

# Basin 14

## Stevens, Wells, Waits, Ompompanoosuc Rivers Water Quality & Aquatic Habitat Assessment Report



Agency of Natural Resources  
Department of Environmental Conservation  
Water Quality Division

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## Contents

|  |    |
|--|----|
| Introduction .....   | 1  |
| General Descriptions of Basin Watersheds .....                               | 1  |
| Floodplain Forests & Wetlands .....  | 9  |
| Exceptional Uses and Values of Watershed Rivers and Streams .....            | 10 |
| Exceptional Uses and Values of Watershed Lakes and Ponds .....               | 11 |
| Population and Housing Growth .....  | 13 |
| Dams .....   | 13 |
| Causes and Sources of Impairment - Rivers .....                              | 14 |
| Causes and Sources of Impairment - Lakes .....                               | 16 |
| Impairments and Threats on specific Basin Lakes .....                        | 18 |
| Status of Support of Designated Uses - Rivers .....                          | 20 |
| Status of Support of Designated Uses - Lakes .....                           | 21 |
| Specific Projects or Work in the Basin .....                                 | 23 |
| Discussion and Recommendations .....   | 26 |
| References and Resources .....   | 27 |
| Appendix A: Land Use and Land Cover of the Four Watersheds in Basin 14 ..... | 29 |
| Appendix B: Floodplain Forests and Wetlands in the Basin .....               | 32 |
| Appendix C: Population and Housing Data .....                                | 38 |
| Appendix D: Dams of Basin 14 .....   | 41 |
| Appendix E: Individual Waterbody Reports .....                               | 45 |

## ***Introduction***

This document summarizes the conditions of the surface waters in the four main watersheds of Basin 14, which are the Stevens, Wells, Waits, and Ompompanoosuc River watersheds. In addition to the compilation and evaluation of any known data and information on surface waters and wetlands, this report also includes land use information, population and housing data, and the results of special river or lake projects in this basin.

This report is organized by subject or topic. Within each of the topic sections, however, the information is often broken down by watershed as it seems likely that those who live, work or play in the Wells River watershed, for example, are interested in those activities that affect the Wells River but not necessarily the activities affecting the Ompompanoosuc River. The organization of the report will hopefully allow both those interested in the entire basin as well as those interested in their own watershed to find the information on water quality and aquatic habitat that they seek.

## ***General Description of the Basin***

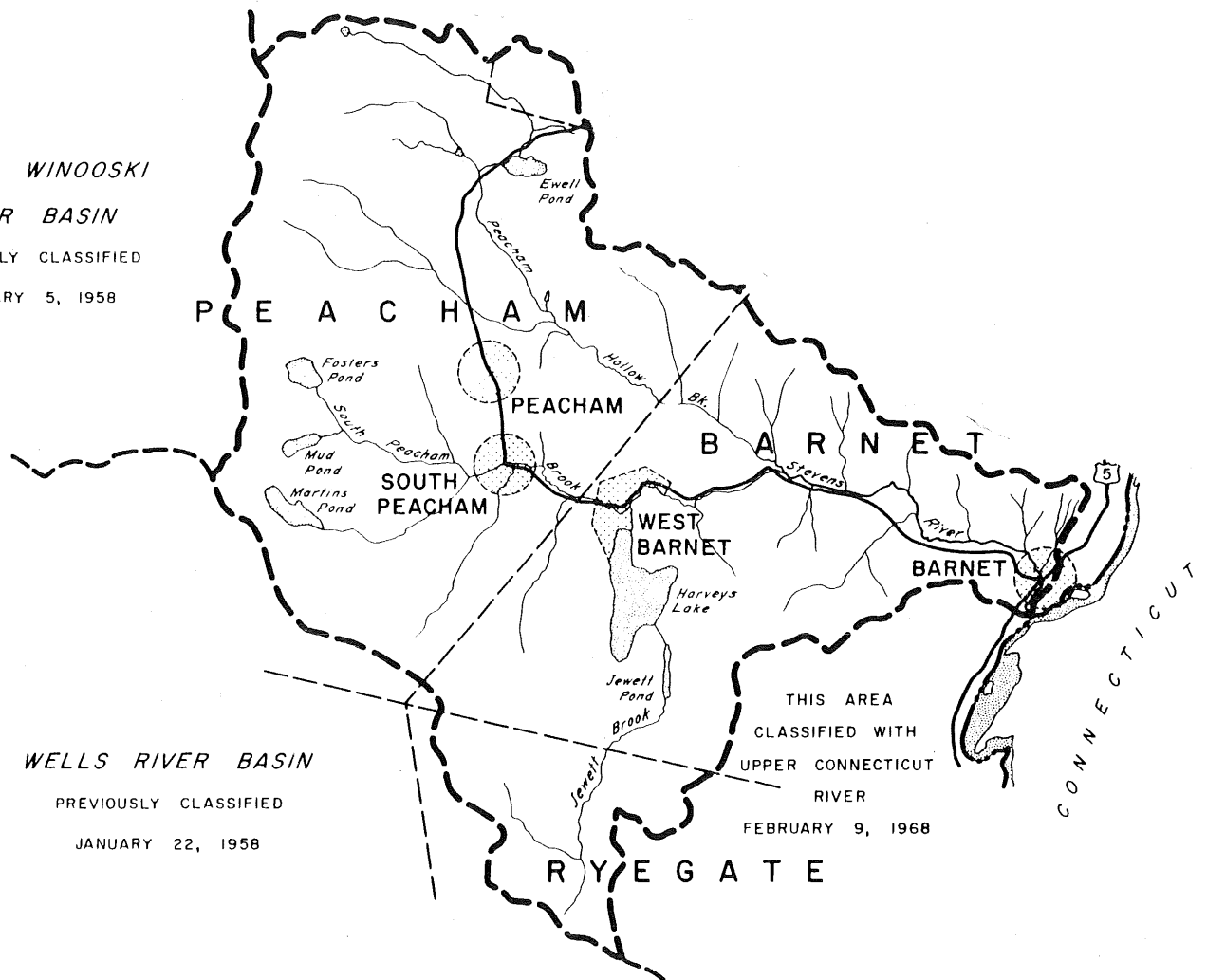
Basin 14 is in the eastern, central part of Vermont and so the four major rivers in the basin flow to the Connecticut River and ultimately to Long Island Sound. Following are general descriptions of each of the four watersheds within the Basin.

### **Stevens River Watershed**

The Stevens River watershed is located adjacent to and just south of, the Passumpsic River basin and is about 49 square miles or 31,360 acres in area. The origin of the river's waters are the tributaries that flow from the eastern sides of Lookout Mountain and Macks Mountain into Willow Brook; from the wetlands and ponds in the northern part of Peacham into Peacham Hollow Brook (East Peacham Brook on the USGS map) and from the tributaries and ponds on the eastern side of Morse Mountain, Devil's Hill, and Jennison Mountain into South Peacham Brook. Peacham Hollow Brook, South Peacham Brook and the drainage from Harvey's Lake, which enters South Peacham Brook in West Barnet, all converge to form the Stevens River. Peacham Hollow Brook is about 7 miles long and its watershed is 17.2 square miles. South Peacham Brook is 4.5 miles long and has a 12.5 square mile watershed. There are a number of large lakes and ponds in the Stevens River watershed including Harvey's Lake (351 acres), Martins Pond (82 acres), Fosters Pond (61 acres), Ewell Pond (51 acres) and Mud Pond (34 acres).

The dominant land cover type in the Stevens River watershed, according to data from the Vermont Satellite Land Cover project (1997), is deciduous, coniferous or mixed forest - 20,782 acres or 68% of the watershed area. Agricultural land use is a distant second with 5,151 acres or 17% of the watershed in either row crops, hay, orchards, or other agricultural activities. Developed land covers 7% or 2,275 acres of the watershed and of that 7%, 5% is roads, highways and other transportation uses. Surface water covers 5% of the watershed or 1,500 acres and wetlands cover 3% or 764 acres. A table of the land cover information can be found in Appendix A.

UPPER WINOOSKI  
RIVER BASIN  
PREVIOUSLY CLASSIFIED  
FEBRUARY 5, 1958



WELLS RIVER BASIN  
PREVIOUSLY CLASSIFIED  
JANUARY 22, 1958

THIS AREA  
CLASSIFIED WITH  
UPPER CONNECTICUT  
RIVER  
FEBRUARY 9, 1968

## Stevens River Watershed

## **Wells River Watershed**

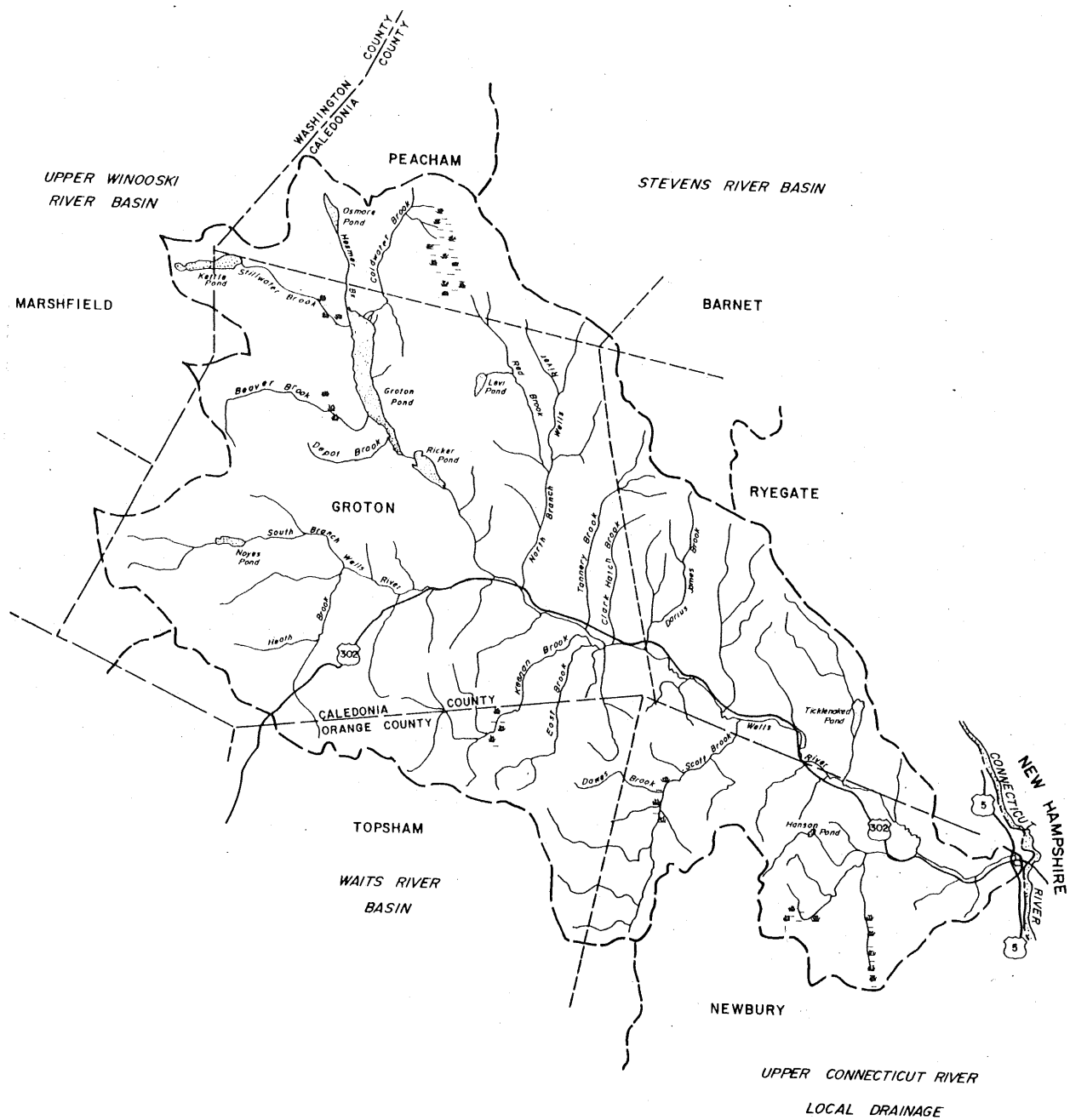
The Wells River watershed lies south of the Stevens River watershed and is approximately 99 square miles or 63,400 acres. The headwaters of this drainage area arise in part on the slopes of Blake Hill, Owlshead Mountain, Spice Mountain, Kettle Mountain and Little Spruce Mountain all in Groton State Forest and flow either into Kettle and Osmore Ponds or form brooks that flow into Groton Lake or Ricker Pond. Drainage from the slopes of Devil's Hill, Jennison Mountain, Jerry Lund Mountain and Wesson Hill form Red Brook and the North Branch Wells River, which are two of the three largest tributaries to the Wells.

The Wells River itself begins below Lake Groton and Ricker Pond and flows southeasterly through Groton, South Ryegate and the northern portion of Newbury before meeting the Connecticut River in the village of Wells River.

The South Branch Wells River is the other significant tributary, in addition to Red Brook and the North Branch. It arises in Noyes Pond and flows for approximately 7 miles before it joins the Wells River mainstem between West Groton and Groton.

There are seven large lakes and ponds in the Wells River watershed including Lake Groton (422 acres), Kettle Pond (109 acres), Ricker Pond (95 acres), Ticklenaked Pond (54 acres), Osmore Pond (48 acres), and Noyes Pond (39 acres).

The dominant land cover type in the Wells River watershed according to data from the Vermont Satellite Land Cover project (1997) is forest with 81.5% of the watershed or 49,995 acres as either deciduous, coniferous or mixed forest. The agricultural component is much smaller in the Wells river watershed than the Stevens River watershed with only 7.6% or 4660 acres in agricultural uses. Surface water and wetlands together cover 6.7% or 4111 acres of the watershed. Developed land (residential, commercial, industrial and transportation) covers 4.2% of the watershed or 2550 acres. Most of the developed land is transportation use. A table with these figures is in Appendix A.



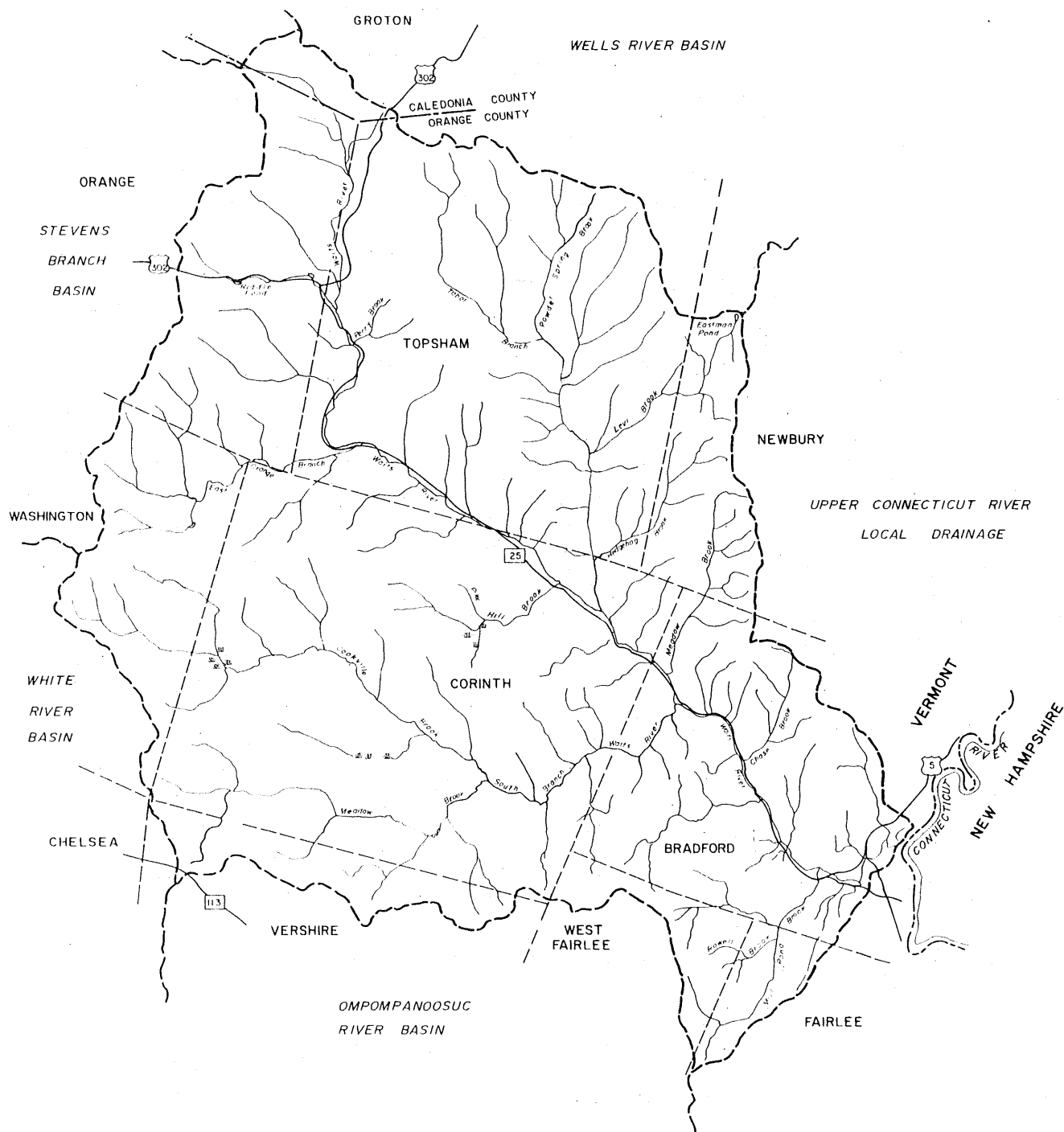
## Wells River Watershed

## **Waits River Watershed**

The Waits River originates below the slopes of Signal, Burnt and Butterfield Mountains in the southern part of Groton State Forest. It is 23 miles long and flows southerly for about 8 or 9 miles before taking a turn and flowing southeasterly for 14 or 15 miles before entering the Connecticut River in Bradford. The total drainage area of the watershed is approximately 144.3 square miles or 92,400 acres.

The two largest tributaries to the Waits River are the South Branch and the Tabor Branch. The Tabor Branch is 10 miles long and drains 28.4 square miles or 18,180 acres. It flows from the base of the hills in northwestern Topsham south, southeast then south again converging with the Waits River just below East Corinth. The South Branch of the Waits River is 10 miles long and drains 44 square miles or approximately 28,160 acres. The South Branch is formed by the confluence of Cookville and Meadow Brooks in the southeastern part of Corinth and flows easterly the northeasterly meeting the Waits River on the eastern edge of Bradford.

Similar to the Wells River watershed, the Waits River drainage is dominated by forested land (84.3% of the watershed or 84,348 acres). Agriculture is a distant second land use with only 8.2% of the watershed or approximately 8,177 acres used for agricultural purposes. Developed land, primarily transportation, accounts for 4.7% of the total watershed or approximately 4689 acres. Surface water covers 1.4% of the watershed or 1439 acres and wetlands cover 1.3% of the watershed or 1334 acres.



## Waits River Watershed



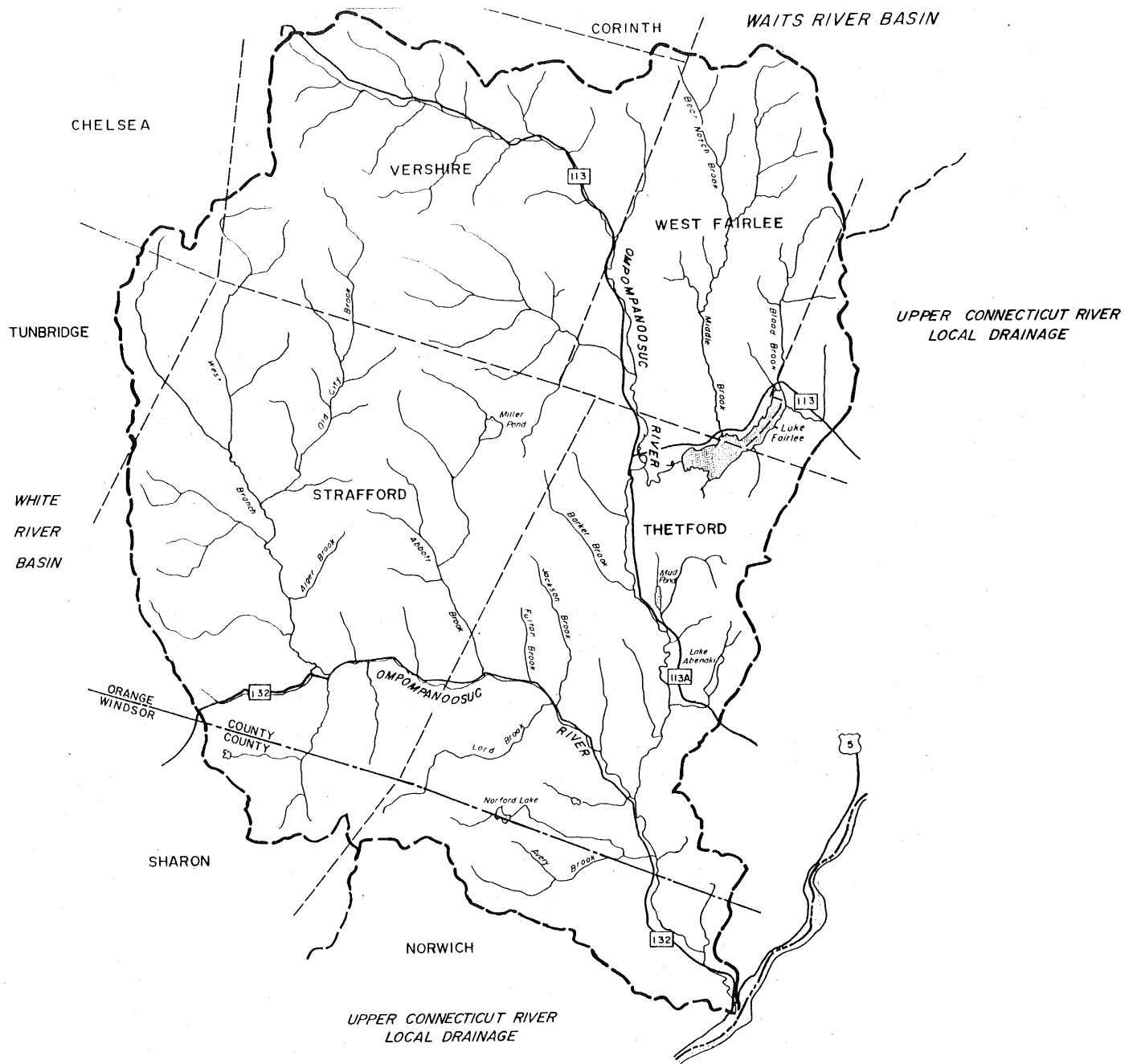
## **Ompompanoosuc River Watershed**

The Ompompanoosuc River originates above the town of Vershire in Vershire Heights and flows southeasterly for about six miles and then southerly for another 18 miles to its confluence with the Connecticut River near Pompanoosuc Village in the town of Norwich. The river drains a watershed of about 136 square miles or 87,040 acres. The river drops 1020 feet in elevation over the first 6 miles then 430 feet in the remaining 18 miles.

The West Branch is the largest tributary to the Ompompanoosuc River with a length of 16.5 miles and a watershed of about 60 square miles or 38,400 acres. The West Branch originates near Hawkins Mountain in the southwestern portion of Vershire. It flows south until South Strafford then flows generally easterly until its confluence with the Ompompanoosuc just above Union Village Dam.

The largest lakes in this watershed include Lake Fairlee (457 acres), Miller Pond (64 acres), Lake Abenaki (44 acres), and Mud Pond (20 acres).

The Ompompanoosuc River watershed is the most forested of the four watersheds comprising Basin 14: 86% or 75,267 acres of the watershed is forested. Agricultural land uses occupy 5.2% or 4507 acres. Developed land, again primarily transportation, covers 4.1% or 3596 acres. Surface water covers 3.2% or 2801 acres and wetlands cover 1.2% or 1016 acres. A category called "barren land" probably refers to the abandoned mines in this watershed and this land use covers about 0.3% or 226 acres.



**Ompompanoosuc River Watershed**

## *Floodplain Forests, Cedar Swamps and Wetlands*

The floodplain forest inventory conducted by ecologists working for the Vermont Nongame and Natural Heritage Program identified five floodplain communities in Basin 14 - four of these communities in the Waits River watershed and one in the Wells River watershed (see Appendix B). All of these floodplain communities are small (between 4 and 10 acres) and none were visited by an ecologist, but these riverside forests may be important resources to the towns in which they occur (Bradford, Corinth, Ryegate) and are an important component of the natural river system.

The cedar swamp inventory, also conducted by the Nongame and Natural Heritage Program, identified 6 cedar swamps of state significance and at least one of local significance in Basin 14. The swamps include Achilles Cedar Swamp, Jewett Brook Cedar Swamp, Roy Mountain Cedar Swamp all in Barnet, Stoddard Swamp in Peacham, East Brook Swamp, Keenan Brook Swamp and Melvin Hill Swamp all in Topsham. Good descriptions and a map locating each site can be found in the cedar swamp report referenced at the end of this assessment report.

The Ompompanoosuc River watershed has an example of an A ranked rich fen, and has many small fens that have not been inventoried. Other fens have also been discovered in the town of Newbury in the Wells River watershed. In general, these small watersheds have the right hydrogeomorphic features that allow for fen development. Threats to these wetland communities come mainly from changes in hydrology, land clearing, and grazing.

Numerous small ponds dot these watersheds, and are generally beaver- influenced with shrub wetlands. The importance of these ponds to the public for aesthetics and recreation is illustrated in the case of Podunk Pond in the Wildlife Management Area in Strafford, Ompompanoosuc Watershed. The pond is a Class 2 palustrine open-water wetland and has a nice fringe of sedges around the edge. The dam on this man-made pond had been breached, and was to be eliminated, however local support for maintaining the dam was strong and so money was found to repair it. Removing the dam could have led to over an acre of wetland loss in an area of very few wetlands.

Riddle Pond and the associated marsh and shrub wetlands, at the headwaters of the Waits River, are important for wildlife (otters, waterfowl, songbirds) and have scenic and open space value. Even though this is also man-made pond, it has been in existence long enough to have developed a diverse wetland community. The town was proposing to culvert the outlet stream, which could have had significant consequences for the wetland and the stream. Instead the decision was to repair the deck of the existing stone bridge for a crossing instead of culverting resulting in no environmental impacts.

Projects potentially affecting wetlands and reviewed by the State Wetlands Program in the four Basin 14 watersheds have not been numerous. Consequently, the number of acres of wetland lost have been small or unknown. In the Stevens River watershed, there were 3.4 acres of wetland lost between 1990 and 1998; in the Wells River watershed, there were 0.5 acres lost; in the Waits River watershed, there were 0.3 acres lost; and in the Ompompanoosuc River watershed, there were 5.0 acres lost. Proposed ponds are one of the most common projects reviewed for this area, and pose a threat to existing natural wetlands and stream water quality. New ponds are generally only allowed outside of the wetland and off-stream.

## *Exceptional Uses and Values of the Basin Rivers*

Several studies have been done for the Vermont Agency of Natural Resources on whitewater boating stretches, waterfalls, cascades, gorges, and swimming holes. The sites and the evaluation of their importance statewide from these studies are given below.

Barnet Falls on the Stevens River in the center of Barnet is considered a site of high importance due to the uniqueness of the site and because it is a popular scenic attraction. Barnet Falls consists of several small drops, a long, narrow diagonal cascade then three steep cascades.

Boltonville Falls is located on the Wells River in Newbury. The falls consist of several cascades approximately 10' high and one large steep cascade 25' high.

The Waits River is a pretty river with a substantial amount of natural vegetation along the river from Waits River Village to East Corinth, a distance of approximately four miles. For boating, the Waits is rated highly important because it is a good continuous stretch of whitewater in an attractive rural valley. During a medium flow of water, the river is rated Class II, with some Class III drops. The most continuous rapids are adjacent to Wrights Mountain, below the confluence with the South Branch. Six swimming holes have been formally documented on the Waits River. One of the swimming holes, located west of Bradford Village, is state significant due to its depth of 20 feet. Swimming holes or bathing spots are also located on the Tabor Branch in East Corinth and in East Topsham. The swimming hole in East Topsham Village is in a ravine, containing scenic falls, cascades, nice rocks and small pools. Most of the swimming holes are accessed over private land.

The West Branch of the Ompompanoosuc River runs in a steep-sided, narrow, wooded valley, parallel to Route 132. It is small and very rocky, and its watershed is steep. Due to its size and gradient, it is only boatable about 12 times each year. At medium high water, the stream is Class II or Class II+ and a demanding Class III at high water. The West Branch is rated highly important for boating. It is a continuous, exciting run, which is the most difficult water in this part of the state. At the end of the boating run at Rices Mills, there is a narrow gorge approximately 50 yards long and 10 feet wide, which is not recommended for boaters. There are two swimming holes that have been formally documented on the West Branch. One of the two holes has public access and is a local swimming hole. The other has two small cascades and two holes four to five feet deep.

The Ompompanoosuc River, from its confluence with an unnamed tributary draining Gillette Swamp and Mud Pond to the West Branch, a distance of about 3.8 miles, was designated an Outstanding Resource Water in March 1996 due to exceptional natural, cultural, scenic and recreational values. There are a diversity of recreational opportunities, including swimming, white water boating, fishing, picnicking, photography and hiking. A popular swimming hole, sandy beach and a developed picnic area are located at the Corps of Engineers Union Village Dam Recreation Area. Swimming holes also occur on the Ompompanoosuc at East Union Village Dam and "The Ledges" in the flood control area. "The Ledges" has scenic cascades and a small gorge with several nice pools up to 7 feet deep. Wooden steps and a railed walkway have been constructed around the site. The largest swimming hole at "The Ledges" is 150 feet long and 10-45 feet wide.

The Ompompanoosuc also has exceptional scenic value due to the Sayer Covered Bridge, pools, riffles, rapids and surrounding landscape, attractive built environment and complexity of natural vegetation. A portion of the river within Thetford Center contains a Historic District, which has been nominated for listing on the National Register. The Historic District contains the Sayer Covered Bridge, 19<sup>th</sup> century mill sites and old dam foundation. The District also contains high potential for archeological sites.

The Lower Falls of Union Village are located on the Ompompanoosuc River in Thetford. The Falls consist of several small cascades from 1-6 feet high, interspersed with islands and low ledges. In many places, the river is divided into several braided channels.

### ***Exceptional Uses and Values of the Basin Lakes***

In 1994, the VTDEC Water Quality Division developed a Lake Protection Classification System - a framework within which lakes larger than 20 acres are evaluated for their priority for protection measures when compared to other lakes statewide. One aspect of the Lake Protection Classification System identifies unique lakes based on their wilderness or wilderness-like status, the occurrence of unusual scenic and natural features, the existence of very high water quality, and the presence of rare, threatened and endangered species. Several of the lakes in Basin 14 are within the Groton State Forest boundary, and as such, already receive some level of protection. The following lakes in Basin 14 have been ranked for protection in the "unique" class under the Classification System.

#### **Lake Groton**

Lake Groton has a bouldered shoreline which is very unusual in Vermont. Indeed, in aggregate, over 2.5 kilometers of shoreline is characterized by large boulders. Approximately one-half of the lake's shoreline is in State ownership, and is managed by the Vermont Department of Forests, Parks, and Recreation (VTFPR). The remaining bouldered areas are characterized by a mix of undeveloped shoreline and shoreline camps situated very close to the water's edge. Combined with a relatively unusual view from the lake of undeveloped mountain peaks, Lake Groton stands out on a statewide scale for its unusual scenic and natural features.

#### **Harveys Lake**

Harveys Lake supports two noteworthy rare species, one plant and one bird. The thin-leaved pondweed (*Potamogeton filiformis* var. *borealis*) is very rare, and has been documented by the Vermont Nongame and Natural Heritage Program (NNHP) in fewer than five Vermont locations. Harveys Lake also serves as a feeding and congregating area for the endangered common loon (*Gavia immer*). In the spring of 1997, no fewer than 14 loons were observed on the lake by a VTDEC biologist during a sampling visit. Loons are not, however, known to breed on the lake.

#### **Martins Pond**

Martins Pond in Peacham supports a population of the rare aquatic buttercup *Ranunculus longirostris*, which has been documented by NNHP in fewer than 20 Vermont locations. Historically, the Vermont Department of Fish and Wildlife (VDFW) has conducted fishery management activities in Martins Pond, including the use of rotenone in 1980.

### **Kettle Pond**

Kettle Pond is a wilderness-like lake located in the Groton State Forest. It is ranked as a priority for protection not only for its wilderness-like status, but also because it serves as a nesting lake for the endangered common loon. In addition, the Kettle Pond shoreline is characterized by large and scenic boulders, similar to those found at Lake Groton, making it unusual on a statewide scale. Presently, the only development near Kettle Pond is an inconspicuous group campsite operated by VTFPR. The entire shoreline is in State ownership, and is managed by VTFPR. Kettle Pond is considered sensitive to acidification due to an acid neutralizing capacity of less than 10 mg/l CaCO<sub>3</sub>.

### **Levi Pond**

Levi Pond is a small, very tannic, wilderness-like pond located in the Groton State Forest. It is surrounded on three sides by bog and wetland vegetation. One area of shoreline is occupied by a stand of rhododendron. This is a very rare and scenic vegetation feature on a Vermont lake. In addition, the pond supports a population of the very rare bur-reed *Sparganium fluctuans*, which has been documented by the Vermont Nongame and Natural Heritage Program in fewer than five Vermont locations. Presently, the only development near the lake is a small cluster of three camps near the access to the lake, but away from the lakeshore. The entire shoreline is in State ownership, and is managed by VTFPR. It is stocked annually by the VDFW with yearling brook trout. The VDFW treated the lake with rotenone in 1977. The lake is extremely sensitive to acidic precipitation due to an acid neutralizing capacity of less than 2.5 mg/l CaCO<sub>3</sub>, and the biological community is considered likely to be impaired accordingly. The lake is on the state's 1998 303(d) Impaired Waters List due to its low acid neutralizing capacity.

### **Mud Pond (Peacham)**

Mud Pond in Peacham is considered very unusual on a statewide scale due to its wilderness-like status. It is one of only nine lakes greater than 20 acres in size in the state ranked as a "10" (out of 10) in the wilderness-like category. There are 10 wilderness lakes greater than 20 acres in the state as well, making Mud Pond one of the 19 most wilderness-like lakes in the state.

### **Norford Pond**

Norford Pond is a private trout club pond located on the border of Norwich and Thetford. It is characterized by extremely high water quality, although the mean spring total phosphorus concentration of 6 ug/l (parts per-billion) is based on only two years of monitoring data. Efforts should be made to expand the amount of spring phosphorus data available on Norford Pond.

### **Osmore Pond**

Osmore Pond is a tannic, wilderness-like lake located in the Groton State Forest. It supports a population of the rare watermilfoil *Myriophyllum alterniflorum*, which has been documented by the Vermont Nongame and Natural Heritage Program in fewer than 20 Vermont locations. The entire shoreline is in State ownership, and is managed by VTFPR. Osmore Pond is considered sensitive to acidification due to an acid neutralizing capacity of less than 10 mg/l CaCO<sub>3</sub>.

## ***Population and Housing Growth in the Basin***

The population in all of the basin towns, except Barnet, grew dramatically between 1970 and 1980 and between 1980 and 1990. Basinwide the population grew 25.8% between 1970 and 1980 and 17.6% between 1980 and 1990. The number of people in the towns of West Fairlee, Vershire, and Corinth almost doubled in that twenty year period. Of the six basin towns with the highest growth rates from 1970 to 1990, four of the towns (West Fairlee, Vershire, Thetford and Strafford) comprise most of the watershed of Ompompanoosuc River.

As might be expected from the population numbers, the growth rate for number of housing units between 1980 and 1990 was also high. Basinwide, the number of housing units grew 15.3%. The growth in housing units, however, was not as large as might be expected with the very large population increases in some towns. For example, Vershire had a population growth rate of 26.7% between 1980 and 1990 while housing units grew only 9.8%. Still West Fairlee's number of housing units increased 42.6%, Orange's increased 30.1%, Topsham's increased 27.6% and Corinth's increased 20.7%. The housing unit increases are of the greatest concern with respect to potential water quality impacts due to the land cover, topography, and pervious surface changes as well as soil erosion, stormwater runoff and other pollutant generation that come with residential development. The numbers for both population and housing units are presented in tables in Appendix C.

## ***Dams in Basin 14***

There are 69 dams in Basin 14: eleven in the Stevens River watershed; twelve in the Wells River watershed; seventeen in the Waits River watershed; and twenty-nine in the Ompompanoosuc River watershed. A number of these dams control the water level of ponds used and enjoyed by lakeshore landowners and/or the general public including Harveys Lake, Ricker Pond, Lake Groton, Noyes Pond and Lake Fairlee. Only four of the dams are for hydroelectric power generation: Barnet No. 14, Boltonville No. 11, Adams Paper Co. and Bradford. Union Village Dam on the Ompompanoosuc is a 170 foot high dam owned and maintained by the U.S. Army Corps of Engineers as a flood control structure. (See Appendix D, Table D.1. for a complete list of dams).

Of the 69 dams in the basin, fifteen are known to be breached or partially breached. Many of the dams are old, some having been built in the early 1900's. For about half of the dams listed in the state's dam database, the status or year of construction are not known.

## ***Causes and Sources of Impairment and Threats to Basin 14 Rivers***

Temperature affects the most miles of river having an impact on the fishery and aquatic habitat in Basin 14 (see Table I below). The major reasons for the thermal impacts include the loss of riparian vegetation (which is the source affecting the greatest number of miles - see Table II) and stretches of wide, shallow river channel.

Metals are the second greatest cause of use impairments. These pollutants, along with pH, which is the fifth largest cause, are a result of the former copper mining activity in the basin and the remaining mine tailings.

Habitat alteration is the third greatest cause of use impairments due to the flooding in 1998 as well as in the 1970's. The instream and bank work that followed the floods also did a lot of damage to the stream channel and thus to aquatic habitat.

An unknown cause affects the fourth greatest number of miles - something is having an impact on the fishery in the Ompompanoosuc mainstem but it is not clear what the pollutant or problem is. In 1984, a high biomass of brook trout was present in the headwaters of the river but in the 1990's, samples further downstream found relatively low populations of brook trout. The temperatures and physical habitat did not appear to be limiting and no other cause was identifiable.

Silt and sediment, pathogens and nutrients are all threats to the rivers and streams in this basin. The sources of these pollutants include agricultural activities, road maintenance work, road runoff and land development.

**Table I. Causes of Impairment and Threats in Basin 14 Rivers**

| Code | Cause                 | High Impact<br>(miles) | Moderate/Slight<br>Impact (miles) | Total<br>(miles) | Threats<br>(miles) |
|------|-----------------------|------------------------|-----------------------------------|------------------|--------------------|
| 1400 | Thermal modifications | 0                      | 23.6                              | 23.6             | 5.0                |
| 500  | Metals                | 16.4                   | 0                                 | 16.4             | 15.2               |
| 1600 | Habitat alterations   | 0                      | 15.2                              | 15.2             | 0                  |
| 0    | Cause unknown         | 0                      | 13.5                              | 13.5             | 0                  |
| 1000 | pH                    | 11.4                   | 0                                 | 11.4             | 0                  |
| 1100 | Siltation             | 0                      | 5.0                               | 5.0              | 23.2               |
| 1700 | Pathogens             | 0                      | 5.3                               | 5.3              | 7.6                |
| 1200 | Low D.O./Enrichment   | 0                      | 2.4                               | 2.4              | 0.5                |
| 900  | Nutrients             | 0                      | 0                                 | 0                | 11.1               |



**Table II. Sources of Impairment and Threats in Basin 14 Rivers**

| Code | Source                      | High Impact<br>(miles) | Moderate/Slight<br>Impact (miles) | Total<br>(miles) | Threats<br>(miles) |
|------|-----------------------------|------------------------|-----------------------------------|------------------|--------------------|
| 7600 | Loss of riparian vegetation | 6.2                    | 11.0                              | 17.2             | 15.0               |
| 5700 | Mine tailings               | 15.4                   | 0                                 | 15.4             | 6.0                |
| 9000 | Unknown source              | 0                      | 14.0                              | 14.0             | 0                  |
| 5100 | Surface mining              | 11.4                   | 0                                 | 11.4             | 8.0                |
| 7100 | Channelization              | 0                      | 6.2                               | 6.2              | 0                  |
| 1000 | Agriculture                 | 0                      | 1.0                               | 1.0              | 17.1               |
| 8300 | Road runoff                 | 0                      | 0                                 | 0                | 10.0               |
| 3200 | Land development            | 0                      | 0                                 | 0                | 9.0                |

### ***Causes and Sources of Impairment and Threats to Basin Lakes***

The greatest cause of impairment to the lakes in Basin 14 is mercury, affecting 351 acres of Harveys Lake and 422 acres of Lake Groton (see Table III below). Mercury contamination of fish flesh has resulted in the Vermont Department of Health issuing a statewide fish consumption advisory for both lake trout and smallmouth bass. Sampling for mercury contamination has not been conducted on all of the lakes in the basin. However, one smallmouth bass from Lake Groton analyzed under the VTDEC Fish Contaminant Monitoring Program (1996) contained a concentration of mercury that was above the Vermont consumption standard of 1 ug/g mercury. Acid deposition is the likely source of the mercury contamination.

An overabundance of nutrients and algae in Ticklenaked Pond is the next greatest cause of lake impacts in the basin. The algae is the result of nutrients inputs, most likely from both internal sources and nonpoint source runoff from the Ticklenaked Pond watershed.

Other causes of use impairment include pH (in Levi Pond), organic enrichment/low D.O. (in Ticklenaked Pond), siltation (in Noyes Pond), and an unknown cause (in Ewell Pond). Other sources of impairment include silvicultural practices. A number of activities pose threats to lake water quality and aquatic habitat including construction, land development, road maintenance and runoff, and boating (through the spread of exotic species).

**Table III. Causes of Impairment and Threats in Basin 14 Lakes**

| Cause                                | Major (acres) | Moderate/Minor (acres) | Total Impact (acres) | Threatened (acres) |
|--------------------------------------|---------------|------------------------|----------------------|--------------------|
| 0000 Cause unknown                   | 26            | -                      | 26                   | -                  |
| 0500 Metals                          | 773           | -                      | 773                  | -                  |
| 0560 Mercury                         | 773           | -                      | 773                  | -                  |
| 0900 Nutrients                       | 54            | -                      | 54                   | 981                |
| 1000 pH                              | 22            | -                      | 22                   | 674                |
| 1100 Siltation                       | 2             | -                      | 2                    | 557                |
| 1200 Organic enrichment/D.O.         | -             | 25                     | 25                   | 25                 |
| 2200 Noxious aquatic plants - Native | -             | -                      | -                    | 7                  |
| 2210 Noxious aquatic plants - Algae  | 54            | -                      | 54                   | 184                |
| 2600 Exotic species                  | -             | -                      | -                    | 263                |

**Table IV. Sources of Impairment and Threats in Basin 14 Lakes**

| Source of Impact (acres)                         | Major (acres) | Moderate/Minor (acres) | Total Impact (acres) | Threatened (acres) |
|--|---------------|------------------------|----------------------|--------------------|
| 1000 AGRICULTURE                                 | -             | 54                     | 54                   | 7                  |
| 1100 Nonirrigated Crop Production                | -             | 54                     | 54                   | -                  |
| 1400 Pasture Grazing                             | -             | 54                     | 54                   | -                  |
| 1800 VT-Animal holding area                      | -             | 54                     | 54                   | -                  |
| 2000 SILVICULTURE                                | -             | 54                     | 54                   | 517                |
| 2100 Harvesting, Restoration, Residue Management | 2             | 54                     | 56                   | 425                |
| 3000 CONSTRUCTION                                | -             | -                      | -                    | 974                |
| 3200 Land development                            | -             | -                      | -                    | 974                |
| 4000 URBAN RUNOFF/STORM SEWERS                   | -             | -                      | -                    | 457                |
| 7600 Removal of riparian vegetation              | -             | -                      | -                    | 95                 |
| 7900 MARINAS AND BOATING                         | -             | -                      | -                    | 629                |
| 7910 In-Water releases                           | -             | -                      | -                    | 629                |
| 8100 ATMOSPHERIC DEPOSITION                      | 795           | -                      | 795                  | 252                |
| 8300 HIGHWAY MAINTENANCE AND RUNOFF              | -             | -                      | -                    | 879                |
| 8530 INTERNAL NUTRIENT CYCLING                   | 54            | -                      | 54                   | -                  |
| 8600 NATURAL SOURCES                             | 22            | -                      | 22                   | 699                |
| 9000 SOURCE UNKNOWN                              | 26            | -                      | 26                   | 87                 |

More detailed information on water quality conditions and the specific causes and sources of threats and problems in five of the larger Basin 14 lakes more commonly used by the public follows.

## ***Impairments and Threats on Specific Basin Lakes***

### **Harveys Lake - Barnet**

The current fish consumption impairment in Harveys Lake is due to the Vermont Department of Health's statewide fish consumption advisory for eating lake trout due to elevated mercury concentrations.

Harveys Lake used to experience algae problems. In the early 1980's, in an attempt to diagnose the cause of repeated algae blooms (*Oscillatoria rubescens*), a diagnostic-feasibility study was conducted by the Vermont Department of Environmental Conservation Water Quality Division (VTDEC). This effort identified several areas where phosphorus loading to the lake could be reduced. Through the 1980's, water quality problems included continuing nuisance algae blooms, fish kills (1990), and beach closures due to high coliform bacteria concentrations. While the recommendations from the diagnostic/feasibility study were not immediately acted upon, the Harveys Lake Association, in cooperation with the Caledonia County NRCS, ultimately made significant progress in correcting watershed problems on Harveys Lake, including the diversion of high nutrient runoff away from the lake and the installation of agricultural BMP's at one farm located directly adjacent to a major inlet. A backflow problem at the outlet dam, which results in runoff from an adjacent watershed entering Harveys Lake during high flow periods, has not been addressed..

During 1994, the Harveys Lake Association conducted in-lake and watershed surveys to find new nutrient and bacteria sources. Water quality parameters measured by VTDEC monitoring programs indicate water quality improvement during the period since 1981, though more years of summer data are desirable to further validate this.

### **Ticklenaked Pond - Ryegate**

Ticklenaked Pond is a eutrophic lake and has been experiencing water quality problems for at least 20 years. The lake's mean spring total phosphorus concentration of 34 ppb is the third highest in Vermont (12 years of data). Summer water transparency measured by Secchi disk ranges from 0.8 to 1.2 meters. VTDEC has recorded daytime epilimnetic pH values exceeding 9 standard units during heavy algae blooms and the hypolimnion is anoxic during the summer. The extent to which such elevated pH persists throughout diurnal cycles is unknown. Finally, according to local residents, a town swimming beach is closed at times each year by the Town Health Officer due to high coliform bacteria concentrations.

Additional information is needed to determine the extent to which phosphorus concentrations in the lake are natural or culturally enhanced. Assuming a volunteer monitor is available, the lake will be incorporated into the Lay Monitoring Program during 1999 and beyond. In addition, VTDEC suggests that a paleolimnological study be undertaken to determine historical in-lake phosphorus concentrations. This would provide an indication of what level of nutrient reduction could be realistically achieved in the lake.

### **Ewell Pond - Peacham**

Ewell Pond is a scenic waterbody which has an undeveloped watershed and an unspoiled feel. Ewell Pond is classified as mesotrophic (medium nutrient concentrations) based on eight years of VTDEC monitoring data having an average total phosphorus concentration of 14  $\mu\text{g/l}$ .

Aquatic life uses in the pond are assessed as threatened due to a recurring hypolimnetic (deep water) dissolved oxygen deficit. Biological assessment activities conducted in 1997 and 1998 highlight two specific problems in the pond's biological community. First, an assessment of the pond's sublittoral zone suggests that there was at one time a major die-off in the gastropod (snail) community of the pond. Second, the VTDEC and the National Wildlife Federation have identified Ewell Pond as having very elevated rates of bullfrog (*Rana catesbeiana*) deformities (37% and 28% for VTDEC and NWF respectively). In Vermont, these are the highest deformity rates recorded outside of the immediate vicinity of Lake Champlain.

The extent to which alterations in the biological community are related to oxygen conditions in the lake is unknown. Furthermore, the extent to which this oxygen depletion may be natural is the subject of an on-going study. Historically, the Vermont Department of Fish and Wildlife has conducted fishery management activities, including the use of rotenone in 1980.

Ewell Pond has been identified as requiring additional assessment to determine whether the recurring hypolimnetic oxygen depletion in the lake is a natural phenomenon.

### **Lake Fairlee - Fairlee, W. Fairlee, and Thetford**

Lake Fairlee is a large lake which supports heavy recreational use and is surrounded by many shoreline homes and camps. Threats to the quality of Lake Fairlee include erosion of the shoreline and sediment inputs evidenced by large sediment deltas at some inlets. Lake Fairlee supports a light infestation of Eurasian watermilfoil (*Myriophyllum spicatum*), which is currently being controlled by handpulling. Ongoing monitoring will allow VTDEC to track water quality changes in Lake Fairlee.

### **Lake Groton - Groton**

Lake Groton is a large lake which supports heavy recreational use and is surrounded by many shoreline homes and camps. Threats to the quality of Lake Groton include changes in pH due to acid rain, and eutrophication (nutrient enrichment) from various watershed land uses including shoreline development. Fish consumption uses are threatened due to elevated concentrations of mercury found in smallmouth bass (*Micropterus dolomieu*).

### ***Designated Use Support Status - Rivers***

Overall, 82% or approximately 218 miles of the 264 assessed river miles in Basin 14 fully support all designated uses, which include aquatic biota and habitat, swimming and fishing among others (see Table V below). Of these fully supported assessed miles, about 6% or 16 miles are threatened by pollutants or activities along their length. Thirty seven miles or about 14% of the assessed river miles partially support one or more uses. Only about 9 miles or 3 ½ % of the river miles do not support one or more uses. The non-support miles are below the Elizabeth, Ely and Pike Hill mines and Bradford hydroelectric facility.

Secondary contact recreation, or fishing in this case, is impaired for the most miles (37.1 miles). The metals and acidity from the mines' runoff, high temperatures, in-channel work, physical habitat limitations plus a cause and source not yet known are all having an impact on the trout populations and the Waits and Ompompanoosuc fishery.

Aquatic biota and habitat are impaired for the second greatest number of miles (17.9 miles). The metals and acidity as a result of the copper mines are by far the main reason for the aquatic community's fair to poor health. Hydroelectric facilities affect aquatic biota/habitat for a very small number of miles (1.5 miles).

Aesthetics are largely affected by the orange staining from the copper mine runoff (11.2 miles) and swimming is impaired by acid mine drainage and levels of indicator bacteria above current standards (13.5 miles) from yet to be determined sources.

**Table V. Use Support Status in Basin 14 Rivers**

| Use                          | Full support | Threatened | Partial support | Non-support | Not assessed |
|------------------------------|--------------|------------|-----------------|-------------|--------------|
| Overall                      | 202.3        | 15.6       | 37.4            | 8.7         | 0            |
| Aquatic biota/habitat        | 217.3        | 28.8       | 9.2             | 8.7         | 0            |
| Fish consumption             | 222.3        | 0          | 1.0             | 5.5         | 35.5         |
| Contact recreation           | 235.0        | 15.5       | 6.3             | 7.2         | 0            |
| Secondary contact recreation | 214.1        | 12.8       | 29.9            | 7.2         | 0            |
| Drinking water supply        | 241.8        | 13.5       | 1.5             | 7.2         | 0            |
| Aesthetics                   | 225.3        | 27.5       | 2.5             | 8.7         | 0            |
| Agricultural water supply    | 107.9        | 3.7        | 1.5             | 7.2         | 143.7        |

### *Designated Use Support Status - Lakes*

There are 2113 lakes acres in Basin 14, of which 2078 acres, or 98%, have been assessed. Overall, 78% or 1623 of the 2078 assessed lake acres in Basin 14 fully support their uses, although 1270 acres (or 61% of the total assessed in the basin) are threatened. One or more uses are only partially supported in 22% or 455 lake acres. There are no acres in the non-support category.

The use that has the most lakes acres in the basin in the partial support category is fish consumption, followed by aquatic life use support, then aesthetics, secondary contact, and swimming uses.

**Table VI. Use Support Status in Basin 14 Lakes**

| Use                    | Full support (acres) | Threatened (acres) | Partial Support (acres) | Non-support (acres) | Not Assessed (acres) |
|------------------------|----------------------|--------------------|-------------------------|---------------------|----------------------|
| Overall uses           | 353                  | 1,270              | 455                     | 0                   | 35                   |
| Aesthetics             | 777                  | 1,245              | 56                      | 0                   | 35                   |
| Aquatic Life           | 786                  | 1188               | 104                     | 0                   | 35                   |
| Fish Consumption       | 839                  | 0                  | 773                     | 0                   | 2113                 |
| Secondary Contact Uses | 954                  | 1,068              | 56                      | 0                   | 35                   |
| Swimming               | 872                  | 1,150              | 56                      | 0                   | 35                   |

Following is a table containing the support status of each lake in Basin 14, the assessment category (monitored, evaluated or not assessed) and the month and year in which it was assessed.

**Table VII. Support Status of all Basin 14 Lakes**

| Lake Name   | Assessment type* | Last assessed (YYMM) | Full support | Partial support | Non-support | Not assessed |
|-------------|------------------|----------------------|--------------|-----------------|-------------|--------------|
| Abenaki     | M                | 9812                 | 44           | 0               | 0           | 0            |
| Brocklebank | Not assessed     |                      |              |                 |             | 7            |
| Buffalo     | Not assessed     |                      |              |                 |             | U            |
| Burnham Mnt | E                | 9812                 | 8            | 0               | 0           | 0            |
| CCC         | M                | 9812                 | 9            | 0               | 0           | 0            |
| Conant      | Not assessed     |                      |              |                 |             | U            |
| Cow Hill    | Not assessed     |                      |              |                 |             | 8            |

| Lake Name       | Assessment type | Last assessed (YYMM) | Full support | Partial support | Non-support | Not assessed |
|-----------------|-----------------|----------------------|--------------|-----------------|-------------|--------------|
| Eastman         | Not assessed    |                      |              |                 |             | 4            |
| Ely             | E               | 9812                 | 5            | 0               | 0           | 0            |
| Ewell           | M               | 9904                 | 25           | 26              | 0           | 0            |
| Fairlee         | M               | 9812                 | 457          | 0               | 0           | 0            |
| Fosters         | M               | 9812                 | 61           | 0               | 0           | 0            |
| Galusha         | E               | 9812                 | 5            | 0               | 0           | 0            |
| Groton          | M               | 9812                 | 422          | 0               | 0           | 0            |
| Harveys         | M               | 9903                 | 0            | 351             | 0           | 0            |
| Kettle          | M               | 9812                 | 109          | 0               | 0           | 0            |
| Levi            | M               | 9812                 | 0            | 22              | 0           | 0            |
| Lily (Thetford) | E               | 9812                 | 19           | 0               | 0           | 0            |
| Manchesters     | E               | 9812                 | 6            | 0               | 0           | 0            |
| Martins         | M               | 9812                 | 82           | 0               | 0           | 0            |
| Miller          | M               | 9812                 | 64           | 0               | 0           | 0            |
| Mud (Peacham)   | M               | 9812                 | 34           | 0               | 0           | 0            |
| Mud (Thetford)  | M               | 9904                 | 20           | 0               | 0           | 0            |
| Norford         | M               | 9812                 | 21           | 0               | 0           | 0            |
| Noyes           | M               | 9711                 | 37           | 2               | 0           | 0            |
| Osmore          | M               | 9712                 | 48           | 0               | 0           | 0            |
| Ricker          | M               | 9812                 | 95           | 0               | 0           | 0            |
| Riddel          | E               | 9904                 | 15           | 0               | 0           | 0            |
| Ryegate Center  | E               | 9812                 | 7            | 0               | 0           | 0            |
| Tenny           | Not assessed    |                      |              |                 |             | 10           |
| Ticklenaked     | M               | 9810                 | 0            | 54              | 0           | 0            |
| Vershire- E     | E               | 9812                 | 10           | 0               | 0           | 0            |
| Waits           | Not assessed    |                      |              |                 |             | 6            |
| West Fairlee    | E               | 9812                 | 15           | 0               | 0           | 0            |
| Whitehouse      | E               | 9812                 | 5            | 0               | 0           | 0            |
| Wilmot          | Not assessed    |                      |              |                 |             | U            |



## *Special Projects or Work in the Basin*

### **Elizabeth Mine Project**

Runoff from the Elizabeth Copper Mine has been carrying heavy metals and acidified water into Copperas Brook and the West Branch of the Ompompanoosuc River for decades and the impact from this has been documented over the last 40 years. Water quality sampling by the then-named Vermont Department of Water Resources dates back to 1954. The mine was closed in February 1958 and sampling was conducted again by the Department in 1966 and 1967 and in 1977. In 1983, the Colorado School of Mines Research Institute did both water quality and sediment sampling in the Ompompanoosuc for the then-proposed Union Village hydroelectric project. They found runoff and tailing erosion from the Elizabeth Mine was resulting in heavy metal enrichment of the West Branch sediments. In 1984, the Army Corps of Engineers sampled several sites on the West Branch and the Ompompanoosuc as part of the sampling program at Corps reservoir sites.

In 1988 and 1989, the Army Corps did another study of the site in order to develop plans for directing surface runoff away from the tailings and to stabilize and revegetate the tailings. Two schemes were developed for water diversion and a preliminary revegetation plan was described. In 1989 and 1990, the Corps did sampling and analysis to determine metal concentrations in fish tissue and sediments. They also studied fish community composition and biomass upstream and downstream of mine discharges. Also in 1989, there was a test planting of some warm season grasses by the Natural Resources Conservation Service (NRCS) Plant Materials Center. The planting was done in spring 1989 and then evaluated in August 1989, August 1990 and April 1992. At that last evaluation, the warm season grass plots on the upper terrace had good cover. The lower terrace, which had been seeded by the landowner versus NRCS, had good cool season grass cover where topsoil had been placed but poor cover on the remaining 20 to 30 acres.

In 1990 and 1991, the Vermont Department of Environmental Conservation Hazardous Materials Management Division did a screening site inspection, which is an early investigation of a potential Superfund site. As part of their inspection, soil, surface water, groundwater and drinking water supply sampling was conducted. Their results added to the growing body of data and information on this site and the surface waters it affects.

In 1996, the Elizabeth Mine Study Group was formed in response to the mine being named one of the top pollution hotspots in the Connecticut River watershed. Over many months, the group has gathered the studies and reports that have already been done; started a public outreach and education campaign; trained volunteers to collect and analyze data; collected a lot of flow, chemical and biological data; held meetings and site visits with key players who can assist with funding or technical expertise; and written and received grants for different aspects of their work. One substantial grant from EPA 319 nonpoint source implementation money paid for a hydrologic assessment and characterization of the site and the development of remediation options based on the characterization.

## **TMDL Waters**

Four Basin 14 waterbodies representing seven river segments and one pond are included on Part A of the December 1998 Vermont Section 303(d) List of Waters. The river segments include those waters impaired by metals and pH changes due to the mine runoff: Copperas Brook, West Branch of the Ompompanoosuc River, Ely Brook, Ompompanoosuc River and Pike Hill Brook. The list also includes two reaches of the Ompompanoosuc where bacteria levels were frequently above standard. Levi Pond is on the 303(d) list, Part A because of low pH values. For more information on the status of these listed waters, please see the State of Vermont 1998 List of Impaired Surface Waters (303(d) List).

## **Pine Mountain Wildlife Management Area Biological Diversity Project**

In 1997 and 1998, the Vermont Agency of Natural Resources Biological Diversity Committee and the Department of Fish & Wildlife's State Lands Team joined forces on a pilot project to apply the ANR Biodiversity Committee's "Elements of Biodiversity" to an inventory and assessment of Pine Mountain Wildlife Management Area (WMA). The goal was an inventory of all the elements of biological diversity as found on this WMA from the species level to geology, climate and landscape level as well as development of some management guidelines to protect the species, communities, processes or context identified. Once the biological diversity inventory and evaluation is complete and recommendations are made, this compilation will be a major consideration as the management plan for this area is re-written.

The work of the Water Resources Element Team, the Species Element Team and the Natural Communities/Ecological Processes Element Team all involved some level of assessment and description of the stream, wetlands and ponds of the WMA. There was a reptile and amphibian survey done as well as a biological survey (macroinvertebrates and fish) of Keenan and East Brooks. The results of both surveys are described in reports listed in the Reference and Resource section of this assessment report. There was also a natural communities inventory done as part of the project and twelve different vegetation communities were described including a small poor fen and a northern white cedar swamp. There is a lot of detail in each of the Pine Mountain Biodiversity Project Element Team reports, which often include appendices with survey or inventory results.

## **Thetford Center Falls Designation as an Outstanding Resource Water**

The petition to have the stretch of the Ompompanoosuc, which includes Thetford Center Falls, designated an Outstanding Resource Water was a joint effort of the Town of Thetford, the Friends of the Ompompanoosuc and the Vermont Department of Environmental Conservation. The large, undammed falls, the largely undeveloped area below the falls, the covered bridge over the river above the falls, the historic village of Thetford Center, the swimming, bathing and other recreational uses were the natural, scenic, cultural values highlighted in the 3.8 mile segment nominated for ORW status (see "Exceptional Uses and Values of Basin Rivers" for more description).

### **U.S. Army Corps of Engineers Sandy Beach E. coli Sampling**

The U.S. Army Corps of Engineers owns over 720 acres of land above Union Village Dam, which they operate as a flood control dam. A small area adjacent to a nice pool and sandy beach has been developed as a picnicking and swimming recreation area known as "Sandy Beach". From 1993 to 1997, the Army Corps had been frequently getting numbers of E. coli above 77 colonies/100 ml. which is the Vermont standard for swimming. In 1997, the Army Corps contacted the Agency of Natural Resources Enforcement Division for assistance. Staff at the Corps were frustrated because each swimming season they had to post Sandy Beach "Swim at Your Own Risk" and their efforts to find and fix the source of the bacteria had not been successful. In 1998, an ANR environmental officer, a biologist from the Water Quality Division and a ranger with the Army Corps conducted a season of sampling from the Sandy Beach location upstream about eight miles to Brimstone Corners. The results are inconsistent and quite difficult to interpret. On any one sampling day, the E. coli numbers would go above and below the 77/100 ml. threshold several times travelling downstream. Over time as well as distance, the numbers vary widely. Precipitation data in conjunction with the E. coli numbers does suggest a nonpoint source surface runoff contribution but there were also violations of the E. coli standard on days when there had been no rain in the past 48 hours. An investigation of the land uses and a septic system survey where there are clusters of high E. coli values is needed.

### **Ticklenaked Pond Watershed Association**

In response to the elevated phosphorus and bacteria conditions discovered at Ticklenaked Pond (see description under Impairments and Threats on Specific Basin Lakes), the Caledonia County NRCD initiated a process during 1997 and 1998 to assist watershed residents in forming a lake and watershed association. The association was officially founded in October of 1998. In response to Association requests, preliminary assessments conducted by VTDEC late in 1998 reveal several areas where remediation could benefit the lake. These include re-buffering approximately one kilometer of shoreline, and identification of nutrient and sediment sources along the main inlet which descends to the lake from Blue Mountain. To date, the Caledonia County NRCD and U.S. Fish & Wildlife Service has assisted one farmer with fencing and a pasture watering system to keep his livestock out of the stream, which is the main inlet to the pond. The farmer with pastures down to the shore on the east side of the pond has voluntarily fenced it off, will leave at least 50 feet from the shore unmowed and is investigating a pasture watering system. Both efforts should make significant contributions to the lake's protection and improvement.

## *Discussion and Recommendations*

The most severe impact to the rivers and streams in Basin 14, and in particular the Ompompanoosuc River watershed, is from the copper mining that occurred in past years. As discussed previously, there is much data and information available on the Elizabeth Mine site, the largest of the three mines in the watershed, due to a number of studies by various agencies over the past few decades. The latest study, which characterized the hydrology of the site also presented a number of detailed remediation options to address the metal-laden, acid runoff from the mine. The Agency has provided financial and technical support to projects in the past and should continue to provide any assistance that will reduce the runoff from these old mines to surface waters.

The greatest source of use impairments on lakes in Basin 14 is atmospheric deposition. Levi Pond is extremely sensitive to acid precipitation due to its very low acid neutralizing capacity (less than 2.5 mg/l  $\text{CaCO}_3$ ). Episodic acidification that impairs aquatic biota is likely in the pond. In addition, a statewide fish consumption advisory issued by the VT Department of Health due to high mercury concentrations in fish flesh impacts the consumption of lake trout from Harveys Lake and smallmouth bass from Lake Groton. Further studies are warranted on Ewell Pond and Ticklenaked Pond to determine the sources of water quality problems in these ponds.

Portions of the basin have been well studied, assessed, protected or restored and there is a lot to be learned by these distinct yet similar efforts. Partnerships between local citizens and government agencies have done important remediation work in the Harveys Lake watershed; have begun such an effort at Ticklenaked Pond; have gotten a portion of the Ompompanoosuc designated an Outstanding Resource Water (ORW), and have tackled the huge task of remediating problems at Elizabeth Mine. Inter-agency and department projects have included bacteria sampling on the Ompompanoosuc and the Pine Mountain WMA Biological Diversity inventory. Each of these projects has involved a number of people with each person bringing their own expertise and dedication to the effort. The complementary skills, talents, and contributions of many people have led to the success of these basin projects.

High percentages of basin waters fully support all designated uses: 82% of the river miles and 78% of the assessed lake acres. Documented threats, however, are substantial, especially to lakes. There should be deliberate measures taken to protect the currently clean waters of this basin.

Demographic and land use change data also indicate that nonpoint pollution prevention work is needed in this basin. The population and housing unit growth rates for basin towns from 1970 to 1980 and from 1980 to 1990 were very high. The number of acres in each of the four watersheds that were covered by transportation uses was also high. Roads, ditches, bridges, and rights-of-way are intensively maintained areas and are a significant threat to surface waters and wetlands.

Programs that target the municipalities, their road crews, AOT, and local residents will likely be an effective pollution prevention effort.

## *References and Resources*

- 1) A Biological Survey of Selected Surface Waters of the Pine Mountain Wildlife Management Area, 1998. Steve Fiske and Rich Langdon for the Agency of Natural Resources Pine Mountain Biological Diversity Project, Waterbury, Vermont.
- 2) Floodplain Forest of Vermont: Some Sites of Ecological Significance, July 1998. Eric Sorenson, Marc Lapin, Brett Engstrom, and Robert Popp for Nongame and Natural Heritage Program, Vermont Fish and Wildlife Department, Agency of Natural Resources, Waterbury, Vermont.
- 3) 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 Fish and Wildlife Department, Agency of Natural Resources, Waterbury, Vermont.
- 4) A Reptile and Amphibian Survey of Pine Mountain Wildlife management Area, December 1997. Jim Andrews for the Vermont Department of Fish and Wildlife, Agency of Natural Resources, Waterbury, Vermont.
- 5) Pine Mountain Wildlife Management area Natural Community Discussion, February 1998. Robert Popp and Eric Sorenson for the Agency of Natural Resources Pine Mountain Biological Diversity Project, Waterbury, Vermont.
- 6) The Waterfalls, Cascades and Gorges of Vermont, September 1985. Jerry Jenkins and Peter Zika for the agency of natural Resources, Departments of Environmental Conservation and Forests, Parks and Recreation.
- 7) The Whitewater Rivers of Vermont: Their Biology, Geography and Recreational Use, March 1992. Jerry Jenkins and Peter Zika for the Agency of Natural Resources, Waterbury, Vermont.
- 8) Annual Water Quality Reports, Fiscal Years 1995 - 1998. U.S. Army Corps of Engineers, New England District. Concord, Massachusetts.

### ***References and Resources Specific to the Elizabeth Mine and its Impacts***

- 1) Report on Mine Pollution in the Ompompanoosuc River Basin, April 1969. Vermont Department of Water Resources, Water Supply & Pollution Control Division.
- 2) The Geology of the Elizabeth Mine, Vermont, 1969. Peter F. Howard. Vermont Geology Survey.
- 3) Memorandum to David L. Clough from Wallace McLean, December 1977 regarding department sampling to determine the impact of the Elizabeth Mine on current water quality.
- 4) Water Quality Implications and Control Techniques Associated with the Proposed Union Village Hydroelectric Project, January 1984. Richard Barth, Colorado School of Mines Research Institute for Union Village Hydroelectric Company, Montpelier, Vermont.
- 5) Hydraulic Evaluation and Revegetation Study for the Elizabeth Mine Site, Strafford, Vermont, August, 1989. U.S. Army Corps of Engineers, New England Division, Waltham, Mass.
- 6) Effects of the Abandoned Elizabeth Copper Mine on Fisheries Resources of the West Branch of the Ompompanoosuc River, January 1990. U.S. Army Corps of Engineers, New England Division, Waltham, Massachusetts.
- 7) Potential Hazardous Waste Site Screening Site Inspection, Elizabeth Mine, Strafford, Vermont, August 1991. Vermont Agency of Natural Resources, Department of Environmental Conservation, Hazardous Materials Management Division, Waterbury, Vermont.
- 8) Elizabeth Mine Study Group 1997 - 1998 Annual Report.
- 9) Hydrologic Characterization and Remediation Options of the Elizabeth Mine, South Strafford, Vermont, February 1999. Step by Step and Damariscotta for the Elizabeth Mine Study Group

**Appendix A**

**Land Use and Land Cover**  
**of**  
**the Four Watersheds of Basin 14**

**Table A.1. Land Use/Land Cover 1997 Data - Stevens River Watershed\***

| Land Cover     | Acres  | % of Total Acres |
|----------------|--------|------------------|
| forested       | 20,782 | 68               |
| agricultural   | 5,151  | 17               |
| transportation | 1,590  | 5                |
| surface water  | 1,500  | 5                |
| wetlands       | 764    | 3                |
| developed land | 685    | 2                |
| Totals:        | 30,478 | 100              |

**Table A.2. Land Use/Land Cover 1997 Data - Wells River Watershed\***

| Land Cover        | Acres  | % of Total Watershed Acres |
|-------------------|--------|----------------------------|
| forested          | 49,995 | 81.5                       |
| agricultural land | 4660   | 7.6                        |
| surface water     | 2387   | 3.9                        |
| transportation    | 2367   | 3.9                        |
| wetlands          | 1724   | 2.8                        |
| developed land    | 183    | 0.3                        |
| Totals:           | 61,316 | 100.0                      |

\* Barren land and transitional land were also identified but they are not included in the tables above as they were a very small percentage of the watershed land cover.



**Table A.3. Land Use/Land cover 1997 Data - Waits River Watershed\***

| Land Cover        | Acres  | % of Total Watershed Acres |
|-------------------|--------|----------------------------|
| forested          | 84,348 | 84.3                       |
| agricultural land | 8177   | 8.2                        |
| transportation    | 4055   | 4.1                        |
| surface water     | 1439   | 1.4                        |
| wetlands          | 1334   | 1.3                        |
| developed land    | 634    | 0.6                        |
| Total:            | 99,987 | 99.9                       |

**Table A.4. Land Use/Land Cover 1997 Data - Ompompanoosuc River Watershed\***

| Land cover     | Acres  | % of Total Watershed Acres |
|----------------|--------|----------------------------|
| forested       | 75,267 | 86.0                       |
| agricultural   | 4507   | 5.2                        |
| transportation | 3327   | 3.8                        |
| surface water  | 2801   | 3.2                        |
| wetlands       | 1016   | 1.2                        |
| developed land | 269    | 0.3                        |
| Total:         | 87,187 | 99.7                       |

\* Barren land and transitional land were also identified but they are not included in the tables above as they were a very small percentage of the watershed land cover.

**Appendix B**

**Floodplain Forests and Wetlands**

VERMONT FLOODPLAIN FOREST INVENTORY MASTER LIST  
NONGAME AND NATURAL HERITAGE PROGRAM

WAITS RIVER WATERSHED

| Site #  | Town     | Quad                                  | Site/Location                   | Priority | Description   | Source   | Aerial Recon '97 |
|---------|----------|---------------------------------------|---------------------------------|----------|---|----------|------------------|
| 1 Waits | Bradford | 4307282 / 4307281<br>Fairlee/Piermont | Golf Course<br>Floodplain       | Low      | 4 acre floodplain forest fringe along the edge of the river; golf course surrounds it.                                  | NWI, CIR | Y                |
| 2 Waits | Bradford | 4307282<br>Fairlee                    | Lower Waits<br>River Floodplain | Low      | 4-5 acre floodplain forest on both sides of river; both sides with forested upland buffer.                              | NWI, CIR | Y                |
| 3 Waits | Bradford | 4407212<br>E. Corinth                 | Bradford Center<br>Floodplain   | Low-Med  | 6-7 acres of floodplain forest on NE side of river; in tact upland buffer; southern most unit of forest appears mature. | NWI, CIR | Y                |
| 4 Waits | Corinth  | 4407212<br>E. Corinth                 | Conifer<br>Floodplain<br>Forest | Low      | 5-10 acres of apparently drier floodplain forest dominated by conifers.   | NWI, CIR | N                |

WELLS RIVER WATERSHED

| Site #  | Town    | Quad                         | Site/Location               | Priority | Description  | Source   | Aerial Recon '97 |
|---------|---------|------------------------------|-----------------------------|----------|--|----------|------------------|
| 1 Wells | Ryegate | 4407221<br>Woodsville, VT-NH | South Ryegate<br>Floodplain | Med      | 5 acre, fairly intact floodplain forest remnant on north side of river; between town road and river. | NWI, CIR | N                |

VERMONT FLOODPLAIN FOREST INVENTORY MASTER LIST  
NONGAME AND NATURAL HERITAGE PROGRAM

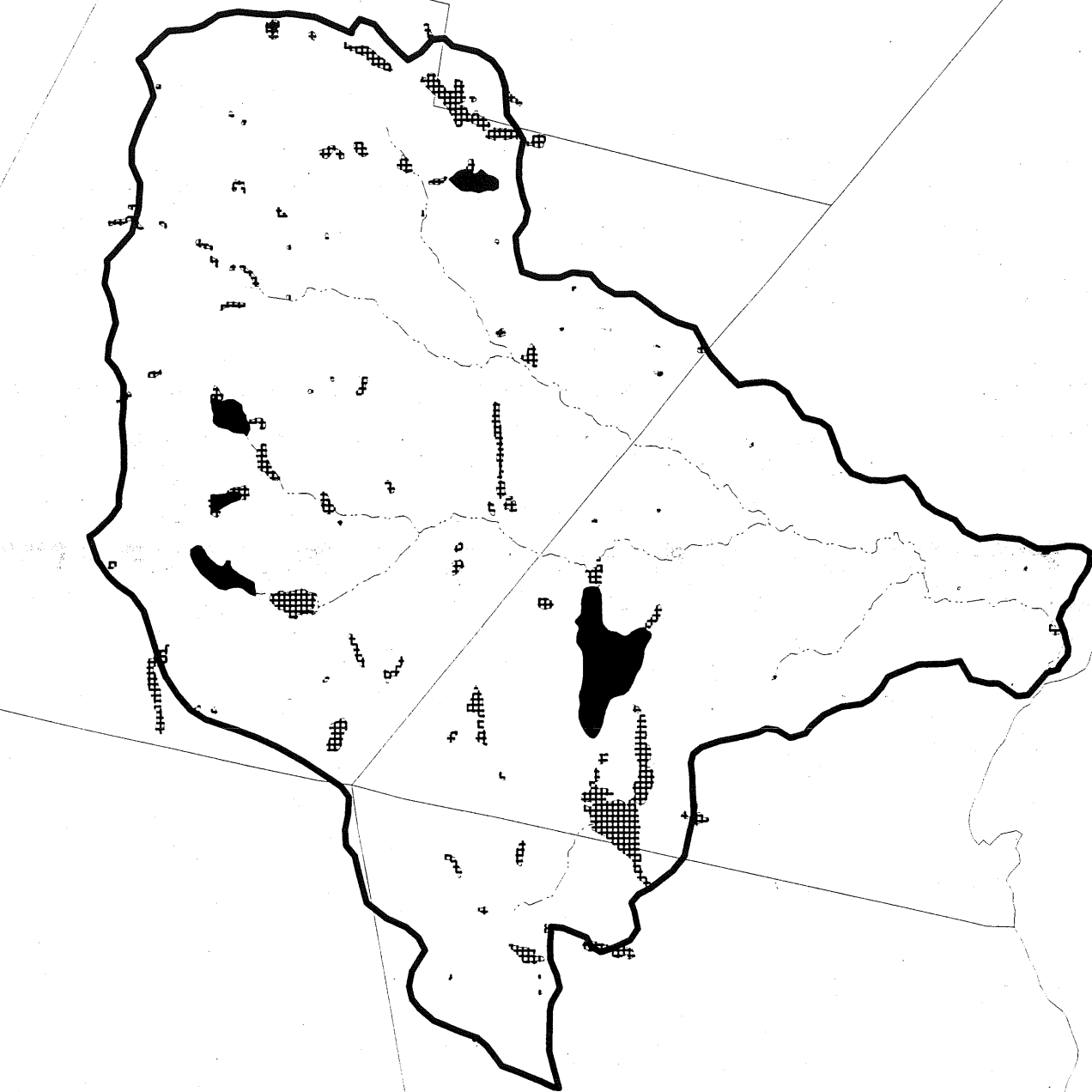
WAITS RIVER WATERSHED






| Site #  | Town     | Quad                                  | Site/Location                   | Priority | Description   | Source   | Aerial Recon '97 |
|---------|----------|---------------------------------------|---------------------------------|----------|---|----------|------------------|
| 1 Waits | Bradford | 4307282 / 4307281<br>Fairlee/Piermont | Golf Course<br>Floodplain       | Low      | 4 acre floodplain forest fringe along the edge of the river; golf course surrounds it.                                  | NWI, CIR | Y                |
| 2 Waits | Bradford | 4307282<br>Fairlee                    | Lower Waits<br>River Floodplain | Low      | 4-5 acre floodplain forest on both sides of river; both sides with forested upland buffer.                              | NWI, CIR | Y                |
| 3 Waits | Bradford | 4407212<br>E. Corinth                 | Bradford Center<br>Floodplain   | Low-Med  | 6-7 acres of floodplain forest on NE side of river; in tact upland buffer; southern most unit of forest appears mature. | NWI, CIR | Y                |
| 4 Waits | Corinth  | 4407212<br>E. Corinth                 | Conifer<br>Floodplain<br>Forest | Low      | 5-10 acres of apparently drier floodplain forest dominated by conifers.   | NWI, CIR | N                |

WELLS RIVER WATERSHED

| Site #  | Town    | Quad                         | Site/Location               | Priority | Description  | Source   | Aerial Recon '97 |
|---------|---------|------------------------------|-----------------------------|----------|--|----------|------------------|
| 1 Wells | Ryegate | 4407221<br>Woodsville, VT-NH | South Ryegate<br>Floodplain | Med      | 5 acre, fairly intact floodplain forest remnant on north side of river; between town road and river. | NWI, CIR | N                |

# Stevens River Watershed

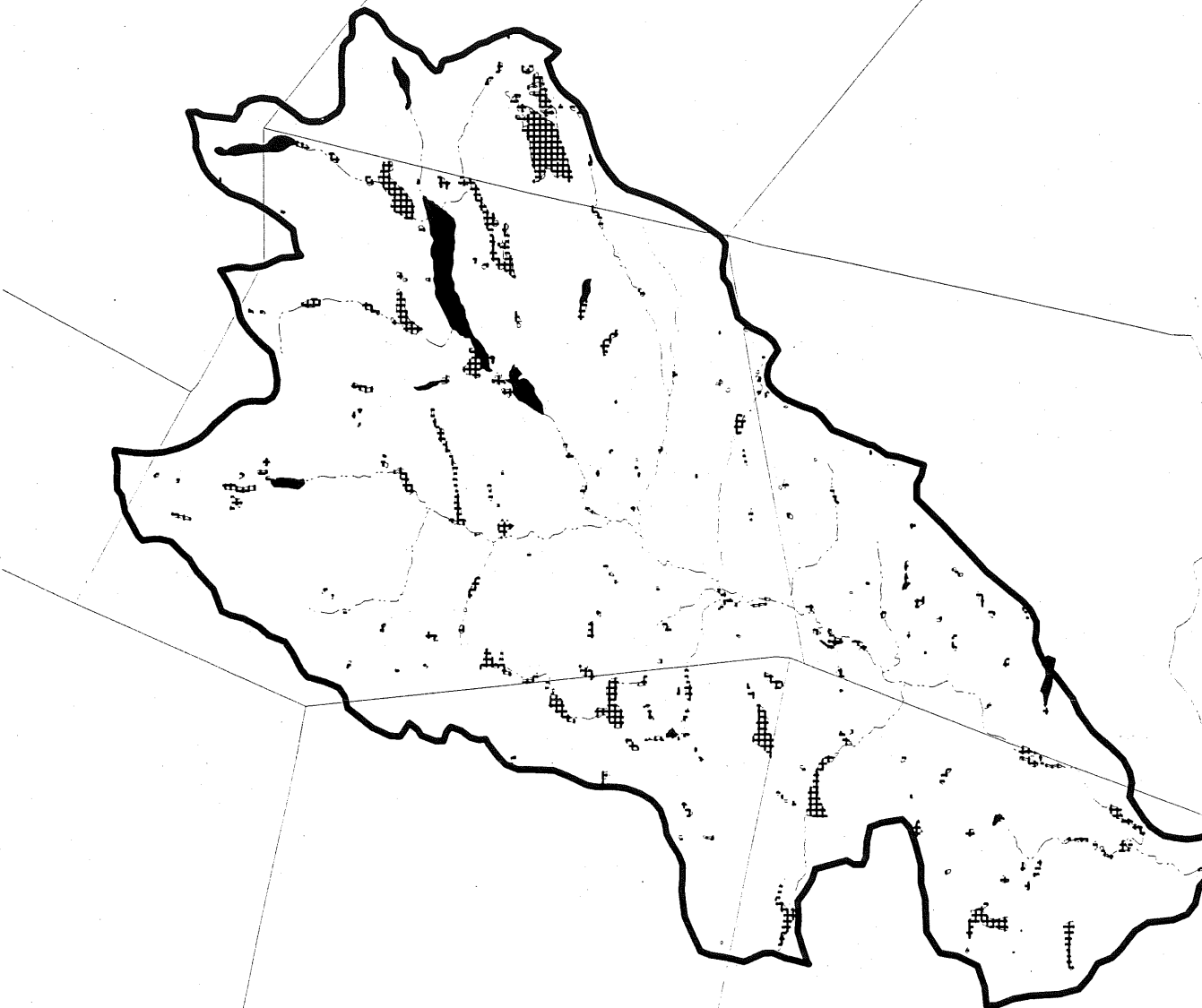


-  NWI Wetlands
-  Rivers
-  Lakes
-  Stevens River Watershed Boundary
-  Towns

1:100000



# Wells River Watershed



- Rivers
- NWI Wetlands
- Lakes
- Wells River Watershed Boundary
- Towns

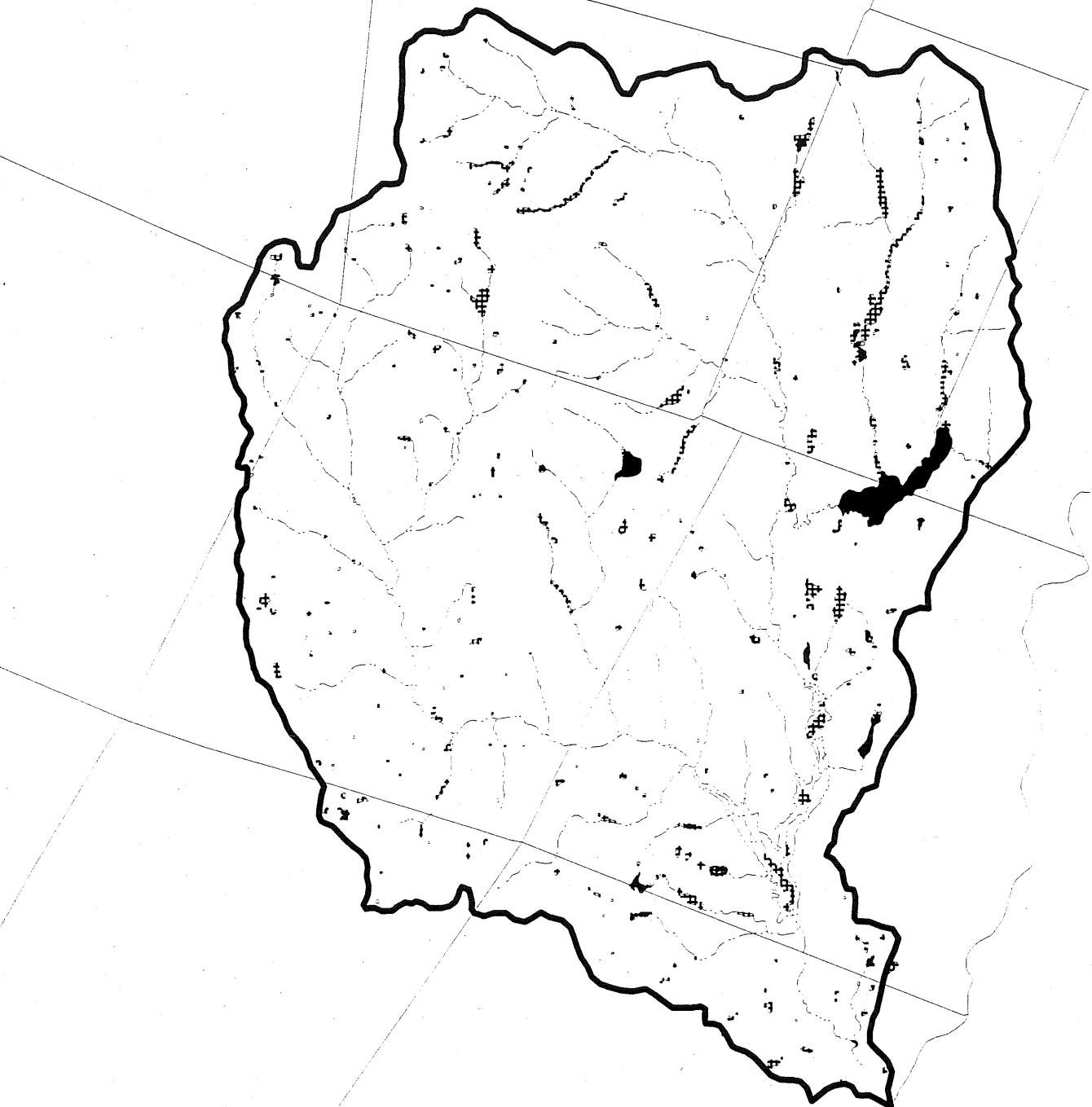
1:150000








# Waits River Watershed



# Ompompanoosuc Watershed



-  Rivers
-  NWI Wetlands
-  Lakes
-  Ompompanoosuc Watershed Boundary
-  Town Boundary

1:150000





**Appendix C**

**Population and Housing Data**

**Table C.1. Population Changes in Basin Towns**

| Town         | 1970<br>Population | 1980<br>Population | % change<br>1970 - 1980 | 1990<br>Population | % change<br>1980 - 1990 |
|--------------|--------------------|--------------------|-------------------------|--------------------|-------------------------|
| Barnet*      | 1342               | 1338               | -0.3                    | 1415               | 5.8                     |
| Bradford*    | 1627               | 2191               | 34.7                    | 2522               | 15.1                    |
| Corinth      | 683                | 904                | 32.4                    | 1244               | 37.6                    |
| Groton*      | 666                | 667                | 0.1                     | 862                | 29.2                    |
| Newbury*     | 1440               | 1699               | 18.0                    | 1985               | 16.8                    |
| Orange*      | 540                | 752                | 39.3                    | 915                | 21.7                    |
| Peacham*     | 446                | 531                | 19.1                    | 627                | 18.1                    |
| Ryegate*     | 830                | 1000               | 20.5                    | 1058               | 5.8                     |
| Strafford*   | 536                | 731                | 36.4                    | 902                | 23.4                    |
| Thetford*    | 1422               | 2188               | 53.9                    | 2438               | 11.4                    |
| Topsham      | 686                | 767                | 11.8                    | 944                | 23.1                    |
| Vershire*    | 299                | 442                | 47.8                    | 560                | 26.7                    |
| Washington*  | 667                | 855                | 28.2                    | 937                | 9.6                     |
| West Fairlee | 337                | 427                | 26.7                    | 633                | 48.2                    |
| Basin total: | 11,521             | 14,492             | 25.8%                   | 17,042             | 17.6%                   |

\* a portion of the town is outside of the basin

**Table C.2. Housing Unit Changes in Basin Towns**

| Town         | 1980<br>Housing Units | 1990<br>Housing Units | % change<br>1980 - 1990 |
|--------------|-----------------------|-----------------------|-------------------------|
| Barnet       | 732                   | 812                   | 10.9                    |
| Bradford     | 955                   | 1075                  | 12.6                    |
| Corinth      | 512                   | 618                   | 20.7                    |
| Groton       | 463                   | 523                   | 13.0                    |
| Newbury      | 977                   | 1132                  | 15.9                    |
| Orange       | 276                   | 359                   | 30.1                    |
| Peacham      | 401                   | 462                   | 15.2                    |
| Ryegate      | 472                   | 531                   | 12.5                    |
| Strafford    | 412                   | 494                   | 19.9                    |
| Thetford     | 1085                  | 1136                  | 4.7                     |
| Topsham      | 395                   | 504                   | 27.6                    |
| Vershire     | 275                   | 302                   | 9.8                     |
| Washington   | 384                   | 447                   | 16.4                    |
| West Fairlee | 249                   | 355                   | 42.6                    |
| Basin total: | 7,588                 | 8,570                 | 15.3%                   |

\* a portion of the town is outside of the basin

## **Appendix D**

### **Dams**

**Table D.1. Dams of Basin 14**

| <b>Dam Name</b>      | <b>Stream</b>            | <b>Town</b> | <b>Status*</b> | <b>Use</b> | <b>Built</b> | <b>Recon</b> | <b>State ID</b> |
|----------------------|--------------------------|-------------|----------------|------------|--------------|--------------|-----------------|
| Harveys Lake         | Stevens River            | Barnet      | In Service     | R          | 1970         |              | 12.01           |
| Judkins Mill         | Stevens River            | Barnet      | Breached       |            |              |              | 12.05           |
| Barnet No. 14        | Stevens River            | Barnet      |                |            |              |              | 12.06           |
| Walker and Brock     | Stevens River            | Barnet      | Breached       |            |              |              | 12.08           |
| Barnet-9             | Stevens River-TR         | Barnet      |                |            |              |              | 12.09           |
| West Barnet Creamery | Stevens River-TR         | Barnet      |                |            |              |              | 12.10           |
| Ewell Pond           | E. Peacham Brook         | Peacham     | In Service     | R          | 1930         |              | 151.01          |
| East Peacham Pond    | Peacham Hollow Brook     | Peacham     |                |            | 1948         |              | 151.02          |
| Martins Pond         | Stevens River-TR         | Peacham     | In Service     | R          | 1958         |              | 151.04          |
| Randall              | Peacham Hollow Brook     | Peacham     |                |            |              |              | 151.06          |
| Aiken                | Peacham Hollow Brook     | Peacham     |                | R          | 1969         |              | 151.07          |
| Ricker Pond          | Wells River              | Groton      | In Service     | R          | 1900         | 1988         | 88.01           |
| Ricker Mill Pond     | Wells River              | Groton      | Breached       |            |              |              | 88.04           |
| Lake Groton          | Ricker Pond-TR           | Groton      | In Service     | R          | 1968         |              | 88.05           |
| Noyes Pond           | South Branch Wells River | Groton      | In Service     | R          | 1934         |              | 88.06           |
| Sanville             | Wells River              | Groton      |                |            |              |              | 88.07           |
| Franconia Paper      | Wells River              | Groton      |                |            |              |              | 88.08           |
| Groton-9             | Wells River              | Groton      | Breached       |            |              |              | 88.09           |
| Boltonville No. 11   | Wells River              | Newbury     | In Service     |            | 1928         |              | 138.05          |
| Adams Paper Co.      | Wells River              | Newbury     | In Service     | H          | 1912         |              | 138.06          |
| Newbury-9            | Wells River              | Newbury     |                |            |              |              | 138.09          |
| Ticklenaked Pond     | Wells River-TR           | Ryegate     | Breached       |            |              |              | 175.01          |
| Wells-6              | Wells Brook-TR           | Wells       |                |            |              |              | 230.06          |

| Dam Name                | Stream                       | Town      | Status                | Use | Built | Recon | State ID |
|-------------------------|------------------------------|-----------|-----------------------|-----|-------|-------|----------|
| Bradford                | Waits River                  | Bradford  | In Service            | H   | 1908  | 1981  | 24.01    |
| Holland                 | Pike Hill Brook-TR           | Corinth   | In Service            | R   | 1966  |       | 53.01    |
| Page                    | Tabor Branch                 | Corinth   |                       |     |       |       | 53.02    |
| Worthley                | Tabor Branch                 | Corinth   |                       |     |       |       | 53.03    |
| Corinth-4               | Tabor Branch                 | Corinth   |                       |     |       |       | 53.04    |
| Riddle Pond<br>(Upper)  | Waits River-TR               | Orange    | Breached              |     |       |       | 147.04   |
| Riddle Pond<br>(Lower)  | Waits River-TR               | Orange    | Breached              |     |       | 1980  | 147.05   |
| Peake                   | Waits River-TR               | Orange    | Breached              |     |       |       | 147.07   |
| Orange-10               | Waits River-TR               | Orange    | Breached              |     |       |       | 147.10   |
| Clark Site No. 2        | Tabor Branch-TR              | Topsham   | In Service            | R   | 1974  |       | 208.01   |
| Morse                   | East Brook                   | Topsham   |                       |     |       |       | 208.02   |
| Blake                   | Tabor Branch-TR              | Topsham   | In Service            | R   | 1972  |       | 208.03   |
| Keenan Pond             |                              | Topsham   | Breached              |     |       |       | 208.04   |
| Hood                    | Tabor Branch                 | Topsham   |                       |     |       |       | 208.05   |
| Miller                  | Tabor Branch                 | Topsham   |                       |     |       |       | 208.06   |
| West Topsham<br>(Lower) | Waits River                  | Topsham   |                       |     |       |       | 208.07   |
| West Topsham<br>(Upper) | Waits River                  | Topsham   |                       |     |       |       | 208.08   |
| CCC Pond                | Ompompanoosuc                | Sharon    | In Service            | R   | 1935  | 1961  | 184.02   |
| Miller Pond             | Abbot Brook-TR               | Strafford | In Service            | R   | 1960  |       | 200.01   |
| Tyson                   | West Branch                  | Strafford | Breached              |     |       |       | 200.03   |
| Rhodes                  | West Branch                  | Strafford |                       |     |       |       | 200.04   |
| Strafford               | West Branch                  | Strafford |                       |     |       |       | 200.05   |
| Malmquist               | Abbot Brook-TR               | Strafford | Breached<br>(partial) |     |       |       | 200.07   |
| Strafford<br>Recreation | West Branch<br>Ompompanoosuc | Strafford |                       |     |       |       | 200.08   |

| <b>Dam Name</b>               | <b>Stream</b>       | <b>Town</b>     | <b>Status</b>         | <b>Use</b> | <b>Built</b> | <b>Recon</b> | <b>State ID</b> |
|-------------------------------|---------------------|-----------------|-----------------------|------------|--------------|--------------|-----------------|
| Lake Fairlee                  | Ompompanoosuc       | Thetford        |                       | R          | 1939         |              | 206.01          |
| Mud Pond                      | Ompompanoosuc       | Thetford        | In Service            | R          | 1940         |              | 206.02          |
| Lake Abenaki                  | Ompompanoosuc       | Thetford        |                       | R          | 1900         |              | 206.03          |
| Manchester                    | Ompompanoosuc       | Thetford        | Breached<br>(partial) |            |              |              | 206.06          |
| Norford Lake                  | Avery Brook-TR      | Thetford        | In Service            | R          | 1925         |              | 206.07          |
| Union Village                 | Ompompanoosuc       | Thetford        | In Service            | C          | 1950         |              | 206.08          |
| Payson                        | Ompompanoosuc       | Thetford        | In Service            | R          | 1975         |              | 206.09          |
| Vaughn                        | Ompompanoosuc       | Thetford        | Breached              |            |              |              | 206.10          |
| Gove Hill Christian<br>Assoc. | Lord Brook-TR       | Thetford        |                       | R          | 1968         |              | 206.12          |
| Vaughn                        | Ompompanoosuc       | Thetford        |                       |            |              |              | 206.15          |
| Slack                         | Ompompanoosuc       | Thetford        |                       |            |              |              | 206.16          |
| Montague Rod<br>and Reel      | W. Branch<br>Ompom. | Thetford        |                       |            |              |              | 206.17          |
| Montague Rod<br>and Reel      | Ompompanoosuc       | Thetford        |                       |            |              | 1925         | 206.18          |
| Rices Mill                    | West Branch         | Thetford        |                       |            |              |              | 206.19          |
| Thetford-20                   | Barker Brook-TR     | Thetford        |                       |            |              |              | 206.20          |
| Thetford-22                   | Ompompanoosuc       | Thetford        |                       |            |              |              | 206.22          |
| Thetford-23                   | Ompompanoosuc       | Thetford        |                       |            |              |              | 206.23          |
| Copperfield                   | Ompompanoosuc       | Vershire        |                       |            |              |              | 215.02          |
| Middle Brook                  | Middle Brook        | West<br>Fairlee | In Service            | R          | 1948         |              | 231.01          |
| Keefe Site 2                  | Middle Brook        | West<br>Fairlee | In Service            | R          | 1965         |              | 231.02          |
| Powell                        | Ompompanoosuc       | Vershire        |                       |            | 1970         |              | 215.01          |
| Geer                          | Middle Brook        | West<br>Fairlee | Breached              |            | 1982         |              | 231.03          |

\* Blank under Status column just means that no information was in the database. In the Use column, R=recreation, C = flood control and H = hydroelectric.

## Appendix E

### Individual River Waterbody Reports



**Lower Ompompanoosuc River****Assessment Report****Waterbody No:** VT14-01**Basin:** 14-Ompompanoosuc**River Length (mi.):** 7**Classification:****Description:** Mouth to Union Village Dam & Tribs

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**Location Identifiers****County:** Windsor Orange**NRCS District:** 10**ANR Enforcement District:** 3**Regional Planning Commission:** UPV**Fish and Wildlife District:** 3

---

**Assessment Information****Assessment Date:** 1998**Assessment Types****Date Last Updated:** 11/23/1998

Surveys of fish and game biologists or other professionals

**Assessment Category:** M

Fixed station chemical/physical monitoring-conventional and toxic p

**Water Quality Limited?****On 303(d) List?****Monitored for Toxics?** N**Aquatic Contamination****Toxics Testing****Waste Management Zone - Miles:****Description:****Assessment Comments****PARTIAL SUPPORT MILES**

Lower Ompompanoosuc River: 4.0 - partial support of aquatic biota due to metals, acidity and turbidity from acid mine drainage. c(500,1100), s(5700)

**COMMENTS**

The lower mile or so of the Ompompanoosuc is a backwater of the Connecticut river, the level of which is controlled by Wilder Dam several miles downstream on the Connecticut.

In 1996, a spot survey was conducted in the Ompompanoosuc River below Union Village Dam to assess Atlantic salmon fry survival. Two age classes of stocked Atlantic salmon fry were present. (1998)

**INFORMATION SOURCES**

John Claussen, Vt Dept of Fish & Wildlife

Rich Kirn, Vt Dept of Fish & Wildlife - memo describing fisheries status based on data from 1980 to 1998.

Union Village Dam Water Quality Evaluation, U.S. Army Corps of Engineers, January 1983 - noted increasing acidity and turbidity with increasing flows, some sedimentation below impoundment with no impairments.

Class III Water Quality Projects Water Quality Evaluation Update, U.S. Army Corps of Engineers, October 1985 - includes data from 1984 sampling of metals and other parameters at 5 sites on the Ompompanoosuc

**Lower Ompompanoosuc River****VT14-01**

or West Branch Ompompanoosuc Rivers. Site UV05 is below the dam and thus in this waterbody: it had levels of aluminum and mercury above the criteria to protect sensitive aquatic life.

| Use No. | Use Description          | Fully | Threat | Partial Support | Non Support | Not Assessed |
|---------|--------------------------|-------|--------|-----------------|-------------|--------------|
| 01      | Overall                  | 3.0   | 0.0    | 4.0             | 0.0         | 0.0          |
| 20      | Aquatic biota            | 3.0   | 0.0    | 4.0             | 0.0         | 0.0          |
| 21      | Fish consumption         | 7.0   | 0.0    | 0.0             | 0.0         | 0.0          |
| 42      | Contact recreation       | 7.0   | 0.0    | 0.0             | 0.0         | 0.0          |
| 44      | Noncontact recreation    | 7.0   | 0.0    | 0.0             | 0.0         | 0.0          |
| 50      | Drinking water supply    | 7.0   | 0.0    | 0.0             | 0.0         | 0.0          |
| 62      | Aesthetics               | 7.0   | 0.0    | 0.0             | 0.0         | 0.0          |
| 72      | Agriculture water supply | 0.0   | 0.0    | 0.0             | 0.0         | 7.0          |
| 82      | Industry water supply    | 0.0   | 0.0    | 0.0             | 0.0         | 7.0          |

| Impairment Cause | Magnitude | Size (mi.) |
|------------------|-----------|------------|
| Metals           | H         | 4.00       |
| Siltation        | M         | 4.00       |

| Impairment Source | Magnitude | Size (mi.) |
|-------------------|-----------|------------|
| Mine tailings     | H         | 4.00       |

| Point Source Description | NPDES No. |
|--------------------------|-----------|
| none                     |           |

| Nonpoint Source Name | Description |
|----------------------|-------------|
|                      | none        |

## West Branch Ompompanoosuc River Assessment Report

**Waterbody No:** VT14-02 **Basin:** 14-Ompompanoosuc  
**River Length (mi.):** 30.5 **Classification:**  
**Description:** Mouth to headwaters and tributaries including Copperas Brook

### Location Identifiers

|                                      |   |
|--------------------------------------|---|
| <b>County:</b> Orange                | <b>NRCS District:</b> 10                |
| <b>ANR Enforcement District:</b> 3A  | <b>Regional Planning Commission:</b> WO |
| <b>Fish and Wildlife District:</b> 3 |   |

### Assessment Information

|                                      |  |
|--------------------------------------|--|
| <b>Assessment Date:</b> 1998         | <b>Assessment Types</b>                                    |
| <b>Date Last Updated:</b> 11/23/1998 | Surveys of fish and game biologists or other professionals |
| <b>Assessment Category:</b> M        | Chemical/physical monitoring                               |
| <b>Water Quality Limited?</b> Y      | Chemical monitoring of sediments                           |
| <b>On 303(d) List?</b> Y             | Fish tissue analysis                                       |
| <b>Monitored for Toxics?</b> Y       | Fish surveys   |

#### Aquatic Contamination

Sediment contamination

#### Toxics Testing

Metals in sediments

Metals in fish tissue

**Waste Management Zone - Miles:** **Description:**

#### Assessment Comments

##### NON-SUPPORT MILES

Copperas Brook: 1.0 - to confluence with West Branch Ompompanoosuc River - non-support of aquatic biota/habitat, all water supplies, recreation and aesthetics due to soluble and precipitated metals and acidity, thermal & habitat modifications and low DO due to an inactive copper mine and tailings and loss of riparian vegetation. c(500,1000,1200,1400) s(5700,5800,7600)

West Branch Ompompanoosuc River: 4.5 - from Copperas Branch to confluence of Ompompanoosuc River - same as above. c(500,1000,1200) s(5100,5700)

##### PARTIAL SUPPORT MILES

West Branch Ompompanoosuc R.: 1.0 - above South Strafford Village - partial support of aquatic habitat due to siltation from streambank erosion and lack of streambank vegetation as a result of agricultural activities (hayfields, horse pasture). c(1100) s(1000,7600,7700)

##### THREATENED MILES

West Branch Ompompanoosuc River: 0.5 - below South Strafford Village - threats to drinking water, contact recreation, aquatic biota due to releases of benzene and BTEX and possible high BOD from a hazardous waste site (0.5 miles is an arbitrary milage assignment). c(300,1200) s(6600)

**West Branch Ompompanoosuc River****VT14-02****COMMENTS**

Coburn's General Store in South Strafford (90-503) was responsible for visible oil sheens and a large discharge of benzene (about 65000 ppb) to the West Branch of the Ompompanoosuc in 1990. A remediation system was installed, which has greatly reduced the toxic materials going to the river. However, up to 5 ppb benzene and 50 ppb BTEX may still be discharged to the river based on the permit conditions. In addition, a neighbor's leachfield if near the recovery well for the site and flow from this domestic system is drawn into the recovery well, treated for pathogens but could add biological oxygen demand (measured at 141 mg/liter) to the discharge.

Information from the district fisheries biologist noted that "upper reaches (elevation 1153-1100) [of the West Branch Ompompanoosuc River] supported moderate densities of wild brook trout during 1984 surveys. Surveys conducted below this reach (elevation 870-505) contained very few wild trout. Experimental stocking of atlantic salmonfry from 1991 - 1993 resulted in poor survival and growth and was subsequently discontinued." The impact of mine drainage is the presumed cause of poor fish populations.

**INFORMATION SOURCES**

John Buck, Vt Dept of Fish & Wildlife - noted stream substrate and iron oxide bacteria, open pits of copper ore. (1988)

Dan Koloski, SCS - noted visual impairment to substrate and 20 acre barren site with metal loading to stream. Also noted impacts upstream of South Strafford village. (1988)

John Clausen, Vt. F&W Fisheries Biologist - noted impairment to fishery along Copperas Brook and West Branch of Ompompanoosuc River. (1988)

Water Quality Implications and Control Techniques Associated with the Proposed Union Village Hydroelectric Project, Colorado School of Mines Research Institute, January 1984 - Mine drainage has measurable negative impact on sediment quality. Sampling data.

Union Village Dam - Water Quality Evaluation, US Army COE, January 1983 - contains surface water quality data for West Branch.

U.S. Army Corps of Engineers 1990 report. Effects of the Abandoned Elizabeth Copper Mine on Fisheries Resources of the West Branch of the Ompompanoosuc River. This study investigated impact of mine drainage on metal levels in blacknose dace and river sediments and fish community composition and biomass upstream and downstream of the mines. They found that "river sediments downstream of the mine contained significantly higher copper levels than those from upstream stations." Other metal levels weren't significantly different above and below the mine. The "biomass of forage species was dramatically reduced downstream of the mine."

U.S. Army Corps of Engineers New England Division 1989 report. Hydraulic Evaluation and Revegetation Study for the Elizabeth Mine Site, Strafford, Vermont. Recommended stabilizing the tailings piles to prevent erosion; a channel diversion scheme to divert water around the tailings and soil amendment and revegetation plan for the tailings piles.

Elizabeth Mine Potential Hazardous Waste Site Screening Site Inspection, ANR DEC Hazardous Materials Management Division, August, 1991.

Vt DEC Waste Management Division - files and data on Coburn General Store as well as Elizabeth Mine (nothing new on latter). (1998)

Rich Kirn, Vt Dept of Fish & Wildlife - memorandum to Cathy Kashanski re: Ompompanoosuc River fish populations dated November 12, 1997

| Use No. | Use Description       | Fully | Threat | Partial<br>Support | Non<br>Support | Not<br>Assessed |
|---------|-----------------------|-------|--------|--------------------|----------------|-----------------|
| 01      | Overall               | 23.5  | 0.5    | 1.0                | 5.5            | 0.0             |
| 20      | Aquatic biota/habitat | 23.5  | 0.5    | 1.0                | 5.5            | 0.0             |
| 21      | Fish consumption      | 25.0  | 0.0    | 0.0                | 5.5            | 0.0             |
| 42      | Contact recreation    | 24.5  | 0.5    | 0.0                | 5.5            | 0.0             |
| 44      | Noncontact recreation | 25.0  | 0.0    | 0.0                | 5.5            | 0.0             |
| 50      | Drinking water supply | 24.5  | 0.5    | 0.0                | 5.5            | 0.0             |
| 62      | Aesthetics            | 25.0  | 0.0    | 0.0                | 5.5            | 0.0             |

**West Branch Ompompanoosuc River****VT14-02**

|    |                          |      |     |     |     |      |
|----|--------------------------|------|-----|-----|-----|------|
| 72 | Agriculture water supply | 24.5 | 0.5 | 0.0 | 5.5 | 0.0  |
| 82 | Industry water supply    | 0.0  | 0.0 | 0.0 | 0.0 | 30.5 |

| <b>Impairment Cause</b>     | <b>Magnitude</b> | <b>Size (mi.)</b> |
|-----------------------------|------------------|-------------------|
| Priority organics           | T                | 0.50              |
| Metals                      | H                | 5.50              |
| pH                          | H                | 5.50              |
| Siltation                   | M                | 1.00              |
| Organic enrichment/Low D.O. | M                | 1.00              |
| Organic enrichment/Low D.O. | T                | 0.50              |
| Thermal modifications       | S                | 5.50              |

| <b>Impairment Source</b>                | <b>Magnitude</b> | <b>Size (mi.)</b> |
|---|------------------|-------------------|
| Agriculture                             | M                | 1.00              |
| Mine tailings                           | H                | 5.50              |
| Acid mine drainage                      | H                | 5.50              |
| Hazardous waste                         | T                | 0.50              |
| Removal of riparian vegetation          | M                | 2.00              |
| Streambank modification/destabilization | M                | 1.00              |

| <b>Point Source Description</b> | <b>NPDES No.</b> |
|---------------------------------|------------------|
| none                            |                  |

| <b>Nonpoint Source Name</b> | <b>Description</b>              |
|-----------------------------|---------------------------------|
| Elizabeth Mine              | Mine Runoff - High Priority/SWI |
| Coburn's Gen Store          | Hazardous Waste Site            |

## Ompompanoosuc River Assessment Report

**Waterbody No:** VT14-03 **Basin:** 14-Ompompanoosuc  
**River Length (mi.):** 32.5 **Classification:**  
**Description:** Union Village Impoundment to headwaters and tributaries

### Location Identifiers

**County:** Orange **NRCS District:** 10  
**ANR Enforcement District:** 3A **Regional Planning Commission:** UPV  
**Fish and Wildlife District:** 3

### Assessment Information

|                                      |  |
|--------------------------------------|--|
| <b>Assessment Date:</b> 1998         | <b>Assessment Types</b>                                    |
| <b>Date Last Updated:</b> 11/23/1998 | Surveys of fish and game biologists or other professionals |
| <b>Assessment Category:</b> M        | Chemical/physical monitoring                               |
| <b>Water Quality Limited?</b> Y      | Biological Monitoring                                      |
| <b>On 303(d) List?</b> Y             | Bacteriological Monitoring                                 |
| <b>Monitored for Toxics?</b> Y       |  |
| <b>Aquatic Contamination</b>         | <b>Toxics Testing</b>                                      |
| None detected                        |  |

**Waste Management Zone - Miles:** **Description:**

### Assessment Comments

#### NON-SUPPORTED MILES

Ely Bk.: 1.4 - drainage of Ely Mine to confluence with Ompompanoosuc River- do not support aquatic habitat/biota, non-contact recreation, all water supplies, and water clarity due to metals(soluble & precipitated), acidity, low DO, and thermal modifications from an inactive mine and tailings  
 c(500,1000,1200,1400) s(5100,5700)

#### PARTIAL SUPPORT MILES

Ompompanoosuc River: 2.4 - Brimstone Corners to just below West Fairlee Village - partial support of contact recreation due to pathogens from unknown sources. c(1700) s(9000)

Ompompanoosuc River: 1.5 - from West Fairlee to Post Mills - partially support aquatic biota and all water supplies due to metals, acidity, some thermal modifications from acid mine drainage from an inactive mine.  
 c(500,1000,1400) s(5100,5700)

Ompompanoosuc River: 2.4 - Sawnee Bean Bridge in Thetford to ACOE swimming area - partial support of contact recreation due to pathogens from unknown sources. c(1700) s(9000)

Ompompanoosuc River: 13.5 (overlaps with the miles in partial support above and threatened below) - from old Route 113 alignment just over a mile above Brimstone Corners to confluence with West Branch - partial support of non-contact recreation (fishery) for reasons yet unknown.

**Ompompanoosuc River**  
**THREATENED MILES**

VT14-03

Ompompanoosuc River: 6.0 - from Post Mills to confluence with West Branch - threats to aquatic biota/habitat, water clarity, and contact rec.(swimming) from metals, sedimentation, turbidity, and pathogens due to mine drainage from an inactive mine, landfill leachate, agricultural land use, and land development. c(500,1100,1700) s(1000,3200,5100,5700,6300)

Ompompanoosuc River: 5.0 - from West Fairlee Village to Sawnee Bean Bridge in Thetford (overlaps with miles above) - threats to contact recreation due to pathogens from unknown sources. c(1700) s(9000)

**COMMENTS**

The macroinvertebrate community sampled in 1997 below Ely Mine (milepoint 1.4) is assessed as poor. Substrate impairment and toxic metals are affecting the health and integrity of the community. At milepoint 1.5, also sampled in 1997, the community is excellent although a lot of sand and sediment were noted in pools and backwater areas.

**INFORMATION SOURCES**

Mark Rosenthal, US Army Corps of Engineers - noted low reproduction capacity of fish due to metals and acidity, some sedimentation caused by logging and agriculture. (1988)

John Claussen, Vt Dept of Fish & Wildlife - noted a less severe condition below Ely Mine vs. Elizabeth Mine but impairment none the less. (1988)

Steve Fiske, Vt.DEC Ambient Biomonitoring Network - data on the macroinvertebrate community below Ely Mine.

Union Village Dam Water Quality Evaluation, US Army Corps of Engineers, January 1983 - notes temperature increase and iron precipitates to Ompompanoosuc above Post Mills. (1988)

VT DEC Waste Management Division - potential threat below Post Mills from the Upper Valley Regional Landfill - volatile organics have been found in private well samples downgradient of the landfill.

Rich Kirn, Vt Dept of Fish & Wildlife - memorandum to Cathy Kashanski re; Ompompanoosuc River fish populations dated November 12, 1998.

Kathryn Patch, ANR Environmental Enforcement Division - memorandum and accompanying E. coli data re: U.S. Army Corps of Engineers Recreational Swim Area (Sandy Beach) - Union Village Dam, Town Thetford: Elevated Bacteria Levels, September 22, 1998

Annual Water Quality Reports for FY95, FY96, FY97, U.S. Army Corps of Engineers - discussed above standard E. coli results from their Union Village Dam Sandy Beach sampling.

| Use No. | Use Description          | Fully | Threat | Partial Support | Non Support | Not Assessed |
|---------|--------------------------|-------|--------|-----------------|-------------|--------------|
| 01      | Overall                  | 17.6  | 0.0    | 13.5            | 1.4         | 0.0          |
| 20      | Aquatic biota            | 23.6  | 6.0    | 1.5             | 1.4         | 0.0          |
| 21      | Fish consumption         | 0.0   | 0.0    | 0.0             | 0.0         | 32.5         |
| 42      | Contact recreation       | 21.3  | 5.0    | 4.8             | 1.4         | 0.0          |
| 44      | Noncontact recreation    | 17.6  | 0.0    | 13.5            | 1.4         | 0.0          |
| 50      | Drinking water supply    | 29.6  | 0.0    | 1.5             | 1.4         | 0.0          |
| 62      | Aesthetics               | 25.1  | 6.0    | 0.0             | 1.4         | 0.0          |
| 72      | Agriculture water supply | 29.6  | 0.0    | 1.5             | 1.4         | 0.0          |
| 82      | Industry water supply    | 0.0   | 0.0    | 0.0             | 0.0         | 32.5         |

| Impairment Cause            | Magnitude | Size (mi.) |
|-----------------------------|-----------|------------|
| Cause unknown               | M         | 13.50      |
| Metals                      | H         | 2.90       |
| Metals                      | T         | 6.00       |
| pH                          | H         | 2.90       |
| Siltation                   | T         | 6.00       |
| Organic enrichment/Low D.O. | S         | 1.40       |
| Thermal modifications       | S         | 2.90       |

**Ompompanoosuc River****VT14-03**

|           |   |      |
|-----------|---|------|
| Pathogens | S | 4.80 |
| Pathogens | T | 7.50 |

| <b>Impairment Source</b> | <b>Magnitude</b> | <b>Size (mi.)</b> |
|--------------------------|------------------|-------------------|
| Agriculture              | T                | 6.00              |
| Land development         | T                | 6.00              |
| Surface mining           | H                | 2.90              |
| Surface mining           | T                | 6.00              |
| Mine tailings            | H                | 2.90              |
| Mine tailings            | T                | 6.00              |
| Landfills                | T                | 1.00              |
| Unknown source           | M                | 13.50             |

**Point Source Description****NPDES No.**

none

**Nonpoint Source Name****Description**

|                    |                                 |
|--------------------|---------------------------------|
| Ely Mine           | Mine Runoff - High Priority/SWI |
| Upper Val landfill | Landfill -                      |



**Lower Waits River  
Assessment Report**

**Waterbody No:** VT14-04**Basin:** 14-Waits**River Length (mi.):** 16.3**Classification:****Description:** Mouth to confluence with South Branch and tributaries

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**Location Identifiers**

**County:** Orange**NRCS District:** 10**ANR Enforcement District:** 3A**Regional Planning Commission:** WO**Fish and Wildlife District:** 3

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**Assessment Information**

**Assessment Date:** 1998**Assessment Types****Date Last Updated:** 11/23/1998

Surveys of fish and game biologists or other professionals

**Assessment Category:** M

Fixed station chemical/physical monitoring-conventional and toxic p

**Water Quality Limited?**

Biological Monitoring

**On 303(d) List?** N**Monitored for Toxics?** N**Aquatic Contamination****Toxics Testing****Waste Management Zone - Miles:** **Description:****Assessment Comments****NON-SUPPORT MILES**

Waits River: 0.3 - from dam to powerhouse - non-support of all uses due to no flow. c(1500), s(7410)

**PARTIAL SUPPORT MILES**

Waits River: 6.2 - from South Branch confluence to mouth (overlaps with 6.2 miles in threats and the 0.5 miles below) - partial support of fishery due to thermal modifications and physical habitat limitations from loss of riparian vegetation and flood 'repair' work. c(1400,1600) s(7100,7600)

Waits River: 0.5 - below powerhouse to Ct River confluence - partial support of contact recreation due to pathogens of unknown sources. c(1700) s(9000)

**THREATENED MILES**

Waits River: 6.2 - from South Branch confluence to mouth (overlaps with 6.2 miles as well as 0.5 miles in partial support above) - threats to aquatic biota/habitat and aesthetics due to thermal modifications, sedimentation and physical habitat alterations from loss of riparian vegetation, flooding and flood repair work. c(1100,1400,1600) s(7100,7600)

**COMMENTS**

Tributaries to this stretch and the stretch of the Waits River itself were hard hit by the heavy rains and

**Lower Waits River****VT14-04**

flooding of June 27, 1998. It was possibly a 500 year flood event on the tributaries. Deltas of sand and silt were seen at the mouths of the tributaries in mid-July 1998.

Temperatures taken instream on July 15, 1998 were 76 F (where Route 25B bridge crosses), 74 F (at the first Route 25 crossing over the river going upstream), and 70 F (upstream of the South Branch confluence). The Route 25B locations was measured again on August 5, 1998 at 76 F.

Information from the Vt Department of Fish & Wildlife, which has done trout population surveys of the Waits river mainstem since 1990, shows that from about one mile below West Topsham to the mouth there is low wild trout abundance. Temperature "appears to be an important factor limiting trout production in the Waits River below West Topsham". Data from 1955 and again from 1977 showed summer temperatures up in the 80's (F) for periods of the day.

**INFORMATION SOURCES**

Jeff Cueto, Vt. DEC Water Quality Division - hydropower impacts

Steve Fiske, Vt. DEC Ambient Biomonitoring Network - Waits River sampling site 2.6 miles up from mouth had a "good" community assessment rating for macroinvertebrates in 1992, 1993 and 1996.

NH DES Ambient Monitoring Program - 1992 & 1993 E. coli data showed 3/4 and 3/3 violations of standard.

Barry Cahoon, Vt DEC Water Quality Division - information on date and frequency of flooding on Waits River. (1998)

Cathy Kashanski, Vt DEC Water Quality Division - field observations of the Waits River and temperature measurements. (1998)

Rich Kirm, Vt Dept of Fish & Wildlife - memorandum to Cathy Kashanski, Water Quality Division dated October 12, 1998 - data and discussion on mainstem fish populations.

Waits River, Orange County, F-12-R-14, John Claussen, Vt Dept of Fish & Wildlife, 1981 - a report on fish population surveys done in 1977 and comparing results to data from 1955.

| Use No. | Use Description          | Fully | Threat | Partial Support | Non Support | Not Assessed |
|---------|--------------------------|-------|--------|-----------------|-------------|--------------|
| 01      | Overall                  | 9.8   | 0.0    | 6.2             | 0.3         | 0.0          |
| 20      | Aquatic biota            | 9.8   | 6.2    | 0.0             | 0.3         | 0.0          |
| 21      | Fish consumption         | 16.3  | 0.0    | 0.0             | 0.0         | 0.0          |
| 42      | Contact recreation       | 15.5  | 0.0    | 0.5             | 0.3         | 0.0          |
| 44      | Noncontact recreation    | 9.8   | 0.0    | 6.2             | 0.3         | 0.0          |
| 50      | Drinking water supply    | 16.0  | 0.0    | 0.0             | 0.3         | 0.0          |
| 62      | Aesthetics               | 9.8   | 6.2    | 0.0             | 0.3         | 0.0          |
| 72      | Agriculture water supply | 0.0   | 0.0    | 0.0             | 0.3         | 16.0         |
| 82      | Industry water supply    | 0.0   | 0.0    | 0.0             | 0.3         | 16.0         |

| Impairment Cause          | Magnitude | Size (mi.) |
|---------------------------|-----------|------------|
| Siltation                 | T         | 6.20       |
| Thermal modifications     | M         | 6.20       |
| Flow alterations          | H         | 0.30       |
| Other habitat alterations | M         | 6.20       |
| Pathogens                 | M         | 0.50       |

| Impairment Source              | Magnitude | Size (mi.) |
|--------------------------------|-----------|------------|
| Channelization                 | M         | 6.20       |
| Flow mod. - hydroelectric      | H         | 0.30       |
| Removal of riparian vegetation | M         | 6.20       |
| Unknown source                 | M         | 0.50       |

**Lower Waits River****VT14-04****Point Source Description****NPDES No.**

Bradford WWTF 0.137mgd

VT0100803

**Nonpoint Source Name****Description**

Bradford Hydro

Hydropower Dam - Priv - R-O-R/Min Flows

## Upper Waits River Assessment Report

Waterbody No: VT14-05

Basin: 14-Waits

River Length (mi.): 45.5

Classification:

Description: Confluence of South Branch to headwaters and tributaries including Tabor Branch and Pike Hill Brook

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### Location Identifiers

County: Orange

NRCS District: 10

ANR Enforcement District: 3A

Regional Planning Commission: WO

Fish and Wildlife District: 3

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### Assessment Information

Assessment Date: 1998

#### Assessment Types

Date Last Updated: 11/23/1998

Surveys of fish and game biologists or other professionals

Assessment Category: M

RBP III or equivalent benthos surveys

Water Quality Limited?

Fish surveys

On 303(d) List? Y

Monitored for Toxics? N

Aquatic Contamination

Toxics Testing

Waste Management Zone - Miles: Description:

### Assessment Comments

#### NON-SUPPORT AND PARTIAL SUPPORT MILES

Pike Hill Brook: 3.0 - mouth upstream to abandoned copper mine - non-support up by milepoint 2.6 and partial support down by milepoint 1.4 of aquatic biota and aesthetics due to metals and acidity from an inactive copper mine and tailings runoff (threats to any water supplies). c(500,1000) s(5100,5700)

Waits River: 9.0 - from South Branch confluence upstream to approximately a mile below West Topsham (also see wb 14-04) - partial support of fishery due to thermal modifications and physical habitat limitations from loss of riparian vegetation and wide, shallow channel. c(1400,1600) s(7600)

#### THREATENED MILES

Unnamed Trib to Waits River: 0.1 - from pasture/barnyard area to junction with Waits River (this tributary is upstream of Waits River Valley school and on north side of the river) - threats to aquatic biota and aesthetics due to pathogens, nutrients and temperature from cows in river and no streamside vegetation. c(900,1700), s(1000)

Unnamed tributary to Waits River: 0.2 - from landfill down to confluence with Waits - threats to aquatic biota, fishery, drinking and agricultural water supplies, contact recreation and aesthetics due to iron, other metals and toluene from landfill leachate. (0.2 arbitrarily chosen) c(300,500) s(6300)

Tabor Branch: 3.0 - threats to aquatic biota/habitat, fishery, and aesthetics due to at least thermal

**Upper Waits River****VT14-05**

modifications from loss of riparian vegetation and the encroachment of yards and residential activity up to the streambank. c(1400) s(3200,7600)

**INFORMATION SOURCES**

Waits River Water Quality Management Plan, Vt DEC May, 1976 - identifies Pike Hill Mine and acid drainage, although much smaller scale than Ely or Elizabeth Mines.

Rich Kirn, Vt Dept of Fish & Wildlife - memorandum to Cathy Kashanski, Vt DEC Water Quality Division date October 12, 1998 - data and discussion on Waits River mainstem fish populations.

Waits River, Orange County, F-12-R-14, John Claussen, Vt Dept of Fish & Wildlife, 1981 - report on fish population surveys done in 1977 comparing results to data from 1955.

Steve Fiske, Vt DEC Water Quality Division - ambient biomonitoring data and analysis from 1997 sampling on Pike Hill Brook and a tributary.

| Use No. | Use Description          | Fully | Threat | Partial Support | Non Support | Not Assessed |
|---------|--------------------------|-------|--------|-----------------|-------------|--------------|
| 01      | Overall                  | 30.2  | 3.3    | 10.5            | 1.5         | 0.0          |
| 20      | Aquatic biota            | 39.2  | 3.3    | 1.5             | 1.5         | 0.0          |
| 21      | Fish consumption         | 42.5  | 0.0    | 0.0             | 0.0         | 3.0          |
| 42      | Contact recreation       | 45.5  | 0.0    | 0.0             | 0.0         | 0.0          |
| 44      | Noncontact recreation    | 36.5  | 0.0    | 9.0             | 0.0         | 0.0          |
| 50      | Drinking water supply    | 42.5  | 3.0    | 0.0             | 0.0         | 0.0          |
| 62      | Aesthetics               | 39.2  | 3.3    | 1.5             | 1.5         | 0.0          |
| 72      | Agriculture water supply | 42.3  | 3.2    | 0.0             | 0.0         | 0.0          |
| 82      | Industry water supply    | 0.0   | 0.0    | 0.0             | 0.0         | 45.5         |

| Impairment Cause          | Magnitude | Size (mi.) |
|---------------------------|-----------|------------|
| Priority organics         | T         | 0.20       |
| Metals                    | H         | 3.00       |
| Metals                    | T         | 0.20       |
| Nutrients                 | T         | 0.10       |
| pH                        | H         | 3.00       |
| Thermal modifications     | M         | 9.00       |
| Thermal modifications     | T         | 3.00       |
| Other habitat alterations | M         | 9.00       |
| Pathogens                 | T         | 0.10       |

| Impairment Source              | Magnitude | Size (mi.) |
|--------------------------------|-----------|------------|
| Agriculture                    | T         | 0.10       |
| Land development               | T         | 3.00       |
| Surface mining                 | H         | 3.00       |
| Mine tailings                  | H         | 3.00       |
| Landfills                      | T         | 0.20       |
| Removal of riparian vegetation | M         | 9.00       |
| Removal of riparian vegetation | T         | 3.00       |

| Point Source Description          | NPDES No. |
|-----------------------------------|-----------|
| Residential subdivision - Topsham | 1-0913    |

| Nonpoint Source Name | Description                          |
|----------------------|--------------------------------------|
| Pike Hill Mine       | Mine Runoff - to Pike Hill Brook +   |
| Hayward Landfill     | Landfill leachate - to unnamed trib. |

**South Branch Waits River  
Assessment Report**

Waterbody No: VT14-06

Basin: 14-Waits

River Length (mi.): 27

Classification:

Description: Mouth to headwaters and tributaries including Cookville Brook

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**Location Identifiers**

County: Orange

NRCS District: 10

ANR Enforcement District: 3A

Regional Planning Commission: WO

Fish and Wildlife District: 3

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**Assessment Information**

Assessment Date: 1998

**Assessment Types**

Date Last Updated: 11/30/1998

Surveys of fish and game biologists or other professionals

Assessment Category: E

Occurrence of conditions judged to cause impairment

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination

Toxics Testing

**Waste Management Zone - Miles:****Description:****Assessment Comments****THREATENED MILES**

Cookville Brook: 1.0 - from junction with Meadow Brook upstream - threats to aquatic biota/habitat and fishery from sedimentation and nutrients due to erosion at least in part from road maintenance and runoff and potentially agricultural land runoff. c(900,1100) s(1000,4500)

South Branch Waits River: 2.0 - from junction of Cookville and Meadow Brooks downstream - threats to aquatic biota, non-contact recreation and aesthetics due to temperature modifications from loss of riparian vegetation. c(1400) s(7600)

**COMMENTS**

Cookville Brook: On August 5, 1998 four different locations on Cookville Brook were observed. The same threat that John Claussen had noted in past assessments was obvious and the sediments are at least in part due to road maintenance practices and road runoff in several places. There are also threats from nutrients as fairly thick algae was seen on the rocks in the stretch described above. Agricultural land adjacent to the brook or a large wetland complex upstream on a tributary are possible sources.

At three of the four locations visited, temperature was measured with a handheld thermometer. Temperatures were as follows: 66 F at the point where the road out of West Corinth crosses the brook; 66 F where the road from West Corinth to Goose Green crosses the brook; and 68 F where the road in Goose Green crosses the brook (just above Cookville's junction with Meadow Brook).

## Lower Wells River Assessment Report

**Waterbody No:** VT14-07 **Basin:** 14-Wells  
**River Length (mi.):** 55.5 **Classification:**  
**Description:** Mouth to confluence of Ricker Pond drainage and tributaries including East and Keenan Brooks

### Location Identifiers

|                                    |        |                                      |    |
|------------------------------------|--------|--------------------------------------|----|
| <b>County:</b> Caledonia           | Orange | <b>NRCS District:</b>                | 11 |
| <b>ANR Enforcement District:</b>   | 7      | <b>Regional Planning Commission:</b> | NE |
| <b>Fish and Wildlife District:</b> | 5      |                                      |    |

### Assessment Information

|                                     |   |
|-------------------------------------|---|
| <b>Assessment Date:</b> 1998        | <b>Assessment Types</b>   |
| <b>Date Last Updated:</b> 12/7/1998 | Surveys of fish and game biologists or other professionals          |
| <b>Assessment Category:</b> E       | Fixed station chemical/physical monitoring-conventional and toxic p |
| <b>Water Quality Limited?</b>       | Biological Monitoring   |
| <b>On 303(d) List?</b> N            |   |
| <b>Monitored for Toxics?</b> N      |   |
| <b>Aquatic Contamination</b>        | <b>Toxics Testing</b>   |
| None detected                       |   |

**Waste Management Zone - Miles:**      **Description:**

#### Assessment Comments

##### PARTIAL SUPPORT MILES

Wells River: 0.2 - partial support of aquatic habitat and non-contact recreation due to lows flows in the bypass reach below Boltonsville hydro. c(1500) s(7410)

Wells River: 1.0 - from mouth up to Newbury Hydro dam - partial support of fish consumption due to mercury contamination from atmospheric deposition c(500) s(8100)

##### THREATENED MILES

Wells River: 10.0 - from Groton to Wells River - threats to aquatic biota/habitat, aesthetics, and non-contact recreation due to siltation/sedimentation, iron, some nutrients, other metals and organics from a large gravel pit, unlined landfill, loss of vegetation in areas where yards and pasture encroach on riparian zone, road and bridge runoff and maintenance. c(500,900,1100) s(4500,5100,6300,7700)

#### COMMENTS

USGS sampled the streambed sediments of the Wells River in the town of Wells River in September 1993. The sediments were sampled for numerous inorganic constituents, organic carbon, and numerous chlorinated organic constituents. Of the six inorganic constituents (chromium, copper, lead, mercury, nickel, zinc) for which a probable effects level (PEL) and threshold effect level (TEL) was given, none exceeded the

**Lower Wells River****VT14-07**

PEL in the sediments at Wells River. However, chromium, lead, nickel and zinc exceed the TEL at this site. The probable effects level is the "concentration above which adverse biological effects are observed frequently" and the threshold effects level is the "concentration below which adverse biological effects are observed rarely."

In August, 1993, a stretch of the Wells River below the Newbury landfill was surveyed by two DEC personnel (one from the Water Quality Division and one from the Waste Management Division). The first area of impact observed was a seep about 400 meters below the Boltonville Dam and Road on a braid of the Wells River. In this area, the cobble river bottom is coated with orange floc and iron bacteria/fungus. From the point where the braid joins the main part of the channel down about 350 meters, there were the following observations: oily, orange seeps, orange-stained shoreline sand and instream substrate, iron bacteria/fungus growth and very high conductivity in some slow water areas.

Six sites were sampled for macroinvertebrate community health in this waterbody. Sites on the Wells River included: milepoint 0.6 sampled in 1992, which had a community assessment of good; milepoint 4.4 sampled in 1993 below the Newbury landfill in the area described above, which also had community assessment of good; and milepoint 10.5 sampled in 1997, which had an assessment of excellent.

The other three sites sampled were on East Brook (2 sites) and Keenan Brook (1 site) and were part of an effort by the Agency of Natural Resources Biodiversity Committee and Dept of Fish & Wildlife to characterize the different ecological communities of the Pine Mountain Wildlife Management Area. Both brooks originate in wetland-beaver pond complexes and their upper reaches are low gradient, sand/silt dominated systems. The lower reaches are higher gradient and the substrate is dominated by boulder, cobble and gravel. "Keenan Brook's biological integrity is fair to good with a very low overall density..." The educated guess is that habitat quality is limiting the streams' productivity and perhaps the dense softwood canopy is limiting primary productivity (algae growth) and leaf litter input. The lower East Brook site is also fair to good with low levels of enrichment and a high amount of sand embedding the substrate perhaps resulting in the low EPT value indicated. The upper East Brook community assessment is excellent. The fish community consisted only of brook trout. A good description of the findings is in the Pine Mountain reference below.

**INFORMATION SOURCES**

Jeff Cueto, Vt DEC Water Quality Division - information on two hydro facilities

Steve Fiske, Vt DEC Water Quality Division Biomonitoring and Aquatic Studies Section - data and analysis on macroinvertebrate communities from Wells River, Keenan Brook, East Brook.

Vt. Dept. of Health, Toxicology and Risk Assessment Program, June 1995 - issued a fish consumption advisory due to mercury contamination including no consumption of walleye for children age 6 and under and pregnant women and no more than one meal per month for all others.

Geographical Distribution and Potential for Adverse Biological Effects of Selected Trace Elements and Organic Compounds in Streambed Sediment in the Connecticut, Housatonic, and Thames River Basins, 1992-94, U.S. Geological Survey Water Resources Investigations Report 97-4169.

Inorganic and Organic Constituents and Grain-Size Distribution in Streambed Sediment and Ancillary Data for the Connecticut, Housatonic, and Thames River Basins Study Unit, 1992-94, U.S. Geological Survey Open-File Report 96-397.

Rick Levey, Vt DEC Water Quality Division BASS - memorandum for the record re: Wells River Survey dated August 24, 1993.

A biological survey of selected surface waters of Pine Mountain Wildlife Management Area 1998, Vt DEC Water Quality Division Biomonitoring and Aquatic Studies Section.

| Use No. | Use Description       | Fully | Threat | Partial Support | Non Support | Not Assessed |
|---------|-----------------------|-------|--------|-----------------|-------------|--------------|
| 01      | Overall               | 45.5  | 8.8    | 1.2             | 0.0         | 0.0          |
| 20      | Aquatic biota         | 45.5  | 9.8    | 0.2             | 0.0         | 0.0          |
| 21      | Fish consumption      | 54.5  | 0.0    | 1.0             | 0.0         | 0.0          |
| 42      | Contact recreation    | 45.5  | 10.0   | 0.0             | 0.0         | 0.0          |
| 44      | Noncontact recreation | 45.5  | 9.8    | 0.2             | 0.0         | 0.0          |
| 50      | Drinking water supply | 45.5  | 10.0   | 0.0             | 0.0         | 0.0          |
| 62      | Aesthetics            | 45.5  | 10.0   | 0.0             | 0.0         | 0.0          |



| Lower Wells River |                          |     |     |     |     | VT14-07 |
|-------------------|--------------------------|-----|-----|-----|-----|---------|
| 72                | Agriculture water supply | 0.0 | 0.0 | 0.0 | 0.0 | 55.5    |
| 82                | Industry water supply    | 0.0 | 0.0 | 0.0 | 0.0 | 55.5    |

| Impairment Cause | Magnitude | Size (mi.) |
|------------------|-----------|------------|
| Metals           | H         | 1.00       |
| Metals           | T         | 9.00       |
| Nutrients        | T         | 10.00      |
| Siltation        | T         | 10.00      |
| Flow alterations | H         | 0.20       |

| Impairment Source              | Magnitude | Size (mi.) |
|--------------------------------|-----------|------------|
| Agriculture                    | T         | 10.00      |
| Highway/road/bridge runoff     | T         | 10.00      |
| Surface mining                 | T         | 2.00       |
| Landfills                      | T         | 0.20       |
| Flow mod. - hydroelectric      | H         | 0.20       |
| Removal of riparian vegetation | T         | 10.00      |
| Atmospheric deposition         | H         | 1.00       |

| Point Source Description | NPDES No. |
|--------------------------|-----------|
| Ryegate WWTF 0.006mgd    | VT0101206 |

| Nonpoint Source Name | Description                             |
|----------------------|---|
| Blue Mtn Union HS    | Indirect Discharge - Wells R. trib. S/L |
| Wells River Hydro    | Hydropower Dam - Priv - R-O-R/Min Flows |
| Newbury Hydro        | Hydropower Dam - Priv - R-O-R/Min Flows |
| Newbury Landfill     | Unlined landfill                        |

## Upper Wells River Assessment Report

Waterbody No: VT14-08

Basin: 14-Wells

River Length (mi.): 11.5

Classification:

Description: From the confluence with the South Branch Wells River to headwaters and tributaries including the South Branch

### Location Identifiers

County: Caledonia

NRCS District: 11

ANR Enforcement District: 7

Regional Planning Commission: NE

Fish and Wildlife District: 5

### Assessment Information

Assessment Date: 1998

#### Assessment Types

Date Last Updated: 12/14/1998

Assessment Category: E

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination

Toxics Testing

Waste Management Zone - Miles: Description:

### Assessment Comments

#### COMMENTS

Part of the South Branch Wells River and most of the other tributaries to the upper Wells River are in Groton State Forest. The only activities which would be a threat, therefore, are logging and/or recreation. No impacts or threats were observed along the South Branch. There are no other known impacts or threats in this waterbody.

#### INFORMATION SOURCES

Cathy Kashanski, Vt DEC Water Quality Division - saw South Branch Wells River on September 2, 1998.

| Use No. | Use Description       | Fully | Threat | Partial Support | Non Support | Not Assessed |
|---------|-----------------------|-------|--------|-----------------|-------------|--------------|
| 01      | Overall               | 11.5  | 0.0    | 0.0             | 0.0         | 0.0          |
| 20      | Aquatic biota         | 11.5  | 0.0    | 0.0             | 0.0         | 0.0          |
| 21      | Fish consumption      | 11.5  | 0.0    | 0.0             | 0.0         | 0.0          |
| 42      | Contact recreation    | 11.5  | 0.0    | 0.0             | 0.0         | 0.0          |
| 44      | Noncontact recreation | 11.5  | 0.0    | 0.0             | 0.0         | 0.0          |

| Upper Wells River |                          |      |     |     |     | VT14-08 |
|-------------------|--------------------------|------|-----|-----|-----|---------|
| 50                | Drinking water supply    | 11.5 | 0.0 | 0.0 | 0.0 | 0.0     |
| 62                | Aesthetics               | 11.5 | 0.0 | 0.0 | 0.0 | 0.0     |
| 72                | Agriculture water supply | 11.5 | 0.0 | 0.0 | 0.0 | 0.0     |
| 82                | Industry water supply    | 11.5 | 0.0 | 0.0 | 0.0 | 0.0     |

| Point Source Description                | NPDES No. |
|---|-----------|
| AOT Groton Rd & bridge constr-So Branch | 1-0706    |

| Nonpoint Source Name | Description |
|----------------------|-------------|
|                      | none        |

## Stevens River Assessment Report

**Waterbody No:** VT14-09 **Basin:** 14-Stevens  
**River Length (mi.):** 38.2 **Classification:**  
**Description:** Mouth to headwaters and tributaries including Peach Hollow Brook and South Peacham Brook

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### Location Identifiers

**County:** Caledonia **NRCS District:** 11  
**ANR Enforcement District:** 7 **Regional Planning Commission:** NE  
**Fish and Wildlife District:** 5

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### Assessment Information

**Assessment Date:** 1998 **Assessment Types**  
**Date Last Updated:** 12/14/1998 Surveys of fish and game biologists or other professionals  
**Assessment Category:** E  
**Water Quality Limited?**  
**On 303(d) List?** N  
**Monitored for Toxics?** N  
**Aquatic Contamination** **Toxics Testing**  
None detected

**Waste Management Zone - Miles:** **Description:**

### Assessment Comments

#### PARTIAL SUPPORT MILES

Stevens River: 1.0 - below Barnet Hydropower Dam - partial support of recreation, aesthetics, and aquatic biota/habitat due to low and fluctuating flows from McIndoe Reservoir operation. c(1500) s(7410)

#### COMMENTS

The 15 Mile Falls agreement currently in place calls for reducing the fluctuations at McIndoes - however, the terms of the agreement don't go into effect until the license is issued which may be 2001. Currently there are studies underway from which more information about the health of the Stevens River will be determined.

About 200 feet of riverbank just above Barnet hydro dam has been stabilized recently with tree revetments.

#### INFORMATION SOURCES

Jeff Cueto, VT DEC Water Quality Division

Tim McKay, NRCS, St. Johnsbury - information on streambank erosion.

**Stevens River****VT14-09**

| Use No. | Use Description          | Fully | Threat | Partial Support | Non Support | Not Assessed |
|---------|--------------------------|-------|--------|-----------------|-------------|--------------|
| 01      | Overall                  | 37.2  | 0.0    | 1.0             | 0.0         | 0.0          |
| 20      | Aquatic biota            | 37.2  | 0.0    | 1.0             | 0.0         | 0.0          |
| 21      | Fish consumption         | 38.2  | 0.0    | 0.0             | 0.0         | 0.0          |
| 42      | Contact recreation       | 37.2  | 0.0    | 1.0             | 0.0         | 0.0          |
| 44      | Noncontact recreation    | 37.2  | 0.0    | 1.0             | 0.0         | 0.0          |
| 50      | Drinking water supply    | 38.2  | 0.0    | 0.0             | 0.0         | 0.0          |
| 62      | Aesthetics               | 37.2  | 0.0    | 1.0             | 0.0         | 0.0          |
| 72      | Agriculture water supply | 0.0   | 0.0    | 0.0             | 0.0         | 38.2         |
| 82      | Industry water supply    | 0.0   | 0.0    | 0.0             | 0.0         | 38.2         |

| Impairment Cause | Magnitude | Size (mi.) |
|------------------|-----------|------------|
| Flow alterations | H         | 1.00       |

| Impairment Source         | Magnitude | Size (mi.) |
|---------------------------|-----------|------------|
| Flow mod. - hydroelectric | H         | 1.00       |

| Point Source Description | NPDES No. |
|--------------------------|-----------|
| none                     |           |

| Nonpoint Source Name | Description                             |
|----------------------|---|
| Barnet Hydro         | Hydropower Dam - Priv - R-O-R/Min Flows |