VERMONT
ENVIRONMENTAL CONSERVATION

The Mad River

Watershed Description

This bacteria TMDL summary applies to a 6.2-mile reach of the Mad River, a 26 mile long river in central Vermont (Field, 2007). The Mad River originates in Granville Notch in the Green Mountain National Forest and ends at its confluence with the Winooski River in Moretown (VANR, 2008). The river's course takes it due north as it flows through a deep valley, flanked by the Green Mountains to the west and the Northfield Mountains to the east (VGS, 2006). Along its northern course there are multiple named and unnamed tributaries that enter the Mad River. The steeped walled basin includes historic villages, ski resorts, agricultural lands and 4,000 foot high peaks (Field, 2007).

The popular ski areas of Sugarbush and Mad River Glenn are both located in the Mad River watershed. The main stem of the Mad River is characterized by an alternating pattern of rocky gorges, sinuous meanders, and broad floodplains. The valley bottom has both agricultural lands and urbanized areas while the upland reaches of the watershed have steep slopes and cascading streams (Field, 2007). These characteristics make the Mad River and the Mad River Valley a popular vacation and seasonal retreat as well as a landscape long treasured by local residents (Mad River, 1995).

The bacteria-impaired segment of the Mad River begins at its confluence with the Winooski River in north central Moretown and travels 6.2 miles upriver. The entire length of the impaired segment is located within the town of Moretown. The Mad River watershed (Figure 1) covers 144 square miles primarily within Granville, Warren, Fayston, Duxbury, Waitsfield, and Moretown. With small sections of the watershed within Huntington, Buels Gore, Lincoln, Roxbury and Northfield. Overall, land use in the watershed is 90% forested, 8.5% agricultural, 1% developed, and 0.5% wetland, as shown in Figure 2 (based on 2006 Land Cover Analysis by NOAA-CSC).

Waterbody Facts (VT08-18)

- **Towns:** Moretown, Waitsfield
- **Impaired Segment Location:** Mouth of River through Moretown
- **Impaired Segment Length:** 6.2 mile
- **Classification:** Class B
- **Watershed Area:** 144 square miles
- **Planning Basin:** 08 – Winooski River

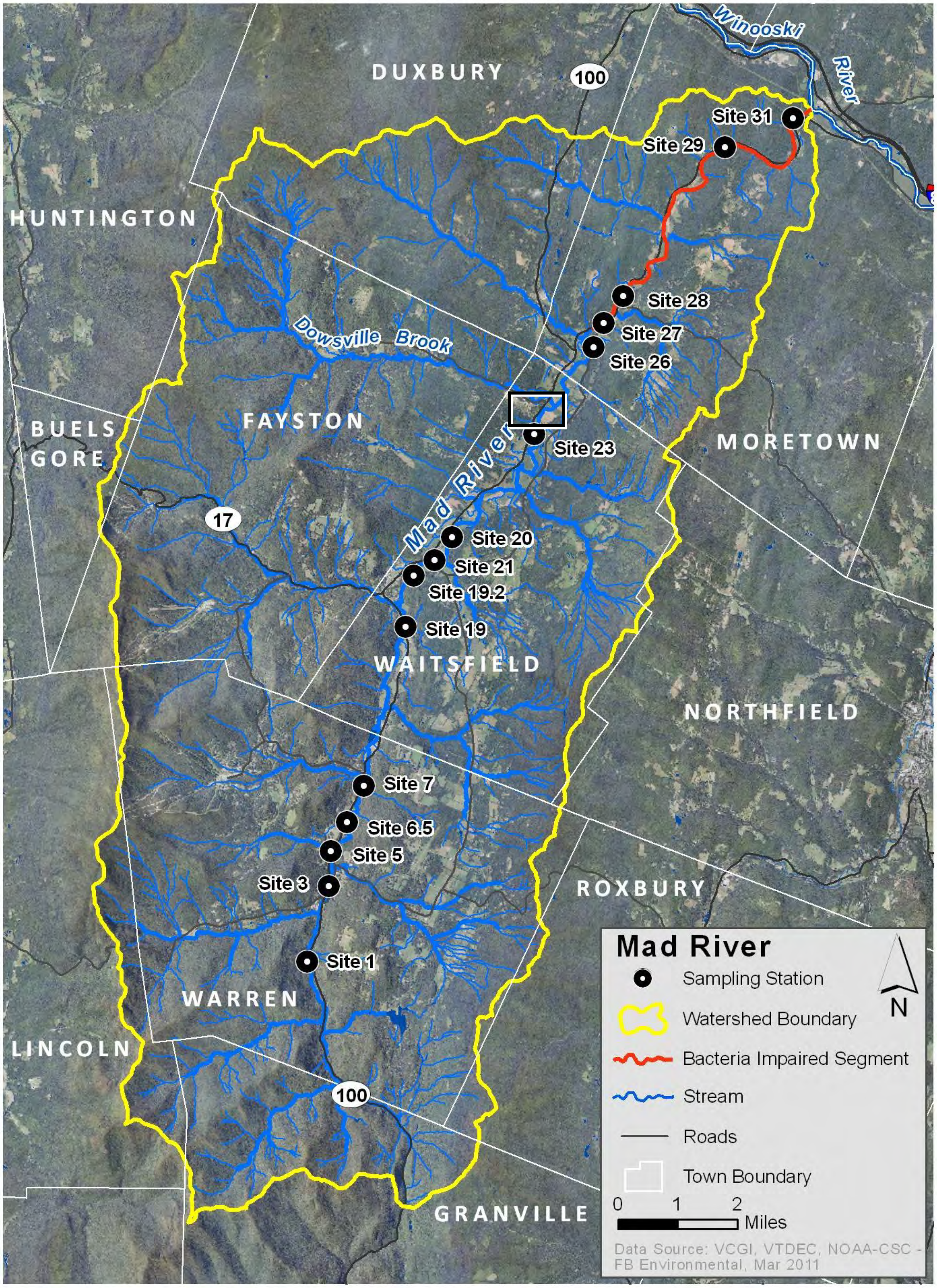

Figure 1: ***Map of Mad River watershed with impaired segment and sampling stations indicated. Insert area correspond to figure 4 below.***

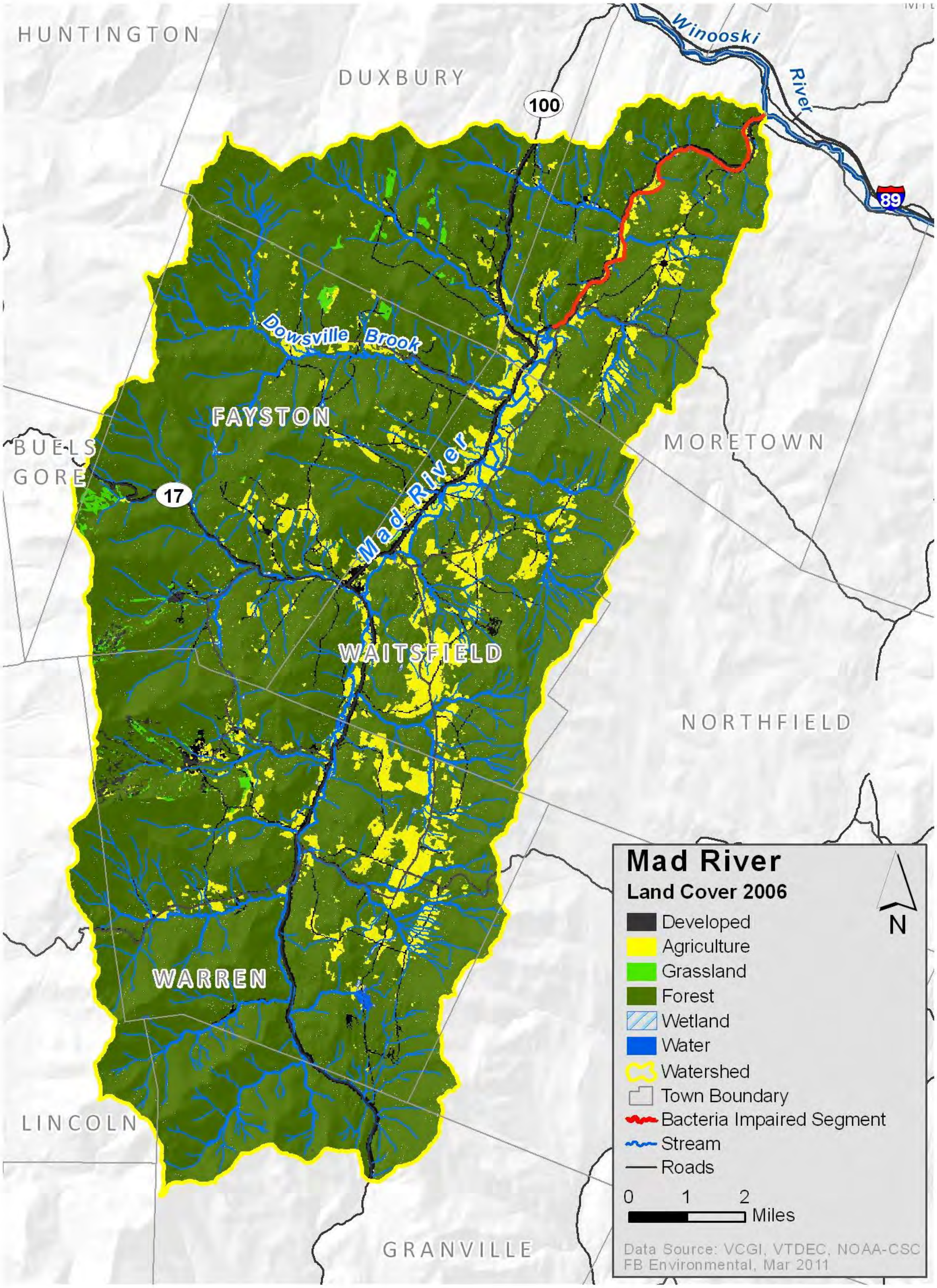

Figure 2: ***Map of Mad River watershed with impaired segment and land cover indicated.***

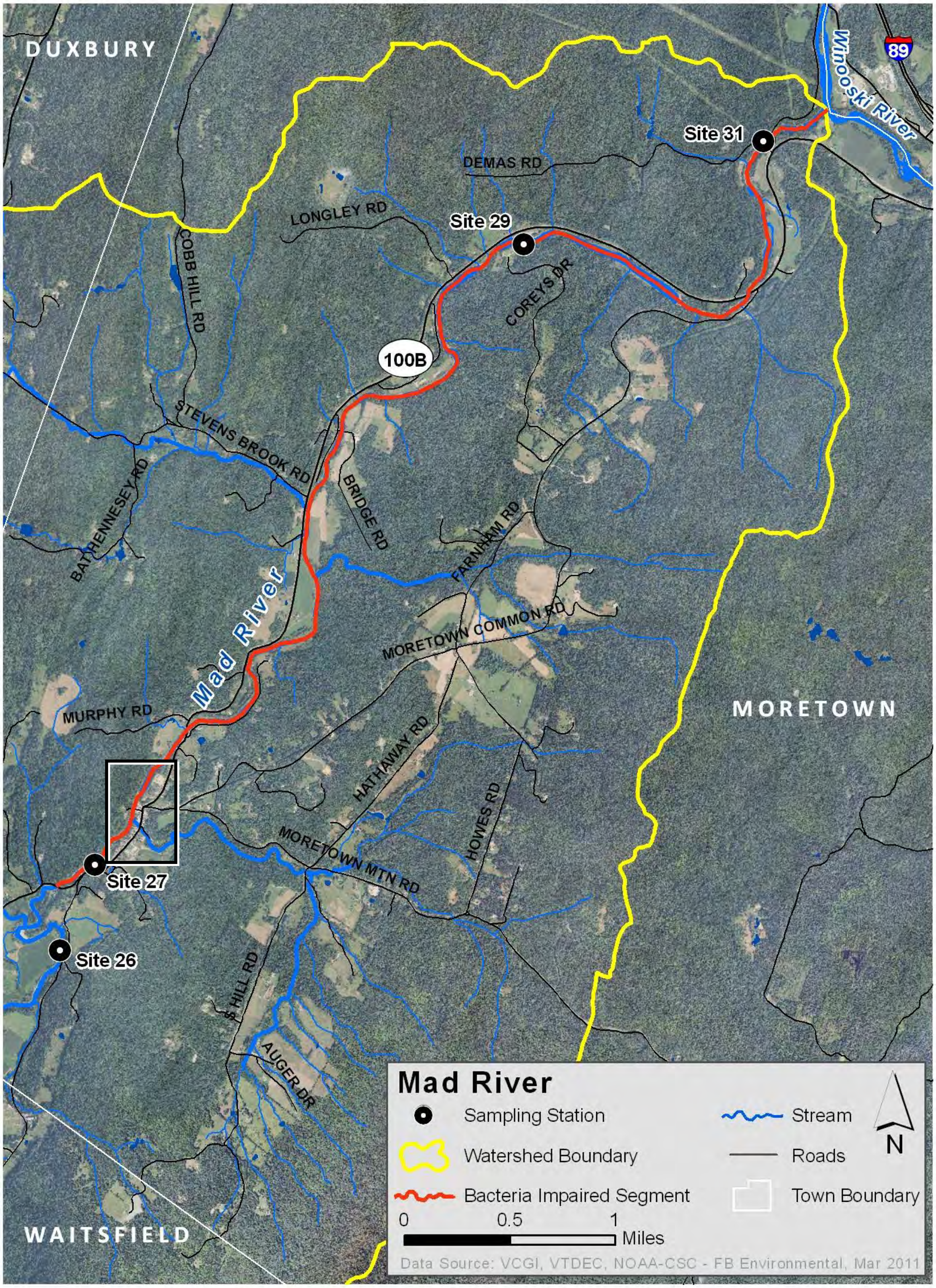

Figure 3: ***Map of Mad River watershed impaired segment and sampling stations indicated. Insert area corresponds to figure 5 below.***

Figure 4: ***Aerial view of the Mad River as it follows along VT Rte. 100 in Moretown. The confluence with Blue Brook takes place opposite of the intersection of Edward's Village Loop and Vt. Rte. 100***

The Mad River watershed is characterized by mountainous terrain with thin soils, steep slopes, and a relatively flat fertile valley bottom along the river. These factors make development in many sections of the watershed towns difficult. As a result, the majority of development has taken place along the valley bottom near the river and its tributaries (Field, 2007). Figure 4 provides a more detailed aerial view of the Mad River as it flows along VT Rte. 100 in northern Waitsfield. Much of the commercial and residential development within the towns of Warren, Waitsfield, and Moretown is concentrated around the river and its tributaries in a similar manner as shown in Figure 4.

There are many reaches of the main stem that have less than 10% forest cover within the river corridor. Large sections of the Mad River's floodplain and former wetland areas have residential and commercial development within them. Historically, wetlands were viewed as mosquito ridden wastelands that should be drained and turned into land better suited for human uses (CVRP, 2008). Consequently, many wetland areas along the Mad River's main stem, and within its flood plain, were filled in for development and agriculture (Waitsfield, 2010). Wetlands play a critical role in reducing runoff pollution and help with flood attenuation. Removing or decreasing wetlands and developing along a rivers bank, as seen in the Mad River watershed, restricts the rivers access to its natural flood plain and decreases the watersheds ability to attenuate flooding (Waitsfield, 2010).

Figure 5: ***Aerial view of the impaired segment of the Mad River in Moretown, showing dense development along the river bank.***

The Mad River has a long history of large and damaging floods, and significant flooding events in the area occurred as recently as 1998 (Field, 2007). In 1882 a local resident once wrote that the Mad River received its name because the river; "rises like sudden anger, overflowing its banks and devouring them at will" (VGS, 2003). The rapid descents of water into the valley from the surrounding mountain slopes, accompanied by the long standing development within the valley flatlands, are the likely causes of such damaging floods. Flooding can cause damage to homes, businesses, and infrastructure such as sanitary sewer pipes and onsite sewage disposal systems (USEPA, 2005). As shown in Figure 5, much of the development within Moretown is located directly adjacent to the river bank, and would get severely damaged during a flood.

The Mad River is highly valued by local residents and seasonal vacationers alike. The Mad River offers more than simply beautiful views. It boasts a wealth of natural and recreational resources, such as trout fishing and over 15 popular swimming holes (VANR, 2008).

Concerns with bacterial contamination in the Mad River go back decades. Years ago, as in most of the United States, there was direct piping into the river and its tributaries which passed untreated sewage directly to the river. Residents that swam in the river would get sick quite often from the pathogens found within fecal matter. The general knowledge of the Mad River's problems with bacterial contamination was so profound that an area physician in the 1960's once told a mother; "If you let those children swim in the (Mad) River, don't bring them to me" (FMR, 2011). While there are no longer direct pipes sending untreated sewage to the river, there are still problems with bacterial contamination that have caused the closing of local swimming holes. Indicating the need for further identification and remediation efforts within the Mad River watershed.

Why is a TMDL needed?

The Mad River is a Class B, cold water fishery with designated uses including swimming, fishing and boating (VTDEC, 2008). Water samples are collected between June and August from the sampling stations shown in Figure 1 and Figure 3. Bacteria data from these sampling locations have exceeded Vermont's water quality criteria for *E.coli* bacteria. Table 1 below provides bacteria data collected at these sampling locations from 2006-2010. 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 the Mad River. For the Mad River between 2006 and 2010, the current single sample water quality criterion was exceeded in nearly 35% of the samples.

Due to the elevated bacteria measurements presented in Table 1, the Mad River from its confluence with the Winooski River, upstream 6.2 miles through Moretown, 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 the Mad River 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

The likely sources of bacterial contamination to the Mad River are failing or malfunctioning septic systems and runoff from agricultural areas. Vermont's 303(d) listing of the Mad River for contact recreation impairment notes that the problem includes failing septic systems and other unknown sources (VTDEC, 2008).

None of the towns within the Mad River watershed are serviced by wastewater treatment facilities. Therefore, all of the residents within the watershed rely on onsite sewage disposal (septic) systems to treat their wastewater (CVRP, 2008). Most of the development within the watershed is concentrated around the Mad River and its tributaries. Unless the disposal of sewage is done properly the potential for pollution to ground and surface water is great, especially systems that are located near the Mad River and its tributaries (Mad River, 1995).

There are several reasons why failing septic systems are a likely cause of bacterial contamination to the Mad River. There are multiple factors that can limit a septic system from functioning properly. They must be well maintained through regular inspections and must be pumped out regularly. They also must be set in soils that are adequate for septic waste disposal. Soils on steep slopes, with a shallow depth to bedrock, with a high water table, with a high flood potential, that drain to quickly, or clay soils with low permeability, are all limiting factors for adequate disposal of septic waste (Mad River, 1995).

Most of the Mad River watershed is covered with soils that are not suitable for septic waste disposal (Waitsfield, 2010; Fayston, 2008). During the 1990s it was found that more than two-thirds of the onsite sewage systems installed in Vermont were installed without state review of the locations suitability for a septic system. Also, at this time few towns had a routine maintenance program in place or even provided information on the proper operation and maintenance of onsite sewage systems (Mad River, 1995). Today there are much stricter regulations and review processes in place, but many of the systems installed during the 1990s and earlier are still in the ground and may be malfunctioning or failing. Furthermore, the flooding from 1998 within the Mad River watershed could have damaged septic systems. When the soil around a septic system becomes saturated the system itself can be damaged and fail if it is not properly inspected and cleaned out after the flood (USEPA, 2005). When systems are old, un maintained, or placed on soils with poor suitability they can malfunction and release high concentrations of dangerous bacteria to nearby surface waters (USEPA, 2002). These characteristics of the Mad River watershed make failing or malfunctioning septic systems a possible source of bacterial contamination.

Extensive agricultural land is found below the Northfield Ridge on the eastern side of the valley from Warren through Waitsfield and also on the valley bottom surrounding the river between Waitsfield and Moretown (UVM, 2000). The proximity of these farming activities (as seen in Figure 4) accompanied by the general lack of adequate riparian buffers along the river and its tributaries make agriculture another potential source of bacterial contamination. Agricultural areas have been shown to have considerably higher bacteria levels during storm events when compared to areas of the river adjacent to undeveloped land (UVM, 2000). Also, many of the tributaries, such as Pine Brook, have little to no riparian buffer adjacent to agricultural lands. A 2007 study documented extensive livestock access to Pine Brook along a quarter mile stretch of the stream (Field, 2007). While long term on-site improvement and restoration projects are being undertaken within the watershed to restore riparian habitat, agricultural runoff of fecal bacteria will likely continue to be a problem in the watershed due to the presence of narrow riparian buffers and adjacent farming activities (FMR, 2011).

Recommended Next Steps

Many local groups and municipalities within the Mad River Watershed have taken a proactive approach to addressing the many water quality problems faced by the river and its tributaries. Friends of the Mad River (FMR), a local non-profit organization, was formed in the 1980's by concerned citizens and the group performs bacteria sampling (as the Mad River Watch) and addresses bacteria problems as well as other water quality issues within the river and its tributaries. The Mad River Watershed Conservation Partnership (MRWCP) was formed in 2000 and is composed of FMR, Mad River Valley Planning District, and the Vermont Land Trust. This group works cooperatively with watershed towns and other local, state, and federal agencies to conserve important lands within the watershed. Through their efforts, more than 7,000 acres of historic farm and forest land have been put into land conservation. FMR, along with MRWCP and watershed municipalities have, over the years, helped to educate local citizens that what happens on the land ultimately affects the water quality in the river (Mad River, 2002). These collaborative efforts will continue to have a positive impact on the Mad River watershed.

It is important for the towns of Warren, Waitsfield, Moretown, and other watershed towns, local stakeholders, as well as other community and watershed based groups to continue the implementation of education and outreach programs, restoration programs, and the identification of land use activities that might be influencing *E. coli* levels.

Additional bacteria data collection may be beneficial to support identification of sources of potentially harmful bacteria in the Mad River watershed. For example, continued and expanded sampling upriver and downriver of potential bacteria sources (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 septic system functionality, riparian buffers, agricultural runoff, and other source identification may also be beneficial.

Previous investigations and concerned groups (Mad River, 1995; Waitsfield, 2010; CVRP, 2008; Field, 2007, FMR, 2004) have recommended the following actions to support water quality goals in the Mad River:

- <u>Septic Systems</u>- Ensure that new development has properly designed, constructed and inspected onsite sewage disposal systems. Discourage development in soils that are too steep or otherwise not suited for septic waste disposal. Support programs that assist with the replacement or upgrading of failed onsite septic systems. Education is the most important means of combating problems with onsite disposal systems; provide watershed residents with a wealth of information on septic system function, maintenance, and identifying a failed system.
- <u>Agricultural</u> – Evaluate riparian buffers and identify opportunities to remove areas near the river from production. Make efforts to work with farmers to restrict livestock access to tributary streams. Federal programs such as the Conservation Reserve Enhancement Program (CREP) can help to make it financially viable for farmers to use their land in ways that reduces negative impacts on water quality.
- <u>Land Use Protection</u> – Continue to work collaboratively to pinpointed important lands for conservation. Landowners should be encouraged and incentives should be in place for them to place conservation easements on important lands within the watershed, such as; contiguous forest land, wetland areas, and floodplains.
- <u>Flood Plain Protection and Riparian Corridors</u> – Ordinances should be enacted to limit further floodplain encroachment. Encourage landowners to install buffers, and other tools that protect shoreline and/or riparian areas. Seek to enhance buffers through a combination of buffer plantings, land conservation, and incentive programs.

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 the Mad River.

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.

Mad River, From the Winooski River through Moretown (6.2 miles).

***WB ID*:** VT08-18

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: **55%**

Data: 2006 – 2010, Mad River Watch

Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year.

Station Name	Station Location	Date	Result	Geometric Mean**
1	Warren Falls	8/23/2010	7	29
1	Warren Falls	8/9/2010	6	
1	Warren Falls	7/26/2010	23	
1	Warren Falls	7/12/2010	25	
1	Warren Falls	6/28/2010	222	
1	Warren Falls	6/14/2010	99	
1	Warren Falls	8/24/2009	6	14
1	Warren Falls	8/10/2009	11	
1	Warren Falls	7/27/2009	19	
1	Warren Falls	7/13/2009	13	
1	Warren Falls	6/29/2009	99	
1	Warren Falls	6/15/2009	5	
1	Warren Falls	8/25/2008	2	14
1	Warren Falls	8/11/2008	13	
1	Warren Falls	7/28/2008	40	
1	Warren Falls	7/15/2008	15	
1	Warren Falls	6/30/2008	23	
1	Warren Falls	6/16/2008	26	

*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 Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
1	Warren Falls	8/20/2007	6	25
1	Warren Falls	8/6/2007	285	
1	Warren Falls	7/23/2007	17	
1	Warren Falls	7/9/2007	127	
1	Warren Falls	6/25/2007	6	
1	Warren Falls	6/11/2007	10	
1	Warren Falls	8/21/2006	4	17
1	Warren Falls	8/7/2006	1	
1	Warren Falls	7/24/2006	26	
1	Warren Falls	7/10/2006	59	
1	Warren Falls	6/26/2006	579	
1	Warren Falls	6/12/2006	8	
3	Warren Covered Bridge	8/23/2010	13	35
3	Warren Covered Bridge	8/9/2010	25	
3	Warren Covered Bridge	7/26/2010	21	
3	Warren Covered Bridge	7/12/2010	18	
3	Warren Covered Bridge	6/28/2010	2420	
3	Warren Covered Bridge	6/14/2010	6	
3	Warren Covered Bridge	8/24/2009	12	18
3	Warren Covered Bridge	8/10/2009	6	
3	Warren Covered Bridge	7/27/2009	27	
3	Warren Covered Bridge	7/13/2009	19	
3	Warren Covered Bridge	6/29/2009	108	
3	Warren Covered Bridge	6/15/2009	9	
3	Warren Covered Bridge	8/25/2008	11	24
3	Warren Covered Bridge	8/11/2008	62	
3	Warren Covered Bridge	7/28/2008	12	
3	Warren Covered Bridge	6/30/2008	39	
3	Warren Covered Bridge	6/16/2008	25	
3	Warren Covered Bridge	8/20/2007	4	29
3	Warren Covered Bridge	8/6/2007	172	
3	Warren Covered Bridge	7/23/2007	7	
3	Warren Covered Bridge	7/9/2007	345	
3	Warren Covered Bridge	6/25/2007	16	
3	Warren Covered Bridge	6/11/2007	20	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
3	Warren Covered Bridge	8/21/2006	13	43
3	Warren Covered Bridge	8/7/2006	2	
3	Warren Covered Bridge	7/24/2006	21	
3	Warren Covered Bridge	7/10/2006	26	
3	Warren Covered Bridge	6/26/2006	2420	
3	Warren Covered Bridge	6/12/2006	179	
5	North End Warren Village	8/23/2010	23	35
5	North End Warren Village	8/9/2010	12	
5	North End Warren Village	7/26/2010	93	
5	North End Warren Village	7/12/2010	29	
5	North End Warren Village	6/28/2010	641	
5	North End Warren Village	6/14/2010	4	
5	North End Warren Village	8/24/2009	35	33
5	North End Warren Village	8/10/2009	15	
5	North End Warren Village	7/27/2009	20	
5	North End Warren Village	7/13/2009	20	
5	North End Warren Village	6/29/2009	365	
5	North End Warren Village	6/15/2009	19	
5	North End Warren Village	8/25/2008	35	40
5	North End Warren Village	8/11/2008	37	
5	North End Warren Village	7/28/2008	31	
5	North End Warren Village	6/30/2008	52	
5	North End Warren Village	6/16/2008	50	
5	North End Warren Village	8/20/2007	6	38
5	North End Warren Village	8/6/2007	365	
5	North End Warren Village	7/23/2007	17	
5	North End Warren Village	7/9/2007	261	
5	North End Warren Village	6/25/2007	19	
5	North End Warren Village	6/11/2007	16	
5	North End Warren Village	8/21/2006	74	35
5	North End Warren Village	8/7/2006	24	
5	North End Warren Village	7/24/2006	30	
5	North End Warren Village	7/10/2006	20	
5	North End Warren Village	6/12/2006	47	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
6.5	Seasons	8/23/2010	31	56
6.5	Seasons	8/9/2010	64	
6.5	Seasons	7/26/2010	46	
6.5	Seasons	7/12/2010	33	
6.5	Seasons	6/28/2010	2420	
6.5	Seasons	6/14/2010	4	
6.5	Seasons	8/24/2009	41	24
6.5	Seasons	8/10/2009	7	
6.5	Seasons	7/27/2009	23	
6.5	Seasons	7/13/2009	15	
6.5	Seasons	6/29/2009	194	
6.5	Seasons	6/15/2009	11	
6.5	Seasons	8/25/2008	20	26
6.5	Seasons	8/11/2008	31	
6.5	Seasons	7/28/2008	15	
6.5	Seasons	6/30/2008	53	
6.5	Seasons	6/16/2008	24	
6.5	Seasons	8/20/2007	7	32
6.5	Seasons	8/6/2007	96	
6.5	Seasons	7/23/2007	13	
6.5	Seasons	7/9/2007	308	
6.5	Seasons	6/25/2007	11	
7	Warren Riverside Park	8/23/2010	77	90
7	Warren Riverside Park	8/9/2010	88	
7	Warren Riverside Park	7/26/2010	31	
7	Warren Riverside Park	7/12/2010	47	
7	Warren Riverside Park	6/28/2010	2420	
7	Warren Riverside Park	6/14/2010	22	
7	Warren Riverside Park	8/24/2009	43	35
7	Warren Riverside Park	8/10/2009	9	
7	Warren Riverside Park	7/27/2009	72	
7	Warren Riverside Park	7/13/2009	17	
7	Warren Riverside Park	6/29/2009	208	
7	Warren Riverside Park	6/15/2009	19	

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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
7	Warren Riverside Park	8/25/2008	19	11
7	Warren Riverside Park	8/11/2008	1	
7	Warren Riverside Park	7/28/2008	4	
7	Warren Riverside Park	7/15/2008	44	
7	Warren Riverside Park	6/30/2008	25	
7	Warren Riverside Park	6/16/2008	26	
7	Warren Riverside Park	8/20/2007	80	23
7	Warren Riverside Park	8/6/2007	79	
7	Warren Riverside Park	7/23/2007	9	
7	Warren Riverside Park	7/9/2007	127	
7	Warren Riverside Park	6/25/2007	1	
9	Punch Bowl	7/13/2009	21	NA
9	Punch Bowl	6/29/2009	435	
9	Punch Bowl	6/15/2009	18	
9	Punch Bowl	8/25/2008	11	8
9	Punch Bowl	8/11/2008	1	
9	Punch Bowl	7/28/2008	1	
9	Punch Bowl	7/15/2008	32	
9	Punch Bowl	6/30/2008	43	
9	Punch Bowl	6/16/2008	22	
9	Punch Bowl	8/20/2007	20	23
9	Punch Bowl	8/6/2007	108	
9	Punch Bowl	7/23/2007	11	
9	Punch Bowl	7/9/2007	365	
9	Punch Bowl	6/25/2007	1	
9	Punch Bowl	6/11/2007	16	
9	Punch Bowl	8/21/2006	13	7
9	Punch Bowl	8/7/2006	38	
9	Punch Bowl	7/24/2006	1	
9	Punch Bowl	7/10/2006	6	
9	Punch Bowl	6/26/2006	33	
9	Punch Bowl	6/12/2006	1	

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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
19	Lareau Swimhole	8/23/2010	127	114
19	Lareau Swimhole	8/9/2010	49	
19	Lareau Swimhole	7/26/2010	56	
19	Lareau Swimhole	7/12/2010	54	
19	Lareau Swimhole	6/28/2010	2420	
19	Lareau Swimhole	6/14/2010	50	
19	Lareau Swimhole	8/24/2009	64	62
19	Lareau Swimhole	8/10/2009	24	
19	Lareau Swimhole	7/27/2009	124	
19	Lareau Swimhole	7/13/2009	27	
19	Lareau Swimhole	6/29/2009	435	
19	Lareau Swimhole	6/15/2009	24	
19	Lareau Swimhole	8/25/2008	24	3
19	Lareau Swimhole	8/11/2008	1	
19	Lareau Swimhole	7/28/2008	1	
19	Lareau Swimhole	7/15/2008	73	
19	Lareau Swimhole	6/30/2008	1	
19	Lareau Swimhole	6/16/2008	1	
19	Lareau Swimhole	8/20/2007	1	1
19	Lareau Swimhole	8/6/2007	1	
19	Lareau Swimhole	7/23/2007	1	
19	Lareau Swimhole	7/9/2007	1	
19	Lareau Swimhole	6/25/2007	1	
19	Lareau Swimhole	6/11/2007	1	
19	Lareau Swimhole	8/21/2006	111	3
19	Lareau Swimhole	8/7/2006	1	
19	Lareau Swimhole	7/24/2006	1	
19	Lareau Swimhole	7/10/2006	1	
19	Lareau Swimhole	6/26/2006	5	
19	Lareau Swimhole	6/12/2006	1	
19.2	Couples Club	8/23/2010	184	167
19.2	Couples Club	8/9/2010	161	
19.2	Couples Club	7/26/2010	99	
19.2	Couples Club	7/12/2010	80	
19.2	Couples Club	6/28/2010	2420	
19.2	Couples Club	6/14/2010	39	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
19.2	Couples Club	8/24/2009	80	70
19.2	Couples Club	8/10/2009	63	
19.2	Couples Club	7/27/2009	105	
19.2	Couples Club	7/13/2009	21	
19.2	Couples Club	6/29/2009	548	
19.2	Couples Club	6/15/2009	19	
19.2	Couples Club	8/25/2008	24	2
19.2	Couples Club	8/11/2008	1	
19.2	Couples Club	7/28/2008	1	
19.2	Couples Club	6/30/2008	1	
19.2	Couples Club	6/16/2008	2	
19.2	Couples Club	8/20/2007	1	1
19.2	Couples Club	8/6/2007	1	
19.2	Couples Club	7/23/2007	2	
19.2	Couples Club	7/9/2007	1	
19.2	Couples Club	6/25/2007	1	
19.2	Couples Club	6/11/2007	1	
19.2	Couples Club	8/21/2006	178	5
19.2	Couples Club	8/7/2006	1	
19.2	Couples Club	7/24/2006	3	
19.2	Couples Club	7/10/2006	1	
19.2	Couples Club	6/26/2006	28	
19.2	Couples Club	6/12/2006	1	
20	Waitsfield Covered Bridge	8/23/2010	195	165
20	Waitsfield Covered Bridge	8/9/2010	172	
20	Waitsfield Covered Bridge	7/26/2010	76	
20	Waitsfield Covered Bridge	7/12/2010	75	
20	Waitsfield Covered Bridge	6/28/2010	2420	
20	Waitsfield Covered Bridge	6/14/2010	44	
20	Waitsfield Covered Bridge	8/24/2009	99	85
20	Waitsfield Covered Bridge	8/10/2009	23	
20	Waitsfield Covered Bridge	7/27/2009	166	
20	Waitsfield Covered Bridge	7/13/2009	29	
20	Waitsfield Covered Bridge	6/29/2009	866	
20	Waitsfield Covered Bridge	6/15/2009	38	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
20	Waitsfield Covered Bridge	8/25/2008	21	3
20	Waitsfield Covered Bridge	8/11/2008	1	
20	Waitsfield Covered Bridge	7/28/2008	1	
20	Waitsfield Covered Bridge	7/15/2008	69	
20	Waitsfield Covered Bridge	6/30/2008	1	
20	Waitsfield Covered Bridge	6/16/2008	1	
20	Waitsfield Covered Bridge	8/20/2007	1	1
20	Waitsfield Covered Bridge	8/6/2007	1	
20	Waitsfield Covered Bridge	7/23/2007	3	
20	Waitsfield Covered Bridge	7/9/2007	2	
20	Waitsfield Covered Bridge	6/25/2007	1	
20	Waitsfield Covered Bridge	6/11/2007	1	
20	Waitsfield Covered Bridge	8/21/2006	378	8
20	Waitsfield Covered Bridge	8/7/2006	3	
20	Waitsfield Covered Bridge	7/24/2006	7	
20	Waitsfield Covered Bridge	7/10/2006	1	
20	Waitsfield Covered Bridge	6/26/2006	47	
20	Waitsfield Covered Bridge	6/12/2006	1	
21	Waitsfield Elementary School	8/23/2010	204	141
21	Waitsfield Elementary School	8/9/2010	121	
21	Waitsfield Elementary School	7/26/2010	62	
21	Waitsfield Elementary School	7/12/2010	60	
21	Waitsfield Elementary School	6/28/2010	2420	
21	Waitsfield Elementary School	6/14/2010	36	
21	Waitsfield Elementary School	8/24/2009	84	74
21	Waitsfield Elementary School	8/10/2009	33	
21	Waitsfield Elementary School	7/27/2009	122	
21	Waitsfield Elementary School	7/13/2009	23	
21	Waitsfield Elementary School	6/29/2009	1733	
21	Waitsfield Elementary School	6/15/2009	12	
21	Waitsfield Elementary School	8/25/2008	19	4
21	Waitsfield Elementary School	8/11/2008	3	
21	Waitsfield Elementary School	7/28/2008	4	
21	Waitsfield Elementary School	6/30/2008	3	
21	Waitsfield Elementary School	6/16/2008	2	

*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 Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
21	Waitsfield Elementary School	8/20/2007	1	2
21	Waitsfield Elementary School	8/6/2007	2	
21	Waitsfield Elementary School	7/23/2007	1	
21	Waitsfield Elementary School	7/9/2007	7	
21	Waitsfield Elementary School	6/25/2007	12	
21	Waitsfield Elementary School	6/11/2007	1	
21	Waitsfield Elementary School	8/21/2006	378	12
21	Waitsfield Elementary School	8/7/2006	1	
21	Waitsfield Elementary School	7/24/2006	6	
21	Waitsfield Elementary School	7/10/2006	4	
21	Waitsfield Elementary School	6/26/2006	276	
21	Waitsfield Elementary School	6/12/2006	1	
23	Meadow Road Bridge	8/23/2010	225	170
23	Meadow Road Bridge	8/9/2010	68	
23	Meadow Road Bridge	7/26/2010	84	
23	Meadow Road Bridge	7/12/2010	157	
23	Meadow Road Bridge	6/28/2010	2420	
23	Meadow Road Bridge	6/14/2010	50	
23	Meadow Road Bridge	8/24/2009	96	116
23	Meadow Road Bridge	8/10/2009	59	
23	Meadow Road Bridge	7/27/2009	140	
23	Meadow Road Bridge	7/13/2009	91	
23	Meadow Road Bridge	6/29/2009	1203	
23	Meadow Road Bridge	6/15/2009	28	
23	Meadow Road Bridge	8/25/2008	29	12
23	Meadow Road Bridge	8/11/2008	1	
23	Meadow Road Bridge	7/28/2008	9	
23	Meadow Road Bridge	7/15/2008	173	
23	Meadow Road Bridge	6/30/2008	4	
23	Meadow Road Bridge	6/16/2008	14	
23	Meadow Road Bridge	8/20/2007	3	6
23	Meadow Road Bridge	8/6/2007	11	
23	Meadow Road Bridge	7/23/2007	12	
23	Meadow Road Bridge	7/9/2007	39	
23	Meadow Road Bridge	6/25/2007	5	
23	Meadow Road Bridge	6/11/2007	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.

Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
23	Meadow Road Bridge	8/21/2006	488	33
23	Meadow Road Bridge	8/7/2006	9	
23	Meadow Road Bridge	7/24/2006	36	
23	Meadow Road Bridge	7/10/2006	9	
23	Meadow Road Bridge	6/26/2006	322	
23	Meadow Road Bridge	6/12/2006	3	
26	North Road near Moretown	8/23/2010	236	180
26	North Road near Moretown	8/9/2010	111	
26	North Road near Moretown	7/26/2010	96	
26	North Road near Moretown	7/12/2010	119	
26	North Road near Moretown	6/28/2010	2420	
26	North Road near Moretown	6/14/2010	46	
26	North Road near Moretown	8/24/2009	101	131
26	North Road near Moretown	8/10/2009	38	
26	North Road near Moretown	7/27/2009	119	
26	North Road near Moretown	7/13/2009	61	
26	North Road near Moretown	6/29/2009	1414	
26	North Road near Moretown	6/15/2009	130	
26	North Road near Moretown	8/25/2008	1	8
26	North Road near Moretown	8/11/2008	19	
26	North Road near Moretown	7/28/2008	25	
26	North Road near Moretown	6/30/2008	1	
26	North Road near Moretown	6/16/2008	88	
26	North Road near Moretown	8/20/2007	1	24
26	North Road near Moretown	8/6/2007	293	
26	North Road near Moretown	7/23/2007	1	
26	North Road near Moretown	7/9/2007	178	
26	North Road near Moretown	6/25/2007	50	
26	North Road near Moretown	6/11/2007	68	
26	North Road near Moretown	8/21/2006	345	62
26	North Road near Moretown	8/7/2006	43	
26	North Road near Moretown	7/24/2006	15	
26	North Road near Moretown	7/10/2006	20	
26	North Road near Moretown	6/26/2006	2420	
26	North Road near Moretown	6/12/2006	5	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
27	Moretown Village Swim Access	8/23/2010	261	242
27	Moretown Village Swim Access	8/9/2010	161	
27	Moretown Village Swim Access	7/26/2010	461	
27	Moretown Village Swim Access	7/12/2010	179	
27	Moretown Village Swim Access	6/28/2010	2420	
27	Moretown Village Swim Access	6/14/2010	24	
27	Moretown Village Swim Access	8/24/2009	78	92
27	Moretown Village Swim Access	8/10/2009	66	
27	Moretown Village Swim Access	7/27/2009	78	
27	Moretown Village Swim Access	7/13/2009	39	
27	Moretown Village Swim Access	6/29/2009	1733	
27	Moretown Village Swim Access	6/15/2009	23	
27	Moretown Village Swim Access	8/25/2008	2	19
27	Moretown Village Swim Access	8/11/2008	29	
27	Moretown Village Swim Access	7/28/2008	39	
27	Moretown Village Swim Access	7/15/2008	173	
27	Moretown Village Swim Access	6/30/2008	1	
27	Moretown Village Swim Access	6/16/2008	108	
27	Moretown Village Swim Access	8/20/2007	2	54
27	Moretown Village Swim Access	8/6/2007	344	
27	Moretown Village Swim Access	7/23/2007	5	
27	Moretown Village Swim Access	7/9/2007	1300	
27	Moretown Village Swim Access	6/25/2007	66	
27	Moretown Village Swim Access	6/11/2007	88	
27	Moretown Village Swim Access	8/21/2006	139	58
27	Moretown Village Swim Access	8/7/2006	66	
27	Moretown Village Swim Access	7/24/2006	18	
27	Moretown Village Swim Access	7/10/2006	22	
27	Moretown Village Swim Access	6/26/2006	2420	
27	Moretown Village Swim Access	6/12/2006	4	
28	Ward Clapboard Mill	8/23/2010	378	241
28	Ward Clapboard Mill	8/9/2010	248	
28	Ward Clapboard Mill	7/26/2010	140	
28	Ward Clapboard Mill	7/12/2010	219	
28	Ward Clapboard Mill	6/28/2010	2420	
28	Ward Clapboard Mill	6/14/2010	28	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
28	Ward Clapboard Mill	8/24/2009	78	133
28	Ward Clapboard Mill	8/10/2009	52	
28	Ward Clapboard Mill	7/27/2009	133	
28	Ward Clapboard Mill	7/13/2009	86	
28	Ward Clapboard Mill	6/29/2009	1733	
28	Ward Clapboard Mill	6/15/2009	69	
28	Ward Clapboard Mill	8/25/2008	8	28
28	Ward Clapboard Mill	8/11/2008	23	
28	Ward Clapboard Mill	7/28/2008	276	
28	Ward Clapboard Mill	6/30/2008	5	
28	Ward Clapboard Mill	6/16/2008	71	
28	Ward Clapboard Mill	8/20/2007	1	44
28	Ward Clapboard Mill	8/6/2007	78	
28	Ward Clapboard Mill	7/23/2007	6	
28	Ward Clapboard Mill	7/9/2007	980	
28	Ward Clapboard Mill	6/25/2007	228	
28	Ward Clapboard Mill	6/11/2007	73	
28	Ward Clapboard Mill	8/21/2006	461	121
28	Ward Clapboard Mill	8/7/2006	62	
28	Ward Clapboard Mill	7/24/2006	74	
28	Ward Clapboard Mill	7/10/2006	83	
28	Ward Clapboard Mill	6/26/2006	2420	
28	Ward Clapboard Mill	6/12/2006	7	
29	Ward Swimhole	8/23/2010	613	268
29	Ward Swimhole	8/9/2010	276	
29	Ward Swimhole	7/26/2010	185	
29	Ward Swimhole	7/12/2010	172	
29	Ward Swimhole	6/28/2010	2420	
29	Ward Swimhole	6/14/2010	28	
29	Ward Swimhole	8/24/2009	96	101
29	Ward Swimhole	8/10/2009	38	
29	Ward Swimhole	7/27/2009	186	
29	Ward Swimhole	7/13/2009	126	
29	Ward Swimhole	6/29/2009	147	
29	Ward Swimhole	6/15/2009	84	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
29	Ward Swimhole	8/25/2008	7	48
29	Ward Swimhole	8/11/2008	33	
29	Ward Swimhole	7/28/2008	144	
29	Ward Swimhole	7/15/2008	228	
29	Ward Swimhole	6/30/2008	12	
29	Ward Swimhole	6/16/2008	127	
29	Ward Swimhole	8/20/2007	7	52
29	Ward Swimhole	8/6/2007	39	
29	Ward Swimhole	7/23/2007	8	
29	Ward Swimhole	7/9/2007	921	
29	Ward Swimhole	6/25/2007	115	
29	Ward Swimhole	6/11/2007	84	
29	Ward Swimhole	8/21/2006	613	174
29	Ward Swimhole	8/7/2006	52	
29	Ward Swimhole	7/24/2006	147	
29	Ward Swimhole	7/10/2006	167	
29	Ward Swimhole	6/26/2006	816	
29	Ward Swimhole	6/12/2006	43	
31	Lover's Lane Bridge	8/23/2010	548	277
31	Lover's Lane Bridge	8/9/2010	119	
31	Lover's Lane Bridge	7/26/2010	261	
31	Lover's Lane Bridge	7/12/2010	240	
31	Lover's Lane Bridge	6/28/2010	2420	
31	Lover's Lane Bridge	6/14/2010	46	
31	Lover's Lane Bridge	8/24/2009	186	80
31	Lover's Lane Bridge	8/10/2009	24	
31	Lover's Lane Bridge	7/27/2009	101	
31	Lover's Lane Bridge	7/13/2009	78	
31	Lover's Lane Bridge	6/15/2009	93	
31	Lover's Lane Bridge	8/25/2008	27	84
31	Lover's Lane Bridge	8/11/2008	24	
31	Lover's Lane Bridge	7/28/2008	365	
31	Lover's Lane Bridge	6/30/2008	172	
31	Lover's Lane Bridge	6/16/2008	104	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
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Table 1: *E.coli* (organisms/100 mL) Data for Mad River (2006-20010) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
31	Lover's Lane Bridge	8/20/2007	5	45
31	Lover's Lane Bridge	7/23/2007	5	
31	Lover's Lane Bridge	7/9/2007	579	
31	Lover's Lane Bridge	6/25/2007	114	
31	Lover's Lane Bridge	6/11/2007	109	
31	Lover's Lane Bridge	8/7/2006	60	133
31	Lover's Lane Bridge	7/24/2006	201	
31	Lover's Lane Bridge	6/26/2006	488	
31	Lover's Lane Bridge	6/12/2006	53	

*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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