VERMONT
ENVIRONMENTAL CONSERVATION

Potash Brook

Watershed Description

This bacteria TMDL summary applies to a 1-mile reach of Potash Brook. Potash Brook originates in South Burlington between Dorset and Spear Streets. The stream flows north, close to the Burlington International Airport and US Rte. 2. It then turns west where it flows and continues to flow through South Burlington before emptying into Lake Champlain in Shelburne Bay. Multiple smaller tributaries enter the main stem along its course.

The Potash Brook watershed covers 43% of the land area within South Burlington (Potash). Along its course it passes through several wetlands and natural areas (Stormwater, 1997). However, the land surrounding the stream's main stem is generally highly developed. The Potash Brook watershed is home to some of the densest residential and commercial development within Vermont (East Woods). The 7.5 square mile watershed is over 19% impervious (SBSU, 2007).

South Burlington has a population of around 16,000 people and is one of the largest municipalities in Vermont. The Champlain Water District (CWD), which provides drinking water to South Burlington and other municipalities in the area, draws its water from Shelburne Bay. Potash Brook has a history of high bacteria levels, which is a concern for the CWD and area residents (Potash, 2003).

The bacteria-impaired segment of Potash Brook runs from its outlet on Lake Champlain north of Red Rocks Beach, upstream for one mile to the Burlington town line. The Potash Brook watershed (Figure 1) covers 7.5 square miles, in the towns of Burlington and South Burlington. Overall, land use in the watershed is 19% forested, 25% agricultural, 54% developed, and 2% wetland, as shown in Figure 2 (based on 2006 Land Cover Analysis by NOAA-CSC).

Waterbody Facts (VT05-11)

- **Towns:** South Burlington
- **Impaired Segment Location:** From outlet to 1 mile upstream
- **Impaired Segment Length:** 1 mile
- **Classification:** Class B
- **Watershed Area:** 7.5 square miles
- **Planning Basin:** 5 – Northern Lake Champlain

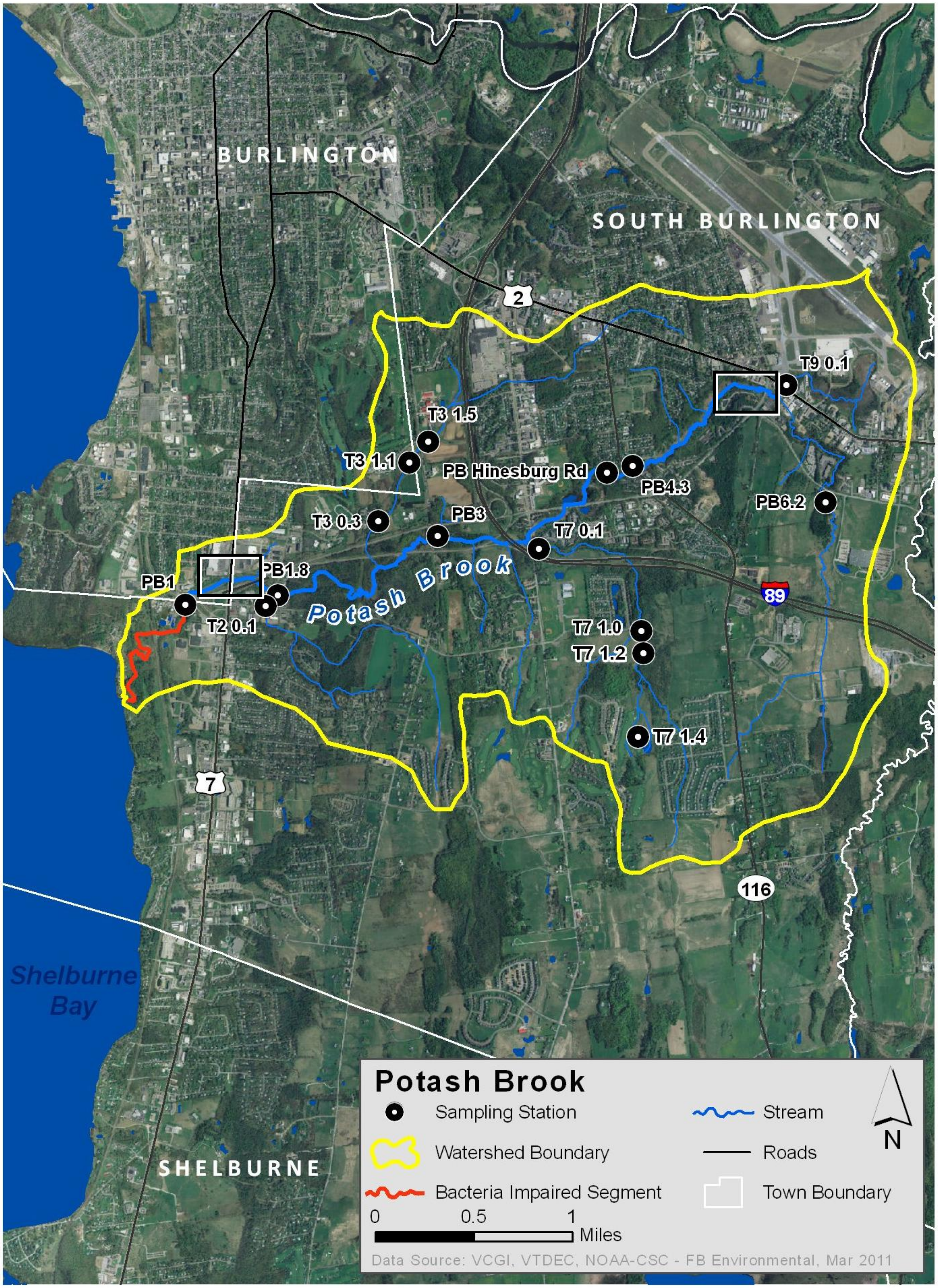

Figure 1: ***Map of Potash Brook watershed with impaired segment and sampling stations indicated. Insert areas correspond to figures 3 and 4.***

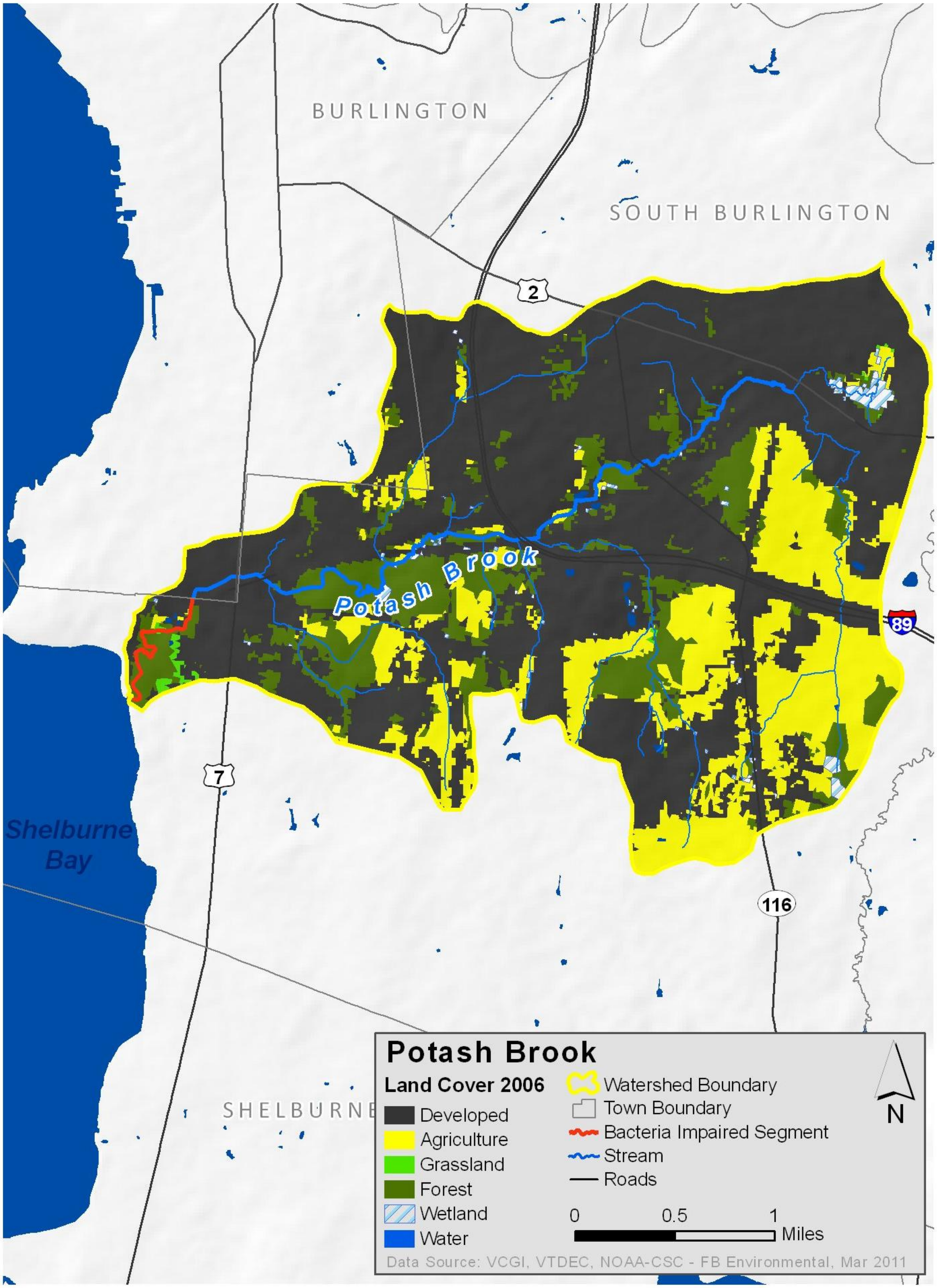

Figure 2: ***Map of Potash Brook watershed with impaired segment and land cover indicated.***

Figure 3: ***Aerial view of Potash Brook where it turns west near US Rte. 2 and the Burlington Airport (Source: Google Maps).***

Figure 3 provides a more detailed aerial view of Potash Brook where it changes its course from north to west. The scene within the photo is typical of Potash Brook's course. Dense residential and commercial development can be seen on both sides of the brook. The entire watershed contains a mix of different land use types. Land uses such as high density residential and commercial development have the potential to negatively impact water quality (Potash, 2003). The negative impacts arise from the significant volumes of stormwater and the pollutants therein entering the brook from these developed areas.

Stormwater flows off impervious surfaces such as driveways, rooftops, and roads when it rains. On these surfaces the water collects a suite of pollutants, including bacteria (VTDEC, 2009). Potash Brook is considered a stormwater impaired stream, in addition to being impaired by bacterial contamination. The stormwater impairment is based on the negative impact that stormwater has on aquatic life such as macroinvertebrates. Much of the stormwater that reaches the brook is carried within municipally owned drainage networks called storm sewers (Smartwaterways, 2010). Due to the amount of development within the city of South Burlington, the city is one of nine municipalities within Vermont regulated by the Environmental Protection Agency (EPA) under the National Pollutant Discharge Elimination System (NPDES) and must retain a permit for their storm sewer system. The city's storm sewer is referred to as a municipal separate storm sewer system (MS4). Anything that enters the MS4 is discharged untreated into the brook at outfalls; this includes bacteria from a variety of possible sources (Smartwaterways, 2010). In order to meet the requirements of its permit, South Burlington must employ a variety of best management practices (BMPs). Educating citizens about the pervasiveness of stormwater and constructing BMPs aimed at reducing pollutant loads are components of the MS4 permit. Since Potash Brook also carries an impairment for contact recreation due to bacteria it is important to consider how BMPs and outreach can work to address each impairment. A TMDL assessment was accepted by EPA for Potash Brook's impairment from stormwater in 2006 (Potash, 2006).

Many wetland acres within the Northern Lake Champlain Basin and within the Potash Brook watershed have been degraded by urbanization and land development activities (VTDEC, 2009). While there are several wetland areas intact within the watershed, there are many areas that are now developed that were once wetland (Stormwater, 1997). Wetlands play a critical role in reducing runoff pollution and help with flood attenuation. Removing wetlands and developing along a streams banks, as seen in the Potash Brook watershed, restricts the brooks access to its natural flood plain. It also converts areas that once played a critical role in filtering runoff, into areas generating polluted stormwater directly adjacent to the brook (VTANR, 2007).

Figure 4 provides an aerial view of Potash Brook as it passes under Interstate 189 and US Rte. 7. This photo shows how close dense development is to the brook. Within the entire Potash Brook watershed, the 100-foot wide buffer adjacent to the stream has over 5 million square feet of impervious surface within it. Therefore, throughout the brooks entire length, the 100-foot buffer area adjacent to the stream is

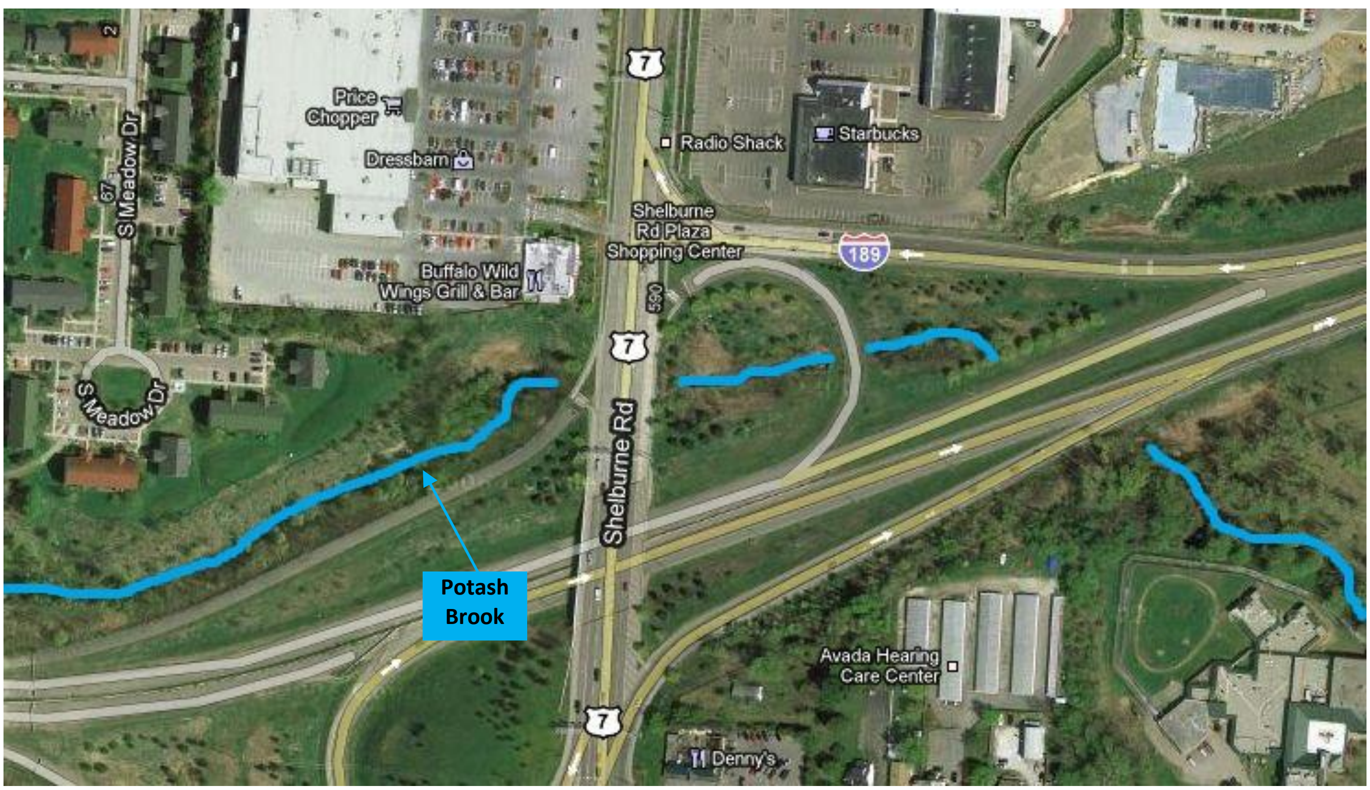

Figure 4: ***Aerial view of Potash Brook in the middle of South Burlington near dense commercial and residential development (Source: Google Maps)***

comprised of over 12% impervious surfaces. In order to help address the multitude of water quality impacts of stormwater, the city of South Burlington created Vermont's first stormwater utility to help provide ongoing stormwater system maintenance, upgrades, and technical support for property owners (SBSU, 2007).

Why is a TMDL needed?

Potash Brook is a Class B, cold water fishery with designated uses including swimming, fishing and boating (VTDEC, 2008). There is a long history of bacterial contamination within the brook, going back to samples taken in 1975 and 1976 (Potash, 1990). More recent samples have been collected from the sampling stations shown in Figure 1 throughout the watershed. Bacteria data from many of these sampling locations have consistently exceeded Vermont's water quality criteria for *E.coli* bacteria. Table 1 below provides bacteria data collected at these sampling locations from 2001 to 2009. The table provides the water quality criteria for *E.coli* bacteria along with the individual sampling event bacteria results and geometric mean concentration statistics for each sampling season on Potash Brook. For Potash Brook, the current single sample water quality criterion is exceeded in nearly half of all sampling events.

Due to the elevated bacteria measurements presented in Table 1, Potash Brook from its outlet to one mile upstream, did not meet Vermont's water quality standards, was identified as impaired and was placed on the 303(d) list. The 303(d) listing states that use of Potash Brook for contact recreation (i.e., swimming) are impaired. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with state water quality standards.

Potential Bacteria Sources

There are many possible sources of bacterial contamination to Potash Brook including: illicit discharges to South Burlington's MS4, stormwater from developed areas, leaking sanitary sewer pipes, and failing septic systems.

South Burlington's Stormwater Services, the city's stormwater utility, attempts to locate illicit discharges to its storm sewer as part of their MS4 permit. Illicit discharges are any discharge to the storm sewer or the brook itself that contains any substances other than stormwater. These discharges can include sanitary sewer pipes from a residence or an under drain from a mechanics garage that are connected into the MS4 (South Burlington, 2009). These discharges have the potential of passing large and dangerous quantities of bacteria (and other pollutants) into the MS4 which can reach Potash Brook at one of the MS4 outfalls on the Brook. These discharges can also be connected directly to the brook. Over the last several years stormwater utility (SWU) staff have located and eliminated multiple illicit discharges to Potash Brook that were contaminating the brook and its tributaries with bacteria (South Burlington, 2008).

SWU staff identify illicit discharges through a variety of methods, including dye testing, sending cameras into storm drains, and stormwater outfall and stream water testing for bacteria. One example of an illicit discharge identified by SWU staff occurred when they were collecting water samples in Potash Brook near the UVM Miller Research Farm. Samples showed elevated levels of bacteria near where the farms treatment wetland discharged into the brook. The outfall pipe was rerouted to empty into the city's sanitary sewer pipe so now the effluent from the wetland goes to the wastewater treatment plant rather than the brook. Follow up testing assured that the problem was the outfall from the wetland, and the problem, at that location, was fixed. Another detection occurred when SWU staff were repairing storm drains on Mill Pond Lane and smelled a foul odor coming from the storm sewer. By using a camera, staff were able to locate where a sanitary sewer line from a single home that was incorrectly connected to the MS4 network and not the sanitary sewer line. Wastewater from this home had been flowing into the MS4 and then directly into Potash Brook untreated for almost 12 years. The homeowner was notified and the pipe was correctly connected to the sanitary sewer. Further monitoring showed that there were no other illicit connections within the neighborhood and the problem was taken care of (South Burlington, 2008).

SWU staff continually found high *E.coli* levels on a small tributary to Potash Brook behind the Grand Union building located at the intersection of Williston and Hinesburg Road. Dye testing showed that one of the floor drains within the meat department was getting piped directly to the stream. The meat waste that was entering the pipe had extremely high levels of *E.coli*. The drain was plugged and the waste is now disposed of properly. Further sampling assured that the problem was fixed (South Burlington, 2008). These are only several examples of the illicit discharges located by SWU staff over the last several years. The presence of these discharges and the elevated levels of *E.coli* associated with them are clear indications that illicit discharges are a likely cause of bacterial contamination to Potash Brook.

Monitoring data for Potash Brook over the years has exhibited a cause and effect relationship between rainfall and bacterial counts. When bacteria levels rise as a result of rain events, as within Potash Brook, contamination from stormwater is a likely source (Stormwater, 1997). There is a multitude of possible sources for bacteria in stormwater. *E. coli* is a bacteria naturally found within the intestinal tract and thus fecal matter of warm blooded animals such as dogs, cows, birds, and humans. Its presence within surface water is a strong indication of fecal matter contamination (USDA, 2000). Therefore, situations where animal waste is not disposed of properly and left near the stream or on impervious surfaces carries the potential of contaminating the brook. Historically, there have been reports of large deer and other road kill on major roadways such as Interstate 89 and 189 within the watershed. A single deer left to decompose in a road ditch or in the woods just off a road could contribute bacteria to the brook. Stormwater running over the land and off the road could carry the bacteria left by the animal through ditching directly to the stream (Stormwater, 1997).

One of the most widely documented and likely sources of *E. coli* in stormwater from urban areas is pet fecal matter, specifically that of dogs. Single and multiple family residential homes are abundant along the banks of Potash Brook. There are also a multitude of storm sewer outfalls on the brook where the city's MS4 discharges stormwater to the brook. If residents are not properly disposing of their pet's fecal matter or not picking fecal matter up from streets where storm drains catch runoff, it can enter and contaminate Potash Brook. This fecal matter can be a major source of bacterial contamination, especially in areas where residential development is so prevalent around the brook (Smartwaterways, 2010).

Most of the residents within the Potash Brook watershed are serviced by a sanitary sewer. The city is serviced by a sanitary sewer carrying wastewater to three treatment plants; Airport Parkway, Bartlett's Bay, and Burlington Main (South Burlington, 2011). There are several locations where the sanitary sewer passes across Potash Brook. If there were to be any leaks within this sewer, the waste from the sewer could enter the brook. Spills and leaks from sanitary sewer systems, and associated high bacteria levels, can pose threats to human health, and can cause ecological damage (Mallin et. al., 2007). Given the proximity of several sewer lines to Potash Brook, leaking sanitary sewer pipes are another potential source of bacterial contamination.

There are some areas of the city that are not serviced by the sanitary sewer. Residents and businesses within these areas rely on on-site septic waste disposal systems to treat their wastewater (South Burlington, 2011). Residential development is close to Potash Brook and its tributaries within these areas. When systems are old, unmaintained, or placed on soils with poor suitability they may malfunction and release high concentrations of bacteria to nearby surface waters (USEPA, 2002). On a tributary, or the brook itself, a single failing septic system that is releasing its waste to the stream could account for high bacteria readings within the water (Potash, 1990). Most of the soils in the areas where residents rely on septic waste disposal are composed of clay. The physical and chemical composition of clay soils pose problems to septic disposal systems (Leduc, 2009). The presence of septic systems close to the brook and its tributaries accompanied with the fact that there are many areas poorly suited for septic waste disposal, makes failing or malfunctioning septic systems another potential source of bacterial contamination.

Recommended Next Steps

The city of South Burlington has taken a proactive approach to dealing with bacterial contamination in Potash Brook. The formation of Vermont's first stormwater utility, Stormwater Services, is a clear indication that South Burlington is working to identify and mitigate problems faced by the brook such as stormwater and illicit discharges. Since 2007 there has been nearly 4.4 million dollars spent on projects related to South Burlington's MS4 network within the Potash Brook watershed (MS4, 2010). The city has also partnered with community organizations, stakeholders, and the other MS4 regulated communities within Vermont (including Burlington) to form the Regional Stormwater Education program (RSEP) in 2003. This collaborative works to encourage residents to become involved in reducing stormwater pollution. While the focus is centered on stormwater's other pollutants and nutrients, the city and its partners have worked to address stormwater related bacterial issues as well (Smartwaterways, 2010). These programs are working to address the problems faced by Potash Brook. Yet, given the long standing water quality problems, the complexity of existing stormwater conveyance systems and the planned future development in the watershed, there is a demonstrated need for continued diligence and ongoing restoration of the Potash Brook watershed (Potash, 2003).

The city of South Burlington, local stakeholders, as well as other community and watershed based groups are encouraged to continue implementing education and outreach programs, restoration programs, and the identification of land use activities that might be influencing *E. coli* levels. Citizens throughout the watershed, especially in residential areas near Potash Brook should be reminded of the importance of picking up after pets. While the MS4 communities in Vermont are already collaborating through RSEP, a focused marketing effort could be made in the greater Burlington area to raise public awareness about bacteria in stormwater. Marketing campaigns and advertisements on TV, in radio, and in print that display in a unique and compelling way the problems associated with improperly disposed of pet waste would be beneficial. In many ways, changing behaviors that increase bacteria loads is the most comprehensive and sustainable approach to bacteria load reduction in an urban stream like Potash Brook. Funds are available to assist communities and organizations with outreach and education from the Non Point Source Grant Program (319 Program), the Lake Champlain Basin Program, and many other nonprofit, governmental, and private organizations.

A great example of an outreach and education effort is the “Scoop the Poop Campaign.” This collaborative effort between Burlington Eco Info and the Burlington Neighborhood Project which started in the early 2000s provides information on how pet waste can impact water quality and can ultimately lead to public health hazards and beach closures (EcoInfo). Efforts that make direct connections between behaviors that are good for streams and recreational activities that people enjoy, such as swimming in Lake Champlain, give educational messages a positive and lasting impact.

There are multiple water quality sampling stations along Potash Brook and its tributaries. However, one limitation of the data on Potash Brook, as indicated in Table 1, is a lack of five or more samples within a one year period at all of the sampling stations. In order for a geometric mean to be calculated and used in decision-making, VT DEC requires five or more samples within the calendar year. Collecting five or more samples at these stations would help to identify which areas of the brook have chronic problems with bacteria. Continued and expanded sampling upstream and downstream of potential sewer leaks and illicit discharges (a practice known as “bracket sampling”) may be beneficial for identifying and quantifying sources. Sampling activities focused on capturing bacteria data under different weather conditions (e.g., wet and dry) may also be beneficial in support of source identification. Field reconnaissance surveys focused on stream buffers, stormwater runoff, and other source identification may also be beneficial.

Previous investigations and concerned groups (Smartwaterways, 2010; CCRPC, 2006; South Burlington, 2009; Potash, 2003) have recommended the following actions to support water quality goals in Potash Brook:

- <u>Stormwater</u> – Continue and expand citizen education about the negative impacts of stormwater, with a focus on the importance of picking up after one’s pet. Continue to hold workshops on new and simple ways to reduce the impact of stormwater from ones property with BMPs such as rain barrels and rain gardens.

- Illicit Discharges, Sewer Leaks, and Septic Malfunction – Expand testing for illicit discharges and continue to educate the public about the located discharges on the Stormwater Services website. Continue to monitor the brook at multiple locations and pay attention to areas where sanitary sewer lines intersect Potash Brook. Educate citizens on proper septic system maintenance and how to make sure their system if functioning properly.
- Land Use Protection **-** Institute controls on development near Potash Brook and focus regulations on reducing stormwater runoff from new or renovated development.
- Riparian Corridor – Encourage landowners to install buffers, and other tools that protect shoreline and/or riparian areas. Continue riparian corridor projects and seek to enhance buffers through a combination of buffer plantings, and land conservation.

Several of the steps outlined above are ongoing and should be continued and enhanced to focus on the goals of bacteria TMDL implementation. If implemented, these actions will provide a strong basis toward the goal of mitigating bacteria sources and meeting water quality standards in Potash Brook.

Bacteria Data

Vermont's current criteria for bacteria are more conservative than those recommended by EPA. For Class B waters, VTDEC currently utilizes an E. coli single sample criterion of 77 organisms/100ml. Although, Vermont is in the process of revising their bacteria WQS to better align with the National Recommended Water Quality Criteria (NRWQC) of a geometric mean of 126 organisms/100ml, and a single sample of 235 organisms/100ml. Therefore, in Table 1 below, bacteria data were compared to both the current VTWQS and the NRWQC for informational purposes.

Potash Brook, entire length (1.4 miles).

***WB ID*: **VT05-11

Characteristics: Class B

Impairment: *E. coli* (organisms/100 mL)

Current Water Quality Criteria for E. coli:

Single sample: 77 organisms/100 mL

NRWQC for E. coli:

Single sample: 235 organisms/100 mL

Geometric mean: 126 organisms/100 mL

Percent Reduction to meet TMDL (Current):

Single Sample: **97%**

Percent Reduction to meet NRWQC:

Single sample: **90%**

Geometric mean: **NA**

Data: 2001 – 2009, VTDEC

Table 1: *E.coli* (organisms/100 mL) Data for Potash Brook (2001-2009) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year.

Station Name	Station Location	Date	Result	Geometric Mean**
PBWQ 1.0	near Kindness Ct.	10/19/2009	16	NA
PBWQ 1.0	near Kindness Ct.	8/27/2009	140	
PBWQ 1.0	near Kindness Ct.	10/17/2007	15	NA
PBWQ 1.0	near Kindness Ct.	9/27/2007	19	
PBWQ 1.0	near Kindness Ct.	11/6/2006	38	NA
PBWQ 1.0	near Kindness Ct.	9/20/2006	326	
PBWQ 1.0	near Kindness Ct.	9/28/2005	276	NA
PBWQ 1.0	near Kindness Ct.	6/11/2002	1046	534
PBWQ 1.0	near Kindness Ct.	5/2/2002	1120	
PBWQ 1.0	near Kindness Ct.	4/25/2002	142	
PBWQ 1.0	near Kindness Ct.	4/14/2002	488	
PBWQ 1.0	near Kindness Ct.	11/27/2001	4	NA
PBWQ 1.0	near Kindness Ct.	10/31/2001	29	
PBWQ 1.8	near Swift St.	10/19/2009	12	NA
PBWQ 1.8	near Swift St.	8/27/2009	150	
PBWQ 1.8	near Swift St.	10/17/2007	9	NA
PBWQ 1.8	near Swift St.	9/26/2007	19	
PBWQ 1.8	near Swift St.	11/6/2006	54	NA
PBWQ 1.8	near Swift St.	9/20/2006	687	
PBWQ 1.8	near Swift St.	9/28/2005	248	NA
PBWQ 1.8	near Swift St.	5/2/2002	517	NA
PBWQ 1.8	near Swift St.	4/25/2002	204	
PBWQ 1.8	near Swift St.	4/14/2002	579	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.

**Only geometric mean values calculated with 5 data points or more are used to determine percent reduction.

Table 1: *E.coli* (organisms/100 mL) Data for Potash Brook (2001-2009) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
PBWQ 3.0	near 189	10/19/2009	5	NA
PBWQ 3.0	near 189	8/27/2009	96	
PBWQ 3.0	near 189	10/17/2007	26	NA
PBWQ 3.0	near 189	9/26/2007	36	
PBWQ 3.0	near 189	11/6/2006	12	NA
PBWQ 3.0	near 189	9/20/2006	225	
PBWQ 3.0	near 189	9/28/2005	186	NA
PBWQ 3.0	near 189	11/27/2001	5	NA
PBWQ 3.0	near 189	10/31/2001	21	
PBWQ 3.5		11/5/2007	NA	NA
PBWQ 3.5		10/17/2007	36	
PBWQ 3.5		11/6/2006	10	NA
PBWQ 3.5		9/20/2006	261	
PBWQ 3.5		9/28/2005	866	NA
PBWQ 4.3	near Winding Brook Dr.	10/19/2009	23	NA
PBWQ 4.3	near Winding Brook Dr.	8/27/2009	140	
PBWQ 4.3	near Winding Brook Dr.	10/17/2007	70	NA
PBWQ 4.3	near Winding Brook Dr.	9/26/2007	52	
PBWQ 4.3	near Winding Brook Dr.	11/6/2006	4	NA
PBWQ 4.3	near Winding Brook Dr.	9/20/2006	80	
PBWQ 4.3	near Winding Brook Dr.	5/2/2002	146	NA
PBWQ 4.3	near Winding Brook Dr.	4/25/2002	1203	
PBWQ 4.3	near Winding Brook Dr.	4/14/2002	260	
PBWQ 6.2	Community Dr. and Kimball Ave.	10/19/2009	10	NA
PBWQ 6.2	Community Dr. and Kimball Ave.	8/27/2009	2400	
PBWQ 6.2	Community Dr. and Kimball Ave.	10/17/2007	41	NA
PBWQ 6.2	Community Dr. and Kimball Ave.	9/26/2007	33	
PBWQ 6.2	Community Dr. and Kimball Ave.	11/6/2006	20	NA
PBWQ 6.2	Community Dr. and Kimball Ave.	9/20/2006	461	
PBWQ 6.2	Community Dr. and Kimball Ave.	9/28/2005	461	NA
PBWQ 6.2	Community Dr. and Kimball Ave.	5/2/2002	17	NA
PBWQ 6.2	Community Dr. and Kimball Ave.	4/25/2002	214	
PBWQ 6.2	Community Dr. and Kimball Ave.	4/14/2002	135	
PBWQ 6.2	Community Dr. and Kimball Ave.	11/27/2001	2	NA
PBWQ 6.2	Community Dr. and Kimball Ave.	10/31/2001	1	
PBWQ Hinesburg Rd	near Hinesbury Rd and Deane St.	10/19/2009	11	NA
PBWQ Hinesburg Rd	near Hinesbury Rd and Deane St.	8/27/2009	120	
PBWQ Hinesburg Rd	near Hinesbury Rd and Deane St.	10/17/2007	41	NA
PBWQ Hinesburg Rd	near Hinesbury Rd and Deane St.	9/26/2007	33	
PBWQ Hinesburg Rd	near Hinesbury Rd and Deane St.	11/6/2006	10	NA
PBWQ Hinesburg Rd	near Hinesbury Rd and Deane St.	9/20/2006	49	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
**Only geometric mean values calculated with 5 data points or more are used to determine percent reduction.

Table 1: *E.coli* (organisms/100 mL) Data for Potash Brook (2001-2009) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
T2 0.1	near Swift St.	10/19/2009	21	NA
T2 0.1	near Swift St.	8/27/2009	280	
T2 0.1	near Swift St.	10/17/2007	38	NA
T2 0.1	near Swift St.	9/27/2007	16	
T2 0.1	near Swift St.	11/6/2006	71	NA
T2 0.1	near Swift St.	9/20/2006	133	
T2 0.1	near Swift St.	9/28/2005	201	NA
T2 0.1	near Swift St.	5/2/2002	326	NA
T2 0.1	near Swift St.	4/25/2002	87	
T2 0.1	near Swift St.	4/14/2002	326	
T3 0.3	near 189 S and Joy Dr.	10/19/2009	68	NA
T3 0.3	near 189 S and Joy Dr.	8/27/2009	150	
T3 0.3	near 189 S and Joy Dr.	10/17/2007	38	NA
T3 0.3	near 189 S and Joy Dr.	9/27/2007	410	
T3 0.3	near 189 S and Joy Dr.	11/6/2006	6	NA
T3 0.3	near 189 S and Joy Dr.	9/20/2006	219	
T3 0.3	near 189 S and Joy Dr.	9/28/2005	365	NA
T3 0.3	near 189 S and Joy Dr.	6/11/2002	2419	1210
T3 0.3	near 189 S and Joy Dr.	5/2/2002	236	
T3 0.3	near 189 S and Joy Dr.	4/25/2002	2419	
T3 0.3	near 189 S and Joy Dr.	4/14/2002	1553	
T3 0.3	near 189 S and Joy Dr.	11/27/2001	1	NA
T3 0.3	near 189 S and Joy Dr.	10/31/2001	12	
T3 1.1		10/17/2007	165	NA
T3 1.1		9/27/2007	110	
T3 1.1		11/6/2006	23	NA
T3 1.1		9/20/2006	921	
T3 1.1		9/28/2005	236	NA
T3 1.1		6/11/2002	2419	1522
T3 1.1		5/2/2002	1414	
T3 1.1		4/25/2002	649	
T3 1.1		4/14/2002	2419	
T3 1.5	near Sherry Rd.	10/19/2009	15	NA
T3 1.5	near Sherry Rd.	8/27/2009	290	
T3 1.5	near Sherry Rd.	10/17/2007	50	NA
T3 1.5	near Sherry Rd.	9/26/2007	150	
T3 1.5	near Sherry Rd.	11/6/2006	12	NA
T3 1.5	near Sherry Rd.	9/20/2006	1740	
T3 1.5	near Sherry Rd.	9/28/2005	727	NA

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
**Only geometric mean values calculated with 5 data points or more are used to determine percent reduction.

Table 1: *E.coli* (organisms/100 mL) Data for Potash Brook (2001-2009) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
T3 1.5	near Sherry Rd.	6/11/2002	613	399
T3 1.5	near Sherry Rd.	5/2/2002	91	
T3 1.5	near Sherry Rd.	4/25/2002	435	
T3 1.5	near Sherry Rd.	4/14/2002	1046	
T3 1.5	near Sherry Rd.	11/27/2001	1	NA
T3 1.5	near Sherry Rd.	10/31/2001	118	
T7 0.1	near Grandview Dr and 89 S	10/19/2009	23	NA
T7 0.1	near Grandview Dr and 89 S	8/27/2009	40	
T7 0.1	near Grandview Dr and 89 S	10/17/2007	4	NA
T7 0.1	near Grandview Dr and 89 S	9/26/2007	816	
T7 0.1	near Grandview Dr and 89 S	11/6/2006	59	NA
T7 0.1	near Grandview Dr and 89 S	9/20/2006	54	
T7 0.1	near Grandview Dr and 89 S	9/28/2005	77	NA
T7 0.1	near Grandview Dr and 89 S	5/2/2002	35	NA
T7 0.1	near Grandview Dr and 89 S	4/25/2002	579	
T7 0.1	near Grandview Dr and 89 S	4/14/2002	86	
T7 0.1	near Grandview Dr and 89 S	12/4/2001	14	NA
T7 0.1	near Grandview Dr and 89 S	11/27/2001	18	
T7 1.0	near Grand Farm Dr.	10/19/2009	9	NA
T7 1.0	near Grand Farm Dr.	8/27/2009	240	
T7 1.4	near Moss Glen Lane	10/19/2009	28	NA
T7 1.4	near Moss Glen Lane	8/27/2009	410	
T9 0.1	near Williston Rd.	10/19/2009	4	NA
T9 0.1	near Williston Rd.	8/27/2009	50	
T9 0.1	near Williston Rd.	10/17/2007	15	NA
T9 0.1	near Williston Rd.	9/26/2007	9	
T9 0.1	near Williston Rd.	11/6/2006	6	NA
T9 0.1	near Williston Rd.	9/20/2006	155	
T9 0.1	near Williston Rd.	9/28/2005	39	NA
T9 0.1	near Williston Rd.	6/11/2002	2419	NA
T9 0.1	near Williston Rd.	5/2/2002	1553	
T9 0.1	near Williston Rd.	4/25/2002	167	
T9 0.1	near Williston Rd.	4/14/2002	1120	
T9 0.1	near Williston Rd.	12/4/2001	2	NA
T9 0.1	near Williston Rd.	11/27/2001	1	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
**Only geometric mean values calculated with 5 data points or more are used to determine percent reduction.

References

CCRPC (2006). Chittenden County Regional Planning Commission. Chittenden County Regional Plan, adopted August, 2006. Available online at: www.ccrpcvt.org/index.asp?Type=B_BASIC&SEC={378E3EB1-84D3-48AD-B30C-26A22DA69B8C}, accessed online on February 14, 2011

East Woods (undated). East Woods: A Piece of the Past. University of Vermont's East Woods Natural Area. Information Sheet. Funded in part by the Federal Highway Administration. Available online at: www.lcbp.org/wayside/PDFS/LC_Byways/East_Woods.pdf, Accessed online on March 16, 2011.

Leduc (2009). The Leduc Farm Landscape, A Natural and Cultural History. Prepared for Common Roots by the 2009 Place Based Landscape Analysis Class at the University of Vermont. Available online at: www.uvm.edu/place/towns/soburlington/LeducDoc.pdf, accessed online on March 16, 2011.

Mallin, et. al. (2007). Mallin, M.A., L.B. Cahoon, B.R. Toothman, D.C. Parsons, M.R. McIver, M.L. Ortwine and R.N. Harrington. 2007. Impacts of a raw sewage spill on water and sediment quality in an urban estuary. Mar. Pollution Bull. 54:81-88

MS4 (2010). Legislative Report of Stormwater Projects Summary. MS4 Municipal Stormwater Projects. Document received from James Pease, Water Quality Division, Vermont Department of Environmental Conservation. Contact: jim.pease@state.vt.us.

Potash (Undated). Stormwater Management on Potash Brook. Information Sheet produced by the South Burlington Stormwater Services.

Potash (1990). Potash Brook, South Burlington, Vermont. Water Pollution Study Preliminary Evaluation. September 4, 1990. Produced for: City of South Burlington. Produced By: Wagner, Heindel, and Noyes, Inc.

Potash (2003). Potash Brook Watershed Restoration Plan South Burlington, Vermont. Final Report. January 27, 2003. Prepared by: Jeffery A. Nelson & Mary M. Nealson, Pioneer Environmental Associates, LLC.

Potash (2006). Total Maximum Daily Load To Address Biological Impairment in Potash Brook (VT05-11) Chittenden County, Vermont. October 2006. Approved by EPA Region 1: December 19, 2006. Prepared by: Vermont Department of Environmental Conservation, Water Quality Division. Available online at: www.anr.state.vt.us/dec//waterq/stormwater/htm/sw_TMDLs.htm, Accessed online on March 16, 2011.

SBSU (2007). South Burlington, Vermont. South Burlington Stormwater Utility. Stream Buffer Report. December 28, 2007. Available online at: www.sburlstormwater.com/downloads/downloads.shtml, Accessed online on March 16, 2011.

Smartwaterways (2010). Chittenden County Regional Stormwater Education Program, Smartwaterways (website). www.smartwaterways.org, last updated in 2010. Accessed online on: March 10, 2011.

South Burlington (2008). City of South Burlington Illicit Discharge Detection & Elimination Program. January 24, 2008. Report Prepared by the South Burlington Stormwater Utility. Available online at: www.sburlstormwater.com/downloads/downloads.shtml, Accessed online on March 16, 2011.

South Burlington (2009). City of South Burlington 2009 Annual Stormwater Report. April 1, 2010. General Permit 3-9014, NPDES # VTR040000. Report prepared by the South Burlington

Stormwater Utility. Available online at: www.sburlstormwater.com/downloads/downloads.shtml, Accessed online on March 16, 2011.

South Burlington (2011). City of South Burlington Comprehensive Plan. South Burlington, Vermont. Adopted by the South Burlington City Council March 9, 2011. Available online at: www.sburl.com/regulations, accessed online on: March 16, 2011.

Stormwater (1997). Parts 1 and 2: Stormwater Assessment. Vermont Department of Environmental Conservation, Water Quality Division.

Tavares et. al. (2009). Tavares, M.D., M.I.H. Spivey, M.R. McIver and M.A. Mallin. 2008. Testing for Optical Brighteners and Fecal Bacteria to Detect Sewage Leaks in Tidal Creeks. University of North Carolina Wilmington, Center for Marine Sciences. Available online at: http://people.uncw.edu/hillj/classes/EVS595/Optical%20brightener%20paper%20for%20NCAS.pdf, accessed online on February 7, 2011.

USDA (2000). Waterborne Pathogen Information Sheet, Principal Pathogens of Concern, *Escherichia coli (E. coli).* United States Department of Agriculture, Natural Resources Conservation Service, Watershed Science Institute. June 2000.

USEPA (2002). Onsite Wastewater Treatment Systems Manual – Office of Water, Office of Research and Development – EPA/625/R-00/008. Available online at: www.epa.gov/owm/septic/pubs/septic_2002_osdm_all.pdf, accessed online on January 27, 2011

VTANR (2007). Lake Champlain Basin Wetland Restoration Plan. December 31, 2007. Prepared for: Vermont Agency of Natural Resources, Vermont Department of Forests, Parks and Recreation, Lake Champlain Clean and Clear Action Plan. Prepared by: Pioneer Environmental Associates, Llc., Arrowwood Environmental, Stone Environmental, Inc., Ice.Nine, Environmental Consulting.

VTDEC (2010). Progress Report on Brook Basin Water Quality Management Planning During 2009. A Report for: House and Senate Committees on Agricultural and Natural Resources and Energy. Prepared by: Vermont Agency of Natural Resources, Department of Environmental Conservation, Water Quality Division, Waterbury, VT. January, 2010

VTDEC (2009). DRAFT Water Quality Management Plan for the Northern Lake Champlain Direct Drainages. Agency of Natural Resources, Department of Environmental Conservation, Water Quality Division. February 2009

VTDEC (2008). State of Vermont, 2008, 303(d) List of Waters, Part A – Impaired Surface Waters in Need of TMDL, October 2008 (Approved by USEPA September 24, 2008). Prepared by: Vermont Department of Environmental Conservation, Water Quality Division, Waterbury, VT.