

**Agency of Natural Resources
Department of Environmental Conservation**

**Water Quality Division
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MEMORANDUM

To: John Schmeltzer, Waste Management
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Thru: Neil Kamman, Monitoring, Assessment and Planning Program

From: Richard Levey, Environmental Scientist

Date: April 14, 2010

Subject: Summary of 2009 Biological and Chemical assessments within Burgess Branch, Hutchins Brook, Dark Branch and Gihon watersheds in Lowell and Eden Vermont.

VTDEC (MAPP) has conducted biological, chemical and physical assessments at 24 sites within the Lamoille and Missisquoi River watersheds since 2005 (**Figure 1**). The assessments were intended to address potential impacts to the aquatic biota, surface waters and streambed sediment related to asbestos mine tailings being transported down into the Lamoille River and Missisquoi River watersheds. All of the sites assessed have been in close proximity to large tailing piles in Eden and Lowell, Vermont (See Summary VTDEC Memo to John Schmeltzer October 05, 2008).

This summary includes biological and/or chemical assessments conducted at nine sites in August and September 2009 on Hutchins Brook, Burgess Branch, Dark Branch and the Gihon River. The stream station locations and landscape attributes are given in **Table 1**.

One new site was established on **Burgess Branch RM 3.9**, to help further delineate the zone of disturbance on Burgess Branch. Biological assessments (macroinvertebrate and fish) were conducted at **Burgess Branch 5.0 and 3.9** to assess the biological integrity of the streams. Streambed sediment samples from nine sites were submitted to KD Associates Inc., of South Burlington, Vt. for analysis of asbestos type and quantity. Results are presented in **Table 3**. Chemical and physical water quality samples were collected at eight sites (**Table 4 & 5**).

Figure 1: Biological and Chemical Sampling Locations within the Lamoille River and Missisquoi River watersheds in Eden/Lowell, Vermont.

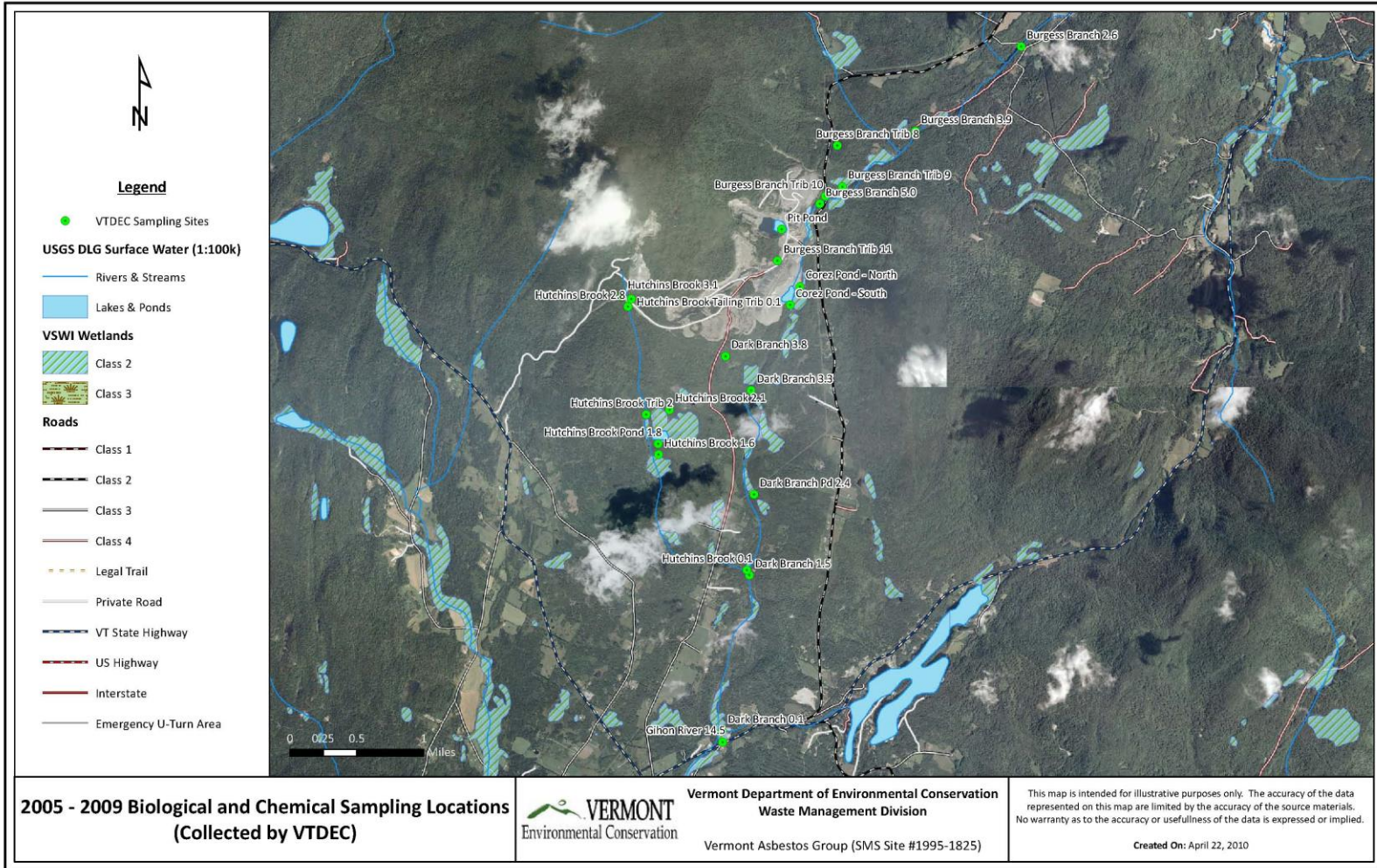


Table 1: Location of biological and/or chemical assessments conducted on Hutchins Brook, Burgess Branch, Dark Branch and the Gihon River in Eden and Lowell, Vermont. Also given are the watershed size (drainage area), and elevation at each station. Note: Station (RM) refers to river mile.

Location	Station (RM)	Description	D.A. (km²)	Elevation (ft)
Hutchins Brook	0.1	Located 0.1 miles above confluence with Dark Branch	4.4	1141
Hutchins Brook	1.6	Below Beaver Pond Outlet	2.2	1325
Hutchins Brook	2.1	Assessment site located 2.1 miles upstream from the confluence with Dark Branch, above wetland depositional area.	1.1	1367
Dark Branch	0.1	Located 0.1 miles above confluence with Gihon River	12.7	1059
Dark Branch	3.8	Located above Beaver Ponds	1.5	1285
Gihon River	14.5	Located below confluence with Dark Branch	31.2	1050
Burgess Branch	3.9	Located approx. 1.0 mile below Mine Rd	14.0	1072
Burgess Branch	4.9	Assessment located below tailing piles and is located immediately below Burgess Branch Trib. 10	6.2	1155
Burgess Branch	5.0	Assessment located below tailing piles and is 50 meters above Burgess Branch Trib. 10.	6.0	1158

Biological Assessment:

Macroinvertebrate Community:

The two sites sampled in 2009, **Burgess Branch 3.9** and **5.0** are considered Small High Gradient (SHG) streams based on their drainage area size, elevation and substrate or gradient (**Table 1**).

Macroinvertebrate Kick Net samples were collected and processed in the laboratory using VTDEC standard operating procedures. Macroinvertebrate community metrics used to evaluate the biological integrity of the stream reaches sampled are presented in **Table 2**. VTDEC applies eight community metrics, which measure community structural and functional attributes, to determine if a SHG stream is supporting its Water Quality Aquatic Life Support (ALS) values (VTDEC Biocriteria Guidance Document February, 2004).

Table 2: Macroinvertebrate Community metrics from Burgess Branch 5.0 & 3.9 for all sampling events. Five of the eight community metrics used to determine if a SHG stream is supporting its Water Quality Aquatic Life Support (ALS) are shown. Data shown in bold print indicates metric at or below Class “B” fair-good threshold. Assessment rating and Class B - Pass, Fail, and Indeterminate (P/F/I) status are also shown.

Location	Station (RM)	Sampling Date	Metrics					Class B Pass/Fail/I
			Density	Richness	EPT-R	BI	EPT/Chiro	
Burgess Branch	5.0	8/25/2005	2492	29	15	4.79	0.93	Good/I
		9/14/2007	1594	31.5	13	4.45	0.94	Fair/ F
		9/03/2009	2084	27	9	5.12	0.87	Fair / F
Burgess Branch	3.9	09/03/2009	2564	44	20	3.63	0.87	Very Good

Burgess Branch 5.0. The macroinvertebrate community present at **Burgess Branch 5.0** was assigned an overall assessment rating of good/ indeterminate in 2005, and fair/fail in 2007 & 2009. The primary biometrics that were found to be degraded, resulting in the “fair/poor” condition at this site in 2007 & 2009 were: 1) **very low number of EPT taxa** (sensitive species)

present 2) **low richness** (number of taxa) and 3) **Biotic Index** was elevated (increased number of tolerant taxa). These three metrics were below the Class B minimal expectations for the SHG stream type.

The Aquatic Life Support of Burgess **Branch RM 4.9 to 5.4** was listed as impaired in 2008 (State of Vermont 303(d) List of Waters), due to sediments from Mine Tailing Erosion.

Burgess Branch 3.9. The macroinvertebrate community present at Burgess Branch 3.9 was given an overall assessment rating of very good based on metrics, well above the Class B minimal expectations for the SHG stream type.

Fish Community:

A backpack DC electrofishing unit was used to stun fish for identification and enumeration. Burgess Branch 3.9 was assessed using the coldwater IBI which is used to assess smaller coldwater streams. RM 5.0 could not be assessed with an IBI because there was only a single species collected.

Burgess Branch 5.0. This site was sampled in 2007 and again in 2009. Only brook trout were collected during both dates. The second collection resulted in a brook trout raw density over twice the first (5.8/100m² vs. 11.8/100m² - one electrofishing pass). At least three year classes were represented during both years, and both included young-of-the-year. While no Coldwater IBI can be applied to a sample with only a single species, based on the moderate density of brook trout, this site is judged to meet the Class B criteria for aquatic biota –fish on both occasions.

Burgess Branch 3.9. The fish assemblage at this site was sampled once- in 2009. The Coldwater IBI score was 30 out of a possible 45 (good condition), just meeting Class B criteria. Only brook trout and blacknose dace were collected. There was a relatively low density and proportion of brook trout and high proportion of blacknose dace, the later a tolerant species. The sample was descored for the IBI for the metrics: number of intolerant species, % coldwater species, and the proportion of top carnivores.

Instream Sediment Analysis for Asbestos Fibers

In-stream sediment samples from nine sites were submitted to KD Associates Inc., of South Burlington, Vt. for analysis of asbestos type and quantity. Results are presented in **Table 3**.

Analysis for asbestos type and quantity (visual area estimate and /or point count) was performed by EPA test method 600/R-93/116, utilizing Polarized Light Microscopy (PLM) and dispersion staining techniques. A total of nine sediment samples were submitted for analysis in 2009. Sediment samples were collected from the stream bottom with collections targeting the smaller size substrate (sand, gravel).

Table 3: Results of Instream Substrate Analysis for Asbestos Type and Quantity at nine sites within Lamoille River and Missisquoi River watersheds. Data from previous sampling events at these sites also shown.

Location	Station (RM)	Sampling Date	Streambed Sediment Percent Chrysotile
Hutchins Brook	2.1	5/13/2005	3.3%
		8/05/2009	4.5%
Hutchins Brook	1.6	8/14/2007	4.5%
		8/05/2009	1.5
Hutchins Brook	0.1	8/05/2009	Trace <1%
Dark Branch	3.8	8/05/2009	3.0%
Dark Branch	3.3	9/17/2007	0.8%
		8/05/2009	Trace <1%
Dark Branch	0.1	8/05/2009	Trace <1%
Gihon River	14.5	9/06/2007	No Detection
		8/05/2009	No Detection
Burgess Branch	5.0	8/25/2005	18.0 %
		9/14/2007	43.5 %
		8/05/2009	2.3%
Burgess Branch	3.9	8/05/2009	2.0%
Burgess Branch	2.6	9/06/2007	No Detection

Chrysotile fiber concentrations observed in 2009 within the Hutchins Brook watershed ranged from 4.5% at **Hutchins Brook 2.1** to Trace (<1%) at **Hutchins Brook 0.1**, the furthest downstream site.

The sediment at **Dark Branch 3.8**, which is located closest to the Lowell Tailing piles, had 3.0% chrysotile fiber detected. **Dark Branch 3.3** and **0.1** had Trace (<1%) amounts detected. Both of these sites are located downstream from several beaver ponds, which are likely retaining much sediment and associated fibers. No fibers were detected at **Gihon 14.5**, which is located just downstream from the confluence with Dark Branch.

Burgess Branch 5.0 and **3.9** had 2.3% and 2.0% detected in 2009 respectively, however previous sampling events at **Burgess Branch 5.0** have yielded concentrations as high 43%. This variability may be due to sediment heterogeneity within this section of stream.

The presence and concentrations of chrysotile fibers observed within these watersheds is likely a good indication of the mine tailings potential to impact these water bodies. Data suggest that the presence of elevated metals in the sediment at these sites is associated with the concentration of chrysotile fibers observed in the stream sediment (VTDEC Memo to John Schmeltzer October 05, 2008).

Streambed sediment concentrations of nickel at **Burgess 5.0** in 2007 were 1440 mg/kg, exceeding the Consensus-Based Sediment Quality Guidelines (CBSQG) Threshold Effect Concentration (TEC) of 22.7 mg/kg by nearly 60-fold. Additionally whole fish metal analysis on Brook Trout collected from **Burgess Branch 5.0** in 2007 yielded the highest concentration of nickel observed (4.5 mg/kg) at the 6 sites sampled within the Eden/Lowell mine site. These findings are consistent with the literature, trace metal uptake in native fish, exposed to very high chrysotile concentrations in a stream have been reported with significant levels of nickel in the epiaxial muscle (Schreier et al. 1987).

Water Quality:

Results of water chemistry measures - pH, alkalinity, conductivity, color, chlorides, sulfates, nutrients: Total phosphorus (TP), dissolved phosphorus (TDP), total nitrogen (TN), nitrate +

nitrite (NOX) - and physical parameters related to sediment stress - turbidity, and total suspended solids (TSS) - are summarized in **Table 4**.

Water samples were also tested for total metals. **Table 5** summarizes the results for the following metals analyzed: Calcium, Magnesium, Sodium, Potassium, Arsenic, Cadmium, Chromium, Copper, Manganese, Nickel, Iron, Lead, Zinc and Hardness.

Many of the water quality measures are reflective of the presence of asbestos mine tailings within the stream and watershed. Conductivity, hardness, alkalinity and pH measures have been observed at elevated levels at sites closest to the mine tailing piles, such as **Burgess Branch 5.0**.

Elevated metals in the water column such as nickel and magnesium are also reflective of the mine tailings and the composition of the chrysotile fiber (Ni, Co, Cr, Mn and Mg). The high levels of magnesium contribute to the elevated conductivity, alkalinity, hardness and pH. The highest levels of magnesium during the 2009 study were observed at **Burgess Branch 5.0**.

Nickel, which is not commonly detected in surface waters, was observed above the detection limit (5 ug/l) at **Burgess Branch 5.0, Hutchins 0.1, Hutchins 1.6** and **Hutchins 2.1**. The highest levels of nickel in the surface water have been observed at **Hutchins 2.1**, and have exceeded the National Ambient Water Quality Chronic Criteria for the protection of aquatic biota. Nickel was not detected at **Burgess Branch 3.9** and **Dark Branch 0.1**; **Hutchins 0.1** was slightly above the detection limit.

Table 4: Concentrations of surface-water chemistry at 8 sites sampled in 2009 within the Lamoille and Missisquoi River watersheds. Data from previous sampling events at these sites also shown.

Location	Station	SampleDate	pH	Alk mg/l	Cond umho	Color	Turb NTU	TSS mg/l	TP ug/l	TDP ug/l	TCI mg/l	TSO4 mg/l	TN mg-N/l	TNOX mg-N/l
Burgess Branch	5.0	8/25/2005	8.58	278	566	5	0.23	<1	7.4	7.3	4.8	29.2	0.43	0.32
		8/15/2007	8.53	246	495	12.5	0.86	1.43	7.03	5	3.31	22.8	0.5	0.37
		9/14/2007	8.74	230	403	-	0.35	-	8.57	6.73	2.36	22.1	0.46	0.39
		9/03/2009	8.39	276	534	12.5	1.46	-	28.6	9.38	3.5	24.6	0.38	0.22
Burgess Branch	4.9	8/05/2009	8.35	191	379	-	0.7	-	11.2	9.11	<2	16.5	0.37	0.27
Burgess Branch	3.9	8/05/2009	8.0	58.2	129	-	2.53	-	13.3	8.91	<2	6.39	0.27	0.15
		9/03/2009	8.18	137	286	12.5	0.97	-	10.2	9.29	<2	13.8	0.32	0.19
Dark Branch	0.1	8/15/2007	7.64	75.6	173	-	1.08	1.15	12.50	9.83	3.87	5.23	0.25	0.08
		8/05/2009	7.74	69.8	150	-	1.9	-	20.3	13.8	2.69	3.99	0.22	<0.05
Gihon River	14.5	8/15/2007	7.77	50.2	133	-	1.01	2.92	10.50	7.17	6.14	5.03	0.24	0.09
		9/06/2007	7.43	51.7	143	15	0.82	-	7.80	7.38	8.34	5.74	0.24	0.1
Hutchins Brook	0.1	9/13/2007	8.29	102	192	25	0.77	-	8.61	6.35	<2	2.34	0.21	<0.05
		8/05/2009	7.75	75.9	148	-	3.76	-	19.2	14.8	<2	2.12	0.23	<0.05
Hutchins Brook	1.6	8/14/2007	7.91	166	315	55	2.38	2.29	12.10	6.51	<2	1.8	0.22	<0.05
		8/05/2009	7.71	106	210	-	1.63	-	11.40	9.03	<2	4.12	0.19	<0.05
Hutchins Brook	2.1	5/13/2005	8.39	87.6	241	10	<0.2	1.4	5.20	<5	0.36	7.93	0.33	0.29
		8/14/2007	8.44	134	278	7.5	0.55	<1	5.73	<5	<2	10.7	0.5	0.4
		9/13/2007	8.40	140	260	15	0.26	-	7.54	<5	<2	11.1	0.51	0.44
		8/05/2009	8.04	95.3	186	-	0.85	-	9.95	10.3	<2	6.47	0.34	0.24

Table 5: Concentrations of surface-water metal chemistry at 8 sites sampled in 2009 within the Lamoille and Missisquoi River watersheds. Data from previous sampling events at these sites also shown.

Location	Station	Sample Date	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Sodium (mg/L)	Total Potassium (mg/L)	Total Arsenic (ug/L)	Total Cadmium (ug/L)	Total Chromium (ug/L)
Burgess Branch	5.0	8/25/2005	17.7	64.6	3.3	1.3	2.28	<1	<5
		8/15/2007	13.8	59.5	2.47	1.2	2.7	<1	<5
		9/14/2007	12.3	55.7	2.15	1.39	2.91	<1	<5
		9/03/2009	15.6	67.8	2.89	1.36	3.1	<1	<5
Burgess Branch	4.9	8/05/2009	9.88	48.6	1.76	1.26	2.85	<1	<5
Burgess Branch	3.9	8/5/2009	6.48	12.1	1.01	0.45	<1	<1	<5
		9/03/2009	11.3	31.1	1.83	0.8	1.1	<1	<5
Dark Branch	0.1	8/15/2007	10.5	13.2	2.01	0.4	2.76	<1	<5
		8/05/2009	9.89	12.9	1.53	0.42	2.77	<1	<5
Gihon	14.5	8/15/2007	7.78	7.71	3.98	0.34	1.95	<1	<5
		9/06/2007	9.08	8.56	5.23	0.39	1.47	<1	<5
		8/05/2009	8.38	8.89	2.9	0.38	1.89	<1	<5
Hutchins Brook	0.1	9/13/2007	9.43	18.9	0.65	0.38	2.43	<1	<5
		8/05/2009	9.53	13.7	0.64	0.26	3.62	<1	<5
Hutchins Brook	1.6	8/14/2007	9.63	36.3	0.52	0.28	7.02	<1	<5
		8/05/2009	8.41	24.3	0.49	0.26	5.12	<1	<5
Hutchins Brook	2.1	5/13/2005	7.58	18.6	0.54	0.26	3.49	<1	<5
		8/14/2007	8.43	32.7	0.73	0.34	12.4	<1	<5
		9/13/2007	8.7	31.4	0.73	0.36	11.7	<1	<5
		8/05/2009	7.64	20.9	0.53	0.25	3.13	<1	<5

Table 5 (continued): Concentrations of surface-water metal chemistry at 8 sites sampled in 2009 within the Lamoille and Missisquoi River watersheds. Data from previous sampling events at these sites also shown.

Location	Station	Sample Date	Total Copper (ug/L)	Total Manganese (ug/L)	Total Nickel (ug/L)	Total Iron (ug/L)	Total Lead (ug/L)	Total Zinc (ug/L)	Total Hardness (mg/L)
Burgess Branch	5.0	8/25/2005	<10	22.0	11.3	-	-	-	-
		8/15/2007	<10	24.4	16.6	103	<1	<50	280
		9/14/2007	<10	23.1	13.6	128	<1	<50	260
		9/03/2009	<10	76.6	15.4	3.34	<1	<50	318
Burgess Branch	4.9	8/05/2009	<10	39.5	12.8	369	<1	<50	225
Burgess Branch	3.9	8/05/2009	<10	54.9	<5	405	<1	<50	66.2
		9/03/2009	<10	37.3	<5	241	<1	<50	156
Dark Branch	0.1	8/15/2007	<10	66.6	<5	340	<1		80.6
		8/05/2009	<10	61.6	<5	329	<1	<50	77.9
Gihon	14.5	8/15/2007	<10	59	<5	263	<1		51.2
		9/06/2007	<10	22.6	<5	-	-		-
		8/05/2009	<10	53	<5	270	<1	<50	57.5
Hutchins Brook	0.1	9/13/2007					<1	<50	-
		8/05/2009	<10	167	9	664	<1	<50	80.3
Hutchins Brook	1.6	8/14/2007	<10	193	23.2	1020	<1	<50	174
		8/05/2009	<10	64.5	22.1	687	<1	<50	-
Hutchins Brook	2.1	5/13/2005	<10	<5	28.7	-	<1	<50	-
		8/14/2007	<10	<5	70.6	<50	<1	<50	156
		9/13/2007	<10	5.66	76.9	-	<1	<50	-
		8/05/2009	<10	5.05	38.7	54.3	<1	<50	105

Summary:

In summary, the biological and/or chemical assessments conducted on nine sites within the Lamoille and Missisquoi watersheds in 2009 helped to complement previous assessments and fill in some data gaps. The addition of **Burgess Branch 3.9**, helped to further delineate the zone of impact within the Burgess Branch watershed, and revealed that the biological community this site meets Class B minimal expectations for the SHG stream type for both fish and macroinvertebrates.

Additional assessments at **Burgess Branch 5.0** provide further evidence that the aquatic biota as measured by the macroinvertebrate community assessment is degraded and does not meet Class “B” biocriteria for SHG type streams. The Aquatic Life Support of **Burgess Branch RM 4.9 to 5.4** was listed as impaired in 2008 (State of Vermont 303(d) List of Waters), due to sediments from mine tailing erosion.

We recommend further monitoring within the Hutchins Brook watershed to include delineating the zone of disturbance within **Hutchins Brook** between **RM 2.0** and **0.1**. The Aquatic Life Support of **Hutchins Brook RM 2.0 to 3.0** is listed as impaired due to sediments from mine tailing erosion. Additionally chemical and biological monitoring should be continued at representative sites within the Lamoille and Missisquoi watersheds. EPA’s recent activities on the mine site have focused on reducing the amount of tailing runoff from entering both the Burgess Branch and the Hutchins Brook watersheds. It is conceivable that these improvements will have positive biological and chemical results in the foreseeable future.