VTrans NPDES Small MS4 Permit (MS4 GP 3-9014) Compliance - Illicit Discharge Detection and Elimination (IDDE): Water Quality Monitoring, Illicit Discharge Search and Remediation Strategies – Final Report

VERMONT AGENCY OF TRANSPORTATION (VTRANS)

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1.0 Introduction

This report prepared by Vanasse Hangen Brustlin, Inc. (VHB) details the completion of detailed investigations of potential illicit discharges identified in the Vermont Agency of Transportation (VTrans) MS4 outfalls Illicit Discharge Detection and Elimination (IDDE): Outfall Assessment – Final Report (VHB Pioneer, 2009). Under the National Pollution Discharge Elimination System (NPDES) small Municipal Separate Storm Sewer System (MS4) Permit all state transportation departments, including VTrans, are defined as non-traditional MS4 entities and are subject to NPDES requirements. The Vermont Department of Environmental Conservation (VT DEC), which administers Vermont General Permit (GP) 3-9014 (Amended February 19, 2004), requires (GP 3-9014, Section 4.2.3 *Illicit Discharge Detection and Elimination)* that MS4 entities, including VTrans, develop an IDDE program to identify, monitor, and remediate illicit discharges associated with their stormwater infrastructure

Under General Environmental Services Contract (CN# 0984775 #1) with VTrans, VHB conducted detailed investigations of potential illicit discharges during the Fall of 2009, and the Spring and Summer of 2010. These investigations were done in order to analyze and investigate the priority outfalls, as identified through prior assessments, in the search for illicit discharges associated with VTrans MS4 designated outfalls in Chittenden County in Vermont (VHB, 2009) After completion of the IDDE investigations conducted during the months of May, June, and July 2009, VHB analyzed all of the field data and made the determination through communications with VTrans and the Vermont Agency of Natural Resources (VT ANR), that a total of 45 outfalls were potential illicit discharges and required additional testing and/or investigation. VHB conducted a similar screening process

as outlined in *Illicit Discharge Detection and Elimination; A Guidance Manual for Program Development and Technical Assessments (*Center for Watershed Protection [CWP] [CWP, 2009]), to identify VTrans outfalls most likely to have an illicit discharge. Each of these priority outfalls was then visited in the field during the Fall 2009 and Spring/Summer 2010 investigations, and water quality testing was done to ascertain the presence or absence of an illicit discharge. The results of these investigations and water quality testing comprise this report.

1.1 Legislative and Regulatory Background

In 2003, VTrans implemented a Stormwater Management Plan (SWMP, updated 2008 - http://www.aot.state.vt.us/ops/TechnicalServices/stormwater/managing.htm) to meet the NPDES Phase II and non-traditional MS4 requirements. According to the VTrans Operations Division, Stormwater Compliance website;

> "*VTrans is committed to the full implementation and enforcement of the SWMP which has been designed to reduce the discharge of pollutants from the VTrans non-traditional small MS4 to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act*." (VTrans, 2009).

The VT DEC administers GP 3-9014 under the delegated authority of the United States Environmental Protection Agency (EPA) through the NPDES program. According to the EPA, an MS4 is a conveyance or system of conveyance that is owned by a state, city, town, village, or other publicly funded entity that discharges to waters of the U.S., and/or is designed or used to collect or convey stormwater flow (including storm drains, pipes, ditches etc.) (EPA, 2009). The NPDES Phase I

regulations were issued by the EPA in 1990 and required medium and large urban areas with populations of generally more than 100,000 residents to apply for and receive permit coverage for their stormwater discharges (EPA, 2009). Phase II of the NPDES Stormwater Program, issued in 1999, has different requirements. This permit requires that small and non-traditional MS4s, which are generally fewer than 100,000 residents, in urbanized areas such as Chittenden County in Vermont, obtain NPDES permit coverage for their stormwater discharges. (EPA, 2009). In Vermont there are currently three publicly owned "non-traditional" separate storm sewer systems (MS4), including VTrans, that are required to come into compliance with the regulations associated with the MS4 General Permit (VTrans, 2009). The other systems belong to the University of Vermont (UVM) and the Burlington International Airport (BTV) (VTrans, 2009). As a non-traditional MS4 entity, VTrans is required to comply with the MS4 General Permit requirements, including highways, transportation facilities, and VTrans maintenance facilities located within their right-of-way (ROW) (VTrans, 2009). This report will detail what has already occurred (Summer 2009 investigations), and will also explain how by completing the latest round of investigations and testing, VTrans will successfully meet the requirements of the MS4 General Permit.

1.2 Illicit Discharge Detection and Elimination (IDDE)

As explained previously in the IDDE Outfall Assessment final report, prepared by VHB Pioneer in 2009, the term "illicit discharge" is defined by the EPA 40 CFR 122.26(b)(2) as "any discharge to an MS4 that is not composed entirely of stormwater," with some exceptions covered under a NPDES permit allowed. The exceptions provided for by the EPA include - among others - any discharges resulting from firefighting activities, landscape irrigation, rising ground waters,

residential car washing and also discharges from NPDES permitted industrial sources (EPA, 2009B). This information is contained on the EPA Fact Sheet 2.5 – *Illicit Discharge Detection and Elimination Minimum Control Measure*, which is located on Pages 1 through 4 of Appendix 1.

Illicit discharges are considered "illicit" because typical stormwater systems, unlike sewer systems, are not designed to accept, process, or discharge non-stormwater wastes. Illicit discharges enter the storm sewer system through direct connections (i.e., piping) or indirect connections (i.e., cracked pipes, spills or wastes dumped directly into a drain) [UNE, 2009]).

2.0 Project Description

2.1 Overview

In the VTrans IDDE: Outfall Assessment – Final Report, VHB identified a total of 45 outfalls that were potential illicit discharges (priority outfalls) and recommended follow-up investigation and testing. Upon discussions with both VTrans and Jim Pease of the VT ANR, VHB modified the list to only include 40 outfalls. This subtraction of priority outfalls was due to prior water quality monitoring data and stormwater infrastructure inspection data received from local municipalities within the IDDE project area, and as a result a total of five outfalls were deemed unnecessary for additional investigation and/or testing. The information provided detailed background information on the five priority outfalls that were removed, which made additional investigation and testing unwarranted. These outfalls will likely need to be visited again at a later date by the local municipalities and VTrans.

Please see the water quality summary spreadsheet on Pages 2 and 3 of Appendix 2 for a complete list of the 40 priority outfalls. Based on the final list of 40 outfalls, VHB then prepared a scope of services to conduct the next round of outfall investigations and water quality testing.

This effort, as explained in the scope of services, consisted of four primary steps, which included:

- Water quality monitoring at all 40 outfalls – Using water quality sampling to determine the background levels of pollutants at each of the priority outfalls.

- Data analysis (determining next steps) – Taking a close look at all of the data, looking for outliers or numbers of importance, and determining what the priorities are for moving forward in the IDDE process.

- In-depth outfall investigations (including tracing dye testing, camera monitoring) – Determining the likelihood of an illicit discharge within the VTrans ROW, and search for the source(s) of the illicit discharge in the upslope drainage area to the maximum extent practicable.

- Development of remediation strategies, if an illicit discharge was discovered, and also the recommendation of continued monitoring and observation by the local municipalities at a select list of the priority outfalls.

Once the scope of work was reviewed and approved by VTrans and the VT ANR in October 2009, VHB began work on the next round of outfall investigations. The sections listed below will briefly summarize each of the steps involved in the outfall investigations and water quality testing. Detailed descriptions are provided in Section 3.0 below.

Water quality monitoring – The first step, water quality monitoring, involved VHB personnel collecting water quality samples at each of the 40 priority outfalls. This occurred in the month of November 2009. Once collected, the samples were sent to a laboratory for analysis. The results of the water quality monitoring can be seen on Pages 2 and 3 of Appendix 2. The purpose of the water quality sampling was to identify the concentration levels of various different pollutants at each of the priority outfalls. Once this information was known, a more pollutant-specific search could be conducted, in an effort to locate the source(s) of the illicit discharge at each of the priority outfalls.

Data Analysis – At the conclusion of the water quality sampling, all of the collected data was analyzed to determine whether an illicit discharge was likely. Through coordination with VTrans and the VT ANR, and local municipalities, VHB determined the next steps of the investigations, including which outfalls warranted additional testing or investigation. Additional testing and investigation was conducted during the next steps of the IDDE process (outfall investigations).

Outfall Investigations – Upon completion of the water quality sampling, OB tests, and data analysis tasks as mentioned above; VHB personnel then began work on the detailed field investigations. This task involved VHB staff conducting field based drainage area investigations to determine the sources of the potential illicit discharge. A definitive determination of the presence or absence of illicit discharges was made within the VTrans ROW and, as explained above, a reasonable effort was devoted to identifying the source(s) of the illicit discharge in the upslope drainage area. If no resolution of the source of a potential illicit discharge was in site, VHB agreed to turn over all data to the local or state officials for further investigation. This outfall investigation step included a sub-set of 13 of the 40 priority outfalls, which was derived during the data analysis step described above and confirmed

through consultation with VTrans and VT ANR. The detailed outfall investigations was the step in the IDDE process in which an illicit discharge was either confirmed present or absent within the VTrans ROW for each of the priority outfalls.

Development of Remediation Strategies – When an illicit discharge was discovered through the investigations or testing, VHB then worked with VTrans, VT ANR and the local municipalities on developing remediation strategies for resolving the issue. The recommendations for remediation activities or continued monitoring are presented in Section 5.0 of this report.

2.2 Study Area

Within the designated VTrans MS4 area, as shown on the Overall Project Site map, which is included on Page 1 of Appendix 2 of this report, the project area for the IDDE outfall investigations included five cities and towns in the Lake Champlain Basin in Chittenden County of Vermont including; Burlington, Colchester, Essex, Shelburne, and South Burlington. As part of this effort outfalls were investigated on a total of 12 separate roads; including US Route 7 (Shelburne Road), I-189, I-89, and VT Route 15. Table 1 (below), provides a summary of the VTrans MS-4 outfalls inventoried in each City or Town during the latest round of outfall investigations and water quality testing, which occurred starting in November 2009 and continuing into August 2010.

Table 1: Outfall Assessment Survey Summary		
Town	**State and U.S. Roadways Included**	**Outfalls Investigated by VHB Pioneer**
Burlington	I-189	1
Colchester	I-89	1
Essex	I-289, VT-15, VT-117	6
Shelburne	US-7, Falls Rd	5
South Burlington	US-7, I-189, I-89, VT-116	24
Williston	US-2, US-2A, Johnson Ln.	3
Totals:	-----	40

3.0 Methods & Materials

3.1 Water Quality Monitoring

As the first step in the outfall investigation and water quality testing investigations, VHB conducted water quality monitoring on all of the 40 priority outfalls. The methodology and procedures used by VHB followed the established Center for Watershed Protection (CWP) guidelines as explained in the *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments* manual by using the steps as outlined below to ensure that VTrans successfully met the requirements of the MS4 permit for implementing and carrying out an IDDE program. Based on the results of the initial IDDE investigations (Summer 2009), and after consultation with the VT ANR and VTrans, each of the 40 priority outfalls were put into one of two sampling parameter categories; specific or generic. This classification meant that based on the results of the initial round of IDDE

investigations, the outfall was identified for a specific water quality test (e.g., *E. coli*), or it was discovered that additional testing was needed to find out more information about the potential pollutants occurring at the outfall. The sampling parameters were identified for each of the 40 priority outfalls. As seen in Table 2 below, the sampling parameters included: *E. coli*, nitrates, pH, MBAS (floatables/suds) and volatile organic compounds (VOCs).

Table 2 – Water Quality Sampling Parameters		
Generic Outfalls		
Indicator Type	**Sampling Parameter**	**Method (EPA/SW/VHB)**
Vegetation Change	*E. coli* & Nitrates	SM 9222D, EPA 300.0
Pipe Benthic/Outfall Damage	*E. coli* & Nitrates	SM 9222D, EPA 300.1
Specific Outfalls		
Indicator Type	**Sampling Parameter**	**Method (EPA/SW/VHB)**
Odor - Gasoline	VOCs	EPA 8015B: TPH-Gasoline Range Organics
Odor - Sewage	E. coli & Nitrates	SM 9222D, EPA 300.0
Clarity (oil sheen)	VOCs	EPA 8015B: TPH-Gasoline Range Organics
Floatables (suds)	MBAS	EPA 425.1: Surfactants, MBAS
Sampling Parameters For All Priority Outfalls		
Sampling Parameter	**Unit of Measurement**	**Method (EPA/SW/VHB)**
Temperature	degrees (c)	VHB Field Unit
Conductivity	umho/cm	VHB Field Unit
Time	Time of Sample	VHB Field Personnel
Optical Brightener Test (OB)	Presence/ absence	Test Will Help to Determine If Non-Stormwater Discharge (sewage) is Present

Once this list of sampling parameters was agreed upon by VTrans and the VT ANR, VHB began to prepare for this effort by contacting the Endyne Laboratory (Endyne) in Williston, VT to obtain the proper sampling materials needed. VHB personnel then collected water quality samples from each of the priority outfalls. Working in a two-person crew, as per the requirements of the Section 1111 highway access permit obtained by VHB, the field crew visited each of the outfalls and collected water quality samples, along with recording the temperature (^{o}C), conductivity and time of sample while at each outfall. On a daily basis, the samples were collected and brought to Endyne for analysis, until each of the priority outfalls had been visited and a sample had been collected. This effort was completed during late November 2009.

The water quality monitoring study developed by VHB through coordination with VTrans and the VT ANR was a study of several different pollutants commonly found in waterways in highly developed areas. The water quality monitoring test overall went as planned with very few unexpected occurrences. The results of this testing proved to be instrumental in moving forward with the remaining steps of the IDDE process, as explained in the sections below.

3.1.1 Optical Brightener Test (Fall 2009)

At the same time as the water quality sampling was being completed, VHB personnel were also preparing to conduct an optical brightener (OB) test at each of the 40 priority outfalls. The OB test is regarded as being an inexpensive, yet successful way of determining if detergents are present in the stormwater system. This test involved placing a steel tea-ball device filled with untreated cotton pads into the flow path of the outfall, or if sampling a catch basin, submerging the tea ball in the catch basin. Per the general guidance set forth for conducting this test, it

should be done only under dry conditions, or when no overland stormwater runoff is expected to occur. For this test, VHB recommended a period of 48 hours of dry weather, or less than 0.10" of measured precipitation, before the OB test could be installed. Once installed, the methodology called for the OBs to be left in place for a period of five to seven days. Once retrieved, the OB samples needed to be brought back to the office and placed under a long-wave ultraviolet (UV) lamp. If the OBs fluoresced in any way that indicated that detergents were detected in the water and the sample was given a positive reading. If the sample did not fluoresce, it was given a negative reading. Any OBs that resulted in a positive reading automatically required a follow-up investigation, per the OB sampling protocol.

3.1.2 Optical Brightener Test (Spring 2010)

As per the agreement between the VT ANR, VTrans and VHB mentioned above, VHB conducted OB testing at a total of 32 outfalls during the months of May 2010. This number was arrived at based upon the number of positive tests returned during the first round of OB testing (six), which did not require a re-test, and also two outfalls were not installed due to active construction at the outfalls (#30 and #46). This resulted in the re-installation of the very same OBs that were used during the fall 2009 testing, which were preserved in air tight, individual containers. Per discussions with Jim Pease of the VT ANR and VTrans, it was deemed allowable that VHB could count the time (days) the OB tests were installed during the Fall 2009 months towards the five to seven day requirement. This meant that the OBs needed to be installed for an additional three to four days, during dry weather conditions, to meet the full five to seven day installation requirement.

The optical brightener (OB) testing came highly recommended by the CWP and many municipalities throughout the County. It continues to be a fairly inexpensive way of telling if fluorescents are present in the waterways. Although the test had to

be re-run in the case of 32 outfalls explained above, the methods used to install, monitor and collect this data proved to be very efficient and worthwhile.

3.2 Data Analysis

After the water quality monitoring and the OBs were completed for all of the priority outfalls, VHB then carefully analyzed all of the collected and received laboratory data in an effort to decide how many of the 40 outfalls needed additional investigation and/or testing. The purpose of this task was to identify the outfalls which are most likely receiving input from an illicit discharge. This process involved two steps, including:

- Summarizing and examining the water quality sampling and OB sampling data
- Successfully coordinating with VTrans, VT ANR, as well as local municipalities on the results

Once the review of all data collected was completed, VHB recommended that a total of 13 outfalls required additional investigation and or testing, and a list of these outfalls was provided to VTrans and the VT ANR for review and approval. A total of 27 priority outfalls either resulted in a negative OB test (twice) or were not tested due active construction at the outfalls. These same priority outfalls also showed pollutant levels below state standards (if applicable) on the water quality monitoring testing that was done. As a result, these 27 priority outfalls were added to the list of no further action being required, resulting in a sub-set of 13 priority outfalls requiring additional investigation and testing.

3.2.1 Stormwater Infrastructure Review

As part of the preparation for the next round of investigations and water quality testing, VHB personnel used the provided stormwater infrastructure layers for all of the municipalities within the study area to determine the approximate size and extent of the drainage areas for each of outfalls that were recommended for additional investigation. Once completed, this information was to be included on the drainage area site maps, which can be found on Pages 1 through 10 of Appendix 3.

3.2.2 Development of the Drainage/Investigation Area Sitemaps

For use in the field, VHB personnel prepared drainage area site maps for the priority outfalls identified as a result of the water quality monitoring and OB test. These maps had all available Geographic Information Systems (GIS) layers included on them, including: the priority outfall locations, the National Agricultural Imagery Program (NAIP) color imagery (2009), stormwater infrastructure layers, road names, stormwater impaired watershed boundaries, Vermont Hydrography Dataset (VHD) streams, and two foot contours, which were derived from a Lidar digital elevation model (DEM) of Chittenden County. Using the above mentioned data layers for reference, VHB personnel prepared drainage areas (investigation areas) for each of the priority outfalls. Once completed this gave VHB personnel a much clearer understanding as to the amount of area (acres) that needed to be investigated for each of the priority outfalls while actually out in the field. Once in the field, VHB personnel would make adjustments or corrections to the investigation boundaries based on actual ground conditions.

3.3 Outfall Investigations

As part of the detailed field investigations, VHB staff completed detailed drainage area investigations at each of the 13 priority outfalls identified as a result of the water quality and OB testing. Using the drainage area field maps (mentioned above), VHB personnel entered the field in an effort to try and locate the potential sources of the illicit discharges, focusing on the area within the VTrans ROW and beyond, at each of the 13 priority outfalls. VHB personnel also made notes and edits to the drainage area boundaries while out in the field, to refine the boundaries based on topography or existing ground conditions. During the investigations, VHB personnel also had an in-pipe camera in their possession for searching the inside of pipes. The camera was used at each of the priority outfalls to check the insides of the pipes for illicit connections. The camera allowed for a view of 15 to 20 feet up the pipes, depending on diameter and condition of the pipe, and was also used in up drainage area connections to check for illicit connections.

At the conclusion of the field investigations, VHB identified structures (buildings, catch basins) of concerns, with noted lateral connections to nearby sewer systems, which would require additional testing (water quality or tracing dye). Once entered, the buildings were to be completely searched and all drain pipes would be inspected, including the basement, if available. Several dye tests were done within each structure to ensure that the building was properly connected to the sanitary sewer system. This would be the next step in the IDDE outfall investigations, and is explained in further detail below in Section 3.3.1 of this report.

3.3.1 Tracing Dye Testing

As a result of the in-depth field investigations, VHB personnel identified several nearby structures that were possible sources of illicit discharges, and needed to be dye tested to confirm or deny the presence of an illicit discharge. These included structures near priority outfalls 62, 69, 75 and 261. The tracing dye test is one of the more commonly used IDDE search methods available. This test involves placing an EPA certified tracing dye (liquid or powder form) into a sink, drain, or toilet, and then confirming that the dye enters the correct system, which in this case, would be the sewer system. Once deployed the tracing dye, would turn the water a fluorescent color, which varies depending on the color of dye used. The dye is not considered to be damaging to the environment, and fully dissolves after a short period of time.

The method VHB used while conducting the tracing dye test was to have one person deploy the tracing dye sample in a sink, drain or toilet. While the sample was released another person would monitor the closest sewer manhole. Lastly, the third person would be standing by at the priority outfall, to see if tracing dye is seen discharging out of the outfall. This method worked out very well in that all of the possible exiting points for the tracing dye deployment were covered. This process also proved successful in that it gave a visual confirmation as to where the tracing dye was going once is left the structure, which made the tracing dye a complete success.

3.3.2 Coordination with Local Municipalities

Before conducting the tracing dye testing at the identified outfalls as mentioned above, VHB personnel contacted representatives from the local municipalities to inform them of this test, and to also seek their assistance in conducting these tests, as many of the sites fell outside of the VTrans right-of-way. VHB sought to conduct the

dye test under the authority of the local municipalities, which led to greater willingness from the public to allow the dye tests to be conducted in their homes or businesses. Each of the sites location was provided to the municipalities in the form of the sites e911 address for investigation purposes. VHB personnel joined the local municipalities at the priority outfalls to conduct the dye tests.

3.3.3 Water Quality Testing

In an effort to locate the source of elevated *E.coli* readings at two particular outfalls (63 and 261), VHB personnel conducted two additional water quality samples to determine if the nearby stormwater ponds are directly related to the elevated E.*coli* readings at these particular two outfalls. The samples were collected from the stormwater ponds by VHB personnel on August 10, 2010, and were sent to Endyne for analysis. The results of these tests can be seen on Pages 14 and 15 of Appendix 2.

These additional tests were designed to tell if the nearby stormwater ponds were contributing elevated levels of *E.coli* into the VTrans ROW. As the results indicated, these ponds did show to have elevated levels of *E.coli* present. Further explanation of the results of this sampling can be found in the Results section below.

4.0 Results

4.1 Water Quality Monitoring

The water quality sampling activities commenced on November 17, 2009, and concluded on November 19, 2009. During this time VHB personnel collected water quality samples from each of the 40 priority outfalls. As stated in an earlier section of the report, sampling parameters were assigned to each of the priority outfalls based upon the data collected during the IDDE investigations during the summer months of 2009, and by also taking a look at aerial photography and determining the nearby residential, commercial and industrial land uses. The following sections will further detail the results of each of the individual sampling parameters for the priority outfalls. Please see the water quality summary spreadsheet on Pages 2 and 3 of Appendix 2 for the full results of the water quality sampling.

pH:

Out of a total of 26 pH tests conducted, it was found that no samples were outside the Vermont Water Quality Standard (VWQS) range for pH in waterways (6.5-8.5 s.u.). The highest recorded value was at outfall 62 (8.06 s.u.), while the lowest recorded value was at outfall 150 (6.98 s.u.). The average pH for all samples collected was 7.62 s.u.

The pH test did have a moderate range of values (1.08) from lowest to highest recorded value, but no values exceeded the threshold. With that said, this test was ultimately not that important in our decision process moving forward, as to deciding which outfalls required additional investigation and or testing.

E. coli:

A total of 12 *E. coli* samples were collected and a total of four outfalls (63, 69,166, and 261) exceeded the VWQS for *E. coli (*less than or equal to 77MPN/100mL). The highest recorded value (550 MPN/100mL) was found at outfall 261. The three other samples over the threshold came in at 110, 180 and 160 MPN/100mL respectively.

We found that we had elevated E.*coli* readings at four of the priority outfalls, and as a result of this test each of these outfalls, listed above, were added to the list of outfalls requiring additional investigation and testing, including tracing dye testing and/or additional water quality testing.

Nitrates:

VHB personnel tested a total of 12 outfalls for elevated levels of nitrates in the water. The result was that all samples came in well below the VWQS threshold for nitrates in water of less than 5.0 mg/L. The highest recorded value (2.40 mg/L) was found at priority outfall 300.

No outfalls sampled displayed a nitrate value that indicated an illicit discharge was occurring. Thus, no outfalls were recommended for additional investigation and or testing as a result of the nitrate test

MBAS (Surfactants):

The MBAS test is designed to analyze the amount of surfactants (suds/detergents) in surface water. A total of 13 MBAS samples were collected by VHB personnel. The highest recorded value of 0.81 (Outfall 80) was the only sample above the VWQS threshold of less than 0.25mg/L. All other samples were less than 0.10 mg/L.

The results of the MBAS test indicated a relatively low amount of suds/detergents present at most of the outfalls tested. Outfall 80, which is located on Shelburne Road at the corner of Swift Street, has a substantial amount of surface runoff from a nearby gas station, Shelburne Road (US-7) itself, and also several nearby commercial businesses. These sources are likely the leading contributing factors to the elevated MBAS reading at priority outfall 80, which was recommended for additional investigation and or testing during the detailed field investigations portion of the IDDE outfall investigations.

Volatile Organic Compounds (VOCs):

A total of 13 outfalls were tested for levels of volatile organic compounds (VOCs), which are more commonly known as petroleum products (e.g., gas or oil). As a result of this test, no outfalls came back with a reading greater than 0.20 mg/L.

Although there is no overall VWQS criterion for VOCs in Vermont waterways, this test showed that levels at the outfalls tested did not indicate the presence of significant discharges related to petroleum.

4.1.1 Optical Brightener (OB) Test (Fall 2009)

The initial round of the OB test was conducted during the week of November 16 through November 20, 2009. A total of 38 OB tests were installed during this week, and a total of 32 OB tests were retrieved during sample pick-up. Six samples became dislodged and were lost during this test. Out of 32 successfully completed samples, a total of six positive (18%) samples were indentified. These included outfalls; 62, #69, #75, #80, #176, and #261. These outfalls, per IDDE guidance, automatically qualify for additional testing and investigation due to their positive reading. The remaining outfalls all tested negative, with no fluorescence evident when placed

under the long-wave UV lamp for inspection. Please see the water quality summary spreadsheet on Pages 2 and 3 of Appendix 2 for the full results of the OB tests.

As a result of an unexpected storm near the midpoint of the OB test, VHB made the decision to pull the OB tests after only being installed for a period of three to four days, depending on the outfall. Although the samples were not installed for the recommended period of time (five to seven days) a total of six samples still did result in a positive reading. When the data was presented to Mr. Jim Pease of the VT ANR, he indicated that the State of Vermont was not willing to accept the results of the OB test due to the installation time of the OB test not meeting the guidance time frame of five to seven days.

Through communications with VTrans and the VT ANR, VHB agreed to re-sample all 32 outfalls that were either not sampled (4), became dislodged (4) and were lost, or the outfalls that resulted in a negative reading (24). This resulted in a total of 32 outfalls requiring an additional OB test to be done. It was agreed upon by VHB and VTrans that the OB tests would be done in the Spring 2010 due to the winter weather conditions, and at no additional cost to VTrans.

4.1.2 Optical Brightener (OB) Test (Spring 2010)

The second round of OB tests was conducted the week of May 24, 2010 through June 1, 2010. As mentioned above in Section 4.1.1, a total of 32 OB tests were re-run per the request of the State of Vermont and VTrans. As a result of this additional test, another four outfalls (#7, #63, #166, and #190) tested positive and were added to the list of six already positive OB tests. This resulted in a total of ten out of 38 outfalls, or 26 percent of outfalls, with a positive reading. VHB was unable to implement the OB test at two outfalls (#30 and #46) due to active construction occurring at the outfalls. Per the IDDE process when dealing with OB tests, all positive readings automatically require follow-up investigations, and in some cases additional testing. Please see the

water quality summary spreadsheet on Pages 2 and 3 of Appendix 2 for the full results of the two rounds of OB tests.

Positive OB tests generally indicate the presence of fluorescent whitening agents (FWA) such as detergents or wastewater in surface water. However, it should be noted that FWAs are also used in many other commonly found products, including; textiles, papers, plastics, certain chemicals, as well as widespread use in petroleum applications (Hagedorn, 2005). Due to the urban setting of many of the priority outfalls investigated, and the close proximity to gas stations, heavily traveled roadways (e.g. Shelburne Road) and commercial businesses (e.g. Shearer GMC), it's our best professional judgment that the OB tests were influenced by non-point pollutant surface runoff in these urbanized areas. Although VOC (petroleum) levels were low where measured, there is no guidance currently available as to the amount of petroleum needed to be present in the runoff for it to cause a positive OB test result. This was discussed with the VT ANR, which agreed that petroleum based runoff could be the cause of the positive OBs for this project, and that the concentrations of petroleum needed to cause a positive OB is unknown at this time.

4.1.3 Water Quality Sampling Results

As a result of the completion of the water quality sampling task described above, VHB personnel identified the next set of priority outfalls which needed to be further investigated and or tested based on the levels of pollutants present or the result of the OB test. These outfalls included; #63 (*E. coli*), #68 (Temperature) #69 (*E. coli*), #165 (*E. coli – shares drainage system with outfall #166*), #166 (*E. coli*), #261 (*E. coli*), and #266 (Temperature). The remaining outfalls included in the next round of investigation were selected due to positive OB tests. This included outfalls; #7, #62, #75, #80, #176,

and #190. Please see Table 3 for a full list of the 13 priority outfalls, and the reason for which they were selected for additional investigation and/or testing during the next round of the IDDE process.

Table 3: (13) Priority Outfall Selection

Outfall	Town	Reason for Selection
7	Colchester	Positive OB Test
62	Shelburne	Positive OB Test
63	South Burlington	High *E.coli*/Positive OB Test
68	South Burlington	High Temperature
69	South Burlington	High *E.coli*/Positive OB Test
75	Shelburne	Positive OB Test
80	South Burlington	MBAS, Positive OB Test
165	South Burlington	Same Drainage Network as Outfall #166
166	South Burlington	High *E.coli*/Positive OB Test
176	Burlington	Positive OB Test
190	Essex	Positive OB Test
261	Shelburne	Positive OB Test/High Temperature
266	Shelburne	High Temperature

4.2 Data Analysis

4.2.1 Stormwater Infrastructure Review

Prior to conducting the in-depth outfall investigations, VHB personnel reviewed all of the stormwater infrastructure (pipe) layers to assist in the on the ground search process. The stormwater infrastructure data was provided by the local municipalities within the project study area, along with an additional dataset provided by the Chittenden County Regional Planning Commission (CCRPC, 2010).

These layers proved to be extremely helpful for both our in-office review and planning, as well as during the outfall investigations. While the layers proved not to be entirely accurate in all areas, it was beneficial to know which areas were connected to adjoining areas, and which were not. It saved a substantial amount of time and effort while in the field conducting the outfall investigations.

4.2.2 Drainage/Investigation Area Site Maps

While conducting the field based drainage area investigations, VHB personnel had copies of the drainage area site maps with them. Please refer to Appendix 3 of this report for the Drainage Area Site maps. While in the field, VHB personnel took notes on the maps to indicate stormwater flow patterns, stormwater infrastructure locations, names of businesses, and other general notes. VHB personnel also indicated if the delineated drainage areas needed to be modified in any way based on existing conditions or topography of the area near the outfall. These changes were made to the delineated drainage areas upon returning to the office.

The drainage area site maps proved to be an asset while in the field. They had a wealth of data already on them, to which we added to. It was well worth the time

and effort put into making these maps, based on the results of having them in our possession while out in the field.

4.3 Outfall Investigations

4.3.1 Investigating Priority Outfalls

Based on the results of the water quality testing and OB test, and in an effort to locate the possible sources of illicit discharges, VHB identified a total of 13 priority outfalls out of the 40 total outfalls, which needed to be further investigated and or tested in the remaining steps of the IDDE process. The list of 13 priority outfalls was derived by subtracting 27 outfalls from the list of the 40 priority outfalls. These outfalls were removed because they had resulted in a negative OB test(s), and also displayed low background levels for pollutants in the urbanized waterways where the outfalls were located. All information collected by VHB personnel showed that these 27 outfalls were no longer considered to be likely sources of an illicit discharge within the VTrans ROW, and because of this, they were removed from the priority outfall list. Please see the water quality summary spreadsheet on Pages 2 and 3 of Appendix 2 for the complete list of the priority outfalls.

VHB personnel proceeded to conduct in-depth on the ground investigations at each of the 13 priority outfall locations. The outfall investigations were conducted by VHB on July 8, 2010 and July 22, 2010. Upon arriving at each of the priority outfalls, field personnel completed a full investigation of the drainage area, as delineated by VHB. During these investigations, VHB was searching for any signs of illicit pipes or illegal dumping into stormwater infrastructure by completing visual inspections of each of the outfalls, along with using an in-pipe camera to examine the insides of the priority outfalls and nearby stormwater infrastructure. Also while conducting these

investigations; VHB took notes and photographs if areas near the outfalls had changed since the last visit. An example of this would be the active replacement of stormwater infrastructure, including the culvert, at priority outfall #190 in the Town of Essex. Due to active construction at this site, along with no visual illicit connections observed within the VTrans ROW or up drainage area stormwater system, this outfall was ultimately removed from the priority outfall list based on these observations.

As a result of these outfall investigations it was noted that no apparent illicit connections were discovered within the VTrans ROW. This included visual inspections inside priority outfalls and nearby stormwater infrastructure, along with detailed on the ground investigations of the up drainage area stormwater network. No obvious connections or illegal dumping was noted at any of the priority outfalls investigated. The next step was to decide what action, if any, should be done next at each of the 13 priority outfalls. Based on the results from the initial round of outfall investigations during the summer months of 2009, along with data and information collected during the latest round of water quality monitoring and outfall investigations, VHB personnel were able put each of the 13 priority outfalls into one of three categories. These categories included:

- Category 1 = (3) Outfalls: These were ruled out as result of water quality monitoring, OB tests, additional field investigations, and outfall inspections.
- Category 2 = (5) Outfalls: A positive OB test or sampling result is due to the high concentrations of surface pollutants present within the drainage area. This result indicates an anthropomorphic input is affecting the outfall, and it is not easily pinpointed to one particular source. These are likely receiving multiple influences (gas stations, heavily traveled roadways, parking lots etc…) of pollutant based runoff. Please see the remediation section later on

in this report for a recommendation that these outfalls be monitored by the local municipalities for which they are located in.

- Category 3 = (5) Outfalls: Additional testing is needed to confirm or deny the presence of an illicit discharge at the outfall.

Table 4 shows the category that each of the priority outfalls was placed into as a result of the completion of field investigations.

Table 4: Priority Outfalls – Recommended Actions

Outfall Category	Outfall Action	Priority Outfalls Included Within Each Category
1	Outfall ruled out as a result of additional field investigations	#68, 190 and #266
2	Outfall ruled out as a result of high concentrations of surface pollutants present in the drainage area	#7, #80, #165, #166, and #176
3	Additional testing is needed to confirm or deny the presence of an illicit discharge	#62, #63, #69 #75, and #261

Based on the above categorization of the priority outfalls, any outfalls that were placed into category 3 needed to have additional investigation and or testing done to confirm or deny the presence of an illicit discharge at the outfall. These outfalls included; #62, #63, #69, #75, and #261. It was proposed that either tracing dye testing or additional water quality monitoring needed to be done at the outfalls listed above to determine the potential source(s) of the illicit discharge. This process is further explained in Section 4.4.2 below.

4.3.2 Tracing Dye Testing

On August 10, 2010, VHB personnel conducted tracing dye testing and investigations at a total of five outfalls (#62, #63, #69, #75, and #261) along Shelburne Road in the Town of Shelburne and the City of South Burlington. For the testing in Shelburne, VHB was joined by Mr. Chris Robinson and Mr. Chris Huestis, both of whom are from the Town of Shelburne Wastewater Department. The sites visited and dye tested in Shelburne included: a residential structure at 3255 Shelburne Road, North Star Motel, Kong Chow Restaurant, 11 Falls Road Commercial Building, and lastly the Bearded Frog Café in Shelburne Village. Please refer to the Drainage Area Sitemaps provided in Appendix 3 of this report for locations of each of these structures. Accompanied by the Mr. Robinson and Mr. Huestis, VHB personnel proceeded to enter each of the buildings and conducted a dye test, along with a visual inspection of the basement (if available).

At each site, a visual confirmation was made by Chris Huestis of the Town of Shelburne that the tracing dye was, in fact, entering the sanitary sewer system and not the stormwater system. This was completed by removing the closest sewer manhole cover and watching as the tracing dye was released from inside of the building. Each time Mr. Huestis visually saw the dye enter the sewer system. Any non-contributing flows, meaning flows not contributing to the drainage system of the priority outfalls were not pursued during the tracing dye testing. Meanwhile, a representative from VHB stood by at each of the priority outfalls as the tracing dye was released. No tracing dye was seen discharging from any of the priority outfalls. The result of these tests indicates that none of the structures listed above are the direct source of an illicit discharge, and with the exception of priority outfall #75, these priority outfalls were reassigned to category one or, outfall ruled out as a result of additional field investigations Please refer to Pages 2 and 3 of Appendix

2 for the final classification of all of the priority outfalls based upon the completion of all testing and field investigations.

Also on the same day, August 10, 2010, VHB personnel were joined by Mr. Tom DiPietro, Stormwater Superintendent of the City of South Burlington Stormwater Utility Department, to conduct investigations and possible tracing dye tests at two locations in South Burlington, VT. These locations included the Shearer GMC/Cadillac facility and the Rodeway Inn (both sites drain to priority outfall #69). Upon arriving at Shearer GMC, Mr. DiPietro and a VHB representative took a look around inside of the service shop facility. Several floor drains and an oil/water separator were observed while in the building. Also, in talking with Mr. Peter Patch, Service Manager at Shearer GMC, we were informed that per a bank's recent request due to a loan requirement, tracing dye testing, along with inspection of the facilities pipe system within the building had just been completed and there were no issues to report. Upon hearing this information from Mr. Patch, Mr. DiPietro and a VHB representative continued the investigations around the perimeter of the property. Near the rear of the facility, it was noted that a large trash and hazardous materials storage area was exposed, and that there was also a catch basin directly beneath one of the dumpsters. These discoveries along with the discovery found behind the Rodeway Inn, which is explained in the next section below, are both likely contributors to the positive OB tests found at priority outfall #69. Mr. DiPietro and the VHB representative agreed that this was the likely source of pollutants from this property, which drains to priority outfall #69. Further detail on this discovery, along with recommendations for improvement at this site are provided later in the Remediation section of this report.

Mr. DiPietro and the VHB representative next visited the Rodeway Inn, located next to Shearer GMC on Shelburne Road in South Burlington. Similar to the Shearer

property, this property also drains to priority outfall #69. Upon arriving at the site, Mr. DiPietro and the VHB representative did a quick walk-over of the property. It was quickly noted that nearly all of the stormwater flow from the property drains to Shelburne Road, as there is only one catch basin located on this property. Upon inspecting the catch basin, a small pipe was noticed. The small pipe led to a fenced-in trash storage area, which upon opening was rather dirty and the trash container was partially left open. The proprietor, Mr. Kiran Manibhai Patel said he was unsure of the pipe and what exactly its purpose was. Mr. DiPietro did inform him of the trash storage area, and how it drained directly into the nearby catch basin. Further recommendations regarding this site can be found later in the Remediation section of this report. The issues found at the Rodeway Inn are very minimal, and can be very easily corrected. This discovery is also likely a contributing source to the positive OB test found at priority outfall #69. As cleaning products from the Inn are disposed of and are thrown into this dumpster, which was left open and not properly sealed off, leachate from the dumpster can discharge into the nearby catch basin. No dye tracing was done at this facility based on the site investigation with Mr. DiPietro, and given the discovery of the trash storage area near the catch basin.

As a result of the observations made during the investigations at the Rodeway Inn and at the Shearer GMC facility, the priority outfall associated with these properties (#69) is recommended to be placed into a category 3, or outfall requires remediation. Although neither of these structures was found to have an illicit connection, there are problems at each of the sites (explained above), that should be corrected. If corrected, noticeable improvements in water quality should be found at outfall #69. Further explanation of the specific suggested improvements can be found later on in this document, within the Remediation section.

Similar to the discovery found at the Rodeway Inn as described above, VHB personnel observed a dumpster discharging leachate into a nearby catch basin behind the 11 Falls Road commercial building in the Town of Shelburne. Please see Page 3 in Appendix 4 for photographs of this area. The discharge was found to be flowing directly into a nearby catch basin, outside of the VTrans ROW, but connected to the same system. The proprietor was not available while VHB personnel were on site. Further explanation of the specific suggested improvements can be found later on in this document, within the Remediation section.

4.3.3 Additional E. Coli Testing

On August 10, 2010, VHB personnel conducted two additional water quality samples along Shelburne Road in the Town of Shelburne, and also in the City of South Burlington. The first stormwater pond is located at the corner of Executive Drive and Shelburne Road in the Town of Shelburne. This is a State-owned stormwater pond, which ultimately discharges into priority outfall #261. The second stormwater pond is privately owned and is located in front of the GE Healthcare (formerly IDX) facility on Shelburne Road in South Burlington and is associated with priority outfall #63.

The purpose of conducting the sampling at these two stormwater ponds was to confirm our hypothesis that elevated *E. coli* readings found at priority outfall #261 (Executive Drive Pond) and priority outfall #63 (GE Pond) are partially due to these stormwater ponds being located within the drainage area of these two outfalls. Our thought was that these two stormwater ponds themselves would have elevated *E. coli* readings, and that would be a contributing factor to the elevated levels at outfall #63 (110 MPN/100mL) and #261 (550 MPN/100mL). The results of these samples indicated that our hypothesis was correct. The *E. coli* levels found at these two ponds

are extremely high, which the Executive Drive stormwater pond at greater than 2,400 MPN/100mL and the GE Healthcare stormwater pond at 1,300 MPN/100mL. This demonstrates that these two ponds are the major contributors of *E. coli* found at outfalls #63 and #261.

In discussions with Mr. Tom DiPietro of the City of South Burlington Stormwater Utility Department, he indicated that the elevated levels of *E.coli* found at the GE Healthcare stormwater pond could be as a result of waterfowl (Canada Geese) residing in the area for an extended period of time. Mr. DiPietro has agreed to follow up with additional testing at the GE Healthcare stormwater pond later this fall. If elevated *E.coli* levels are still present, Mr. DiPietro has indicated that he would meet with representatives from GE Healthcare to discuss this matter. VHB has asked Mr. DiPietro to keep both VTrans and VHB informed of any additional testing or communications with GE regarding this matter.

4.4 Development of Remediation Strategies

If an illicit discharge was discovered during the IDDE water quality monitoring and outfall investigations, VHB personnel would have first notified VTrans and the appropriate local authorities. After completing these first initial steps, VHB would have then worked with VTrans to develop remediation strategies for the illicit discharges found. Although no apparent illicit discharges or illicit dumping was discovered during the IDDE outfall investigations, VHB personnel have identified several areas in which through installation of some general stormwater best management practices (BMPs), and by also setting some general guidelines for the storage of waste or trash on-site, water quality may be improved. To complete these efforts, it will take coordination between VTrans and the local municipalities. These efforts are explained in further detail in the remediation section of this report.

5.0 Results

5.1 IDDE Program Compliance

Under Vermont GP-9014 requirements VTrans is required to implement an IDDE program consisting of the identification, monitoring, and remediation of illicit discharges found at stormwater outlets. The conclusion of the IDDE outfall investigations, testing and remediation recommendations indicates the last and final step in the IDDE process, ensuring that VTrans has been successful in meeting the requirements of the IDDE program. Continued monitoring and/or observation by the local municipalities, through coordination with VTrans, is recommended at the priority outfalls as explained in the sections below.

5.2 Recommended Monitoring of Category Two Outfalls

At the conclusion of the IDDE fieldwork and after all data had been analyzed, VHB prepared a list of outfalls that are recommended for additional monitoring, or require remediation, based upon the results of the water quality sampling and OB testing. With the exception of priority outfall #69, the remaining outfalls recommended for continued monitoring showed a positive OB test. A complete list of the outfalls recommended for monitoring or requiring remediation can be seen below in Table 5. This table also includes the following information regarding these outfalls; the City or Town in which they are located in, the outfall category assigned by VHB, and lastly, the action item for each of the outfalls listed.

Table 5: Priority Outfalls - Monitor/Remediation Guide			
Priority Outfall	**City/Town**	**Outfall Category**	**Action Item**
7	Colchester	2	Monitor
69	South Burlington	3	Remediation
75	Shelburne	3	Remediation
80	South Burlington	2	Monitor
165	South Burlington	2	Monitor
166	South Burlington	2	Monitor
176	Burlington	2	Monitor

The outfalls recommended for future monitoring (as shown above) will be assigned to the local public works department in the appropriate municipality listed above for follow-up. This effort will require coordination between VTrans and the local municipalities to ensure that these areas are monitored for changing water quality conditions. The two outfalls recommended for remediation (#69 and #75) will be explained in further detail below.

5.3 Remediation

Shearer GMC – (Outfall #69) -

As described in the outfall assessment section above, an issue with storing trash, debris and hazardous materials (used antifreeze, oil, filters etc.) over the top of a catch basin was discovered on a visit to the Shearer GMC/Cadillac facility on Shelburne Road in the City of South Burlington on August 10, 2010. Upon noticing this issue, both Mr. Tom DiPietro and a representative from VHB informed Peter Patch of Shearer GMC of the problem. It was explained to him that by having the trash storage area located on top of the catch basin, and by also not covering this

area, it was likely contributing pollutants to the stormwater system in this area. It was also noted that stormwater runoff from the shop and the trash area enter the catch basin beneath the dumpster. Please see Pages 1 and 2 in Appendix 4 for photographs of this area. Though minor, these issues at the Shearer facility could be contributing factors to the water quality issues that were observed at priority outfall #69 by VHB personnel.

While on-site, Mr. DiPietro suggested some potential resolutions for fixing the issues found, including; moving the dumpsters away from the catch basin, and organizing the trash storage area in a tidier manner. Also, it was recommended that the lids on all of the dumpsters should be closed at all times to prevent precipitation from getting into the dumpsters and eventually leaking out of the bottom of the dumpsters and into the catch basin. An alternative suggestion was to construct a roof over the top of this area so that precipitation would not have the chance to interact with this area and run off into the catch basin. Both of these ideas were presented to Mr. Patch of Shearer, and he indicated that Shearer would be willing to work with VTrans, and the City of South Burlington to correct these issues. Due to the issue occurring outside of the VTrans ROW, it's recommended that the City of South Burlington Stormwater Utility Department work with Shearer to remediate these issues.

Rodeway Inn – (Outfall #69) -

Similar to the findings at the Shearer GMC/Cadillac facility, it was found that the Rodeway Inn also had a storage area directly near a catch basin that is tied into the VTrans right-of-way. Upon discovering this, Mr. DiPietro and a VHB representative had a discussion with the proprietor of this property, Kiran Manibhai Patel. The trash container lid was left open and the area surrounding the dumpster was littered with debris. It was expressed to Mr. Patel that this area could be kept a little tidier,

and that the dumpster lids should remain closed at all times. Mr. Patel agreed to work on these issues, which should help improve the water quality in this area and at priority outfall #69. Again, due to the issues mentioned above occurring outside of the VTrans ROW, it's recommended that the City of South Burlington Stormwater Utility Department work with the Rodeway Inn to remediate these issues.

11 Falls Road Commercial Building – (Outfall #75) –

Similar to the suggestions mentioned above for the Shearer GMC facility, the dumpster at this location could be relocated away from the catch basin to a covered area, or a flow control device could be installed near the dumpster to divert flow away from directly entering the catch basin. VHB recommends that the Town of Shelburne Department of Public Works work with the property owners involved to remediate this issue as described above.

Although no apparent illicit discharges were discovered through the IDDE outfall investigations, these minor remediation efforts mentioned above will assist in the effort of improving water quality along Shelburne Road in the City South Burlington and the Town of Shelburne. It is the recommendation of VHB that continued monitoring should be conducted at priority outfalls #7, #80, #165, #166 and #176, along with ensuring that remediation activities are successfully implemented at priority outfalls #69 and #75 in the upcoming years.

6.0 References

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