected from the stormwater drainage system. No phosphorus reduction load was estimated given the nature of the source.
- BTN-130: A broken stormwater line allowed a sanitary sewer line to sag into it, resulting in leakage of sewage from the line's joints. Both pipes were replaced at their intersection. Further inspection revealed that the no water was continuing to leak from the outfall. The issue is considered resolved. Approximately 0.98 kg of phosphorus were eliminated annually.
- BTN-209: There is possible illicit dumping of sanitary tanks from RVs or trucks at the Bennington Visitor's Center, managed by VTrans. There is no direct confirmation of this suspicion – rather it was inferred via canine investigation with Environmental Canine Services. The facility's manager has been notified of the possibility of this type of activity. Monitoring will be left to them. No phosphorus reduction estimate was made.
- BTN-New-8 – CB-52: The area around a catchbasin was being used as a toilet by a local homeless population. The owner of the building, which houses the Bennington VA Clinic, has been notified of the issue. Given the random, intermittent nature of the discharge, notification of the property constitutes the best possible resolution of this issue. No phosphorus reduction estimate was made.
- BTN-New-53 – 54: A broken water main was discovered by WCA and the Town of Bennington around the same time. When the town was notified by WCA of the possibility of a broken water main, they responded that they knew of the issue and were working to resolve it. As of 11-20-15, the issue was actively being repaired by town staff and is considered resolved. As there is likely little to no phosphorus content in potable water, no phosphorus reduction was calculated.

Pawlet:

- PWL-12: Sanitary pipes from a multi-apartment building were discovered entering an underground sluiceway adjacent to the building's septic tank. The Town of Pawlet, State of VT, and resident were

notified. The resident began to take immediate action with the regional Wastewater Division. Once the issue is resolved, an annual reduction of 0.73 kg P is anticipated.

In conclusion, we would like to note that there were two methods of illicit discharge detection that stand out as particularly fast, effective methods by which to potentially uncover illicit discharge issues. The first is the use of specially trained canines employed by Environmental Canine Services. These canines were able to help our team find illicit discharge issues in large, complex stormwater drainage systems that we otherwise would not have found using typical Outfall Reconnaissance Inventory (aka Dry Weather Survey) techniques. While we may have ultimately been able to find these discharges using OB pad bracketing, the time and effort involved to conduct that investigation would have taken far longer than using the canines. Canine investigation, to us, is a very effective tool in illicit discharge detection.

The second method which was also very effective was the use of liquid smoke to find discharges into the municipal stormwater system in an area dominated by onsite wastewater treatment systems. Without the smoke testing, combined with direction given by the canines, we would not have been able to pinpoint the discharge in Pawlet using ORI techniques at all. To us, this is a strong argument to include this work in future IDDE studies.

7 REFERENCES

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