VERMONT
ENVIRONMENTAL CONSERVATION

Englesby Brook

Watershed Description

This bacteria TMDL summary applies to the entire 1.4-mile reach of Englesby Brook. Englesby Brook flows east to west across south central Burlington before eventually emptying into Lake Champlain in Burlington Bay (Englesby, 2007). The brook's headwaters originate within the Burlington Country Club near the South Burlington town line. Throughout its course the brook flows through dense residential development. The brook itself is entirely within the city of Burlington; however, some of the watershed extends into the northern section of South Burlington. Approximately 84% of the watershed is within Burlington with 16% of the land within the city of South Burlington (USGS, 2000).

Burlington has a population of around 40,000 people and is the largest municipality within Vermont. The drinking water for the city comes directly from Lake Champlain, therefore protecting the lake and the areas that drain directly to it, such as Englesby Brook, is important. Because of its connection to Lake Champlain, Englesby Brook has been listed as a Significant Natural area within Burlington (Burlington, 2006).

The bacteria-impaired segment of Englesby Brook runs for its entire length, from the outlet on Lake Champlain north of Blanchard Beach, upstream to the headwaters within the Burlington Country Club. The Englesby Brook watershed (Figure 1) covers 0.6 square miles, in the towns of Burlington and South Burlington. Overall, land use in the watershed is 20% forested, 4% agricultural, 75% developed, and 1% wetland, as shown in Figure 2 (based on 2006 Land Cover Analysis by NOAA-CSC).

Waterbody Facts (VT05-10)

➢ **Towns:** Burlington

➢ **Impaired Segment Location:** Entire stream length

➢ **Impaired Segment Length:** 1.4 miles

➢ **Classification:** Class B

➢ **Watershed Area:** 0.6 square miles

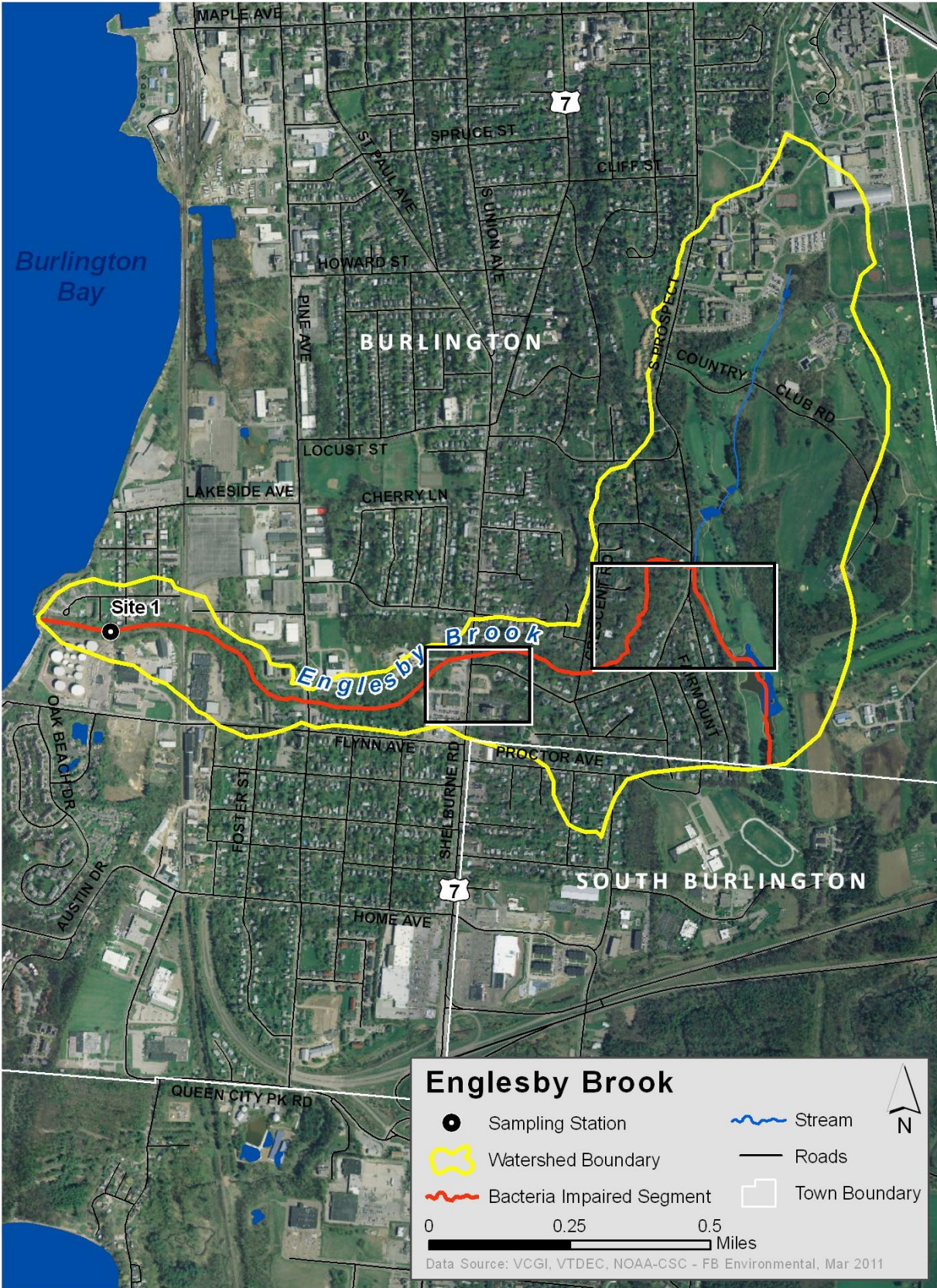➢ **Planning Basin:** 5 – Northern Lake Champlain

Figure 1: *Map of Englesby Brook watershed with impaired segment and sampling stations indicated. Insert areas correspond to figures 3 and 4 below.*
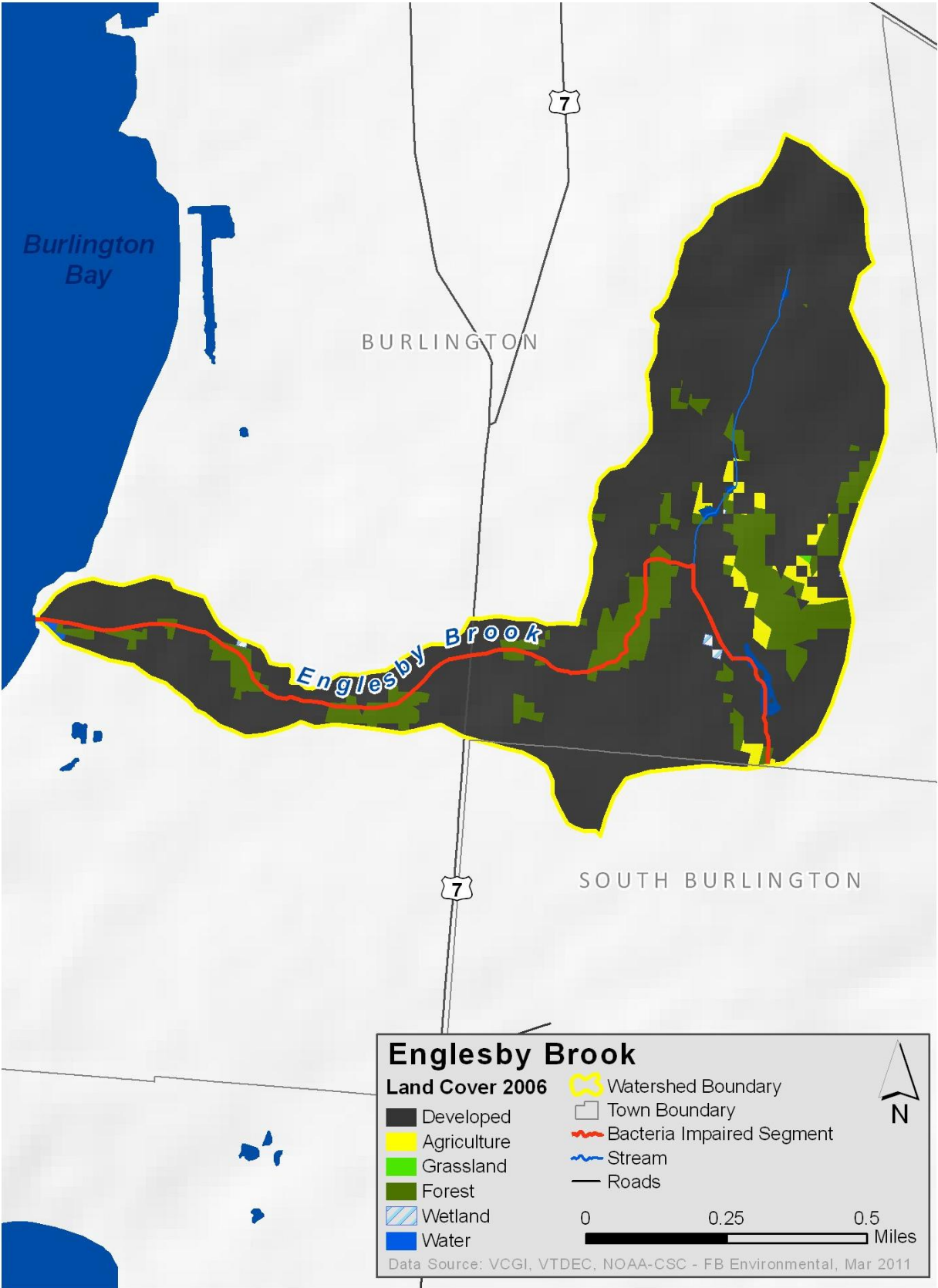
Figure 2: *Map of Englesby Brook watershed with impaired segment and land cover indicated.*

Figure 3: *Aerial view of Englesby Brook near its headwaters within the Burlington Country Club (Source: Google Maps).*

Figure 3 provides a more detailed aerial view of Englesby Brook near its headwaters. The stream leaves the golf course impoundment pictured above before it flows west through dense residential development. The primary type of development within the watershed is single family residential with other significant development types being commercial development along the Shelburne Road corridor with some industrial areas located in the lower portion of the watershed (Englesby, 2007). Englesby Brook receives a stormwater runoff 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). Englesby Brook is considered a stormwater impaired stream, in addition to being impaired for bacterial contamination. The stormwater impairment is based on the negative impact that stormwater has on aquatic life such as macro invertebrates. Much of the stormwater that reaches the brook is carried within municipally-owned drainage networks called storm sewers (Englesby, 2007). Due to the amount of development within the city of 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, 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. Nutrients such as phosphorous and nitrogen as well as pollutants such as metals are generally the focus of stormwater BMPs. Bacteria is not generally a pollutant of focus for constructed stormwater BMPs. However, many of the BMP treatment systems aimed at treating Englesby Brook's stormwater impairment have been shown to reduce bacteria as well (Blanchard, 2007). Therefore, better citizen understanding of the problems caused by stormwater and targeted stormwater BMPs can have a positive impact on bacterial impairment even though their focus may be Englesby Brook's other impairment: stormwater. A TMDL assessment was accepted by EPA for Englesby Brook's stormwater impairment in 2007 (Englesby, 2007).

Many wetland acres within the Northern Lake Champlain Basin and within the Englesby Brook watershed have been degraded by urbanization and land development activities. Burlington only has 600 acres of wetlands remaining, as most of the wetland areas within the city have been filled in for development (Burlington, 2006). Wetlands play a critical role in reducing runoff pollution and help with flood attenuation. Removing wetlands and developing along a stream's bank, as seen in the Englesby Brook watershed, restricts the brooks access to its natural flood plain and 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 Englesby Brook around 0.7 miles up from its confluence with Lake Champlain. This photo shows that there is development directly on the stream bank and within what was once the brook's natural flood plain.

Figure 4: *Aerial view of Englesby Brook near some commercial development along the Shelburne Road. Corridor (Source: Google Maps)*

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Why is a TMDL needed?

Englesby Brook is a Class B, cold water fishery with designated uses including swimming, fishing and boating (VTDEC, 2008). Since 2005 samples have been collected year round from the sampling station shown in Figure 1 near the brooks outlet. Bacteria data from sampling location 4282815 has consistently exceeded Vermont's water quality criteria for *E.coli* bacteria. Table 1 below provides bacteria data collected at this sampling location from 2005 to 2009. Table 1 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 Englesby Brook. For Englesby Brook, Vermont's current water quality criterion was exceeded in nearly three quarters of the sampling events.

Due to the elevated bacteria measurements presented in Table 1, Englesby Brook for its entire course, 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 Englesby 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 several likely sources of bacterial contamination to Englesby Brook. These sources include; stormwater runoff from developed areas, leaking sanitary sewer pipes, combined sewer overflows, and illicit discharges to Burlington's MS4.

The increased bacteria readings found within Englesby Brook are water-related problems characteristic of urbanizing and urbanized areas. An increase in the amount of impervious surfaces results in an increase in stormwater runoff to waterbodies(USGS, 2000). Blanchard Beach, which is a city owned swimming beach on Burlington Bay was closed to swimming between 1992 and 2007 due to dangerously high *E. coli* levels recorded at the beach. Englesby Brook outlets into Lake Champlain just to the north of Blanchard Beach. It is believed that bacteria readings were high at the beach due to Englesby Brook and readings within the brook were high due to stormwater runoff (Blanchard, 2007). Since 2007 nearly $1.6 million has been spent on MS4 municipal projects within the Englesby Brook watershed to reduce the impact of stormwater (MS4, 2010). It is culturally and economically important for Burlington to have clean water in Englesby Brook (Burlington, 2006).

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 (CCRPC, 2006). Its presence within surface water is a strong indication of fecal matter contamination. Testing for *E. coli* helps to indicate the presence of other water borne fecal pathogens that can pose serious threats to human health (USDA, 2000). One of the most widely documented and likely source 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 Englesby 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 Englesby 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).

All of the residents within the Englesby Brook watershed are serviced by the city's sanitary sewer. Over 98% of Burlington is serviced by one of the three waste water treatment facilities within the city (Burlington, 2006). If there were to be any leaks within this sewer in Englesby Brook's watershed, the waste from the sewer, containing potentially high levels of bacteria, could enter the brook. Spills and leaks from sanitary sewer systems can pose threats to human health from high bacteria levels, and can cause ecological damage (Mallin et. al., 2007). In order to detect leaks within the sewer, Burlington's Wastewater Division (WD) of its Public Works Department dye tests, with optical brighteners, the sanitary sewer lines that cross rivers and streams within the city twice a year (Burlington, 2009).

One way of determining if there is a leak in a sanitary sewer is to test for optical brighteners. These chemicals are added to laundry detergents to make whither whites and brighter colors. Optical brighteners give off fluorescence in their excited state when light from specific ranges of the spectrum are shined on them. Water from washing machines is carried from homes and businesses in the sanitary sewer. If leaking sanitary sewers are suspected, the presence of optical brighteners, from dye testing or from laundry detergent, is one indication that leaks are present (Tavares et. al., 2009).

During 2009 when testing the sewer crossings on Englesby Brook the WD decided to test an apparently abandoned manhole within the stream channel located downstream of the Pine Street crossing. The manhole tested positive for optical brighteners and further *E. coli* testing showed very high counts. Through further investigations, including smoke testing, the WD found that there was a single property on Pine Street that had its sewer connected to the manhole and the presumed abandoned manhole was actually connected to the city's sanitary sewer (Burlington, 2009). No leak in the manhole pipe was found, but the WD had no prior knowledge of a sanitary sewer connection to the manhole, if it was continued to be presumed abandoned and fell into disrepair, a leak would have passed raw sewage directly to the brook, since the manhole was directly over the stream channel. This finding indicates how important testing for these leaks is when attempting to locate potential bacteria sources. Much of the sanitary sewer infrastructure within Burlington is over 50 years old and the most feasible way to ensure it is functioning properly is continued testing by Burlington's WD (BPW, 2006). Given the proximity of several sewer lines to Englesby Brook and the age of much of the infrastructure, leaking sanitary sewer pipes are another potential source of bacterial contamination.

Historically, municipalities did not have completely separated storm sewers; they had what are referred to as combined sewers. Some of the storm sewer pipes were tied into the sanitary sewer pipes and all of the water and waste carried therein ended up at the wastewater treatment plants. The problem with this design is that during high flow storm events the treatment plants could not handle the volume of water coming in

from the combined sewers (BPW, 2006). In these cases, in order to reduce the volume flowing to the treatment plant, combined sewer overflows (CSOs) were in place on surface waters. This meant that during high flows there would be outfalls on the brook where raw and untreated sewage, and associated bacteria, would enter the surface water. Over the last several decades, the city has separated the combined sewers in the northern and southern sections of the city but due to dense development in the downtown area, that portion of the sewer system remained combined. To compensate for this the capacity at the main treatment facility was significantly expanded to treat stormwater runoff in addition to normal sewer flows (Burlington, 2006). However, there are currently no CSOs discharging to Englesby Brook.

Burlington periodically checks for illicit discharges to its storm sewer as part of their MS4 permit. Illicit discharges are any discharge to the storm sewer 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, examples of a "direct discharge." They can also include a leaking sanitary sewer pipe that is leaking its contents into the MS4, an example of an "indirect discharge" (Burlington, 2009). Both types of discharges have the potential of passing large and dangerous quantities of bacteria (and other pollutants) into the MS4 which can eventually reach Englesby Brook at one of the eight MS4 outfalls on the brook (IDDE, 2008). In 2005 when checking the MS4 for illicit discharges using optical brightener testing, the city came across an illicit discharge on Englesby Brook. This was the result of a leaking sanitary sewer pipe near the MS4. The city installed a new manhole and fixed the problem quickly, while further *E. coli* sampling confirmed the discharge had been eliminated (IDDE, 2008). While this discharge was found and eliminated, illicit discharges remain a potential source of bacterial contamination to Englesby Brook.

Recommended Next Steps

The city of Burlington has in the effort to improve the water quality of Englesby Brook. The city established a dedicated stormwater program in 2009 and now all properties that have impervious surfaces pay a small user fee which is used to help improve stormwater management throughout Burlington (Stormwater, 2010). The city partnered with community organizations, stakeholders, and the other MS4 regulated communities within Vermont (including South Burlington) to form the Regional Stormwater Education program (RSEP) in 2003. This collaborative encourages residents to get personally involved in reducing stormwater pollution. While the focus has been 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). Over the years, Burlington has also partnered with companies such as the Green Mountain Power Corporation, governmental organizations such as the USGS and EPA (Medalie, 2007), national non profits such as the Center for Watershed Protection, and local stakeholders such as the Lake Champlain Committee and the University of Vermont, to tackle the multitude of problems Englesby Brook faces. While there have been signs that the water quality of the brook has improved over time, there is still much work to be done (Blanchard, 2007).

The city of Burlington, local stakeholders, as well as other community and watershed based groups are encouraged to continue implementing education, outreach and restoration programs, and identifying land use activities that might be contributing to *E. coli* levels. Citizens throughout the watershed, especially in residential areas near Englesby 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. 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.

Additional bacteria data collection would be beneficial to support identification of sources of potentially harmful bacteria in the Englesby Brook watershed. There is currently only one sampling station on Englesby Brook. It is recommended that USGS or the city of South Burlington implement sampling at several other locations along the brook's course. An additional station at Shelburne Street (US Rte. 7) and an additional station at the outlet of the golf course would provide adequate coverage of the three distinct sections of the watershed: upper reach in the golf course, the central reach in primarily residential areas, and the lower reach in commercial development. More than one point of reference would be beneficial for locating areas and land uses that contribute large loads of bacteria to the brook. Additional sampling locations would allow for education, outreach, and mitigation efforts to focus on portions of the watershed contributing the largest loads of bacteria. Also, 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; Blanchard, 2007; Burlington, 2006; Burlington, 2009) have recommended the following actions to support water quality goals in Englesby Brook:

➢ Stormwater – 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, CSOs, and Sewer Leaks – Expand testing for illicit discharges using the knowledge gained over the last five years of testing.

➢ Land Use Protection - Institute controls on development near Englesby 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 Englesby 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.

Englesby Brook, entire length (1.4 miles).

WB ID: VT05-10

Characteristics: Class B

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

Current Water Quality Criteria for E. coli:	*NRWQC for E. coli:*
Single sample: 77 organisms/100 mL	Single sample: 235 organisms/100 mL
	Geometric mean: 126 organisms/100 mL

Percent Reduction to meet TMDL (Current):	*Percent Reduction to meet NRWQC:*
Single Sample: **97%**	Single sample: **90%**
	Geometric mean: **53%**

Data: 2005 – 2009, USGS

Table 1: *E.coli* (organisms/100 mL) Data for Englesby Brook (2005-2009) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year.

Station Name	Station Location	Date	Result	Geometric Mean**
4282815		10/15/09	290	NA
4282815		5/20/09	210	
4282815		3/16/09	3	
4282815		12/15/08	1600	191
4282815		10/16/08	2400	
4282815		9/16/08	220	
4282815		5/22/08	100	
4282815		3/13/08	3	
4282815		11/15/07	820	268
4282815		11/14/07	100	
4282815		10/15/07	190	
4282815		7/16/07	210	
4282815		4/16/07	2400	
4282815		3/27/07	47	
4282815		12/14/06	68	158
4282815		11/15/06	200	
4282815		10/16/06	330	
4282815		8/15/06	550	
4282815		7/17/06	610	
4282815		6/14/06	66	
4282815		5/15/06	730	
4282815		4/17/06	88	
4282815		3/15/06	14	
4282815		12/5/05	110	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.

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