2018 REPORT – CITY OF ST ALBANS – ILLICIT DISCHARGE DETECTION AND ELIMINATION STUDY

ST ALBANS, VERMONT

Progress Report

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WATERSHED CONSULTING

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City and Town of St. Albans Illicit Discharge Detection and Elimination(IDDE) Study Final Report, *Watershed Consulting Associates, LLC (2012)*

Missisquoi River Basin Advanced Illicit Discharge Detection and Elimination (IDDE) Study FINAL REPORT , *Aldrich + Elliott, PC & Stone Environmental (2014)*

1 INTRODUCTION

In Fall, 2018, Watershed Consulting Associates, LLC was awarded a contract with the City of St Albans to conduct Illicit Discharge Detection and Elimination (IDDE) work on a selection outfalls. This work involved initially reviewing the results of studies performed in 2007 (VT DEC), 2012 (Watershed Consulting, with Center for Watershed Protection working on a grant awarded by VT DEC) and 2014 (Aldrich + Elliott, PC, with Stone Environmental working on a grant awarded by VT DEC).

In 2007, limited optical brightener testing was conducted on 30 outfalls by Karen Bates of VT DEC and Jeff Rouleau, Bellows Free Academy using unbleached cotton pads left at the outfalls for a period of several days. Five (5) outfalls tested positive for optical brightener. No further investigation was performed as part of this study in 2007.

In 2012, a more comprehensive study was performed in the City of St Albans on 65 outfalls, 17 of which were suspected for some form of illicit discharge initially. 10 of these were more thoroughly investigated. 7 of these were not investigated further during the course of the 2012 study.

The 10 that were investigated in 2012 are:

1. Outfall 24 – Maple Pro Plant, Lemnah Drive
2. Outfall 26 – Blooming Minds Daycare, Lemnah Drive
3. Outfall 27 – Lower Welden Street
4. Outfall 34 – La Salle Street
5. Outfall 37 – Pearl Street
6. Outfall 43A – Rewes Street (across from St Albans Messenger)
7. Outfall 16 – Upper Welden Street / Main Street
8. Outfall 15 - Upper Welden Street / Main Street
9. Outfall 11 – Barlow Street
10. Trunkline (old sanitary sewer trunkline being used for stormwater conveyance)

The 7 outfalls that were not investigated in 2012 are:

1. Outfall 38 – Aldis Street
2. Outfall 29 / 29.1 – Lower Welden Street (Homeland Security Building)
3. Outfall 40 – North Elm Street (Four Winds Apartments)
4. Outfall 26.2 – Not Found
5. Outfall 39 / 39.2 – City of St Albans Public Works Garage Yard

In 2014 Aldrich + Elliott, PC, in partnership with Stone Environmental, conducted additional investigation on the 10 outfalls that were more thoroughly investigated in 2012 by Watershed Consulting. They found the following:

- Outfall 24: The team found high ammonia values in the system and discussed the issue with the owner of the Maple Pro Plant, but discussions were inconclusive. The study recommends cleaning the catch basins. No illicit discharge was either confirmed or denied.
- Outfall 26: Dye testing was conducted from the Blooming Minds Daycare facility but was inconclusive, as was televising the pipe network. The study recommends catch basin cleaning to alleviate the high ammonia seen at the site. No illicit discharge was either confirmed or denied.
- Outfall 27: The study found that this issue was due to a combined sewer manhole backing up on to the street and flowing into the separate storm sewer during rain events. The recommended

solution was to more adequately manage stormwater in the combined sewer system to alleviate flows. This work has begun. This constitutes a confirmed illicit discharge and the design and implementation of stormwater Best Management Practices (BMPs) constitutes a management plan to deal with it.

- Outfall 34: The study conducted dye testing from sanitary to storm sewers but did not see any dye crossover. The study also conducted televising of the storm line between two suspect manholes, but did not see any suspect pipe entering the storm line. There was mention of a pipe from the Holy Angel Rectory that needed to be found. No illicit discharge was confirmed or denied during this study.
- Outfall 37: Additional water quality bracket sampling was conducted at this outfall. The study concluded that the issue might be located near the intersection of North Elm Street and Pearl Street. Additionally, the stormwater line is regularly backwatered by Stevens Brook, which was thought to cause the high bacteria levels seen in the system.
- Outfall 43A: The study found slightly elevated *E. coli* of 108 MPN and conducted televising of the stormwater line which was inconclusive. No illicit discharge was confirmed or denied at this outfall.
- Outfall 16: Extensive water quality bracket sampling was conducted and a sanitary sewer crosstie into the stormwater sewer was found at North Main and Hudson Streets. The study recommended disconnection and the City planned on doing this work.
- Outfall 15: Based on the conclusion from the 2012 study that results were due to contaminated groundwater or runoff from upstream agricultural fields, no follow up was conducted.
- Outfall 11: As televising was conducted in 2012 as part of the previous study and nothing conclusive was found, no additional work was done on this outfall in 2014.
- Trunkline: Extensive televising of this system was conducted in 2014 using Hartigan's Septic Service. Of the areas that could be televised (some buried structures were hit that prevented televising), no obvious pipe connections were found. Numerous fractures were seen in this line. The study concluded that flow observed in the line is likely from groundwater intrusion to the line through pipe fractures or joints. The study also recommends that structure TL-7, which is adjacent to a former Central Vermont Power Systems cooling station and diesel depot, be referred to VT DEC's Site Management Division for investigation for acetone and naphthalene.

No other outfalls were investigated as part of the 2014 study.

Prior to commencing work in 2018, Watershed Consulting met with City of St Albans staff to discuss results from the previous studies and plan a course of action. The following strategies for follow up investigation were decided upon based on the previous studies conclusions, the City's priorities, and follow-up work that had already been conducted:

- Outfall 24: Based on inconclusive water quality testing in the past, coupled with the concern that the issue could possibly be due to illegal dumping or spills in the Maple Pro Plant yard, it was decided that smoke testing using liquid smoke would provide the most conclusive results.
- Outfall 26: Similar to Outfall 24, based on inconclusive water quality testing, dye testing, and televising in the past, it was decided that smoke testing would provide the best results.
- Outfall 27: This issue is known to be due to a combined sewer overflow entering the storm system via an open catch basin. As this is considered a confirmed illicit discharge, and given that the City of St Albans is actively pursuing stormwater management within the combined system to alleviate this issue, no further work was conducted as part of this study.
- Outfall 34: As dye testing and televising in 2014 was somewhat inconclusive, it was decided that smoke testing of the entire network would be the best way of finding any potential illicit discharges.

- Outfall 37: The 2014 report recommends conducting some additional water quality bracketing to further hone in on the potential issue. This work was conducted in 2018. Additionally, it was decided that smoke testing of this system could prove beneficial.
- Outfall 43A: Televising of the suspect line in 2014 did not find any obvious connections and the outfall and system were often dry, preventing water quality sampling. Based on this, it was decided that smoke testing would be the most efficient follow up method.
- Outfall 16: The 2014 study found a confirmed illicit discharge via the sanitary sewer crosstie into the stormwater system. The City had plans to disconnect this crosstie.
- Outfall 15: The 2012 report concluded that results seen at this outfall could potentially be due to farm field runoff. As a result, no follow-up was conducted in 2014. Based on these results, Watershed Consulting and the City of St Albans made this system a lower priority for investigation using Environmental Canine Services (ECS) Ship and Sniff testing (see Methods for explanation of this investigation technique).
- Outfall 11: No follow up was deemed warranted based on the conclusions of the two previous studies.
- Trunkline: No follow up was deemed warranted based on the conclusions of the two previous studies.
- Outfall 38: No work was performed in 2012 or 2014. Additional bracket sampling was performed on this outfall. Smoke testing was planned as time and conditions allow.
- Outfall 29 / 29.1: These two outfalls at the Homeland Security building would best be investigated using additional water quality testing, dye testing, or televising of the pipes. Smoke testing was deemed inadvisable due to the nature of the site. While these testing methods would be relatively easy to pursue, access might be an issue given that it is a Federal facility with possible security concerns. The City of St Albans planned on conducting outreach to determine the most feasible course of action. Watershed Consulting did not plan on conducting any additional work in 2018.
- Outfall 40: The system associated with this outfall is relatively small and residential. As a result it was decided that smoke testing would be the most efficient follow up method.
- Outfall 39 / 39.1: Water quality results from 2012 indicated that the source of contamination may be a result of deicing salts accumulating on the public works yard and running off to the outfall as well as possible washwater contamination from the yard. The City decided that the best course of action as a follow up would be to review the operational procedures for deicing material storage and handling to promote exclusion of these materials from runoff. The City also planned on reviewing vehicle washing procedures to ensure that no washwater could run off to the stormwater system in the yard. No additional investigation was conducted in 2018, nor is any planned as this is deemed to be an operational issue.
- Outfall 14: The only result at this outfall was from the 2007 optical brightener study which suspected a washwater source of illicit discharge to this outfall. It was decided that additional water quality bracketing needed to be conducted on this system. In 2018 sampling was conducted on the outfall only. Work is expected to resume in 2019. Of note regarding this outfall – there is potentially an old stone block sewer on Lincoln Avenue that may be allowing sanitary sewage to enter the stormwater system. The City has conducted some work on this issue in the past but may not have resolve the issue fully.
- Outfall 46: It was decided that water quality sampling at this outfall would be the best way to proceed. However, obtaining a sample from the outfall was infeasible in 2018 given that that outfall pipe was partially buried in sediment and backwatered by Stevens Brook. Upstream sampling was not possible due to a lack of flow. As a result, smoke testing would be the best follow-up strategy. This work was not conducted in 2018 due to early onset of wintry conditions.

Table 1: Summary of Assessments by Outfall

Outfall	Location	Summary
Outfall 24	Maple Pro Plant, Lemnah Drive	Resolved - Smoke Testing Indicates No Chronic or Direct Illicit Discharge
Outfall 26	Blooming Minds Daycare, Lemnah Drive	Resolved - Smoke Testing Indicates No Chronic or Direct Illicit Discharge
Outfall 27	Lower Welden Street	Resolved - Combined Sewer Overflow Being Managed Through Stormwater BMPs
Outfall 34	La Salle Street	Resolved - Smoke Testing Indicates No Chronic or Direct Illicit Discharge
Outfall 43A	Rewes Street	Resolved - Smoke Testing Indicates No Chronic or Direct Illicit Discharge
Outfall 11	Barlow Street	Resolved - 10' Pipe Doesn't Warrant Further Investigation
Trunkline	Below Lower Welden Street	Resolved - Refer Issues to DEC Site Management Division
Outfall 40	North Elm Street	Resolved - Smoke Testing Indicates No Chronic or Direct Illicit Discharge
Outfall 26.2	Not Found	Not Found - Neither City Nor Previous Consultants Know Where This Outfall Is
Outfall 39 / 39.2	Public Works Garage	Resolved - City to Review Deicing Material / Washwater Exclusion Practices
Outfall 37	Pearl Street	Not Resolved - One Possible Illicit Discharge Found Through Partial System Smoke Testing
Outfall 16	Upper Welden Street / Main Street	No Study Conducted in 2018
Outfall 15	Upper Welden Street / Main Street	No Study Conducted in 2018
Outfall 38	Aldis Street	Not Resolved - Water Quality Sampling at Outfall Conducted - Indicates Possible Illicit Discharge
Outfall 29 / 29.1	Lower Welden Street	No Study Conducted in 2018
Outfall 14	Lincoln Avenue	Not Resolved - Water Quality Sampling at Outfall Conducted - Indicates Possible Illicit Discharge
Outfall 46	Lake Street	Not Resolved - Preliminary Study in 2018 Only

2 METHODS

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

2.1 Field Work Preparation

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

A kick-off meeting was held with the City of St Albans to discuss methodology, access, and data generation.

2.2 Outfall Reconnaissance Inventory – Dry Weather Survey

Note – the methods described for the Outfall Reconnaissance Inventory only apply to systems where additional water quality bracket sampling was performed.

Stormwater systems were assessed during dry weather to minimize dilution by large volumes of runoff. Dry weather was defined as <0.1" precipitation in the previous 24 hours to the maximum extent practicable. There were times during the study when outfalls were assessed when precipitation had marginally exceeded this amount – this was noted on the Outfall Reconnaissance Inventory reports. Surveys during these times were kept to a bare minimum and avoided whenever possible. Outfalls in the public right of way or along a water body were accessed via public land. Where portions of the stormwater system were on private land, permission was obtained prior to investigating the system. If access to property was denied, infrastructure within the public right of way was assessed. Where no publicly accessible infrastructure existed, access denial was noted and the system was not analyzed.

Watershed developed a digital smartphone-based application to use for the collection, storage, analysis, and reporting of survey data. This application, developed using a third-party software platform, is based on the CWP field and laboratory forms merged into one overall interface and accessed in the field using a smartphone or tablet device. An integral part of the creation of this application was the import of all stormwater and sanitary sewer infrastructure points from Vermont DEC's stormwater infrastructure mapping program. Each of these features was imported into Watershed's app using a code assigned by previous studies. 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 data is sub-meter accurate.

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

If flow was present, immediate analysis for temperature, pH, specific conductance, 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 2), a further sample was taken for analysis later that day for total chlorine (if applicable depending on municipality and methylene blue active substances (MBAS, a detergent indicator).

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

2.3 Water Quality Analysis Methods

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

Ammonia:
Ammonia was measured immediately in the field using the LaMotte Colorimeter 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.

Optical Brighteners:
Where indicated Watershed 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 4-10 days encased in a plastic-coated wire mesh pouch. After this period, pads were retrieved, rinsed, and dried, then exposed to a UV (black) light. In the presence of detergents, the pad will fluoresce to varying degrees. Watershed did not attempt to make measurements of the relative amount of fluorescence – this test was only for presence or absence. However, fouling with other debris and dirt often made reading 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 2), 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.

Table 2: Water quality threshold values for determining possibility and nature of illicit discharges.

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

2.4.1 Televising Sanitary and Stormlines:

An additional method to positively identify illicit discharges is to use either a push or track camera, depending on pipe type and size, to obtain video of pipe cross connections, leaks, or other means by which non-stormwater discharges may be entering storm pipes. This method is most effective when combined with line flushing using dyed water. We did not use this method during this study. It was, however, used in the 2012 and 2014 studies as noted.

2.4.2 Smoke Testing with Vermont Rural Water Association:

Smoke testing using non-toxic liquid smoke was used during this study. The general procedure for smoke testing is a follows:

- Smoke is blown into a manhole or catch basin structure (storm) and the system is allowed to pressurize with smoke until all (or nearly all in the case of larger systems) are observed emitting smoke.
- Visual observations are made of surrounding sanitary infrastructure (manholes are opened adjacent to the storm infrastructure, building sewer gas vent stacks are scrutinized for smoke escaping, and at times buildings are entered, with permission, to check for smoke in basements or other areas). This is to check to see if there are any direct or semi-direct connections between sanitary and storm sewers.
- The reverse test is also always done where smoke is blown into sanitary sewer infrastructure and the storm system is inspected, via manholes and catch basins, for smoke intrusion. Watershed has found that this is one of the most efficient, reliable means of identifying possible illicit discharges, especially when infrastructure is poorly mapped or understood. Smoke testing from sanitary sewer infrastructure also has the benefit of discovering bad or faulty plumbing issues within residences (cracked sewer pipes or other issues that could allow sewer gas to enter homes).

2.4.3 Environmental Canine Services (ECS) Alerts:

Environmental Canine Services (ECS) uses specially trained canines to detect the presence or absence of sanitary sewage. Watershed has used this method before in Vermont with success. There are two primary methods to use with ECS. The first method is the 'ship and sniff' method where a sample is collected in a sterile plastic Whirl-Pak bag. The outside of the bag is rinsed in distilled water and double-bagged in a resealable plastic bag. These samples are then shipped to ECS in Maine where they are evaluated by the canines and their handlers. A report is prepared of the results. If a dog alerts on a sample, that outfall is then flagged for additional follow-up investigation. This method provides a good screening of outfalls that, based on previous water quality parameters, may have illicit discharges to them. The second method involves bring a canine and handler to a storm sewer system and doing on-site field investigations of structures. During the course of this study, field investigation was not used.

3 RESULTS

3.1 Drainage Systems – Resolved

What follows are summaries for drainage systems where the investigation established conclusively an illicit discharge, or other confirmed or plausible explanation for the water quality results seen at the outfall or at other infrastructure within the network. These are the systems that require no further work at this time and should only be checked on semi-annually (to ensure that no new non-stormwater discharges are present). Each outfall has an associated map on which work is described as well.

3.1.1 Outfall 24

The system leading to Outfall 24, located in the loading yard area of the Maple Pro Plant on Lemnah Drive was smoke tested using the procedure described in the Methods section. During smoke testing, no smoke was observed crossing from one system into the next. The building was entered and an inspection made for any smoke entering the building via floor drains or other orifices. No smoke was seen.

Based on the results of this testing, we do not believe there to be a direct or chronic illicit discharge at this system.

3.1.2 Outfall 26

The system leading to Outfall 26, located near the Blooming Minds Daycare center, was smoke tested using the procedure described in the Methods section. During smoke testing, no smoke was observed crossing from one system into the next. The building was entered and an inspection made for any smoke entering the building via floor drains or other orifices. No smoke was seen.

Based on the results of this testing, we do not believe there to be a direct or chronic illicit discharge at this system.

3.1.3 Outfall 27

No investigation of this system was conducted as part of field work in 2018 as the illicit discharge source is known and is being actively managed using stormwater Best Management Practices (BMPs).

3.1.4 Outfall 34

The system leading to Outfall 34, which runs along La Salle, Spruce, North Elm, South Elm, and Lake Streets, was extensively smoke tested using the procedure described in the Methods section. During smoke testing, no smoke was observed crossing from one system to the next. However, several issues were discovered. The locations of each of these issues and descriptions can be seen on the summary map for this outfall. The issues found include:

- Sewer gas leak near a washer/dryer in a house on La Salle
- Sewer gas leak from a cracked iron pipe in a house basement on La Salle
- Sewer gas leak from the corner of a house foundation on Spruce
- Sewer gas leak from an improperly capped sewer pipe in a house basement on North Elm

Additionally there was a broken stormwater manhole on La Salle street that could not be opened due to damage. There was also a stormwater manhole that was fully backwatered on La Salle. This may prevent complete draining of the stormwater system during storms and may cause localized flooding.

This system also contains the Holy Angel Rectory, from which a suspect illicit connection was though to exist. However no smoke was observed entering this building. It would seem that this suspected pipe either does not exist or has been capped.

Based on the results of this testing, we do not believe there to be a direct or chronic illicit discharge at this system.

3.1.5 Outfall 43A

The system leading to Outfall 43A, located near the St Albans Messenger office building, was smoke tested using the procedure described in the Methods section. During smoke testing, no smoke was observed crossing from one system into the next.

Based on the results of this testing, we do not believe there to be a direct or chronic illicit discharge at this system.

3.1.1 Outfall 11

No investigation of this outfall was performed in 2018. The 2012 study notes that this outfall is only connected to a 10' pipe and that televising didn't show anything. The 2014 study does not draw conclusions different from the 2012. No further study of this outfall is recommended.

3.1.1 Trunkline

No further investigation of this system was performed in 2018.

Extensive televising of this system was conducted in 2014 using Hartigan's Septic Service. Of the areas that could be televised (some buried structures were hit that prevented televising), no obvious pipe connections were found. Numerous fractures were seen in this line. The study concluded that flow observed in the line is likely from groundwater intrusion to the line through pipe fractures or joints. The study also recommends that structure TL-7, which is adjacent to a former Central Vermont Power Systems cooling station and diesel depot, be referred to VT DEC's Site Management Division for investigation for acetone and naphthalene.

Apart from the recommendations made above, we do not believe that further investigation of this system needs to be performed.

3.1.1 Outfall 40

The system leading to Outfall 40, located on North Elm Street and encompassing the Four Winds Apartment buildings, was smoke tested using the procedure described in the Methods section. During smoke testing, no smoke was observed crossing from one system into the next.

Based on the results of this testing, we do not believe there to be a direct or chronic illicit discharge at this system.

3.1.1 Outfall 26.2

The 2012 study notes that this outfall should be investigated further. However, the study does not note where this outfall is nor is there a map included. The 2014 study also did not investigate this outfall. Watershed Consulting checked its internal database of mapped outfalls for St. Albans City (as Watershed was the original mapping contractor). However, outfall identifications had not been assigned during original mapping. This outfall could not be located and therefore no investigation of this outfall occurred during the 2018 season.

3.1.1 Outfall 39 / 39.1

Previous study results indicated that these outfalls were potentially experience issues related to deicing chemical runoff and potential washwater runoff to the outfalls. As this site is the City of St. Albans Public Works Garage, the City is reviewing best practices for the site with the intent of further excluding these substances from the outfalls. No further investigation of these outfalls was conducted during the 2018 season and no further investigation is planned for this site.

3.2 Drainage Systems – Unresolved (or Requiring Further Investigation)

3.2.1 Outfall 37

The system leading to Outfall 37, located on Pearl, North Elm, Cedar, and Walnut Streets, was bracket testing to determine if water quality indicators could be used to determine the source of a potential illicit discharge. These results can be seen on the investigation summary map. Water quality samples at the outfall (the nearest adjacent manhole was sampled as the outfall itself was backwatered by Stevens Brook) revealed ammonia at 0.5mg/L, detergents (as MBAS) at 0.5ppm, and *E. coli* at 550 MPN. Further testing of the system of the system upstream of the outfall was also conducted. One of the of the most suspect results came from SWMH-40, a stormwater manhole at the intersection of Pearl and North Elm Streets from the 'North pipe' (the pipe running north up North Elm Street). Ammonia was very high at 1.94 mg/L, indicating the possible presence of large amounts of decaying organic matter.

During smoke testing, Watershed found smoke coming from a catch basin opposite 67 North Elm Street while blowing smoke into the sanitary sewer from a manhole on lower Pearl Street (noted on the summary map). Watershed then blew smoke from the sanitary manhole directly adjacent to the catch basin - smoke immediately came out of the catch basin rim from the lower pipe in the catch basin. Watershed then cleared the line of smoke and blew smoke into the stormwater sewer from a nearby catch basin. Smoke came in from the upper pipe in the catch basin. The catch basin opposite 67 North Elm Street is tied to both the sanitary and storm sewer. As the pipe to the storm sewer is considerably higher than the pipe to the sanitary sewer, it would require a surcharge from the sanitary sewer of between 5-5.5' to cause sewage to flow into the stormwater sewer. However, this potential discharge should be eliminated as soon as possible.

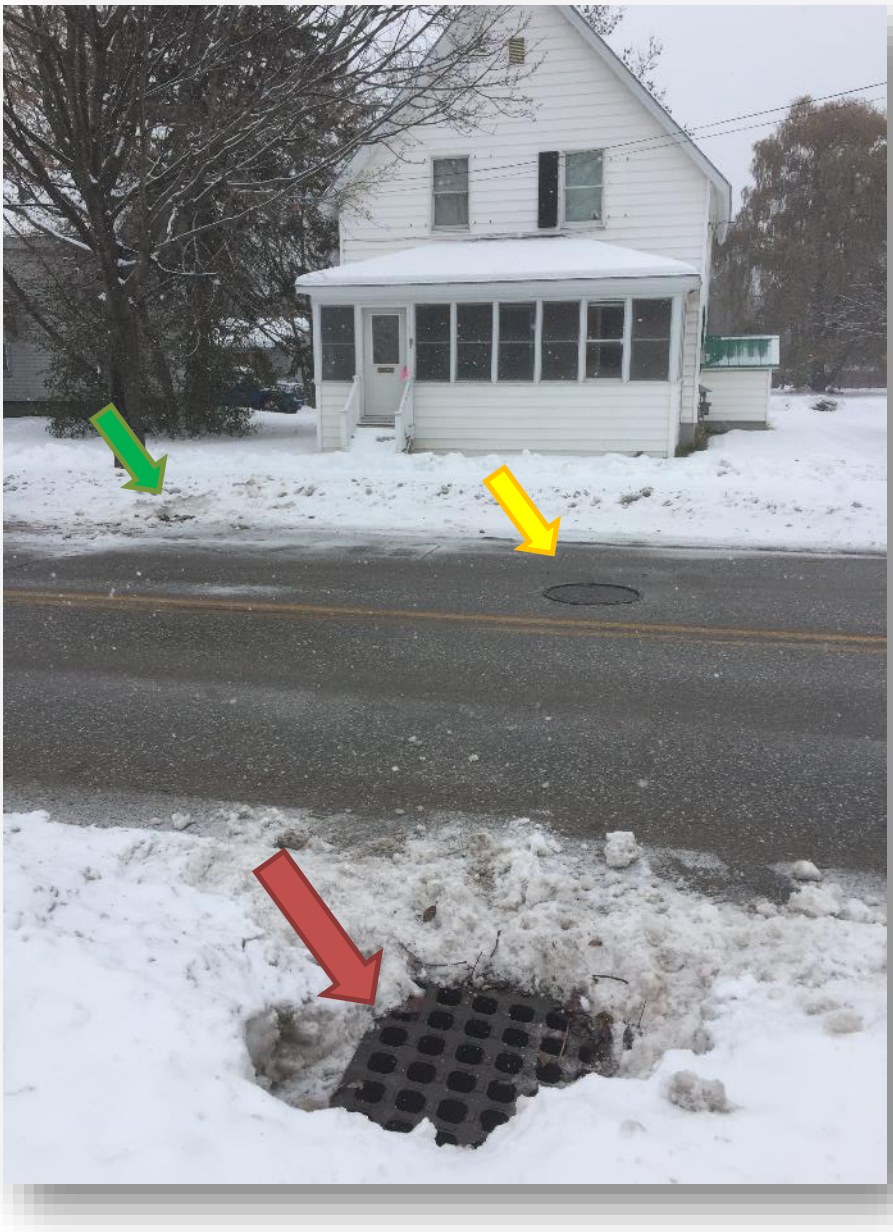

Figure 1: Picture taken facing 67 North Elm Street (white house in the background). The catch basin in the foreground (red arrow) is directly connected to both the storm and sanitary sewers. The lower pipe in the catch basin flows directly to the sanitary manhole (yellow arrow). The catch basin in the background (green arrow) is not connected to the sanitary system.

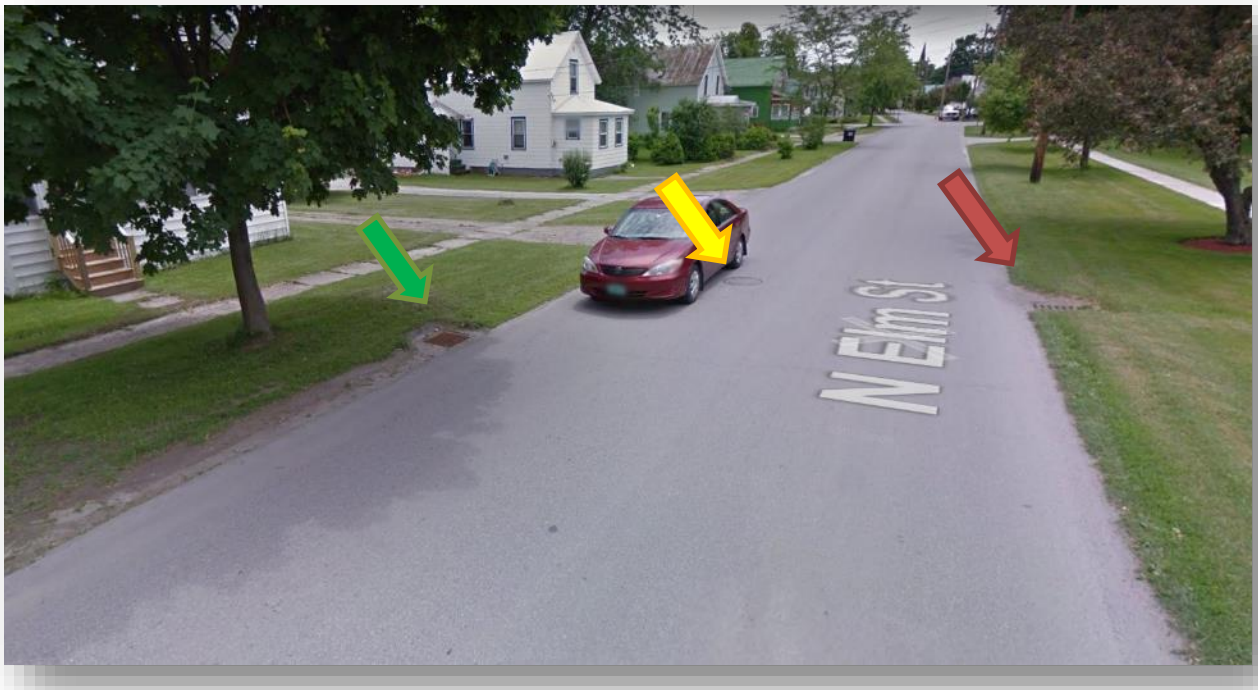

Figure 2: Image from Google StreetView. The red arrow indicates the catch basin connected to both the sanitary and storm sewers. The yellow arrow indicate the sanitary sewer manhole to which the catch basin is connected. The green arrow indicates the catch basin that is not connected to the sanitary sewer.

Figure 3: Picture of the catch basin connected to both the sanitary and storm sewers. The red arrow is pointing to the pipe that is directly connected to the sanitary sewer (lower pipe). The blue arrow points to the pipe that leads to the stormwater sewer. In runoff events most runoff would go into the sanitary sewer.

Smoke testing and additional investigation of the system was not conducted beyond the intersection of Pearl and North Elm Streets. Water quality indicators, other than the ECS alerts, don't indicate the strong potential of an illicit discharge above this intersection. However, because of the ECS alerts, additional investigation should be conducted using either smoke or in-field investigation using ECS canines.

We consider this outfall to be partially resolved.

3.2.2 Outfall 16

No investigation of this outfall was performed in 2018. The issue was studied in 2014 and found to be a sanitary sewer crosstie into the stormwater sewer at North Main and Hudson Streets. The City of St Albans was planning to disconnect this tie. No further study of this outfall should occur until this repair occurs as it could mask other potential illicit discharges to the stormwater system.

3.2.1 Outfall 15

No investigation of this outfall was performed in 2018. The issue was determined to potentially be due to groundwater flow contaminated with farm field runoff. In speaking with the City of St Albans, they noted that their sewer main runs underneath Stevens Brook (and in certain locations is actually in the Brook where the pipe has begun to emerge from the ground). For this reason, it may be worthwhile to investigate this area using ECS Ship and Sniff or using in-field investigation with ECS.

3.2.1 Outfall 38

Only initial outfall sampling was conducted at this outfall in 2018. While most water quality indicators were weak (ammonia was 0.25 mg/L, just at threshold for potential illicit discharge, detergent were 1.0 ppm which is somewhat elevated, and *E. coli* was 56 MPN, which is below threshold of 400 MPN), ECS canines alerted on a sample sent via the Ship and Sniff program. The alert may be due to some backwatering of the outfall by Stevens Brook, which may contain enough residual sanitary sewage, or other non-stormwater constituents, to trigger the dogs. However, we believe that this is enough to warrant further investigation using liquid smoke. The system is small and located in a relatively quiet area, traffic-wise.

3.2.1 Outfall 29/29.1

No investigation of this outfall was performed in 2018. The City of St Albans is still in the process of conducting outreach to the Department of Homeland Security for access to the site to conduct advanced investigation using either smoke, dye, or camera techniques. We would recommend that this system be investigated in 2019.

3.2.1 Outfall 14

Only initial outfall sampling was conducted at this outfall in 2018. Ammonia was above threshold at 0.73 mg/L and detergents were 1.0 ppm, while *E. coli* was above threshold at 2400 MPN. ECS canines did alert on this sample as well. The system that drains to this outfall is large and will require additional bracket sampling at key system intersection points. This work was not performed in 2018 due to the early onset of wintry conditions. However, this work may be able to be performed during the winter of 2019 or spring/summer of 2019. We would recommend that bracket sampling be conducted first prior to smoke testing as the system is large and could prove challenging to smoke test efficiently unless better target areas are first established. We would recommend that this system be further investigated in 2019.

3.2.1 Outfall 46

An initial screening of this outfall was conducted in 2018 during an attempt to sample flow from the outfall. However, the outfall is partially buried in sediment and is backwatered by Stevens Brook under the middle of a bridge on Lake Street. Additionally, no flow was seen in the upstream infrastructure. It was therefore decided that smoke testing would be the most efficient means to identify a potential illicit discharge. However, the early onset of wintry conditions prevented this work from occurring. We would recommend that this system be further investigated in 2019 using smoke testing as the primary technique.

4 RECOMMENDATIONS FOR FUTURE ACTION

4.1 Outfall 37 – Future Action Recommendations:

- The crosstie found near 67 North Elm Street should be fixed as soon as possible. Once fixed, this area should be smoke tested again and the rest of system investigated for other possible illicit discharges.

4.2 Outfall 16 – Future Action Recommendations:

- The crosstie found near Hudson and North Main Streets should investigated and repaired by the City of St Albans.
- Once this work is done, water quality testing should be conducted within the drainage area.
- If indicated, this work should be followed by smoke testing in targeted locations.

4.3 Outfall 15 – Future Action Recommendations:

- Smoke testing of this outfall should be conducted to determine if prior water quality results were due to an illicit connection or to groundwater flow contaminated with farm field runoff as previously thought.
- The reach of Stevens Brook near Outfall 15 should be investigated using Environmental Canine Services Field Team to determine if and where the sanitary sewer main may be leaking into the Brook directly.

4.4 Outfall 38 – Future Action Recommendations:

- Smoke testing of this outfall should be conducted to determine if there is an illicit discharge as possibly indicated by initial water quality testing results or if the results can be attributed to backwatering by Stevens Brook.

4.5 Outfall 29/29.1 – Future Action Recommendations:

- The City of St Albans should secure access to investigate these outfalls.
- If possible, smoke testing of these outfalls would be expedient and efficient.
- If not possible, dye testing or televising of the pipes could occur following water quality testing.

4.6 Outfall 14 – Future Action Recommendations:

- Additional water quality bracketing of this system should occur to further target investigation of the system.
- Following water quality testing smoke testing should occur if and where warranted to confirm the location of suspected illicit discharges.

4.7 Outfall 46 – Future Action Recommendations:

- Smoke testing of this outfall should be conducted to determine if there is an illicit discharge. Water quality sampling of this system proved infeasible.

5 CONCLUSIONS

Of the 17 systems investigated for non-stormwater discharges to the stormwater system:

- 1 system was found to have a confirmed non-stormwater (illicit) discharge to the stormwater system (Outfall 37).
- 10 systems were investigated and are considered Resolved with respect to potential illicit discharges (whether through management of confirmed illicit discharge or lack of an illicit discharge to the stormwater system).
- 6 systems have yet to be fully investigated for illicit discharge. These are noted in Section 4 – Recommendations for Future Action.

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