Basin 6

Missisquoi River Watershed
Assessment Report

Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division

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Water Quality and Aquatic Habitat

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November 2004

Contents

General Watershed Description

The Missisquoi River rises near the town of Lowell, flows northward into Canada crossing the border at North Troy, returns to the United States at East Richford, Vermont and then follows a westerly direction to Lake Champlain. The highest point in the watershed is Jay Peak at elevation 3,861 feet. The watershed drains 855 square miles of which 619 square miles are in Vermont and 236 square miles are in Canada. Its length is about 88 miles. The major tributaries include Black Creek, Tyler Branch, and the Trout River, which come from the south, and Mudd Creek and the North Branch, which flow from the north.

The river valley from the mouth to North Troy is generally open farming country, about one-third to one-half mile wide with the exception of several rock sections. The uplands are rolling, moderately wooded with small sections under cultivation. The upper reaches of the river and some of the tributaries are mountainous and covered with second growth timber. Rock outcrops appear in both the river bed and on the banks at Highgate, Sheldon Springs, Enosburg Falls, Richford, and North Troy. Land use is briefly summarized in Table 1 below. Housing unit and population numbers and growth are given in Appendix C.

Table 1. Land Use and Land Cover in the Vermont portion of the Missisquoi River Watershed[1]

Land Use	Acres	% of Total
Forested	259,935.3	66.0
Agriculture	74,397.8	18.9
Surface Water	20,779.4	5.3
Wetlands	17,913.3	4.5
Transportation	14,309.2	3.6
Developed Land	4,207.9	1.1
Old Field & Barren	2,323.8	0.6
Total:	393,866.7	100.0

1 Vermont Land Cover Classification Project, 1997 (based on satellite photographs from 1991 - 1993).

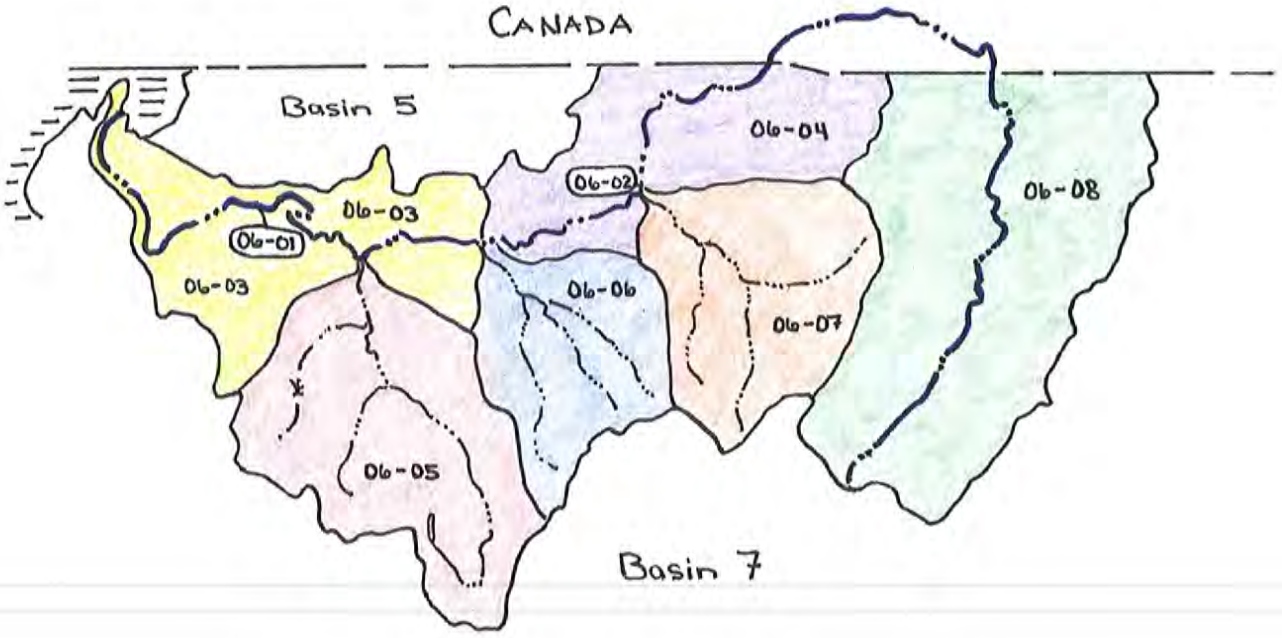
The 37 inventoried lakes and ponds in the Missisquoi River basin comprise 943 acres. Most of these lakes and ponds are quite small, and the ownership status of these is unknown to Vermont DEC. As such, only 9 of the ponds are assessed, which accounts for 78%, or 744 of the 943 lake acres in the basin. Individual lakes in the basin range in size from 446 acres (Fairfield Pond) to only 1 acre (Lockwood Pond). A few small unassessed waterbodies are discussed below as these may constitute important public resources.

The Missisquoi River watershed has been divided into eight "waterbodies" for the purpose of assessing the rivers and streams of this large drainage basin. Lakes and ponds are numbered as subsets of the eight riverine waterbodies. Waterbody VT06-01 or the "Lower Missisquoi River" is the mainstem stretch of the river from its mouth upstream to the confluence of the Tyler Branch. VT06-02 or the "Mid Missisquoi River" is another mainstem waterbody and is the reach from the confluence of the Tyler Branch to the

Canadian border. VT06-03 consists of all the tributaries that flow into the Lower Missisquoi River such as Hungerford Brook and Kelly Brook. The tributaries that flow into the Mid Missisquoi River including Giddings Brook, Trout Brook, Stanhope Brook, and Lucas Brook are all part of VT06-04. VT06-05 is Black Creek and its watershed, which includes the Fairfield River, Dead Creek, Wanzer Brook, Elm Brook and a number of other streams. The Tyler Branch and its tributaries such as The Branch, Bogue Branch, Beaver Meadow Brook are VT06-06. The Trout River and its numerous tributaries including the South Branch, West Hill Brook, Black Falls Brook, and Jay Brook is VT06-07. The Missisquoi River upstream of the Canadian border and the tributaries to it are waterbody VT06-08. Some of the large tributaries to the upper Missisquoi include Burgess Branch, Mineral Spring Brook, Mill Brook, Jay Branch, and Crook Brook.

In the text below, four waterbodies are combined into two subwatersheds for organization and description purposes: the Lower Missisquoi and its tributaries are discussed together and the Mid Missisquoi and its tributaries are discussed in one section as well.

Missisquoi River Watershed Waterbodies



Uses, Values, and Significant Features of the Missisquoi Watershed

Waterfalls, Cascades, Gorges, and Swimming Holes

The *Waterfalls, Cascades, and Gorges of Vermont* (1985) report describes five sites in Basin 6 that were surveyed in 1983. The sites include: Tillotson Mill site on Lockwood Brook in Lowell; Highgate Falls on the Missisquoi River in Highgate; Sheldon Falls on the Missisquoi in Sheldon; Bakers Falls on the Missisquoi in Troy; and Big Falls on the Missisquoi also in Troy. Highgate Falls, Sheldon Falls, and Bakers Falls have all been altered by hydroelectric facilities, although at Bakers Falls, the facility is not operating and water flows over the dam into the cascades below, and at Sheldon Falls, there are minimum flow requirements that were not in place at the time of the *Waterfalls, Cascades and Gorges* study. Big Falls of the Missisquoi are spectacular falls consisting of three channels, which drop about 25 feet. They are the largest undammed waterfalls on a major river in Vermont. Below the falls is a gorge over 200 feet long with 600-foot high walls. Deep water and several sandy beaches are at the bottom of the gorge. A 16-acre site that includes Big Falls is now a State Natural Area.

The *Vermont Swimming Hole Study* (1992) report describes eleven river or stream swimming hole sites in the Missisquoi River watershed. Two of these sites are on the Missisquoi mainstem and are described above: Big Falls and Highgate Falls Dam. Nine sites are on tributaries to the Missisquoi River: Lowell Twin Falls on the East Branch; Troy Four Corners on the Jay Branch; Hectorville Bridges and Hutchins Covered Bridge on the South Branch of the Trout River; Montgomery School House and Longley Covered Bridge on the Trout River; Kidder's on Tyler Branch; and Creamery Covered Bridge and Hippy Hole on West Hill Brook. Of these nine sites, seven of them have either falls or cascades or both as features as well as the pools people enjoy for swimming. These and additional swimming holes, waterfalls, and other special features are described in the separate waterbody sections below.

The *Whitewater Rivers of Vermont* (1989) report describes two whitewater stretches on the Missisquoi River. The first is a 6-mile reach that begins in East Richford and goes to Richford. Most of the length is quickwater or Class I whitewater but about a mile above Richford, it becomes Class II and in Richford village, there are some Class III ledges with difficult waves. The second stretch on the Missisquoi goes from the bridge in North Sheldon to Sheldon Springs dam. The reach is largely quickwater and flatwater with a mile-long stretch of intermittent Class II rapids.

Significant Natural Communities

A number of statewide natural community inventories have been done by the Vermont Department of Fish and Wildlife Nongame and Natural Heritage Program (NNHP) over the last 10 years: northern white cedar and red maple-cedar swamps, floodplain forests, and hardwood swamps are some of the communities inventoried. In addition, other significant natural communities as well as rare, threatened or endangered plant or animal species have been documented by NNHP. The documented significant natural communities and rare, threatened or endangered species in the Missisquoi River watershed are summarized below.

The Missisquoi River Delta Complex contains the largest floodplain forest ecosystem in Vermont and includes both riverine and lakeshore floodplain forests. The Missisquoi delta also includes deep bulrush marshes, a pitch pine woodland bog known as Maquam Bog, excellent examples of silver maple-green ash swamps, and a buttonbush swamp. There are a number of rare, very rare, threatened and endangered plant and animal species on the delta. Some of these include: the pied-billed grebe, sora, and red-headed woodpecker all of which are species of special concern; the Virginia chain-fern and the black tern, which are threatened; rare black gum trees; rare to uncommon small beggar's-ticks; the endangered osprey; and the very rare lance-leaved loosestrife and prickly hornwort; among others.

The Missisquoi River itself, especially in the stretch from Highgate Falls down to the mouth, has a number of threatened or endangered aquatic species present. Below Highgate dam in Highgate Falls, there are five endangered mussel species including the cylindrical papershell mussel, pocketbook mussel, fluted-shell mussel, black sandshell mussel, and giant floater mussel; and a threatened fish, the eastern sand darter. The Lower Missisquoi has the endangered lake sturgeon, the threatened spiny softshell turtle, and also five species of endangered mussels as part of its aquatic community.

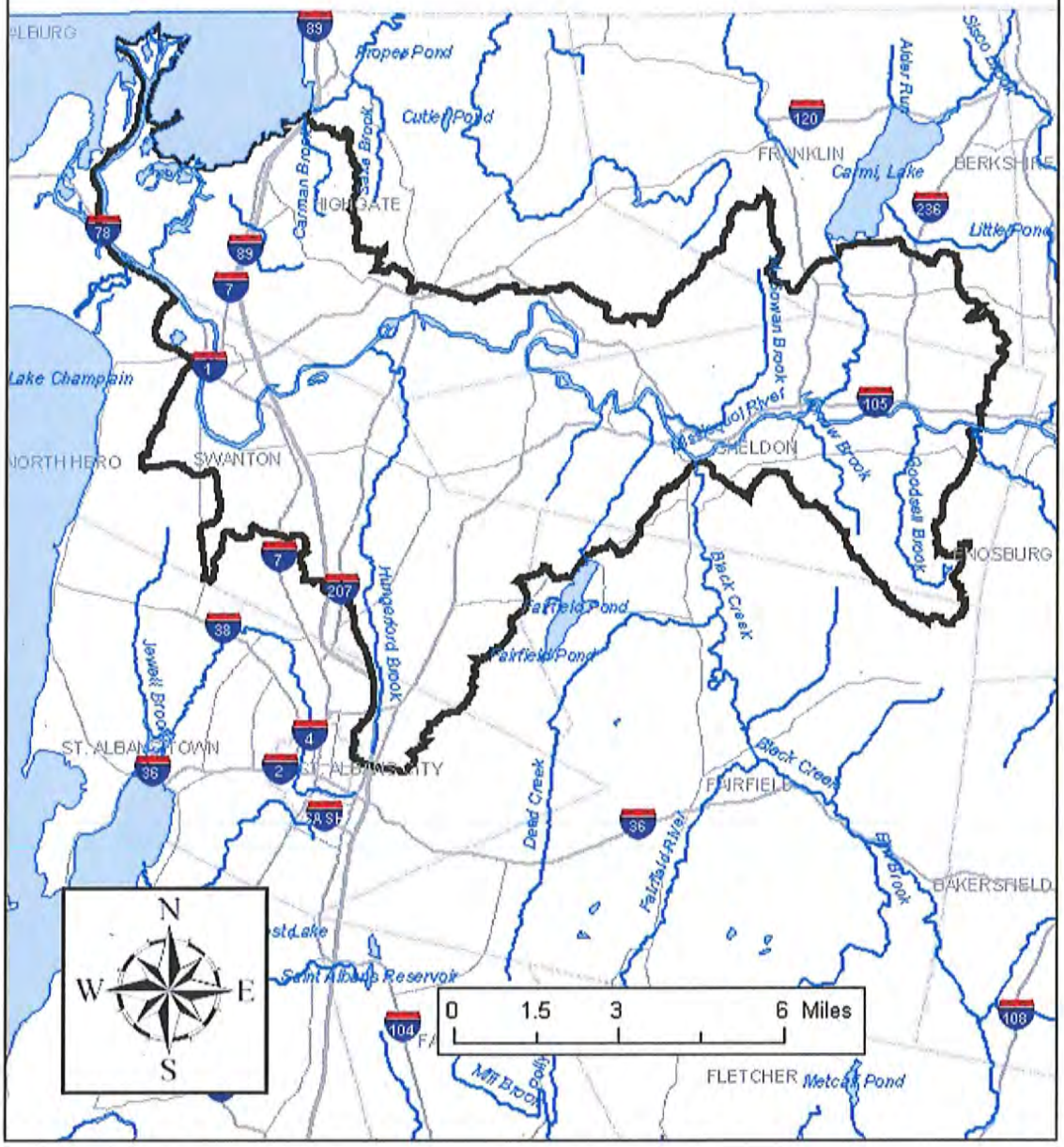
Fairfield Swamp is a 1500-acre lake/wetland complex that includes a number of wetland community types: deep bulrush marsh, dwarf shrub bog, northern white cedar swamp, and red maple-northern white cedar swamp. The red maple-cedar and northern white cedar swamps cover about 140 acres south of Route 36 and these communities are also likely north of the road. In addition, three very rare plant species, one of which is state-threatened, and the least bittern, which is a species of special concern, are all part of the Fairfield Swamp complex.

Three other sites have either a northern white cedar swamp or red maple-northern white cedar swamp community. Tamarack Brook Flats in Lowell and Troy is a site that has an extensive beaver pond at the headwaters and an undisturbed northern white cedar swamp and spruce-fir flat south of the brook. The ecologist who visited it called the site " a magical, remote, little hollow." West Sheldon-Red Maple Cedar Swamp is a small remnant (about 10 acres) of a once large swamp at the headwaters of a small tributary to the Missisquoi in Sheldon. The swamp contains the state-threatened white adder's mouth. Quarry Swamp, a northern white cedar swamp in Swanton, was not included in the NNHP inventory.

The Missisquoi River Islands from Sheldon Junction to Highgate Falls include three groups of islands and a few single islands. The Highgate Falls Islands are just downstream of the Missisquoi River Islands and the dam at Highgate Falls and consist of a group of five islands. Two rare plants are found on the Missisquoi River Islands and a silver maple-ostrich fern floodplain forest and two uncommon plant species are found on the Highgate Falls Islands.

In addition to these sites and the significant plant, animal and natural communities mentioned above, other occurrences of unique or unusual species are found throughout the watershed. Water-related occurrences are described in the appropriate text below.

Lower Missisquoi River Watershed



Lower Missisquoi River

The lower Missisquoi River is considered the stretch of the mainstem from the mouth up to the confluence of Tyler Branch. The river flows through Sheldon, Highgate, and Swanton for just over 33 miles. The lowest portion of the river flows through the facscinating and diverse Missisquoi River Delta described some above. Much of the Delta is part of the 6300 acre Missisquoi National Wildlife Refuge.

The U.S. Geological Survey has operated a gage station on the Missisquoi River at Swanton since 1990. The monthly mean flows from 1990 to 2002 in cubic feet per second ranged from a low August mean of 591 cfs to a high April mean of 4,730 cfs. Peak flows at this station have been 37,700 (January 20,1996), 32,200 (January 9,1998), and 28,800 cfs (July 15,1997).

This reach of river includes the Highgate Falls and Sheldon Falls hydroelectric facilities. The Sheldon Springs facility includes a dam that was constructed on Sheldon Falls eliminating the falls, an intake structure, a penstock, a powerhouse and tailrace. The bypass is about 2800 feet long. The 1984 Water Quality Certification requires minimum flows in the bypass to support fisheries and whitewater boating and downstream of the powerhouse to support fisheries including walleye. The state-threatened great St. John's-wort grows on a flat shale bench high on the gorge walls below the dam. The Highgate Falls facility operates in a peaking mode with a maximum drawdown of 2 ½ feet and a minimum bypass of 35 cfs (which is only 10% of 7Q10 or 7 day low flow at this site). Below the dam, there are falls and cascades about 15 feet high and then below the falls, there is a gorge about a third of a mile long with 20 to 30 foot high walls. The minimum bypass flows are through this gorge. A table with all the dams is in Appendix B.

Walleye come up from Lake Champlain into the lower Missisquoi as far as the Swanton dam. Due to high levels of mercury in the tissue of walleye, the Department of Health has issued a fish consumption advisory recommending that women of childbearing age and children age 6 and under avoid eating walleye caught from these waters. It also recommends no more than one meal of walleye per month for all other people.

There are three permitted direct wastewater discharges, two indirect wastewater discharges, and at least seven permitted stormwater discharges to the lower Missisquoi River and its tributaries. The wastewater facilities on this stretch include the Swanton Village wastewater treatment facility (WWTF), the Sheldon Springs WWTF, and the Rock-Tenn WWTF (see Table 2.)

A hazardous waste site, the Boise Cascade/North Landfill/Lagoon (Boise Cascade/NLL), is located on Mill Street in Sheldon and is bounded on the north by the Missisquoi River. The north landfill was operated from 1955 to 1974 and was used for solid waste produced by the paper mill operations as well as paper sludge from its wastewater treatment plant. When the north landfill was closed in 1974, a new landfill (south landfill) was opened. This is also a Superfund site. The lagoon was completed in 1974 to provide secondary treatment of the paper mill wastewater. Surface flow is generally from the Boise Cascade/NLL site to the Missisquoi River.

In 1985, there was a leak in the liner of the lagoon and the lagoon contents bypassed the underdrain system. Effluent discharged to the Missisquoi River. Also in 1985, sludge

samples from the Rock-Tenn (site owners) WWTF were analyzed. Acetone, chloroform, methylene chloride, toluene, pentachlorophenol, phenol, 2-butanone, arsenic, cadmium, copper, lead, nickel, and zinc were detected. In 1994, field staff of the consulting firm hired by EPA collected four landfill surface soil samples, five Missisquoi River sediment samples, two groundwater monitoring well samples, and two lagoon samples. The results indicated "the presence of contaminants at significant concentrations in the landfill and lagoon samples." In the landfill, volatile organic compounds, semi-volatile organic compounds, and metals were detected. In the lagoon, acetone, calcium, mercury, and sodium were detected. In the groundwater, inorganics were generally at concentrations below Maximum Contaminant Levels (MCLs); nickel however was slightly above the MCL and lead was found at the federal action level. Copper was detected above the background concentration in one Missisquoi River sediment sample.

Kelly Brook

Kelly Brook is a small, low gradient slow winding stream that flows through the large sandy flat northeast of Swanton Village. Macroinvertebrates were sampled from this brook at rivermiles 1.2 and 1.4 in 1998 but no assessment was formally made due to the stream type. No severe impacts were noted when it was sampled. Kelly Brook is home to the state-threatened American brook lamprey in its mid-portion between Route 78 and the open pastures downstream where the habitat conditions support the lamprey.

The Young Landfill property is a hazardous waste site in Highgate, which is bordered on the east by wetlands that are adjacent to Kelly Brook and the "toe of the slope of the landfill is in contact with surface water. The property was first used as a sand and gravel quarry from 1953 until the early 1960s. At that time, it began operating as a municipal landfill serving nine towns. "Industrial waste disposal occurred from the 1960s until 1979 in three solvent trenches, located approximately 300 feet northwest of the landfill." (Trip Report for the Young Landfill, Highgate, Vermont done for EPA by Roy F. Weston Inc. Feb. 1999)

Following the 1978 Vermont Solid Waste Rules, the Young Landfill was given an "Assurance of Discontinuance" requiring the facility to close by April 1, 1983. In May 1984, Vermont Agency of Environmental Conservation personnel saw leachate coming from the eastern edge of the landfill and on the landfill slopes. Also in September 1984 paper sludge was being used as a landfill cover. In December 1985, the owner was told that disposal activites should cease by January 20, 1986 (no information on the failure to close by 4/1/1983 was in the files). Later investigations found that disposal activities had continued still. Groundwater, soil, surface water, and sediment sampling occurred over the years following: 1989, 1993, 1996, and 1998. The 1998 sampling done by a U.S. EPA and Vermont DEC team found nine inorganic elements above Vermont Groundwater Enforcement Standards in seep samples, and sediment in Kelly Brook contained beryllium and bis(2-ethylhexyl) phthalate in concentrations exceeding the sample detection limit and reference level respectively.

Hungerford Brook

Hungerford Brook originates east of Interstate 89 and St. Albans City. It flows north through generally flat, agricultural land into and through Swanton, the northwest corner of Sheldon, and the southern part of Highgate before joining the Missisquoi River

downstream of Highgate Falls. Hungerford Brook is a very sinuous stream with only one steep section west of Route 207 in its 10.3-mile long journey.

Hungerford Brook was sampled in 1999 at rivermile 3.9 and determined to be stressed - very turbid water, lots of algae and macrophytes (rooted aquatic plants). It needs further assessment.

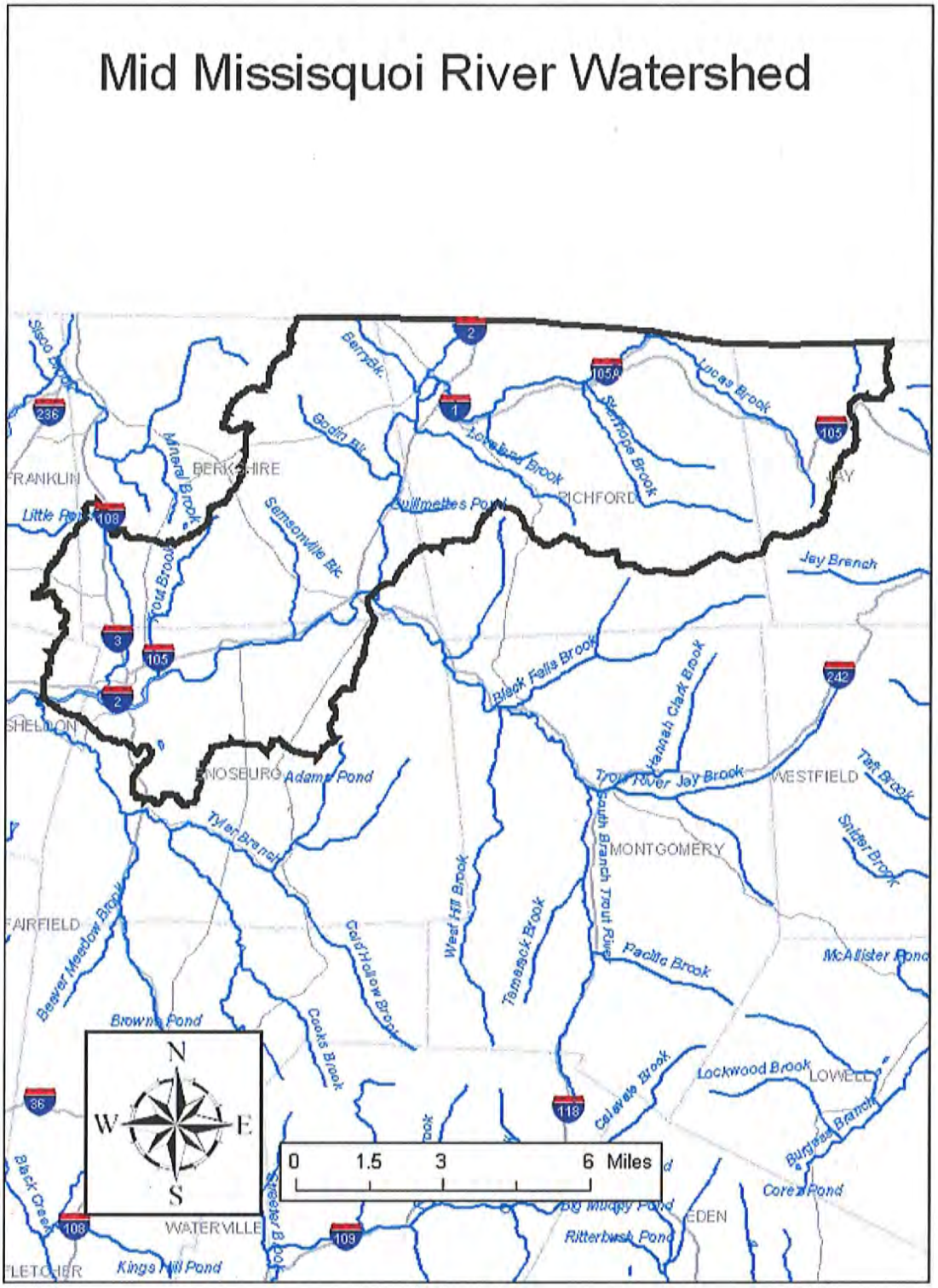
Morrow and McGowan Brooks
Morrow and McGowan Brooks are two small streams in the town of Sheldon that enter the Missisquoi below North Sheldon and Sheldon Junction respectively. Both streams were visited in July 2000. The turbid waters, lack of buffers, and presence of cows in the streams were noted during the field visit.

Oxbow Lake
This is a true oxbow of the Missisquoi River, located in Swanton. No water quality data are available for the pond. The most recent aerial orthophotograph shows this pond to be surrounded on all but the southern shore by active agricultural land. The south shore is forested, and there appears to be a narrow buffer of trees along much of the shoreline. The public accessibility of this pond is unclear, and the pond merits assessment to determine designated use support.

Assessment Summary for the Lower Missisquoi River

Impaired Miles
Missisquoi River: 8.0 - from mouth upstream to Swanton dam - fish consumption impaired due to mercury contamination from atmospheric deposition.

Stressed Miles
Missisquoi River: whole length - aquatic biota/habitat and aesthetics stressed from high sediment loads, turbidity, nutrient enrichment, likely temperature from agricultural land uses, loss of riparian vegetation and streambank erosion. Also (subset of above) aesthetics stressed below Highgate Falls Hydro facility due to 35 cfs minimum flow (1/10 of 7Q10) and habitat, aesthetics stressed for 3 miles upstream of the facility due to impoundment.
Hungerford Brook: 2.0 - upstream from rivermile 2.9 - aquatic biota/habitat and aesthetics stressed from nutrients, sediment, turbidity caused likely by agricultural activities.
Kelly Brook: 0.3 - downstream from Youngs Landfill site - aquatic habitat (at least) stressed due to an inorganic and semivolatile organic compound found in sediments from the landfill.
Morrow Brook: 2.6 - whole length - aquatic habitat, aesthetics stressed due to sedimentation, turbidity, nutrient enrichment, likely temperature, due to cows in the stream, pasture land.
McGowan Brook: 1.0 - upstream from mouth - aquatic habitat, aesthetics stressed due to sedimentation, turbidity, nutrient enrichment, likely temperature, due to cows in the stream, pasture land.


Mid Missisquoi River Watershed
FRANKLIN
BERKSHIRE
RICHFORD
Little Pond
Mineral Brook
Trout Brook
Sampsonville Bk
Bullimettes Pond
Berry Bk
Sodin Bk
Lowland Brook
Stevens Brook
Lucas Brook
Jay Branch
Black Falls Brook
Hannah Clark Brook
Trout River
Jay Brook
WESTFIELD
Tatt Brook
Snitzer Brook
SHELDON
ENOSBURG
Adams Pond
Tyler Branch
MONTGOMERY
South Branch Trout River
Pacific Brook
McAllister Pond
FAIRFIELD
Beaver Meadow Brook
Cold Hollow Brook
West Hill Brook
Tamasack Brook
Brown's Pond
Cooks Brook
Lockwood Brook
LOWELL
Calvert Brook
Burgess Branch
Coren Pond
Big Muddy Pond
EDEN
Ritterbush Pond
WATERVILLE
Kings Hill Pond
Black Creek
N
W
E
S
0 1.5 3 6 Miles

Mid Missisquoi River
The Mid Missisquoi River is the reach of the river from the U.S.-Canada border downstream to the confluence of Tyler Branch. As the Missisquoi flows back into the United States from Quebec, it flows southwesterly through East Richford where Lucas Brook joins it. About a mile and a half downstream, Stanhope Brook flows into the Missisquoi from the south. The Missisquoi River then continues generally westerly to the village of Richford where the North Branch comes in. From Richford, it flows in a southerly direction. Upstream of East Berkshire, the Trout River joins the Missisquoi. The Missisquoi River then flows more westerly than southerly for almost seven miles before it passes through Enosburg Falls and over the dam in the village. A few miles below the village, the Tyler Branch comes in and marks the end of this river reach.

On August 5, 2000, there was large fire in North Troy at a feed mill. Water used to extinguish the fire washed copper sulfate from the mill buildings into the Missisquoi River causing a huge fish kill. The extent of the fish kill was from North Troy through Quebec to rivermile 49.6 in Richford, Vermont, an estimated 8.6 miles in Vermont and approximately 23 ½ miles overall. Personnel from the Department of Fish and Wildlife and the Department of Environmental Conservation Water Quality Division estimated that 26,600 fish of 16 different species died based on sample counts. Young of year fish were observed in areas where adults were dead or dying and young were also seen at the mouths of tributaries. These observations were the basis for the expectation that there would be a good recovery of the fish community within a few years.

There are two direct wastewater discharges and at least ten permitted stormwater discharges that go to the Mid Missisquoi River and its tributaries. The wastewater treatment facilities are Enosburg and Richford (see Table 2).

Samsonville, Godin, and Berry Brooks
Samsonville and Godin Brooks originate in Berkshire and flow south/southeasterly to the Missisquoi River. Berry Brook and its North Branch originate in Quebec, flow south-easterly through Berkshire and into Richford where Berry Brook joins the Missisquoi River.

Samsonville, Godin, and Berry (including the North Branch of Berry) Brooks watersheds were part of the federal Clean Water Act Section 319 National Monitoring Program. Calibration monitoring occurred in these watersheds from 1994 through 1996. Samsonville (watershed 1) and Godin (watershed 2) received nonpoint source pollution prevention treatments in 1997. Berry Brook watershed was the control with no treatments. Follow-up monitoring occurred from November 1997 through November 2000. Although Godin Brook watershed was a treatment watershed, there was a large farm expansion from Year 6 of the project through Year 7 and the erosion and runoff from major land clearing and poor riparian zone management negated the earlier positive effects of treatments.

Phosphorus, nitrogen, suspended solids, and indicator bacteria were all reduced in the brooks in response to livestock exclusion and riparian zone protection. Values for Samsonville Brook at the project end showed the reductions in nutrient and suspended solid concentrations and exports and the reductions in bacteria concentrations as a response to the treatments. Those for Godin Brook did not because of the land disturbance at the farm and runoff in the last year of project sampling.

Macroinvertebrate sampling occurred on Godin Brook, Samsonville Brook, Berry Brook, and North Branch Berry Brook prior to and throughout the Section 319 nonpoint source treatment project described above. The Godin Brook macroinvertebrate community was in "poor" to "fair" health from 1992 until 1999 when it looked as if the brook was improving (a "good" assessment was obtained in 1999). A "fair" condition in 2000, however, quickly halted the trend but was not surprising given the land disturbance that occurred during the unexpected large farm expansion in this small watershed between those two years. Samsonville Brook did show an improvement to a "good" macroinvertebrate community in the fourth year at one of two sampling points on the brook. Berry Brook was the reference stream and had a "good" to "excellent" macroinvertebrate community. The specific macroinvertebrate sampling results, the year of the sample, and the rivermile are given in Appendix A, Table A-1.

Trout Brook

The macroinvertebrate community was sampled in September 1993 at rivermile 2.3 and was found to be in "poor" condition. No more recent information is available.

Assessment Summary for the Mid Missisquoi River Watershed

Impaired Miles

North Branch Berry Brook: 0.5 - from confluence with Berry Brook upstream 1/2 mile - aquatic biota/habitat, contact recreation, and aesthetics impaired due to nutrients, pathogens, organic matter and sediments from agricultural activities including barnyard and milkhouse runoff.

Berry Brook: 0.9 - from mouth upstream to confluence of North Branch - aquatic biota/habitat, contact recreation, and aesthetics impaired due to nutrients, organic matter, pathogens, and sediment due to agriculture.

Samsonville Brook: 2.0 - from mouth upstream 2 miles - aquatic biota, contact recreation, and aesthetics due to nutrients, pathogens, organic matter and sediment from agriculture.

Godin Brook: 1.0 - aquatic biota/habitat, contact recreation, and aesthetics due to nutrients, organic enrichment, and pathogens from agricultural activities including cows in the brook.

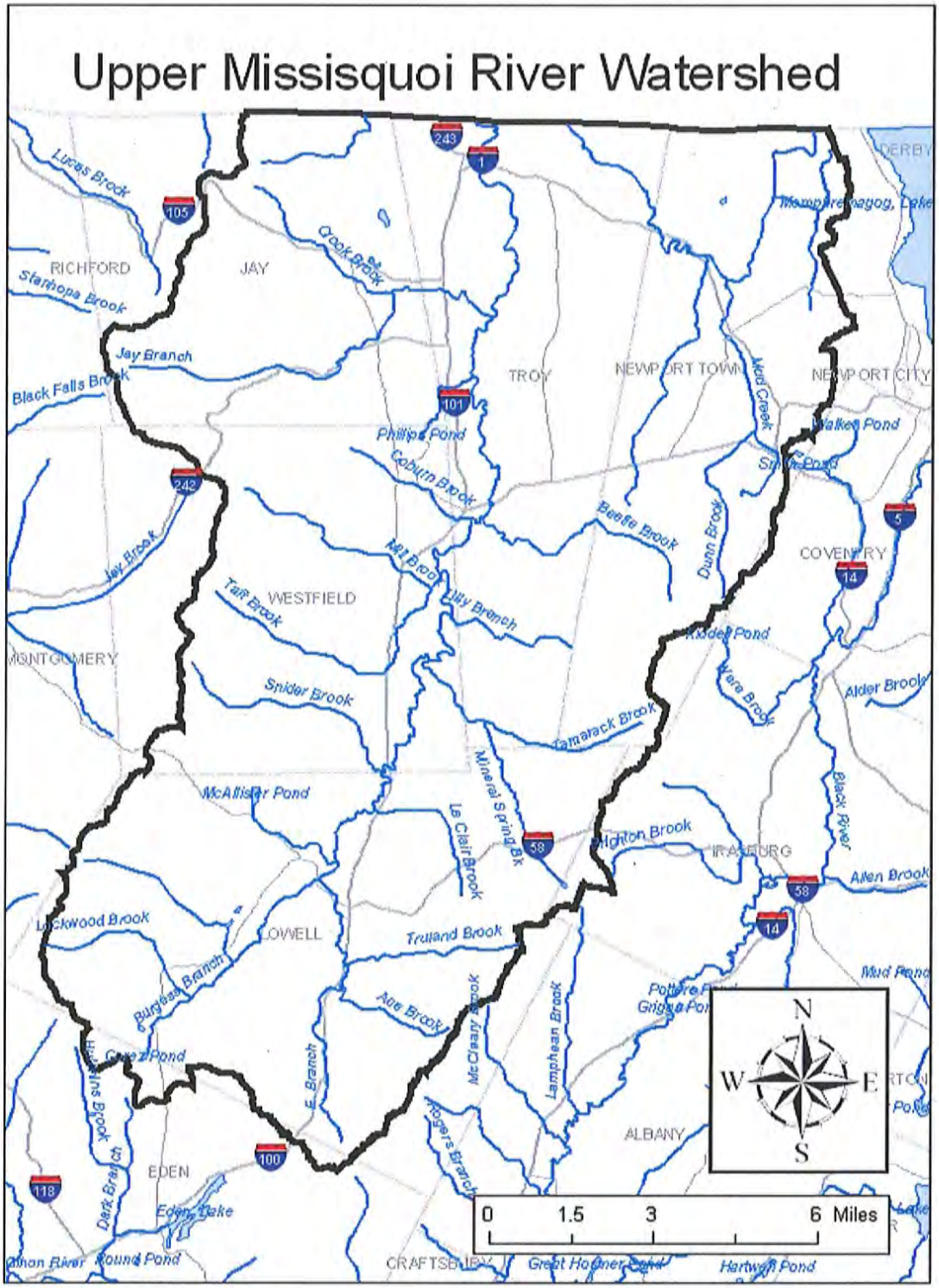
Trout Brook: 2.3 - aquatic biota/habitat impaired due to nutrients and organic enrichment from agriculture.

Altered Miles

Missisquoi River: 0.1 - below Enosburg Falls - aquatic biota/habitat altered due to artificial flow regulation from hydroelectric facility.

Stressed Miles

Missisquoi River: 22.7 - aquatic biota/habitat and aesthetics due to sedimentation and turbidity, habitat and thermal modifications, and nutrient enrichment from agricultural land uses, streambank erosion, streambed erosion and re-suspension of bottom sediments.


Upper Missisquoi River Watershed
Lucas Brook
Creek Brook
RICHFORD
JAY
Starhope Brook
Jay Branch
Black Falls Brook
TROY
NEWPORT TOWN
NEWPORT CITY
Mud Creek
Walker Pond
Phillips Pond
Cobb Brook
Beebe Brook
Dunn Brook
COVENTRY
Jay Brook
Taft Brook
WESTFIELD
Mill Brook
Lilly Branch
Snider Brook
Tamarack Brook
Alder Brook
Black River
McAllister Pond
Le Clair Brook
Mineral Spring Br
Lockwood Brook
LOWELL
Truland Brook
Burgess Branch
Ayer Brook
Lamphear Brook
Hawkins Brook
Dark Branch
E. Branch
Rogers Branch
ALBANY
EDEN
Eden Lake
Round Pond
CRAFTSBURY
Great Hosmer Pond
Hartwell Pond
N
W
E
S
0
1.5
3
6 Miles

Upper Missisquoi River
The Upper Missisquoi River is the stretch from the junction of Burgess Branch and the East Branch northwest of Lowell village to the Canadian border in North Troy. From the confluence of these two branches, the Missisquoi River flows in a northerly direction. As it flows into the town of Westfield, Snider Brook joins the river. About three and a half miles downstream, the river passes east of Westfield village and Taft Brook enters the river. In another four miles, Beetle Brook flows into the river. The river flows over Phelps Falls masonry dam and then north still with Jay Branch, which carries the flow of its watershed as well as that of its tributary Crook Brook, joining the river from the west. The river continues north over Black Falls and through its dramatic gorge below then through the village of North Troy and over the Canadian border into Quebec.

There are three permitted direct wastewater discharges, two permitted indirect wastewater discharges, and at least seven permitted stormwater discharges to the upper Missisquoi River watershed. The wastewater treatment facilities include Troy/Jay, Newport Town, and North Troy (see Table 2.)

East Branch Missisquoi River
The East Branch of the Missisquoi River flows northwesterly down off the slope of the Lowell Mountains and flows under Route 100 just north of Eden/Lowell town line. From here, it flows northerly through a small valley into Lowell Village where it meets Burgess Branch. Ace Brook and Truland Brook are tributaries to the East Branch that enter from the east. The East Branch is about 6.3 miles long.

Lowell Twin Falls is a place to swim and fish in Lowell Village on the East Branch. The site has cascades, a large waterfall split in two by a bedrock outcrop, and a deep pool good for swimming. This place was visited and described in 1991 for a swimming hole survey.

The East Branch was surveyed by Vermont DEC Water Quality Division staff in June 2000 and July 2004. The land uses seemed to stay the same over this four year period: pastureland with cows, gravel pits, rural residential development, gravel and paved roads (Routes 100 and 58) and associated bridges, and the village of Lowell. The gravel pits, including access to them, and the pastureland with the brook flowing right through it and no cow exclusion, appear to have the greatest impact on this stream.

Taft Brook
Taft Brook originates up in the Green Mountains on a ridge between Domey's Dome and Buchanan Mountain. It flows southeasterly from the mountains, turns to the north after Route 100, and then flows northerly through agricultural fields (hay and some pasture) to the Missisquoi River. It is approximately 6 ½ miles long. Mill Brook enters Taft Brook just before Taft joins the Missisquoi.

Taft Brook was sampled in 1999 and 2000. In September 1999 at rivermile 0.1, the macroinvertebrate community was in "poor" condition. There was poor EPT and BI and the sample was dominated by bloodworms. The stream bed smelled strongly and it looked like whey or milkhouse waste was getting into the stream. In September 2000 at rivermile 0.1, the fish community was in "fair" condition. A field survey in June 2000 noted cultivated fields and pasture with a cow crossing at the lower end of Taft Brook. A field survey in July

2004 noted hayfields, clear water, no silt or algae on substrate, vegetated banks and a narrow buffer (one tree wide). This brook was re-sampled in fall 2004.

Coburn Brook
Coburn Brook originates on the eastern slopes of the foothills of the Green Mountains north of Taft Brook and Mill Brook. It flows southeasterly and enters the Missisquoi River just southeast of Troy. The upper portion of the brook is forested but the lower one mile to mile and a half is through pasture and hay lands with scattered small wooded stretches.

Macroinvertebrate sampling on Coburn Brook in 1999 at ABN rivermile 0.1 below Route 100 bridge had a community in "poor" condition and sampling in 2000 at rivermile 0.2 above Route 100 also showed the community in "poor" condition. The metrics showed high density and a lot of Oligochaetes. Nutrient enrichment is causing the impairment. This is unfortunate because an early assessment reported: "[t]he 1994 biological assessment of both the fish and macroinvertebrate communities show the stream community is now recovered from the Kraft Agri-Mark impact documented in previous years... In summary, [the Coburn Brook aquatic community] is moderately stressed by non-point sources of enrichment but still in overall good conditions."

Jay Branch
The Jay Branch originates in the Green Mountains north of Jay Peak. It flows rapidly to the east through steep, mostly forested but partially developed land for several miles before making a northeasterly turn. It continues northeasterly then north and after Crook Brook enters, east again for another few miles into the Missisquoi River. The well-used "Troy Four Corners" swimming hole area is on Jay Branch located east of Route 101 – falls, a deep pool, jumping spots, clear water, and shade make it a popular place on many summer days.

Jay Branch was surveyed in summer 1999 and summer 2000. The macroinvertebrate community was sampled on this brook in 1999 at rivermile 4.6 and was in "fair" condition. The fish community has not been sampled in the last 10 years. In the summary from the 1999 windshield survey, it was noted that " The channel is dominated by cobble and boulder riffles, runs, and pools. Evidence of degradation and aggradation was apparent practically everywhere: large gravel bars, eroded and slumped banks, and split channels. It is often channelized with rip-rap sections - especially near the roads and houses further upstream." Jay Branch Trib 7 was sampled in 1993 and the macroinvertebrate community at rivermile 1.2 then was assessed as "good".

Jay Branch was also surveyed in the summer 2004 and was found to be turbid unlike nearby Crook Brook and the agricultural Coburn Brook. The silt and sediment discharges were originating from a major land disturbance/golf course construction project at Jay Peak Ski Area where there was much exposed soil and inadequate erosion control. The situation needs follow-up monitoring and compliance checks.

Crook Brook
Crook Brook originates on the eastern slopes of the Green Mountains in the town of Jay. It flows southeasterly for three and a half miles before joining the Jay Branch.

Windshield surveys done in August 1999, June 2000, and August 2004 noted a good canopy cover and forested land along much of this stream. Eroded banks were noted in some locations but there is not enough information provided to determine the causes. The brook flows down a narrow, steep valley in stretches and looks to be a flashy stream. The substrate is identified as boulder, cobble, gravel in most locations observed and the water was clear. Roads cross this brook seven times. A macroinvertebrate sample was taken on Crook Brook at rivermile 1.6 in 1999 and the community was found to be in "good" condition.

Beetle Brook

Beetle Brook originates from several small upland streams in the southern part of the town of Newport. It flows generally northwesterly for about five miles joining the Missisquoi River southeast of Troy village.

Beetle Brook was surveyed in August 1999. The canopy cover and riparian vegetation varies along the brook's length - hayfield, pasture, and near Morey Road (a relatively new or upgraded road) residential lawns alternate with wooded areas as the adjacent land use. Algae was noted on the channel substrate fairly frequently and embeddedness up to 50% was noted. The 1990 assessment read: "Beetle Brook: 1.0 - from Troy talc mine to Missisquoi - partial support of biota due to severe sedimentation from erosion. Town highway being upgraded." It is not known if this town highway upgrade is the Morey Road seen in the field in 1999. The last time Beetle Brook was sampled was in 1993 and the macroinvertebrate community at rivermile 1.1 was in "excellent" condition.

Mud Creek

Mud Creek originates south of Newport Center a few miles and flows in a northerly direction to and through Newport Center. Dunn Brook is a headwater tributary to Mud Creek. After flowing through Newport Center, two relatively large, unnamed tributaries also join Mud Creek – one from the south and one from the north, which enlarge the Mud Creek watershed substantially. Mud Creek then flows generally in a northwesterly direction to the Canadian border. It joins the Missisquoi River in Quebec. The length of Mud Creek in the United States is about ten miles; its watershed is approximately 37 square miles.

Mud Creek was sampled in the early 1990s and then the macroinvertebrate community was sampled at two locations in 1999. At rivermile 4.0 the community was assessed as "good" and at rivermile 6.6, the community was assessed as "poor". Nutrient samples were collected four times over the summer season also in 1999 around rivermile 4.0. Phosphorus concentrations were as follows: 118 ug/liter on 6/24/1999; 145 ug/liter on 7/7/1999; 113 ug/liter on 8/3/1999; and 94 ug/liter on 9/9/1999. Windshield surveys of the creek were done in August 1999 and June 2000. A stream walk was done on a segment of Mud Creek about 0.9 miles long upstream from Bear Mountain Road. Observations during the streamwalk included high percentages of filamentous algae coverage on the channel substrate and often a multiple thread channel, cut-off channels and flood chutes. A number of indicators of aggradation were also noted. Other observations during the windshield survey included slightly turbid to turbid water clarity conditions. On 6/01/2000, the water temperature at a point near Bear Mountain Road was 23.5°C - sites upstream were 20°C and 18°C.

Lockwood Pond
Little information is available about this small pond. It occupies an undisturbed forested watershed south of Tillotson Peak, in the Cold Hollow Mountains in Lowell. This pond is presently classified A1 due to its elevation above 2500 feet.

McAllister Pond
This is a shallow pond (maximum depth 7 feet) with extensive wetland surroundings and surfacing plant growth. It appears to be have high wildlife value. Monitoring data indicate that this pond is threatened by acidification.

Mud Pond – Lowell
This is a small pond in a completely forested watershed on the side of Norris Mountain in Lowell. No water quality data are available, but aerial orthophotographs show no evidence of land use activity in the lake watershed. This pond merits assessment for acidity and as a candidate B1 water.

Phillips Pond
This is a small pond with one home adjacent to it, and a dock. The upper third of the watershed is in agricultural land and the remainder is forested. The pond is hidden from the nearby Town Highway 3. Public accessibility to this pond is unknown. No additional information is available.

Assessment Summary Upper Missisquoi River Watershed

Impaired Miles
Coburn Brook: 0.5 - upstream from the mouth - aquatic biota/habitat impaired due to nutrient enrichment, likely temperature increases as well from agricultural land uses (barnyard, stream through the pasture, loss of riparian vegetation).
Taft Brook: 0.1 - upstream from the mouth - aquatic biota/habitat due to nutrient and organic enrichment (smelled like whey or milk house waste) from agricultural activities.
Mud Creek: 4.2 miles - from Newport Center downstream to the Newport/Troy town line (north of Route 105 where stream enters forested area) - aquatic biota/habitat and aesthetics impaired due to nutrient enrichment, turbidity, likely temperature but not measured, from agricultural activities (waste storage problems at least in the past, pasture, hay, cropland adjacent to creek, cows with access to the stream), loss of riparian vegetation.

Altered Miles
Missisquoi River: 4.0 - below Bakers Falls hydro - aquatic biota/habitat altered due to flow fluctuations by the hydroelectric facility.
Jay Branch: 4.7 - below Jay Peak ski area - aquatic biota/habitat altered due to flow modifications from snowmaking withdrawals.

Stressed Miles / Acres
Jay Branch: 6.0 miles - from Jay Peak golf course construction to mouth - aquatic biota/habitat, aesthetics, contact recreation stressed due to turbidity from extensive land disturbance, bare soils with inadequate erosion control.

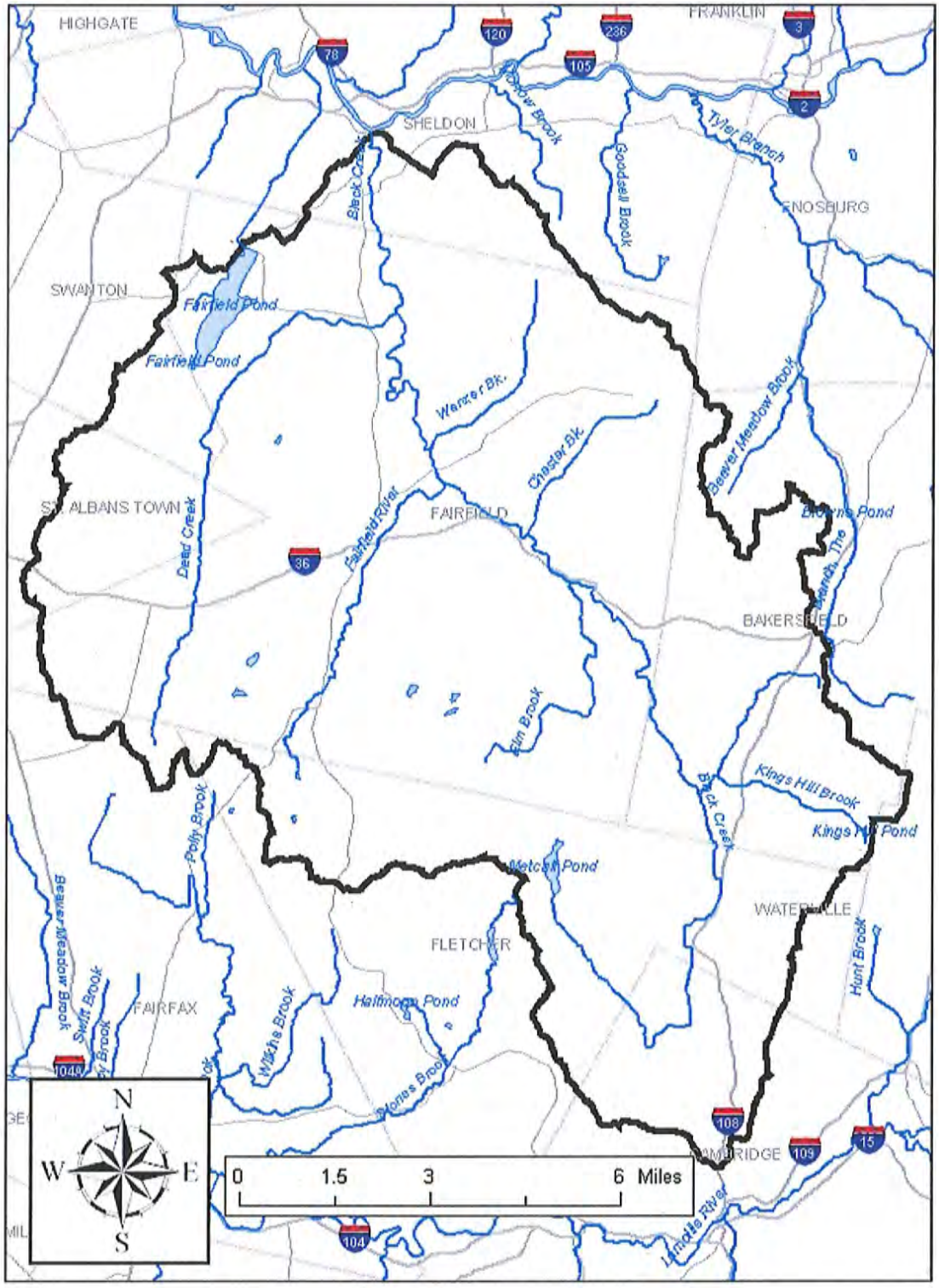
Stressed Miles / Acres (cont.)

Mud Creek: 2.6 miles - town line downstream to Canadian border - aquatic biota/habitat and aesthetics stressed due to nutrient enrichment, turbidity, likely temperature, habitat alterations need investigation, from agricultural activities.

East Branch Missisquoi River: 0.9 - from Route 100 downstream to Cheney Road bridge - aquatic habitat and aesthetics stressed due to sedimentation, nutrients, likely temperature, from sand and gravel inputs from a gravel pit operation (mostly its road and tributary crossing), pasture (with no fencing along stream), loss of riparian vegetation, eroding banks.

McAllister Pond: 25 acres are stressed for aquatic life use due to acid precipitation and the potential for lake acidification.

Black Creek Watershed



Black Creek
Black Creek is one of the largest tributaries to the Missisquoi River and has a mainstem length of approximately 23 miles and a drainage area of 122 square miles. The creek begins at the outlet of Metcalf Pond in Fletcher and flows southeasterly for about four miles. From its origin downstream for the first mile and a half, Black Creek is part of a large, diverse, rich wetland complex that consists largely of open water and marsh but also includes some shrub and forested wetlands as well. Below the long beaver dam at the end of the wetland complex, Black Creek becomes a distinct stream again and alders line it in a number of locations.

In North Cambridge, the creek begins a northerly flow. Deep in its channel, the creek meanders northerly mostly among hay fields down to East Fletcher. For the approximately five and a half miles downstream from East Fletcher, the creek flows through adjacent land dominated first by wet meadow and shrub swamp and then by hay and corn land. The wetland area is most extensive along the creek from East Fletcher downstream to Lost Nation Road although alders and wetland herbaceous plants occur interspersed with upland plants and agricultural crops along the rest of the stretch down to East Fairfield.

In East Fairfield, the creek flows under the road and then through a breached dam over a 25 to 30-foot falls. Below the dam, the creek is wide and pond-like for about 600 feet then it flows under a covered bridge through another breached dam before continuing in a northwesterly direction.

Downstream of East Fairfield, Elm Brook comes into Black Creek. Black Creek widens somewhat after this point. The creek continues in a northwesterly direction still deep within its channel through the heart of Fairfield agricultural land: corn, hayfields, and pasture. Several miles later, the Fairfield River joins Black Creek just upstream of Fairfield Station. Black Creek meanders in a northerly direction another four plus miles still through productive agricultural land before Dead Creek flows into Black Creek. Black Creek continues north through Sheldon Village and then into the Missisquoi River.

Elm Brook
Elm Brook is a five and a half mile long tributary to Black Creek with an eight square mile watershed. The brook originates on the northern slopes of Gilson Mountain in Fletcher and flows north into Fairfield. It meanders alternately in northerly and easterly directions through primarily agricultural land (hay and corn) reaching Black Creek downstream of East Fairfield. In the mid section of its length, the brook is part of Elm Brook State Wildlife Management Area (WMA) managed by the Vermont Department of Fish and Wildlife.

Fairfield River
The six and a half mile long Fairfield River is another significant tributary to Black Creek. This river has a twenty-one square mile watershed. It originates northwest of Gilson Mountain and flows westerly a short distance then northerly for most of its length joining Black Creek near Fairfield Station. A number of tributaries drain the farmlands of Fairfield from the east and the west contributing to the river's flow.

Dead Creek
Dead Creek originates as part of the large, 1500-acre Fairfield Swamp wetland complex mentioned above under the natural communities section. The creek is an integral part of

this large wetland from its origin in Fairfax north almost to Church Road in Swanton. Much of this wetland complex is part of Fairfield Swamp Wildlife Management Area. North of Church Road, Dead Creek is distinct as a stream and flows through a more narrow, well-defined valley to the outlet stream from Fairfield Pond. Fish were sampled in Dead Creek downstream of the WMA in 1986 and the species present were both stream and pond fish.

Wanzer Brook
Macroinvertebrate sampling on Wanzer Brook at rivermile 1.4 produced the following results: in 1992, the community was in "poor" biological condition. Wanzer was re-sampled in fall 2004.

Nutrient samples were taken on Wanzer Brook in the summer of 1999 to provide information to supplement the biological sampling. The stream was sampled for total phosphorus and total nitrogen four times at two sites. At the uppermost site: on 6/24/1999, TP was 0.042 mg/liter and TN was 0.40 mg/liter (low flow); on 7/7/1999, TP was 0.102 mg/liter and TN was 1.47 mg/liter (rain event); on 8/4/1999, TP was 0.070 mg/liter and TN was 0.28 mg/liter (low); and on 9/9/1999, TP was 0.061 mg/liter and TN was 1.02 mg/liter (rain event). At the lower site: on 6/24/1999, TP was 0.022 mg/liter and TN was 0.24 mg/liter (low); on 7/7/1999, TP was 0.092 mg/liter and TN was 1.52 mg/liter (rain event); on 8/4/1999, TP was 0.023 mg/liter and TN 0.22 mg/liter (low); and on 9/9/1999, TP was 0.051mg/liter and TN was 0.95 mg/liter (rain event).

A streamwalk was done on Wanzer Brook from just below Wanzer Road bridge upstream about 3000 feet. Many problems were noted including streambank erosion, aggradation, braiding, high coverage of filamentous algae, lack of a buffer and canopy coverage, and gravel mining (farm use likely though) in two locations. A windshield survey in August 2000 also noted poor gravel road ditch maintenance along the road above the stream. Field observations in August 2004 noted three locations on Wanzer Brook where road runoff appears to reach the brook. Large sand deposits were noted below Chester Arthur Road culvert (1st one) where the stream meanders through pasture. The cobble substrate upstream at Ryan Road was quite embedded too. The impacts of pasture along the stream (with no fencing in most locations, no buffers and thus some eroding banks and widening stretches) and road runoff appear to be the largest problems for this brook. Given the monitoring data of "poor" at rivermile 1.4 and the field observations, the length of the impairment is described from the point approximately 3000 feet above Wanzer Road bridge where there are a number of documented instream problems down through the sample point to the mouth. The stretch upstream of here needs assessment.

Chester Brook
Macroinvertebrate sampling on Chester Brook at rivermile 2.4 produced the following results: in 1992, the community was in "fair" biological condition. No new data or information are available.

Fairfield Pond
This 446-acre lake is located in Fairfield in close proximity to St. Albans. During the early 1980s through the early 1990s, Fairfield Pond experienced rapid degradation in water quality. The concentration of total phosphorus, measured during spring, increased from already modestly elevated values (~ 25 parts per billion, or ppb) to over 50 ppb by 1986. After 1990, changes to farming practices and the loss of two farms in the Fairfield Pond

watershed resulted in significant declines in phosphorus concentrations, associated declines in algal growth, and improvements in water clarity. Since 1992, the concentration of phosphorus in Fairfield Pond has remained stable at "meso-eutrophic" levels (~17 ppb phosphorus). While Fairfield Pond was once considered impaired due to elevated nutrient concentrations and associated algal growth, it is now only considered stressed, indicating that nutrients and algal growth no longer preclude uses of the lake. These findings are corroborated by the results of a biological assessment of macroinvertebrate and algal communities in the lake.

In 1993, the invasive exotic aquatic plant Eurasian watermilfoil was found in Fairfield Pond. Despite strong and continued local efforts to control the milfoil, it has become well established in the lake. The infestation is currently characterized as moderate, meaning that there are localized heavily-infested areas, even while other parts of the lake bottom are free of the milfoil. DEC considers aesthetics, aquatic life, swimming, and secondary contact uses altered on 20 percent of the pond.

Despite the milfoil infestation, Fairfield Pond does support swimming and fishing uses, particularly where Eurasian milfoil is not present. Fairfield Pond is monitored annually by several DEC monitoring programs.

Fairfield Swamp
Not enough is known by DEC about the ponded areas of Fairfield Swamp, which comprise 152 acres located amidst the aforementioned Fairfield Swamp Wildlife Management Area. The aerial orthophotograph for this area shows that Fairfield Swamp has an intact, undeveloped shoreline, which is alternately forested or openwater wetland, including the significant communities discussed above. Vermont DEC has a record of the potentially invasive *Phragmites sp.* in one area of the pond near Route 36 from a photograph taken in 2003. No information on the extent of the *Phragmites sp.* infestation is available. A full assessment is recommended for the ponded sections of Fairfield Swamp.

Kings Hill Pond
Based on a small number of monitoring datapoints from 1983 to present, DEC has determined this small wooded pond to be extremely sensitive to episodic acidification. Remediation of this condition will require controls on emissions of nitrogen oxides and sulfur dioxides from areas outside of Vermont. A total maximum daily load (TMDL) pollution control plan has been approved by EPA for numerous acidified lakes in Vermont, including Kings Hill Pond.

Metcalf Pond
This 81-acre pond in Fletcher has been monitored by several DEC programs since 1981. The pond was most recently visited in 2003. During that time, locally abundant Eurasian watermilfoil was noted, and use of the pond was low. Long-term water quality test results indicate that phosphorus, algae, and water clarity are within average concentrations for lakes statewide, and there is no evidence of stress attributable to acidification. One area of moderately turbid water with algal growth was noted during the 2003 visit, but the size of the area was far short of the "lakewide submerged periphyton noted" during the previous 1993 survey. The northern end of the lake is a wetland-lake complex, with thick sediments that are typical of wetlands and associated aquatic plant growth. Owing to the algal growth observed during the 1993 survey, and to a lesser extent during the 2003 survey,

aesthetics, aquatic life, and swimming uses are considered stressed by nutrients and algae. DEC also considers aesthetics, aquatic life, swimming, and secondary contact uses altered throughout the pond due to the moderate Eurasian milfoil infestation.

Assessment Summary Black Creek Watershed

Impaired Miles / Acres

Wanzer Brook: 2.0 (at least) - from mouth upstream to first tributary above Wanzer Road bridge - aquatic biota/habitat and aesthetics impaired due to nutrients, siltation, organic enrichment, thermal modifications due to agricultural activities, loss of riparian vegetation, streambank erosion, gravel road runoff.

Chester Brook: 2.5 - aquatic biota/habitat impaired due to nutrients, sedimentation, likely other problems due to agricultural activities and road runoff.

Kings Hill Pond: 6 acres are impaired for aquatic life use due to acid precipitation and lake acidification.

Altered Acres

Fairfield Pond: 89 acres are altered for aesthetic, aquatic life, secondary contact, and swimming uses, due to the Eurasian watermilfoil infestation.

Metcalf Pond: 81 acres are altered for aesthetic, aquatic life, secondary contact, and swimming uses, due to the Eurasian watermilfoil infestation.

Stressed Miles / Acres

Wanzer Brook: 2.0 - from first tributary above Wanzer Road bridge upstream to pasture above Dodd Road - aquatic habitat and aesthetics stressed due to sedimentation, physical alterations, temperature from pasture land use with no fencing on stream, road runoff.

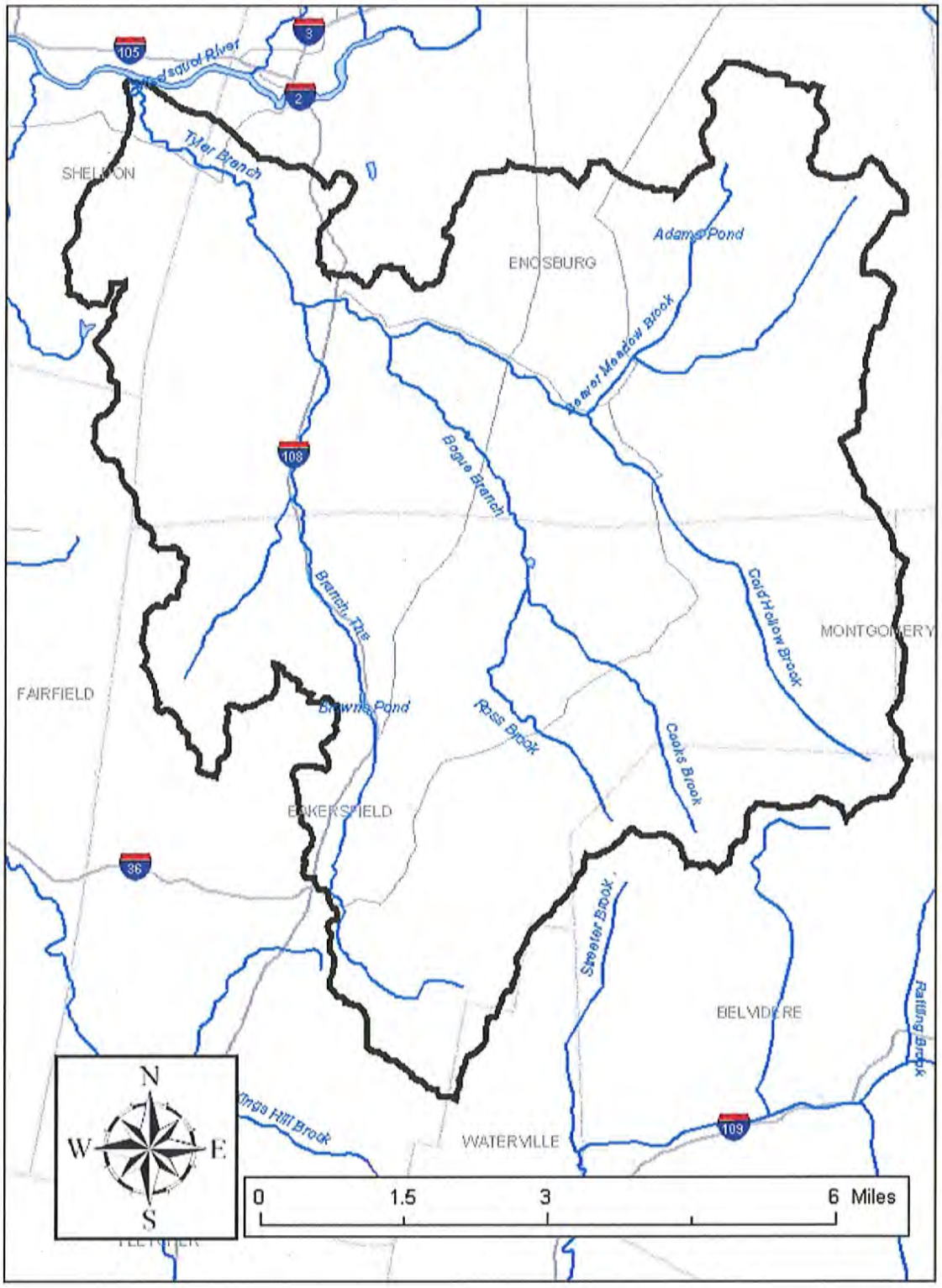
Black Creek: 12.0 - from confluence with Missisquoi upstream to East Fairfield - aquatic biota/habitat and aesthetics stressed due to nutrient enrichment, turbidity, thermal changes, and sedimentation from corn, hay, and pasture with small or no buffers, loss of riparian vegetation and its shading and soil binding values.

Fairfield Pond: 446 acres are stressed for aesthetic, aquatic life, secondary contact, and swimming uses, due to the potential for algae blooms.

Fairfield Swamp: 152 acres are stressed for aesthetic, aquatic life, secondary contact, and swimming uses, due to the potential for Eurasian watermilfoil infestation.

Metcalf Pond: 81 acres are stressed for aesthetic, aquatic life, and swimming uses due to the potential for algae blooms.

Tyler Branch Watershed



Tyler Branch
The Tyler Branch is a major tributary of the Missisquoi River and has been measured at approximately 11 miles long draining an area of 59 square miles. From the mouth of Cold Hollow Brook, the stream flows in northwesterly direction. It picks up Beaver Meadow Brook as it passes south of East Enosburg. About two miles below East Enosburg, the Bogue Branch enters the Tyler Branch. Just under a mile below this juncture, Tyler Branch flows through West Enosburg and then The Branch joins Tyler Branch. Tyler continues in a northwesterly direction and flows into the Missisquoi River about a mile and a half below Enosburg Falls.

The Lake Champlain Committee and the Northwest Regional Planning Commission have done a geomorphic assessment (Phase I) of the Tyler Branch and a number of its tributaries: Beaver Meadow Brook, Bogue Branch, Ross Brook, Cooks Brook, Cold Hollow Brook, The Branch and an unnamed tributary. On Tyler Branch itself, 11 of the 14 fourteen reaches that were delineated were found to be only in "fair" physical condition. The other streams and brooks were found to be in better condition except for the mid-section of The Branch which was largely in "fair" physical condition as well. Windshield surveys in summer 1999 and summer 2000 noted similar conditions - small woody riparian buffer, agricultural land uses (pasture,corn, hay), stretches with rip-rap and/or channelized, some siltation, some algae growth, and eroding banks in some spots.

The Vermont Swimming Study (1992) report identified a small gorge with a popular swimming hole on Tyler Branch east of West Enosburg. The swimming hole is the site of small falls, a gorge that has nice rocks and cliffs for jumping and a pool at the base of the gorge for swimming. This section of Tyler Branch with the bedrock channel and swiftly moving water is unlike much of the rest of this brook.

Cold Hollow Brook
Cold Hollow Brook originates in the Cold Hollow Mountains and steps rapidly down the western slopes of this range. After flowing north initially, the brook turns northwesterly. At either the Bakersfield/Enosburg town line or at a tributary north of this town line, the brook becomes Tyler Branch.

Beaver Meadow Brook
Beaver Meadow Brook originates at the mouth of a pond and shrub swamp north of Enosburg Town Highway 11. It flows south/southwesterly through Adams Pond and another pond and wetland all set in a relatively narrow valley before going under Nichols Road in East Enosburg. Steep road ditches along Nichols Road empty into the brook at this point. From here the brook flows roughly parallel to Tyler Branch Road; shows signs of physical adjustments; and is considered in “fair” physical condition.

Bogue Branch
Bogue Branch begins in a series of ponds in the valley east of Butternut Ridge in Bakersfield. Ross Brook comes in soon from the southeast. Bogue Branch continues flowing in a north/northeasterly direction and then Cooks Brook also joins it from the southeast. After Cooks Brook enters Bogue Branch, Bogue Branch flows more northerly then shifts northwesterly into Enosburg where it winds through a forested and, at times, agricultural valley to the Tyler Branch upstream of West Enosburg. There are several stretches where shrub swamps and other wetland communities border this stream.

The Branch
The Branch originates on the western side of Checkerberry Ledge in Bakersfield and flows westerly down the slope. The Branch then flows north passing east of the village of Bakersfield in an open valley. The stream continues northerly roughly paralleling Route 108 until it joins the Tyler Branch downstream of West Enosburg. The land uses are rural residential and agriculture. Alders line the brook in a number of stretches. Relatively new mid-channel and point bars were observed at several locations on The Branch in 2004.

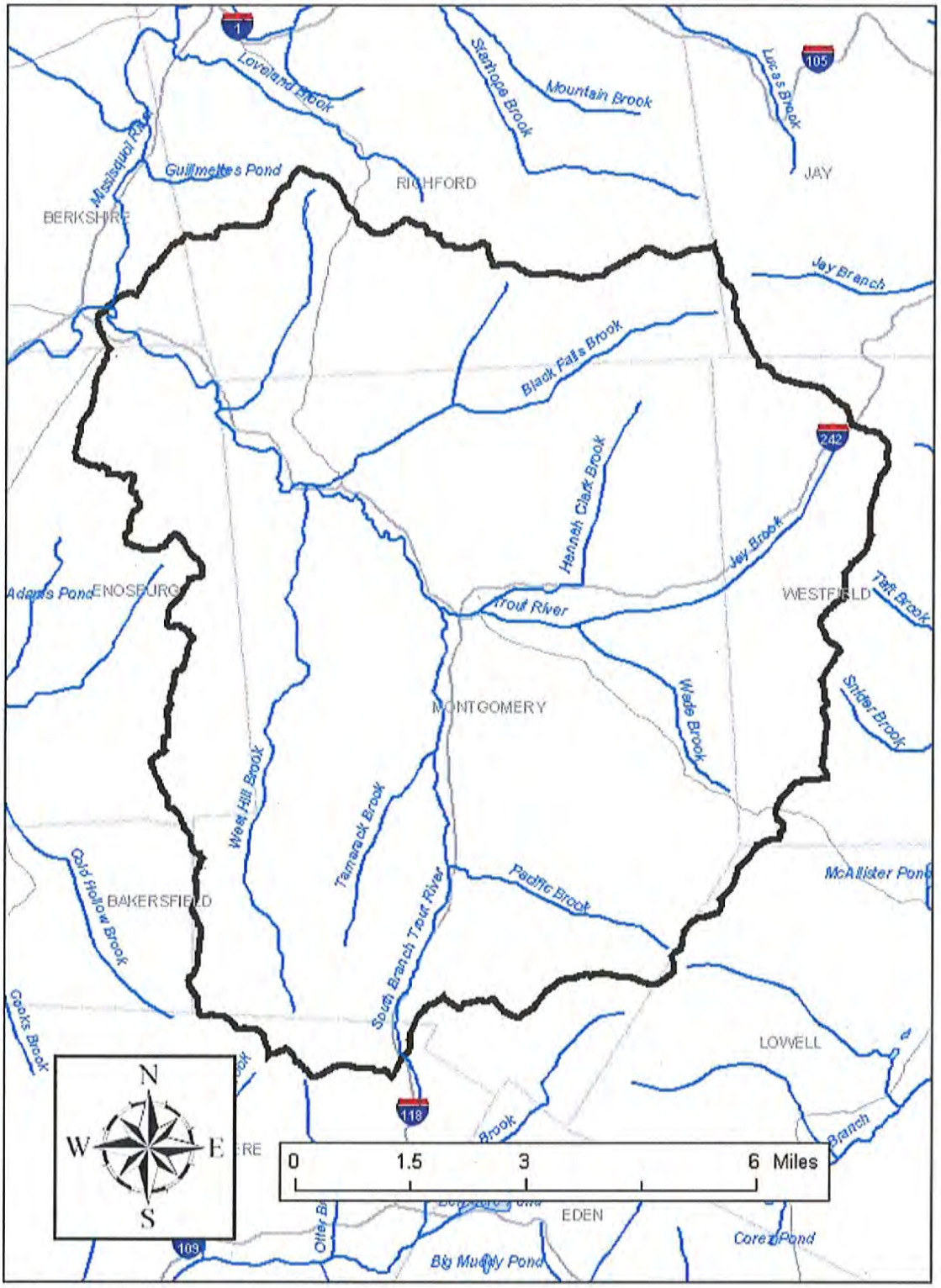
Assessment Summary Tyler Branch Watershed

Stressed Miles

Tyler Branch: 11.0 - aquatic biota/habitat and aesthetics stressed due to sediment, physical habitat alterations, likely nutrients, temperature, and pathogens due to agricultural land activities (pasture with cows having access to brook, some hay and some corn), loss of riparian vegetation, channelization, dredging, rip-rap.

The Branch: 4.9 - from the confluence of Beaver Meadow Brook upstream to the bridge on East Bakersfield Road - aquatic habitat and aesthetics stressed due to physical alterations and sedimentation from loss of riparian vegetation, de-stabilized streambanks, channelization.

Trout River Watershed



Trout River

The fourteen mile long Trout River originates at the confluence of Jay Brook and Wade Brook and drains an 86-square mile watershed before it joins the Missisquoi River in East Berkshire. From its origin, the river flows in a westerly direction passing through Montgomery Center. Just downstream of Montgomery Center, the South Branch comes into the Trout. The river flows northwesterly from Montgomery Center and then in the village of Montgomery, Black Falls Brook comes in and then downstream, West Hill Brook joins the Trout River. The Trout continues its northwesterly flow for another five and a half plus miles until it meets the Missisquoi River in East Berkshire.

Floods in 1997 exacerbated an already unstable stream situation and streambank erosion on the Trout River below Montgomery Center. Money from the Federal Emergency Management Agency and other sources funded a natural channel design and implementation on the mile below Montgomery Center in the summer of 1999. This large restoration project resulted in a mile of stable river with buffers on both sides.

Macroinvertebrate sampling in 2001 at rivermile 0.8 on the Trout River showed a community in "good" condition. Fish sampling in 2002 on the Trout at rivermile 8.5 indicated a community in "excellent" condition. Macroinvertebrate sampling on West Hill Brook at rivermile 0.2 resulted in a community assessment of "very good-good" in 1996, "poor" in 1997, "good-fair" in 1998, and "very good-good" in 1999. The "poor" assessment in 1997 was probably due to scouring from the flood of that summer.

An existing use survey for swimming holes on the Trout River was conducted in August 1998. The survey was done in response to the possibility of a proposal for a wastewater treatment facility in Montgomery that would discharge to the Trout River (which did not happen). Four sites were described between Montgomery village and the Missisquoi River on the Trout: one below the confluence of West Hill Brook with the Trout River; one just upstream of Longely Bridge; one in the vicinity of Hopkins Bridge; and one off a farm road across from the Montgomery/Enosburg town line sign.

Other swimming holes were described in the *Vermont Swimming Hole Study* (1992) report. An additional swimming hole on the Trout River ("Montgomery Schoolhouse") is located north of Montgomery Center. It consists of a deep pool below two cascades plus a rock slide, some other pools, and secluded areas. On the South Branch above and below the Gibou Road bridge, there are several sets of cascades and a deep green pool: a beautiful site. There is a trail down to the brook from each side of the road. Another swimming and sitting site is located near the Hutchins Covered Bridge. Here there is a bedrock island, cascades, and pools.

Hazardous waste site #88-0230, D & D Deli and Redemption Center on Comstock Road in Montgomery, is about 100-120 feet away from the Trout River. Two surface water samples were taken annually from the Trout River from 1994 - 2001 at the time groundwater samples from around the site were taken. Initially (1994-1996), levels of benzene exceeded the water quality standards for the protection of human health and toluene, ethyl benzene, xylenes, and MTBE were elevated at one of the two surface water sample sites. In December 2001, it was recommended that the surface water samples be removed from the sampling plan because no petroleum contaminants had been detected in these samples for at least 2 1/2 years.

West Hill Brook
West Hill Brook originates from headwater streams that flow off the steep eastern slopes of a section of the Cold Hollow Mountains. The brook flows north in a relatively narrow and steep valley. The watershed is largely forested although there are also a number of sloping fields that appear to be hayed. New homes and associated driveways and yards and constructed ponds that appear to have been made in some former shrub wetlands have the potential to exacerbate the flashy nature of the brook if these cumulative watershed changes haven't already done so.

There are two swimming hole sites on West Hill Brook that have been visited and described. At the Creamery Covered Bridge, there is a nice set of cascades and a pool. There were two areas where campfires had been made near the bridge. A sign on the bridge in 2004 states that the site will be posted as private property if the destructive behavior doesn't stop. Downstream on West Hill Brook is another swimming hole called "Hippy Hole" which consists of a narrow cascade that flows into a deep pool. There are places to jump and sit. There was no apparent access in 2004 to this lower site that was identified in 1992.

West Hill Brook flows into the Trout River just below Montgomery and deposits its cobble, gravel and sand as it levels out and reaches the Trout River. Sediment deposits fill up the bays of the Route 118 bridge over West Hill Brook and the brook has had to be dredged out for a number of years.

Black Falls Brook
Black Falls Brook originates high on the slopes of the Green Mountain Range that includes the Jay Peaks (North Jay, Jay, Big Jay, Little Jay). Numerous, narrow mountain streams contribute to its flow. The watershed of Black Falls Brook is largely hardwood forest although a few farms with pasture and hayland are located on the less steep slopes of the brook's valley along the two main gravel roads – Black Falls Road and North Hill Road. The brook tumbles down among boulders under a relatively new Black Falls Road bridge and into the village area of Montgomery where the land flattens out and the brook slows down. In the last half to three-quarters mile before flowing into the Trout River, the brook is rip-rapped and hemmed in by roads, yards, and houses.

Assessment Summary Trout River Watershed

Altered Miles
Trout River: 5.0 - upstream from mouth - aquatic habitat and aesthetics altered due to sedimentation and physical alterations from removal of riparian vegetation, gravel removal, channel instability and stresses from turbidity, nutrient enrichment, and thermal modifications from erosion, cropland runoff, removal of riparian vegetation along waterways.

Stressed Miles
West Hill Brook: 3.0 - upstream from mouth - aquatic habitat and aesthetics stressed due to habitat alterations, sedimentation from residential development, road runoff, flood damage and 'repair' .

Unassessed Ponds in the Missisquoi River Watershed

There are several small ponds scattered throughout the Missisquoi River watershed that may merit assessment. These are largely between 10 and 20 acres in size, and the public accessibility of the ponds is unclear. Given the small number of lakes and ponds in the entire watershed, these unassessed waters have the potential to provide significant uses and values to people and wildlife, and may merit assessment as the Missisquoi River Basin Plan is implemented.

Pond name (VT Lake Inventory)	Acres	Town
ADAMS	11	Enosburgh
BAKERSFIELD-N;	10	Bakersfield
BEAVER MEADOW BRK-L;	18	Enosburgh
BEAVER MEADOW BRK-U;	14	Enosburgh
BROWNS	10	Bakersfield
COREZ	9	Lowell
FAIRFIELD-NE;	12	Fairfield
FAIRFIELD-SE;	18	Fairfield
GOODSELL;	10	Sheldon
GUILLMETTES	12	Richford
MCGOWAN-E;	18	Highgate
MCGOWAN-W;	10	Highgate
SHAWVILLE;	11	Highgate
SOUTH RICHFORD;	12	Richford

Wastewater, Stormwater, Large Farms, and Logging in the Basin

Wastewater

There are seven permitted municipal wastewater treatment plants and one permitted industrial wastewater treatment plant in the Missisquoi River watershed. Following is a summary table of these facilities with average annual flow, design flow, and the receiving water.

Table 2. Wastewater Treatment Facilities in Basin 6

Facility	Annual Avg Flow (in gallons)	Design Flow (in gallons)	Receiving Water
Rock-Tenn	250,000	3,500,000	Missisquoi River mainstem
Sheldon Springs WWTF	22,333	54,000	Missisquoi River mainstem
Swanton Village WWTF	468,333	900,000	Missisquoi River mainstem
Enosburg WWTF	292,333	450,000	Missisquoi River mainstem
Richford WWTF	230,083	380,000	Missisquoi River mainstem
Troy/Jay WWTF	58,583	200,000	Missisquoi River mainstem
North Troy WWTF	81,500	110,000	Missisquoi River mainstem
Newport Town WWTF	10,745	41,500	Mud Creek

Stormwater Discharges

There are twenty-two permitted stormwater discharges to the Missisquoi River or its tributaries. Eleven of the discharges go to the mainstem and eleven go to tributaries. Information about individual permits is available from the DEC Water Quality Division.

Large Farms

There are four permitted "Large Farm Operations" (or LFOs) in the Missisquoi River watershed. A large farm for purposes of needing a permit is defined as a farm with 950 or more "animal units." An animal unit is defined as 1000 lbs live body weight of livestock and a single mature dairy cow is about 1.4 animal units. A dairy farm in North Troy in the Upper Missisquoi watershed, a dairy farm in Richford in the Mid Missisquoi watershed, a dairy farm in Enosburg in the Tyler Branch watershed, and a dairy farm in Sheldon in the Lower Missisquoi watershed are all considered large farms and regulated as such.

Logging Site Investigations

The Vermont Department of Forests, Parks, and Recreation in conjunction with the Vermont forest industry works to ensure that the "Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont" are followed. Site investigations of complaints made by the general public either result in correction of a logging-related water quality problem or the determination that there isn't a problem. On occasion when voluntary corrections are not made, a case has to go to enforcement. In the Missisquoi River watershed, there were 2 site investigations made in 1999, 4 made in 2000, 3 made in 2001, 3 made in 2002, and 5 made in 2003 for a total of 17 in the last five years.

Designated Use Support Status of Missisquoi Watershed Waters

Use Support Status

The following tables summarize the status of each of the seven designated uses of the rivers and streams of the basin and six designated uses of the lakes and ponds.

Rivers
Drinking and agricultural water supplies have not been assessed. Fish consumption is impaired in the lower eight miles of the Missisquoi River because of the high levels of mercury in Lake Champlain walleye that come up river.

There are sixteen miles of aquatic biota and/or habitat determined to be impaired in this watershed largely due to nutrient and organic impacts from agricultural activities too close to the streams or lacking all needed management practices. Some changes in agricultural operations just prior to this assessment may soon result in less impact from agricultural activity.

The miles of aesthetics and contact recreation impaired are a subset of the miles impaired for the use of aquatic biota/habitat and the same cause and source of nutrient enrichment from agriculture (as well as pathogens with respect to swimming) trigger these impairments.

Alterations to aquatic habitat are due to a mix of activities: gravel removal; removal of riparian vegetation; hydroelectric flow regulation; and snowmaking water withdrawals.

The stresses on the different uses are from agricultural activities, streambank erosion and riparian vegetation removal largely.

Table 3. Use Support Status of River and Stream Uses in Basin 6.

Designated Use	Full Support (miles)	Stressed (miles)	Altered (miles)	Impaired (miles)	Not assessed (miles)
Overall	273.0	90.5	13.8	24.0	0
Aquatic biota/habitat	273.0	98.5	13.8	16.0	0
Fish consumption	0	393.3	0	8.0	0
Contact recreation	362.5	34.4	0	4.4	0
Secondary contact recreation	368.2	33.1	0	0	0
Drinking water supply	0	0	0	0	401.3
Aesthetics	287.4	98.3	0	10.6	0
Ag water supply	0	0	0	0	401.3

Lakes
For lakes, aquatic life is the only designated use that has documented impairments – six acres are impaired due to acidification from atmospheric deposition. Swimming, secondary contact recreation, aesthetics, and aquatic life on 170 acres are altered due to invasive exotic species. These same four uses are stressed on over 500 acres. See Table 4 below.

Table 4. Use Support Status of Lake and Pond Uses in Basin 6

Designated Use	Full Support (acres)	Stressed (acres)	Altered (acres)	Impaired (acres)	Not assessed (acres)
Overall Uses	32	536	170	6	0
Aesthetics	38	536	170	0	0
Aquatic Life Use Support	7	561	170	6	0
Drinking Water Supply	0	0	0	0	0
Fish Consumption	744	0	0	0	0
Secondary Contact Uses	65	509	170	0	0
Swimming Uses	38	536	170	0	0

Causes and Sources of Impacts to Missisquoi Watershed Waters

The four tables below give the miles of rivers and streams and the acres of lakes and ponds affected by various causes (pollutants or modification) and sources (land use or activity).

Rivers and Streams
Nutrients from agriculture and sediments from agriculture, riparian vegetation removal, and streambank erosion have the greatest effect on water quality and aquatic health in the rivers and streams of the Missisquoi watershed. Turbidity and thermal modifications (increased water temperatures) stress the aquatic ecosystem for large numbers of miles as well.

Table 5. Causes of Impacts and Stresses to River Uses in Basin 6

Cause/pollutant	Impact (High or moderate) (river miles)	Stressed (river miles)
Nutrients	16.0	81.0
Sedimentation	11.4	89.0
Flow alterations	8.8	0
Metals	8.0	0.3
Habitat alterations	7.0	38.7
Turbidity	4.2	79.4
Thermal modifications	2.0	74.8
Pathogens	4.4	5.0

Table 6. Sources of Impacts and Stresses to River Uses in Basin 6

Source/Activity	Impact (High or moderate) (river miles)	Stressed (river miles)
Agriculture	21.0	89.0
Riparian vegetation removal	11.7	56.1
Atmospheric deposition	8.0	0
Streambank erosion	7.0	66.8
Channel instability	5.0	11.0
Flow mod - snowmaking	4.7	0
Flow mod - hydroelectric	4.1	0

Lakes and Ponds

Nutrients and algae resulting from agricultural activities and road runoff and maintenance are causing uses on many acres of lakes and ponds to be stressed. Impacts occur due to pH changes from atmospheric deposition and invasive exotic species.

Table 7. Causes of Impacts and Stresses to Lake Uses in Basin 6

Cause/pollutant	Impact (High or moderate) (lake acres)	Stressed (lake acres)
Nutrients	0	554
Phosphorus	0	473
pH	6	25
Siltation	0	81
Noxious aquatic plants - Algae	0	527
Exotic Species	170	152

Table 8. Sources of Impacts and Stresses to Lake Uses in Basin 6

Source/Activity	Impact (High or moderate) (lake acres)	Stressed (lake acres)
Agriculture	0	473
Nonirrigated crop production	0	446
Pasture grazing-riparian and/or upland	0	446
Animal holding/management area	0	473
Removal of riparian vegetation	0	81
Marinas and recreational boating	170	152
In-Water releases	170	152
Atmospheric deposition	6	106
Highway maintenance and runoff	0	527
Natural sources	6	25

Recent Water Resource Protection Projects

The Missisquoi River Basin Association (MRBA) is the organization that has planned, catalyzed, and implemented many of the water quality projects in the Missisquoi watershed. In the 2003 field season, the MRBA was involved in buffer establishment and streambank stabilization projects on six different properties on the Missisquoi River, Black Creek, and Wanzer Brook. The largest project was the Brownway River Restoration Project that began in spring of 2003: restoration of a 30-acre floodplain forest along the Missisquoi in Enosburg Falls. In 2003, volunteers planted thousands of native trees and in spring 2004, another two thousand were scheduled to be planted at this site.

In addition to many tree planting and bank stabilization projects, the MRBA has: organized a "soil builders" workshop to discuss improving soil quality while reducing impacts to water quality; conducted river clean-ups; led canoe trips; cost-shared nutrient management programs with two farms; and done geomorphic assessments on a number of watershed streams and river segments. MRBA has also created the Missisquoi Bay Working Group to focus the concern and interest in the bay and its severe algae problems.

The Northwest Regional Planning Commission (NRPC), the Local Roads Program, the Lake Champlain Committee (LCC) and the University of Vermont (UVM) have all been involved in projects in the watershed as well. The regional planning commission is taking the lead on a Tyler Branch project that includes restoring riparian buffers and stabilizing priority sections of eroding streambank. The RPC has also been doing a Phase I geomorphic assessment on the Rock, Pike, and Missisquoi rivers watershed not including Tyler Branch. The towns of Enosburg and Fairfield have both received grants for streambank erosion-related work. The numerous projects that have occurred in, or began in, 2002 through 2004 are summarized in the table below.

Table 9. Projects Funded in the Missisquoi River Watershed in 2002, 2003, 2004

Grant*	Year	Project Title	Grantee
Watershed	2004	Missisquoi Watershed Bank Stabilization	MRBA
Watershed	2003	Missisquoi Watershed Bank Stabilization	MRBA
Watershed	2003	Fairfield Pond Education and Aquatic Nuisance Control and Clean-up	MRBA
319	2004	Missisquoi Bay fieldwork to reduce NPS phosphorus	MRBA
319	2004	Vermont Pasture Network: technical assistance for dairy farms going to management intensive grazing (part in Basin 6)	UVM – Center for Sustainable Agriculture
319	2004	Growing by Design: cropping systems for improved water quality (part in Basin 6)	UVM – Extension
319	2003	Missisquoi, Rock and Pike Rivers Geomorphic Assessment	Northwest RPC
LCBP	2002	Missisquoi Basin Streambank Restoration Initiative	MRBA
LCBP	2002	MRBA organization support	MRBA
LCBP	2002	A Geomorphic Assessment of the Tyler Branch of the Missisquoi River	LCC
604(b)	2002	GIS mapping of physical characteristics of Tyler Branch watershed (in support of geo assessment)	Northwest RPC
Backroads	2004	Enosburg – Bogue Road streambank erosion	Town of Enosburg
Backroads	2004	Enosburg – Tyler Branch Rd streambank erosion	Town of Enosburg
RCG	2004	River Restoration Project Development for the Wanzer Brook in Franklin County	Town of Fairfield
RCG	2004	Tyler Branch River Corridor Project	Northwest RPC

* Watershed = watershed grants funded by the conservation license plate program; 319 = EPA Clean Water Act Section 319 Nonpoint Source Pollution grants; LCBP = Lake Champlain Basin Program grants (organization support, annual priorities, partnership grants or education/ outreach grants; Backroads = Local Roads Program grants; 604(b) = EPA CWA Section 604(b) pass-through grants; RCG = River Corridor Grants funded by the Clean and Clear Action Plan.

References and Resources

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2) Hardwood Swamps of Vermont: Distribution, Ecology, Classification, and Some Sites of Ecological Significance, March 2004. Eric Sorenson, Robert Popp, Michael Lew-Smith, Brett Engstrom, Marc Lapin, and Mark Ferguson for Nongame and Natural Heritage Program, Vermont Department of Fish and Wildlife, Agency of Natural Resources, Waterbury, Vermont.

3) Hydropower in Vermont: An Assessment of Environmental Problems and Opportunities, Volume II: Project Site Reports, May 1988. Alison DesMeules and Cynthia Parks for the Vermont ANR DEC Water Quality Division.

4) Missisquoi River Basin Association newsletters, Spring 2003 – Spring 2004.

5) Missisquoi River Basin Water Quality Management Plan, June 1974. Vermont Agency of Environmental Conservation, Department of Water Resources.

6) Northern White Cedar Swamps and Red Maple-Northern White Cedar Swamps of Vermont: Some Sites of Ecological Significance, August 1998. Eric Sorenson, Brett Engstrom, Marc Lapin, Robert Popp, and Steve Parren for Nongame and Natural Heritage Program, Vermont Department of Fish and Wildlife, Agency of Natural Resources, Waterbury, Vermont.

7) Vermont Swimming Hole Study, 1992. Jerry Jenkins, Deborah Benjamin, and Jane Dorney for Vermont DEC, Water Quality Division.

8) Waterfalls, Cascades and Gorges of Vermont, 1985. Jerry Jenkins and Peter Zika for the Vermont Department of Environmental Conservation and Department of Forests, Parks and Recreation.

9) Whitewater Rivers of Vermont, 1989. Jerry Jenkins for Vermont DEC.

Appendix A

Macroinvertebrate Community Samples

1993 – 2002

Table A.1. Macroinvertebrate Sampling Sites in the Missisquoi Watershed 1993-2001

WBID	River/Stream	Town	River-mile	Date	Assess-ment
VT06-02	Missisquoi River	Richford	53.0	09/26/2000	Excellent
VT06-03	Kelly Brook	Swanton	1.2	09/18/1998	
VT06-03	Kelly Brook	Swanton	1.4	10/19/1998	
VT06-03	Hungerford Brook	Swanton	3.9	09/27/1999	
VT06-04	Trout Brook	Berkshire	2.3	09/16/1993	Poor
VT06-04	Samsonville Brook	Enosburgh	0.2	09/16/1993	Poor
VT06-04	Samsonville Brook	Enosburgh	0.2	09/26/2000	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	09/06/1994	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	09/06/1995	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	09/05/1996	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	08/31/1998	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	09/14/1999	Good
VT06-04	Samsonville Brook	Berkshire	0.6	09/11/2000	Good
VT06-04	Godin Brook	Berkshire	0.9	09/16/1993	Fair
VT06-04	Godin Brook	Berkshire	0.9	09/07/1994	Fair
VT06-04	Godin Brook	Berkshire	0.9	09/07/1995	Fair
VT06-04	Godin Brook	Berkshire	0.9	09/05/1996	Fair
VT06-04	Godin Brook	Berkshire	0.9	09/01/1998	Fair
VT06-04	Godin Brook	Berkshire	0.9	0915/1999	Good
VT06-04	Godin Brook	Berkshire	0.9	09/11/2000	Fair
VT06-04	Godin Brook Trib 4	Berkshire	0.1	09/07/1994	Poor
VT06-04	Berry Brook	Berkshire	0.2	09/16/1993	Good
VT06-04	Berry Brook	Berkshire	0.9	10/20/1994	Poor
VT06-04	Berry Brook	Richford	1.2	09/16/1993	Exc
VT06-04	Berry Brook	Richford	1.2	09/06/1994	Exc
VT06-04	Berry Brook	Richford	1.2	09/07/1995	Exc
VT06-04	Berry Brook	Richford	1.2	09/05/1996	Exc
VT06-04	Berry Brook	Richford	1.2	08/31/1998	Good
VT06-04	Berry Brook	Richford	1.2	09/15/1999	Exc
VT06-04	Berry Brook	Richford	1.2	09/11/2000	Exc
VT06-04	North Branch Berry Brook	Richford	0.1	09/06/1994	Poor
VT06-04	North Branch Berry Brook	Richford	0.1	10/20/1994	Poor
VT06-04	North Branch Berry Brook	Richford	0.1	09/06/1995	Fair
VT06-04	North Branch Berry Brook	Richford	0.1	09/05/1996	Fair
VT06-04	North Branch Berry Brook	Richford	0.1	08/31/1998	Poor
VT06-04	North Branch Berry Brook	Richford	0.1	09/15/1999	Poor
VT06-04	North Branch Berry Brook	Richford	0.1	09/11/2000	Fair
VT06-07	Trout River	Berkshire	0.7	09/16/1993	Good
VT06-07	Trout River	Berkshire	0.8	10/24/2001	Good

Table A.1. (continued)

WBID	River/Stream	Town	River-mile	Date	Assess-ment
VT06-07	West Hill Brook	Montgomery	0.2	09/05/1996	Vg-good
VT06-07	West Hill Brook	Montgomery	0.2	09/05/1997	Poor
VT06-07	West Hill Brook	Montgomery	0.2	08/31/1998	Fair-good
VT06-07	West Hill Brook	Montgomery	0.2	09/15/1999	Vg-good
VT06-08	Missisquoi River	Troy	71.6	09/07/1999	Good
VT06-08	Missisquoi River	Troy	74.5	09/16/1993	Good
VT06-08	Missisquoi River	Troy	74.5	09/08/1999	Exc
VT06-08	Coburn Brook	Troy	0.1	09/19/1993	Fair
VT06-08	Coburn Brook	Troy	0.1	09/15/1994	Good
VT06-08	Coburn Brook	Troy	0.1	09/07/1999	Fair
VT06-08	Coburn Brook	Troy	0.2	09/26/2000	Poor
VT06-08	Beetle Brook	Troy	1.1	09/16/1993	Exc
VT06-08	Mill Brook	Westfield	1.2	09/05/1997	Poor
VT06-08	Mud Creek	Troy	4.0	09/08/1999	Good
VT06-08	Mud Creek	Newport	6.6	09/08/1999	Poor
VT06-08	Jay Branch	Jay	4.6	09/07/1999	Fair
VT06-08	Jay Branch – Trib 7	Jay	1.2	09/16/1993	Good
VT06-08	Crook Brook	Jay	1.6	09/07/1999	Good

Table A.2. Fish Sampling Sites in the Missisquoi River Watershed 1993 – 2003

WBID	River/Stream	Town	River-mile	Date	Assess-ment
VT06-03	Missisquoi R Trib #10		0.6	06/11/1999	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	09/06/1994	Good
VT06-04	Samsonville Brook	Berkshire	0.6	09/06/1995	Good
VT06-04	Samsonville Brook	Berkshire	0.6	09/28/1996	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	09/02/1997	Good
VT06-04	Samsonville Brook	Berkshire	0.6	08/31/1998	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	09/29/1999	Fair
VT06-04	Samsonville Brook	Berkshire	0.6	09/11/2000	Fair
VT06-04	Samsonville Brook	Berkshire	0.7	09/06/1994	Good
VT06-04	Samsonville Brook	Berkshire	0.7	09/06/1995	Fair
VT06-04	Samsonville Brook	Berkshire	0.7	09/28/1996	Poor
VT06-04	Samsonville Brook	Berkshire	0.7	09/02/1997	Good
VT06-04	Samsonville Brook	Berkshire	0.7	08/31/1998	Fair
VT06-04	Samsonville Brook	Berkshire	0.7	09/29/1999	Good
VT06-04	Samsonville Brook	Berkshire	0.7	09/11/2000	Poor
VT06-04	Godin Brook	Berkshire	0.9	09/07/1994	Fair
VT06-04	Godin Brook	Berkshire	0.9	09/07/1995	Fair
VT06-04	Godin Brook	Berkshire	0.9	09/03/1997	Good
VT06-04	Godin Brook	Berkshire	0.9	09/01/1998	Good
VT06-04	Godin Brook	Berkshire	0.9	09/14/1999	Fair
VT06-04	Godin Brook	Berkshire	0.9	09/08/2000	Fair
VT06-04	Godin Brook	Berkshire	1.3	09/07/1994	Very Good
VT06-04	Godin Brook	Berkshire	1.3	09/07/1995	Good
VT06-04	Godin Brook	Berkshire	1.3	09/03/1997	Fair
VT06-04	Godin Brook	Berkshire	1.3	09/01/1998	Good
VT06-04	Godin Brook	Berkshire	1.3	09/15/1999	Fair
VT06-04	Godin Brook	Berkshire	1.3	09/08/2000	Good
VT06-04	Berry Brook	Richford	1.2	09/08/1994	Very Good
VT06-04	Berry Brook	Richford	1.2	09/08/1995	Very Good
VT06-04	Berry Brook	Richford	1.2	09/05/1997	Good
VT06-04	Berry Brook	Richford	1.2	09/02/1998	Good
VT06-04	Berry Brook	Richford	1.2	09/15/1999	Good
VT06-04	Berry Brook	Richford	1.2	09/12/2000	Good
VT06-04	North Branch Berry Brook	Richford	0.1	09/08/1994	Fair
VT06-04	North Branch Berry Brook	Richford	0.1	09/06/1995	Poor
VT06-04	North Branch Berry Brook	Richford	0.1	09/06/1996	Poor
VT06-04	North Branch Berry Brook	Richford	0.1	09/05/1997	Poor
VT06-04	North Branch Berry Brook	Richford	0.1	09/02/1998	Fair
VT06-04	North Branch Berry Brook	Richford	0.1	09/15/1999	Poor
VT06-04	North Branch Berry Brook	Richford	0.1	09/12/2000	Poor
VT06-07	Trout River	Montgomery	8.5	08/23/2002	Excellent
VT06-08	Coburn Brook	Troy	0.1	09/29/2000	Very Good
VT06-09	Taft Brook	Troy	0.1	09/29/2000	Fair

Appendix B

Dams in the Missisquoi River Watershed

Table B.1. Dams in the Missisquoi River Watershed

Dam Name	Stream	Town	Status	Use*	Built	Re-con+	State ID
Swanton	Missisquoi	Swanton	In service	H	1920	1948	205.02
Highgate Falls	Missisquoi	Highgate	In service	H	1918	1951	96.01
East Highgate	Missisquoi	Highgate	Breached				
Enosburg Falls	Missisquoi	Enosburg	In service	H	1912	1928	68.01
Sheldon Springs	Missisquoi	Sheldon	In service	H	1908	1980	187.01
North Troy	Missisquoi	Troy	In service	H	1890		210.01
Bakers Falls	Missisquoi	Troy	In service	H	1920	1952	210.02
Sheldon – 2	Goodsell Brk	Sheldon	Unknown				187.02
Sheldon	Black Creek	Sheldon	Unknown				187.03
Fairfield Swamp Pond	Dead Creek	Swanton	In service	RF	1967	1980	205.01
Fairfield Pond	Dead Creek-Trib	Fairfield	Unknown				71.01
Webster (Lower)	Black Creek	Fairfield	Unknown				71.02
Webster (Upper)	Black Creek	Fairfield	Unknown				71.03
Fairfield	Fairfield River	Fairfield	Breached				71.05
East Berkshire	Missisquoi-Trib	Berkshire	Unknown				19.03
Trout Brook Res	Trout Brook	Berkshire	In service				19.02
Johnsons Mill	Bogue Branch	Bakersfield	Unknown				9.01
Browns Pond	The Branch	Bakersfield	Abandoned				9.02
Guilmettes Pond	Missisquoi-Trib	Richford	In service	S			165.03
Jay Peak	Jay Branch Brk (offstream)	Jay	In service	R	1988	1989	106.01
Sleeper Pond	Mud Creek	Newport	Unknown				142.01
Bonneau	Mud Creek-Trb	Troy	Unknown		1969		210.03
Coburn Brook Res	Coburn Brook	Westfield	Unknown				232.01
Vermont Asbestos Co	Burgess Brnch	Lowell	Unknown				116.01
Corez Pond	Burgess Brnch	Eden	Unknown				66.03

*H = hydroelectric, R = recreation, C = flood control, S= water supply, O = other, blank = unknown

+ date re-constructed

Appendix C

Population and Housing Units in Missisquoi River Watershed Towns

Table C.1. Population of Missisquoi River watershed towns

Town	Pop 1970	Pop 1980	Pop 1990	Pop 2000	Change 1970-1980	Change 1980-1990	Change 1990-2000
Highgate	1936	2493	3020	3397	29%	21%	12%
Swanton	4622	5141	5636	6203	11%	10%	10%
Sheldon	1481	1618	1748	1990	9%	8%	14%
Fairfield	1285	1493	1680	1800	16%	13%	7%
Bakersfield	635	852	977	1215	34%	15%	24%
Enosburg	1918	2070	2535	2788	8%	22%	10%
Berkshire	931	1116	1190	1388	20%	7%	17%
Richford	2116	2206	2178	2321	4%	-1%	7%
Montgomery	651	681	823	992	5%	21%	21%
Jay	182	302	381	426	66%	26%	12%
Westfield	375	418	422	503	16%	1%	19%
Lowell	515	573	594	738	11%	4%	24%
Troy	1457	1498	1609	1564	3%	7%	-3%
Newport Town	1125	1319	1367	1511	17%	4%	11%

Table C.2. Housing Units of Missisquoi River watershed towns

Town	Housing Units 1980	Housing Units 1990	Housing Units 2000	Change 1980-1990	Change 1990-2000
Highgate	926	1247	1375	35%	10%
Swanton	2167	2423	2689	12%	11%
Sheldon	488	627	691	28%	10%
Fairfield	564	682	768	21%	13%
Bakersfield	348	415	504	19%	21%
Enosburg	902	1115	1149	24%	3%
Berkshire	419	474	550	13%	16%
Richford	878	968	1017	10%	5%
Montgomery	485	556	666	15%	20%
Jay	196	333	417	70%	25%
Westfield	232	265	339	14%	28%
Lowell	222	323	403	45%	25%
Troy	565	641	734	13%	14%
Newport Town	527	654	746	24%	14%

Lower Missisquoi River
Assessment Report

Waterbody No: VT06-01 **Assessment Year:** 2004

River Length (mi.): 33.1 **Date Last Updated:** 9/21/2004

Description: Missisquoi River mainstem from the mouth to the confluence with Tyler Branch

Location Identifiers

ANR Enforcement District: 6 **NRCS District:** 6

Fish and Wildlife District: 4 **Regional Planning Commission:** NW

Assessment Information

Monitored (mi.): 8.0

Evaluated (mi.): 25.1

On 303(d) List? Y

Monitored for Toxics? Y

Assessment Type

Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Fish tissue analysis

Toxics Testing

Metals in fish tissue

Waste Management Zone - Miles 1.00 **Description** below Swanton WWTF outfall

Assessment Comments

IMPAIRED MILES

Missisquoi River: 8.0 - from mouth upstream to Swanton dam - fish consumption impaired due to mercury contamination from atmospheric deposition. c(500) s(8100)

STRESSED MILES

Missisquoi River: whole length - aquatic biota/habitat and aesthetics stressed from high sediment loads, turbidity, nutrient enrichment, likely temperature from agricultural land uses, loss of riparian vegetation and streambank erosion. c(900,1100,1400,2500) s(1000,7600,7700) Also (subset of above) aesthetics stressed below Highgate Falls Hydro facility due to 35 cfs minimum flow (1/10 of 7Q10) and habitat, aesthetics stressed for 3 miles upstream of the facility due to impoundment.

COMMENTS

The Boise Cascade/North Landfill/Lagoon (Boise Cascade/NLL) is located on Mill Street in Sheldon and is bounded on the north by the Missisquoi River. The north landfill was operated from 1955 to 1974 and was used for solid waste produced by the paper mill operations as well as paper sludge from the wastewater treatment plant. When the north landfill was closed in 1974, a new landfill (south landfill) was opened. This is also a Superfund site. The lagoon was completed in 1974 to provide secondary

Lower Missisquoi River **VT06-01**

treatment of the paper mill wastewater. "Overland flow generally drains from Boise Cascade/NLL to the Missisquoi River."

In 1985, there was a leak in the liner of the lagoon and the lagoon contents bypassed the underdrain system. Effluent discharged to the Missisquoi River. Also in 1985, sludge samples from the WWTF were analyzed. Acetone, chloroform, methylene chloride, toluene, pentachlorophenol, phenol, 2-butanone, arsenic, cadmium, copper, lead, nickel, and zinc were detected. In 1994, field staff of the consulting firm hired collected 5 surface soil samples, 5 Missisquoi River sediment samples, and 2 lagoon samples. The results indicated "the presence of contaminants at significant concentrations in the landfill and lagoon samples." In the landfill, VOCs, SVOCs, and metals were detected. In the lagoon, acetone, calcium, mercury, and sodium were detected. In the groundwater, inorganics were generally at concentrations below Maximum Contaminant Levels (MCLs); nickel however was slightly above the MCL and lead was found at the federal action level. Copper was detected above reference concentration in one Missisquoi River sediment sample.

The Missisquoi River was visited on Auguts 13, 2002 to look for Myriophyllum spicatum (Eurasian water milfoil). Notes from the visit said: " Water was extremely turbid and visibility was low. M. spicatum was noted to be scattered in the area where Dead Creek diverges to the north. Due to low visibility, a more thorough survey of this river is recommended."

INFORMATION SOURCES

Jeff Cueto, Vermont DEC Water Quality Division - current info on Highgate Falls (2004)

Final Site Inspection Prioritization Report for Boise Cascade/North Landfill/Lagoon. Sheldon Springs, Vermont. June 14, 1995. Prepared for U.S. EPA Region I by CDM Federal Programs Corporation, Camp Dresser & McKee, Boston, Mass.

Dan Farrell & Heather Nicholson, Vermont DEC Water Quality Division - streamwalk on the Missisquoi above and below the confluence of Tyler Branch (below=VT06-01), August 1999

Missisquoi River Streambank Erosion Inventory, September 1996. Northwest Regional Planning Commission for the Vermont Agency of Natural Resources, Department of Environmental Conservation, Water Quality Division.

Hydropower in Vermont: An Assessment of Environmental Problems and Opportunities, Volume II, Project Site Reports, May 1988. Vermont ANR Department of Environmental Conservation.

Jon Anderson - Vt. Dept. of Fish & Wildlife (past assessment)

Vermont Dept. of Health, Toxicology and Risk Assessment Program - issued fish consumption warning due to mercury, June 2000

Use No	Use Description	Fully	Stressed	Altered	Impaired	Not Assessed
01	Overall	0.0	25.1	0.0	8.0	0.0
20	Aquatic biota/habitat	0.0	33.1	0.0	0.0	0.0
21	Fish consumption	0.0	25.1	0.0	8.0	0.0
42	Contact recreation	0.0	33.1	0.0	0.0	0.0
44	Noncontact recreation	0.0	33.1	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	33.1
62	Aesthetics	0.0	33.1	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	33.1

Impairment Cause	Magnitude	Size (mi.)
Metals	H	8.00
Nutrients	S	33.10
Siltation	S	32.70
Thermal modifications	S	33.10
Turbidity	S	33.10

Lower Missisquoi River **VT06-01**

Impairment Source	Magnitude	Size (mi.)
Agriculture	S	33.10
Removal of riparian vegetation	S	33.10
Streambank modification/destabilization	S	33.10
Atmospheric deposition	H	8.00

Permit No.	Point or Nonpoint Source Description	Receiving Water
9-0009	Highgate Elementary School - indirect	Missisquoi River
1-0833	Vermont AOT - Route 105 relocation - sw	Missisquoi River
1-0982	Sheldon Springs Cogeneration Project- sw	Missisquoi River
3431	Pomerleau Real Estate - sw	Missisquoi River
VT0000469	Rock-Tenn - noncontact cw	Missisquoi River
VT0000469	Rock-Tenn - treated process wastewater	Missisquoi River
VT0100340	Sheldon Springs WWTF 0.054mgd	Missisquoi River
VT0100501	Swanton Village WWTF 0.90mgd	Missisquoi River

3 stormwater

Mid Missisquoi River
Assessment Report

Waterbody No: VT06-02 **Assessment Year:** 2004

River Length (mi.): 22.8 **Date Last Updated:** 6/2/2004

Description: Main Stem - Confluence of Tyler Branch to Canadian Border

Location Identifiers

ANR Enforcement District: 6 **NRCS District:** 6

Fish and Wildlife District: 4 **Regional Planning Commission:** NW

Assessment Information

Monitored (mi.): 0.0

Evaluated (mi.): 22.8

On 303(d) List? N

Monitored for Toxics? N

Toxics Testing

Assessment Type

Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Non-fixed station chemical/physical monitoring-conventional and t

Waste Management Zone - Miles **Description**

Assessment Comments

ALTERED MILES

Missisquoi River: 0.1 - below Enosburg Falls - aquatic biota/habitat altered due to artificial flow regulation from hydroelectric facility. c(1500) s(7410)

STRESSED MILES

Missisquoi River: 22.7 - aquatic biota/habitat and aesthetics due to sedimentation and turbidity, habitat and thermal modifications, and nutrient enrichment from agricultural land uses, streambank erosion, streambed erosion and re-suspension of bottom sediments. c(900,1100,1400,1600,2500) s(1000,7700)

COMMENTS

On August 5, 2000, there was large fire in North Troy, Vermont at a feed mill. Water used to extinguish the fire washed copper sulfate into the Missisquoi River causing a huge fish kill. The extent of the fish kill was from North Troy through Quebec to rivermile 49.6 in Vermont, an estimated 8.6 miles in Vermont. Personnel from the Dept of Fish and Wildlife and the Dept of Environmental Conservation Water Quality Division estimated that 26,600 fish of 16 different species died based on sample counts. Young of year fish were observed in areas where adults were dead or dying. In addition, young were seen at the mouths of tributaries. These observations were the basis for the expectation that there would be a good recovery

Mid Missisquoi River **VT06-02**

of the fish community with a few years. No sampling has been done on this affected stretch since the fire (as of 12/2003) but it is expected that the fish have recovered.

At Sheldon/Enosburg town line, there was an essentially severe streambank slump and erosion that almost completely closed the channel.

The Richford Short Stop (Pinnacle Peddler) is a hazardous waste site (#88-0247) in this waterbody. Eight monitoring wells are sampled and a surface water sample is taken from a "swale to the south of the site." It is not yet known if the swale is actually a stream or connected to a stream and how far this is from the Missisquoi. MTBE levels are elevated in the surface water sample. CK - need to see this site.

Saint's Quick Stop in East Berkshire is another hazardous waste site (#95-1804) in this waterbody. Soil has been removed from the site (which had leaking USTs) and there were plans to remove soil from one more area as of August 2003. Missisquoi "riverbank porewater" was sampled and one of the two samples in June 2003 showed elevated levels of eight organic compounds. The targeted percent reductions had been met at 6 out of the 8 groundwater monitoring wells as of the June 2003 sampling though most of the contamination appears to have been removed from the site. Further monitoring is happening.

INFORMATION SOURCES

Memo from Rich Langdon, Vermont DEC Aquatic Biologist to Chris Recchia, Deputy Commission, Vermont DEC, August 18, 2000 re: Fish Kill on Missisquoi River.

2nd Semi-Annual Groundwater Monitoring Report, Richford Short Stop (Pinnacle Peddler), Richford, Vermont. Hoffer Consulting, Barre, Vermont. November 2001. Also answers to questions from Matt Moran, Vermont DEC Hazardous Waste Section.

James Monahan - SCS St. Albans - reported streambank erosion sites at Sheldon/Enosburg town line and Stevens Mills

Peter Kaseoruu - UVM Extension Service - noted ag uses and hydro facility

Rolf Anderson - Vt. Voyagers Canoe Guide - noted absence of swimming on the river primarily due to high sediment load in suspension and ag nature of the watershed

USDA/NRCS 6/84 - heavy agricultural contribution from U.S. and Canada ag operators. Need for ag BMP implementation.

Use No	Use Description	Fully	Stressed	Altered	Impaired	Not Assessed
01	Overall	0.0	22.7	0.1	0.0	0.0
20	Aquatic biota/habitat	0.0	22.7	0.1	0.0	0.0
21	Fish consumption	0.0	22.8	0.0	0.0	0.0
42	Contact recreation	22.8	0.0	0.0	0.0	0.0
44	Noncontact recreation	22.8	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	22.8
62	Aesthetics	0.0	22.8	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	22.8

Impairment Cause	Magnitude	Size (mi.)
Nutrients	S	22.70
Siltation	S	22.70
Thermal modifications	S	22.70
Flow alterations	H	0.10
Other habitat alterations	S	22.70
Turbidity	S	22.70

Impairment Source	Magnitude	Size (mi.)
Agriculture	S	22.70
Flow mod. - hydroelectric	H	0.10
Streambank modification/destabilization	S	22.70

Mid Missisquoi River **VT06-02**

Permit No.	Point or Nonpoint Source Description	Receiving Water
1-0653	Richford Business Park - sw	Missisquoi River
1-0733	Vermont Creative Software - sw	Missisquoi River
1-0996	Gervais & Sons Retail Bldg - sw	Missiquoi River
1-1204	Enosburg Falls Shopping Center - sw	Missisquoi River
3067	Kaytec Inc Richford - sw(2)	Missisquoi River
3085	Enosburg Falls Bus and Ind Center - sw	Missisquoi River
VT0100102	Enosburg WWTF 0.450mgd	Missisquoi River
VT0100790	Richford WWTF 0.380mgd	Missisquoi River

7 stormwater

Tributaries to Lower Missisquoi River

Assessment Report

Waterbody No: VT06-03 **Assessment Year:** 2004

River Length (mi.): 32.7 **Date Last Updated:** 6/2/2004

Description: Tributaries to the lower mainstem of the Missisquoi River including Hungerford Brook, McGowan Brook, Kelly Brook, Morrow Brook

Location Identifiers

ANR Enforcement District: 6 **NRCS District:** 6

Fish and Wildlife District: 4 **Regional Planning Commission:** NW

Assessment Information

Monitored (mi.): 5.0

Evaluated (mi.): 27.7

On 303(d) List? N

Monitored for Toxics? Y

Assessment Type

Surveys of fish and game biologists or other professionals

Chemical monitoring of sediments

RBP III or equivalent benthos surveys

Toxics Testing

Organics in sediment

Metals in sediments

Waste Management Zone - Miles **Description**

Assessment Comments

STRESSED MILES

Hungerford Brook: 2.0 - upstream from rivermile 2.9 - aquatic biota/habitat and aesthetics stressed from nutrients, sediment, turbidity caused likely by agricultural activities. c(900,1100,2500) s(1000)

Kelly Brook: 0.3 - downstream from Young's landfill site - aquatic habitat (at least) stressed due to an inorganic and semivolatile organic compound found in sediments from the landfill c(300,500) s(6600)

Morrow Brook: 2.6 - whole length - aquatic habitat, aesthetics stressed due to sedimentation, turbidity, nutrient enrichment, likely temperature due to cows in the stream, pasture land.. c(900,1100,2500) s(1000)

McGowan Brook: 1.0 - upstream from mouth - aquatic habitat, aesthetics stressed due to sedimentation, turbidity, nutrient enrichment, likely temperature due to cows in the stream, pasture land.. c(900,1100,2500) s(1000)

COMMENTS

Hungerford Brook was sampled in 1999 at rivermile 3.9 and determined to be stressed - very turbid water, lots of algae and macrophytes. It will be assessed again in fall 2004.

Kelly Brook is a low gradient slow winder. Macroinvertebrates were sampled from this brook at

Tributaries to Lower Missisquoi River **VT06-03**

rivermiles 1.2 and 1.4 in 1998 but no assessment was formally made due to stream type. No severe impacts were noted when it was sampled. In addition, it was noted by the fisheries biologist in an earlier assessment that Kelly Brook has never been fishable - it is a small warmwater brook.

The Young Landfill property is a hazardous waste site in Highgate, which is bordered on the east by wetlands that are adjacent to Kelly Brook. The "toe of the slope of the landfill is in contact with surface water." The property was first used as a sand and gravel quarry from 1953 until the early 1960s. At that time, it began operating as a municipal landfill serving nine towns. "industrial waste disposal occurred from the 1960s until 1979 in three solvent trenches, located approximately 300 feet northwest of the landfill."

Following the 1978 Vermont Solid Waste Rules, the Young Landfill was given an "Assurance of Discontinuance" requiring the facility to close by April 1, 1983. In May 1984, Vermont AEC personnel saw leachate coming from the eastern edge of the landfill and on the landfill slopes. Also in September 1984 paper sludge was being used as a landfill cover. In December 1985, the owner was told that disposal activites should cease by Jan. 20, 1986 (no info on failure to close by 4/1/1983). Later investigations found that disposal activities had continued still. Groundwater, soil, surface water, and sediment sampling occurred over the years following: 1989, 1993, 1996, 1998. The 1998 sampling done by an EPA and Vermont DEC team found nine inorganic elements were detected above Vermont Groundwater Enforcement Standards in seep samples and sediment in Kelly Brook contained beryllium and bis(2-ethylhexyl)phthalate in concentrations exceeding reference levels.

INFORMATION SOURCES

Steve Fiske, Vermont DEC Water Quality Division - data and information on Kelly and Hungerford Brooks (2004)

Jerry McArdle, Vermont DEC Water Quality Division - field observations on McGowan and Morrow Brooks in summer 2000 (2004)

Final Expanded Site Inspection Summary Report for Young Landfill, Highgate Vermont. Prepared for U.S. EPA Region I Office of Site Remediation and Restoration by Roy F. Weston Inc Superfund Technical Assessment and Response Team, Burlington, Mass. 24 July 2000. (2004)

Trip Report for the Young Landfill, Highgate, Vermont, Prepared for: U.S. EPA Region I Office of Site Remediation and Restoration by Roy F. Weston Inc Superfund Technical Assessment and Response Team, Burlington, Mass. 2 February 1999. (2004)

Jon Anderson - Vt. F&W Fisheries Manager - info on Kelly Brook (1988)

Use No	Use Description	Fully	Stressed	Altered	Impaired	Not Assessed
01	Overall	26.8	5.9	0.0	0.0	0.0
20	Aquatic biota/habitat	26.8	5.9	0.0	0.0	0.0
21	Fish consumption	0.0	32.7	0.0	0.0	0.0
42	Contact recreation	32.7	0.0	0.0	0.0	0.0
44	Noncontact recreation	32.7	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	32.7
62	Aesthetics	27.1	5.6	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	32.7

Impairment Cause	Magnitude	Size (mi.)
Nutrients	S	5.60
Siltation	S	5.60
Turbidity	S	5.60
Priority organics	S	0.30
Metals	S	0.30

Impairment Source	Magnitude	Size (mi.)
Agriculture	S	5.60

Tributaries to Lower Missisquoi River		**VT06-03**
Hazardous waste	S	0.30

Permit No.	Point or Nonpoint Source Description	Receiving Water
9-0188	Homestead Acres Mobile Home Park	Trib Hungerford Brook
1-0748	Leduc Sand Pit Access Road - sw	Trib Hungerford Brook
1-1443	FCIDC Multi-Tenant Facility Swanton - sw	Trib Missisquoi River
2-1166	Leduc Bushey Street subdivision - sw	Trib Missisquoi River
3065	Franklin County State Airport - sw	Trib Missisquoi River
	Young's Landfill	Kelly Brook

4 stormwater

(A) UNASSESSED STREAMS (Named)

Goodsell Brook in Sheldon

Tributaries to Mid Missisquoi River

Assessment Report

Waterbody No: VT06-04 **Assessment Year:** 2004

River Length (mi.): 61.6 **Date Last Updated:** 7/13/2004

Description: Tributaries to the middle segment of the Missisquoi River including Giddings, Trout, Loveland, Stanhope, Lucas, Samonsville, Godin, and Berry Brooks.

Location Identifiers

ANR Enforcement District:

NRCS District:

Fish and Wildlife District: 4

Regional Planning Commission:

Assessment Information

Monitored (mi.):	6.7
Evaluated (mi.):	54.9
On 303(d) List?	Y
Monitored for Toxics?	N
Toxics Testing	

Assessment Type

Chemical/physical monitoring

RBP III or equivalent benthos surveys

RBP V or equivalent fish surveys

Waste Management Zone - Miles **Description**

Assessment Comments

IMPAIRED MILES

North Branch Berry Brook: 0.5 - from confluence with Berry Brook upstream 1/2 mile - aquatic biota/habitat, contact recreation, and aesthetics impaired due to nutrients, pathogens, organic matter and sediments from agricultural activities including barnyard and milkhouse runoff. c(900,1100,1200,1700) s(1000)

Berry Brook: 0.9 - from mouth upstream to confluence of North Branch - aquatic biota/habitat, contact recreation, and aesthetics impaired due to nutrients, organic matter, pathogens, and sediment due to agriculture. c(900,1100,1200,1700) s(1000)

Samsonville Brook: 2.0 - from mouth upstream 2 miles - aquatic biota, contact recreation, and aesthetics due to nutrients, pathogens, organic matter and sediment from agriculture. c(900,1100,1200,1700) s(1000)

Godin Brook: 1.0 - aquatic biota/habitat, contact recreation, and aesthetics due to nutrients, organic enrichment, and pathogens from agricultural activities including cows in the brook. c(900,1100,1200,1700) s(1000)

Trout Brook: 2.3 - aquatic biota/habitat impaired due to nutrients and organic enrichment from agriculture. c(900,1200) s(1000)

Tributaries to Mid Missisquoi River **VT06-04**

COMMENTS

Macroinvertebrate sampling on Godin Brook at rivermile 0.9 resulted in the following assessments of the community: "poor" in September 1992; "fair" in September 1993, September 1994, September 1995, September 1996, September 1998; "good" in September 1999; and "fair" in September 2000.

Macroinvertebrate sampling on Samsonville Brook at two sites resulted in the following assessments of the community: at rivermile 0.2, the community was "poor" i n 1992; "poor" in 1993; and "fair" in 2000; and at rivermile 0.6, the community was "fair" in 1994; "fair" in 1996; "fair" in 1998; and "good" in 2000.

Macroinvertebrate sampling on Berry Brook at two sites resulted in the following assessments: at rivermile 0.2, the community was "fair" in 1992; and "good" in 1993; and at rivermile 1.2, the community was "excellent" in 1992, 1993, 1994, 1995, 1996; "good" in 1998; "excellent" in 1999 and 2000. Berry Brook at rivermile 0.9 was sampled once in 1994 and the community was "poor".

Macroinvertebrate sampling on the North Branch of Berry Brook at rivermile 0.1 resulted in the following assessment of the community: "poor" in 1994; "fair" in 1995; "fair" in 1996; "poor" in 1998; "poor" in 1999; and "fair" in 2000.

Samsonville, Godin, and Berry (including the North Branch of Berry) Brooks watersheds are part of the Section 319 National Monitoring Program. Calibration monitoring occurred in these watersheds from 1994 through 1996. Samsonville (watershed 1) and Godin (watershed 2) received nonpoint source pollution prevention treatments from June to November 1997. Berry Brook watershed was the control with no treatments. Follow-up monitoring occurred from November 1997 through November 2000. Although Godin Brook watershed was a treatment watershed, there was a large farm expansion from Year 6 of the project through Year 7 and the erosion and runoff from major land clearing and poor riparian zone management negated the earlier positive effects of treatments.

Phosphorus, nitrogen, suspended solids, and indicator bacteria were all reduced in the brooks in response to livestock exclusion and riparian zone protection. Values for Samsonville Brook at the project end showed the reductions in nutrient and suspended solid concentrations and exports and the reductions in bacteria concentrations as a response to the treatment. Those for Godin Brook did not because of the land disturbance at the farm and runoff in the last year of project sampling.

In Year 7 of the project (2000), the median values for the water quality variables were as follows:

Samsonville Brook (WS1): TP - 0.072 mg/liter; TSS - 13.0 mg/liter; E. coli - 43/100 ml; fecal coliform - 34/100 ml.

Godin Brook (WS2): TP - 0.167 mg/liter; TSS - 20.6 mg/liter; E. coli - 760/100 ml; fecal coliform - 1175/100 ml.

Berry Brook (WS3): TP - 0.055 mg/liter; TSS - 5.5 mg/liter; E. coli - 258/100 ml.; fecal coliform - 335/100 ml.

The Richford Water System outtake is on Stanhope Brook. Impacts to the stream or aquatic biota are not know at this time.

Domestic discharge enforcement program results (6/90 - 8/91) include Richford (2 Notice of Alleged Violations (NOAVs), 1 correction) and Berkshire (10 NOAVs, 0 corrections so far).

(A)

INFORMATION SOURCES

Lake Champlain Basin Agricultural Watersheds Section 319 National Monitoring Program Project: Final Project Report, May 1994 - November 2000, June 2001. Don Meals, Vermont ANR Department of Environmental Conservation, Waterbury, Vermont,

Steve Fiske, Vermont DEC Water Quality, Biomonitoring and Aquatic Studies section (BASS) - data on integrity of macroinvertebrate community

Rich Langdon, Vermont DEC Water Quality, BASS - data on integrity of fish community

Rick Hopkins, Vermont DEC Water Quality - information on National Monitoring Program project

Biennial Report to EPA FY90 Section 319 VT004 Vermont Domestic Discharge Enforcement August 28, 1991 - Sean McVeigh

Jon Anderson, District Fisheries Manager - noted threats due to ag during 1990 assessment

Kathy Fallon & Water Supply Division information - stream water supply

Use No	Use Description	Fully	Stressed	Altered	Impaired	Not Assessed
01	Overall	54.9	0.0	0.0	6.7	0.0

Tributaries to Mid Missisquoi River **VT06-04**

20	Aquatic biota/habitat	54.9	0.0	0.0	6.7	0.0
21	Fish consumption	0.0	61.6	0.0	0.0	0.0
42	Contact recreation	57.2	0.0	0.0	4.4	0.0
44	Noncontact recreation	61.6	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	61.6
62	Aesthetics	57.2	0.0	0.0	4.4	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	61.6

Impairment Cause	Magnitude	Size (mi.)
Nutrients	H	6.70
Siltation	H	4.40
Organic enrichment/Low D.O.	H	6.70
Pathogens	H	4.40

Impairment Source	Magnitude	Size (mi.)
Agriculture	H	6.70

Permit No.	Point or Nonpoint Source Description	Receiving Water
1-0964	Villeneuve subdivision - sw	Trib Lucas Brook
1-1125	Valentine Drive subdivision - sw	Giddings Brook
3085	Enosburg Falls Bus and Ind Center - sw	Trout Brook

3 stormwater

Black Creek

Assessment Report

Waterbody No: VT06-05 **Assessment Year:** 2004

River Length (mi.): 44 **Date Last Updated:** 8/24/2004

Description: Mouth to headwaters and tributaries including Dead Creek, Fairfield River, Wanzer Brook, Elm Brook

Location Identifiers

ANR Enforcement District: 6 **NRCS District:** 6

Fish and Wildlife District: 4 **Regional Planning Commission:** NW

Assessment Information

Monitored (mi.): 4.5

Evaluated (mi.): 39.5

On 303(d) List? Y

Monitored for Toxics? N

Toxics Testing

Assessment Type

Surveys of fish and game biologists or other professionals

Non-fixed station chemical/physical monitoring-conventional pollut

RBP III or equivalent benthos surveys

Waste Management Zone - Miles **Description**

Assessment Comments

IMPAIRED MILES

Wanzer Brook: 2.0 (at least) - from mouth upstream to first tributary above Wanzer Road bridge - aquatic biota/habitat and aesthetics impaired due to nutrients, siltation, organic enrichment, thermal modifications due to agricultural activities, loss of riparian vegetation, streambank erosion, gravel road runoff. c(900,1100,1400,1600) s(1000,4500,7600,7700)

Chester Brook: 2.5 - aquatic biota/habitat impaired due to nutrients, sedimentation, likely other problems due to agricultural activities and road runoff. c(900,1200) s(1000,4500)

STRESSED MILES

Wanzer Brook: 2.0 - from first tributary above Wanzer Road bridge upstream to pasture above Dodd Road - aquatic habitat and aesthetics stressed due to sedimentation, physical alterations, temperature from pasture land use with no fencing on stream, road runoff. c(1100,1400,1600) s(1000,4500)

Black Creek: 12 - from confluence with Missisquoi upstream to East Fairfield - aquatic biota/habitat and aesthetics stressed due to nutrient enrichment, turbidity, thermal changes, and sedimentation from corn, hay, and pasture with small or no buffers, loss of riparian vegetation and its shading and soil binding values. c(900,1100,1400,2500) s(1000,6500,7600)

Black Creek **VT06-05**

COMMENTS

Macroinvertebrate sampling on Chester Brook at rivermile 2.4 found the following results: in 1992, the community was in "fair" biological condition.

Macroinvertebrate sampling on Wanzer Brook at rivermile 1.4 found the following results: in 1992, the community was in "poor" biological condition.

Nutrient samples were taken on Wanzer Brook in the summer 1999. The stream was sampled for total phosphorus and total nitrogen four times at two sites. At the uppermost site: on 6/24/1999, TP was 0.042 mg/liter and TN was 0.40 mg/liter (low flow); on 7/7/1999, TP was 0.102 mg/liter and TN was 1.47 mg/liter (rain event); on 8/4/1999, TP was 0.070 mg/liter and TN was 0.28 mg/liter (low); and on 9/9/1999, TP was 0.061 mg/liter and TN was 1.02 mg/liter (rain event). At the lower site: on 6/24/1999, TP was 0.022 mg/liter and TN was 0.24 mg/liter (low); on 7/7/1999, TP was 0.092 mg/liter and TN was 1.52 mg/liter (rain event); on 8/4/1999, TP was 0.023 mg/liter and TN 0.22 mg/liter (low); and on 9/9/1999, TP was 0.051mg/liter and TN was 0.95 mg/liter (rain event).

A streamwalk was done on Wanzer brook from just below Wanzer Road bridge upstream about 3000 feet. Many problems were noted including streambank erosion, aggradation, braiding, high coverage of filamentous algae, lack of a buffer and canopy coverage, gravel mining (farm use likely though) in 2 locations. A windshield survey in August 2000 also noted goor gravel road ditch maintenance along the road above the stream. Field observations in August 2004 noted three locations on Wanzer Brook where road runoff appears to reach the brook. Large sand deposits were noted below Chester Arthur Road culvert (1st one) where the stream meanders through pasture. The cobble substrate upstream at Ryan Road was quite embedded too. The impacts of pasture along the stream (with no fencing in most locations, no buffers and thus some eroding banks and widening stretches) and road runoff appear to be the largest problems for this brook. Given the monitoring data of "poor" at rivemile 1.4 and the field observations, the length of the impairment is described from the point approximately 3000 feet above Wanzer Road bridge where there are a number of documented instream problems down through the sample point to the mouth. The 2 +/- mile stretch upstream of here needs some monitoring.

INFORMATION SOURCES

Vermont DEC Water Quality Division - field surveys and nutrient sampling results summer 1999, summer 2000 and summer 2004.

Dan Batchelder - Consulting Forester in area since 1979 - noted severe deterioration in water quality, decreased fish populations, poor ag. practices, and algal blooms. (1988)

Lower Missisquoi River Watershed Preauthorization Planning and Report and Plan of Work. 6/1984, USDA

Jon Anderson, Vermont Dept of Fish & Wildlife - noted that 10.0 miles should be shifted from CWA fishable supported to partially supported. (1990)

Use No	Use Description	Fully	Stressed	Altered	Impaired	Not Assessed
01	Overall	28.0	12.0	0.0	4.5	0.0
20	Aquatic biota/habitat	28.0	12.0	0.0	4.5	0.0
21	Fish consumption	0.0	44.0	0.0	0.0	0.0
42	Contact recreation	32.0	12.0	0.0	0.0	0.0
44	Noncontact recreation	34.0	10.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	44.0
62	Aesthetics	30.5	12.0	0.0	2.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	44.0

Impairment Cause	Magnitude	Size (mi.)
Nutrients	M	4.50
Nutrients	S	12.00
Siltation	H	2.00
Siltation	S	14.00
Thermal modifications	M	2.00

Black Creek		**VT06-05**
Thermal modifications	S	14.00
Turbidity	S	12.00
Other habitat alterations	M	2.00
Other habitat alterations	S	2.00

Impairment Source	**Magnitude**	**Size (mi.)**
Agriculture	H	4.50
Agriculture	S	14.00
Removal of riparian vegetation	M	2.00
Removal of riparian vegetation	S	12.00
Streambank modification/destabilization	M	2.00
Highway/road/bridge runoff	M	2.00
Highway/road/bridge runoff	S	2.00

Tyler Branch

Assessment Report

Waterbody No: VT06-06 **Assessment Year:** 2004

River Length (mi.): 54.1 **Date Last Updated:** 6/21/2004

Description: Mouth to headwaters and tributaries including The Branch, Beaver Meadow Brook, Bogue Branch, Cold Hollow Brook, Cook Brook, Ross Brook

Location Identifiers

ANR Enforcement District: 6 **NRCS District:** 6

Fish and Wildlife District: 4 **Regional Planning Commission:** NW

Assessment Information

Monitored (mi.): 38.0

Evaluated (mi.): 16.1

On 303(d) List? N

Monitored for Toxics? N

Toxics Testing

Assessment Type

Surveys of fish and game biologists or other professionals

Land use information and location of sources

Occurrence of conditions judged to cause impairment

Habitat assessment

Waste Management Zone - Miles **Description**

Assessment Comments

STRESSED MILES

Tyler Branch: 11.0 - aquatic biota/habitat and aesthetics stressed due to sediment, physical habitat alterations, likely nutrients, temperature, and pathogens due to agricultural land activities (pasture with cows having access to brook, some hay and some corn), loss of riparian vegetation, channelization, dredging, rip-rap. c(900,1100,1400,1600,1700) s(1000, 7550,7600,7700))

The Branch: 4.9 - from the confluence of Beaver Meadow Brook upstream to the bridge on East Bakersfield Road - aquatic habitat and aesthetics stressed due to physical alterations and sedimentation from loss of riparian vegetation, de-stabilized streambanks, channelization.

COMMENTS

The Lake Champlain Committee and the Northwest Regional Planning Commission have done a geomorphic assessment (Phase I) of the Tyler Branch and a number of its tributaries: Beaver Meadow Brook. Boque Branch, Ross Brook, Cooks Brook, Cold Hollow Brook, The Branch and unnamed tributary. On Tyler Branch itself, 11 of the 14 fourteen reaches that were delineated were found to be only in "fair" condition. The other streams and brooks were found to be in better condition except for the mid-section of The Branch which was largely in "fair" condition as well.

Windshields surveys in summer 1999 and summer 2000 noted similar conditions - small woody riparian

Tyler Branch **VT06-06**

buffer, agricultural land uses (pasture,corn, hay), stretches with rip-rap and/or channelized, some siltation, some algae growth, eroding banks in some spots.

Cooks Brook was surveyed in July 2000 and no impacts or threats were noted. Buffers were greater than 500 feet on both sides. A cascades, gorge, and small waterfall were observed on the lower end of the brook.

Paul's (formerly Charley's) Quick Stop in Bakersfield is a hazardous waste site (#95-1768). Eleven groundwater monitoring wells and three surface water sampling locations were sampled inb November 2002. SW-1 had elevated levels of ethylbenzene, xylene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene. SW-2 had elevated levels of toluene, ethylbenzene, xylenes, 1,3,5 and 1,2,4-trimethylbenzene and naphalene. SW-3 had elevated levels of toluene, ethylbenzene, xylene, 1,3,5 and 1,2,4-trimethylbenzene and naphalene.

INFORMATION SOURCES

Vermont DEC Water Quality Division River Management Section - data from electronic reports on Phase I geomorphic assessment work on Tyler Branch and its tributaries (2003)

Annual Groundwater Monitoring, Charley's Quick Stop Site, Bakersfield, Vermont. Hoffer Consulting Inc, Barre, December 2002.

Jerry McArdle, Dan Farrell, Vermont DEC Water Quality Division - observations from windshield surveys and other field work in summers of 2000 and 1999 respectively.

Jon Anderson, Vermont Department of Fish & Wildlife - felt the whole watershed faced threats from level of ag activities adjacent to streams (1988)

Chris O'Shea, area resident for 30 years - noted worst problems during warm period of lower flows. Attributes foamy waters to improper whey applications. (his comments from 1988 assessment)

Lower Missisquoi River Watershed Preauthorization Planning Report and Plan of Work, USDA, 6/84.

MILAGES

Use No	Use Description	Fully	Stressed	Altered	Impaired	Not Assessed
01	Overall	38.2	15.9	0.0	0.0	0.0
20	Aquatic biota/habitat	38.2	15.9	0.0	0.0	0.0
21	Fish consumption	0.0	54.1	0.0	0.0	0.0
42	Contact recreation	54.1	0.0	0.0	0.0	0.0
44	Noncontact recreation	54.1	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	54.1
62	Aesthetics	38.2	15.9	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	54.1

Impairment Cause	Magnitude	Size (mi.)
Siltation	S	11.00
Other habitat alterations	S	11.00

Impairment Source	Magnitude	Size (mi.)
Agriculture	S	11.00
Channel instability	S	11.00
Removal of riparian vegetation	S	11.00
Streambank modification/destabilization	S	11.00

Trout River

Assessment Report

Waterbody No: VT06-07 **Assessment Year:** 2004

River Length (mi.): 45 **Date Last Updated:** 9/27/2004

Description: Mouth to headwaters and tributaries including West Hill Brook, South Branch, and Hannah Clark Brook

Location Identifiers

ANR Enforcement District: 6 **NRCS District:** 6

Fish and Wildlife District: 4 **Regional Planning Commission:** NW

Assessment Information

Monitored (mi.): 0.0

Evaluated (mi.): 45.0

On 303(d) List? N

Monitored for Toxics? Y

Toxics Testing

Assessment Type

Land use information and location of sources

Fish surveys

Other inorganics in water column

Waste Management Zone - Miles **Description**

Assessment Comments

ALTERED MILES
Trout River: 5.0 - upstream from mouth - aquatic habitat and aesthetics altered due to sedimentation and physical alterations from removal of riparian vegetation, gravel removal, channel instability and stresses from turbidity, nutrient enrichment, and thermal modifications from ag. related erosion, cropland runoff, removal of riparian vegetation along waterways. Leaking inactive landfill creates threat. c(900,1100,1400,1600,1700) s(1000,5000,7550,7600,7700)

STRESSED MILES
West Hill Brook: 3.0 - upstream from mouth - aquatic habitat and aesthetics stressed (at least) due to habitat alterations, sedimentation from residential development, road runoff, flood damage and 'repair' c(1100,1600) s(3200,4500,7100)

COMMENTS
Floods in 1997 exacerbated an already unstable stream situation and streambank erosion on the Trout River below Montgomery Center. Money from the Federal Emergency Management Agency and other sources funded a natural channel design and implementation on the mile below Montgomery Center in the summer of 1999. This large restoration project resulted in a mile of stable river with buffers on both sides.

Trout River **VT06-07**

The six miles of partial support that had been listed above has been changed to five miles.

Macroinvertebrate sampling in 2001 at rivermile 0.8 on the Trout River found a community in good condition. Fish sampling in 2002 on the Trout at rivermile 8.5 found a community in excellent condition. Macroinvertebrate sampling on West Hill Brook at rm 0.2 resulted in a community assessment of very good-good in 1996, poor in 1997, good-fair in 1998, very good-good in 1999. The "poor" assessment in 1997 was probably due to scouring from the flood of that summer.

An existing use survey for swimming holes on the Trout River was conducted in August 1998. Thr survey was done in response to the possibility of a proposal for a wastewater treatment facility in Montgomery that would discharge to the Trout River. Four sites were described between Montgomery village and the Missisquoi River: one below the confluence of West Hill Brook with the Trout River; one just upstream of Longely Bridge; one in the vicinity of Hopkins Bridge; and one off a farm road across from the Montgomery/Enosburg town line sign.

Other swimming holes were described in the Swimming Holes of Vermont report. An additional swimming hole on the Trout River ("Montgomery Schoolhouse") is located north of Montgomery Center. It consists of a deep pool below two cascades plus a rock slide, some other pools, and secluded areas. On the South Branch above and below the Gibou Road bridge, there are several sets of cascades and a deep green pool: a beautiful site. There is a trail down to the brook from each side of the road. On West Hill Brook, there are two sites that have been visited and described. At the Creamery Covered Bridge, there is a nice set of cascades and a pool. There were two areas where campfires had been made near the bridge. A sign on the bridge states that the site will be posted as private property if the destructive behavior doesn't stop. Downstream on West Hill Brook is another swimming hole called "Hippy Hole" which consists of a narrow cascade that flows into a deep pool. There are places to jump and sit.

Hazardous waste site #88-0230, D & D Deli and Redemption Center on Comstock Road in Montgomery, is about 100-120 feet away from the Trout River. Two surface water samples were taken from the Trout River from 1994 - 2001 at the time groundwater samples from around the site were taken. Initially (1994-1996), levels of benzene exceeded the water quality standards for the protection of human health and toluene, ethyl benzene, xylenes, and MTBE were elevated at one of the two surface water sample sites. In December 2001, it was recommended that the surface water samples be removed from the sampling plan because no petroleum contaminants had been detected in these samples for at least 2 1/2 years.

INFORMATION SOURCES

Semi-Annual Site Monitoring Report - October 2001, Cota's Deli and Beverage (D & D now), Montgomery, Vermont Marin Environmental, Richmond, Vermont.

Vermont Water Quality Division Rivers Management Program - info on Trout River restoration (2000)

Brian Chipman, Vt. Dept. of Fish & Wildlife - reiterated impacts to lower 6 miles of Trout River during 1996 assessment. Trout sampling done in 1993 and 1994 found: below Rte 118 bridge - 10 trout collected (no young of the year) in 1993 and no trout collected in 1994; above Longley covered bridge - 9 trout collected (5 young of the year) and not sampled in 1994. (1996)

Jon Anderson, Vt. Dept. of Fish & Wildlife - noted the threats to the Trout River upstream from Montgomery Center. (1990)

Dan Batcheleder, Consulting Forester - noted highest levels of impairment during spring (high flows & velocity), summer (low flow & high temp.) and fall (high flows); notes ag. sources and suspicious of failed septic systems. (1988)

Jim Monahan, SCS - estimates up to 20' of streambank lost per year due to cultivation activities near stream. (1988)

Vermont DEC Solid Waste Files, Jan. 1988 - high iron (Fe) content found in 5 surface sample sites near landfill (St. Onge?) exceed 'freshwater chronic' levels; organics present in spring and 1 surface water sample. Sampling start May 1985.

MILEAGES

Monitored miles: lowest 6 miles of Trout River plus less than a mile at Rich's rm 8.5 on the Trout river pluas lowest 0.2 miles on West Hill

Trout River **VT06-07**

Use No	Use Description	Fully	Stressed	Altered	Impaired	Not Assessed
01	Overall	37.0	3.0	5.0	0.0	0.0
20	Aquatic biota/habitat	37.0	3.0	5.0	0.0	0.0
21	Fish consumption	0.0	45.0	0.0	0.0	0.0
42	Contact recreation	45.0	0.0	0.0	0.0	0.0
44	Noncontact recreation	45.0	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	45.0
62	Aesthetics	37.0	3.0	5.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	45.0

Impairment Cause	Magnitude	Size (mi.)
Nutrients	S	5.00
Siltation	H	5.00
Thermal modifications	S	5.00
Other habitat alterations	H	5.00
Pathogens	S	5.00
Siltation	S	3.00
Other habitat alterations	S	3.00

Impairment Source	Magnitude	Size (mi.)
Agriculture	H	5.00
Channel instability	H	5.00
Removal of riparian vegetation	M	5.00
Streambank modification/destabilization	H	5.00
Land development	S	3.00
Highway/road/bridge runoff	S	3.00
Channelization	S	3.00

Upper Missisquoi River
Assessment Report

Waterbody No: VT06-08 **Assessment Year:** 2004

River Length (mi.): 108 **Date Last Updated:** 6/22/2005

Description: Upper Missisquoi River from Canadian border to headwaters and tributaries including East Branch, Burgess Branch, Jay Branch, Mud Creek, and Truland, Mineral Spring, Snider.Taft. Mill. Beetle. Crook Brooks.

Location Identifiers

ANR Enforcement District: 7 **NRCS District:** 12

Fish and Wildlife District: 4 **Regional Planning Commission:** NE

Assessment Information

Monitored (mi.): 13.5

Evaluated (mi.): 94.5

On 303(d) List? Y

Monitored for Toxics? N

Toxics Testing

Assessment Types

Land use information and location of sources

Occurrence of conditions judged to cause impairment

Biological Monitoring

Waste Management Zone - Miles: 1.00 **Description:** 1 mile downstream from Jay/Troy WWTF

Assessment Comments

IMPAIRED MILES

Coburn Brook: 0.5 - upstream from the mouth - aquatic biota/habitat impaired due to nutrient enrichment, likely temperature increases as well from agricultural land uses (barnyard, stream through the pasture, loss of riparian vegetation). c(900) s(1000,7600)

Taft Brook: 0.1 - upstream from the mouth - aquatic biota/habitat due to nutrient and organic enrichment (smelled like whey or milk house waste) from agricultural activities. c(900,1200) s(1000)

Mud Creek: 4.2 miles - from Newport Center downstream to the Newport/Troy town line (north of Route 105 where stream enters forested area) - aquatic biota/habitat and aesthetics impaired due to nutrient enrichment, turbidity, likely temperature but not measured, from agricultural activities (waste storage problems at least in the past, pasture, hay, cropland adjacent to creek, cows with access to stream..), loss of riparian vegetation c(900,2500,1400?) s(1000,7600)

Jay Branch: 6.0 miles - from Jay Peak golf course construction to mouth - aquatic biota/habitat, aesthetics, contact recreation impaired due to turbidity from extensive land disturbance, bare soils with inadequate erosion control. c(2500) s(3200,8710)

ALTERED MILES

Missisquoi River: 4.0 - below Bakers Falls hydro - aquatic biota/habitat altered due to flow fluctuations by facility c(1500) s(7410)

Upper Missisquoi River **VT06-08**

Jay Branch: 4.7 - below Jay Peak ski area - aquatic biota/habitat altered due to flow modifications from snow making withdrawals. c(1500) s(7420)

STRESSED MILES

Mud Creek: 2.6 miles - town line downstream to Canadian border - aquatic biota/habitat and aesthetics stressed due to nutrient enrichment, turbidity, likely temperature, habitat alterations need investigation, from agricultural activities. c(900,1400?,2500) s(1000)

East Branch Missisquoi River: 0.9 - from Route 100 downstream to Cheney Road bridge - aquatic habitat and aesthetics stressed due to sedimentation, nutrients, likely temperatures from sand and gravel inputs from a gravel pit operation (mostly its road and tributary crossing), pasture (with no fencing along stream), loss of riaprian vegetation, eroding banks. c(900,1100,1400) s(1000,4500,5100,7600,7700)

COMMENTS

The East Branch of the Missisquoi River was surveyed in June 2000 and July 2004. The land uses seemed to stay the same over this four year period: pastureland with cows, gravel pits, rural residential development, gravel and paved roads (Routes 100 and 58) and associated bridges, and the village of Lowell. The gravel pits, including access to them, and the pastureland with the brook flowing right through it and no cow exclusion, seem to be having the greatest impact on this stream.

Macroinvertebrate sampling on Coburn Brook in 1999 at ABN rivermile 0.1 below Route 100 bridge had a community in "poor" condition and sampling in 2000 at rivermile 0.2 above Route 100 also showed the community in "poor" condition. The metrics showed high density and a lot of Oligochaetes. Nutrient enrichment is causing the impairment. This is unfortunate because an early assessment reported: "[T]he 1994 biological assessment of both the fish and macroinvertebrate communities show the stream community is now recovered from the Kraft Agri-Mark impact documented in previous years... In summary, [the Coburn Brook aquatic community] is moderately stressed by non-point sources of enrichment but still in overall good conditions."

Crook Brook had a section listed in partial support and threatened in earlier assessments. However, windshield surveys done in August 1999 and June 2000 noted a good canopy cover and forested land cover along much of this stream. Eroded banks were noted in some locations but there is not enough information provided to determine the causes. This brook should be investigated for stability issues. The brook flows down a narrow, steep valley in stretches and looks to be a flashy stream. The substrate is identified as boulder, cobble, gravel in most locations observed. Roads cross this brook seven times. A macroinvertebrate sample was taken on Crook Brook at rivermile 1.6 in 1999 and the community was found to be in "good" condition.

Beetle Brook was surveyed in August 1999 too. The canopy cover and riparian vegetation varies along the brook's length - hayfield, pasture, and near Morey Road (a relatively new or upgraded road) residential lawns alternate with wooded areas as the adjacent land use. Algae was noted on the channel substrate fairly frequently and embeddedness up to 50% was noted. The past assessment read: "Beetle Brook: 1.0 - from Troy talc mine to Missisquoi - partial support of biota due to severe sedimentation from erosion. Town highway being upgraded. c(1100) s(8300) (from 9001 assessment)" Do not know if this town highway upgrade is the Morey Road seen in the field in 1999. Do not yet know where this talc mine is located. The last time Beetle Brook was sampled (biological sampling) was in 1993 and the macroinvertebrate community at rivermile 1.1 was in "excellent" condition.

Taft Brook was sampled in 1999 and 2000. In September 1999 at rivermile 0.1, the macroinvertebrate community was in "poor" condition. There was poor EPT and BI and the sample was dominated by bloodworms. The stream bed smelled strongly and it looked like whey or milk house waste getting into the stream. In September 2000 at rivermile 0.1, the fish community was in "fair" condition. A field survey in June 2000 noted cultivated fields and pasture with a cow crossing at the lower end of Taft Brook. A field survey in July 2004 noted hayfields, clear water, no silt or algae on substrate, vegetated banks and a narrow buffer (one tree wide). Needs re-sampling in fall 2004.

Mud Creek was sampled in the early 1990s and then the macroinvertebrate community was sampled at two locations in 1999. At rivermile 4.0 the community was assessed as "good" and at rivermile 6.6, the community was assessed as "poor". Nutrient samples were collected four times over the summer season

Upper Missisquoi River **VT06-08**

also in 1999 around rivermile 4.0. Phosphorus concentrations were as follows: 118 ug/liter on 6/24/1999; 145 ug/liter on 7/7/1999; 113 ug/liter on 8/3/1999; and 94 ug/liter on 9/9/1999. Windshield surveys of the creek were done in August 1999 and June 2000. A stream walk was done on a segment of Mud Creek about 0.9 miles long upstream from Bear Mountain Road. Observations during the streamwalk included high percentages of filamentous algae coverage on the channel substrate and often a multiple thread channel, cut-off channels and flood chutes. A number of indicators of aggradation were also noted. Other observations during the windshield survey included slightly turbid to turbid water clarity conditions. On 6/01/2000, the water temperature at a point near Bear Mountain Road was 23.5 C - sites upstream were 20 C and 18 C.

Jay Branch was surveyed in summer 1999, in summer 2000, and in summer 2004. The macroinvertebrate community was sampled on this brook in 1999 at rivermile 4.6 and was in "fair" condition. The fish community has not been sampled in the last 10 years. In the summary from the 1999 windshield survey, it was noted that " The channel is dominated by cobble and boulder riffles, runs, and pools. Evidence of degradation and aggradation was apparent practically everywhere: large gravel bars, eroded and slumped banks, and split channels. It is often channelized with rip-rap sections - especially near the roads and houses further upstream." When the stream was observed in August 2004, it was running turbid. It turned out there was runoff coming from a major land disturbance/golf course construction project at Jay Peak and discharging into Jay Branch. Monitoring site TM-07A located on the North Branch below the golf course practice hole, hole 9, and hole 1 had turbidity values from 2.95 to over 1000 NTU. Of the 15 samples, 12 were above standard - a number of them way above standard. Monitoring site TM-08A on the tributary to North Branch belows holes 3 & 8 had values from 0.59 to over 1000 NTU. Fifteen of 19 samples were above standard - there were many samples that were labelled "ERR" indicating a turbidity value beyond the range of the Lamotte 2020 Turbidity Meter (> 1000 NTU). There is supposedly going to be improvements on the erosion control at this site. Follow-up is needed.

Jay Branch Trib 7 was sampled in 1993 and the macroinvertebrate community at rivermile 1.2 then was assessed as "good".

Jay Peak Maintenance Garage is DEC hazardous waste site #96-2083. Surface water samples and seep samples from in and along the South Brook tributary to Jay Branch are taken. The latest sampling from a seep (SS2) that goes to the brook had 6 ug/liter 1,2,4-trimethylbenzene. No detect for benzene, toluene, napthalene, and others.

Troy WWTF on line and the cheese plant wastewater now goes to the WWTF. The WWTF discharge point is to the Missisquoi below Bakers Falls hydro. (1996)

Updated the miles of partial support based on the use attainability analysis for streams affected by snowmaking water withdrawals. (1998)

INFORMATION SOURCES

Vermont DEC Waste Management Division Haz Material Section - info on Jay Peak Maintenance Garage site and sampling (2004)

Vermont DEC Water Quality Division BASS - biological monitoring data and analysis (2003)

Vermont DEC Water Quality Division - field notes, reports, maps, and nutrient sampling results from summer 1999 and summer 2000 field work (2003)

Coburn Brook Biological Assessment 1994, Memo to the Record from Steve Fiske and Rich Langdon, Aquatic Biologists 12/12/95. (1998)

Tom Broido, Vt. Dept. of Health Asbestos specialist - noted presence of mine in Lowell and high probability of fibers in water column in Burgess Brook (1996)

Peter LaFlamme, Vt DEC Water Quality Division - information on Troy WWTF and cheese plant discharge (1996)

Use Attainment for Streams Affected By Snowmaking Water Withdrawals in Vermont, David Bottamini for Vermont ANR DEC Water Quality Division, May 1996.

Phil Wightman, Len Gerardi, Will Staats, Vermont Department of Fish & Wildlife - in 1988, Len reported a fish kill from a manure storage failure on Mud Creek north of Newport City; in 1990, they noted sedimentation from erosion in Beetle Brook and the town highway upgrade, dam construction and flow alteration due to snowmaking on Jay Branch, and gravel mining on the Missisquoi above and below Lowell Village. (1988-1990)

Upper Missisquoi River **VT06-08**

Use No.	Use Description	Fully	Stressed	Altered	Impaired	Not Assessed
01	Overall	89.7	3.5	4.0	10.8	0.0
20	Aquatic biota/habitat	89.7	3.5	4.0	10.8	0.0
21	Fish consumption	0.0	108.0	0.0	0.0	0.0
42	Contact recreation	107.5	0.0	0.0	0.5	0.0
44	Noncontact recreation	108.0	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	108.0
62	Aesthetics	94.3	3.5	0.0	10.2	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	108.0

Impairment Cause	Magnitude	Size (mi.)
Nutrients	H	4.80
Nutrients	S	3.50
Organic enrichment/Low D.O.	H	0.10
Flow alterations	H	8.70
Turbidity	H	10.20
Turbidity	S	2.60

Impairment Source	Magnitude	Size (mi.)
Agriculture	H	4.80
Agriculture	S	2.60
Flow mod. - hydroelectric	H	4.00
Flow mod.- snowmaking water withdrawal	H	4.70
Removal of riparian vegetation	M	4.70
Land development	H	6.00
Golf courses	H	6.00

Permit No.	Point or Nonpoint Source Description	Receiving Water
VT0101168	Troy/Jay WWTF 0.200 mgd	Missisquoi River
9-0008	Jay Peak Inc - indirect sewage condos	Jay Branch
9-0120	Jay Peak Inc - indirect sewage hotel	Jay Branch Brook
3122	Troy/Jay WWTF - sw	Missisquoi River
3213	The Foothills Local Boys Dev Corp- sw(2)	Jay Branch & Trib Jay Branch
2-1195	Vermont AOT	Jay Branch
1-1038	Jay Peak Village Phase II - sw	Jay Branch
1-1085	Jay Peak Village Phase I - sw	Jay Branch
VT0101036	Newport Town WWTF 0.042 mgd	Mud Creek
VT0100234	North Troy WWTF 0.11mgd	Missisquoi River