

– Basin 12 – Water Quality and Aquatic Habitat Updated Assessment Report

The Deerfield River rises in the Green Mountains in the towns of Glastenbury and Stratton in the southern part of Vermont. The Deerfield River has four branches in Vermont: North Branch, South Branch, East Branch and West Branch. Two of the Deerfield's main tributaries, the East Branch of the North River and the Green River, originate in Vermont but then cross the Vermont-Massachusetts state line and enter the Deerfield River before it joins the Connecticut River near Greenfield, Massachusetts. The Deerfield River system, including the East Branch of the North River and the Green River, drains 14 towns in two counties and is about 318 square miles in area.

There are 17 lakes and ponds in the Deerfield Basin that are 20 acres or greater, which total approximately 4,000 acres. The largest is Harriman Reservoir (2,040 acres), followed by Somerset Reservoir (1,568 acres), Sadawga Lake (194 acres), and Sherman Reservoir (160 acres.) Harriman Reservoir is the second largest lake found entirely in Vermont.

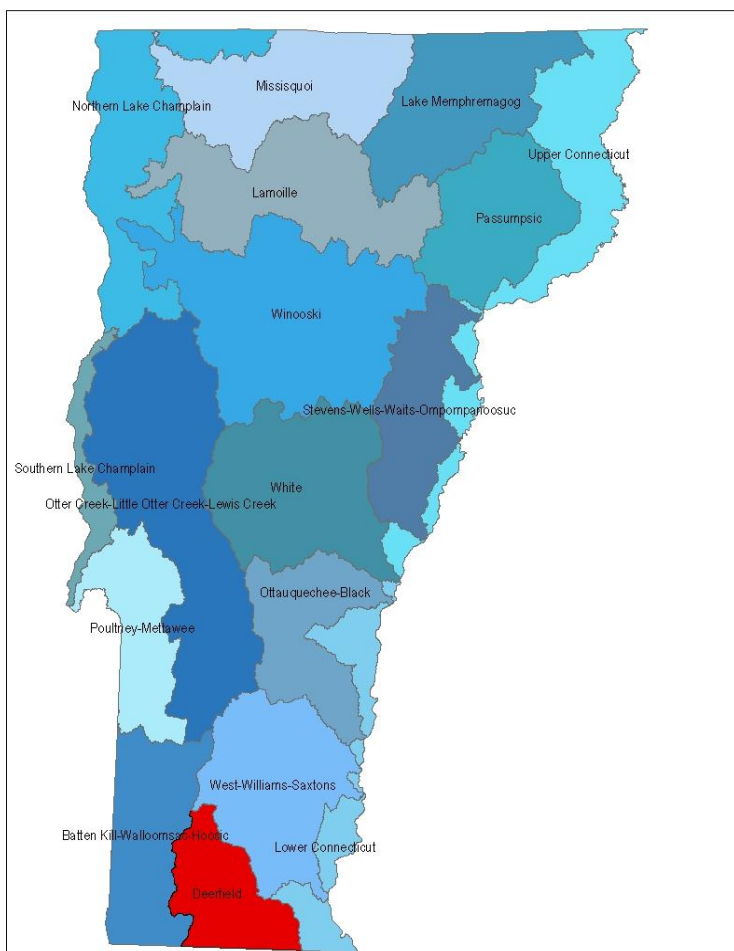
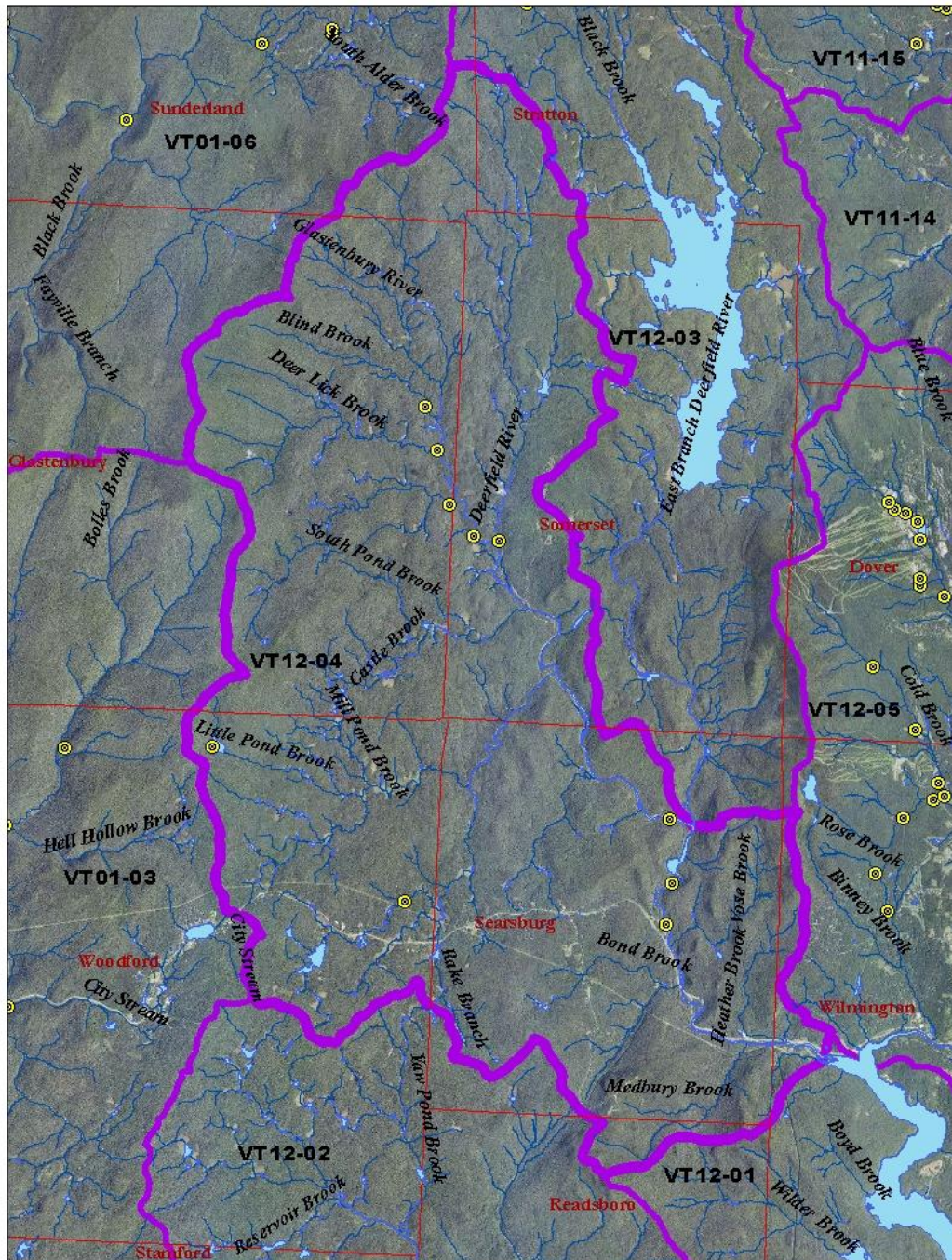


Figure 1. The Deerfield River basin in relation to the other planning basins in Vermont.

Deerfield River Watershed

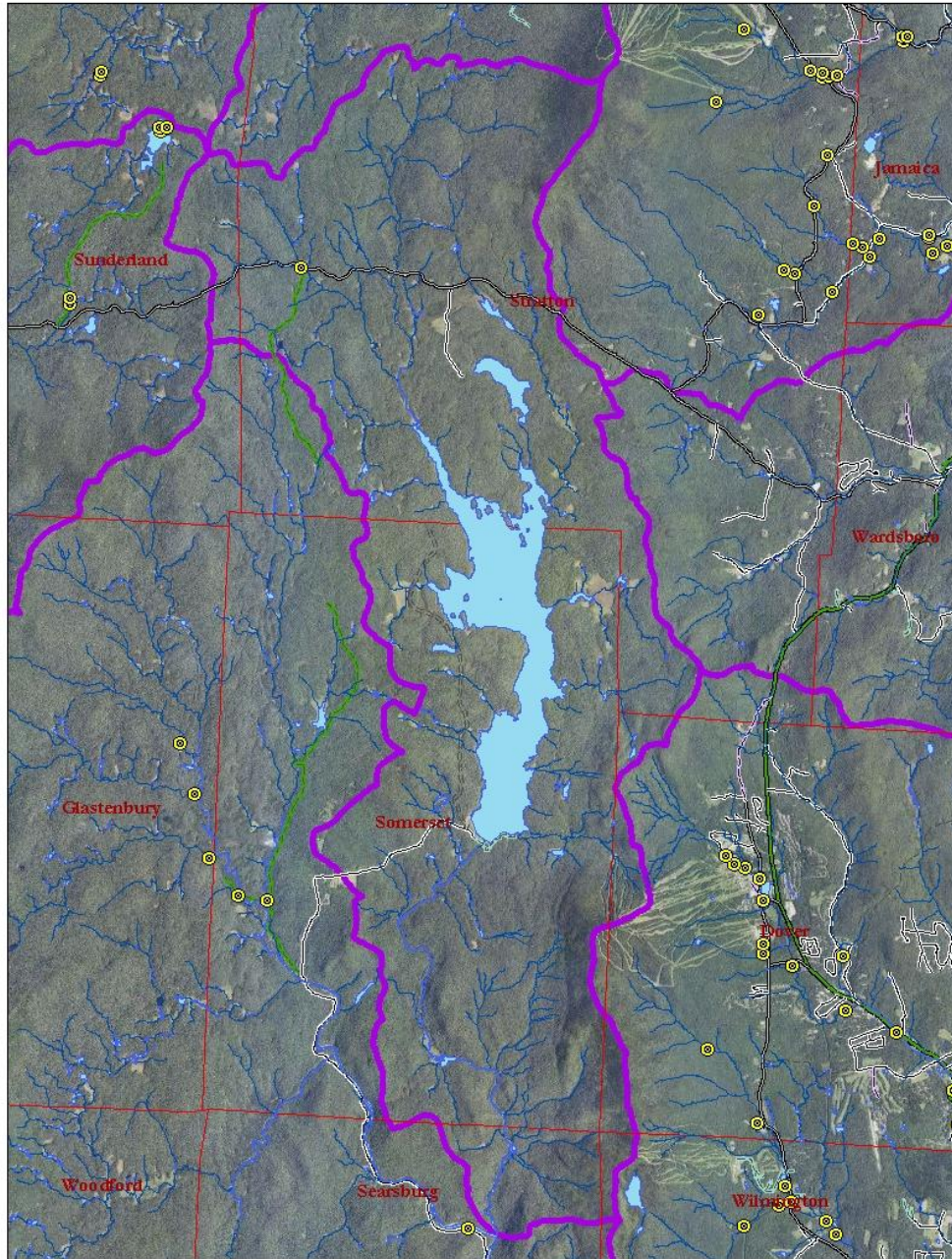
The Deerfield River flows through the counties of Bennington and Windham a distance of about 26 miles and comprises a drainage area of 224 square miles in Vermont. The mainstem of the Deerfield rises on the eastern slope of Glastenbury Mountain in the southwest corner of the town of Stratton. The **upper Deerfield** flows rapidly from its source for 5.0 miles, with a vertical drop of 500 feet, to its confluence with the Glastenbury River. The Deerfield continues in a southeasterly direction a distance of 5.3 miles to Searsburg Reservoir. At this point, the river is joined by the East Branch from the north.

Upper Deerfield River



The **East Branch** has Somerset Reservoir and its tributaries as its source. Grout Pond, with an area of 84 acres, flows into Somerset Reservoir which has an area of 1568 acres at elevation 2131 (normal spring high water). From the spillway at Somerset Reservoir, the East Branch flows rapidly for a distance of 5.5 miles to the Deerfield River.

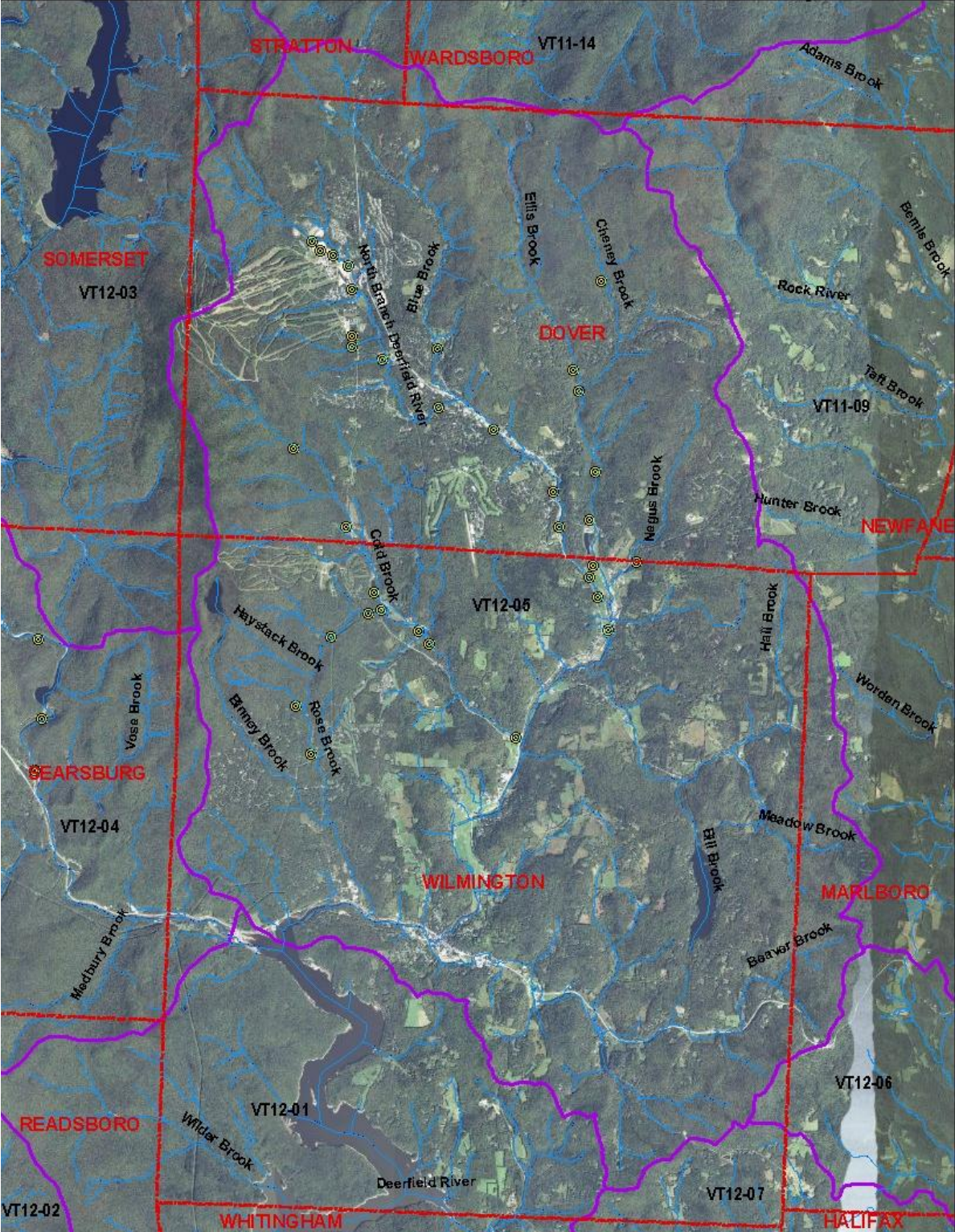
East Branch Deerfield River



From the spillway at Searsburg Reservoir, the Deerfield continues in a southerly and then an easterly direction to Harriman Reservoir. The North Branch of the Deerfield enters Harriman Reservoir about 2.0 miles east of the location where the main Deerfield River enters.

The **North Branch** of the Deerfield River drains the area northeast of Harriman Reservoir. The North Branch rises in the Green Mountain National Forest in the town of Dover and flows for approximately 11.0 miles to the village of Wilmington, passes through on its westerly course and enters the northeast corner of Harriman Reservoir.

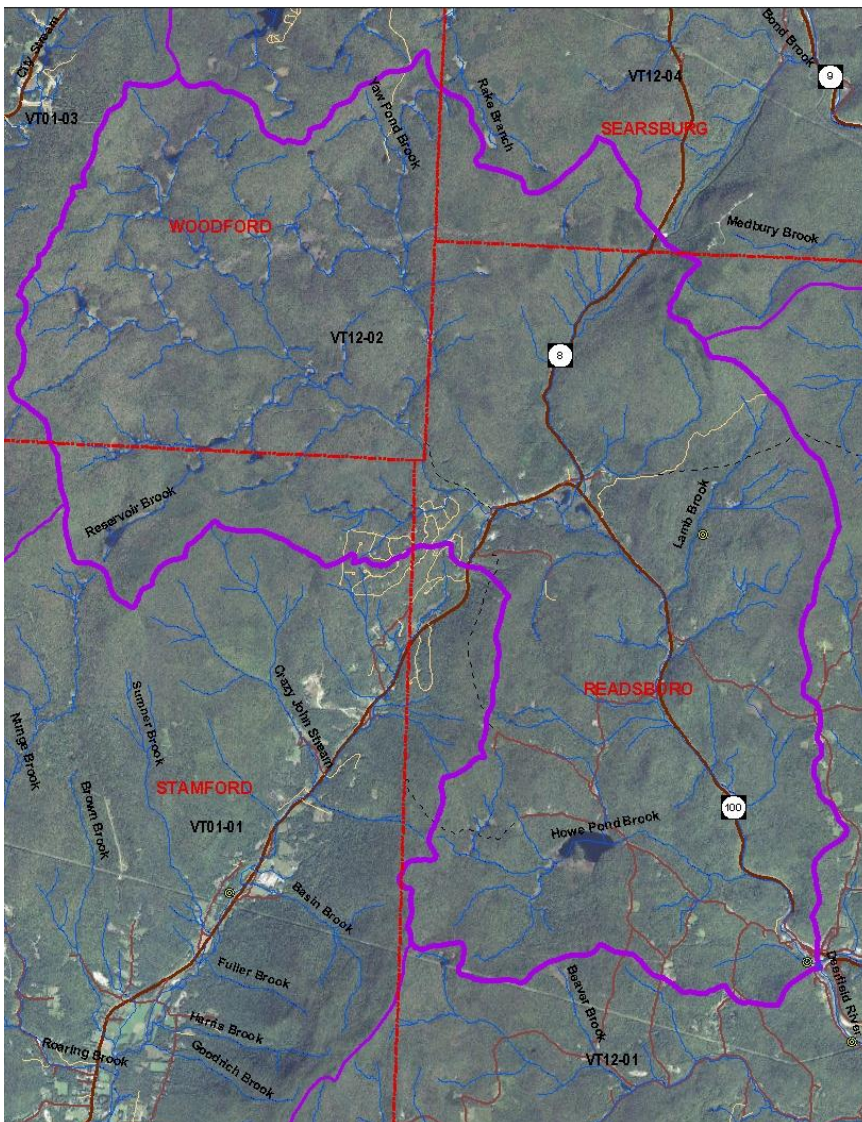
North Branch Deerfield River



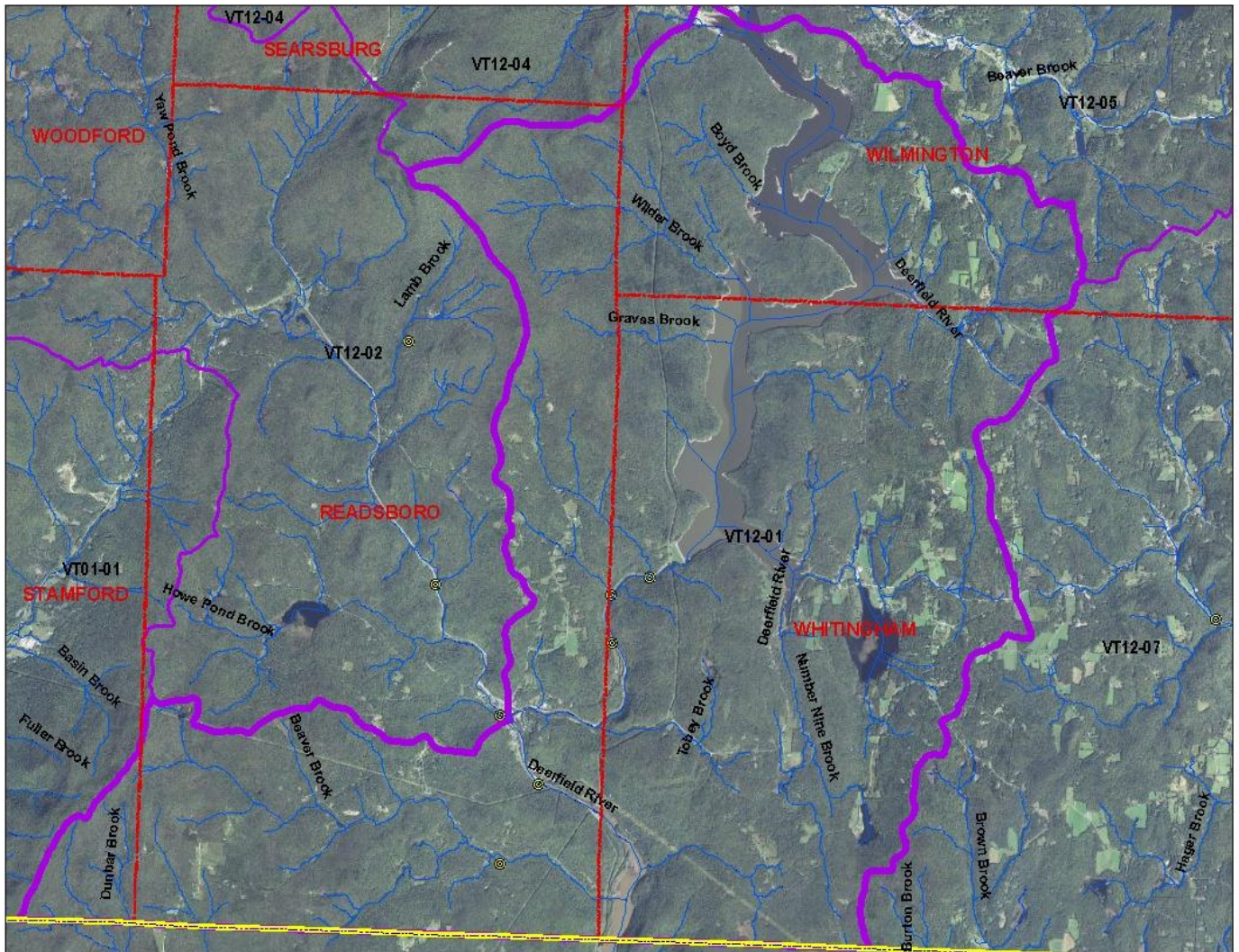
Harriman Reservoir extends approximately 9 miles southward through the valley south of Wilmington Village and has the following small tributaries starting at the source: Boyd Brook, Wilder Brook, Graves Brook, No. 9 Brook, the outlet of Clara Lake, the outlet of Sadawga Lake, and an unnamed tributary entering from the east. The surface area of this reservoir is 2040 acres at the spillway crest elevation 1492.

From the spillway of Harriman Reservoir, the Deerfield River flows in a southwesterly direction for a distance of 3.0 miles where it is joined by the West Branch in the village of Readsboro.

The **West Branch** forms in the so-called Beaver and Camp Meadows in the southeast quarter of the town of Woodford. Reservoir Brook, Yaw Pond Brook, plus five unnamed tributaries comprise the headwaters. These tributaries are flashy streams draining a wooded and mountainous area. The West Branch reaches the village of Heartwellville 5.5 miles from its source where it is joined by another small tributary. The West Branch continues in a southeasterly direction for 5 miles to its confluence with the Deerfield River in Readsboro.



The Deerfield River then flows for about a mile and a half in a southeasterly direction into Sherman Reservoir, which is about a mile long to the Vermont-Massachusetts state line. The South Branch enters the Deerfield River about a quarter mile upstream from the state line.



The South Branch rises on the east side of the Hoosic Range of mountains, so-called, in the town of Readsboro. The branch is only 5.5 miles long and flows quite rapidly for its entire length. There is scattered rural habitation on this stream.

Following is updated data and information on the various sections and branches of the Deerfield River. The last water quality and aquatic habitat assessment report for the Deerfield was completed in March 2003.

Upper Deerfield River

Biological Monitoring

There has not been much biological monitoring in the Upper Deerfield River in recent years. The most recent samples are shown below:

| Year | Rm 65.6 | Rm 67.5 |
|------|------------|-----------|
| 2003 | --- | --- |
| 2004 | --- | --- |
| 2008 | --- | --- |
| 2009 | Vgood-Good | Very Good |

The site, rivermile (rm) 65.6 is located on the upper Deerfield River below the Searsburg Dam about 1 mile and rm 67.5 is located above the confluence with the East Branch about 200 meters.

Assessment Status of Streams in the Upper Deerfield Watershed

Impaired Miles

Deerfield River: 3.6 - below Searsburg Dam down to Harriman Reservoir - aquatic biota/habitat and secondary contact recreation impaired due to low alkalinity, low pH, and summer temperature stress from low buffering capacity, acid rain, open and wide channel, lack of canopy coverage.

Deerfield River: 5.0 - upstream from confluence of Glastenbury River - aquatic habitat due to low pH caused by low buffering capacity and acid rain.

East Branch Deerfield River

Assessment Status of Streams in the East Branch Deerfield Watershed

Impaired Miles

East Branch Deerfield River: 5.2 - below Somerset Reservoir - aquatic biota/habitat impaired (and secondary contact recreation stressed) due to low pH from atmospheric deposition and low alkalinity conditions and due to cold water from dam discharge.

North Branch Deerfield River

General Description

The North Branch of the Deerfield River drains the area northeast of Harriman Reservoir. The North Branch rises in the Green Mountain National Forest in the town of Dover and flows for approximately 11.0 miles to the village of Wilmington, passes through on its westerly course and enters the northeast corner of Harriman Reservoir. The tributaries of the North Branch starting near the headwaters are Blue Brook, Ellis Brook, Cheney Brook, Negas Brook, Bill Brook (outlet of Lake Raponda), and Cold Brook. These tributaries are of a steep and flashy nature.

Tropical Storm Irene Impacts

The North Branch of the Deerfield River suffered severe damage and the village of Wilmington was one of the worst hit in the state during Tropical Storm Irene August 28, 2011. Beaver Brook, Ellis Brook and other tributaries not yet identified were also damaged.

Macroinvertebrate Sampling

North Branch Deerfield mainstem

Biological sampling in 1998 on the North Branch Deerfield River discovered impacts associated with development at Mt. Snow Ski Area. The river was assessed at four different river mile sites: one below the town of West Dover at rivermile 5.8, one about a mile below Snow Lake at the Tanney road crossing at rivermile 11.0, immediately above Snow Lake at rivermile 12.0 and above the Mt. Snow maintenance sheds at rivermile 12.6.

The biological assessments indicated that at rivermile 12.0 and 11.0, above and below Snow Lake respectively, the macroinvertebrate community was depressed in density compared to both the upper rivermile at 12.6 and lower site at 5.8 indicating an impact to the macroinvertebrate community. The cobble substrate at both low density sites was embedded 50-75% and was probably in large part responsible for the low densities. High turbidity events from a construction project on Mount Snow in summer 1998 also likely accounted for the low density numbers. (This information is directly from a memorandum dated 11/18/98 from Steve Fiske and Rich Langdon to The Record).

Table 1. More recent macroinvertebrate sampling results on the North Branch

| Year | Rm 6.5 | Rm 7.0 | Rm 7.6 | Rm 8.9 | Rm 11.0 | Rm 12.1 | Rm 12.6 |
|------|-----------|-----------|-----------|--------|---------|-----------|-----------|
| 2000 | | | Very good | --- | --- | --- | --- |
| 2002 | --- | --- | --- | Good | Good | --- | Very good |
| 2003 | --- | --- | --- | --- | Good | Good-Fair | --- |
| 2004 | --- | --- | --- | --- | Good | Fair | --- |
| 2005 | Good | --- | Vg-Good | --- | --- | Fair | Excellent |
| 2008 | Very good | Very good | --- | --- | --- | Poor | Excellent |
| 2010 | Fair | --- | Vg-Good | --- | --- | --- | --- |

At rivermile 12.1 in 2008, which is located immediately below a small tributary draining the Mount Snow baselodge and opposite lot "E", the macroinvertebrate sample was "poor" as shown above. The density was very low in both replicates, richness was very good and EPT good but somewhat variable between replicates. This was due to a number of EPT taxa mostly with only a single animal representing a number of taxa in one of the replicates. Over 40% of community was *Oligochaeta* mostly *Lumbriculidae*. This is an extremely high percentage and coupled with low density, it is the main reason that the reach has been assessed as "poor". Both *Plecoptera* and *Ephemeroptera* are very low in composition of community as a result. A low density community dominated by *Oligochaeta* strongly indicates sediment as the primary stressor. Habitat sediment observations report sand to be high at 20%, as well as embeddedness being rated poor >75%, and silt rating being also very high 4/5. Water quality data show the reach is low in alkalinity similar to upstream reach 12.6. Nutrients were also low. Chloride showed slight increase from background above. Several metals were elevated but not above Aquatic Life Use criteria, these were iron and manganese.

Ellis Brook

Ellis Brook is a four mile long stream draining a 9 ¼ square mile watershed that flows to the North Branch of the Deerfield River in Wilmington. It originates in a wetland in the northern part of Dover and flows south, with Cheney Brook joining it, into Wilmington. There is an indirect discharge to Ellis Brook from the sprayfields of the Dover WWTF. The biological monitoring sites are above and below the WWTF and the sprayfields to which the indirect discharge permit applies.

Table 2. Macroinvertebrate Sampling Results for Ellis Brook

| Year | Rm 0.5 | Rm 1.0 |
|------|------------|------------|
| 2003 | Vgood-Good | --- |
| 2004 | Very good | --- |
| 2008 | Good | Vgood-Good |
| 2009 | Very good | Excellent |

The fish community in 2008 was considered in "fair" condition on Ellis Brook.

Cold Brook

Macroinvertebrate sampling on Cold Brook in Dover occurred at rivermile 0.1 in 1992, 1998, and 2004. The community integrity and health was found to be "good" in 1992 and 1998 and "excellent" in 2004. Cold Brook was sampled at rm 3.3 in 2003 and was "good" at this location.

Fish community sampling occurred on Cold Brook also sampled in 2003 and was in "excellent" health at rm 3.3.

Other Tributary Streams to the North Branch Deerfield

Iron Stream was sampled at rivermile 0.2 in 1996 and the community was found to be in "poor" condition. It was sampled again at the same location in 2004 and was "poor" again. "Habitat observations indicate the stream bed to be entirely covered with iron precipitate to the point where the cobble was considered over 50% embedded."

Jacks Brook was sampled in Dover at rm 0.3 and in 2004 and 2008 was in "very good-good" condition both times. Jacks Brook was sampled as a local control stream for Iron Stream because of its very small size.

Tannery Brook was also sampled in 1996 and the community at that site (rivermile 0.3) was in "good" condition.

Baselodge Tributary was sampled in Dover in 2004 and at rm 0.1, the macroinvertebrate community was "fair" in health and integrity. This tributary comes into the North Branch Deerfield River just above rm 12.1. Baselodge Tributary was described as "highly incised, often to bedrock, and channelized. The cobble left in the stream was found not to be highly embedded, however over 12 percent sand was estimated in the substrate. The low density of macroinvertebrates in this stream is more likely due to extreme scour of the stream bed." (See Aquatic Life report cited below).

Fishery

Environmental and aquatic habitat impacts associated with a long history of land and water developments, such as stream flow diversions for snowmaking, on-stream impoundments (e.g., Snow Lake), barriers (dams and culverts), increased storm water runoff and sediment loading, loss of riparian corridor vegetation, past channelization activities after flood events, streambank encroachment and development, bank erosion, gravel extraction, etc.) have exacted a very heavy toll on this watershed and its fishery. All of these anthropogenic impacts have only exacerbated the natural limitations (low fertility) characteristic of the Deerfield River watershed. Water level manipulations for hydropower generation in Harriman Reservoir, which back up into the North Branch as far upstream as almost to the center of downtown Wilmington, may also impact the river at different times of the year

Indirect Discharge Sampling

Ellis Brook and the North Branch of the Deerfield have been sampled monthly at two (2) locations each by the North Branch Fire District #1 in accordance with the requirements of their Indirect Discharge Permit ID-9-0074. The sampling stations are located upstream and downstream of their spray disposal areas for each stream. Samples are collected for *E. coli* and a number of other parameters and the results reported to Vermont DEC – Indirect Discharge Permit Program.

For the five-year period 2006-2010 there were two (2) exceedences of the state *E. coli* standard of 77 per 100 mL on Ellis Brook at the upstream station and one (1) exceedence of the same standard at the downstream station.

For the five-year period 2006-2010 there were eight (8) exceedences of the state *E. coli* standard of 77 per 100 mL on the North Branch Deerfield River at the upstream station and nine (9) exceedences of the same standard at the downstream station.

For the five-year period for both monitored streams, only one (1) North Branch Deerfield River upstream station sample value and one (1) Ellis Brook downstream station sample value exceeded the EPA designated beach area single sample maximum of 235 per 100 mL. The results were 244 per 100 mL and 313 per 100 mL, respectively.

All the data are housed at the Vermont DEC Drinking Water and Groundwater Protection Division – Indirect Discharge Permit Program.

Landfills

The Wilmington landfill is in the North Branch Deerfield River watershed. It was closed in 1993 and has a post-closure monitoring plan for 20 years. Semi-annual monitoring occurs to detect changes in groundwater quality in the vicinity of the landfill. Shallow groundwater beneath the Site flows from north to south, toward Meadow Brook. An intermittent stream, an unnamed tributary to Meadow Brook, is adjacent to the landfill and leachate from the landfill reaches this stream. The stream has not been sampled although it may be in the future in lieu of sampling one of the groundwater monitoring wells.

Groundwater monitoring wells MW-1, MW-4 and MW-5 are within 80 feet of the downgradient end of the landfill, monitoring well MW-2 is approximately 400 feet southwest of the landfill, and monitoring well MW-3 is approximately 200 feet south of the landfill. Two monitoring wells had dissolved iron and manganese levels above groundwater enforcement standards in October 2001. Two volatile organic compounds were also detected at the same 2 wells but were below standards. In May 2002, manganese exceeded the groundwater enforcement standard at all 3 downgradient wells and dissolved iron was above standard at 1 well. One volatile organic compound was detected at one well but again the level was below the enforcement standard. In October 2002, dissolved iron and dissolved manganese were above VGES in both downgradient wells and dissolved iron was above the average allowable concentration in the stream. Cis-1-2 dichloroethene was detected in the stream but there is no water quality standard for this organic compound.

The most recent sampling available from May 2011 indicates that the following analytes exceed VGES: the concentration of dissolved manganese in MW -2 and -5 exceeded the primary and secondary VGES and the concentration of dissolved iron in MW-2 and MW-5 exceeded the secondary VGES. “Analysis of groundwater data indicates the following trends. Groundwater quality at MW-2 (farthest from the landfill) remained static or slightly improved. All reported inorganic analytes are within historical ranges at MW-2. The dissolved manganese was the lowest since 2005. Groundwater quality at MW-5 (closer to the landfill) generally improved. All analyte concentrations are within normal ranges except for dissolved manganese which was the lowest reported concentration to date. The stream water quality is generally improving with time.”

Assessment Status of Streams in the North Branch Deerfield Watershed

Impaired Miles

Iron Stream: 0.4 - aquatic biota/habitat impaired due to high levels of iron due to ski area associated land development.

North Branch Deerfield: 0.5 - 0.5 miles above Snow Lake (rm 12.1) to Snow Lake - aquatic biota/habitat impaired due high levels of sedimentation, habitat alterations and likely thermal modifications caused by parking lot runoff, land development (construction erosion), streambank encroachment and erosion.

Altered Miles

North Branch Deerfield River: 11.5 - below Mt Snow/Haystack snowmaking water withdrawal - aquatic habitat altered due to low flows from withdrawals

Trib to North Branch Deerfield: 1.0 - below 1 of the 3 Mt Snow/Haystack withdrawals - aquatic habitat altered due to low flows from withdrawals

Cold Brook: 2.5 - from 2.5 miles below 1 of the 3 Mt Snow/Haystack withdrawals - aquatic habitat altered due to low flows from withdrawals

Stressed Miles

North Branch Deerfield River: 0.6 - Snow Lake to Tannery Brook Road (rm 11.0) - aquatic biota/habitat stressed due to habitat alterations and thermal modifications caused by the lake and the upstream land uses cited under impaired miles (parking lot runoff, land development (construction erosion), streambank encroachment and erosion.)

Baselodge Tributary: 0.2 - from mouth upstream - aquatic biota/habitat stressed (at least) due to habitat alteration, sedimentation due to land development, stream channel changes.

Beaver Brook: 2.8 - from 1st place Route 9 crosses brook east of Wilmington and extending east - aquatic habitat stressed due to sedimentation and physical habitat alteration from channel alteration and relocation and removal of streamside vegetation due to highway reconstruction.

Binney Brook: 3.0 - from mouth to Haystack Pond - threats to aquatic biota/habitat and water clarity from metals, acidity, sedimentation, and turbidity due to atmospheric deposition, land development, and recreation activities.

Cold Brook: 2.5 - upstream from the mouth and Haystack Brook: 1.0 - threats to water clarity, aesthetics, and aquatic biota/habitat from sedimentation, turbidity, and thermal modifications due to land development, a gravel mining operation (Cold Brook) and loss of riparian vegetation.

Rose Brook: 1.0 - upstream from mouth - threats to aquatic biota/habitat and aesthetics from sedimentation and nutrient enrichment due to land development and watershed hydrology changes.

Information Sources

Biological and Aquatic Life Use Attainment Assessment of the North Branch of the Deerfield River and Tribs in the Upper Reaches of the Watershed, draft April 24, 2008. Vermont DEC Water Quality Division Biological and Aquatic Studies Section, Waterbury, Vermont.

Semi-Annual Monitoring Report, Wilmington, Vermont Municipal Landfill, June 13, 2011. Prepared for the Town of Wilmington by KAS, Williston, Vermont

Lower Deerfield River and South Branch

Biological Sampling

Biological sampling on the Deerfield River occurred in 2003, 2004, 2008, and 2009. Rivermile (rm) 44.4 is located adjacent to Tunnel Road below Readsboro. Rm 52.4 is about a quarter mile below Harriman Reservoir in Whitingham and rm 51.3 is located about a mile below the reservoir.

The results of the macroinvertebrate sampling are below.

Table x. Macroinvertebrate sample assessment results 2003 – 2009.

| Year | Rm 44.4 | Rm 51.3 | Rm 51.8 | Rm 52.4 |
|------|-----------|---------|-----------|---------|
| 2003 | --- | Fair | --- | Poor |
| 2004 | Excellent | --- | Good-Fair | --- |
| 2008 | --- | --- | --- | Poor |
| 2009 | --- | --- | --- | --- |

Assessment Status of Streams in the Lower Deerfield Watershed

Impaired Miles

Deerfield River: 3.1 - aquatic biota/habitat and secondary contact recreation (fishing) impaired due to cold summer water temperatures from Harriman Reservoir dam releases and low alkalinity and low pH.

Stressed Miles

South Branch Deerfield: 3.0 - upstream from Sherman Reservoir - aquatic biota/habitat and secondary recreation stressed from low alkalinity and low pH due to low buffering capacity and from atmospheric deposition.

East Branch of the North River

The East Branch of the North River drains 41 square miles of hilly wooded terrain southeast of the Deerfield River drainage basin. The branch has as its source Ryder Pond, located in the northern portion of the town of Whitingham about 2 miles northwest of Jacksonville. The East Branch of the North River flows in a southeasterly direction through the towns of Whitingham and Halifax, a distance of 11 miles, to the Vermont-Massachusetts state line.

From Ryder Pond to Jacksonville, a distance of 1.7 miles, the East Branch of the North River flows rapidly. At Jacksonville, the river is joined by a small tributary which is fed by three ponds: Laurel Lake, Gates Pond and Jacksonville Pond.

Another small tributary joins the East Branch main stem at Jacksonville. This unnamed tributary parallels Route 100. The stream is flashy and flows a distance of 1.3 miles.

Continuing its southeast course for 4.5 miles, the East Branch of the North River forms small rapids until it reaches a short stretch of cascades opposite the turn-off road which leads to West Halifax. The river continues another half mile to its confluence with Branch Brook, which enters from the north. In this 4.5 mile stretch, five small tributaries join the river, all but one entering from the southwest.

Branch Brook, the largest tributary to the East Branch of the North River, flows from its source near the Marlboro-Halifax town line a distance of 5.5 miles in a southerly direction to its confluence with the East Branch. Three miles from its source, Branch Brook flows through the village of West Halifax. A distance of 1.5 miles further downstream it joins with Sperry Brook, a small tributary 1.5 miles long, and then travels a distance of 1.0 mile to its juncture with the East Branch North River.

Continuing in a southeast direction, the East Branch North River flows a fast 2.5 miles to the Vermont-Massachusetts state line. This stretch of river receives six more small flashy tributaries.

Biomonitoring Results

| | 2003 | 2008 | 2009 | 2010 | 2011 |
|---------|-----------|-----------|-----------|-----------|-----------|
| Rm 11.7 | --- | excellent | excellent | excellent | good-fair |
| Rm 17.6 | excellent | very good | --- | --- | --- |

The site at rm 11.7 is located just to the east of the confluence with Randall Brook about 1.8 miles from the Massachusetts border in Halifax and rm 17.6 is located below the first bridge below the Jacksonville WWTF outfall.

The biomonitoring results in 2011 showed that abundance was very low - at threshold - due to Tropical Storm Irene scour of the stream reach. All other metrics are in excellent range for a medium high gradient (MHG) stream type. This includes richness and EPT

taxa present. Several *Ephemeroptera* seem to be the fastest re-colonizers here. The sample was collected 5 weeks post TS Irene. There was evidence of flood debris in trees 15 feet up and well out into floodplain.

Green River

The Green River drainage basin lies directly to the east of the East Branch North River. The Green River from its source in the southwest corner of the town of Marlboro, flows in the town of Halifax in a westerly direction until it crosses the Halifax-Guilford town line where it changes its course to a southerly direction. The total length of the river in Vermont is 13.0 miles.

The Green River flows a distance of 3.5 miles from its source to Harrisville where it is joined by Harrisville Brook. From Harrisville, the Green River flows 0.5 miles to its confluence with Pond Brook, which originates at South Pond 1.0 miles east of Marlboro College. Pond Brook travels a slow and then rapid course a distance of 3.3 miles. The Green River then continues for 3.8 miles in a southeast direction to its confluence with Hinesburg Brook. This stretch of the river flows through a sparsely populated area and lies in a narrow valley.

Hinesburg Brook joins the Green River at a bend in the river 1.0 mile south of Hinesburg. This brook is 4.0 miles long and drains a small farming area.

Continuing southward, the Green River flows 1.8 miles to the village of Green River. From Green River Village, the Green River flows a distance of 3.2 miles to where it crosses the Vermont-Massachusetts state line.

Biological monitoring

| | 2003 | 2008 | 2011 |
|---------------------------|---------------|-----------|------|
| Green River rm 16.0 | --- | --- | fair |
| Green River Trib 6 rm 1.7 | exc-very good | excellent | --- |