VERMONT
ENVIRONMENTAL CONSERVATION

Allen Brook

Watershed Description

This bacteria TMDL summary applies to 4.6-mile segment of Allen Brook, an approximately 10-mile long stream located entirely in the Town of Williston in Chittenden County (Figure 1). The headwaters of the stream flow in a northerly direction through sparsely developed and forested land until it intersects Interstate Route 89. North of the Interstate, the stream flows in a westerly and then a northerly direction through areas of significant residential, commercial and industrial land uses (VTDEC, 2008a). Allen Brook flows into Muddy Brook just before it enters the Winooski River, which flows to Lake Champlain (Barg et al., 2003).

Allen Brook is a low to moderate gradient stream (VTDEC, 2008a), with an average gradient of 1% (Barg et al., 2003). Topographic relief in the watershed is low with the highest point at 908 feet above sea level and the lowest point at 210 feet. The stream's eight tributaries are mostly ephemeral, with drainage areas generally less than one square mile (Barg et al., 2003). A notable stream feature is the Allen Brook Cascades which are 200 feet long and drop a total of 20 feet (VTANR, 2008).

The watershed drains an increasingly developed landscape on formerly agricultural lands. The Town of Williston has experienced rapid growth with a 57% increase in population between 1990 – 2000, making it the fast growing community in Vermont (Barg et al., 2003). Increases in impervious cover and man-made drainage infrastructure, and loss of wetlands in the Allen Brook watershed have impacted the stream's hydrologic regime in the lower and middle reaches of the watershed (Fitzgerald, 2008). Increased development results in increased impervious areas, leading to increased stormwater runoff which picks up pollutants such as sediments, nutrients, heavy metals and bacteria.

Waterbody Facts (VT08-02)

- **Town:** Williston
- **Impaired Segment Location:** From River Cove Rd. upstream to Route 2
- **Impaired Segment Length:** 4.6 miles
- **Classification:** Class B
- **Watershed Area:** ~ 11 square miles
- **Planning Basin:** 8-Winooski River

The Allen Brook watershed contains a mixture of land uses (Figure 2) including significant amounts of agricultural land (mostly in the upper watershed), and large, contiguous areas of forest land in the southern portions of the watershed south of Interstate 89. Overall, land use in the watershed is 41% forested, 38% agricultural, 14% developed, and 4% wetland and water (Based on 2006 Land Cover Analysis by NOAA-CSC). The developed land is largely attributed to residential development and transportation related uses (Fitzgerald, 2008). Impervious cover in the watershed is considered low to moderate at 7.4% (Fitzgerald, 2007).

Biological monitoring data (macroinvertebrate and fish) indicate that the principal aquatic life and habitat impairment in Allen Brook stems from excess sediment, nutrient enrichment, high temperatures, habitat alterations from stormwater runoff from developed areas, erosion, and lack of streambank vegetation (VTANR, 2008). The bacteria impaired segment extends from the mouth of Allen Brook, upstream to Route 2 and is believed to be the result of *E. coli* numbers above state standards due to stormwater runoff, occasional malfunctioning septic systems and beaver (VTANR, 2008). There are eleven sampling stations in Allen Brook (Figure 1) including three within the impaired segment (Figure 3).

Previous efforts to restore the water quality in Allen Brook have focused on identifying the sources of these impairments. Major components of these studies include a geomorphic assessment (Fitzgerald, 2006) and stressor analysis (Fitzgerald, 2008) which led to the identification of 21 unique restoration projects. The assessment found that in the absence of pervasive beaver impacts, current day stressors like urbanization appear to dominate in the lower portion of Allen Brook in addition to historic impacts from flood plain encroachment, road crossings, and agricultural impacts in the lower watershed (VTANR, 2008).

Example of a restoration project to replace bridges at River Cover Rd. (Source: Fitzgerald, 2008)

A hydrologically-based Total Maximum Daily Load (TMDL) was developed in 2008 to address the biological impairments in the stream (VTDEC, 2008a). The major focus of the TMDL is to address stormwater runoff, the report describes how mitigation of this runoff will help reduce the impacts of other pollutants of concern in the watershed, including sediments, nutrients, heavy metals, and fecal bacteria.

Despite these studies, little information is available to characterize the extent of the *E. coli* bacteria monitoring data in the stream.

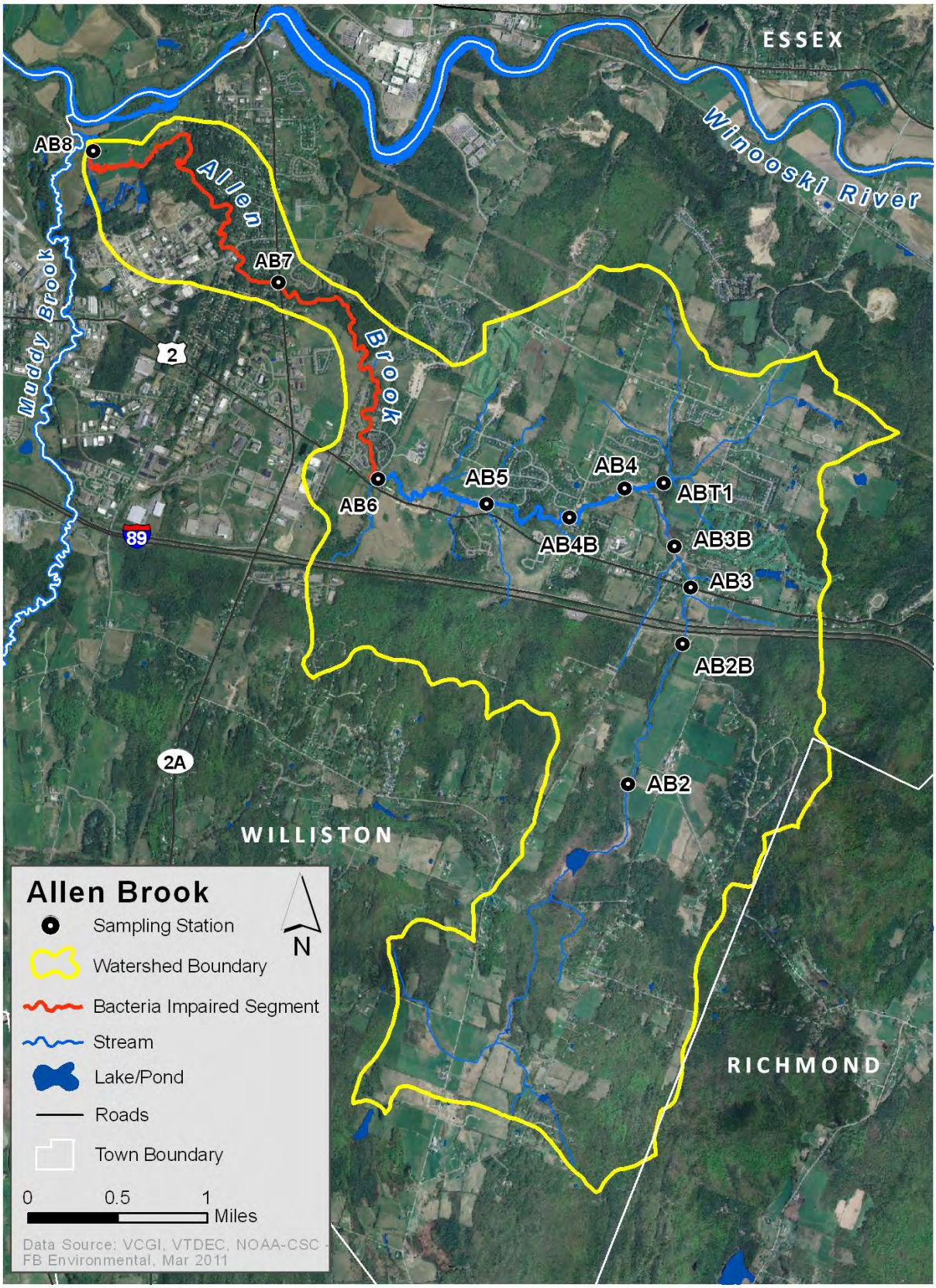

Figure 1: ***Map of the Allen Brook watershed with impaired segment and sampling stations indicated.***

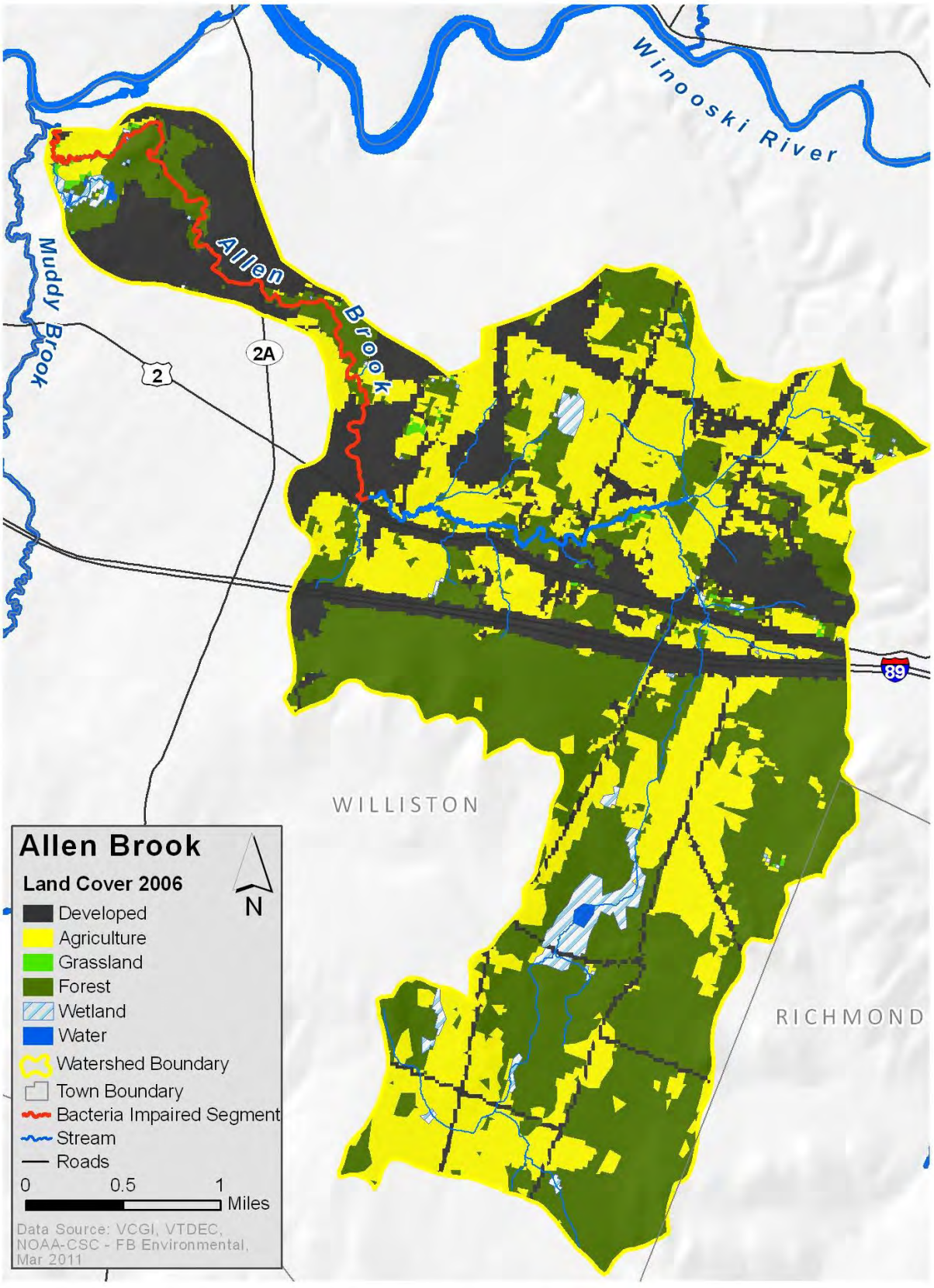

Figure 2: ***Map of the Allen Brook watershed with impaired segment and land cover indicated.***

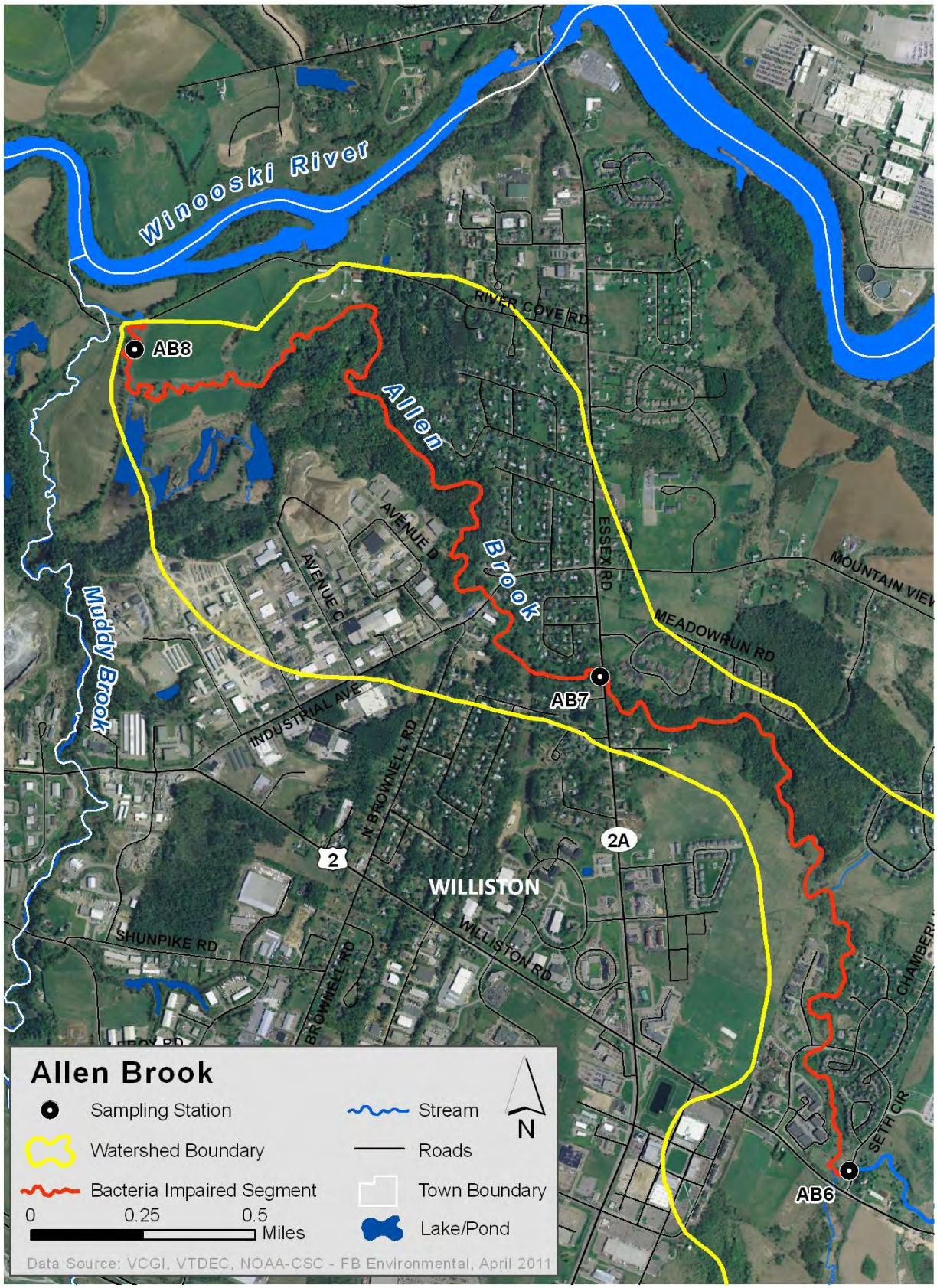

Figure 3: ***Map of the downstream reach of Allen Brook with impaired segment and sampling locations indicated.***

Why is a TMDL needed?

Both historic and recent beaver activity has been recorded in Allen Brook (Photo: Fitzgerald, 2006)

Allen Brook is a Class B, cold water fishery with designated uses including swimming, fishing and boating (VTDEC, 2008b). In the summer of 2007, 2008 and 2010, the Williston Conservation Commission partnered with the LaRosa Environmental Laboratory to collect and analyze water samples on Allen Brook. Bacteria data from the downstream sampling locations (AB6, AB7 and AB8) were used to determine percent reductions needed for the impaired segment. These sites consistently exceed Vermont's water quality criteria for *E.coli* bacteria. Tables 1-3 (below) provide bacteria data collected at these downstream sampling locations in 2007 and 2008, as well as the water quality criteria for *E. coli* bacteria and the individual sampling event bacteria results and geometric mean concentration statistics for each sampling season at each station. Station AB6, at the Route 2 road crossing exceeded bacteria standards in all but two sampling events in 2007, and all but one event in 2008 (Table 1). AB7 exhibited high levels of bacteria and numerous exceedances throughout the sampling period, but had the lowest incidences of exceedances of the three stations and did not exceed the geometric mean standard in 2007 (Table 2). Station AB8 at the River Cove Rd. exceeded standards in all sampling events in 2007, and all but one sampling event in 2008, and exceeded the geometric mean standard in both years (Table 3).

Due to the elevated bacteria measurements presented in Tables 1-3 (below), Allen Brook, from upstream of the River Cove Rd. crossing, upstream 4.6 miles to the Route 2 crossing did not meet Vermont's water quality standards, and was identified as impaired and placed on the 303(d) list (VTDEC, 2008c). The 303(d) listing states that use of Allen Brook for contact recreation (i.e., swimming) is 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

Bacterial contamination in streams of urbanizing watersheds can be the result of a variety of sources. These sources include: illicit sewer connections; sewer line leaks; septic systems; urban stormwater runoff; and animal waste including wildlife, agriculture and pets.

As of November 2007, there were 135 stormwater discharges to Allen Brook and its tributaries (VTANR, 2008). Urban stormwater runoff is typically considered a significant source of bacteria during wet weather, as is contamination from wildlife and domesticated animals (including pet waste). Bacteria

loading problems during dry weather can be linked to illicit sewer connections and sewer-line breaks, or wildlife, since the loadings are independent of runoff from storm events.

Despite major losses of agricultural land to rural residential and suburban development in the Allen Brook watershed, five important farms in the Town of Williston are still operational (Williston, 2006). The close proximity of agricultural land to Allen Brook and its tributaries make management of agricultural land important in order to limit bacteria contributions to the stream. The land use analysis for Allen Brook estimates that 38% of the watershed area (4 sq. miles or 2,573 acres) is used for agriculture. The watershed study for Allen Brook (Fitzgerald, 2007) recommends fencing along the stream to exclude grazing animals from the stream channel and riparian buffer plantings to stabilize stream banks in several stream reaches including approximately 1500 linear feet for channel near the intersection of South Rd. and East Hill Road. Manure management and manure spreading, livestock exclusions including fencing, and adequate bridge and culvert crossings for livestock are examples of management practices that can be used to limit the impacts from agriculture in the watershed.

Wildlife, including beaver, which have been documented throughout the stream (Fitzgerald, 2006) are a potential source of bacterial contamination in Allen Brook.

Recommended Next Steps

As described above, the recently developed TMDL (VTDEC, 2008a) to address biological impairments in Allen Brook focuses on reducing the effects of urban stormwater runoff in the watershed. Implementation of stormwater controls within the Allen Brook watershed should result in quantifiable improvements in bacterial loading. The Town of Williston has been proactive in developing a Stormwater Management Plan to address stormwater discharges, developing a regional stormwater education and community outreach program, and a water quality monitoring program. The town also has a stream buffer program which has resulted in revegetation of buffers along the Allen Brook stream corridor. Despite these efforts a separate and specific investigation as to the specific sources of high bacteria levels in Allen Brook is required in order to fully assess these impacts.

Additional bacteria data collection will be beneficial to support identification of sources of potentially harmful bacteria in the Allen Brook watershed, and to determine if improved management practices, or changes in ownership changes of contributing farmland has improved conditions in the stream. Sampling upstream and downstream of known stormwater discharges and agricultural sources (a practice known as “bracket sampling”) may be beneficial for identifying and quantifying sources. Ongoing sampling focused on capturing bacteria data under different weather conditions (e.g., wet and dry) will also be beneficial in support of source identification. Microbial source tracking (MST) studies can be conducted to differentiate sources of bacteria among wildlife types. Wildlife sources do not require mitigation because they are “natural sources”, however, many best management practices (BMPs) designed to disconnect stormwater runoff from Allen Brook will also reduce wildlife source contributions (FBE, 2010).

Illicit Discharge Detection & Elimination (IDDE) Investigations are useful for removing bacteria sources from stormdrain networks and identifying illicit (i.e., unlawful) sewage sources. An IDDE investigation requires starting at an outfall where presence of bacteria is known to exist, and working up gradient to identify and isolate source(s) of bacteria. Several different investigative tools can be used for these surveys including: stormdrain network reconnaissance, inventory and mapping; bracket sampling; optical brightener surveys, and television surveys.

Previous investigations (Barg et al., 2003; Fitzgerald 2006, 2007, 2008; VTANR 2008; VTDEC 2008a) have recommended actions to support water quality goals in Allen Brook with a focus on reducing stormwater runoff and sediment. Below are a few of the major objectives:

- Reduce overall pollutant loading (emphasis on sediment) from urban/developed land by installing stormwater controls, issuance of a watershed-wide general permit, upgrade of existing stormwater treatments, development of a stormwater utility, routine street sweeping and catch basin cleaning, improved stormwater ordinances.
- Reduce runoff from agricultural land by expanding the CRP program to create easements on farms along the streams for buffer implementation, provide technical assistance to farmers with BMPs including nutrient management, and livestock exclusion.
- Improve riparian buffers by increasing land in conservation easements, expanding buffers beyond 150' to include all tributaries, ephemeral, intermittent and perennial, and through riparian revegetation projects.

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 help provide a strong basis toward the goal of mitigating bacteria sources and meeting water quality standards in Allen 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.

Allen Brook, from River Cove Rd. upstream 4.6 miles to Route 2

***WB ID*:** VT08-02

Characteristics: Class B

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

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: **59%**

Data: 2007-2008, Williston Conservation Commission, VTDEC

Table 1: *E.coli* (organisms/100 mL) Data for Allen Brook (2007-2008) and Geometric Mean (organisms/100mL) for Station AB6 based on Calendar Year.

Station Name	Station Location	Date	Result	Geometric Mean**
AB6	Talcott Road East	9/29/2008	50	269
AB6	Talcott Road East	9/22/2008	96	
AB6	Talcott Road East	9/15/2008	248	
AB6	Talcott Road East	9/8/2008	127	
AB6	Talcott Road East	8/25/2008	131	
AB6	Talcott Road East	8/18/2008	236	
AB6	Talcott Road East	8/11/2008	122	
AB6	Talcott Road East	8/4/2008	457	
AB6	Talcott Road East	7/28/2008	132	
AB6	Talcott Road East	7/21/2008	816	
AB6	Talcott Road East	7/14/2008	2420	
AB6	Talcott Road East	7/7/2008	299	
AB6	Talcott Road East	6/30/2008	365	
AB6	Talcott Road East	6/23/2008	2420	
AB6	Talcott Road East	6/16/2008	313	
AB6	Talcott Road East	6/9/2008	137	

**Shaded cells indicate geometric mean and single sample values used to determine percent reduction.*
***Geometric mean used to calculate % reduction has no fewer than 5 data points.*

Table 1 cont.: *E.coli* (organisms/100 mL) Data for Allen Brook (2007-2008) and Geometric Mean (organisms/100mL) for Station AB6 based on Calendar Year.

Station Name	Station Location	Date	Result	Geometric Mean**
AB6	new Fire Station	9/25/2007	649	305
AB6	new Fire Station	9/18/2007	1050	
AB6	new Fire Station	9/11/2007	299	
AB6	new Fire Station	8/28/2007	60	
AB6	new Fire Station	8/21/2007	21	
AB6	new Fire Station	8/14/2007	79	
AB6	new Fire Station	8/7/2007	2420	
AB6	new Fire Station	7/31/2007	326	
AB6	new Fire Station	7/24/2007	151	
AB6	new Fire Station	7/17/2007	248	
AB6	new Fire Station	7/10/2007	2420	
AB6	new Fire Station	7/2/2007	99	
AB6	new Fire Station	6/26/2007	249	
AB6	new Fire Station	6/19/2007	308	
AB6	new Fire Station	6/12/2007	579	
AB6	new Fire Station	6/5/2007	866	

**Shaded cells indicate geometric mean and single sample values used to determine percent reduction.*
***Geometric mean used to calculate % reduction has no fewer than 5 data points.*

Table 2: *E.coli* (organisms/100 mL) Data for Allen Brook (2007-2008) and Geometric Mean (organisms/100mL) for Station AB7 based on Calendar Year.

Station Name	Station Location	Date	Result	Geometric Mean**
AB7	Route 2A	9/29/2008	276	207
AB7	Route 2A	9/22/2008	34	
AB7	Route 2A	9/15/2008	172	
AB7	Route 2A	9/8/2008	55	
AB7	Route 2A	8/25/2008	72	
AB7	Route 2A	8/18/2008	86	
AB7	Route 2A	8/11/2008	206	
AB7	Route 2A	8/4/2008	411	
AB7	Route 2A	7/28/2008	347	
AB7	Route 2A	7/21/2008	866	
AB7	Route 2A	7/14/2008	2420	
AB7	Route 2A	7/7/2008	27	
AB7	Route 2A	6/30/2008	144	
AB7	Route 2A	6/23/2008	2420	
AB7	Route 2A	6/16/2008	236	
AB7	Route 2A	6/9/2008	150	
AB7	Route 2A	9/25/2007	2	70
AB7	Route 2A	9/18/2007	11	
AB7	Route 2A	9/11/2007	21	
AB7	Route 2A	9/4/2007	39	
AB7	Route 2A	8/28/2007	24	
AB7	Route 2A	8/21/2007	32	
AB7	Route 2A	8/14/2007	102	
AB7	Route 2A	8/7/2007	1550	
AB7	Route 2A	7/31/2007	65	
AB7	Route 2A	7/24/2007	125	
AB7	Route 2A	7/17/2007	186	
AB7	Route 2A	7/10/2007	2420	
AB7	Route 2A	7/2/2007	25	
AB7	Route 2A	6/26/2007	35	
AB7	Route 2A	6/19/2007	131	
AB7	Route 2A	6/12/2007	32	
AB7	Route 2A	6/5/2007	866	

**Shaded cells indicate geometric mean and single sample values used to determine percent reduction.*
***Geometric mean used to calculate % reduction has no fewer than 5 data points.*

Table 3: *E.coli* (organisms/100 mL) Data for Allen Brook (2007-2008) and Geometric Mean (organisms/100mL) for Station AB8 based on Calendar Year.

Station Name	Station Location	Date	Result	Geometric Mean**
AB8	River Cove Rd	9/29/2008	144	244
AB8	River Cove Rd	9/22/2008	86	
AB8	River Cove Rd	9/15/2008	461	
AB8	River Cove Rd	9/8/2008	135	
AB8	River Cove Rd	8/25/2008	147	
AB8	River Cove Rd	8/18/2008	117	
AB8	River Cove Rd	8/11/2008	62	
AB8	River Cove Rd	8/4/2008	411	
AB8	River Cove Rd	7/28/2008	137	
AB8	River Cove Rd	7/21/2008	1733	
AB8	River Cove Rd	7/14/2008	2420	
AB8	River Cove Rd	7/7/2008	79	
AB8	River Cove Rd	6/30/2008	122	
AB8	River Cove Rd	6/23/2008	2420	
AB8	River Cove Rd	6/16/2008	260	
AB8	River Cove Rd	6/9/2008	131	
AB8	River Cove Rd	9/25/2007	150	198
AB8	River Cove Rd	9/18/2007	113	
AB8	River Cove Rd	9/11/2007	172	
AB8	River Cove Rd	9/4/2007	91	
AB8	River Cove Rd	8/28/2007	131	
AB8	River Cove Rd	8/21/2007	84	
AB8	River Cove Rd	8/14/2007	186	
AB8	River Cove Rd	8/7/2007	1300	
AB8	River Cove Rd	7/31/2007	91	
AB8	River Cove Rd	7/24/2007	114	
AB8	River Cove Rd	7/17/2007	93	
AB8	River Cove Rd	7/10/2007	2420	
AB8	River Cove Rd	6/26/2007	147	
AB8	River Cove Rd	6/19/2007	119	
AB8	River Cove Rd	6/12/2007	248	
AB8	River Cove Rd	6/5/2007	770	

**Shaded cells indicate geometric mean and single sample values used to determine percent reduction.*
***Geometric mean used to calculate % reduction has no fewer than 5 data points.*

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