Demonstration Report No. 7

The Best River Ever - A conservation plan to protect and restore Vermont's beautiful Mad River Watershed

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and
Friends of the Mad River

for
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This demonstration report is the seventh in a series of reports prepared under the Lake Champlain Basin Program. Those in print are listed below.

Lake Champlain Basin Program Demonstration Reports

1. *Case Study of the Town of Champlain.* Yellow Wood Associates. October 1993.

2. *(A) Demonstration of Local Economic/Other Community Impacts.* Community Case Studies for Economic Plan Elements. The City of Vergennes, Vermont. Economic and Financial Consulting Associates, Inc. October 1993.

   (B) Demonstration of Local Economic/Other Community Impacts. Community Case Studies for Economic Plan Elements. Appendix. The City of Vergennes, Vermont. Economic and Financial Consulting Associates, Inc. October 1993.

3. *The Archeology on the Farm Project.* Improving Cultural Resource Protection on Agricultural Lands: A Vermont Example. Jack Rossen. May 1994.

4. (A) *The 1992 Fort Ticonderoga-Mount Independence Submerged Cultural Resource Survey. Executive Summary.* Arthur Cohn. May 1995.

   (B) *The 1992 Fort Ticonderoga-Mount Independence Submerged Cultural Resource Survey.* Arthur Cohn. May 1995.

   (C) *The Great Bridge "From Ticonderoga to Independant Point".* Arthur Cohn. May 1995.

   (D) *Geophysical Reconnaissance in the Mount Independence Area: Larrabee's Point to Chipman Point.* Patricia Manley, Roger Flood, Todd Hannahs. May 1995.

   (E) *Ticonderoga's Floating Drawbridge; 1871-1920.* Peter Barranco, Jr. May 1995.

   (F) *Bottom Morphology and Boundary Currents of Southern Lake Champlain.* Hollistir Hodson. May 1995.

5. *Implementation, Demonstration, and Evaluation of BMPs for Water Quality: Application Methods ("Manure Injections") for Improved Management of Manure Nutrients.* Bill Jokela, Sid Bosworth and Don Meals. September 1995.

6. (A) *Malletts Bay Recreation Resource Management Plan.* T.J. Boyle and Associates, Resource Systems Group, Associates in Rural Development and Engineering Ventures. October 1995.

   (B) *Malletts Bay Recreation Resource Management Plan. Executive Summary.* T.J. Boyle and Associates. October 1995.

   (C) *Review and Relevant Studies. Malletts Bay Recreation Resource Management Plan.* T.J. Boyle and Associates. October 1995.

   (D) *Natural and Built Resources Inventory: Data Documentation. Malletts Bay Recreation Resource Management Plan.* Associates in Rural Development. October 1995. **This report will not be published but data is available at the LCBP office.**

   (E) *Survey Implementation and Analysis. Malletts Bay Recreation Resource Management Plan.* Resource Systems Group. October 1995.

(F) *Institutional Review and Analysis. Malletts Bay Recreation Resource Management Plan.* Engineering Ventures. October 1995.

7. *The Best River Ever. A conservation plan to protect and restore Vermont's beautiful Mad River Watershed.* Mad River Planning District and Friends of the Mad River. December 1995.

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The Best River Ever

A conservation plan to protect and restore
Vermont's beautiful Mad River Watershed

1995
Mad River Valley Planning District
PO Box 471, Waitsfield, Vermont 05673

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Contents

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Appendices

Acknowledgments

The Valley Reporter

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to the many others who contributed ideas, talent, time, effort, and materials to make this plan possible.

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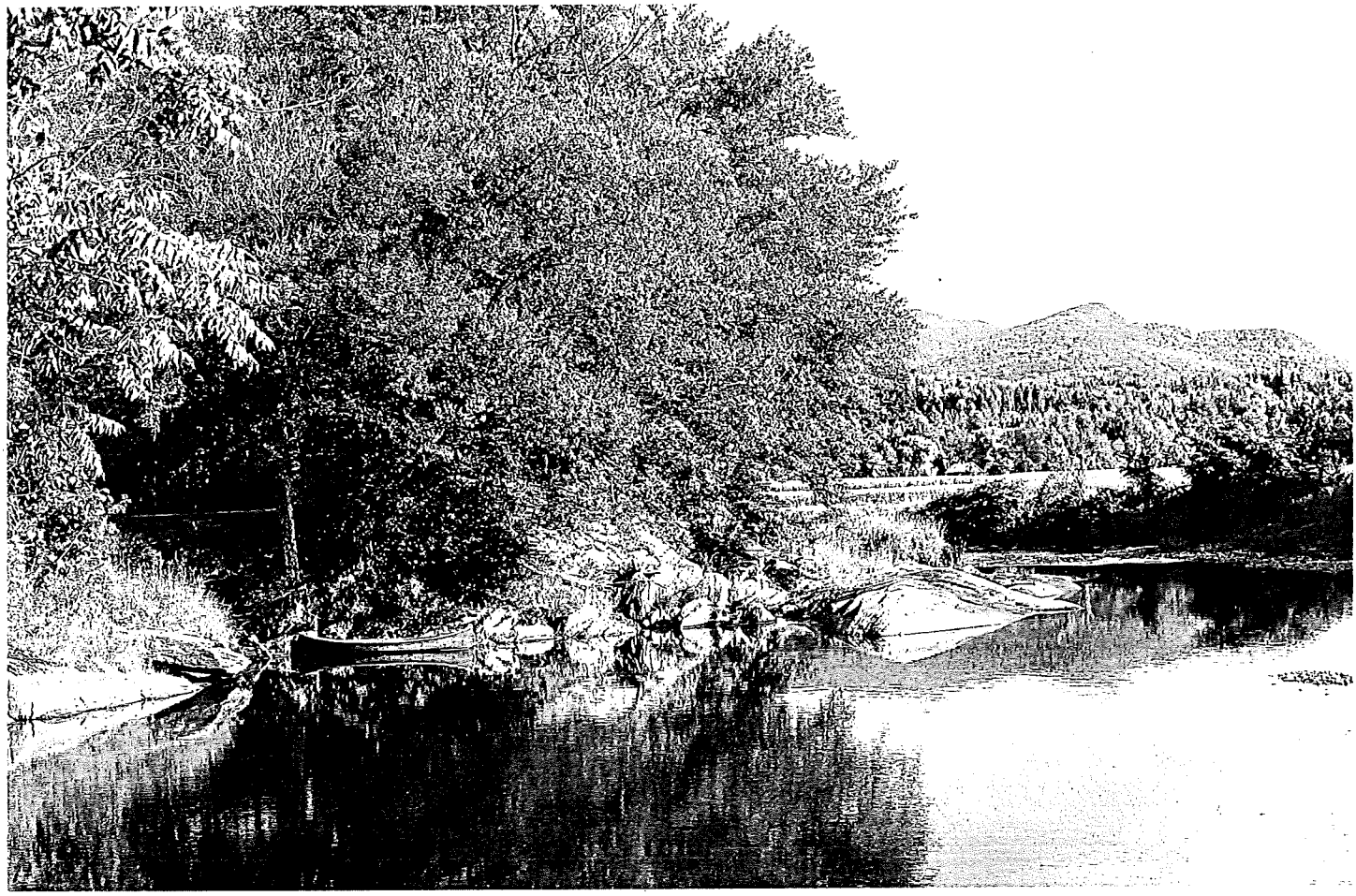
Foreword



Dana Jinkins

Foreword

Rising high in Vermont's Green Mountains, the Mad River gathers its strength and temperament from deep forests and clear mountain streams. Ranging from secluded swimming hole to raging gorge, from wilderness trout stream to industrial power source, the Mad is a remarkable river with a diversity and complexity rarely found in rivers many times its size.

From its calm headwaters in the Granville Gulf to its confluence with the Winooski River 26 miles to the north, the Mad River and its tributaries bind together the towns of Duxbury, Fayston, Moretown, Waitsfield, and Warren and provide a link to their common heritage.

Encompassing a diverse community of farms, forests, and villages, the entire Mad River Valley serves as the ultimate expression of this River's remarkable character. The Mad River's role in shaping the valley's landscape is obvious. Equally profound is its subtle influence on the spirit and emotions of the valley's 5,800 inhabitants. This influence is reflected in the history of our community and can be heard in the voices of our neighbors.

This conservation plan was developed to protect and restore Vermont's beautiful Mad River Watershed. Section I of *The Best River Ever* presents a Summary of residents' visions of a better river, conditions in the watershed, and some of the priority recommendations to protect and restore it.

Section II, the Introduction, explains the project's background, and explains how the plan's recommendations will be implemented.

Section III, The watershed today, describes the watershed and its resources, and outlines major problems, threats, and issues.

Section IV advances Recommendations to prevent and solve problems.

Section V pulls all the threads together in a Conclusion.

The appendices provide valuable background information. Appendix A provides ideas for a vision of the watershed put forth at the Moretown, Waitsfield, and Warren River Forums.

Appendix B groups the 19 topic papers that describe the various factors that affect the welfare of the watershed, and are the sources of the 112 recommendations.

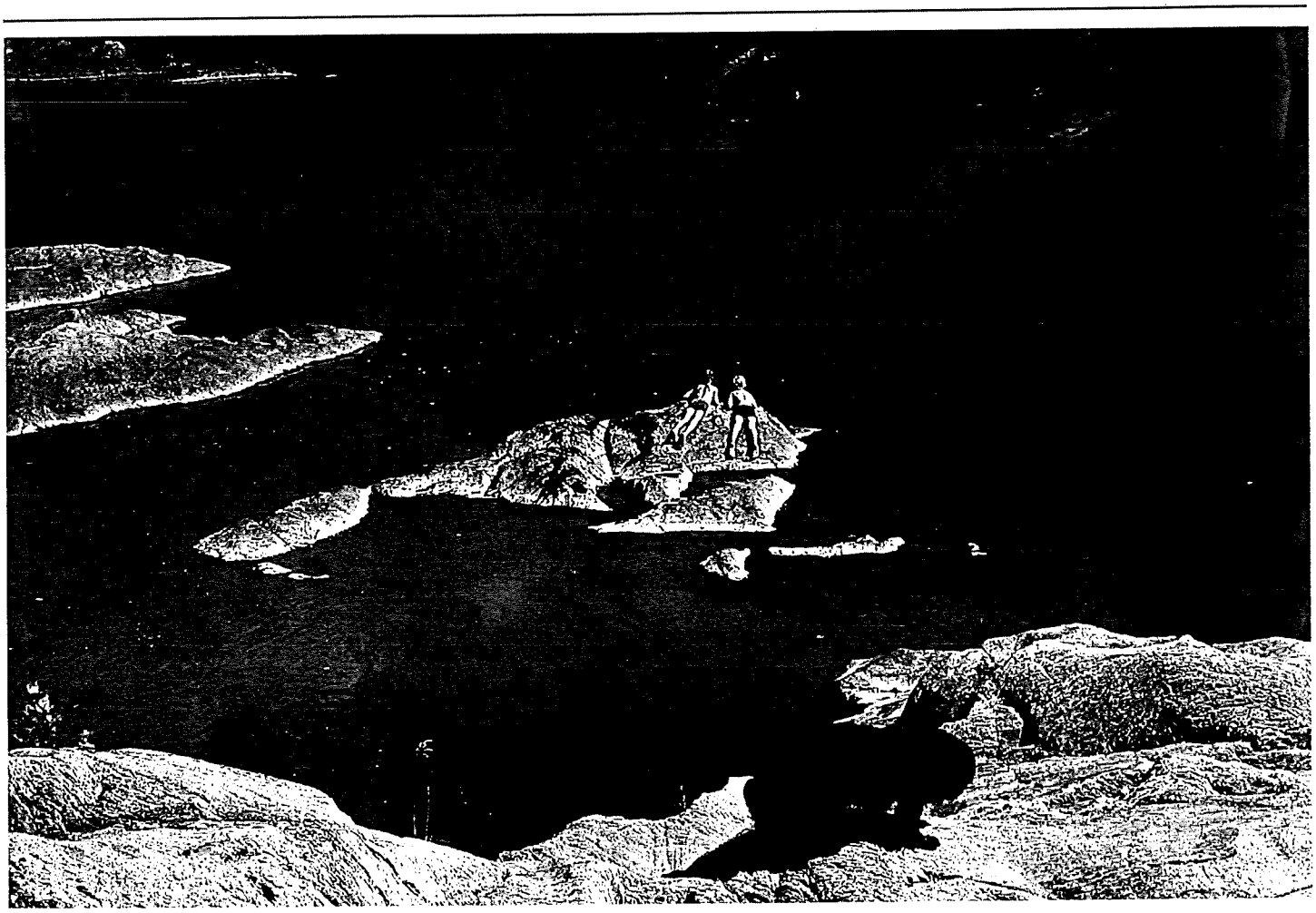
Appendix C describes the activities and needs of watershed associations, and how they involve people.

Appendix D explains the plan's preparation.

Watershed maps are grouped in Appendix E.

Finally, Appendix F details comments and suggestions about the plan received in letters and at public meetings, and how these issues have been addressed.

I. Summary



Ann Day

I. Summary

A. A vision of a better Mad River

Imagine the Mad River as the best river ever. How do you see it? What would it look like? How would it be used? What would it take to realize your vision?

Over 100 people who attended three public meetings (River Forums) in the spring of 1994 expressed their ideas about the Mad River as the best river ever.

The outcome was a vision of a river that is ecologically healthy, beautiful, and widely enjoyed for its diverse benefits. The qualities envisioned for the best river ever were:

- a very healthy river with water quality so high its waters would be drinkable without treatment; a river and tributaries that maintain stable stream banks, healthy ecosystems, and good fishing;
- a natural, free flowing river of scenic beauty with tree-lined stream banks, providing good wildlife habitat, deep pools, and limited development along banks that offer privacy and seclusion; and
- a river that is accessible for many uses including swimming, boating, walking to view scenery and wildlife, limited hydroelectric power generation and gravel harvesting, and snowmaking.

The people attending the river forums recognized that there are inherent conflicts when the river is used in diverse ways, and that conflicts increase as uses increase.

Strategies were suggested to attain their visions of the best river ever. Among the recurring themes were suggestions that we should:

- educate ourselves and become more aware of the river—how it works, and how it can be protected;
- protect the river by controlling activities that cause runoff, erosion, and pollution by providing incentives for good farming and forestry practices, and by planning for and managing the watershed to improve the river and the quality of its water;
- provide better access to the river so that it can be enjoyed more widely to benefit the community and economy through tourism;
- develop a respect and appreciation for the river and for those landowners who take care of the river and allow us access to the river for our enjoyment;
- restore and enhance the river to improve its fishing, scenic beauty, wild character, safety for swimming, and habitat for fish and wildlife; and
- organize public events that would foster enjoyment and appreciation of the river and help to fund its management.

Strategies to attain these visions of the best river ever are the main subjects of this Mad River conservation plan.

B. What is the situation?

After a yearlong effort, we are able to identify with confidence problems in the watershed and threats to the river.

We know that the upland reaches of the Mad River and its tributaries are healthy and in relatively good condition except where development is intense. There is generally good stream bank cover in these upland reaches. Water temperatures are cool, coliform violations are few, and stream embeddedness from sedimentation is rare. The benefits are good fishing of healthy, wild populations of brook and rainbow trout; and safe swimming in many lovely pools.

There are problems in the lower reaches of the Mad River below Warren, through Waitsfield and Moretown, to the confluence with the Winooski River. In these areas:

- stream banks have little cover from trees and shrubs, and the banks have been riprapped for stabilization without making provisions for fish habitat;
- agricultural land is worked close to the river, and much of the river has inadequately vegetated buffer strips;
- water temperatures are much higher than in the upper reaches of the watershed, and sampling has revealed contamination from failing on-site sewage systems.

These factors translate into poor fishing and the need for the Vermont Fish and Wildlife Department to stock the river.

Although the Mad River is considered to be one of the state's best rivers for swimming, we know its health is threatened. Swimming in the lower reaches of the river is not as safe as in most upland areas.

C. Priority recommendations

There are many actions that can be taken to protect the River's outstanding assets and to restore those that have been degraded. Recommendations to achieve these worthwhile goals are presented in Section IV of the Plan, where they are arranged in seven categories of actions that would help solve the problems that are detracting from the Mad River:

A. monitor the health of the river;

B. develop education programs to foster awareness;

C. control erosion and sedimentation;

D. revegetate stream banks, and protect aquatic habitat;

E. improve and protect water quality;

F. improve access and recreational opportunities;

G. promote planning efforts and necessary legislation.

Following are some of the priority recommendations grouped according to those who would be mainly responsible for executing them—individuals, towns, and the state government, for example.

Priority recommendations for individuals

- Become an active member of Friends of the Mad River.
- Support the Mad River Watch Program.
- Observe and document river changes.
- Join the Adopt-a-River Program.

Priority recommendations for business

- Consider and plan for cumulative effects of activities in the watershed.
- Implement the Sugarbush fish habitat restoration plan.

C. Priority recommendations—continued

Priority recommendations for Friends of the Mad River

- Organize an "adopt a river" program to assist landowners who are implementing river conservation practices.
- Start a nursery to cultivate native stream bank shrub and tree species, and make them available to revegetate barren stream banks.

Priority recommendations for non-profit volunteer groups

- In planning for, building, and maintaining the river path, the Mad River Path Association, in cooperation with towns and landowners, should fully address stream bank buffer strips, stability, revegetation, stream crossings, erosion control, monitoring, and educational opportunities.
- The Mad River Watch Program should establish macroinvertebrate sampling stations at key locations in the watershed.
- The Mad River Watch Program should establish a training program to teach landowners and those involved in the Adopt-a-River Program how to conduct their own stream inventories to assess river conditions.

Priority recommendations for towns

- Revise town plans, zoning ordinances, and subdivision regulations to provide adequate stream buffer strips to protect existing swimming holes, to address stormwater runoff, and any erosion and sedimentation issues.
- Adopt sewage or health ordinances that incorporate adequate minimum standards for siting and construction of on-site sewage systems.
- Review the administration of sewage requirements to ensure there is adequate oversight of designers and contractors; and if needed, utilize part-time professionals, or train town health officers or zoning administrators.
- Develop a capital budget to provide for acquisition of high-priority access areas on the Mad River and its tributaries, and for recreation easements when such lands are offered for sale.

Priority recommendations for schools

- Develop a comprehensive and integrated river curriculum, and implement it at all grade levels using existing resources and materials, as well as new materials.
- Foster an appreciation and understanding of the ecosystem of the Mad River and its watershed.

Priority recommendations for the Mad River Valley Planning District

- Implement a formal arrangement to include the towns of Duxbury and Moretown in any District deliberations relating to the protection of and impacts on the Mad River.
- Develop a valley-wide (five town) approach to administering sewage disposal requirements to lessen costs and improve effectiveness.

Priority recommendations for the state

- The Vermont Legislature should enact a forestry practices act, along with the necessary tax reforms to ensure a sustainable forestry resource and an economically viable agricultural community.
- Biomonitoring/water quality sampling stations should be set up by the Department of Environmental Conservation at appropriate locations on Dowsville and Mill Brooks to determine the impact of the intensive logging that is occurring in those locations.
- The Vermont Fish and Wildlife Department should plan for and emphasize protection, enhancement, and restoration of fish habitat in the Mad River Watershed. As such efforts renew natural reproduction, the stocking program should be phased out, and any savings invested in additional habitat restoration and enhancement.

Priority recommendations for the Federal Government

- The U.S. Fish and Wildlife Service should develop a plan to protect, restore, enhance, and monitor fish habitat.

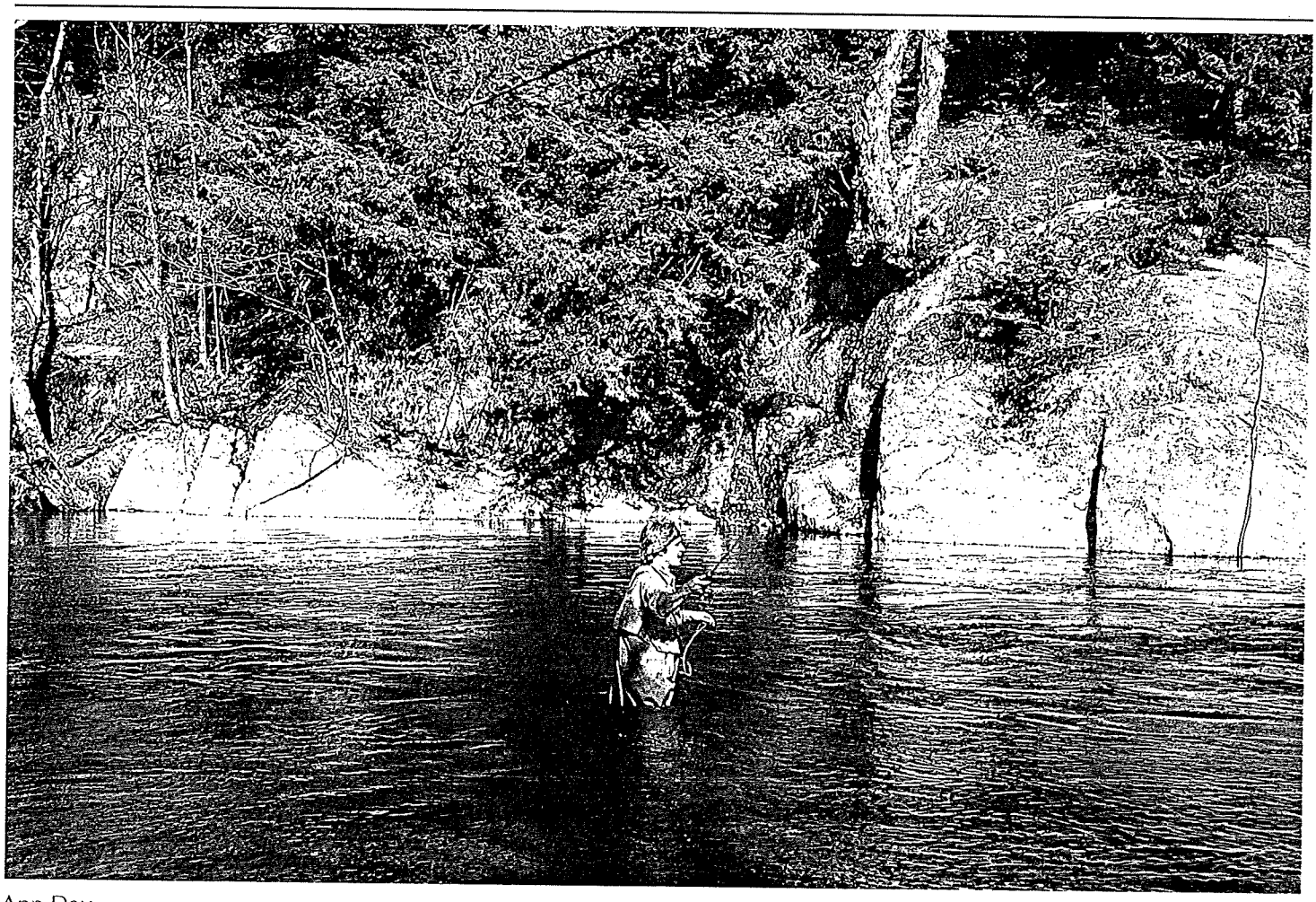
- The Soil Conservation Service (SCS), now called the Natural Resources Conservation Service (NRCS); and the Consolidated Farm Services Agency (CFSA), which includes what was known as the Agricultural Stabilization and Conservation Service (ASCS), should continue to provide financial and technical assistance to farmers.

- The U.S. Forest Service and other federal agencies should continue to provide financial and technical assistance to help communities secure public access to the river and preserve headwater lands.

A special recommendation that encompasses all the topics

Encourage valley towns, businesses, schools, and organizations to work together on an annual "river celebration" to remind us of the importance of the river to our community.

II. Introduction



Ann Day

A. Project background

In November 1993, the Mad River Valley Planning District, in cooperation with Friends of the Mad River, was awarded a small grant by the U.S. Environmental Protection Agency to develop a river conservation plan that can be used by individuals; businesses; citizens' groups; municipal, state, and federal officials to guide decisions that affect the Mad River. This grant is part of the Lake Champlain Basin Program, a five-year effort to plan for effective management of the Lake and its watershed, of which the Mad River Watershed is a small part. The plan:

1. identifies a vision for the Mad River based on three public forums held in the spring of 1994 (Appendix A summarizes the results of those forums);

2. identifies the assets of the river (its uses and values), threats to those assets, and any existing or potential river-use conflicts; this was done through development of 19 topic papers (Appendix B);

3. advances recommendations for solving existing and potential problems.

Broad public involvement was encouraged in formulating the plan. The emphasis was on collaboration and consensus building, learning, and working together to understand the Mad River, to develop solutions to conflicts and threats to the river. To share the work and ensure good communication in developing the plan, two committees and three subcommittees were formed.

The Planning Committee determined how the project should proceed. It was made up of the chair of each of the subcommittees, the president of Friends of the Mad River, and the executive director of the Mad River Planning District.

The Public Outreach Subcommittee contacted citizens, businesses, organizations, and schools in the valley to encourage their participation, solicit their knowledge and opinions, and increase their awareness of the assets and problems of the Mad River. Their assistance was obtained in developing visions for the river; identifying preferred uses and values and suggesting potential solutions to conflicts, problems, and threats facing the river. Two of the methods used by the committee were public town forums, and a one-day river walk, which brought together river experts and people from the community.

The River Subcommittee focused on the uses, values, and problems of the river and its immediate vicinity. This committee compiled and summarized data on the chemical, physical, and biological conditions of the river and its tributaries. Also, the committee analysed conditions of the river to see if present uses are sustainable, and if not, what can be done.

The Land use Subcommittee looked at impacts on the river from uses in the surrounding watershed; gathered data about on-site sewage disposal, road maintenance, agricultural practices, sludge disposal, stormwater runoff, forestry practices, construction practices, recreational access, and water withdrawal. These activities were documented and analysed to identify present and future effects and their impacts on the river, its uses, and values.

An Advisory Committee, composed of citizens and watershed organizations from the Lake Champlain Basin in the states of New York and Vermont, was formed to learn about and offer suggestions for the Mad River project and how similar efforts in other parts of the Lake Champlain Basin have been, and can be, conducted to help protect and manage local watersheds, and in so doing protect Lake Champlain as well. One product of this committee was a report on Lake Champlain Basin watershed association activities and needs (Appendix C).

Appendix D gives a brief description of the events the various committees organized in the process of preparing the Mad River conservation plan.

B. Authority of the plan, and implementation

The plan's authority and beneficial impact will depend on the degree to which it is taken into account when decisions are made on planning, zoning, funding, and management of natural resources.

Implementation of the Mad River conservation plan will begin with its presentation to town planning commissions and selectboards, state and federal agencies, interested citizens' groups, and the public.

Section I-C lists some of the plan's priority recommendations to protect the river. Formal adoption of the plan by all three levels of government would ensure that the recommendations will be taken into account when decisions affecting the river are made by governments, organizations, businesses, and individuals.

Progress toward adoption of the recommendations will be tracked systematically by Friends of the Mad River, and the Mad River Valley Planning District. This follow-up could include making revisions in recommendations as new information becomes available and as experience is gained.

III. The watershed today

Ann Day

III. The watershed today

A. A brief description of the watershed

The Mad River's source is a small mountain brook, narrow enough to jump across, north of Granville, Vermont in the twelve-mile Granville Wilderness Area.

Perhaps the name "Mad" originated with the observation that this river actually flows north—not south as many rivers in the area do—toward the Atlantic Ocean via the Winooski River, Lake Champlain, the Richelieu River, and the St. Lawrence River. As the river flows north, it is fed by major tributaries from the mountains in the five valley towns—Warren, Waitsfield, Moretown, Fayston, and Duxbury.

Like much of the rest of Vermont's Green Mountains, the Mad River Valley lies along a north-south axis. The valley is formed by a series of gentle benches eroded from the mountainsides. The western side of the valley is formed by the Lincoln ridge on the northern edge of the Green Mountain National Forest. The eastern side of the valley is bounded by the forested slopes of the Northfield Ridge.

The Mad River is 26 miles long, and the watershed has an area of 143 square miles. It is part of the much larger Winooski River watershed (90 miles long and 1,080 square miles) that drains to Lake Champlain just north of Burlington (see the maps in Appendix E). The Mad River Watershed includes many small tributary streams. Those with names are:

- Clay Brook (with Rice Brook), Bradley Brook, Freeman Brook, Lincoln Brook, Stetson Brook, Mills Brook, and Austin Brook entering the Mad River at Warren, with some tributaries rising at Lincoln and Granville;
- Pine Brook, High Bridge and Folsom Brooks at Waitsfield;
- Shepard Brook (with French and Deer Brooks) and Mill Brook (with Slide, Lockwood, and Chase Brooks), rising at Fayston and entering the Mad River at Waitsfield;
- Welder Brook (with Cunningham Brook) and Dowsville Brook, rising at Duxbury and entering the Mad River at Moretown.

B. Resources of the Mad River Watershed

The Mad River Valley is one of many beautiful and bountiful river valleys in Vermont. Many upland tributaries, good agricultural soils, abundant forests, and mountainous terrain are its major natural resources. They sustain good farming (although it is declining for many economic reasons), a good timber supply where it is managed for sustainability, good fishing for wild trout in the headwaters and tributaries, good boating, good hiking, and thriving skiing and tourist industries.

Following are the most significant of these watershed resources.

- The headwaters of the Mad River and its tributaries support excellent natural populations of native brook trout, and introduced rainbow and brown trout.
- In a survey of Vermont swimming holes, the Mad River Watershed was rated as an outstanding swimming resource—one of the state's best.
- Eighty-six percent of the land in the watershed is covered by forests that not only provide scenic beauty but an economic resource for valley communities.
- According to local boaters, the Mad River offers people of all ages and abilities natural, scenic, exciting boating experiences that are second to none.
- Several active farms in the valley contribute greatly to its pastoral and scenic beauty.
- The mountains that form the watershed's boundaries and direct water into the upland brooks and groundwater aquifers provide critical habitat for wildlife, high-quality hiking with spectacular views along ridges and bubbling books, and exciting alpine and cross-country skiing, as well as many other recreational pleasures.

C. Major problems, threats, and issues

It should not have to be said, but a reminder always seems necessary that human activity, unless conducted to be as harmonious as possible with the natural environment, is the cause of most Mad River problems. The natural occurrences of river meander and resulting stream bank erosion are only problems because these processes threaten human developments and activities in the valley.

All of the issues facing the Mad River are interconnected, some more closely than others. Detailed discussions of the issues are found in the topic papers (Appendix B).

The major issues about the Mad River are summarized below under headings of erosion and sedimentation, lack of stream bank vegetation, water pollution, threats to public access, lack of information and education about the river, and other threats to the health of the river. Relevant topic papers are mentioned after each problem description.

Erosion and sedimentation

Accelerated sedimentation caused by human activity results in-stream embeddedness—that is, sediment filling of the spaces between pebbles and rocks of the stream bottom that aquatic organisms require to survive. Sedimentation is being caused by lack of proper erosion control measures during construction of buildings and roads, and by lack of good management practices on forest and agricultural lands. Several topic papers present information on erosion and sedimentation.

Topic Paper B, on the fishery, stresses the importance of vegetative cover on stream banks and in adjacent buffer strips to prevent siltation of the stream bottom.

Topic Paper J, on logging and forestry, discusses the importance of following good management practices when logging to prevent erosion.

Topic Papers O and P, on roads and construction practices, give more information about how these activities can contribute significantly to erosion and sedimentation.

Lack of stream bank vegetation

When river banks lack mature trees, solar radiation raises stream temperatures, making the habitat for trout much less hospitable—even lethal at times. Lack of stream bank vegetation also makes stream banks more vulnerable to erosion during high water periods and during ice jams. The Mad River has been riprapped extensively to repair stream bank damage from flooding. However, when riprap was installed neither trees nor adequate buffer strips were planted.

On agricultural land, there is the tendency to cultivate land as close to the riverbank as possible to maximize land use. Artificial riprap and channelization of the river prevents it from meandering naturally, thus reducing the pool-and-riffle habitat important for aquatic ecosystems. Also, removing gravel bars means that vegetation cannot grow next to the stream channel, where it is needed to provide fish habitat.

Topic Papers B, D, H, J and Q discuss the need for stream bank vegetation with respect to the fishery, gravel removal, the river path, forestry, and farming, respectively.

Water pollution

Mad River Watch sampling data show that failing on-site sewage systems for residences and businesses are contaminating the Mad River, resulting in repeated violations of water quality standards that restrict fecal coliform, thus greatly increasing risks to swimmers. Sometimes runoff from the land during storms washes manure into the river, also violating coliform limits, but this appears to be a lesser cause than on-site sewage systems. The topic papers on on-site sewage disposal (C) and swimming (G) give detailed analyses of Mad River Watch data that reveal a problem of fecal coliform contamination. The topic paper on farming (Q) discusses how water quality can be affected by poor agricultural practices and what can be done to prevent such contamination.

Lack of stream bank vegetation allows solar radiation to warm the river, creating significant thermal pollution, especially in the lower reaches of the Mad River. This is discussed in Topic Paper B—The fishery: problems and potential.

Water pollution can be caused by stormwater runoff, which carries many different pollutants to the river. The combination of various activities in the watershed can result in a cumulative water quality

C. Major problems, threats, and issues—continued

impact on fish and wildlife and our uses of the river. These topics are discussed in the topic papers on stormwater runoff (M) and on cumulative impacts and river assimilative capacity (L).

Threats to public access

Development, overuse, misuse, and changes in land ownership can threaten the public's access to and enjoyment of the river for swimming, boating, and other uses. See the topic papers on public recreational access (F), swimming (G), and boating (N).

Lack of information and education about the river

Not knowing how the river works, and how we contribute to the river's problems through our everyday activities may be the biggest threats to the river. In the process of preparing this plan, it became evident that people wanted more information about the river—education was high on the list of responses at the three river forums. People repeatedly expressed a strong desire for both formal educational curricula at valley elementary and secondary schools as well as an adult educational effort.

A meeting of town officials involved with on-site sewage disposal and related health problems showed the need for greater communication among towns on such issues.

A river walk that brought river experts and people from the valley together showed the need for greater knowledge to foster greater appreciation of the river.

All the topic papers presented in Appendix B of this plan show to varying degrees the need for information and education about the river, but see especially Topic Papers A on river health, and I on education and protection of the river.

Other threats to health of the river

Other human activities in the watershed can combine to threaten the overall health of the river. Water withdrawal (Topic Paper E) unless limited and properly done, can have serious impacts on the river's aquatic habitat. Gravel removal can have serious impacts on the river channel and on fish and other aquatic life. The topic paper on gravel removal (D) explains how river channel dynamics are affected. Also, trash and debris, oils, chemicals, and hazardous wastes can affect the river adversely.

IV. Recommendations to solve problems

Ann Day

IV. Recommendations to solve problems

The overall goal for the Mad River conservation plan is to determine what might be done to remove existing and future threats to the Mad River, and to implement solutions on a priority basis.

This section presents all 112 recommendations from the topic papers, grouped in solution categories:

A. Monitor the health of the river;

B. Develop education programs to foster awareness;

C. Control erosion and sedimentation;

D. Revegetate stream banks, and protect aquatic habitat;

E. Improve and protect water quality;

F. Improve access and recreational opportunities;

G. Promote planning efforts and necessary legislation.

The letters and numbers in parentheses after each recommendation identify the source topic paper. For example, "A-6" indicates Topic Paper A's recommendation number 6. Two recommendations were made in two solution categories and those recommendations are marked with an asterisk. Thus there is actually a total of 110 distinct recommendations rather than 112.

Implementing all the recommendations would be a major step in solving the river's problems, as well as helping to protect the river in the future.

A. Monitor the health of the river

Monitoring is concerned with systematic observation or measurement of aspects of the environment over time. It answers the question, "What is happening?" Research, on the other hand, answers the question, "Why is it happening?" Knowing what is happening in and around the river and why are keys to its protection. It takes continued, often precise and detailed observations to determine the health of the river. Are the laws and related regulations to protect the river effective? Are permits, economic incentives, enforcement, and education having their intended effects? We need the answers to these questions.

The following 19 recommendations for monitoring the health of the river come from 10 of the topic papers.

Recommended citizens' initiatives

1. Friends of the Mad River should organize a "citizens initiative" to help ensure that all state environmental and highway construction permits require sound conservation techniques. This effort should include overseeing development of the River Path, and continuing checks that state agencies are monitoring to ensure permit conditions are being met (A-6).

2. To further protection efforts, Friends of the Mad River should develop an adopt-a-river program in which riparian landowners or other residents would be trained to observe specific sections of the watershed and any activities that may be harmful to the river. "River watchers" would spotlight any problems and harmful activities so that Friends of the River and town or state officials could take appropriate action (B-6).

3. Individuals should be encouraged to become active members of Friends of the Mad River and participate in river protection efforts (A-11).

Recommended Mad River Watch activities

4. The Mad River Watch Program, in cooperation with the Vermont Agency of Natural Resources (ANR), should establish macroinvertebrate sampling stations at key locations in the watershed. For example, stations should be established on Dowsville and Mill Brooks

downstream from the intensive logging that is to occur there over the next year or two (A-8).

5. The Mad River Watch Program should establish a program to teach landowners and those involved in the adopt-a-river program to conduct stream inventories to assess conditions and impacts on the river (A-9).

6. As part of the monitoring effort, the Mad River Watch sampling program should be given continuing support by the community (B-8).

7. The Mad River Watch Program, with all valley towns and the Agency of Natural Resources, should identify and investigate sources of river contamination, and encourage and assist owners of failed sewage systems to repair or replace them to eliminate and prevent health hazards (C-6).

8. The Mad River Watch sampling program should be expanded to monitor river conditions. This should include continued monitoring of the physical condition of swimming holes to see how and why they change, and posting the results of sampling at swimming holes to let swimmers know the current risks of swimming (G-4*).

Recommended monitoring by the Vermont Agency of Natural Resources

9. The ANR should continue monitoring the river cross section at the Turner Farm to record channel changes over time (D-2).

10. The ANR should require monitoring of the river and streams affected by new water withdrawals to determine if minimum streamflow and other requirements are being met (E-2).

11. The ANR should evaluate

a) all existing water withdrawals (allowed before the Agency's Minimum Flow Procedure became effective);

b) its minimum streamflow requirements; and

c) the cumulative impact of all withdrawals relative to the Agency's Minimum Flow Policy to determine if protection of the river or stream is adequate, and if not make adjustments to achieve it (E-3).

12. Proper closeout of logged areas should be assured by the Vermont Department of Forests, Parks, and Recreation before loggers and their equipment leave the area (J-4).

13. Biomonitoring/water quality sampling stations should be set up by the Vermont Department of Environmental Conservation in appropriate locations to determine the impact on Dowsville and Mill Brooks of the intensive logging that is to occur in those locations (J-8).

14. For the duration of logging operations, the Vermont Department of Forests, Parks, and Recreation, in cooperation with Friends of the Mad River, and the Mad River Valley Planning District, should monitor (via aerial photos and videos) weekly or as often as needed to determine how well Acceptable Management Practices (AMPs) are being applied to logging jobs in these locations. Correlations can be made about effectiveness of the AMPs in protecting water quality (J-9).

15. The ANR should continue overseeing disposal of sludge and septage, with sufficient monitoring of method and content to prevent contaminating the river, lands, and crops in the watershed (K-1).

16. For the larger and more critical stormwater discharges, the ANR should perform spot field inspections to ensure stormwater permit conditions are being met and that any engineered stormwater control measures are in good repair (M-2).

17. The ANR and towns should increase the amount of compliance monitoring and enforcement of the erosion control provisions of permits issued for critical construction sites (P-2).

A. Monitor the health of the river — continued

18. Local, state, and federal governments and conservation organizations should cooperate in continuing monitoring efforts in two critical categories to ensure that fish habitat is protected:

a) ensure that conditions are being met for permits issued for the construction of dams, water withdrawal facilities and structures under Act 250, and for stormwater;

b) ensure that conditions imposed in the permits are in fact protecting the river and fish habitat (B-7).

Recommended school projects

19. Students at Harwood Union High School who have been involved in the Mad River Watch Program should monitor Dowsville Brook to determine the impact of logging operations on water quality. There should be daily sampling for turbidity, and weekly sampling for phosphorus. Weather and streamflow conditions should also be recorded (J-10).

B. Develop education programs to foster river awareness

Implementing the recommendations for monitoring the health of the river that were described in the previous section would increase our awareness of the river. Having such information would also enable us to develop river educational programs that make this information readily available to many others in the watershed.

Recommendations concerning education and increasing awareness of the river appear in 10 of the 19 topic papers. Several of these recommendations call for training and assistance for landowners, valley residents, individuals, and town officials involved directly or indirectly in river protection efforts. Some of the recommendations call for the information about river changes that is collected by the state environmental agency to be shared with local conservation groups and town governments.

Most recommendations in this section deal with making information on protecting the river widely available to residents. There are other recommendations to further river education efforts by using radio, newspapers, and cable television; by developing school curricula; by making inventories of wildlife resources; and by making information available to valley residents and visitors through a river resource and education center.

Recommendations for a river resource and education center

The following three recommendations come from three topic papers. Each recommendation has a different emphasis, but all three could be implemented by creating a river resource and education center.

20. Friends of the Mad River and the Mad River Valley Planning District, with the cooperation of the U.S. Forest Service, the Agency of Natural Resources, and valley towns should establish a river resource center where people could obtain basic information about the river and how it works, and on river conservation techniques. The Lareau Swim Hole, or an historic building, such as the General Wait House, would be a suitable location for the center (A-1).

21. Friends of the Mad River and other interested groups should create an educational center, such as a nature center or museum. It should include a self-guided interpretive trail, historical and cultural information, workshops on topics relating to the river and watershed, special events and celebrations, and a community meeting place. The center should also include a greenhouse and nursery for displaying examples of vegetation that can be planted to stabilize stream banks and buffer strips against erosion, and for starting and growing trees and shrubs. It could be a valuable hands-on learning tool (I-8).

22. Friends of the Mad River, in cooperation with valley towns (including the historical societies of each town), as well as valley businesses and other interested groups, should create a Mad River natural and historical resource center. It would provide opportunities to learn about and be responsible for good stewardship of the watershed. The resource center should include:

a) maps and models of the watershed showing historical and future land uses and conditions (forests, agriculture, mills, and intended land use with zoning build-out maps);

b) interactive, hands-on, changing displays on such topics as mill and skiing artifacts, the Ward Lumber Company watershed model, and Mad River Watch information and data;

c) a library of river related historical materials including books, tapes (oral histories and radio programs), and videos;

d) materials provided in cooperation with town historical societies on such topics as flooding history, agriculture, logging, music, and changes in land use in the valley;

e) an interpretation center for residents, students, and visitors to find answers to questions about the river, and a place to train volunteers for river and watershed work (S-1).

Recommended information materials

23. Valley towns should provide information sheets that list telephone numbers for residents to call if river problems or violations of the law are discovered (A-3).

24. Valley schools, in cooperation with Friends of the Mad River, the Mad River Valley Planning District, and state and federal environmental agencies should develop education materials and programs to be integral parts of school curricula, using the Mad River as a real-world laboratory for learning (A-5).

25. The river path plan should take advantage of every opportunity for education, including signs to explain channel dynamics and natural phenomena. A brochure should be considered for self-guided walking tours, with brochure sections keyed to numbered path stations (H-10).

26. Friends of the Mad River should prepare pamphlets that outline best practices, such as safe disposal of hazardous wastes, and provide telephone numbers of resource persons for more information. These pamphlets should be distributed to landowners and made available in town offices, libraries, and other public locations. Existing publications, such as *Accepted Management Practices* (for forestry)*; Native Vegetation for Lakeshores, Streamside, and Wetland Buffers;* and *Wetlands Rules and Regulations* should be available at all town offices (I-3).

27. Friends of the Mad River, in cooperation with valley towns and businesses, should establish information kiosks at strategic river locations for posting pertinent data, as well as information resources and events (I-4).

28. Landowners who decide to have their land logged should use a model "Timber Sale Contract," such as the one used by the Department of Forest, Parks and Recreation. This should help ensure erosion control and proper closeout of logging to prevent erosion. The contract should require a review by a forester capable of applying Acceptable Management Practices. Model timber sale contracts, AMPs, and other educational materials should be available in town offices (J-2).

B. Develop education programs to foster river awareness—continued

29. Through use of workshops and educational materials made available by towns, Friends of the Mad River, and the Mad River Valley Planning District, valley residents should become familiar with proper logging practices and actions they can take if they see that AMPs are not being applied, or observe water quality violations (J-5).

30. Valley residents should be aware of the boating resource of the Mad River, monitor it, and help to preserve it from future harm (N3).

31. Friends of the Mad River and other conservation groups, in cooperation with canoe and related businesses in the valley, should organize interpretive canoe trips on the river to foster boating and appreciation of the river. Part of this education effort should recognize that boating can conflict with other uses, such as fishing (N-4).

32. Friends of the Mad River should take a lead role in increasing public awareness of good farming practices (Q-2).

33. Valley towns should disseminate educational materials on erosion control practices on construction-sites, especially the need to minimize the amount of earth exposed, explain the impacts of season and duration of exposure, and the benefits of immediate mulching of disturbed earth (P-3).

Recommended training and assistance

34. Friends of the Mad River should facilitate meetings and workshops for planning commissions, the Vermont Agency of Transportation, health officers, and local groups whose practices impact the river. These meetings should include subject matter experts, up-to-date information materials, and discussions of responsible use of the river and watershed (I-5).

35. Selectboards and road commissioners should keep current on road maintenance by utilizing the Vermont Roads Scholar program (O-6).

Recommended monitoring and information sharing

36. Riparian landowners, towns, and conservation groups should document changes in the river channel to gain a better long-term understanding of how the river changes and reacts to the changes we make to the river and watershed. This effort should be incorporated in the adopt-a-river program by Friends of the Mad River (D-3).

37. When large tracts of land are purchased with the intent of heavy logging—the case with the New England Land Associates sale, for example—the Department of Forests, Parks, and Recreation should notify the new landowner and loggers about the requirement for using Acceptable Management Practices, and should assign staff to ensure compliance (J-3).

38. The Agency of Natural Resources should provide information on monitoring and evaluating water withdrawals to all valley towns affected, and to Friends of the Mad River so that oversight can be provided to ensure that requirements are being met and the river is being protected (E-4).

39. The Mad River Watch sampling program should be expanded to monitor river conditions. This should include monitoring of the physical condition of swimming holes to see how and why they change, and posting sampling results at swimming holes to inform swimmers of any risks (G-4*).

Recommendations about school curricula

40. With the support of Friends of the Mad River, state and federal agencies, and others, valley schools should develop a rich, integrated curriculum and implement it in the schools using existing resources and materials, as well as new material. For example, the elementary school gardening program could be expanded to include growing river and stream bank vegetation for educational as well as practical uses in the watershed. The goal is to foster an appreciation and understanding of the ecosystem of the Mad River and its watershed. The curriculum should include components outlined in the topic paper on education, plus

other subjects that may be identified, such as development of a recreational ethic that encourages the various river users to respect each other; methods of conflict-resolution; and an historical curriculum of the watershed that includes oral history (I-6).

41. Valley schools should develop an historical curriculum of the watershed, including an oral history (S-2).

Recommended media events

42. Friends of the Mad River should continue to write articles for The Valley Reporter newspaper that target specific areas of interest about the river, such as preventing runoff and erosion, Mad River Watch data, and problems or issues in the watershed (I-1).

43. Friends of the Mad River, in cooperation with various sponsors in the watershed, should organize special events to promote understanding, appreciation, and celebration of all aspects of the river (I-2).

44. Friends of the Mad River should organize radio and community cable television spots and shows that feature oral histories, river stories, Mad River Watch data, and public service announcements about the river (I-7).

C. Control erosion and sedimentation

The problem of erosion and sedimentation in the Mad River Watershed has been documented through formal monitoring and informal observations. Efforts to control sedimentation caused by construction projects are made when the Agency of Natural Resources, and District Environmental Commissions require erosion control measures as conditions of issuing permits. Many recommendations in the previous section are based on using education as a way to ameliorate problems and threats to the river, including sedimentation. The following recommendations deal specifically with the problem of erosion.

Recommendations to halt erosion

45. All construction projects in the valley, whether under local, state, or federal jurisdiction, should follow accepted management practices for erosion control, such as those contained in the Agency of Natural Resources' *Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites* (P-1).

46. Contractors and others involved in construction should attend Department of Environmental Conservation training sessions on erosion control methods (P-4).

47. Valley towns, in cooperation with the Vermont Agency of Transportation, should develop a single set of standards for controlling erosion and sedimentation from road construction, maintenance, and repair; and for vegetative buffer strips along roads and streams. All town plans and local zoning and subdivision regulations should include these standards (O-1*).

48. For public swimming holes, there should be a continuing town or state maintenance program with Natural Resources Conservation Services assistance to remedy erosion problems resulting from human use and natural drainage. Specifically at Ward Access, the stormwater drainage from the parking lot should be diverted where foot traffic has eroded the bank. Also, the eroding bank should be repaired, and a firm stone surface, or wooden steps installed to prevent erosion (G-5).

C. Control erosion and sedimentation—continued

The following four recommendations come from the Topic Paper H, River Path, but could well apply to other situations.

49. Develop an erosion control plan for the construction period and afterwards (H-8).

50. Develop a continuing maintenance and monitoring plan that calls for an annual check of erosion control measures and any habitat improvement structures. Plantings of stream side vegetation should also be checked to ensure they are healthy. Any trouble spots, such as new erosion areas or unexpected river meanders, should be noted and addressed (H-9).

51. Plan access points to the river to minimize disturbance to stream banks, and yet allow maximum access to points of interest. Where access points are located in areas where stream banks have been disturbed, repairs should be made to prevent erosion and sedimentation. Also, vegetation should be replanted where desirable (H-4).

52. Keep the path as narrow as practical to minimize disturbance and erosion, and sedimentation of the river (H-3).

D. Revegetate stream banks and protect aquatic habitat

Two of the most critical aspects of a healthy river ecosystem are: (1) good stream bank cover that provides shading and fish food sources, and protects stream banks from the erosive forces of flooding; and (2) good in-stream habitat for aquatic organisms. These aspects of a healthy river are threatened even in the more pristine upland areas of the Mad River, and are severely degraded in the lower reaches. The following recommendations are aimed at restoring and preserving the stream bank and in-stream environments of the river through planning, revegetation, and protecting stream banks and the aquatic habitat.

Recommended planning for stream bank and aquatic-habitat protection

53. The Vermont Fish and Wildlife Department should emphasize protection, enhancement, and restoration of fish habitat in the Mad River Watershed, and as such efforts prove successful, and natural production occurs, the department should phase out its stocking program and use any money saved to further habitat restoration and enhancement (B-1).

54. The U.S. Fish and Wildlife Service, U.S. Forest Service, Vermont Department of Fish and Wildlife, conservation organizations, and valley towns should cooperate in developing a Mad River Watershed fish habitat protection, restoration, and enhancement plan. Funds should be appropriated to develop and implement the plan on a priority basis as opportunities become available. The plan should include an educational component to foster appreciation of a healthy fishery resource. The plan should consider establishing catch-and-release and kids' fishery components (B-5).

55. Valley town planning commissions should update their plans and zoning and subdivision ordinances to require protection and enhancement of fish habitat. Specific measures should be included, such as maintaining vegetative buffer strips along waterways, providing adequate setbacks for buildings near rivers, limiting new road building— especially in headwaters, providing for proper road maintenance to prevent erosion and siltation, and placing culverts appropriately for fish passage (B-3).

56. Local town plans and zoning ordinances should call for forested buffer strips along the Mad River and its tributaries, and local zoning ordinances should require that logging on forest lands conform to Acceptable Management Practices (J-1).

57. When planning the river path, minimize the number of river and stream crossings. A bridge abutment is vulnerable during high flows, and if jeopardized will need protection that can be expensive and reduce aquatic habitat (H-7).

Recommendations for stream bank revegetation and buffer strips

58. Friends of the Mad River, and the Mad River Valley Planning District, with the cooperation of valley towns, should start a nursery with purchased or leased lands to cultivate native stream bank shrub and tree species and make them available to revegetate barren stream banks. Part of the nursery program should be developing a stream bank planting plan along barren stretches of the river, as well as areas along the river path, and protecting large trees along stream banks. Also, consideration should be given to including a river-vegetation nursery in the Lareau Swimming Hole design (A-4).

59. Friends of the Mad River should use its adopt-a-river program to assist landowners who are implementing river conservation practices. The assistance could range from finding technical assistance and funding, to a pool of labor and tools for installing conservation measures. Part of this assistance should be a leaflet for landowners that discusses basic stream and river protection and care. River volunteers should be trained to provide quality assistance. To help with the training, consider an AmeriCorp team, Vermont Youth Conservation Corps, and an adaptation of COVERTS, the UVM wildlife habitat program (A-7).

60. Revegetate riprapped areas that are devoid of vegetation (Q-5).

61. Where appropriate, stream bank stabilization should utilize biological stabilization (trees and other vegetation) instead of or in conjunction with riprap. Also, consideration should be given to creating stream bank and in-stream fish habitat when any stream bank work is carried out (Q-4).

62. Friends of the Mad River, in cooperation with towns, should take a lead role in contacting farmers to discuss mutual objectives of farmers and river health, and to explore opportunities for habitat enhancement projects on farmland (Q-6).

63. When farmers elect to sell or remove development rights on their land to preserve it for agriculture, the Vermont Land Trust and the Vermont Housing and Conservation Board should establish conservation easements as a means of establishing buffer strips along the river, and of instituting other river and habitat enhancement measures, including use of the Accepted Agricultural Practices (Q-7).

The following recommendations were made concerning the river path, but are applicable to many other projects.

64. Avoid, or minimize encroachment on existing, undeveloped stretches of the river corridor to minimize impact on natural plant and animal communities and to the stream bank (H-1).

65. Maintain a buffer strip at least 50 feet wide (more where steep slopes and erodible soils exist, and where the river is expected to meander over time) wherever possible to minimize sediment and nutrient input to the river, and disturbance to stream banks. If usable farmland is involved, consider any compensation that may be necessary to farmers (H-2).

66. Where existing stream banks are unstable, the Mad River Path Association should work with landowners to develop a plan for stabilization before agreement is reached on path alignment so as to minimize future threats to the path. Where stabilization is done, improvements to aquatic habitat should be considered, such as planting trees for shading. If riprap is installed, consider improving fish habitat with such

D. Revegetate stream banks and protect aquatic habitat—continued

devices as current deflectors, and log cribs where fish can hide (H-5).

67. Where stream banks are bare, trees should be planted for long-term river shading, bank stabilization, and a fish food source from falling insects. Where trees exist, they should be managed for long-term health and diversity to keep the stream bank stable (H-6).

Recommended protection of aquatic habitat

68. The law should not be changed restricting the amount and method of gravel removal from rivers until observations and knowledge about the relationship of gravel bars and stream channel dynamics clearly suggests a need to clarify or change the regulations (D-1).

69. The Agency of Natural Resources should consistently and effectively apply its *Minimum Flow Procedure* to proposed water withdrawals in the watershed (E-1).

70. The *Sugarbush Stream Habitat Restoration Enhancement Plan* should be implemented fully at all sites designated in the 2.5-mile stretch below the proposed Mad River water withdrawal location (B-4).

71. Valley towns, in cooperation with the Vermont Agency of Transportation, should develop a single set of standards for controlling erosion and sedimentation from road construction, maintenance, and repair; and for vegetative buffer strips along roads and streams. All town plans and local zoning and subdivision regulations should include these standards (O-1*).

72. Friends of the Mad River, the Mad River Valley Planning District, and valley towns should explore petitioning the Vermont Water Resources Board to have portions of the Mad River and its tributaries designated as Outstanding Resource Waters to gain the extra protection afforded by this designation (B-2).

E. Improve and protect water quality

The water quality of the Mad River and its tributaries is generally good, but it is being degraded, sometimes very seriously, by erosion and sedimentation, failures of on-site sewage systems, and other nonpoint sources of pollution. Many of the following recommendations deal with the problem of on-site sewage pollution. Others deal with agricultural practices, road construction and related matters, and other issues.

Recommendations to prevent on-site sewage pollution

73. Valley towns that have not done so—Waitsfield, Moretown, and Duxbury—should adopt sewage ordinances that incorporate adequate minimum standards for siting and construction of on-site sewage systems. These requirements should include ensuring the adequacy of the system when use of existing septic tank/leach field systems increases owing to expansion of homes or businesses (C-1).

74. Valley towns should review the administration of their sewage requirements, and should ensure there is adequate oversight of designers and contractors by utilizing part-time professionals, or by training town health officers and zoning administrators (C-2).

75. Valley towns and the Mad River Valley Planning District should explore a valley-wide, five town approach to administering sewage disposal requirements to lessen costs and improve effectiveness (C-3).

76. Valley towns should provide a brochure to all homeowners and businesses covering the proper operation and maintenance of on-site sewage systems. The brochure should include telephone numbers for more information, and guidance about reporting health hazards and failed septic systems (C-4).

77. Based on experience with past performance in the valley, towns should maintain a list of recommended engineers, technicians, contractors and septic system pumpers who are capable of designing, installing, or servicing on-site sewage disposal systems (C-5).

78. Valley towns should work with septic system pumpers to help educate system owners about operation and maintenance, and about setting up a three-year (or as needed) cycle of pumping septic tanks and checking distribution boxes (C-7).

79. Valley towns should provide incentives for repair or replacement, and maintenance of systems by providing low-interest revolving loans. Towns and the Mad River Valley Planning District should investigate the availability of Section 319 (Implementation of Nonpoint source Control Measures) Clean Water Act funds, and the State Revolving Loan Fund for this purpose (C-8).

80. The built up communities of Warren and Moretown, and the region of Irasville, Waitsfield Village, Mad River Glen, and Sugarbush North should be encouraged to explore community on-site sewage disposal systems in concert with individual disposal systems that meet standards in an economical and environmentally sound manner (C-9).

81. State and local governments, conservation groups, and individuals should combine efforts to identify sources of pollution that are threatening the use of swimming holes (G-3).

82. Those who have on-site wastewater disposal (septic) systems should operate them to ensure the septage is free of toxic materials and chemicals, and is safe to apply to the land (K-2).

Recommendations about roads and construction

83. Valley towns should implement local road-maintenance and construction standards, such as those contained in the handbooks *Maintaining the Backroad,* and *Vermont Backroad Erosion and Sediment Control.* (O-2).

84. Valley towns should use the state's policies and best management practices concerning application, storage, and siting of road salt products, particularly combined applications of sand and salt (O-3).

85. The Vermont Agency of Transportation maintenance shed and salt storage area that is located within 20 feet of the Mad River should be relocated immediately (O-4).

86. Valley towns, working with the Natural Resources Conservation Service, should check sites for direct snow disposal into streams, and implement alternatives where possible (O-5).

87. Valley town plans and zoning ordinances should contain provisions that address stormwater runoff to minimize impact on the river, with emphasis on preventing stormwater problems by maintaining adequate vegetated buffer strips for streams, and by dispersing rather than concentrating stormwater (M-1).

Recommended farming practices

88. The Natural Resources Conservation Service and the Consolidated Farm Services Agency should continue to provide farmers with technical and financial assistance to solve management problems, such as manure storage, livestock watering, and stream bank stabilization (Q-3).

89. The Vermont Department of Agriculture, Winooski Conservation District, and the Agency of Natural Resources should cooperate to help farmers implement the Accepted Agricultural Practices to be adopted soon, and the Best Management Practices (BMPs) that are to be adopted as requirements for cost sharing (Q-1).

Recommendations about other activities

90. State and local governments, with the cooperation of conservation organizations and land trusts, should plan for and acquire, in fee or in protective easements, high-elevation and headwaters lands to help protect the Mad River and its tributaries, and to help provide for a sustainable, productive forest resource (J-11).

91. The Agency of Natural Resources should encourage the use of water conservation measures, water recycling, water reuse, and storage ponds to minimize impacts of existing water withdrawals on streams (E-5).

E. Improve and protect water quality—continued

92. When making decisions about their uses of the river or land in the watershed, governments, businesses, organizations, and individuals should review the impact of their activities in relation to all other activities in the watershed to ensure that the cumulative effects are not exceeding the assimilative capacity of the river and are not degrading its beneficial uses (L-1).

F. Improve access and recreational opportunities

Protecting the water quality of the Mad River and its tributaries ensures that we can continue to enjoy its many recreational uses, but to enjoy the river there must be access. There are a few public access points for swimming and boating, but most access is via private property. The following recommendations deal with planning ahead to ensure good access through town planning, acquisition, site improvement, and working cooperatively with private landowners.

Recommendations about planning ahead

93. Valley towns and the state should develop a capital budget (with an educational component to make the proposals and their effects readily understandable to the public) to enable prompt acquisition of priority access areas and recreation easements when such lands are offered for sale (F-2).

94. Town zoning ordinances should be adopted or revised to protect existing swimming holes from encroachment by new development (G-2).

95. In its planning and construction of the state-owned road and adjacent corridor, the Vermont Agency of Transportation should provide well-landscaped parking, access, and enhancements, such as picnic areas, at key access points to the river that have been identified by towns and Friends of the Mad River (F-7).

96. Town and state plans should include goals and objectives to preserve and enhance existing swimming holes, and in some cases to purchase lands or obtain easements to provide access to swimming holes (G-1).

97. Valley towns, working in conjunction with Friends of the Mad River, and the Mad River Planning District, should revise or update their plans to:

a) identify important river access points for public acquisition, or for acquiring easements;

b) identify town-owned properties that are adjacent to the Mad River and its tributaries, and recommend provisions for their future use, protection, management, and public access;

c) identify all town-owned and other public easements (such as the Vermont Land Trust easements, and town-owned development rights) that provide public access to the river ;

d) list Agency of Transportation right-of-way accesses to the river; and

e) map the above information and make it readily available to the public (F-1).

Recommendations about working with private landowners

98. Possibilities of ensuring continued public access to private swimming holes should be explored with landowners by Friends of the Mad River in cooperation with towns. This effort should include public education about private swimming holes where there is public access, and advice on what swimmers must do to respect the owners' property and privacy (G-6).

99. Valley businesses, towns, and organizations should encourage boating because it is an activity that has little impact on the environment and brings revenue to the valley (N-1).

100. Boaters should continue to maintain good relationships with landowners to ensure adequate access to the river (N-2).

101. To encourage and foster public access to the river across private property, Friends of the Mad River through an adopt-a-river program should:

a) contact owners of key access areas to determine the status of their areas, and document any problems and concerns the owners may have;

b) meet with owners to determine what support they would like in maintaining access, such as volunteer cleanup, improved parking, and path maintenance;

c) develop educational materials to increase respect and care for private land and the owners' privacy; and

d) provide information to property owners about easements, potential grants for enhancement, and other programs that might help to preserve access (F-4).

Recommendations about acquisition and site work

102. The U.S. Forest Service should continue to acquire land and easements along the Mad River and its tributaries to protect the watershed and public access to the river and its tributaries (F-5).

103. In any negotiations about trading lands with Sugarbush, the U.S. Forest Service should give priority to acquiring land or easements along the Mad River and its tributaries (F-6).

104. Valley towns should provide parking, boat access, and path maintenance at important access points to the river that lie in town-owned road corridors and rights of way. Risks and potential liability should be considered carefully for each access point, and the access designed accordingly. Specifically, the town of Waitsfield, with assistance from the Mad River Path Association, and the Friends of the Mad River, should seek permission to develop the parking area at S.G. Phillips, with consideration being given to bathroom facilities (portable toilets) and a plan to control stormwater runoff from the parking lot to avoid harming the stream bank or river (F-3).

G. Promote planning efforts and necessary legislation

Long-term protection of the Mad River depends on planning ahead to prevent problems. Several related recommendations have been made, such as cooperation between valley towns, legislation on forestry practices, and broad-based tax reform.

Recommendations about long-term planning and legislation

105. Representatives from the towns of Duxbury and Moretown should be included in the Mad River Valley Planning District deliberations on all matters relating to protection of and/or impacts on the Mad River. Formal arrangements should be established among the five valley towns (A-2).

106. Town planning commissions, in cooperation with Friends of the Mad River, should inventory wildlife in the watershed, including migratory species, and develop guidelines for supporting wildlife habitat and corridors. Subsequently, town planning commissions should prepare maps showing the areas and cover needed. Towns should incorporate wildlife corridor information in town plans (R-1).

107. When imposing fines for violations of permit conditions and water quality standards in the Mad River, the Agency of Natural Resources and the courts should ensure that fines collected are used to remedy damage to the river, enhance overall river habitat and condition, and fund educational programs about river protection (A-10).

108. To ensure that Vermont maintains a sustainable, continuous-yield forest resource, the provisions of Title 10 of the Vermont Statutes Annotated (VSA) Chapter 83 should be implemented by the Agency of Natural Resources. Also, the law should be amended as necessary to provide for effective implementation of sustainable forestry in Vermont (J-6).

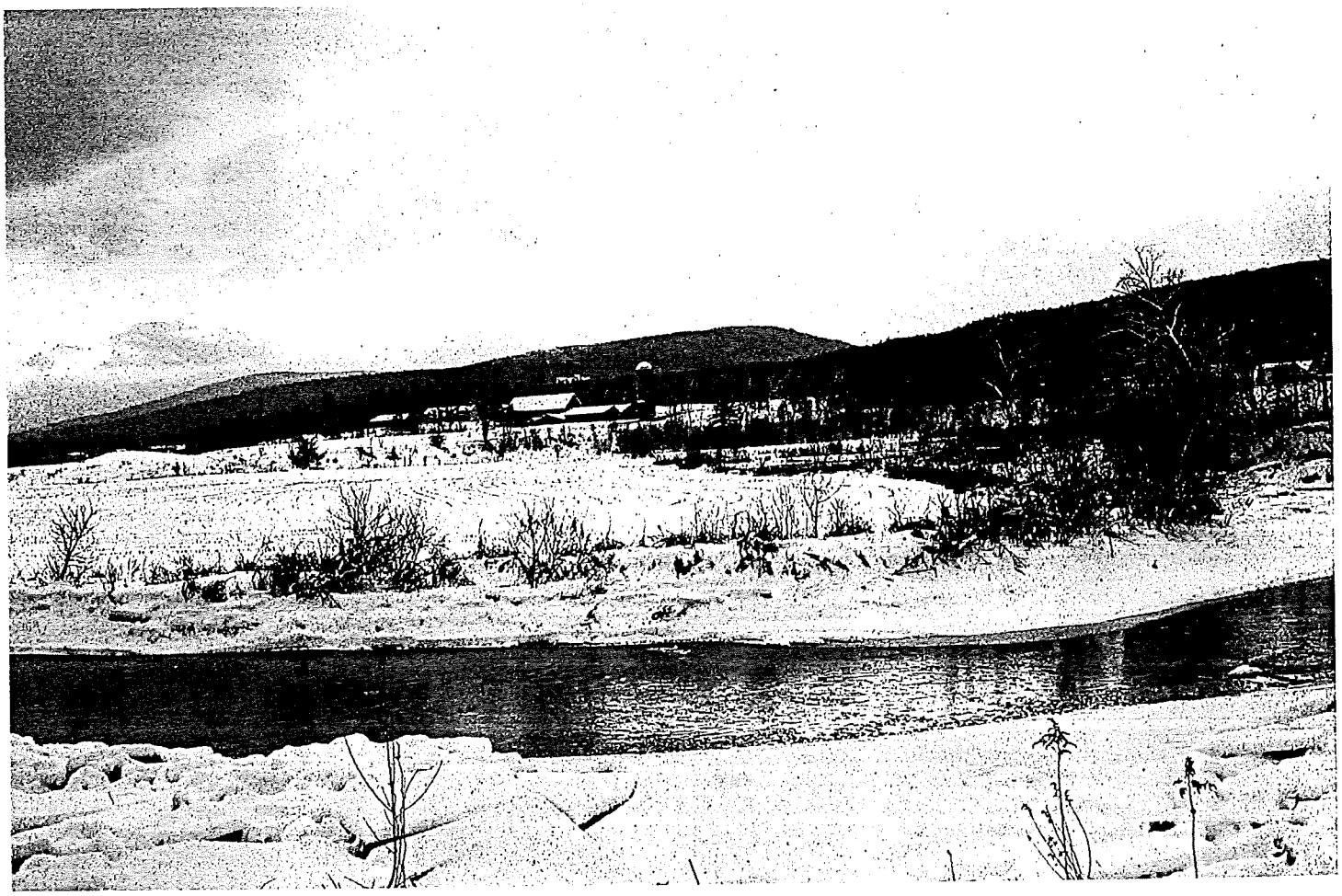
109. To provide funds to oversee and manage the forest resource as required by law, and to ensure that economic incentives are available to foster forest resource, broad-based tax reform should be undertaken by the Vermont Legislature to ensure that forest lands are taxed on the income they generate. This tax reform should provide economic incentives for good, long-term forest management practices, and disincentives for owners' actions that jeopardize a sustainable and productive forest resource (J-7).

110. The Agency of Natural Resources should, if possible, require that wastewater treatment plants include facilities adequate for accepting septage from surrounding communities (K-3).

111. The Mad River Valley Planning District, and the Friends of the Mad River should explore the availability of funds from the U.S. Forest Service and other sources to develop a more detailed sustainable use/economic/natural resource plan for the Mad River Watershed (L-2).

112. Broad-based tax reform should be initiated by the Vermont Legislature to ensure that agricultural lands are taxed on the amount of income generated, not on fair market value to help preserve agricultural land in the state (Q-8).

V. Conclusion—
Protect and restore the Mad River Watershed



Dana Jinkins

V. Conclusion— Protect and restore the Mad River Watershed

In the Mad River Watershed, as in any other place on earth, people are a large part of the forces affecting the complex dynamics of ecosystems. To avoid destroying the very environment on which we depend for our livelihood and enjoyment, we must become more aware of the natural processes of the river and the land in the watershed. We must observe carefully and try to see clearly how our activities affect the natural environment, in which there is constant change.

Preparing this plan has clarified our vision and increased our awareness of the Mad River. We have discovered many problems, and threats to the river and to the land in the watershed. In our efforts to understand these problems and threats we have found that there are many actions we can take to avoid or solve them. These actions have been outlined in the plan's recommendations.

The task now is to bring these recommendations to fruition. This will not be an easy or quick job, but it will be a satisfying and rewarding one for all of us who are concerned about the well-being of the Mad River.

Protecting and restoring the Mad River is a critical part of ensuring the health and prosperity of our valley communities.

Appendix A

Summary of the Mad River forum responses by category

Ann Day

Appendix A

Summary of the Mad River forum responses by category

Three river forums were sponsored in Warren, April 27; Moretown, May 3; and Waitsfield, May 5, 1994 by Friends of the Mad River, and the Mad River Valley Planning District as part of the Mad River plan project. The goal of the project was to involve valley residents in developing a conservation plan to be used by local and state officials, individuals, and groups to guide decisions and actions on issues that affect the river.

More than 100 residents participated in the river forums, which were preceded by an open house, at which information on the river and watershed was presented through models, photographs, maps, and demonstrations. Participants then formed small groups to answer the question: "What would you like the Mad River to be like in the future?" The responses by each group were rated (5 points for highest priority, 1 point for lowest priority).

The following table presents the number of points voted for the various concerns or desirable values mentioned (and given at least one vote) at the river forums. Where no vote appears for a topic, that may be because the participants at that location happened to express that particular concern or desirable value in another way, or not at all.

Summary of all river forum responses

	Warren	Moretown	Waitsfield	Totals
High-quality/Swimmable	41	36	51	128
Public access	47	16	49	112
Healthy ecosystems	16	47	25	88
Education	21	30	35	86
Limited development	42	30	—	72
Very-high quality	53	—	18	71
Wildlife habitat	40	7	16	63
Scenic	27	10	19	56
Stable stream banks	31	5	18	54
Control erosion in watershed	—	47	1	46
Tree-lined stream banks	—	40	5	45
Remove gravel	11	12	15	38
Path	13	3	19	35
Deeper pools	4	29	—	33
Control pollution	3	—	28	31
Privacy/seclusion	18	—	12	30
Natural/free flowing	10	15	—	25
Better fishing	12	2	9	23
Landowners' incentives	—	20	1	21
Management and protection	3	5	11	19
Respect for river	14	—	—	14
Snowmaking	6	6	1	13
Navigable	8	—	—	8
More dams	—	8	—	8
Public events	—	—	7	7
No snowmaking	—	—	7	7
Water quantity	1	4	—	5
Economy/tourism	3	—	—	3
Economy	—	—	2	2

The votes that each small group gave to the various concerns or desirable attributes for the river are summarized on this page. The categories are broad (some responses could be listed in more than one category) and are not meant to be rigid groupings of responses, but rather are simply used to highlight issues that need special attention.

A. Water quality

High water quality/swimmable—128 points
Very-high water quality/potable—71 points
Control runoff and pollution—44 points

B. Condition of riverbanks and riverbed

Limited development along river—77 points
Preserve scenic qualities of the river—56 points
Stable stream banks—54 points
Control erosion/sedimentation—48 points
Tree-lined stream banks—47 points
Gravel removal—38 points
Deeper pools in river—33 points
Natural/free flowing river—26 points
No gravel removal—4 points

C. Uses and access

More public access—112 points
Recreation path—35 points
Preserve private and secluded areas—30 points
Better fishing—23 points
Snowmaking—14 points
Economics/tourism—12 points
Recreational uses—11 points
Dam—8 points
Navigable/no barriers—8 points
Public events—7 points
No expanded snowmaking—7 points
Water quantity—5 points

D. Wildlife/river ecosystems

Healthy ecosystems—88 points
Better wildlife habitat—63 points
Treat for black flies—3 points
Beaver control—0 points

E. Education and awareness

Education about the river—90 points
Respect for river—20 points

F. Management and protection

Landowners—respect/incentives/compensation—26 points
Management and protection measures—24 points

G. Other

In the following detailed listings

- W=Warren forum; M=Moretown forum; WT=Waitsfield forum
- The code in the left-hand column identifies the forum site, the small-group number, and the response. Thus "W-3-c" indicates Warren forum, small group 3, response c.
- The numbers in parenthesis after each response from the small group represent individual votes, and the total for each response. No number in parenthesis indicates that the response has been combined with another response (in which case that is mentioned), or no points voted.

Appendix A

Summary of the Mad River forum responses by category

A. Water quality

High water quality/swimmable (128 points)

WT-3b Clear, clean water, less sand pollution, no downgrading, no discharge (WT-3-b, u, x: 5+5+5+4+4= 23 points).

W-3c Free of sources of external pollution, i.e., septic, industry, agriculture (clean enough to swim in August) (W-3-QC: 4+4+4+5+5 = 22 points).

WT-3d Safe place to swim—deep, cool pools even in August (combined with f, g, s, o, q and summarized as follows: Safe place to swim, shade trees, public access, family recreational areas (WT-3d, f, g, s, o, q: 5+4+3+3+3+2= 20 points).

W-1j Swimmable/drinkable river and tributaries (W-1j, y: 3+5+5+1+5= 19 points).

M-3d Suitable for fishing, swimming, canoeing—free of pollution (5+4+5= 14 points).

M-2g Water quality standards met at all swim holes (1+1+5+5= 12 points).

M-3f River sewage-free with purification if necessary (1+5= 6 points).

M-2c As it is now but cleaner (4 points).

WT-4e Clean water running free; flora and fauna undisturbed, algae limited, swimmable, playable, non-odoriferous; serve the people of the valley and the economy in meaningful ways (1+2+1= 4 points).

M-1b Clean water (combined with Response w).

W-6q Swimming.

Very-high water quality/potable (71 points)

W-6o River and headwaters with very-high-quality water, including monitoring and sustained biodiversity (W-6Oa, b, f, k: 4+4+5+5+5+5+5= 33 points).

WT-4k Plan for goal of potability of river water (5+5+4+4 =18 points).

W-7b Clean, drinkable water (4+4+4= 12 points).

W-5h Potable along entire length (5+3 = 8 points).

Control runoff and pollution (44 points)

WT-4a Less degradation of river from septic, salt, and fertilizer runoff (4+5+5= 14 points).

WT-1n Control runoff, septic discharges, increased pesticide buffers. (WT-1n, q: 1+4+2+2+3= 12 points).

M-3w Safe use of river for agriculture (1+3+4= 10 points).

M-3h Addressing runoff along river banks (3 points).

W-1m Detoxified roadways (3 points).

WT-3n Salt shed away from river (2 points).

W-6d Monitoring of household effluent leaching into river (combined with Response o)

WT-1q Increased pesticide buffer zones (combined with Response N).

W-1aa Top Gas station removed and land restored.

W-1bb No cows in river.

W-1cc No cows next to river.

M-2h Easier waste-oil collection process.

M-3k No salt shed.

B. Condition of riverbanks and riverbed

Limited development along river (77 points)

W-3b Natural shaded shorelines without development along river (3+5+5+5+1+5= 24 points).
M-2i Maintain existing productive agricultural lands along the river (3+5+1+2= 11 points).
W-1a No riverside development (5+3+2= 10 points).
M-1c Farmland along the river (5+2+2= 9 points).
M-1i Keep valley rural (1+2+3+2= 8 points).
W-1i Watershed-wide protection from development (5+3= 8 points).
W-7u 100-yard green belt from the river (5 points).
M-1l Limit additional development near the river (1+1= 2 points).
W-6g Reasonable setbacks prescribed for development (100' outside village, 50' inside village) (combined with Response ai).
W-1g Open meadows to water's edge.
W-6u Don't want to see too much encroachment of civilization on it.
W-7i No further shoreline development.
WT-2p Zero growth. No commercialism of the river.

Preserve scenic qualities of the river (56 points)

WT-4o Preserve scenic quality and character as it is today (The historic and natural beauty of the valley) (2+3+3+5= 13 points).
W-1ff Kept scenic and trash free (W-1z, ff: 5+1+3= 9 points).
W-5i Picturesque—fewer guard rails, telephone lines etc.; no mercury vapor lighting, more natural (2+5+1= 8 points).
M-2l Maintain pastoral character of river (4+3+1= 8 points).
W-6c Pastoral (4 points)
W-3S Crooked riprap, contour management (3 points).
WT-2u View variety of scenes along river (villages, wildlife, etc.) (2+1= 3 points).
WT-1j No ugly riprap/no graffiti (3 points).
W-6m Protected aesthetically along its course, along its "viewshed" (1+1= 2 points).
M-1x Designated scenic corridors/aesthetic from roads (1+1= 2 points).
W-1z No trash on riverbanks (combined with Response FF).
W-5t Gentle, natural and beautiful (combined with Response I).
W-5z Free from mercury vapor and other high-intensity lighting fixtures (combined with Response I).
WT-3a Less trash at Ward Access.

Stable stream banks (54 points)

W-6ai Stream bank protection, including alternative to riprap, tree and vegetative planting, erosion prevention, buffer, reasonable set backs for development (W-6ai, aa, vg: 5+4+4+4+4+3+2= 26 points).
WT-3e Stabilized stream banks (combined with I, R, T, and V and summarized as follows: Stabilized stream banks, control of brush trees, riprap, no riprap (WT-3i, r, e, t, v: 5+5+4+4= 18 points).
M-3y Identify and use best way to protect banks (2+3= 5 points).
W-3i Curb erosion, keep it natural (3 points).
W-1gg No erosion (2 points).
M-2aa Help to protect riprap.
M-3x Use of riprap to protect banks.
W-5cc Within its current banks.
WT-4f Control erosion of stream banks.

Control erosion/sedimentation in the watershed (48 points)

M-3a Clear and clean, even after rainstorms (1+5+5+5+5+3= 24 points).
M-1j Reduce erosion in the watershed (3+3+4+4+4+5= 23 points).
WT-3x Less sand pollution from tributaries near ski resorts (combined with Response b).
W-1x Plowing to river bank discouraged.
W-6w Full. Slow runoff. Less pavement.
WT-4c Encourage more strict enforcement of erosion control—wherever soil is disturbed, law should be enforced.

Summary of the Mad River forum responses by category

B. Condition of river banks and riverbed—continued

Tree-lined stream banks (47 points)

M-1a Long stretches of river with mature trees and stable vegetation that provide shade (4+4+5+3+5+5+4= 30 points).
M-2d Provide for riparian buffer strips (50 feet wide) to provide shade on 75 percent of the streams (1+5+4= 10 points).
WT-1o Bank stabilization through innovative methods—specifically vegetation (willows) (4+1= 5 points).
W-1e Tree-lined (4 points).
W-7h Shaded "green" shorelines (2 points).
M-1o Tree-lined/shady (combined with Response a).
M-2w Plant willows and dogwood along banks for erosion control.
W-5d Tree-lined banks (combined with Response m).
W-5ee A forested section of river on both sides that is protected.
W-6aa Protected by continuous, undeveloped, vegetated buffer (combined with Response ai).
W-6j Alternate solution for riprap (tree planting program) (combined with Response o).
WT-3f More shade trees (combined with Response d).

Remove gravel (38 points)

M-2e Remove gravel bars to the low water line; remove or clean up dirt, silt, and sand bars (M-2e, j: 5+5= 10 points).
WT-4n Statute changed to allow controlled, regulated gravel removal. Fish like it better, better for boaters, better for bridge abutments (2+4= 6 points).
W-5g Gravel extracted and managed as a natural resource (3+2= 5 points).
W-1i Restored/dredged to 1925 characteristics (pools by banksides) (5 points).
WT-1a Deep pools protected—gravel removal (4 points).
M-1n Remove gravel to mitigate flooding (2 points).
WT-2w Gravel extraction—valuable resource; good for river (1 point).
W-6n Compromise in gravel extraction so not forbidden entirely (1 point).
M-2j Gravel removal to low water line (summer flows) (combined with Response e).
WT-3i Better control of gravel to include extraction (combined with Response e).

Deeper pools in river (33 points)

M-2a Cold, clear, deep holes for swimming and fishing (4+2+4+4+4+3+4= 25 points).
M-1d Deep, clean, clear pools for fishing/swimming (1+3= 4 points).
W-3h Make river deeper for swim holes and fish management (2+2= 4 points).
M-1f Narrower/deeper channel.
M-3n Deep pools.
W-6p Mixed sun and shade and deep holes (bank stabilization).
W-7s Deep pools/less gravel
WT-1c Cooler and more shaded in summer, with more deeper pools of trout.
WT-3n Restore river to what is once was—deeper, dams (note: there were two responses labeled "n" on the flip chart).

Natural/free flowing river (26 points)

W-1d Unobstructed, free flowing watershed (4+4= 8 points).
M-3m Restoring wildness to the river and keep it free flowing (2+3+2+1= 8 points).
M-1g Free flowing (3+2+2= 7 points).
W-1b Changing with nature (let nature take its course) (2 points).
WT-1d Run free and clean—no new dams (1 point).
M-2k No obstruction to fish migration.
W-5q Undammed except for grandfathered existing dams.
W-6y Maintain the flood plain so the water can flow over the banks.

No gravel removal (4 points)

W-1h No gravel removal (4 points).

C. Uses and access

More public access (112 points)

WT-4b Development of parks along the river without loss of aesthetics; hiking trails; parking; Port-o-lets; access; 75-acre Mary Alice Bisbee tract made public (WT-4b, g, r, t, u, v: 4+5+5+4+1+3= 22 points).

M-1k Adequate rustic/rural access maintained by users, for users of all abilities (combined with Response k) (4+3+4+1+4= 16 points).

W-7e Access in varied forms (2+3+3+4+4= 16 points).

WT-1b Maintain public access, promote recreational use, but manage pollution associated with public use; more accessible (sloping) areas for swimming, fishing, canoeing, public use of Warren Falls.

WT-1e Promote recreational use, but manage pollution problems associated with public use (combined with Response b) (WT-1b, e, i, t: 3+5+2+3+1= 14 points).

WT-2i Mad River State Park (tent-camping and water access) (WT-2i, x: 4+4+2+2+1= 13 points).

W-5b Public access for recreation in more places.

W-5u Swimming areas to include rock beach, nude and natural, shaded, sunny, secluded/crowded, night/day, car/no car, hiking (combined with Response b) (W-5b, u: 4+4+4= 12 points).

W-3a Public access including g, m, n, f, access points to river, and handicapped access (3+4+2+4= 13 points).

WT-3k Camping in certain areas (3+3= 6 points).

W-1u Accessible, but limited developed access (3+2+1= 6 points).

WT-2h Nice swimming accesses (1+1= 2 points).

WT-4p Safe, beautiful swimming settings (2 points).

W-3p. Handicapped access (combined with Response a).

W-5r Maps for visitors and residents showing access for recreation, i.e. jet skis (combined with Response dd).

WT-3g Public access—Warren and Turner Falls (combined with d).

WT-3o Sandy beach access (combined with Response d).

WT-3q Public access to special places, i.e., the Flues, Stone Arches (combined with d).

WT-3s A family recreational backdrop—picnic table, swings, safe for bikes (combined with Response d).

M-2o Protection of access.

M-3e More guaranteed public accesses/river bordered by public path.

W-1p Accessible to all.

W-5k Visible to tourists as a welcome; signs identifying river; attract visitors from afar.

W-7q XC-ski access (winter season uses).

W-7z More accessibility for "kids."

WT-2a Water park stuff for kids—slides.

Recreation path (35 points)

WT-2b Recreational path along the river (5+5+3+3+2= 18 points).

W-5e Places to walk, XC-ski, etc. along river, contiguous, towns' own banks of river (5+2+1= 8 points).

W-3e Warren-Moretown bike path along river (3+1= 4 points).

M-1q Rustic river path (2+1= 3 points).

W-1q Treed path along entire river (1 point).

WT-1k Pathway to walk along river (1 point).

M-2p Bike path from Moretown to Waitsfield.

M-2v Interpretive hiking trail from Warren to Moretown.

W-1ii Bike path.

W-7v Recreation path.

W-7x Pure walking paths.

WT-4g Good hiking trails along the river.

Preserve private & secluded areas (30 points)

W-6l River magic: secret spots retain their character even after river becomes used (3+3+1= 7 points).

W-7k Not overused (1+3+2= 6 points).

W-3d Sense of privacy, not too public, more natural/remoteness (1+4= 5 points).

WT-1p Preserved (non-invasive use only) (4 points).

WT-3j Areas of quiet seclusion—just for looking (3+1= 4 points).

Summary of the Mad River forum responses by category

C. Uses and access—continued

Preserve private & secluded areas (30 points)—continued

WT-1p Preserved (non-invasive use only) (4 points).
M-1h Rustic/rural public access (combined with Response k).
W1-v Less publicized river (1 point).
M-3i Retain present character of swimming holes.
W-1c Secluded swimming holes.
W3-l Signs for public access kept to a minimum.
W-6e Increase natural access (no signs) for swimming and boating.
W-7aa Discreet signs.
WT-2r Enjoyed as a private place to go.

Better fishing (23 points)

W-6a A river that supports higher natural fish populations (3+3= 6 points).
WT-4d Fly fishing only in designated portions of river (2+3= 5 points).
W-7f Blue ribbon trout stream (fishery management) (5 points).
WT-2l Kids able to catch trout born and raised in river (4 points).
M-2y Abundant wild trout populations (2 points).
W-5c Abundant stocks of all three species of trout and spawning salmon (1 point).
M-1r More native trout and trout habitat.
M-3j Become high-quality trout stream again.
M-3p Native fish—no zebra mussels.
W-3y Lots of natural fish populations (crossed out).
W-6ah Turn it into blue ribbon trout waters.

Snowmaking (14 points)

WT-4j Responsible amount of water provided to Sugarbush (1+2+5= 8 points).
W-7t Resolve water withdrawal issues (2+3+1= 6 points).
W-6x Cautious use of water extraction.
W-7bb Snowmaking.

Economics/tourism (12 points)

M-1m River contributes to economy but maintain river's health (2+3+2= 7 points).
W-6h A river that supports multiple uses (2+1= 3 points).
WT-2s Clean commercialism (non-polluters, laptop recharge areas at hydro plant) (2 points).
W-3g Fish farms for Mad River fish farm products.
W-6ag A river that can both attract visitors and enhance the lives of valley residents.
W-7r Ecotourism generating profits with a percentage back to river.
WT-4m Balance commerce and economy so folks who've grown up here can still feel comfortable living here and not have to leave.
WT-4s Campaign to increase outside of the valley the recreational resource the river provides—bring money to the valley. Doable.

Recreational uses (11 points)

M-3b Greater recreational opportunities—canoe, fish, swim, improved fish habitat (4+4+1= 9 points).
WT-3h Recreational activities, i.e., canoeing, swimming (holes), fishing (1 point).
W-7w Appropriate boating.

Dams (8 points)

M-3c More hydropower developed—replacing old dams (4 points).
M-1e More power from Moretown Dam (4 points).
W-1dd Occasional wooden dams, strategically located.
W-3v Small in-river hydro projects.
W-6af Water power can somehow be used in an appropriate area.
WT-2c Unobtrusive small hydropower plant.

Navigable/no barriers (8 points)

W-6i Navigable: no more dams, fences, other impediments. Also means access (5 points).
W-5bb Possible to canoe entire length with public portages as needed (4 points).
WT-2t Canoe length of river.

Public events (7 points)

WT-4l Summer river festival—Big! (1+3= 4 points).
WT-1r Music festival to help fund river management (3 points).
M-1v Triathlon.
W-5j More municipal activities—races, swimming, derbies, events, annual photography contest.

No expanded snowmaking (7 points)

WT-4i Sugarbush would not go through with water extraction project (3+4= 7 points).

Water quantity (5 points)

M-3o Sufficient flow for snowmaking, irrigation, and recreation. Balance between uses (4 points).
W-3r No droughts—enough water (1 point).
M-2n Higher water levels (especially at power dam in Moretown).
WT-3p Maintain water level appropriate for boating.

D. Wildlife/river ecosystems

Healthy ecosystems (88 points)

WT-3l Continued good fishing in tributaries and good health of tributaries (2+2+2+1= 7, 1 M-1w. Aquatic habitat and water quality for all inhabitants (clean water). (1+5+5+3+5+1+3= 23 points).
WT-1s Improve overall health and quality of river (4+5+5+4= 18 points).
W-7a Healthy balanced ecosystem (5+5+1+5= 16 points).
M-3v River ecologically healthy (3+5+4+2= 14 points).
M-2b Keep the river clean, healthy and alive (5+5= 10 points).
W-6f Healthy (combined with Response o).
W-7j Alive.

Better wildlife habitat (63 points)

WT-2f Be able to see wildlife along the entire river (combined with k and m and summarized as follows: Encourage more use by wildlife and less by man (and woman). (WT-2m—Wildlife watches: combined with Response f) (WT-2f, k, m: 5+4+4+3= 16 points).
W-6ab Maintain the animal habitats, especially beaver ponds in the headwaters (3+3+2+2= 10 points).
W-1t Wildlife corridors plus wildlife using river (W-1t, w: 4+2+3= 9 points).
W-3o Support for fish and other wildlife (2+2+3+1= 8 points).
W-5m Better habitat for animals and birds; posted ARPAs for birds, wildlife—ospreys, otters, kingfishers (2+5= 7 points).
M-2t Provide good fish and wildlife habitat (3+2+1+1= 7 points).
W-1ee Wetland conservation (2+1= 3 points).
W-6ad Nurture all types of ecosystems (1+2= 3 points).
W-6k Sustained biodiversity (combined with Response o)
W-7n Increased species diversity (combined with Response a).

D. Wildlife/river ecosystems—continued

Better wildlife habitat (63 points)—continued

WT-4q More natural environment for ??? Black flies (3 points)
W-3f Treat river for black flies (3 points).

Beaver control

M-2s Stop the beavers.
WT-3w Beaver control.

E. Education and awareness

Education about the river (90 points)

WT-2e Education (training to teach proper uses and maintenance; information about access and safety (combined with J, N, and O and summarized as follows: Education and resource awareness (Training with outreach) (j, n, o: 5+5+4+3+3+2= 22 points).
M-2f Educate adults and students (through elementary and high school curricula) about the river (M2-f, q: 4+3+2+5= 18 points).
WT-1g Education to teach respect, history, natural living history of river; identification of historic site uses (WT-1g, h, m: 2+2+3+5= 12 points).
W-1f Children and adult education (re: river and watershed) (2+1+4+4= 11 points).
M-1u Communities knowledgeable about water resource issues (5+5= 10 points).
M-3g More awareness of river—promoting the natural resource to give people incentive to treat it well (2+2+3= 7 points).
W-7g Source for learning (3+1+2 = 6 points).
W-6r Education center to share information about river to locals and visitors (2 points).
M-3u River as part of school curriculum (1 point).
WT-3m River educational resource for school and community (1 point).
W-5w Ninety percent of citizens should be river literate (1 point).
W-5x Classify fish, wildlife, and vegetation at accesses (1 point).
M-2q Information to landowners about runoff contamination (combined with Response f).
W-1k Public education, re watershed (combined with Response f).
WT-1h More awareness of natural history of river (combined with Response g).
WT-1m Education program to teach kids respect, history, natural history and living history of river (combined with Response g).
WT-2j History of valley and maps in educational center and available in libraries (watershed awareness) (combined with Response e).

WT-2n Summer programs for kids to learn how to use (fishing, canoeing etc.) and appreciate it (combined with Response e)

WT-2o Awareness of natural areas, environment, people-growth center (combined with Response e).

W-5aa Information available where public can access it (combined with Response dd).

M-3r More information available about history of river.

M-3s Potential point source pollution-sites identified.

M-2u Educate the Agency of Transportation and towns on impact of road.

W-3x Knowing flow rate at various places on river.

W-5o All elementary students should study watershed as a major unit.

W-5p A place of education, i.e., mill, underwater viewing place, etc., practices.

W-7l Historical awareness related to power, settlements.

Respect for river (20 points)

W-5a The Mad River to be viewed as the "Signature" of the valley (W-5af & ff: 5+5+3= 13 points).

M-3t People thinking about themselves as living in a watershed—both socially and naturally (4 points).

WT-1l Recognized as a resource and a valuable asset to be husbanded as such (2 points).

W-7m River respect, and community identity with the river (attitude) (1 point).

W-5f The rope that ties the towns together politically, economically, etc. (combined with Response a).

W-1s People using the river cooperatively (working together for the river).

W-3m Reputation for having been preserved, but used and enjoyed.

W-6ae River viewed as a valley asset worth protecting.

W-6z Remains revered and respected as namesake of the valley.

F. Management and protection

Landowners—respect/incentives/compensation (26 points)

M-2r Landowners of valley benefit from the recreational activities (2+2+2+3= 9 points).

M-2m Landowners compensated for good land-management practices (3+3= 6 points).

WT-3c Respect for people's property along river (4+1+1= 6 points).

M-3l Financial incentives for improving agricultural practices (1+2= 3 points).

M-2x Respect for landowners by users (2 points).

W-6s Good relationship with property owners or an easement.

Management and protection measures (24 points)

WT-1f River should be managed in the context of a comprehensive river/watershed plan (5+5+1= 11 points).

WT-2d Local land trust for conserving land in the watershed (5 points).

M-3q Town and schools adopt portion of the river for conservation (5 points).

W-5l Protection plan in effect to maintain vision of forums; town ordinances to protect river (3 points).

W-5s An ombudsperson for the river (combined with Response l).

W-1o Ongoing planning process occurring.

W-3aa Public acquisition, easement as a tool.

W-5y Service clubs sponsor "miles" along river.

W-6t Improved conditions and continual restoration through a management plan.

WT-2q More monitoring of river.

WT-4h Preserve some stands of old trees to grow old and huge for their spiritual values. A balance between harvest and preservation (3+4+1+3= 11 points).

W-5dd A book about the Mad River (4+1= 5 points).

W-5n Places to buy approved skipping stones and places to skip them (1 point).

WT-2v Two-lane river—flowing in both directions (1 point).

W-1hh No exotic plants.

W-1n Tree swings (ropes) into pools.

W-1r Surfing wave—"the big one."

Summary of the Mad River forum responses by category

F. Management and protection —continued

Management and protection measures (24 points)—continued

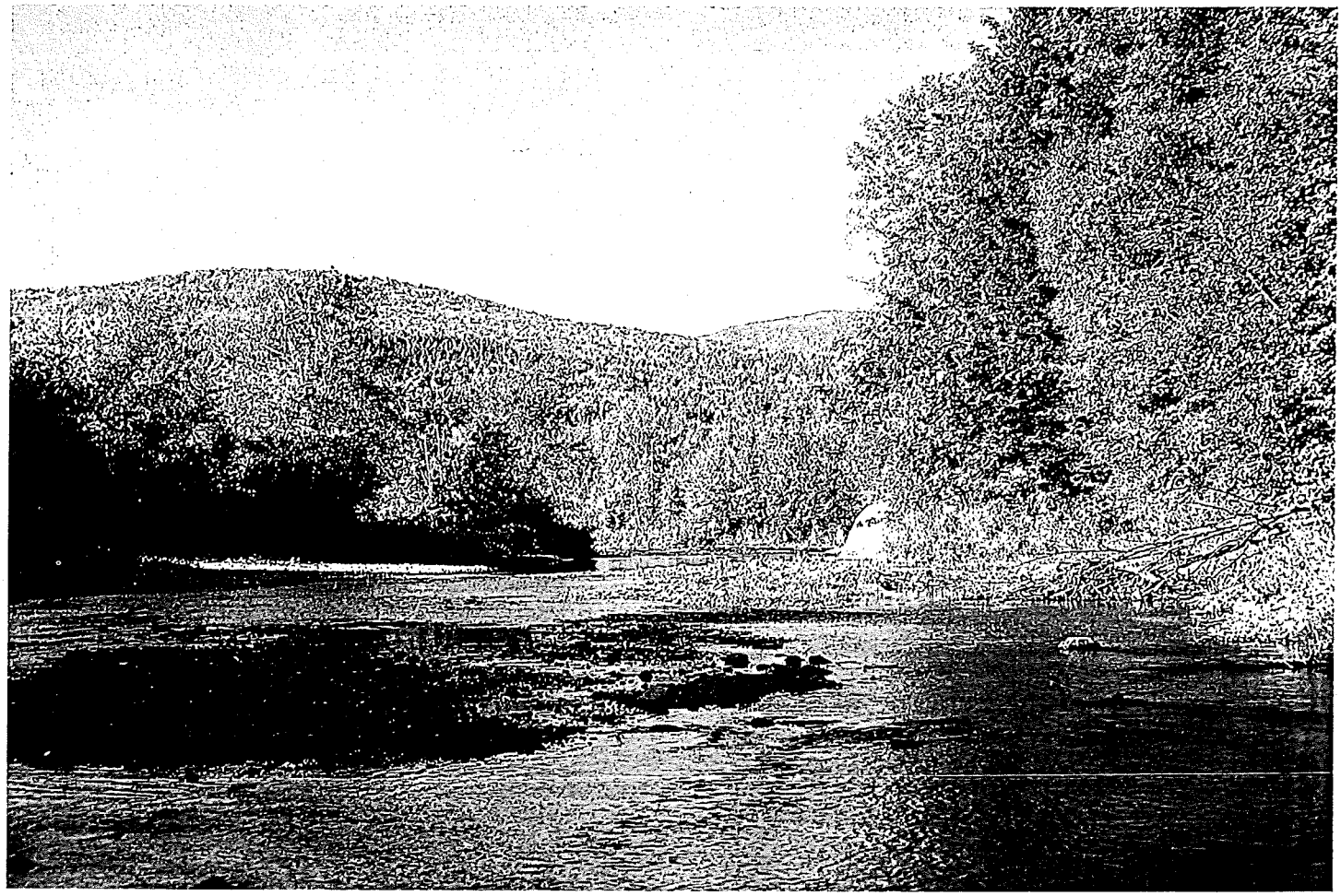
W-3n Ice skate from Warren to Moretown.
W-3t Maintain historic bridges.
W-3z Zero crime on river.
W-5v To be photographed more (combined with Response dd).
W-6ac Maintain the covered bridges.
W-7c Sustain current river values.
W-7d Still there.
W-7p Really cool bridges.
WT-2g Big waterfall north of Warren.

G. Other

WT-4h Preserve some stands of old trees to grow old and huge for their spiritual values. A balance between harvest and preservation (3+4+1+3= 11 points).
W-5dd A book about the Mad River (4+1= 5 points).
W-5n Places to buy approved skipping stones and places to skip them (1 point).
WT-2v Two-lane river—flowing in both directions (1 point).
W-1hh No exotic plants.
W-1n Tree swings (ropes) into pools.
W-1r Surfing wave—"the big one."
W-3n Ice skate from Warren to Moretown.
W-3t Maintain historic bridges.
W-3z Zero crime on river.
W-5v To be photographed more (combined with Response dd).
W-6ac Maintain the covered bridges.
W-7c Sustain current river values.
W-7d Still there.
W-7p Really cool bridges.
WT-2g Big waterfall north of Warren.

Appendix B—Topic Paper A

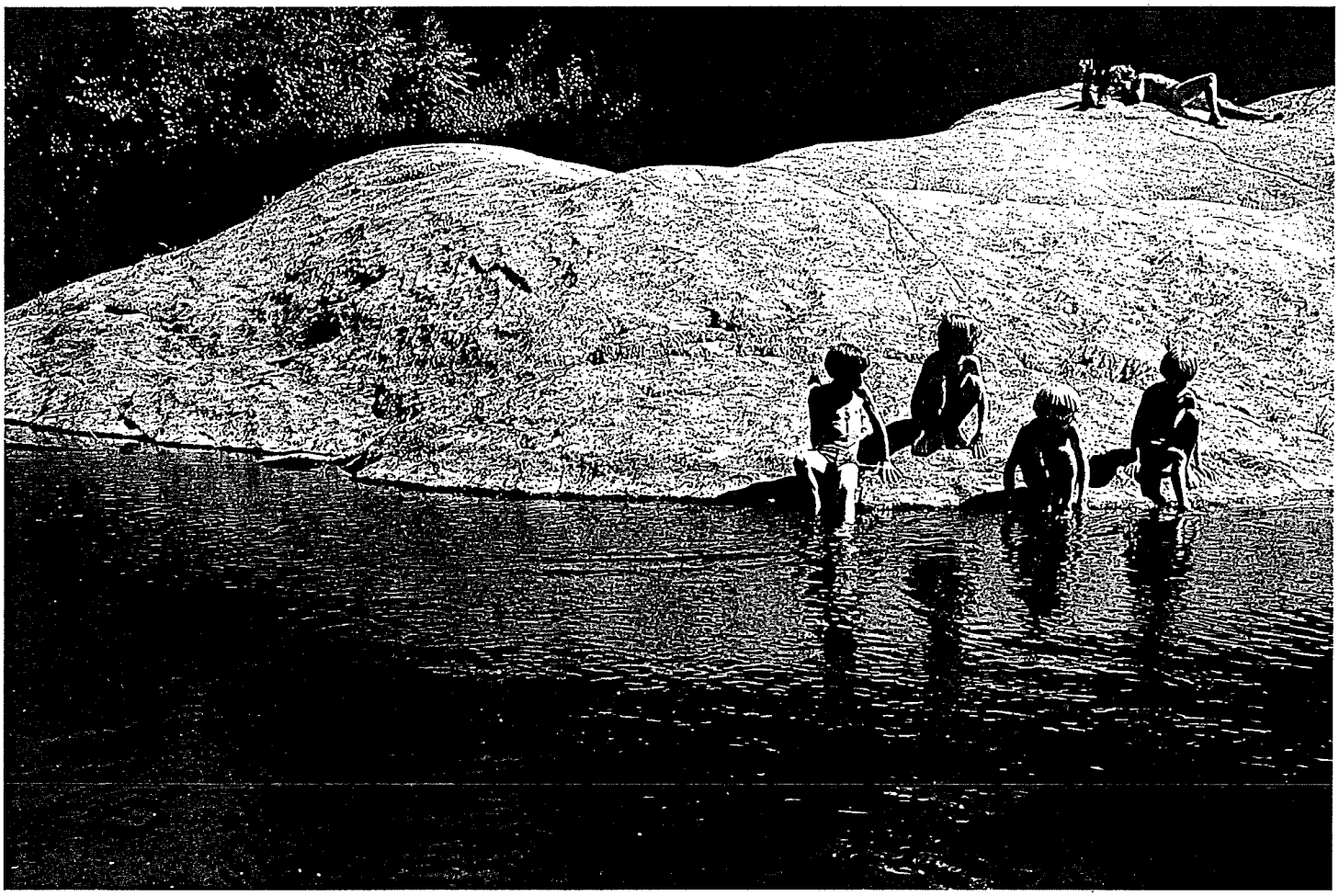
River health



Ann Day

Appendix B

Topic papers



Ann Day

A. River health
B. The fishery—problems and potential
C. On-site sewage disposal and river protection
D. Gravel removal—concerns and impacts
E. Water withdrawal
F. Public recreational access
G. Swimming
H. River path
I. Education and protection
J. Logging and forestry
K. Sludge and septage disposal
L. Cumulative impacts and river assimilative capacity
M. Stormwater runoff
N. Boating
O. Roads
P. Construction practices
Q. Farming
R. Wildlife
S. A brief natural and cultural history of the Mad River Valley

I. Introduction

The Mad River is more than swimming areas; boating corridors; fishing areas; waste disposal areas; a source of energy, sand and gravel; and a source of water to make snow, irrigate crops, or fight fires. It is "home" to an interconnected web of creatures, many of which we never see or think about. Yet, because the uses we make of the river have tremendous impacts on these communities, the health of Mad River is our responsibility.

II. The river as a community

Once we begin to think of the river as a web of living organisms bound together by water, we should begin to wonder how our uses of the river affect that community. We should also begin to wonder what that community is like.

We can think of the Mad River's community as part physical, part chemical, and part biological. The physical layout and foundation for the river community is flowing water and its relationship to the land area that drains into the river—its watershed. It is water rushing through Warren Falls, or flowing lazily through the oxbow in Moretown. It is a physical process, cutting a channel through rock and soil, and carrying eroded material downstream.

The river's chemical characteristics are the basic building blocks for a river community. These include the water's oxygen content (dissolved oxygen), acidity (pH), ability to neutralize acid (alkalinity), nutrients, metals, and other constituents. In the absence of human influence, water chemistry is determined by the soils and rocks in the watershed, the chemistry of the precipitation, and interaction with plants and animals on land and in the water. It profoundly affects and is affected by aquatic organisms.

The biological inhabitants of river communities are wonderfully varied—from single-celled plants and animals, aquatic insects, and other small residents to large fishes. Flowing water is the thread that binds this living community within itself and with the surrounding land.

How does this community work? A leaf falls into a small stream high in the Green Mountains. It is attacked quickly by bacterial and fungal "decomposers." Some of the nutrients in the leaf are dissolved in the water, and flow downstream until taken up by aquatic plants or decomposers. Aquatic insect "shredders" (such as caddis fly larvae and snails) feed on the leaf and its attached "frosting" of decomposers. Meanwhile, "grazers" (such as mayfly nymphs) feed directly off living aquatic plants. Grazers and shredders reduce plant tissue to smaller particles, some of which are used by insects to grow. Excreted or unused food is washed downstream, and this detritus provides food for the "collectors," such as black fly larvae and worms. The insects themselves provide food for other predatory

II. The river as a community—continued

insects and fish. Some organic material is stored (as insect or animal tissue), some is cycled (changed to different forms), and some is released to flow downstream. Downstream aquatic communities take advantage of inefficiencies upstream.

River communities are neither homogeneous, nor static. The Mad River community changes dramatically from its headwaters to its mouth, from season to season, and from year to year. However, healthy rivers are remarkably stable communities owing to a diversity of organisms. Since many aquatic organisms are opportunistic, they can adapt to changes in the food supply. Diversity means a menu of food choices for aquatic life. If these choices are reduced owing to alteration of the physical or chemical aspects of the ecosystem, the community will become less diverse. Organisms that are most effective in using the remaining food sources will dominate, and others may disappear. Serious disruptions may eliminate large portions of the community.

III. Human impacts on the river community

People can affect rivers directly by dumping things in them or changing their channels. They can change things indirectly by changing the land through which the rivers flow. Let's assault a hypothetical river and see how a chain of events can be set in motion throughout the aquatic ecosystem.

Dumping sewage into a river results in organic material decomposing, which consumes oxygen and adds nutrients to the water. As decomposers go to work they use oxygen in the water (oxygen demand). If we put too much organic material in the river, it can't replace oxygen fast enough, and demand for oxygen exceeds supply. Fish like salmon and trout need high oxygen levels in the stream to survive. Aquatic organisms that need the most oxygen will suffocate first, reducing the food choices for surviving species. If the oxygen drain continues, more species will perish, further reducing the food choices.

When nutrients enter a river from cropland, lawns, and golf courses they encourage aquatic plant growth. These plants may create wild swings in oxygen levels, since they release it during the day and consume it at night. When the plants die and decompose, more oxygen is used. Again, aquatic organisms may suffocate, especially in the wee hours of the morning.

Removing trees from river banks means less bank stability, resulting in erosion and sedimentation, less food from leaf fall, and warmer water temperatures as the sun strikes and heats more of the water surface. Since most biochemical processes speed up as temperature increases, warmer water can push the system into high gear—decomposers work and use oxygen faster. To compound the problem, warm water holds less oxygen than cold water. Some species cannot survive in warm water, either due to lower oxygen levels, or sensitivity to heat.

Sediment (which may have nutrients and other pollutants attached to soil particles) can be contributed by eroding cropland, construction sites, and logging areas in addition to that from natural bank erosion. Sediment clogs the habitat and gills of many aquatic organisms, and catches and holds heat from the sun, causing warmer water temperatures.

Impervious road, parking lot, and roof surfaces speed up the overland flow of water, which means

more water gets to the river faster. Higher flows, more channel scouring, and more erosion (since there's more energy and soil-particle dislodging potential) are the result. Asphalt surfaces also heat the water runoff, so the water entering the river may be warmer than the river water itself.

A dam changes the physical foundation of a river when it replaces rapids and cascades with a reservoir. Above the dam, water velocity is slowed, causing soil particles and organic material to settle to the bottom and cover the riverbed with mud. Oxygen levels are reduced as the organic material, which previously flowed downstream, decomposes. At the same time, oxygen is not replenished as quickly in the reservoir as it was in white water. Downstream of the dam, the flow may fluctuate dramatically if water is stored and released daily. The food supply from upstream is reduced.

A bulldozer or bucket loader taking gravel out of the stream below the water line can change the habitat (gravel beds are important for some insect and fish species) and cause sedimentation by stirring up the bed (see Topic Paper D on gravel removal).

Not only do these actions cause impacts, there is a cumulative effect that may go beyond the total of the individual impacts. For example, if a dam is built and there is a significant upstream influx of organic enrichment, the reservoir behind the dam may become an algal incubator. It spawns so much algae that it consumes much of the oxygen in the reservoir and chokes off other forms of aquatic life.

Like almost any river in Vermont, the Mad is subjected to this treatment to varying degrees in its relationship with humans. These cumulative impacts can grow so severe that the river will no longer support the same aquatic community it once did.

IV. Problems and threats

How is the Mad River doing? In order to measure the river's health we need information on its physical, chemical, and biological components. While there isn't an ideal amount of information, we are fortunate to have the Mad River Watch Program (MRWP), which regularly monitors water quality. The data includes pH, temperature, and turbidity as well as extensive bacteria testing at 38 sites since 1985. In 1988, the MRWP conducted a study of the river's benthic macroinvertebrate communities at 13 sites, and walked 49 miles of the river and its tributaries to document physical characteristics and activities that might affect river health *(Watching the River's Health).*

The Vermont Department of Environmental Conservation has also gathered data on the benthic macroinvertebrate communities at 13 sites, mostly on tributaries. Extensive study within a 2.5-mile section of the river has also been done by Sugarbush in conjunction with its proposed water withdrawal from the river for snowmaking.

Of the water quality data that have been gathered by the MRWP, the most keenly followed is the bacteria data, which are discussed in more detail in Topic Paper G on swimming. That data show that there is a problem with sewage from failing septic systems getting into the river. This problem affects both public health as well as the health of the river community. Nutrient enrichment from failing septic systems may be accelerating the growth of algae in the river and tributaries during low flow periods in the summer. Excessive algal growth in small streams can hinder fish passage and lower the water's oxygen levels. The 1988 stream walk found that algal growth was one of the most common problems identified: 10 instances of light algal growth, and 11 of moderate growth were documented (tributaries had 3 light and 4 moderate; the main stem had 7 light and 7 moderate).

The other water quality data gathered by the MRWP show that the pH (a measure of acidity) and turbidity (a measure of the water's clarity) is generally in the range considered suitable for aquatic life. The temperature data tell a different story—the lower river, roughly from Waitsfield Village to its confluence with the Winooski, is susceptible to high temperatures in the summer. These extreme temperatures (in the range of

IV. Problems and threats—continued

80°F) make the lower river an inhospitable place for trout and other species that require cold water for survival. There are many sections of the river, not just the lower stretch, that are without shrub and tree growth along the riverbanks. These stretches are exposed continuously to the hot summer sun, which warms the water. This is an especially efficient process where the river runs shallow, wide, and slow. The temperature data show also that during the same hot periods, tributaries to the river are generally much cooler than the river's main stem—in the range of 10°F cooler than the main stem at its hottest. This underscores the importance of the tributaries as refuge areas for fish life.

The benthic macroinvertebrate data collected in 1988 are particularly helpful in assessing the river's health. An effective integrator of all impacts on the river—good and bad—a healthy macroinvertebrate community is a sign that the rest of the river community should be healthy. The 1988 data show that the macroinvertebrate communities in the river's main stem at four sites (above and below Warren, below Waitsfield, and below Moretown) were healthy, but less healthy downstream. The data showed also that many of the tributaries were not as healthy as would be desired. Also, macroinvertebrate data gathered by the Vermont Department of Environmental Conservation for tributaries around the ski areas showed that the macroinvertebrate communities there were in fair or poor health.

The stream walk data gathered by the MRWP provide insight into factors that may be causing these symptoms. The top problems identified by the stream walk were: algal growth (discussed above), bank erosion, sedimentation, organic runoff, and trash and debris. With the exception of trash and debris, all these impacts diminish the condition of the river as habitat for macroinvertebrates and other aquatic life. The report made this finding regarding the relationship between these impacts and the macroinvertebrate results:

"There is a significant impact on the aquatic life in the lower reaches of the Mad River starting somewhere around Waitsfield Village to the river's confluence with the Winooski River. The same conclusion can be made about the streams draining the land around Sugarbush ski area.

"It is difficult to be specific about the cause of these observations. The effects are cumulative and the result of a range of activities that take pace on the land around these streams. The most prominent problems that need to be addressed are:

- erosion and resulting sedimentation which destroy the preferred gravely habitat of sensitive aquatic organisms, such as trout and mayflies, which are a primary food source for trout;
- runoff of organic material, such as soil fertilizer and manure, which lowers the oxygen content of the water and accelerates algal growth which, in turn, eliminates habitat space in the stream; and
- loss of stream side vegetation owing to bank erosion and instability, cutting down of vegetation, and riprapping without revegetating, which eliminates shade and causes water temperatures to rise beyond the comfort zone for trout and other species."

V. Existing and potential methods to protect river health

State laws and regulations that address many of the issues outlined above are described in other topic papers. There are also local plans and ordinances that may address some of these problems that affect river health (see the Table, *Summary of stream policies in local plans and zoning ordinances*).

This paper began with the statement that the health of the river is our responsibility. That means each of us living in the Mad River Watershed can make a difference.

Education

The vital first step is to educate ourselves about these impacts and their causes and to learn how they can be prevented or mitigated. We could establish a river resource center where people could obtain materials on river conservation techniques, such as how to stabilize eroding banks in a way that not only fixes the bank, but creates additional habitat. Perhaps a nursery could be started to cultivate native riverbank shrub and tree species to be available for revegetating barren banks. We can also develop education materials and programs for schools that use the Mad River as a real-world example for learning and school projects.

Permits

It is apparent that many of the permits issued are not monitored adequately by state agencies owing to lack of resources. Citizens can take the initiative to ensure that permitted activities that affect the river are being conducted according to permit conditions. They can also be more insistent that state agencies practice proper conservation techniques in their activities. For example, when the Agency of Transportation is improving a roadway along a river, does the Agency (or their contractor) have a sound erosion control plan, and are they implementing it? Has the Agency taken into consideration how it might create additional fish habitat when altering the stream? The same is true for local road maintenance and improvement projects.

Neighbors helping neighbors

We can look for ways that neighbors can help neighbors by creating a volunteer corps willing to assist those who are implementing conservation practices. One example is the assistance Friends of the Mad River provided to the owner of a sand and gravel pit that was leaking large volumes of sand into the river during spring runoff. The Friends arranged for technical assistance to develop a plan for controlling the problem, and provided labor to help seed, fertilize, and mulch critical areas of the gravel pit.

Mad River Watch

The Mad River Watch Program can check on the health of the river more effectively through more frequent collection and analysis of benthic macroinvertebrate communities at key points in the watershed. It could also train people to conduct their own stream inventories so that landowners are able to recognize impacts or potential impacts and how to address them.

Today's benchmark for healthy rivers may be this: let's eliminate or prevent pollution and physical disruption of rivers, and the aquatic communities will take care of themselves. That's a daunting task, given the nature of our culture. But, we have to start somewhere, so let's start by organizing river protection efforts and implementing some of the ideas that we have generated through the process of creating a conservation plan for the Mad River.

Health of the river

Health of the river—the health of the entire web of organisms bound together by water—is a broad topic that encompasses most of the other topics discussed in the topic papers. The health of the river depends on every one of us. It is our responsibility to use the river and the surrounding land so that our uses are not harmful to the river.

The following recommendations are intended to increase our awareness of the river and how our actions affect it, and to propose specific actions that we can take to protect the river's health.

VI. Recommendations

1. Friends of the Mad River and the Mad River Valley Planning District, with the cooperation of the U.S. Forest Service, the Agency of Natural Resources, and valley towns should establish a river resource center where people could obtain basic information about the river and how it works, and on river conservation techniques. The Lareau Swim Hole, or an historic building, such as the General Wait House, would be a suitable location for the center.

2. Representatives from the towns of Duxbury and Moretown should be included in the Mad River Valley Planning District deliberations on all matters relating to protection of and/or impacts on the Mad River. Formal arrangements should be established among the five valley towns.

3. Valley towns should provide information sheets that list telephone numbers for residents to call if river problems or violations of the law are discovered.

4. Friends of the Mad River, and the Mad River Valley Planning District, with the cooperation of valley towns, should start a nursery with purchased or leased lands to cultivate native stream bank shrub and tree species and make them available to revegetate barren stream banks. Part of the nursery program should be developing a stream bank planting plan along barren stretches of the river, as well as areas along the river path, and protecting large trees along stream banks. Also, consideration should be given to including a river vegetation nursery in the Lareau Swimming Hole design.

5. Valley schools, in cooperation with Friends of the Mad River, the Mad River Valley Planning District, state and federal environmental agencies should develop education materials and programs to be integral parts of school curricula, using the Mad River as a real-world laboratory for learning.

6. Friends of the Mad River should organize a "citizens initiative" to help ensure that all state environmental and highway construction permits require sound conservation techniques. This effort should include overseeing development of the river path, and continuing checks that state agencies are monitoring to ensure permit conditions are being met.

7. Friends of the Mad River should use its Adopt-a-River Program to assist landowners who are implementing river conservation practices. The assistance could range from finding technical assistance and funding, to a pool of labor and tools for installing conservation measures. Part of this assistance should be a leaflet for landowners that discusses basic stream and river protection and care. River volunteers should be trained to provide quality assistance. To help with the training, consider an AmeriCorp team, Vermont Youth Conservation Corps, and an adaptation of COVERTS, the UVM wildlife habitat program.

8. The Mad River Watch Program, in cooperation with the Vermont Agency of Natural Resources (ANR), should establish macroinvertebrate sampling stations at key locations in the watershed. For example, stations should be established on Dowsville and Mill Brooks downstream from the intensive logging that is to occur there over the next year or two.

9. The Mad River Watch Program should establish a program to teach landowners and those involved in the Adopt-a-River Program to conduct stream inventories to assess conditions and impacts on the river.

10. When imposing fines for violations of permit conditions and water quality standards in the Mad River, the Agency of Natural Resources and the courts should ensure that fines collected are used to remedy damage to the river, enhance overall river habitat and condition, and fund educational programs about river protection.

11. Individuals should be encouraged to become active members of Friends of the Mad River and participate in river protection efforts.

Summary of stream policies in local plans and zoning ordinances

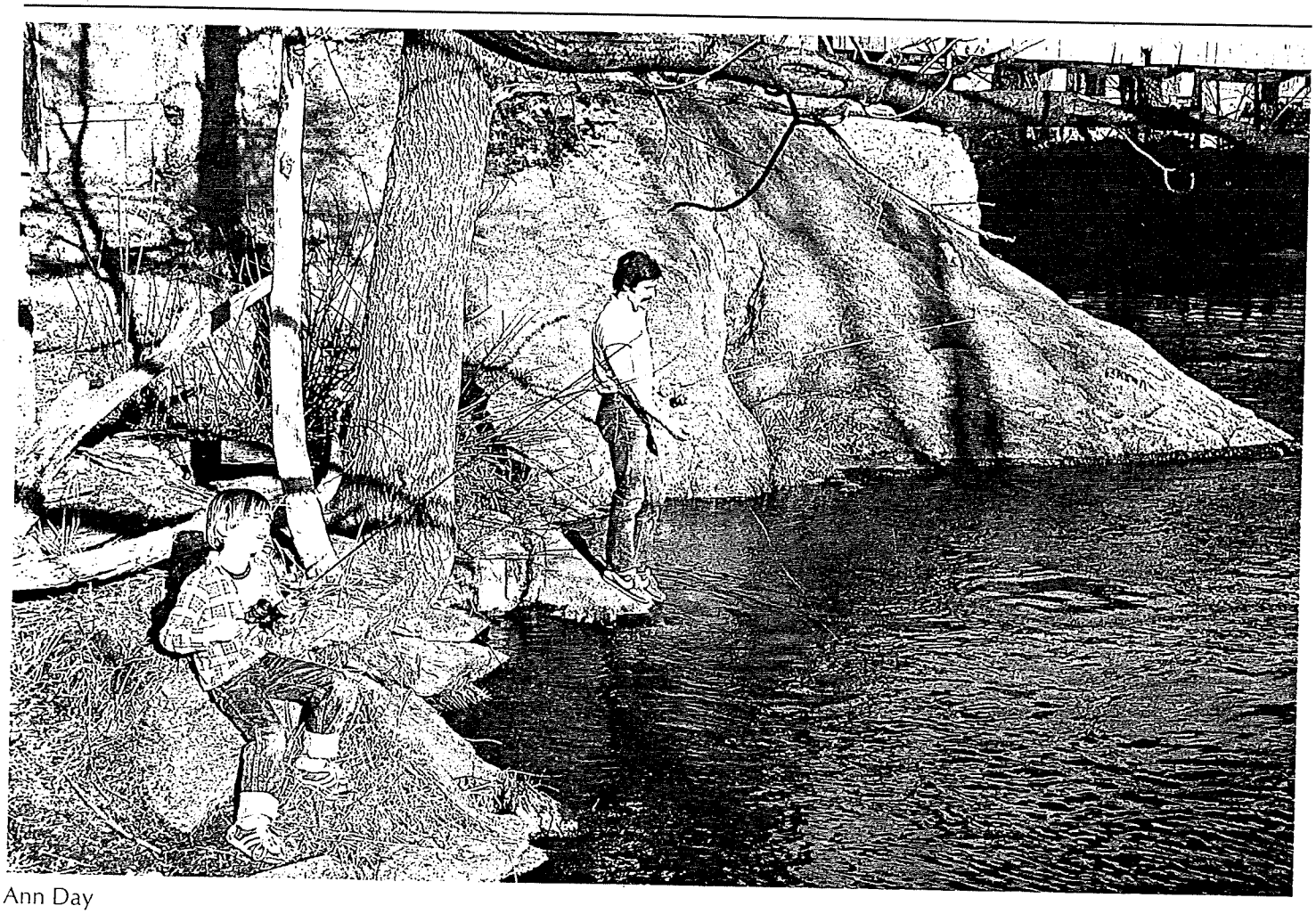
Policy	Fayston	Waitsfield	Warren	Duxbury	Moretown
Addressed in town plan	Yes	Yes	Yes	Yes	Yes
Predominant zoning density	1 unit/acre	1 unit/acre	1 unit/acre	1 unit/5 acres	1 unit/acre
Septic setback from stream	100 ft. and 10 ft. elevations from streambed	50 ft. from bank or 75 ft. from edge	50 ft. and 10 ft. elevations	50 ft. from streams; 100 ft. from ponds, bogs, & wetlands	50 ft.
Building setback	100 ft. and 10 ft. elevations from streambed	50 ft. from bank and 75 ft. from edge	100 ft. and 10 ft. elevations	None	None
Prohibit stream alteration	Yes	No	Yes	No	No
Flood-hazard bylaw	1	2	3	3	3
Subdivision regulations	Yes	Yes	Yes	No	No
Health ordinance	Yes	No	Yes	No	No

Flood hazard bylaw

1 Fayston prohibits all construction in floodplains.
2 Waitsfield has adopted the FEMA model, with more stringent review criteria.
3 Warren, Moretown, and Duxbury have adopted the FEMA model.

Appendix B—Topic Paper B

The fishery—problems and potential



Ann Day

I. Background

Let's have "better fishing," was one of the comments made over and over at the Mad River forums held to help develop a conservation plan for the Mad River. More specifically, people said they want to see:

- a river that supports higher natural fish populations;
- a blue ribbon trout fishery;
- more native trout and trout habitat (free of zebra mussels);
- fly fishing only in designated portions of the river;
- a quality trout stream again; and
- kids able to catch trout born and raised in the river.

The emphasis of the comments by the public was mostly on maintaining and improving *natural* or wild trout populations and habitat

Important water quality conditions for trout to survive and thrive.

Cool temperatures Trout are much less tolerant of temperature extremes than the minnows and suckers in the same stream. In general, trout prefer a temperature range of 54 to 66°F. Excesses in temperature can stress trout severely causing loss of appetite, loss of equilibrium, and eventually death. As temperature levels fall, the trout's activity and metabolism slow. At water temperatures below 50°F, trout may slow feeding and cease growth all together. Trout can survive high temperatures for short periods and will try to avoid temperature extremes by moving to cooler waters, such as groundwater seeps and tributaries.

Plenty of oxygen Dissolved oxygen is essential to fish respiration. Rivers and lakes obtain oxygen from the atmosphere by mixing (water splashing over falls and rapids, or by wave action in ponds and lakes). The amount of dissolved oxygen in water decreases with higher temperature and as organic wastes entering the stream use up oxygen in the decay process. Trout have evolved in a habitat that is well oxygenated, and thrive best in waters that contain as much oxygen as it can hold (saturation). Other fish, such as bass or carp, can extract oxygen and survive at low oxygen concentrations.

Good pH range Acidity or alkalinity of water is measured by the concentration of hydrogen ions in solution. Trout prefer cold, well-oxygenated water with a pH of 6 to 9. Brook trout are the most acid tolerant of trout species and show stress signs at pH 5.5 or less. When pH is too low, edging into the alkaline side of neutral, other species of trout are threatened.

Free of turbidity and siltation Turbidity is caused by suspended matter, such as clay, silt, finely divided organic matter, bacteria, plankton, and other microscopic organisms. Trout need clear water, so when turbidity is high they have more difficulty breathing owing to fouling of their gills, and they become more susceptible to infections and diseases. When suspended matter settles in water it causes siltation—filling the small and larger spaces between rocks and pebbles on the stream bottom. This reduces and degrades the habitat for bottom dwelling organisms on which trout depend heavily for food.

In addition to good water quality, there must be good physical habitat in the stream, on the banks, and in the buffer strip adjacent to the stream.

Stream The stream should have sufficient water flow and depth at all times of the year so that necessary habitat and quality are not reduced. There must be riffles and pools for feeding and resting, and cover provided by rocks, boulders, and large woody debris in the stream.

Stream bank The stream bank is a highly important part of the physical habitat for trout. Bank undercuts and overhanging trees and shrubs provide food from insects falling into the water, and shade to keep temperatures down. A stream bank with adequate vegetation also ensures that the bank is stable.

Buffer strip The buffer strip adjacent to the stream bank is also highly important to trout. It filters out silt, sand, and other materials from water flowing off the land from roads, developments, forests, and farms. The buffer strip's trees, shrubs, and root systems help to protect the stream when the stream bank is damaged by high water flows or spring ice movements.

II. Status of the fishery

The fish habitat in the Mad River basin supports cold water native brook trout and introduced rainbow and brown trout. The only lake in the basin—Blueberry Lake—is an artificial lake that could support a warm-water fishery.

Generally, natural trout populations in the headwaters of the Mad River (above Warren Village) and in the tributaries are excellent. The exceptions are in portions of Clay and Rice Brooks, the watersheds of which are affected by intensive development. Many of the problems on Clay and Rice Brook have been remedied, and trout populations are rebounding. On the other hand, fishing in the main stem of the Mad River is far from ideal. This may be due to poor habitat from lack of shading and resulting high water temperatures, sedimentation, and lack of habitat diversity (such as large woody debris) and in-channel diversity (large in-stream rocks, bank undercuts, and fewer pools too widely spaced).

III. Problems, and threats to the fishery

A. Nonpoint source pollution

Nonpoint source pollution occurs when rain and snowmelt carry pesticides, soil, silt, fertilizer, manure, and other materials into streams and lakes to degrade both water quality and the physical habitat of fish. This nonpoint source pollution can be caused by improper agricultural or riparian land use and logging practices; road and building construction without proper erosion controls, and by mining that does not provide proper stormwater runoff controls.

Siltation is probably the biggest threat to fish because it reduces stream bottom habitat and fish food sources and nesting sites, and because it is so common. Clean substrates are very important to trout because they build redds (nests) in smaller cobble and gravel matter. When these cobble and gravel mixtures become embedded (filled with silt and fine particles), they reduce the oxygen available to trout embryos. Indeed in severe cases, embryos and aquatic insects are smothered and die. Areas with high substrate embeddedness are so smothered they become devoid of life.

Nutrients from nonpoint sources can cause increased algal growth in-streams and lakes, which degrades trout habitat. Other substances coming off the land, such as oil, pesticides, and metals, can accumulate and combine to degrade stream conditions and water quality for fish.

B. Macrohabitat problems

The proposal by Snowridge, Inc. to withdraw water from the Mad River for snowmaking at Sugarbush South Ski Resort has focused attention on the river's trout habitat from the Kingsbury Store location downstream 2.5 miles to the confluence with Mill Brook. This area has been studied by Wagner, Heindel, and Noyes, Inc. for Sugarbush Resort since 1986. Trout habitat conditions were studied, and it was determined that they are far from ideal. The limiting conditions are:

- sedimentation (primarily); also
- lack of adequate, diverse cover;
- high summer water temperatures; and
- a general lack of habitat diversity, and degraded stream bank stability.

Much of this trout habitat degradation is the result of human activity that has been going on for decades. Many of the poor trout habitat conditions that occur in the 2.5-mile section studied are repeated downstream on the main stem through Waitsfield and Moretown where the river empties into the Winooski River. The condition of the river upstream from Warren is much better.

Any river ecosystem is composed of three primary macrohabitat types:

Pools are the areas of a stream that are deeper than surrounding water and have reduced current velocity. It is in pools that trout rest, feed, and find cover.

Riffles are shallow rapids with greater water velocity, and more highly oxygenated water produced by the water's swift flow over partially or completely submerged rocks and boulders. Riffles harbor many species of aquatic insects and are important food factories for trout.

Runs are the areas between pools and riffles. There, water typically flows swiftly but has more uniform flow than riffles. Water depth is greater than in riffles and will not have standing waves or severe agitation. Again, these areas are used for feeding and shelter.

One of the major deficiencies in the studied section of the river is that pools comprise only 37 percent of the stream area. Raleigh et. al. (1986) states that optimal brown trout habitat in rivers contains 50 percent to 70 percent pool habitat, and 30 percent to 50 percent riffle-run habitat. Rainbow trout require a mix of 50 percent pools and 50 percent riffles and runs.

Many of the large pools in the Mad River occur in association with bedrock outcrops, and are widely spaced throughout the river's length. Lacking are smaller pools formed by currents scouring around in-stream boulders or woody debris. These types of pools, where scouring has occurred, are a vital element in trout habitat.

C. Temperature

Trout are a cold water species. High temperatures can limit populations and cause mortality. When water temperatures approach 21°C (70°F), trout lose out to other fish species in competition for a common food supply, according to a study by Reeves and colleagues, reported in 1987. Stream temperatures "preferably should not exceed 65°F," according to Miller & Tibbett in their 1992 *Fish Habitat Improvement for Trout Streams,* published by the Pennsylvania Fish & Boat Commission. Temperatures that exceed 78°F are potentially lethal to trout if they continue for extended periods and if trout cannot migrate to cooler waters of tributaries or cold groundwater seeps. Summer water temperatures in most Vermont streams reach the upper 70s, and temperatures in the Mad River have been recorded in the 72-77° range and higher.

Higher water temperatures in the river can be attributed to many wide and shallow areas that have a large surface area exposed to the warming of the sun's rays, as well as the lack of riparian vegetation. Lack of shading intensifies the problem. The lack of riparian growth is the result of poor past and present land use practices, such as lawns and development encroaching to the edge of the stream, and elimination of buffer strips.

It is important to recognize that the Mad River is a typical "freestone" river. It relies to a great extent on rainwater runoff for flow regeneration. Flows increase with rainfall, and temperature variations are greater because the river is not spring fed.

D. Cover

Trout utilize cover to avoid predators. Bankside cover, in-stream cover, and water depth provide opportunities for concealment. There is a lack of all three types of cover in many sections of the river.

Bankside cover Many sections of the river lack bank vegetation, especially on the main stem below Warren. Buffer strips have not been maintained along the stream. Obviously, the lack of larger trees along river banks means a relative lack of large woody debris (LWD) in the stream. In fact, in many areas debris in the streams has been removed.

Throughout the length of the Mad River, there is a general lack of LWD that could provide much needed habitat diversity. Habitat diversity and complexity are essential to the trout's well-being. The three species of trout in the river require different habitats at their various life stages as the seasons change. The impor-

III. Problems, and threats to the fishery—continued

tance of LWD cannot be overestimated. This in-stream debris can store significant amounts of sediment. The U.S. Forest Service has stated that up to 50 percent of the sediment yield of a watershed can be caught by LWD. In addition, this debris can be a primary pool-forming agent in small-to-medium-size rivers like the Mad. The lack of LWD inhibits the creation of in-stream cover and pools.

The absence of LWD can be the result of historic logging practices. Many years ago when trees were first cut along the Mad River for lumber or to clear land for farms, large boulders and woody in-stream debris were removed to facilitate moving logs to mills. The second- or third-growth forests in the valley have not yet become old enough to decay and fall into the river to provide important habitat.

In-stream cover In *Trout Biology*, Bill Willers points out that obstructions in the current are important to anyone "reading" the water for signs of trout. Objects in the streamflow cause both upstream and downstream eddies to form. These eddies are important sources of both food organisms and resting places for trout. Larger eddies form around big objects, but eddies increase in size and turbulence as water velocity increases around an object of any size. The Mad River lacks boulders in most sections, except in the upper reaches above Warren Village. Boulders also provide depth cover—defined as water exceeding 18 inches in depth—due to scouring by the water's velocity around an object. The lack of boulders and woody debris means the habitat lacks diversity.

Water Depth There are sites in the river where there are larger pools adjacent to stable bedrock. These deeper, lower-velocity areas provide important, cooler water in the summer and shelter in the winter. Unfortunately, some of these larger pools are being filled with fine sediments.

Raleigh et. al. indicate that gravel with less than 5 percent fines (small particles and sediment) is optimal for spawning trout. Gravel spawning areas with greater than 30 percent fines result in low survival rates for trout embryos and fry. Areas of the Mad River have substrate materials with more than 30 percent fines.

Due to the lack of riparian growth to stabilize the stream bank, erosion is a problem in some areas. According to consulting geologists Wagner, Heindel and Noyes, Inc., in the area of water withdrawal down to Mill Brook, a distance of 2.5 miles, two thirds of the river bank has poor stability and high erosion potential. A prime example is in the area upstream of the so-called Punch Bowl swimming area.

E. In-stream habitat alterations

Gravel removal from streams Removing in-stream gravel has several detrimental effects on fish habitat including:

- changes in channel shape,
- loss of existing and potential riparian vegetation,
- stream bank and bed erosion,
- sedimentation, and
- loss of habitat for both fish and aquatic insects.

Removing gravel changes the channel morphology (its form and structure). After gravel has been removed at low water periods in the summer, and when water levels rise later, the stream's channel is wider, shallower, and thus less turbulent than before. The result is a reduction in the precious habitat diversity that salmonid populations need to remain healthy.

Removing gravel bars is an example of river channelization. Gravel bars are an important part of the trout's world. The bars' edges soften the water's flow, providing resting and feeding areas for trout. Lost to trout is the area next to the bar that provided a seam of fast-moving water adjacent to slow moving water. Such areas are sought by trout for rest and food within easy reach. Quite often a back eddy is formed on the downstream end of a gravel bar. The water here is slow moving, and if of sufficient depth, provides trout with a moving smorgasbord of insects.

As mentioned previously, riparian vegetation in the river corridor is very important to trout. Research indicates that trout not only winter in pools, but also along a stream bank under ice cover. Brush growing on gravel bars that are underwater during the winter promotes the formation of ice cover and provides shelter from the river's current. This ice accumulates snow cover, which insulates the bankside microhabitat.

Such insulated habitats are important in improving the trout's winter survival.

Another benefit of gravel bars is that they trap sediments that can gradually build up into banks that will gradually narrow and deepen the stream channel. This is, of course, a benefit to the trout. Many people believe that removing gravel banks can help prevent stream bank erosion along agriculture fields and so help prevent flooding of fields. Often this is not the case, and in most situations may actually increase flooding and stream bank damage. When a gravel bar is removed, erosion is increased by shifts in-streamflow due to river current flowing straight downstream rather than being redirected and dispersed by the gravel bar. Also, removing gravel increases a phenomena called "head cutting," which degrades the channel bottom and undermines protective riprap. A serious by-product of removing gravel is the sedimentation damage to aquatic biota and trout redds (egg-deposit area). Siltation during gravel removal and later during the season as water levels rise and wash exposed sediments downstream can smother trout eggs and other insects.

Channelization Outright channelization of a stream or river for whatever purpose results in the detrimental impacts to fish habitat discussed above, but potentially to a much greater degree.

Removal of boulders and large woody debris Removing boulders and LWD from the stream eliminates both cover and diversity of habitat for trout. These features cause changes in current patterns that form eddies which provide feeding and resting places for trout.

F. Dams

The 1988 Vermont Agency of Natural resources document *Hydropower in Vermont,* by DesMeules and Parks found that of 62 dams operating in the state prior to 1980, 79 percent were detrimental to fisheries. As of 1988, there were 103 hydroelectric projects operating or under construction in Vermont.

Some of the physical impacts on fisheries by dams are as follows (paraphrased from *The Vermont Management Plan for Brook, Brown and Rainbow Trout,* Fish and Wildlife Department, September, 1993):

- Dams cause impoundments upstream of the structure, converting free flowing rivers into static, slow water environments. This change in river dynamics causes some loss, change, or replacement of native fauna.
- The change in a river's ecosystem includes changes in the water temperature and stream morphology that affect native fishes.
- Spawning and rearing habitats are lost due to upstream flooding.
- There are inadequate fish passages.
- Loss of stream productivity occurs owing to variable downstream water flows (releases) and levels, scouring of the streambed, and water temperature fluctuations.
- The types of fish species change because in some cases introduced species are more compatible with the altered stream environment.

As the Vermont Department of Fish and Wildlife points out, from a fisheries standpoint the first choice is no dam. There are, however, engineering solutions to some of the problems. An example is that of the Waterbury Dam on the Little River, where unfavorable temperatures in the Little River were avoided by having cooler water released from the bottom of the dam.

The Moretown Dam on the Mad River (used to generate electricity) is a different case. There the absence of fish ladders or other passages means fish cannot move upstream. Water passes over the top of the dam and through turbines. This surface water is warmer, so river temperatures up and downstream are elevated to levels trout can't tolerate. Siltation upstream of the dam is severe, reducing habitat due to shallow water, complete substrate embeddedness (filling in of the spaces between rocks and pebbles of the stream bottom), and high water temperature.

The only other dam on the Mad River is a non-power-generating structure at Warren.

G. Culverts in-stream crossings

Many obstacles to fish migration and passage have

III. Problems, and threats to the fishery—continued

been introduced. In addition to dams, culverts are barriers to free movement of fish. There are many examples of poorly installed culverts in the valley that impede fish passage. An excellent example occurs on German Flats Road, where a brook flows under the road toward beaver ponds. The outlet of this large culvert is set above the brook's level so that fish passage upstream into Slide Brook is impossible.

IV. State fishery and water quality management plans for the river

The Vermont Agency of Natural Resources and the Vermont Water Resources Board use several plans, policies, and laws to protect fish habitat and fish. Chapter 47 of the Vermont Statutes, the "Water Pollution Control Law," has several provisions to protect water quality. It provides for a permit system to ensure there is no discharge harmful to water quality, or which impairs designated uses of the waters of the state. The law also sets up a classification system for the waters of the state and gives the Water Resources Board authority to adopt water quality standards to ensure protection of the quality and designated uses of waters.

The Water Quality Standards designate all the waters of the Mad River Watershed as Class B (*E. coli* not to exceed 77 organisms per 100 milliliters of water). The Standards also designate most of the waters of the basin as cold water fish habitat, giving specific values and limits that must be met for water quality parameters vital to fish, such as oxygen content, temperature, and pH. A year ago, the Fish and Wildlife Department issued its management plan for brook, brown, and rainbow trout. The plan has four goals:

1. Protect, conserve, enhance, and manage all fisheries resources and habitats; and provide a diversity of quality fishing opportunities.

2. More closely align fisheries management with public desires and the ecology of Vermont's waters.

3. Optimize public fishing access to state waters.

4. Through education, promote public awareness and support for fishery resource conservation.

These broad fishery goals boil down to one basic departmental goal for trout: sustain optimal populations of trout supportive of quality recreational opportunities. To meet this goal the Department has adopted two policies:

- Place priority on implementing effective harvest regulation and habitat protection/ restoration/ enhancement measures.

- Utilize cultured trout where management of a recreational trout fishery is justified, but cannot be sustained solely through wild trout management.

The tributaries and headwaters of the Mad River have excellent trout habitat, sustaining good wild trout populations. However, the main stem of the MadRiver has significantly degraded trout habitat. Although the priority and emphasis of the Department of Fish and Wildlife is on habitat protection, stocking is done to provide a "put and take" fishery where habitat isn't good enough to sustain naturally reproducing fish populations. The Department's management plan makes general recommendations to protect and restore trout habitat that are quite applicable to the situation in the Mad River Watershed. The Department is to:

- participate aggressively in environmental regulatory processes to protect and restore fish habitat;
- strongly advocate habitat protection with other agencies, developers, private landowners, and the public;
- develop a program to restore damaged trout habitat and evaluate the effectiveness of habitat enhancements.

To carry out its objectives, the Department has set up a "Trout Management Team" to ensure that District Biologists' action plans are on target and carried out. For each district in the state, these action plans are to:

- survey the existing trout resource and identify needs for more information;
- determine the best management strategy (should a wild, self-sustaining fishery be emphasized or a stocking program?); and
- develop a systematic approach to managing the river based on available information.

This approach will lead to a set of goals for the fishery of the Mad River Watershed, some elements of which could be:

- no stocking above Warren Village (maintain a wild trout population);
- stock river sections downstream of Warren Village;
- pursue habitat protection and public outreach to do so; and
- use the regulatory process (Act 250 and other permitting mechanisms) to restore, maintain, and improve habitat.

Further protection of the Mad River fishery is provided by the Agency of Natural Resources "Agency Procedure for Determining Acceptable Minimum Streamflows" (July 14, 1993). This procedure adopts the U.S. Fish and Wildlife Service recommended minimum flows for spring, summer, and fall/winter to preserve the fishery. The procedure states: "All reasonable alternatives to altering streamflow and water conservation measures should be thoroughly considered before reduction of the natural flow rate is considered."

In addition, the procedure requires establishing more generous minimum streamflows to ensure that seasonal trout spawning and egg incubation are supported when water withdrawal is increased by existing commercial ventures. This ensures upgrading of water quality where it has been lowered, rather than its continued degradation.

V. Recommendations and future actions

The goal is for the Mad River to be a wild trout stream with natural reproduction. Accordingly, the following recommendations are aimed at protecting excellent upland and headwaters fish habitat, and restoring and enhancing the tributaries and lower portions of the Mad River to support a wild fishery.

1. The Vermont Fish and Wildlife Department should emphasize protection, enhancement, and restoration of fish habitat in the Mad River Watershed, and as such efforts prove successful, and natural production occurs, the department should phase out its stocking program and use any money saved to further habitat restoration and enhancement.

2. Friends of the Mad River, the Mad River Valley Planning District, and valley towns should explore petitioning the Vermont Water Resources Board to have portions of the Mad River and its tributaries designated as Outstanding Resource Waters to gain the extra protection afforded by this designation.

3. Valley town planning commissions should update their plans, and zoning and subdivision ordinances to require protection and enhancement of fish habitat. Specific measures should be included, such as maintaining vegetative buffer strips along waterways, providing adequate setbacks for buildings near rivers, limiting new road building—especially in headwaters, providing for proper road maintenance to prevent erosion and siltation, and placing culverts for fish passage.

4. The Sugarbush Stream Habitat Restoration Enhancement Plan should be implemented fully at all sites designated in the 2.5-mile stretch below the proposed Mad River water withdrawal location.

5. The U.S. Fish and Wildlife Service, U.S. Forest Service, Vermont Department of Fish and Wildlife, conservation organizations, and valley towns should cooperate in developing a Mad River Watershed Fish Habitat Protection, Restoration, and Enhancement Plan. Funds should be appropriated to develop and implement the plan on a priority basis as opportunities become available. The plan should include an educational component to foster appreciation of a healthy fishery resource. The plan should consider establishing catch-and-release and kids fishery components.

6. To further continuing protection efforts, Friends of the Mad River should develop an adopt-a-river program in which riparian landowners or other residents would be trained to accept responsibility to observe specific sections of the watershed that may be harmful to the river. The "river watchers" would spotlight any problems and harmful activities so that Friends of the River and town or state officials could take appropriate action.

7. Local, state, and federal governments and conservation organizations should cooperate in continuing monitoring efforts in two critical categories to ensure that fish habitat is protected:

a) ensure that conditions are being met for permits issued for the construction of dams, water withdrawal facilities and structures under Act 250, and for stormwater;

b) ensure that conditions imposed in the permits are in fact protecting the river and fish habitat.

8. As part of the monitoring effort, the Mad River Watch sampling program should be given continuing support by the community.

References

Agency of Natural Resources, "Agency Procedures for Determining Acceptable Minimum Stream Flows," July 14, 1993.

DesMeules, Alison and Cynthia Parks, *Hydropower in VT: An Assessment of Environmental Problems and Opportunities,* Vol. I, Summary of Study and *Results,* ANR, May 1988.

Miller and Tibbett, *Fish Habitat Improvement for Trout Streams,* Pennsylvania, Fish and Boat Commission, 1992.

Raleigh, R.F., T. Hickman, R.C. Solomon and P.C. Nelson, *1984 Habitat Suitability Information: Rainbow Trout,* U.S. Fish & Wildlife Service FWS/OBS-82/10.60 64 pp.

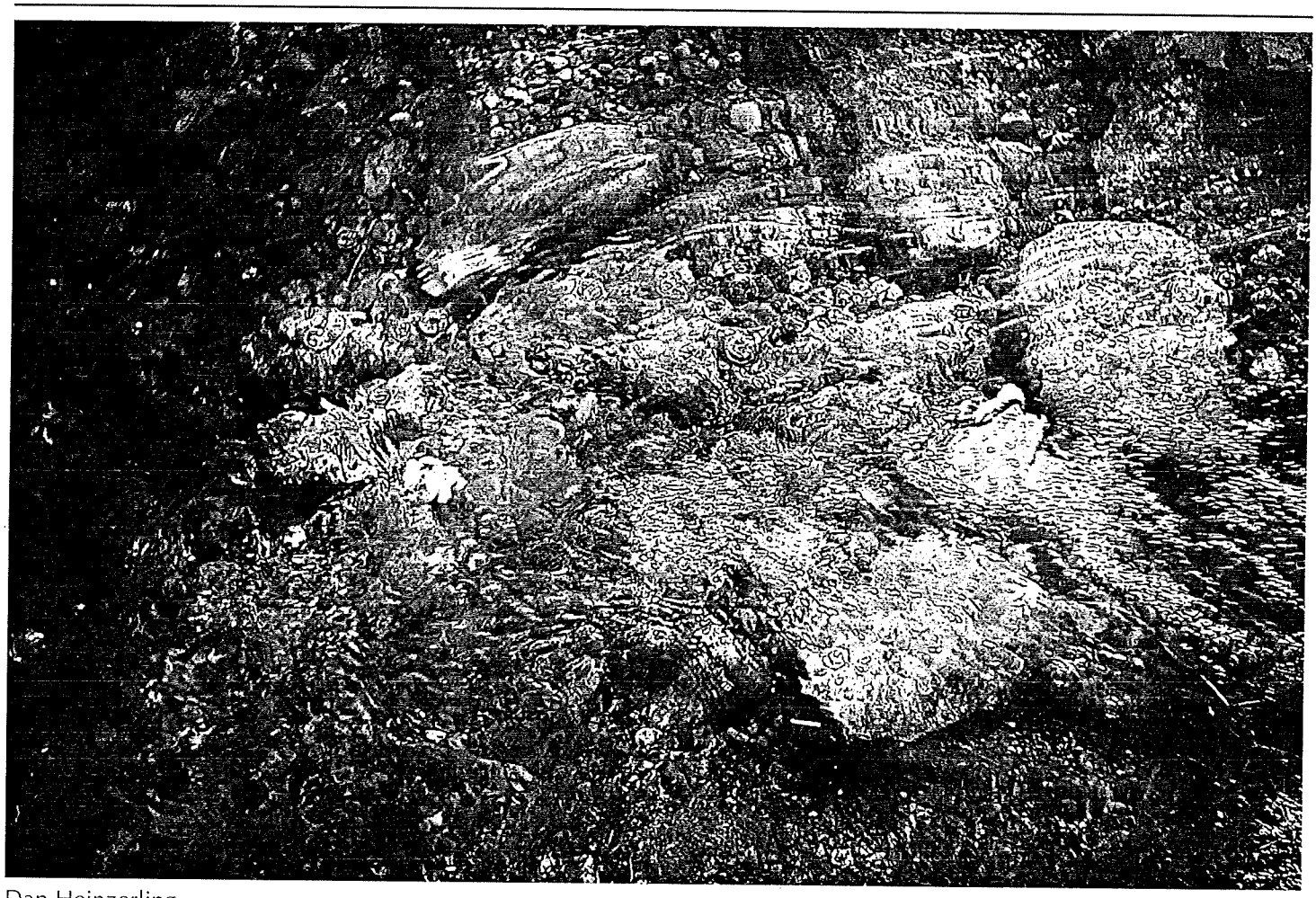
Raleigh, R.F., L.D. Zuckerman, and P.C. Nelson, *1986 Habitat Suitability Under Models and In-stream Flow Suitability Curves: Brown Trout,* Revised USF&WS Biol. Rept. 82 (10.124) 65 pp.

Vermont Fish and Wildlife Department, *The Vermont Management Plan for Brook, Brown and Rainbow Trout,* September 1993.

Willers, Bill, *Trout Biology, A Natural History of Trout and Salmon,* Lyons and Burford, 1991.

Appendix B—Topic Paper C

On-site sewage disposal and river protection



Dan Heinzerling

I. Introduction

Only a generation ago, if we lived near water we were piping sewage from our homes directly to rivers and streams. It was a routine if not accepted practice. Today, that would be unthinkable, yet we are tolerating many failed sewage disposal systems and are not ensuring that new systems are being installed properly. In the 1960s, orders were issued by the Water Resources Board and the Water Resources Department to eliminate direct discharges of sewage by installing septic tank and leach field systems. That corrected one problem but created another—the built-in failure of many of these newly installed systems, and the resulting pollution of the rivers and streams. Many of these systems have failed because four indispensable requirements haven't been met:

- located on soils that will absorb and treat wastewater;
- properly designed with sufficient soil depth to bedrock, and where a seasonal water table isn't too high;
- properly constructed; and
- properly used and maintained.

Two decades ago, sufficient attention was not paid to these basic on-site wastewater disposal criteria. There were no instructions or requirements included in orders issued by the Water Resources Board for properly siting, designing, and constructing on-site sewage systems. Many systems were bound to fail. After 25 years, we know a lot more about how on-site wastewater disposal systems work, how they fail, and how they should be built and maintained.

An on-site waste water disposal system can fail in two ways:

- Gross failure—effluent breaks out of the ground or backs up into the house when the septic tank or leach field becomes plugged, or a high water table prevents leachate from being absorbed and percolated away. One can easily see and smell this failure.
- Treatment failure—a failure of the system to provide adequate treatment of the sewage effluent. The problem isn't evident, and sometimes it begins right after initial use of a new system.

In order for bacteria, viruses, and other disease causing organisms in sewage effluent to be killed or die off, they must be exposed to air and unsaturated soil long enough for this to happen. The leach field will not provide adequate treatment to kill bacteria and viruses and absorb nutrients, such as phosphorus, if: the leach field is wet, on ground that is too steeply inclined, has developed preferential flow channels, percolates too quickly or too slowly through the soil, the leach field is too small for the volume of sewage effluent, or if the effluent is not distributed in the field uniformly. The result will be groundwater and surface-water contamination.

Included at the end of this paper are diagrams and notes on the functioning of various components of a septic tank/leach field and mound wastewater disposal systems, indications of system failure, and how to maintain a system so that it does not fail.

II. The importance of on-site sewage disposal in the valley

There is no sewage treatment facility that discharges directly to the Mad River or its tributaries, but evidence is mounting that there is an increasing problem of contaminated water from failed on-site systems.

All waters in the Mad River Watershed are classified by the Water Resources Board as Class B, which reserves them for body contact recreation, such as swimming. Discharge of treated effluent to the river is not compatible with such recreational uses because associated health risks are too great. This means that all sewage and wastewater must be disposed of away from the river at or near the originating site in an approved manner. Unless that disposal is carried out properly, the potential for polluting ground and surface waters is great. This is especially true for systems near the Mad River and its tributaries.

The Mad River Watch Program monitors the river and its tributaries during the summer, and at many locations has found that bacterial contamination has been higher than the standards permit. In the summer of 1994, the levels at many locations were higher than in previous years. Many systems were constructed years ago on marginal soils with little room for system expansion and without areas designated for replacement leach fields. Evidence indicates that many are failing.

Examples of such failures include the leach field systems for the Moretown School and Mountain Wastewater, Inc. In Moretown, the search for a replacement site and design is under way. At Mountain Wastewater, Inc. the leach field has been reconstructed, and the effluent is highly treated before it is discharged to the leach field. Each failure of an on-site system adds to what is already a significant problem.

III. How on-site sewage is handled in Vermont

Construction of some new on-site systems and some replacements for failed systems come under state jurisdiction. There is a review and approval process to ensure that these systems are placed properly (adequate soils, slopes, depth to bedrock, seasonal high water table, percolation rates, isolation distances to wells—100 to 200 feet, and rivers or lakes—50 feet) and properly designed. This process applies to large systems and those that come under Act 250, for systems that serve public buildings, and where subdivisions of land are required. But according to the statewide survey carried out by the On-Site Sewage Committee, more than two-thirds of on-site sewage systems are installed without state review.

Before the demise of the Vermont Association of Conservation Districts' On-site Sewage Program, about one half of the towns in Vermont were enrolled in the program and were receiving technical assistance. Now, for those systems not under state review, towns must rely on their own regulations (sewage or health ordinances) and their own administration and enforcement. The Agency of Natural Resources has models of on-site sewage ordinances that can be adopted by towns for this purpose, and many towns have done so. But few towns administer adopted sewage ordinances in a thorough manner—visiting the site, checking the site and soils information, reviewing the adequacy of the design, and then inspecting the system to ensure it has been constructed properly.

A recent on-site sewage survey of all towns in Vermont (conducted by the On-Site Sewage Committee formed by Chuck Clark, the then secretary of the Agency of Natural Resources), shows that about one third of the sewage systems installed each year in Vermont replace failed systems at an estimated annual cost of about $7.5 million. However many other failed systems are not replaced. About one fourth of the towns do not have a sewage or health ordinance to ensure that systems are installed properly.

The On-Site Sewage Program that provided technical assistance to towns was eliminated due to state budget cuts a few years ago. The On-Site Sewage Committee is attempting to develop workable statewide solutions to the problem of on-site sewage disposal. However, the means are already in place for

towns to take responsibility for their residents by ensuring that sewage is disposed of properly.

However, there are very few towns that have a routine maintenance program or even provide information on the proper operation and maintenance of on-site sewage systems. Poor maintenance is one of the biggest causes of sewage system failure, and it is a tragedy that so little attention is paid to this matter.

IV. How on-site sewage disposal is handled in valley towns

Two of the five towns in the Mad River Valley—Fayston and Warren—have adopted a sewage or health ordinance that regulates on-site sewage disposal. Moretown and Duxbury have minimal requirements for sewage systems in their zoning ordinances. All towns have some requirements in their zoning or health ordinances for the minimum distance of sewage systems from water courses and from drinking water supplies. Waitsfield does not have a requirement to separate septic systems from water supplies.

Following is an outline of how each valley town plans and administers sewage and health ordinances.

A. Duxbury

Town Plan The Duxbury Town Plan adopted June 18, 1991 (based on a 77 percent positive response to a question circulated to everyone at the 1990 town meeting: "Do you think the Town should regulate new septic systems?") recommends that the Planning Commission investigate the On-site Sewage Program of the Vermont Association of Conservation Districts, or any other appropriate program, to determine if it fits the Town's needs.

Sewage Requirements Section 5.1.2.6 of the Duxbury Zoning Ordinance (with amendments adopted in March 1994) requires that a permit be obtained for constructing a septic system. Repairing a system does not require a permit, but must meet requirements of Section 6.8 on Health for constructing a septic system (a 50-ft. setback from the shoreline—mean water mark—of any stream, brook, river, bog, swamp, or marsh; and a 100-ft. setback from any drinking water supply). This section also requires that proposed drainage fields for subsurface disposal systems have a minimum of five feet of soil, earth, or granular material over ledge or bedrock. These requirements are inadequate to ensure properly designed and constructed systems.

Administration No town sewage disposal permit is required. Normally, disposal is handled with the zoning permit. Setback of the system from watercourses is checked for the minimum distance of 50 feet. There is no review of the design and no inspection before covering. If the state has jurisdiction, associated

IV. How on-site sewage disposal is handled in valley towns—continued

requirements and permit processes are administered without town involvement.

B. Fayston

Town Plan The Fayston Town Plan discusses sewage disposal in relation to soils, flood plains, water recharge areas, and the need to protect the town from the administrative and technical failures of any large sewage systems approved by the state.

Sewage Requirements A Health Ordinance governing individual sewage disposal systems in Fayston was adopted by the Board of Selectmen on April 15, 1983. The ordinance requires the Health Officer to issue a permit before a sewage disposal system is built, replaced, or altered. The system must be designed in accordance with Vermont Health Regulations, Chapter 5, Subchapter 10, and bear the seal of a Vermont professional engineer or a certified site technician.

The Health Officer is to be notified 48 hours before a system is to be covered so it can be inspected for compliance, and certified by the Health Officer before use. The ordinance provides for alternative systems if a replacement disposal area is available. These requirements are adequate to ensure properly designed and constructed systems.

The Fayston Zoning Ordinance last amended in March 1993, has the following requirements for on-site sewage disposal:

- Section 5.5.1 No building or development that includes or would have an effect on an existing or proposed wastewater systems can begin unless a permit for a wastewater disposal system is issued by the Fayston Health Officer, or a certificate of compliance has been issued by the Vermont Agency of Natural Resources.
- Section 5.6.4 Septic systems in flood plains are prohibited.
- Section 5.7.1 No septic system is allowed less than 10 feet in elevation above the bottom of the streambed.
- Section 5.7.2a No septic system is allowed within 100 feet of either side of streams.

Administration A permit for constructing a sewage system is issued by the zoning administrator if plans have been prepared and signed by a professional engineer. The plans are not reviewed independently to check the engineer's work. Inspection of the system by the engineer is required before it is covered and a report is filed with the town. A system-use permit is not issued by the town.

C. Moretown

Town Plan The Draft Moretown Town Plan contains several recommendations about sewage disposal:

- ***Land Use, page 11, R10*** Improve the quality of the rivers and streams with septic regulations and farming standards.
- ***Utility and Facility, page 15, R4*** The village will stop pollution and encourage appropriate growth by the continued planning, funding, and construction of a septic system for the village.
- ***Preservation, page 18, R6*** The zoning ordinance shall establish setbacks from watercourses for septic, sludge, and fecal matter disposed of or dispensed by any individuals on land in Moretown.
- ***Preservation, page 18, R7*** In certain cases, improvements to existing pollution problems shall be supported by the town even if the improvement "fails" to meet preferred standards completely. The Zoning Ordinance shall address the type of cases where this action is acceptable (i.e., direct discharge of treated effluent into a watercourse in lieu of an existing failed system).
- ***Regional Relationship, page 25, R6*** Plan for community water and sewer systems that have the ability to be linked to neighboring systems.
- ***Housing, page 26, R4*** State septic regulations shall be adopted for areas outside the identified growth centers. Setback and environmental requirements shall be drafted to discourage housing sprawl in the countryside.

The Plan also includes an appendix entitled "Preliminary Wastewater Disposal Feasibility Report for Moretown, Vermont" (October 1992) which

summarizes investigations of six sites for a community wastewater disposal system, all within less than one mile of the village center.

Sewage Requirements Article III, Section 15 of the Moretown Zoning Ordinance with amendments adopted March 6, 1990 sets the requirements for sewage disposal systems:

- all water systems must be 100 ft. from septic systems;
- no subsurface sewage disposal system may be constructed on a slope of greater than 15 percent;
- a professional engineer or certified technician must certify that:
  - a system will not be constructed on shallow soil or on poorly drained (wet) soil;
  - an adequate replacement leach field area is available if the primary leach field fails;
- if the above two conditions cannot be met, the applicant must certify that:
  - a suitably engineered, permeable leaching area will be constructed; or
  - an alternate system of sewage disposal will be employed, such as use of holding tanks, or use of a chemical or incineration system, or composting toilets; holding tanks may be used for a period of not more than six months;
- all sewage systems are to be a least 25 ft. from property lines or 50 ft. from any year-round water body or watercourse.

Administration The requirements of the zoning ordinance, particularly the option for the applicant to certify a system if an engineer does not, seem very difficult if not impossible to administer and to ensure that an adequate system is built. The requirements are administered by relying on an engineer to design the disposal system adequately. The site plans for the disposal, signed by an engineer, are not reviewed independently by the town, and no inspection or certification is required before covering and on completion.

In April 1994, the Moretown School was closed due to failure of its septic system. The leach field was filled with water and no more waste could be accommodated. Portable toilets were brought in until the high water table problem subsided.

D. Waitsfield

Town Plan The Waitsfield Town Plan (1993) has only one objective for sewage disposal (Objective 3e, page 110)—continue to explore the development of a wastewater treatment disposal facility and community water system to serve Irasville and Waitsfield Villages. Coordinate the development of a wastewater treatment system with the potential development of such a facility serving Sugarbush North.

Sewage Requirements Waitsfield has no health or sewage ordinance, but it does have zoning (last revised March 5, 1991) and subdivision (adopted November 1989) ordinances that contain a few minor requirements on sewage disposal systems. The zoning ordinance requirements are:

- In granting conditional uses, the Zoning Board of Adjustment "shall require that all water supply and sewage disposal systems comply with all State requirements." (Page 18, Section 5)
- Standards for Planned Unit Developments specify that "water supply and sewage disposal systems shall meet all applicable State and local regulations." (Page 28, Section 7F7)
- A sewage system setback of 50 ft. from the top of a stream bank or 75 ft. from the edge of a stream where there is no identifiable bank. This requirement can be waived by the Board of Adjustment if it can be demonstrated that a lesser setback will not adversely affect water quality or scenic beauty. The Planning Commission may require greater setbacks if in its judgment they are needed to accomplish the purpose of protecting water quality and scenic beauty. (Page 41, Section 9)
- On-site waste disposal systems are to be located to avoid impairment to them or contamination from them during flooding. (Appendix B, Flood Hazard Area Zoning, Page 6, Section 11.1h, Conditional Use Approvals by Board of Adjustment for structures in the flood plain)

IV. How on-site sewage disposal is handled in valley towns—continued

The Subdivision Regulation requirement is: "Subsurface disposal of sewage shall meet all state and local requirements, and the sewage disposal system designed by a registered professional engineer." (Page 14, Section 5.1)

Administration No separate town sewage disposal permit is required. The above requirements do not cover any systems that do not come under state jurisdiction.

E. Warren

Town Plan The Warren Town Plan adopted in December of 1989, has several strategies for sewage disposal: 1E—Protect, and where necessary improve ground- and surface-water quality:

- 50-ft. setback of subsurface disposal systems from brooks, streams, and shorelines;
- support the River Watch water quality monitoring programs;
- investigate further the alternatives for sewage treatment and disposal in the town's village centers;
- maintain the town's on-site sewage disposal ordinance, and require approval under the ordinance as a prerequisite to other development approvals.

Sewage Requirements The Town of Warren adopted a Health Ordinance relating to individual sewage disposal systems in December 1983. Basic provisions of the ordinance are:

- a permit is needed to build, alter, or use single-family sewage systems;
- existing systems are approved provided they do not create a health hazard or nuisance;
- no increases in residential capacity until a permit is issued to increase the capacity of the sewage system;
- permit applications must contain the soil and site information required by the Vermont Health Regulations;
- technical information for the application must be prepared by a Vermont licensed professional engineer or a Type-B-certified site technician;
- designer must submit a final inspection report certifying that the system has been installed as approved;
- alternative systems may be allowed if a full replacement disposal field is available.

Zoning bylaws were amended last in March 1994 and contain the following provisions for sewage disposal:

- land development shall not commence until approval of the disposal of domestic wastes or other effluent has been granted by a Town of Warren Health Permit or a permit issued under the Environmental Protection Rules of the State of Vermont;
- septic systems and disposal fields shall be located no closer than 50 ft. of the nearest edge of a stream.

Administration The Warren Health Ordinance requires an application with site plans. The Health Officer issues a Health Permit, but does not do an independent technical review of the plans. Each system is inspected before covering, and certification is required from the design engineer that the system was built as per plan. A system-use permit is not issued.

V. What it means if we do not dispose of sewage properly

The first and obvious implication of not properly handling on-site sewage in the valley is that sooner or later there will be more contamination of groundwater and drinking water supplies and pollution of the Mad River and its tributaries. This, in turn, could mean:

- boiling or hauling water for drinking, or finding more distant and more expensive supplies;
- forgoing swimming unless we take on greater risks to our health;
- constructing expensive community sewage treatment plants that transport sewage effluent to a suitable and usually distant location at considerably more expense; and
- with continuing development of the land, when all other means fail it could mean construction of one or several *sewage treatment plants that would discharge effluent directly to the river.*

This latter implication means first, controversy within the communities so involved, and a hearing before the Water Resources Board to reclassify the Mad River to allow a Waste Management Zone. This is not done easily, because it pits some vested interests against others, and it leads to blaming others for actions not taken that could have avoided such a hard and expensive decision.

It also means that once there is a discharge to the river, much of the river is lost for swimming due to health risks from disease causing organisms, such as Giardia, that are not killed or removed in normal secondary treatment processes. In addition, sewage treatment plants fail from time to time, depending on the diligence of operation, maintenance, and their age, and when this happens, a far greater portion of the river is lost to swimming due to the greater health risk of discharging untreated or partially treated sewage directly to the river.

VI. On-site sewage systems —the basics

There is no direct discharge of effluent to the Mad River and its tributaries. Most people use septic tank (leach field systems) or mounds to dispose of sewage and waste water. Accordingly, it is vitally important that these systems be properly designed, constructed, and maintained to ensure protection of our health and ground and surface waters, and to avoid unnecessary repair and replacement costs to the owner. Here are the basics.

Septic tank

- Settles out solids.
- Prevents floating substances from entering leach field.
- Large enough to ensure settling of solids.
- Leak tight (frost holes plugged and joints sealed).
- Easily accessible for pumping with access extension and cover.
- Pumped every three to five years (more often if used heavily, such as when garbage grinders are used and there are more than four people in the house).
- Baffles inspected each time tank is pumped.
- Additives avoided (likely to do more harm than good).

Distribution box

- Distributes effluent evenly to leach field pipes.
- Level, and protected against frost heaving.
- Baffles to prevent short circuiting.
- Checked each time septic tank is pumped.

Pump or dosing chamber, and mound

- Used where site conditions for in-ground systems cannot be met (high water table, shallow soils to bedrock).
- One to two feet of special sand used to create an artificial soil system for treatment.
- Two to four daily doses of waste water by an automatic, level controlled, on-off pump.

VI. On-site sewage systems—the basics—continued

- Alarm system to warn of pump failure.
- Pump chamber and alarm system inspected whenever septic tank is pumped (every two or three years) to ensure proper dosing and operation.
- Pump chamber cleaned if solids and floating materials have entered (cause investigated, and problem fixed to prevent damage to the mound).

Leach field

- Perforated pipes in beds or trenches of crushed rock.
- Effluent distributed into the ground for proper treatment without contaminating ground or surface waters.
- Located to work effectively (isolated from wells and surface waters; away from wet areas and high groundwater levels, steep slopes, shallow soils, dense soils to bedrock).
- Area of beds or trenches adequate for the type of soil and size of house.
- Clean, properly sized crushed rock in the bed or trenches to ensure proper treatment.
- Protected from heavy equipment that could break pipes and compact the soil
- Clear of trees and brush.

Septic and mound system maintenance

In-ground septic systems and mound systems must be used and maintained regularly if they are to work properly. If the septic tank and the mound pump chamber are not pumped every two to three years (or as often as necessary) they may fail. Pumping frequency should be increased if solids are flushed (when garbage grinders are used, or when more than four people occupy the house). Pump operation of mound systems should be checked to ensure proper dosing of the mound.

A failing system can not only be expensive and difficult to replace, it can: contaminate your own and your neighbors' wells to cause health problems, bring raw sewage to the surface of your yard or up into your sink or toilet, and pollute streams or other surface waters.

Your septic system may not be working properly if you have noticed any of the following conditions:

- persistent wet soils near the leach field or mound area;
- odors near the leach field, or in the house;
- plumbing that drains slowly or backs up.

If your septic tank is full of sludge or you think the leach field is not working properly, **do not** try to fix it by using septic system additives and cleaners. They may upset or stop natural bacterial action in the septic tank or flush solids into the leach field, doing harm rather than good.

Do not flush pesticides, chemicals, paint, thinners, acids, disinfectants, oil, grease, diapers, sanitary pads, kitty litter, and the like down the toilet. Chemicals can kill necessary bacteria in the septic tank, and grease and oil can clog the leach field. Flushing solids down the system merely fills the tank sooner, requiring more frequent pumping.

Do not drive heavy equipment over the mound or leach field and replacement areas.

Do pump your septic tank and inspect the pump chamber and D-box every two or three years, and keep a record of inspections. Ask the pumper to inspect the baffles in the tank (necessary for proper settling and to prevent solids from overflowing into the leach field) and repair them if necessary.

Do find out how much sludge and floating material was in the tank and how close it was to overflowing into the leach field. If the buildup of solids in the tank is slow, you may be able to get by pumping less often.

Do keep the leach field area mown and free of brush and trees.

Do check the distribution box and pump operation periodically to ensure even distribution and proper dosing of waste water to the leach fields and mound.

Do ask your town health or sewage officer to come out and take a look if you think you have a problem. They may be able to suggest how to investigate the problem further, and help you decide how to proceed.

VII. What can be done now and in the future?

More information

Understanding Septic Systems, Northeast Rural Water Association, 512 St. George Road, Williston, Vermont 05495.

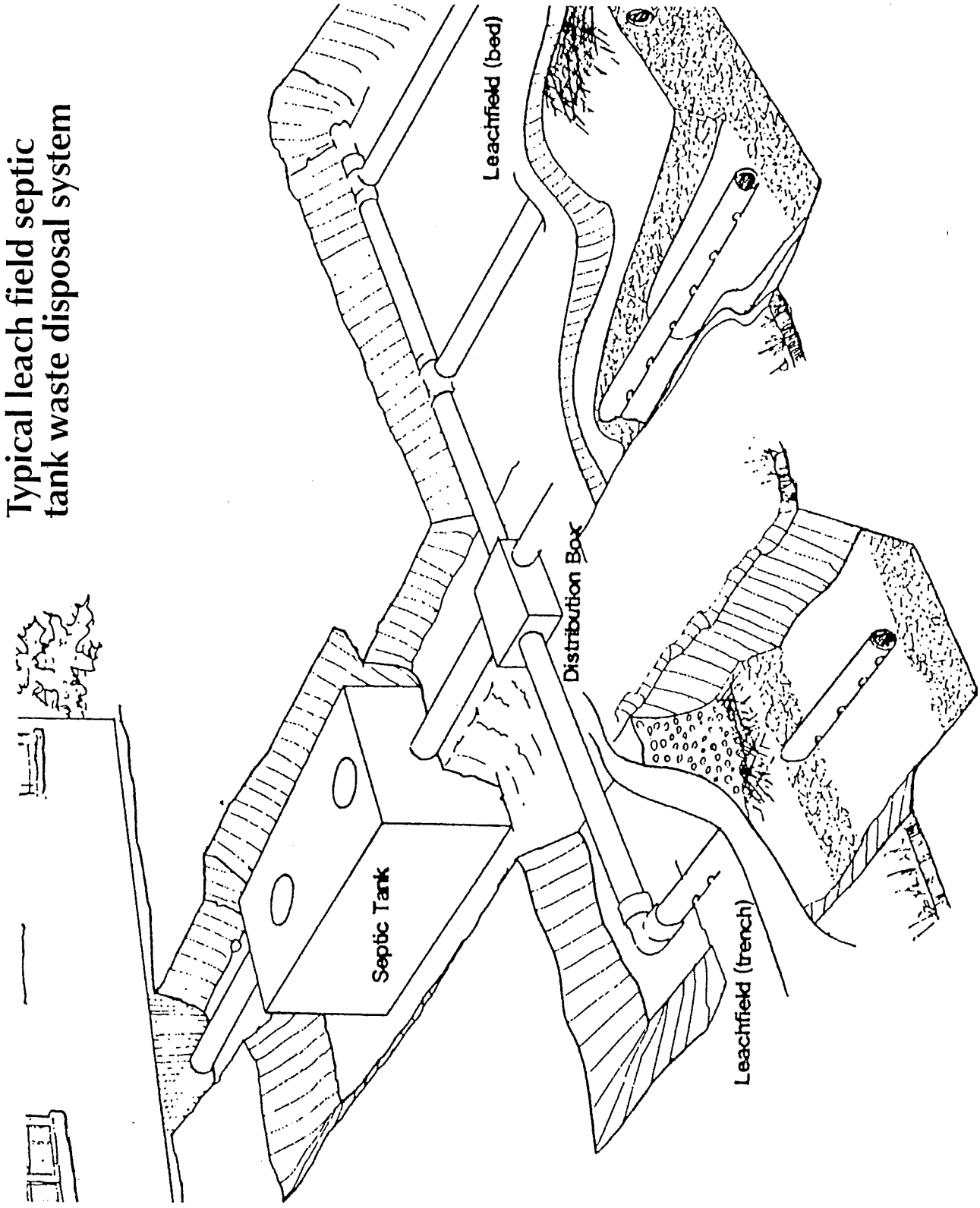
Septic Systems, How They Work and How to Keep Them Working in Vermont, Vermont Agency of Natural Resources Publication.

What can be done about on-site sewage before we get into much deeper trouble falls into several categories.

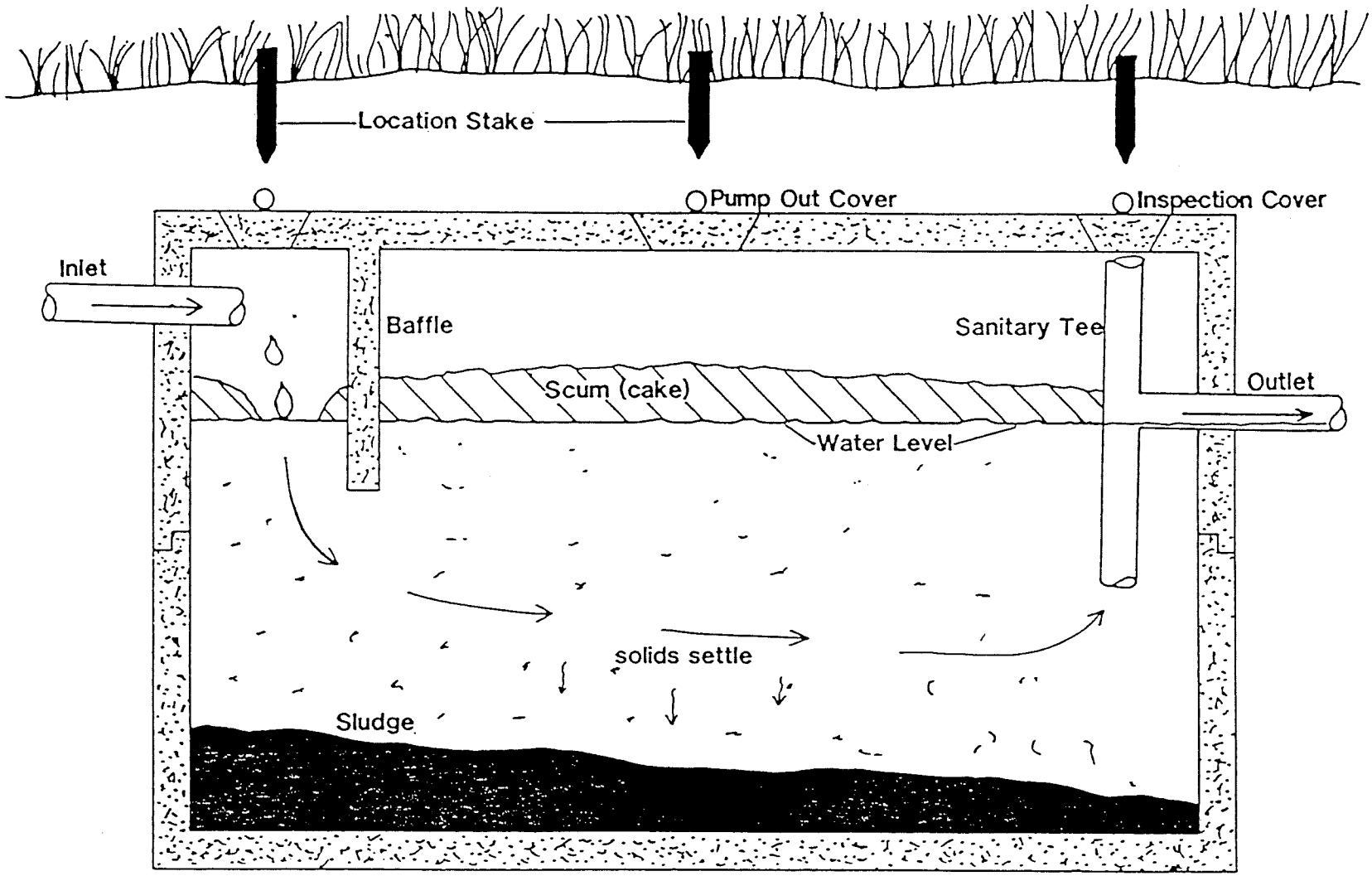
The first is education. Everyone must know what an on-site sewage system is, how and why it works, and how to maintain it properly. But education will not help unless everyone takes a personal responsibility to put in a good system and keep it working properly. Right now, in many cases it is conveniently out-of-sight, out-of-mind. We need to cultivate the attitude that handling our sewage properly is part of being a good neighbor.

Secondly, towns as a whole and town officials specifically, have a responsibility to the community to ensure that each person is responsible for properly disposing of the sewage they generate. This means taking the lead in education, and adopting and administering a health or sewage ordinance that ensures proper disposal. There will always be people who don't know, those who don't care, those who don't want to spend the money, or in some hardship cases, those who don't have the finances to maintain or replace their system. This is why assistance, oversight, and sometimes enforcement are necessary.

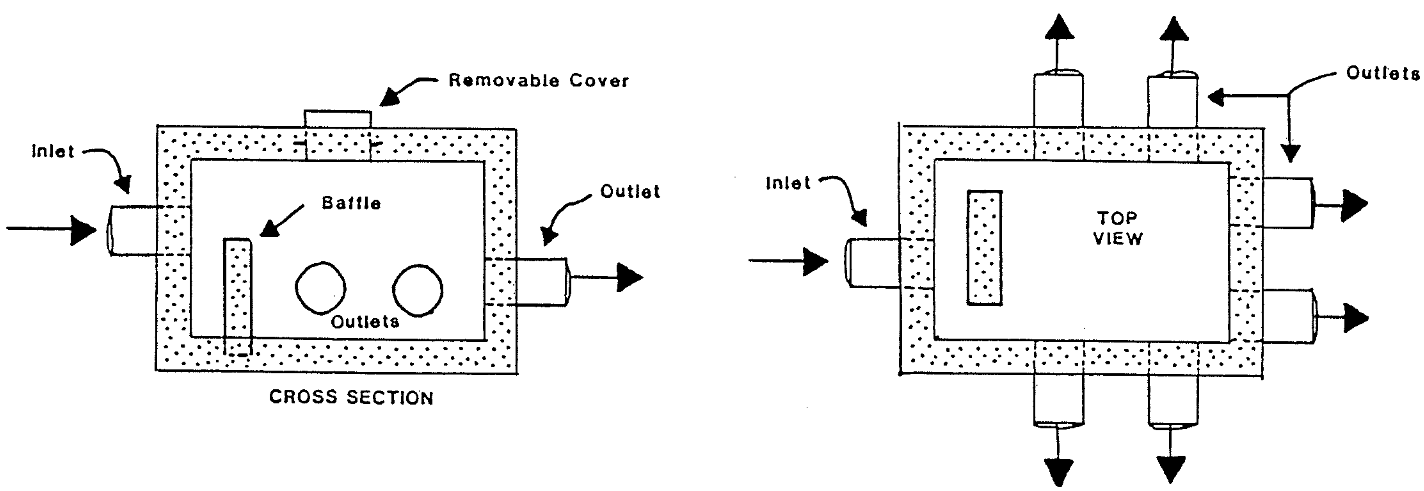
We can and must be very thoughtful now about how we use the land in our communities, asking such questions as: Is sufficient land reserved to take our sewage if present systems fail? Is the sewage disposal system for this development, home, or business adequate to last indefinitely? Are our drinking water supplies protected? What will it cost in money, well-being, and diminishment of recreational uses to build large, community, on-site, or discharging wastewater disposal systems?


Typical leach field septic tank waste disposal system
Leachfield (bed)
Distribution Box
Septic Tank
Leachfield (trench)

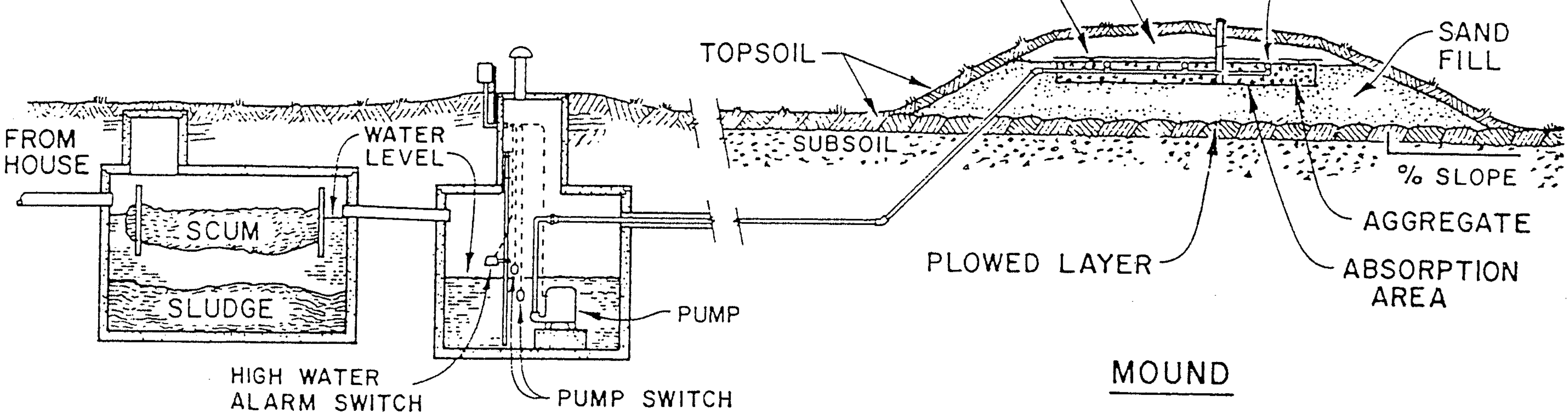
Septic tank


Location Stake
Pump Out Cover
Inspection Cover
Inlet
Baffle
Sanitary Tee
Outlet
Scum (cake)
Water Level
solids settle
Sludge

Distribution box



Mound system



VIII. Recommendations

Here are specific recommendations to improve on-site sewage disposal in the valley based on this review and a meeting with town officials:

1. Valley towns that have not done so—Waitsfield, Moretown, and Duxbury—should adopt sewage ordinances that incorporate adequate minimum standards for siting and construction of on-site sewage systems. These requirements should include ensuring the adequacy of the system when use of existing septic tank/leach field systems increases owing to expansion of homes or businesses (C-1).

2. Valley towns should review the administration of their sewage requirements, and should ensure there is adequate oversight of designers and contractors by utilizing part-time professionals, or by training town health officers and zoning administrators.

3. Valley towns and the Mad River Valley Planning District should explore a valley-wide, five town approach to administering sewage disposal requirements to lessen costs and improve effectiveness.

4. Valley towns should provide a brochure to all home owners and businesses covering the proper operation and maintenance of on-site sewage systems. The brochure should include telephone numbers for more information, and guidance about reporting health hazards and failed septic systems.

5. Based on experience with past performance, valley towns should maintain a list of recommended engineers, technicians, contractors and septic system pumpers who are capable of designing, installing, or servicing on-site sewage disposal systems.

6. The Mad River Watch Program, with all valley towns and the Agency of Natural Resources, should identify and investigate sources of river contamination, and encourage and assist owners of failed sewage systems to repair or replace them to prevent health hazards.

7. Valley towns should work with septic system pumpers to help educate system owners about operation and maintenance, and about setting up a three-year (or as needed) cycle of pumping septic tanks and checking distribution boxes.

8. Valley towns should provide incentives for repair or replacement, and maintenance of systems by providing low-interest revolving loans. They and the Mad River Valley Planning District should investigate the availability of Section 319 (Implementation of Nonpoint source Control Measures) Clean Water Act funds, and the State Revolving Loan Fund for this purpose.

9. The built up communities of Warren and Moretown, and the region of Irasville, Waitsfield Village, Mad River Glen, and Sugarbush North should be encouraged to explore community on-site sewage disposal systems in concert with individual disposals that meet standards in an economical and environmentally sound manner.

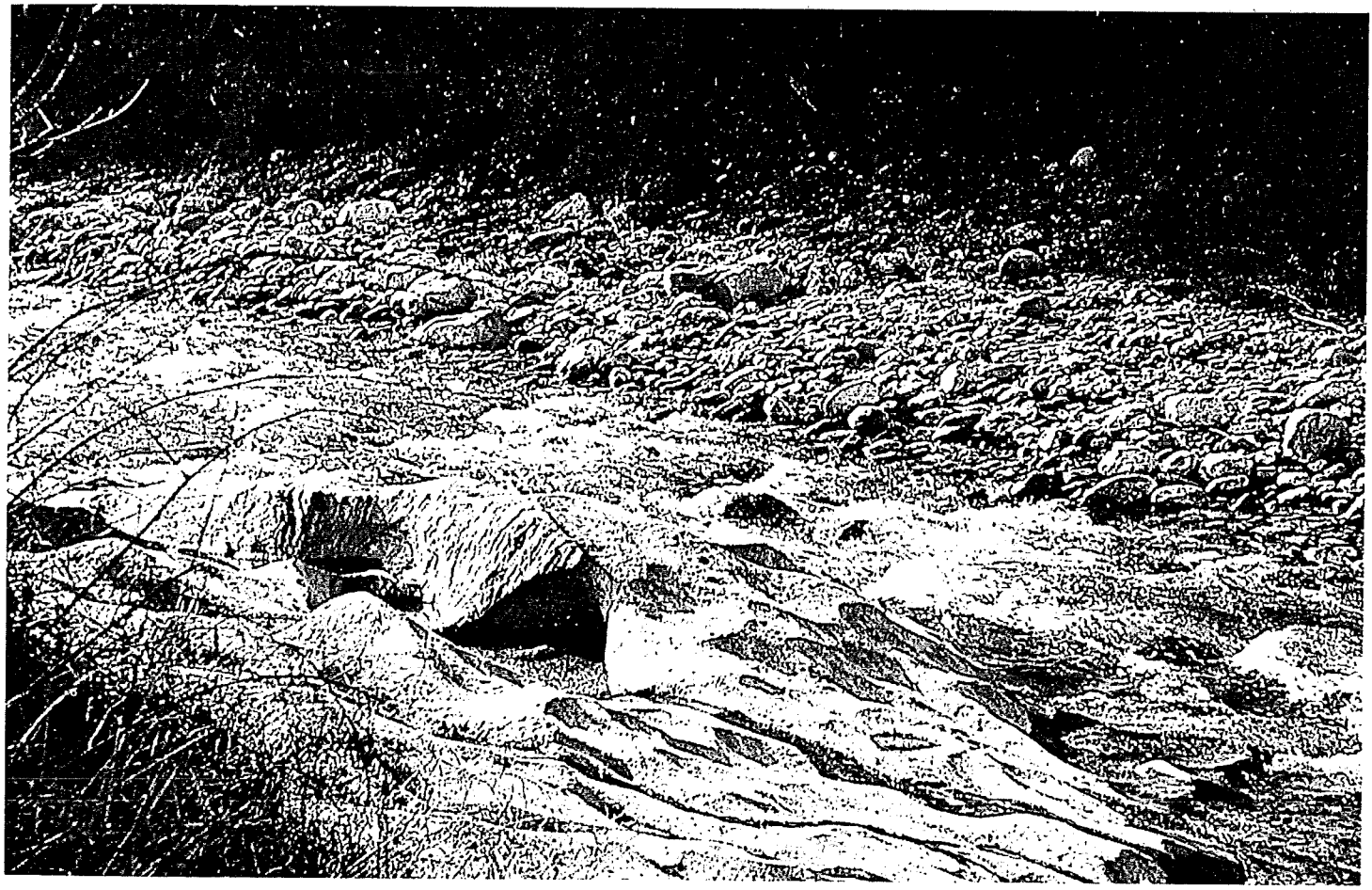
References

Vermont Agency of Natural Resources, "Environmental Protection Rules," Chapter 7, Sewage Disposal 9/10/82.

Vermont On-site Sewage Committee, *The Management of Individual On-site Sewage Disposal Systems in Vermont,* January, 1995.

Appendix B—Topic Paper D

Gravel removal: concerns and impacts



Ann Day

I. Background

Although it was far from the public's top Mad River concern, gravel removal was mentioned often enough at river forums, and with sufficiently strong feelings, to warrant more discussion in the conservation plan. Comments made at the forums included:

- manage gravel removal as a valuable natural resource,
- fish like it better if gravel is removed,
- bridge abutments are protected if gravel is removed,
- gravel removal maintains deep holes in the river,
- remove gravel to mitigate flooding,
- compromise in gravel extraction so it is not entirely forbidden,
- don't remove gravel at all,
- gravel removal is better for boating,
- dredge the river to recreate the characteristics it had in 1925 (deep pools by the banksides).

Is gravel removal better for boating and fishing? Does gravel removal lessen the danger of flooding? Will deep pools be maintained by allowing gravel removal? Can we dredge the Mad River channel to recreate the conditions of long ago? Do we really know the impacts of gravel removal on the river and river uses?

The purpose of this paper is to explore such questions. One thing is certain. As we continue to learn more about the river, we find that it is very complex and dynamic, almost alive in the ways it reacts to the changes we make to the river, its banks and watershed, and to natural floods of varying size and intensity.

II. The law and present gravel removal in the Mad River

The questions listed above were debated in much detail and with passion before the "Rivers Bill of 1987" passed the Vermont Legislature. This bill put additional restrictions on gravel removal, allowing no more than 50 cubic yards of gravel removal per year by riparian landowners for the owner's use on the owner's property. Gravel removal in other situations can still be allowed if it can be shown that the removal will result in significant flood control or property protection benefits (such as erosion control and protection of roadways), without increasing flood hazards, and without significantly damaging fish and wildlife and the rights of other riparian landowners. Gravel cannot be removed for sale, or for construction use by municipalities.

Before passage of the "Rivers Bill of 1987," stream alteration permits with certain conditions were issued by the Agency of Natural Resources to riparian landowners seeking to remove more than 10 cubic yards of gravel for use by municipalities and others for construction purposes. Removal of gravel bars was allowed to the low water line, and work had to be done "in the dry," that is, no equipment in the water.

Where extensive gravel removal had been allowed over a period of time, experience began to show that there were damaging effects. These included undermining of bridge abutments, undermining of riprap protection of stream banks, and significant decrease in good fish habitat. The West Branch in Stowe is often cited as the prime example of these effects. Also, there are indications that the Mad River bed elevation is lowering in places and jeopardizing protective riprap placed after the 1973 and 1976 floods. Examples of such areas are at the Kingsbury Store location and the Turner Farm.

Presently, several permits for gravel removal are issued to riparian landowners every year. In 1994, six permits were issued to remove 300 cubic yards of gravel. This is typical of the gravel removal allowed since the 1987 change in the law. Before that, as much as 20,000 cubic yards of gravel were removed from the Mad River each year.

Gravel removal: concerns and impacts—continued

III. Impacts of removing gravel from the river, and its uses

The impacts of gravel removal on the river are in two areas: (1) effects on the river and the channel itself, and (2) effects on fish and other aquatic life.

River dynamics—the way a river reacts to rain, flow, changes in its channel and banks and the land surrounding it—are very complex, ongoing, and long-term. The river is always trying to reach an equilibrium to balance the many influences that affect it: flooding, ice formation and ice jams, stream bank instability, erosion and sedimentation from the land, gravel removal, and channelization. In so doing, it overflows, shifts, scours, and changes its bed and banks, and therefore changes conditions for animals, plants, and humans.

Gravel is a portion of the material that is constantly entering and being transported down the river channel. The total amount of material eroded, transported, or deposited in a channel is a function of sediment supply and channel transport capacity. Sediment is supplied by erosion from the watershed, tributaries, and the upstream channel. Sediment transport capacity is a function of the size of the sediment, the discharge capacity of the river, and the geometric and hydraulic properties of the channel. When transport capacity equals sediment supply, a state of equilibrium is reached.

When sediment supply (upstream input) is less than the transport capacity (downstream output) erosion will occur in the reach. Where stream banks have been stabilized (with riprap along farmland, highways, and near bridge abutments), erosion is concentrated on the streambed, resulting in degradation through lowering of elevation. This results in undermining of stream banks and foundations of structures.

The usual result of streambed mining or gravel removal is an imbalance between sediment supply and transport capacity. Upstream of gravel removal, water slope is increased, and stream bank erosion and head cutting occur. Head cutting—erosion of the channel bottom to a lower elevation—will continue upstream to a control point, such as where rock ledge forms the channel bottom. If the amount of gravel removed is large enough and deep enough, sediment is trapped in the "pit" created, and degradation will occur downstream as well.

Often, the effects of gravel removal are not immediate, and may be observable only over an extended period of time. The reason is that sediment is transported in most Vermont streams only at flow velocities that occur at full-flood stages, which don't happen every year. Therefore, several years may elapse before the effects of gravel removal (or stopping it) are observed. Since Vermont streams are still recovering from the effects of gravel mining, it may take years, possibly a decade or more, before many streams reach dynamic equilibrium.

As to the impact of gravel removal on fish and aquatic habitat, the Vermont Fish and Wildlife Department stresses a number of detrimental effects that gravel removal can have on trout, salmon, and other aquatic life. Four river characteristics are important for good trout habitat: channel shape, gravel bar vegetation, stream bank and streambed erosion, and sediment transport.

1. ***Channel shape*** Gravel removal results in a stream channel that is wider, shallower, with less turbulent water flows, so fish have fewer refuges and fewer areas of concentrated food drift, less cover from deeper pools, and therefore increased mortality. Overall diversity of the channel is decreased. Gravel bars break up water flow, with eddies providing resting and feeding habitat. When bars are removed, these places are removed just as in river channelization.

2. ***Gravel bar vegetation*** Riparian vegetation is very important for salmonids, providing cover, especially in the winter, by promoting ice cover that is insulated with snow. When gravel bars are removed, this vegetation does not form to provide such protection. When vegetation takes hold on gravel bars it traps more sediment, narrowing and deepening the stream channel, benefiting salmonids.

3. ***Stream bank and streambed erosion*** Removing gravel bars does not prevent stream bank erosion. In fact it may increase erosion, because erosion occurs at high flows, and gravel bar removal will increase the velocity of water flow by removing an impediment. Removing a gravel bar will start a process

of streambed erosion upstream to compensate for removal (head cutting). This disrupts the biota and areas where there may be incubating salmonid eggs.

4. *Sediment transport* Removing gravel bars disrupts the dynamic river balance of sediment transport. Fall spawning salmonids (Brook and Brown Trout) may lay eggs in areas where gravel bars were removed in the summer, only to have the eggs smothered in silt as it settles out in greater amounts in the fall after spawning has occurred and streamflows increase. Also, any machinery working in the channel can cause sedimentation, especially when work being done "in the dry" is hampered by the sudden occurrence of high flows.

For all these reasons, the Fish and Wildlife Department argues that gravel removal from Vermont's streams and rivers should not be allowed because it is harmful to fish.

With respect to boating, gravel removal would only be helpful if the removal deepened the channel to allow boating during lower flows. This means that removal would be from the channel rather than from gravel bars and, as discussed above, would conflict with maintaining a good fishery. In contrast, some boaters argue that gravel bars in the stream make for better boating, providing more interesting flows, patterns, and resting areas on the bar and in the eddies downstream.

IV. Gravel removal and protection of the Mad River

Given the very complex and long-term processes that comprise a river system, it is difficult to say with any certainty that a particular action causes a particular result. But the experience and arguments about gravel removal and its role in the sediment transport process indicate that gravel removal can have significant harmful affects not only to fish life, but to the artificial structures that we construct in and adjacent to the channel for our convenience, such as roads, riprap protection, and bridges.

To gain a better long-term understanding of the river, every year the Agency of Natural Resources monitors the river bottom elevation at the Turner Farm in the area of Carpenter Rock, downstream to the Moretown town line. Over time, and after major floods, this will provide information on shifts, and degradation or buildup of the river bottom.

This monitoring area is a good spot for an educational initiative about the river. Photos of the area could be taken annually in conjunction with the channel cross-section measurements. Another area where this could be done is the area where riprap is being outflanked near the Newton House.

Another activity that could be undertaken to gain a better long-term understanding of what is happening in the river is to inventory the number and size of pools in the river, or in particular reaches, to see how they vary in shape and depth, or move over time.

Still another effort to increase our understanding of the river would be to install monitoring devices in gravel bars to determine their stability and growth. During high flows, some gravel bars may be eroded significantly, only to be reestablished when flows decrease. Vegetative growth on gravel bars indicates stability of the bar. Gravel bars with no vegetation could be tested by monitoring with the chain technique (burying a chain vertically in the gravel bar and excavating to see if it has been laid horizontal by erosion of the bar during high flows).

Given the complexity of the river, it is best to take a conservative approach that works with nature, minimizing gravel removal as much as possible. Until we know the river dynamics better and the particular affects of gravel removal, the law restricting gravel removal should not be changed.

V. Recommendations

Future actions with respect to gravel removal must focus on observing and understanding the river better, and respecting the state law that was passed in 1987 that put limits on gravel removal from streams. There are three recommendations about gravel removal:

1. The law should not be changed restricting the amount and method of gravel removal from rivers until observations and knowledge about the relation of gravel bars and stream channel dynamics clearly suggest a need to clarify or change the regulations.

2. The ANR should continue monitoring the river cross section at the Turner Farm to record channel changes over time.

3. Riparian landowners, towns, and conservation groups should document changes in the river channel to gain a better long-term understanding of how the river changes and reacts to the changes we make to the river and watershed. This effort should be incorporated in the adopt-a-river program by Friends of the Mad River.

References

Leopold, Luna, M.G. Wolman, and J.P. Miller, *Fluvial Processes in Geomorphology*, 1964.

U.S. Corps of Engineers, *Advice to the State of Vermont on Gravel Extraction from River Channels for Flood Control and Streambank Protection Purposes*, Anne MacDonald and Marty Abair, October 1987.

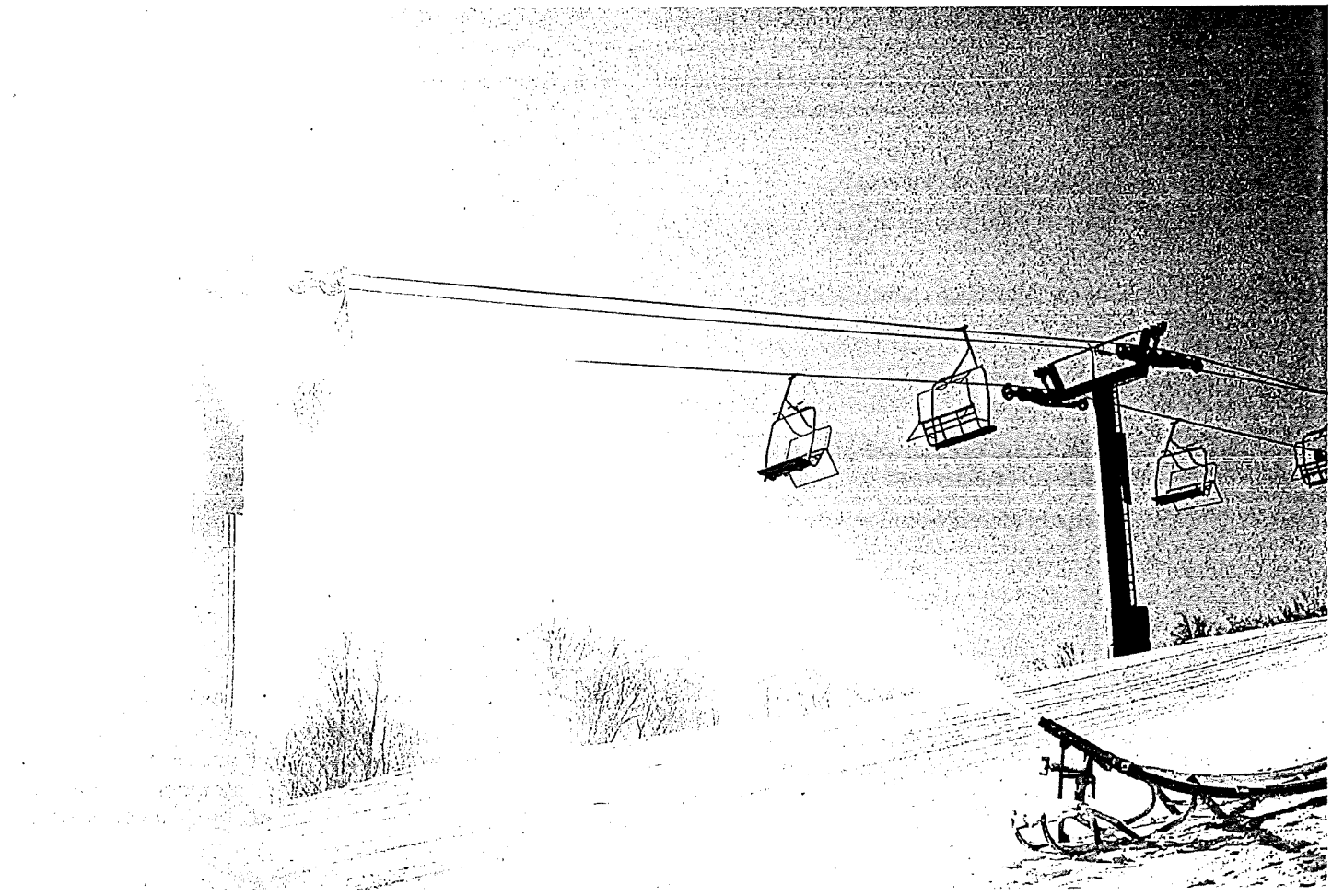
U.S. Department of Transportation, *Highways in the River Environment—Hydraulic and Environmental Design Considerations*, May 1975.

U.S. Department of Transportation, *Stream Stability and Highway Structures*, Federal Highway Administration Publication FHWA-IP-90-014, February 1991.

Vermont Fish and Wildlife Department, *Biological Effects of Stream Gravel Mining in Vermont*, Rod Wentworth, March 17, 1987.

Appendix B—Topic Paper E

Water withdrawal



Dennis Curran

Appendix B—Topic Paper E

Water withdrawal

I. Background

At the Mad River public forums in the spring of 1994, people were asked how they would like the Mad River to be in the future. Responses included several comments about withdrawing water from the river:

- resolve water withdrawal issues,
- provide a responsible amount of water to Sugarbush,
- be cautious when extracting water,
- use water for snowmaking,
- don't expand water withdrawal for snowmaking,
- balance the uses between snowmaking, irrigation, and recreation,
- keep the river unobstructed and free flowing,
- use the river to contribute to the economy, but maintain its health.

Water has been withdrawn from the river for various uses in the valley for some time, but withdrawal for snowmaking has been in the spotlight because of its magnitude, occurrence during the winter when the streamflow is low, and importance for recreation and the economy. From the comments noted above, it can be seen that the views on this issue vary widely. However, of paramount importance is the need to balance the economic uses of the Mad River with its overall health and other uses. The purpose of this paper is to outline the significance of existing and proposed water withdrawals in the Mad River Watershed.

II. Existing and proposed water withdrawals

Not counting small water withdrawals by individual households, fire departments, and others, there are five major water withdrawals in the watershed. For perspective, water flows from a garden hose at the rate of about 1 gallon per minute (gpm). The flow from 449 garden hoses is equivalent to 1 cubic foot per second (cfs), or 449 gpm. Minimum streamflow required just after (downstream from) a water withdrawal point is expressed in csm, calculated by multiplying the number of cubic feet per second (cfs) by the number of square miles of watershed above the point of water withdrawal.

1. Mad River Glen

This withdrawal for snowmaking is taken from the small tributary of Mill Brook. From Thanksgiving to Christmas, and during thaw periods that make water available in winter, water is withdrawn at 100 gpm (0.2 cfs) for two snowmaking machines. There is no pond to store water.

2. Sugarbush North

This withdrawal for snowmaking, governed by an Act 250 Land Use Permit (5WO538-2), is from three points on Chase and Slide Brooks, tributaries to Mill Brook. The first is from a one-acre pond on Chase Brook at the base of the mountain. Minimum streamflow of 0.31 cubic feet per second per square mile of watershed (csm) is assured by a drain pipe at the bottom of the dam. The other two withdrawals are located just above the confluence of Chase and Slide Brooks. A weir on each brook facilitates water withdrawal, and ensures automatic passage of a combined minimum streamflow of 1.86 cubic feet per second (835 gpm).

3. Sugarbush South

This withdrawal for snowmaking is from Clay Brook above Golf Course Pond. A weir installed in the brook measures streamflow, and the pumping rate of up to 1,500 gpm (3.42 cfs) is adjusted electronically to ensure a minimum flow of 0.5 cubic feet per second per square mile of watershed (csm) below the withdrawal point.

4. Sugarbush Golf Course

This withdrawal is for golf-course irrigation and is taken from a pond on Clay Brook with a storage capacity of about one million gallons. Withdrawals occur

between May 1 and October 15 on an "as needed" basis. Pumping capacity for irrigation is 400 gpm (0.9 cfs).

5. Mountain Water Company

This withdrawal for drinking water at Sugarbush Village is taken from seven wells adjacent to Clay and Rice Brooks. While not a direct withdrawal from the brooks, at least two wells may be close enough to the brooks to influence their flow. The other half of Mountain Water Company's drinking water supply is taken from an infiltration gallery (area of gravel or sand beside a stream) on Clay Brook above Inferno Road. The permit for this withdrawal does not specify a minimum streamflow requirement, but withdrawal is limited to 190 gpm (274,200 gallons per day). During the busiest time of year (Christmas), the pumping rate is about 100 gallons per minute continuous (144,000 gallons per day).

There is a proposal to withdraw water from the Mad River at the Warren-Waitsfield town line for additional snowmaking at Sugarbush South. Two of the several permits required for this project have been issued by the Agency of Natural Resources. The first, (January 24, 1994) is a Water Quality Certification, with certain conditions to ensure minimum flow to protect fish habitat, and necessary actions to ensure its passage.

The second permit for this project, issued on January 26, 1994, allows construction of a diversion structure in the stream, and a storage reservoir for water taken from the river at high flows. The water-surface area of the storage pond would cover about 10 acres in the flood plain adjacent to the west bank of the river, and would store up to 63.5 million gallons of water. The diversion structure would be a concrete "key way" built across the stream bottom so that stop logs could be installed to make a temporary dam to divert water into two intake pipes (8.5 feet and 10 feet in diameter) leading to the storage pond. The stop logs would be installed on November 1 and taken out on March 15, or upon ice-out each season, to ensure that there is no obstruction for boaters. Part of the structure would also be a six-foot wide Parshall flume next to the west bank to measure streamflows. A three-mile long, 16-inch diameter pipeline would deliver up to 11.4 cfs (5,000 gpm) to the ski area.

III. Impacts of water withdrawal

Withdrawal of water from the Mad River and its tributaries can affect the river and its uses in several ways. The biggest effect is on the fishery and other aquatic biota. Any water withdrawal reduces streamflow. Withdrawals when streamflow is naturally low, could reduce streamflow beyond the danger point. Lower flows reduce water depth and current in the stream. This reduces the amount and quality of aquatic habitat available. Low flow can also mean higher water temperatures in summer, less oxygen and food drift for fish, and anchor ice formation in the winter, which reduces the overall quality and amount of fish habitat.

Water withdrawal can also affect other recreational uses of the river. Structures built in the stream to divert water to storage ponds or sumps can obstruct boaters. Storage ponds located along the river, and structures in the river can detract from the scenic beauty of the area. Also, the construction of storage ponds and dam structures associated with water withdrawals can disturb the riparian zone (buffer strip), stream banks, and river channel causing erosion and sedimentation during construction, and continuing erosion and adjustments to the channel bottom and banks until the river reaches a new equilibrium after the disturbances.

Construction of ponds or reservoirs on a stream cause a big change in aquatic habitat, loss of the stream type habitat in which trout thrive, and an increase in water temperature. Dams to create ponds, and structures to divert water into off-stream storage reservoirs limit fish passage upstream and downstream. Also, when ponds are desilted to maintain their storage capacity, associated sedimentation of the stream can occur unless the process is controlled carefully.

IV. Water withdrawal and protection of the Mad River and its tributaries

Protecting the Mad River and its tributaries so that they are not degraded in quality and use by water withdrawals requires attention to several key factors:

1. ensuring adequate flows at all times to maintain habitat for fish and other aquatic biota;

2. ensuring that construction work and built structures do not result in stream bank and channel instability, and erosion that would increase sediment loads to the river;

3. ensuring that adequate buffer strips remain along the river, or are constructed and maintained to protect water quality, riparian zone habitat, and the scenic beauty of the river;

4. monitoring water withdrawal, the operating structures, and river health to ensure that minimum streamflows and other requirements are met; also, monitoring data must be evaluated periodically to ensure that the river is, in fact, protected by the conditions imposed on those who withdraw water.

Since there is no separate permit authority and procedure for handling water withdrawals, the Agency of Natural Resources relies on the Act 250 permit process and on the issuance of Water Quality Certificates and Dam Permits to protect water quality. Vermont's Water Pollution Control Law (10 VSA Chapter 47) is also used by the Agency to deal with water quality violations caused by erosion and resulting sedimentation of the river and tributaries.

Over the past decade or so, much study, monitoring, scientific collaboration, and other work has been carried out to determine the kinds of conditions that need to be placed on water withdrawals to protect water quality and uses of the river. This work culminated in the Agency of Natural Resources "Procedure for Determining Acceptable Minimum Streamflows," issued on July 14, 1993. This procedure adopts the U.S. Fish and Wildlife Service recommended minimum flows for spring, summer, and fall/winter to preserve the fishery. Flows needed to protect the fishery resource appear to be generally adequate to ensure that other uses and river qualities are not degraded.

The procedure allows for applicants to conduct stream gauging and fishery studies to determine if lower minimum flows than those required by the procedure may be appropriate. Methods to better estimate or correlate streamflows using existing gauging stations are outlined in the procedure.

The procedure states: "All reasonable alternatives to altering streamflow and water conservation measures should be thoroughly considered before reduction of the natural flow rate is considered."

In addition, the procedure requires greater minimum streamflows to ensure that seasonal trout spawning and egg incubation are supported when ski area operations are expanded and existing water withdrawal operations are stepped up. This ensures upgrading of water quality where it has been lowered, rather than its continued degradation.

V. Future actions and recommendations

The Agency of Natural Resources "Procedure for Determining Acceptable Minimum Streamflows," together with effective implementation appears to provide a foundation for protecting the Mad River and enjoyment of associated uses into the indefinite future. However, the key to protection will be careful monitoring of the withdrawals, the effects they have on the river, and the effects of the increased human activities that those withdrawals make possible.

The following recommendations are made to help protect the Mad River and its tributaries from degradation due to water withdrawals:

1. The Agency of Natural Resources should consistently and effectively apply its Minimum Flow Procedure to proposed water withdrawals in the watershed.

2. The ANR should require monitoring of the river and streams affected by new water withdrawals to determine if minimum streamflow and other requirements are being met.

3. The ANR should evaluate

- all existing water withdrawals (permitted before the Agency's Minimum Flow Procedure became effective);
- its minimum streamflow requirements; and
- the cumulative impact of all withdrawals relative to the Agency Minimum Flow Policy to determine if protection of the river or stream is adequate, and if not make adjustments to achieve it.

4. The Agency of Natural Resources should provide information on monitoring and evaluating water withdrawals to all valley towns affected, and to Friends of the Mad River so that oversight can be provided to ensure that requirements are being met and the river is being protected.

5. The Agency of Natural Resources should encourage the use of water conservation measures, water recycling, water reuse, and storage ponds to minimize impacts of existing water withdrawals on streams.

These activities—application of the flow policy, monitoring, and evaluation—are the responsibility of those who withdraw water, and the Agency of Natural Resources. If the requirements are met there is a high likelihood that the Mad River and its tributaries will be protected from degradation by water withdrawal.

Ensuring that other uses of the river are protected in the face of water withdrawals is also the responsibility of the community and local conservation groups. By understanding the potential impacts of water withdrawal and other uses, by observing and monitoring how the river reacts to actual withdrawals, the community and conservation groups can play a role in the long-term monitoring of the river to ensure that actions are taken to keep it healthy.

References

Agency of Natural Resources, "Procedure For Determining Conservation Flows—Specific Application to Snowmaking by Ski Areas," March 4, 1994.

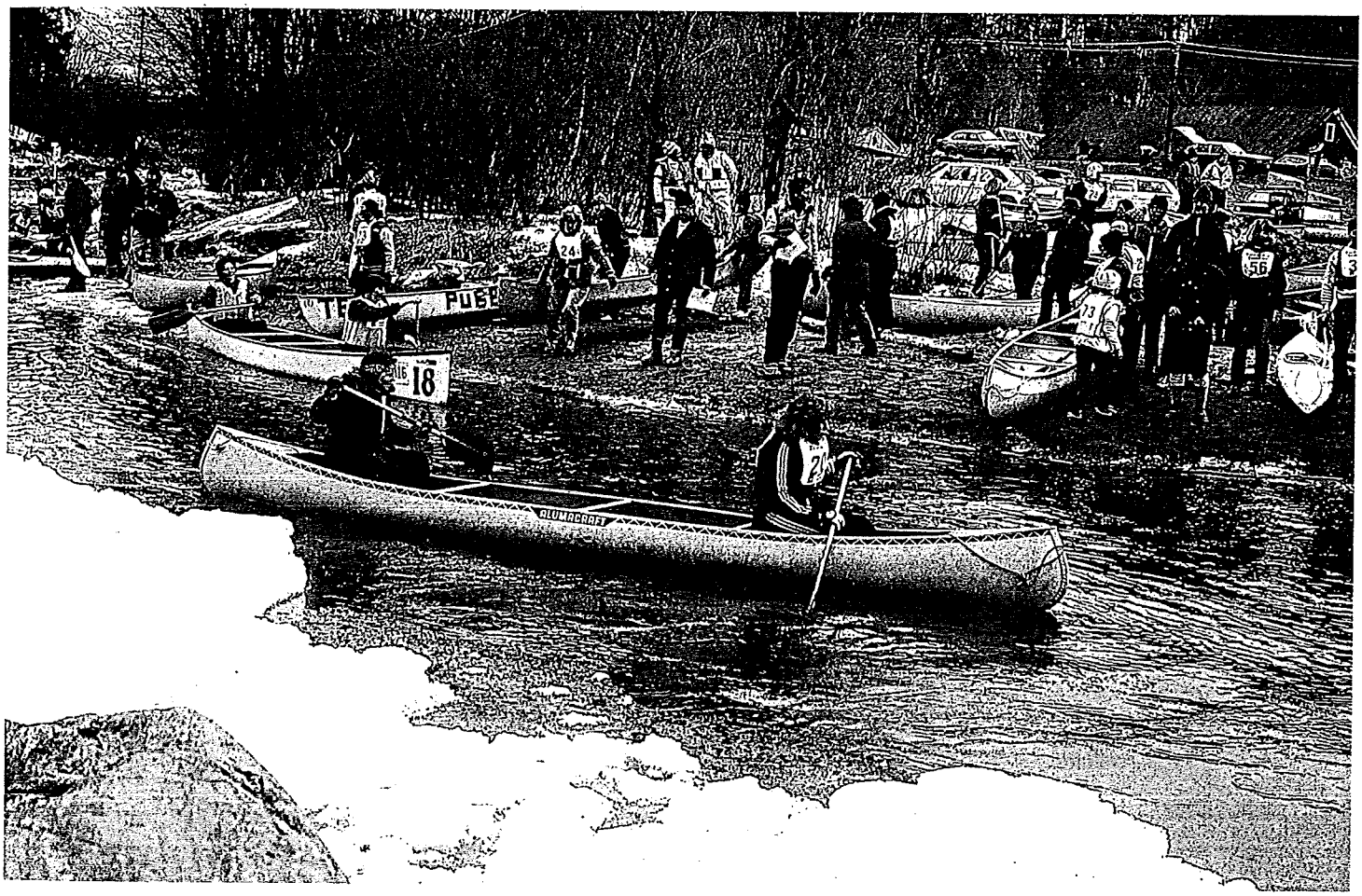
ANR, "Agency Procedure for Determining Acceptable Minimum Streamflow," July 14, 1993

ANR, Permit for Sugarbush Snow Pond Dam (Application 93-4), January 26, 1994.

ANR, Water Quality Certification to Snowridge, Inc. for Mad River Water Diversion and Snowmaking Reservoir, January 24, 1994.

Appendix B—Topic Paper F

Public recreational access



Ann Day

I. Introduction

Responses from participants in the Friends of the Mad River (FoMR) public forums indicate that public recreational access to the Mad River is second only to water quality as a concern. Participants want to see existing access maintained, and increased access made available. They also want to see the character of the river preserved with mostly quiet, secluded, undeveloped areas. Also, there is interest in safe, family recreational areas, handicapped access, boat launching points and portages, educational and interpretive areas, picnic spots, and more.

Both the Forum responses and responses to the FoMR 1992 Questionnaire confirm that residents are interested in a variety of recreational uses including swimming, boating, fishing, camping, hiking, and walking. There was consistent concern that the river's quality and character not be degraded.

The types of access required for these uses varies. In some cases, a single access area can accommodate several uses (e.g. Lareau: swimming, canoe/kayak landing, picnicking), while others can serve a single use (e.g. triathlon field-boat take-out). The access points used most frequently have varied ownership. A substantial area of the river's headwaters in Warren is in the Green Mountain National Forest. Some points along Route 100 (along with land under the highway) are owned by the State of Vermont. A few parcels are owned by municipalities. There is at least one public access easement over private land, but most recreational access areas along the river are owned by private landowners.

II. Swimming holes

There are 19 commonly used swimming holes in the watershed. Four of the 19 are on tributaries, and the others are on the main stem of the Mad River. While all provide an opportunity for a refreshing dip, the character of the areas varies considerably. The Lareau Swim Hole and Ward Access are the most developed, and accommodate the greatest number of swimmers. At the other end of the spectrum, pristine swimming holes in some of the river's tributaries are virtually undeveloped and provide quiet and seclusion to the few who can find them.

A recurring theme in the state swimming hole study is bathers' desire not to draw attention to the more secluded swimming holes. There is concern that promotional photographs, tourist brochures, and recreational touring trips attract more people and change the character of fragile resources.

Of the 19 swimming holes listed in the topic paper on swimming, access to five of them is via public land, and access to at least another five is across the lands of owners who allow public access. The owners of at least three of the areas actively discourage public access.

III. Canoe/kayak access

According to canoe and kayak enthusiasts, boat access to the Mad River is generally quite good. Many access points are within state or town highway rights-of-way. Only a few private owners discourage boat access.

Boaters would like to see public access allowed at the sites of three portages. FoMR could facilitate this by working with the boaters and property owners.

Boaters made specific suggestions about improvements of parking, paths, and cleanup at certain sites that are within the town or state rights-of-way. These improvements probably could be implemented by town road crews or volunteer efforts.

IV. Lands in public ownership

Between the United States Forest Service, the State of Vermont, and local municipalities there is a significant amount of land in the Mad River Watershed that is in public ownership. While most should not actually be developed for public access, public ownership provides opportunities for long-term protection and perhaps some future access or use.

A list of these lands and public ownership should be developed and mapped. Transfer of development right lands with provisions for public access, and public access easements should be included.

V. Strategies and recommendations

The following recommendations are made to help preserve existing access to the river and to increase access in the future.

1. Valley towns, working in conjunction with Friends of the Mad River, and the Mad River Planning District, should revise or update their plans to:

a) identify important river access points for public acquisition, or for acquiring easements;

b) identify town-owned properties that are adjacent to the Mad River and its tributaries, and recommend provisions for their future use, protection, management, and public access;

c) identify all town-owned and other public easements (such as the Vermont Land Trust easements, and town-owned development rights that provide public access to the river ;

d) list Agency of Transportation right-of-way accesses to the river; and

e) map the above information and make it available to the public.

2. Valley towns and the state should develop a capital budget (with an educational component to make the proposals and their effects readily understandable to the public) to enable prompt acquisition of priority access areas and recreation easements when such lands are offered for sale.

3. Valley towns should provide parking, boat access, and path maintenance at important access points to the river that lie in town-owned road corridors and rights-of-way. Risks and potential liability should be considered carefully for each access point, and the access designed accordingly. Specifically, the town of Waitsfield, with assistance from the Mad River Path Association, and the Friends of the Mad River, should seek permission to develop the parking area at S.G. Phillips, with respect to bathroom facilities (portable toilets) and a plan to control stormwater runoff from the parking lot to avoid harming the stream bank or river.

4. To encourage and foster public access to the river across private property, Friends of the Mad River through an Adopt-a-River Program should:

a) contact owners of key access areas to determine the status of their areas, and document any problems and concerns the owners may have;

b) with owners , determine what support they would like in maintaining access, such as volunteer cleanup, improved parking, and path maintenance;

c) develop education materials to increase respect of and care for private land and the owners' privacy; and

d) provide information to property owners about easements, potential grants for enhancement, and other programs that might help to preserve access.

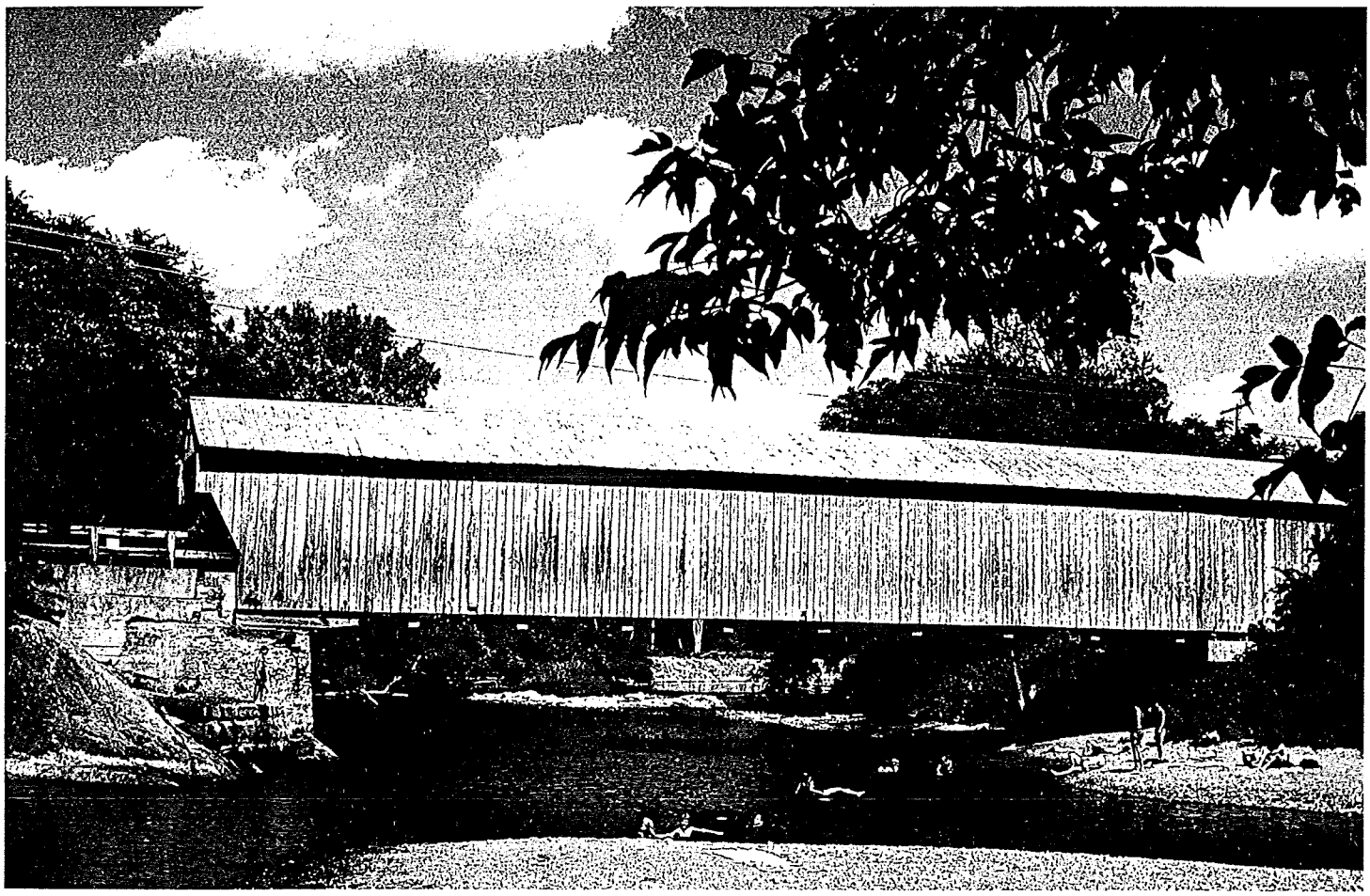
5. The U.S. Forest Service should continue to acquire land and easements along the Mad River and its tributaries to protect the watershed and public access to the river and its tributaries.

6. In any negotiations about trading lands with Sugarbush, the U.S. Forest Service should give priority to acquiring land or easements along the Mad River and its tributaries.

7. In its planning and construction of the state owned road and adjacent corridor, the Vermont Agency of Transportation should provide well-landscaped parking, access, and enhancements, such as picnic areas, at key access points to the river that have been identified by towns and Friends of the Mad River.

Appendix B—Topic Paper G

Swimming



Ann Day

I. Introduction

In a recent unpublished survey of swimming holes in Vermont, commissioned by the Division of Water Quality of the Vermont Agency of Natural Resources, the Mad River was rated as "an outstanding swimming resource, and unquestionably one of the State's best." The survey covered 210 swimming holes, and of those 19 are in the Mad River Watershed—well above the average number per town. One—Ward Access—was rated as significant for very heavy use, and five were rated as significant for heavy use. Only four of the 19 on the Mad River are publicly owned. See Table 1 and the accompanying map (which shows the numbers and locations of associated Mad River Watch sampling stations).

The swimming holes in the Mad River Watershed vary in size and character. Warren Falls, in a beautiful gorge in the headwaters, has falls and potholes with clear, turquoise water. Ward Access is a readily accessible and heavily used swimming hole downstream at Moretown, plus there are many small, secluded swimming holes on the tributaries.

The Vermont survey listed several threats to swimming holes, and problems—including water quality deterioration, sedimentation, development, posting of private land, overuse, noise, and change in character of secluded swimming holes due to increased use. Some, and maybe all, of these threats and problems exist in the Mad River Watershed.

Although state Water Quality Standards classify the waters of the Mad River Watershed as Class B (the waters are to be clean enough to support body contact recreation), actual quality falls well below this standard. Nine years of water quality data obtained by the Mad River Watch from 1986 to 1994 indicate clearly that the Mad River has at various times been contaminated with bacteria to above-acceptable levels for swimmers' health. The waters at many locations have been consistently below health standards for all nine years of sampling. This was the case in almost all locations except the headwaters, where there is very little human activity.

There are several key questions. What will happen to these outstanding swimming holes over the next 50 years? Will they be there for our children and grandchildren to use freely in the middle of the next century? Will the water be clean and without health risks in undeveloped settings that make so many of the Mad River's swimming holes so attractive and pleasurable? Will they continue to be accessible to the public? Can access over private lands be maintained?

The River Forums held in the spring of 1994 revealed that the greatest public concern is to keep the Mad River and its tributaries swimmable and of very high quality. However, even though some of the plans of the five valley towns mention swimming as a valuable recreational asset, there is little protection of any kind, except public ownership of a few swimming holes. Given nine years of substandard water quality conditions, it is clear we cannot take the continued use and quality of these exceptional natural resources for granted.

I. Introduction—continued

Table 1. Location and description of commonly used swimming holes

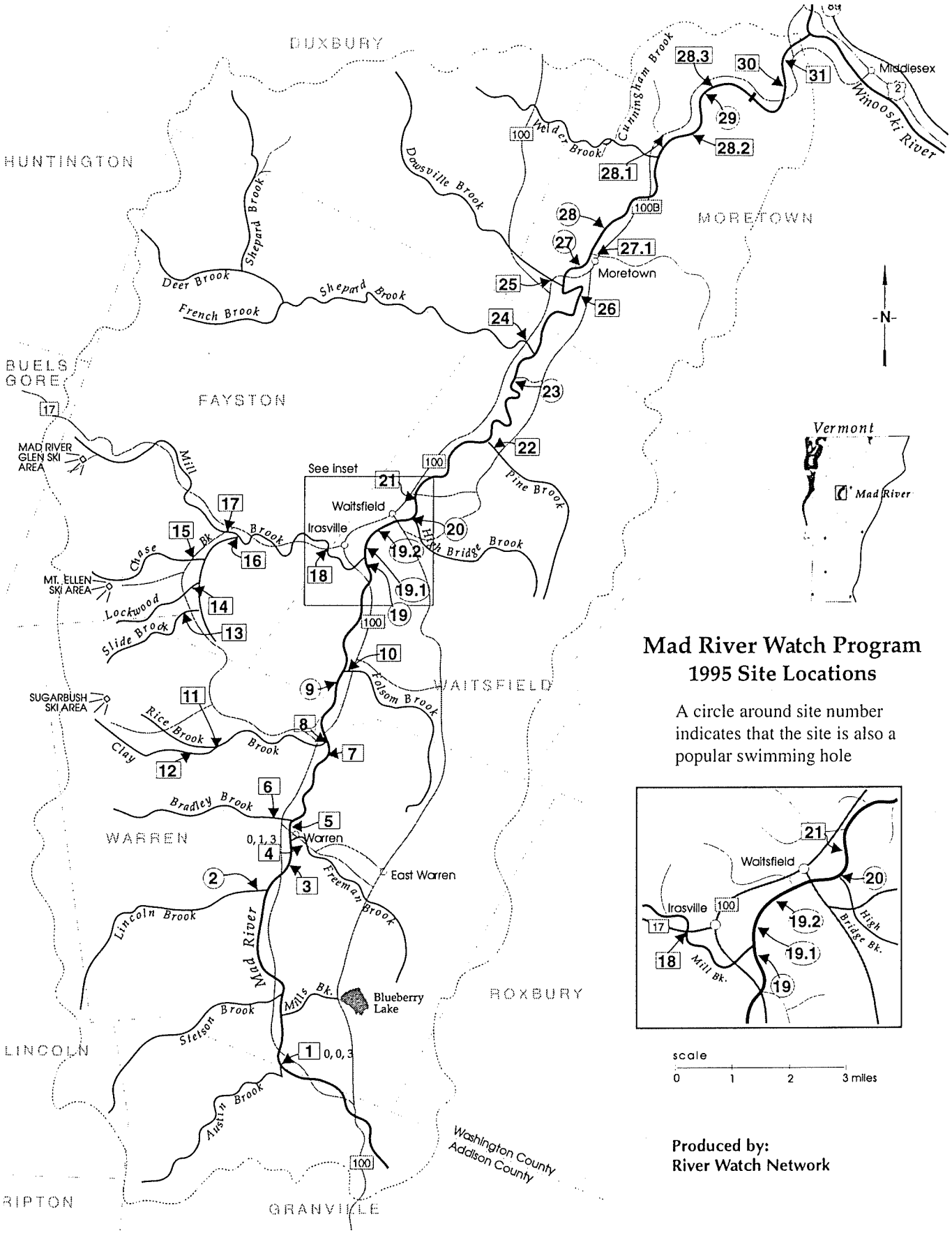
There are 15 commonly used swimming holes on the main stem of the Mad River. These are listed below with the locations and numbers of the Mad River Watch sampling stations that apply (see the map of the Mad River Watch sampling station locations).

Swimming hole	Number	Location	Ownership/access
Picnic Area Cascades	—	Route 100, 3 miles south of Warren Village	State: access from picnic area
Warren Falls	1	Route 100, 1.1 miles south of Lincoln Gap Road	Private: posted
Warren Village	3	In Warren Village at Covered Bridge	Private: access from road
Warren Gorge	—	Warren Village	Private
Punch Bowl	9	At Warren/ Waitsfield boundary	Private: access allowed
Lareau's	19	Route 100, south of Waitsfield Village	Town
Laundry	19.1	Behind laundromat at Fiddler's Green, Waitsfield	Private
Couples Recreation Field	19.2	Behind recreation field, Waitsfield	Private
Waitsfield Covered Bridge	20	Above the Covered Bridge	Private: not posted
Meadow Road Bridge	23	Just downstream of S.G. Phillips	Private: not posted
Moretown Gorge	27	South end of Moretown Village	Public access: part private
Fulton's	—	Moretown Village	Private
Clapboard Mill	28	Behind and downstream of the Ward Clapboard Mill	Private: not posted
Ward Access	29	Route 100-B (also called Palisades)	Public
Lower Gorge	31	Just above river mouth	Private: posted

There are four commonly used swimming holes on Mad River tributaries.

Stetson Brook Cascades	—	.25 of a mile up Stetson Brook Road	Public: USFS
Bobbin Mill Cascades	2	Behind Dirt Road Company	Private: public access
Hartshorn Falls	—	3 miles up Lincoln Road	Public: USFS
Blueberry Lake	—	East Warren	Private: not posted

Map of Mad River Watershed swimming hole locations.



Mad River Watch Program
1995 Site Locations

A circle around site number indicates that the site is also a popular swimming hole

scale
0 1 2 3 miles

Produced by:
River Watch Network

II. Problems and threats

All threats to swimming holes stem from human activity, either directly or indirectly. If carried out irresponsibly, certain land uses and river uses can compromise the values of a good swimming hole:

- good water quality—no bacterial contamination; low turbidity, high clarity; low in nutrients such as phosphorus;
- sufficient area and depth for swimming;
- good bottom for wading (not muddy or slimy);
- good setting—attractive natural features, such as trees, rocks, pools, cascades, waterfalls, seclusion, sun and shade);
- accessible—legal access, parking, foot path;
- limited conflicts with other uses, such as nearby development, noise, fishing, canoeing, overuse, traffic.

Threats to good water quality result from various sources, including failing sewage systems, erosion and sedimentation, excessive nutrients, stream bank erosion, and some agricultural practices. However, there are indications that the biggest threat to water quality for swimming is from failing on-site sewage systems. A summary of the Mad River Watch data for eight of the nine years it has been collected is presented in Table 2, "Mad River Main Stem—Analysis of River Watch Network Data, 1986-1993." These analyses were carried out to determine the possible causes of continuing fecal coliform and *E. coli* contaminations of the river. The River Watch data are in two categories:

- data at low flows (when one would expect the major cause of contamination to be from failing sewage systems); and
- data at high flows (when one would expect the major cause of contamination to be from land runoff from farm fields on which animal manure and sludge and septage had been spread).

The data show that there are many more violations due to bacterial contamination during lows flows (25 percent) than during high flows (6 percent). Increased volume of water during high flow periods may be diluting the bacterial contamination of the river (see the graphs in this paper). We can't tell how much of the problem is due to land runoff since there is no way to accurately and economically measure such diffuse contamination. Since there is little or no land runoff when flows are low, and since violations increase with low flows, this strongly indicates failing sewage systems as the continuing source of contamination.

There was only one sampling station on the main stem of the Mad River that had no violation during the eight-year period presented in Table 2. This station is at Warren Falls, located in the headwaters above Warren Village. The data show that violations increase as one proceeds further downriver to Waitsfield Village and beyond. Some stations show violations for almost every sampling in the last eight years. There is no doubt that increased human activity and habitation are causing the increased and unacceptable levels of human health risks in the watershed.

Other growing threats to swimming holes are development, and the posting of private holdings to prohibit access. Most swimming holes happen to be located so that private land must be crossed and used to enjoy the public resource. A well-known example of posting is at Warren Falls, which had been used heavily.

An example of how development can compromise a swimming hole involves two new homes on the lower gorge of the Mad River, just before it enters the Winooski River. When homes are built so close to a traditional swimming hole, the homeowners' understandable desire for privacy leads them to post their property, which conflicts directly with public enjoyment. As development continues, more such losses are bound to occur unless swimming holes can be protected somehow.

The development of a swimming hole to make it more accessible and convenient for public use, and the resulting increased activity can result in problems of overuse, which can drastically alter a location's quiet, secluded character—the very reason it is attractive. High usage can also result in physical problems. A good example is at Ward Access, where foot traffic is causing stream bank erosion that is being aggravated

by runoff from the parking lot. These problems can be fixed, but an adequate maintenance program is not in place to do so.

Other threats to swimming holes include dams, which can inundate an area; inappropriate user conduct (rowdiness, noise, littering) that can detract from the recreational experience, and encourage posting of private land; and natural events, such as flooding, that can alter a swimming hole by changing the depth of water or altering the stream banks.

Generally, swimming holes that endure are located near control points in the river, such as rocks and ledges, that are relatively unaffected by seasonal high water periods and flooding. Compared to the greatest threats to swimming of water quality degradation, encroachment by development and loss of access by posting, other threats are minor and usually can be managed relatively easily.

III. Existing and potential protection

Vermont's Class B standard applies to all waters of the Mad River and its tributaries. The job of attaining and maintaining that standard is mainly the responsibility of the Vermont's Agency of Natural Resources, and its Water Resources Board has set water quality standards through a public process.

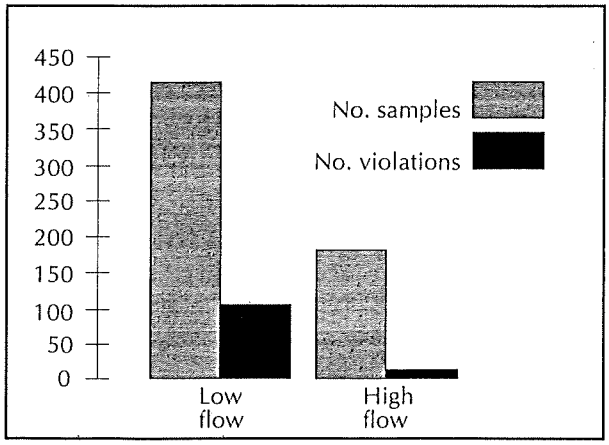
The fact that there is considerable bacterial contamination of the Mad River means that there are polluting sources that must be identified and abated if the river is to meet the health standard.

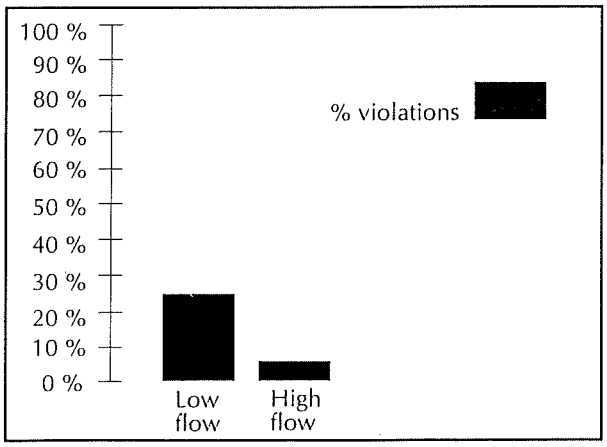
In the past when there was straight piping of sewage into state waters, state Water Resources investigators visited residences along rivers and lakes to determine who was polluting. Orders were then issued to abate the pollution, usually by installing a septic tank and leach field disposal system. Today, problems are not so obvious. On-site sewage systems may be failing owing to insufficient treatment, or breakout of sewage and overland flow. With more systems in place to fail, and poor maintenance, we may have a growing problem.

There is no state program now to perform house by house "sanitary surveys" to pinpoint pollution and abate it. Such a program may be needed. Vermont's Agency of Natural Resources could do additional monitoring to locate sources of pollution, but apparently lack of funding makes this impossible.

Another way that swimming holes could be protected and enhanced is for the state Agency of Transportation to consider swimming holes in its

Mad River Watch mainstem data 1986-1993





III. Existing and potential protection—continued

Table 2. Mad River Main Stem—analysis of River Watch network data, 1986-1993

	Total			Note 1 *Falling hydrograph Low flow*			Note 2 *Falling hydrograph High flow*			Note 3 *Rising hydrograph*		Note 4 *Peak 111*	*Peak 684*
Site	#Sam	# Vio	% Vio	#Sam	#Vio	%Vio	#Sam	#Vio	%Vio	Low	High	Low	High
1	35	0	0	24	0	0	8	0	0	—	No	No	No
3	40	2	5	26	2	8	10	0	0	No	No	No	No
5	38	2	5	26	2	8	9	0	0	—	No	No	No
7	39	5	13	26	5	19	9	0	0	No	—	No	No
9	40	2	5	26	1	4	10	0	0	No	No	***Yes***	No
19	40	7	18	25	7	28	9	0	0	No	No	No	No
19.1	29	9	31	23	8	35	3	1	33	—	No	No	No
19.2	30	5	17	24	4	17	3	0	0	—	No	***Yes***	No
20	39	11	28	25	9	36	10	0	0	***Yes***	—	***Yes***	***Yes***
21	35	8	23	25	8	32	8	0	0	—	—	No	No
23	40	10	25	26	8	31	10	0	0	No	No	***Yes***	No
26	39	14	36	26	12	46	9	1	11	No	No	***Yes***	***Yes***
27	38	11	29	26	11	42	9	0	0	—	No	***Yes***	***Yes***
28	37	14	38	26	12	46	9	2	22	—	No	No	—
29	38	9	24	26	7	27	9	1	11	No	No	***Yes***	—
30	39	7	18	23	4	17	10	3	30	No	No	No	No
31	10	3	30	10	3	30	0	0	—	—	—	No	—
Totals	**606**	**119**	**20%**	**413**	**103**	**25%**	**135**	**8**	**6%**	**11%**	**0%**	**41%**	**21%**

#Sam Number of samples taken
#Vio Number of violations of water quality standards
%Vio Percentage of total number of violations of water quality standards
Low Low water flow
High High water flow
Yes Violation occurred
No No violation
— No data

Note 1 Samples when the hydrograph was falling (flow decrease) for low flows—less than 100 cubic feet per second (cfs). This happened on 26 sample days.

Note 2 On 10 sample days there were falling hydrographs and high flows (greater than 100 cfs).

Note 3 For 2 sampling days, hydrographs were rising: low flow (99 cfs on July 13, 1987). High flows (269 cfs on June 21, 1989).

Note 4 For 2 sampling days, hydrographs were at peak: on June 19, 1993, flow was relatively low at 111cfs, up from 100 cfs the day before (little rain). On August 14, 1990, flow was at 684 cfs, up from 373 cfs the day before (heavy rain).

Note 5 Median Mad River flow is 129 cfs; 95% exceedance is 27 cfs (i.e. Mad River flow exceeds 27 cfs 95% of the time).

planning and construction of state roadways.

Town road planning, and construction and maintenance departments, such as the state Agency of Transportation, could provide for access and protection of swimming holes. Off-road parking at swimming holes located near roadways is one way. Another is planning for protection of swimming holes during roadway reconstruction.

Towns seem to have the greatest potential to protect swimming holes for water quality and public accessibility. However, only two of the five towns in the valley have health ordinances that could ensure proper sewage disposal. All towns should have health or sewage ordinances with effective administration. There could also be an education program on how to maintain on-site wastewater disposal systems. For replacement of failed systems in hardship cases there could be a revolving loan fund to help those in need.

If town plans and zoning and subdivision ordinances mention swimming holes at all they do so only superficially. These instruments could take a much stronger approach to protection. Town plans could recognize swimming holes as a valuable natural resource of the town that should be protected. Zoning and subdivision ordinances could contain provisions to restrain development in ways that avoid compromising this valuable public resource. Planning, priority setting, and capital funding could include swimming hole purchase and easement. Planning could ensure that as lands adjacent to swimming holes and those needed for public access come up for sale, the town would be ready to proceed with negotiations for purchase of land or an easement.

Citizen groups and organizations, such as the Mad River Watch, play a crucial role in monitoring water quality and making other observations of the river when state environmental agencies are unable to do so. More could be done. There could be an "adopt-a-swimming hole" program in which volunteers make seasonal observations of the use and changes occurring at swimming holes. Volunteers could also post the results of water sampling to inform swimmers of the current health risk. There is no doubt that increased human activity and habitation are causing unacceptable human health risks in the watershed.

IV. Recommendations and future actions

1. Town and state plans should include goals and objectives to preserve and enhance existing swimming holes, and in some cases to purchase lands or obtain easements to provide access to swimming holes.

2. Town zoning ordinances should be introduced or revised to protect existing swimming holes from encroachment by new development.

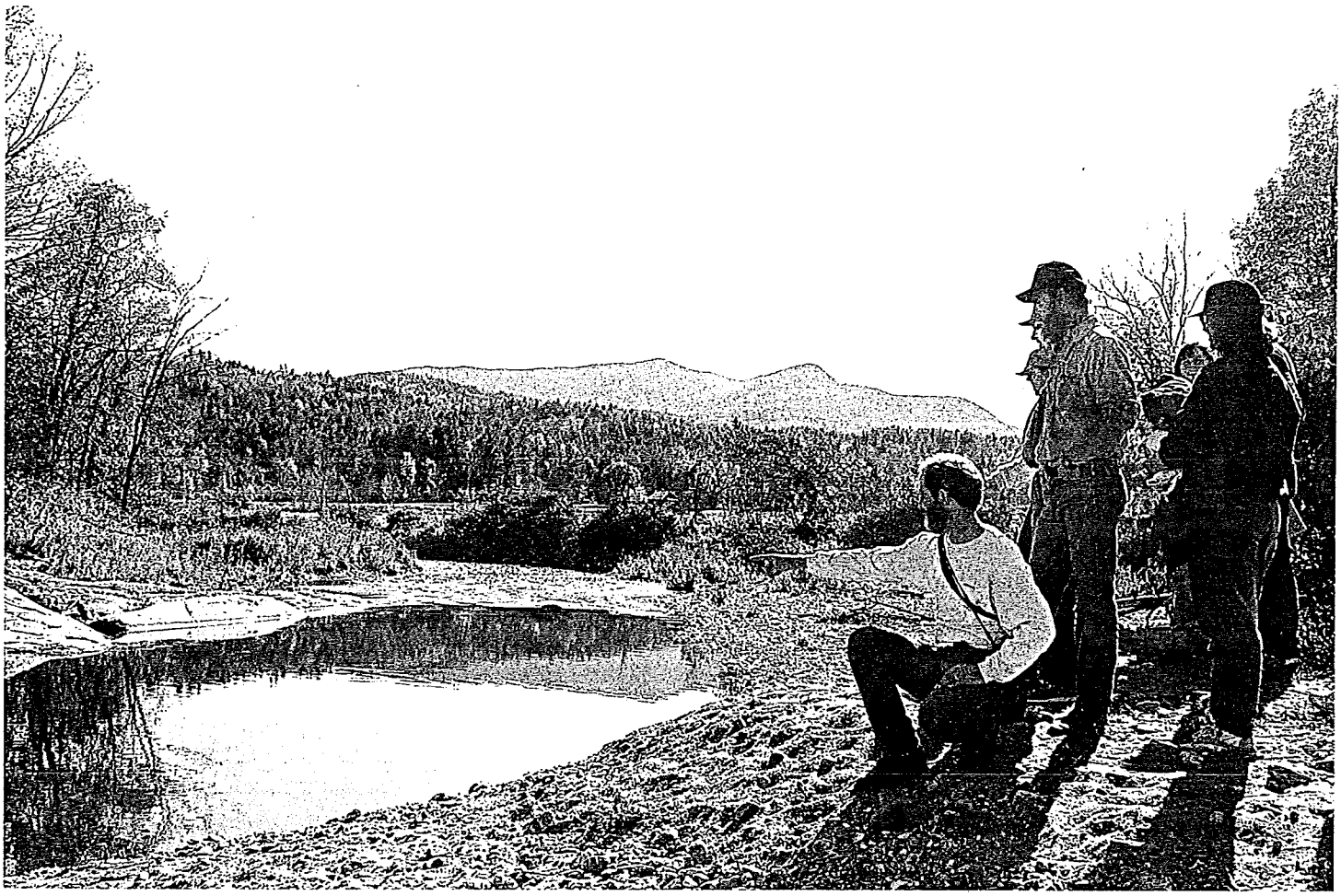
3. State and local governments, conservation groups, and individuals should combine efforts to identify sources of pollution that are threatening the use of swimming holes.

4. The Mad River Watch sampling program should be expanded to monitor river conditions. This should include continued monitoring of the physical condition of swimming holes to see how and why they change, and posting the results of sampling at swimming holes to let swimmers know the current risks of swimming.

5. For public swimming holes, there should be a continuing town or state maintenance program with Natural Resources Conservation Services assistance to remedy erosion problems resulting from human use and natural drainage. Specifically at Ward Access, the stormwater drainage from the parking lot should be diverted where foot traffic has eroded the bank. Also, the eroding bank should be repaired, and a firm stone surface, or wooden steps installed to prevent erosion.

6. Possibilities of ensuring continued public access to private swimming holes should be explored with land owners by Friends of the Mad River in cooperation with towns. This effort should include public education about private swimming holes where there is public access, and advice on what swimmers must do to respect the owners' property and privacy.

River path



The Valley Reporter

A river path is a trail, walkway, or primitive roadway along or near a river. It allows people to enjoy the diverse character of the river though such recreational pursuits as hiking, jogging, cross-country skiing, or biking. There are many other benefits to a river path, such as use of interpretive signs to help people enjoy and become better acquainted with the river's character and attributes.

It is imperative that a path be planned carefully, considering river dynamics, proper construction, and maintenance. Otherwise, time and resources could be wasted, and the river could be worse off.

Portions of the path along the Mad River are being constructed, and plans are being made to extend it. One of the elements of protecting the Mad River should be consideration of how the path will impact the river. A path adjacent to the river can affect both water quality and the aquatic habitat by causing erosion and sedimentation. Also, there are tensions between use of land for a path, for agriculture, and for a buffer strip to maintain-stream bank stability and river shading. Agricultural users wish to maximize the amount of tillable land, and so would push the path closer to the river. The need for a protective buffer strip along the river would use otherwise tillable land.

Careful alignment of the river path can minimize use conflicts. A plan should be prepared for each portion of the path to minimize impacts on water quality. The Mad River Path Association, in cooperation with towns and landowners, should fully address the following considerations in planning, building, and maintaining the river path.

Recommendations

1. Avoid, or minimize encroachment on existing, undeveloped stretches of the river corridor to minimize impact on natural plant and animal communities and to the stream bank.

2. Maintain a buffer strip at least 50 feet wide (more where steep slopes and erodible soils exist, and where the river is expected to meander over time) wherever possible to minimize sediment and nutrient input to the river, and disturbance to stream banks. If usable farmland is involved, consider any compensation that may be necessary to farmers.

3. Keep the path as narrow as practical to minimize disturbance and erosion, and sedimentation of the river.

4. Plan access points to the river to minimize disturbance to stream banks, and yet allow maximum access to points of interest. Where access points are located in areas where stream banks have been disturbed, repairs should be made to prevent erosion and sedimentation. Also, vegetation should be replanted where desirable.

5. Where existing stream banks are unstable, the Mad River Path Association should work with landowners to develop a plan for stabilization before agreement is reached on path alignment so as to minimize future threats to the path. Where stabilization is effected, improvements to aquatic habitat should be considered, such as planting trees for shading. If riprap is installed, consider improving fish habitat with such devices as current deflectors, and log cribs where fish can hide.

6. Where stream banks are bare, trees should be planted for long-term river shading, bank stabilization, and a fish food source from falling insects. Where trees exist, the plan should call for their management for long-term health and diversity to keep the stream bank stable.

7. When planning the River Path, minimize the number of river and stream crossings. A bridge abutment is vulnerable during high flows, and if jeopardized will need protection that can be expensive and reduce aquatic habitat.

Recommendations—continued

8. Develop an erosion control plan for use during and after construction.

9. Develop a continuing maintenance and monitoring plan that calls for an annual check of erosion control measures and any habitat improvement structures. Plantings of stream side vegetation should also be checked to ensure it is healthy. Any trouble spots, such as new erosion areas or unexpected river meanders, should be noted and addressed.

10. The river path plan should take advantage of every opportunity for education, including signs to explain channel dynamics and natural phenomena. A brochure should be considered for self-guided walking tours, with brochure sections keyed to numbered path stations.

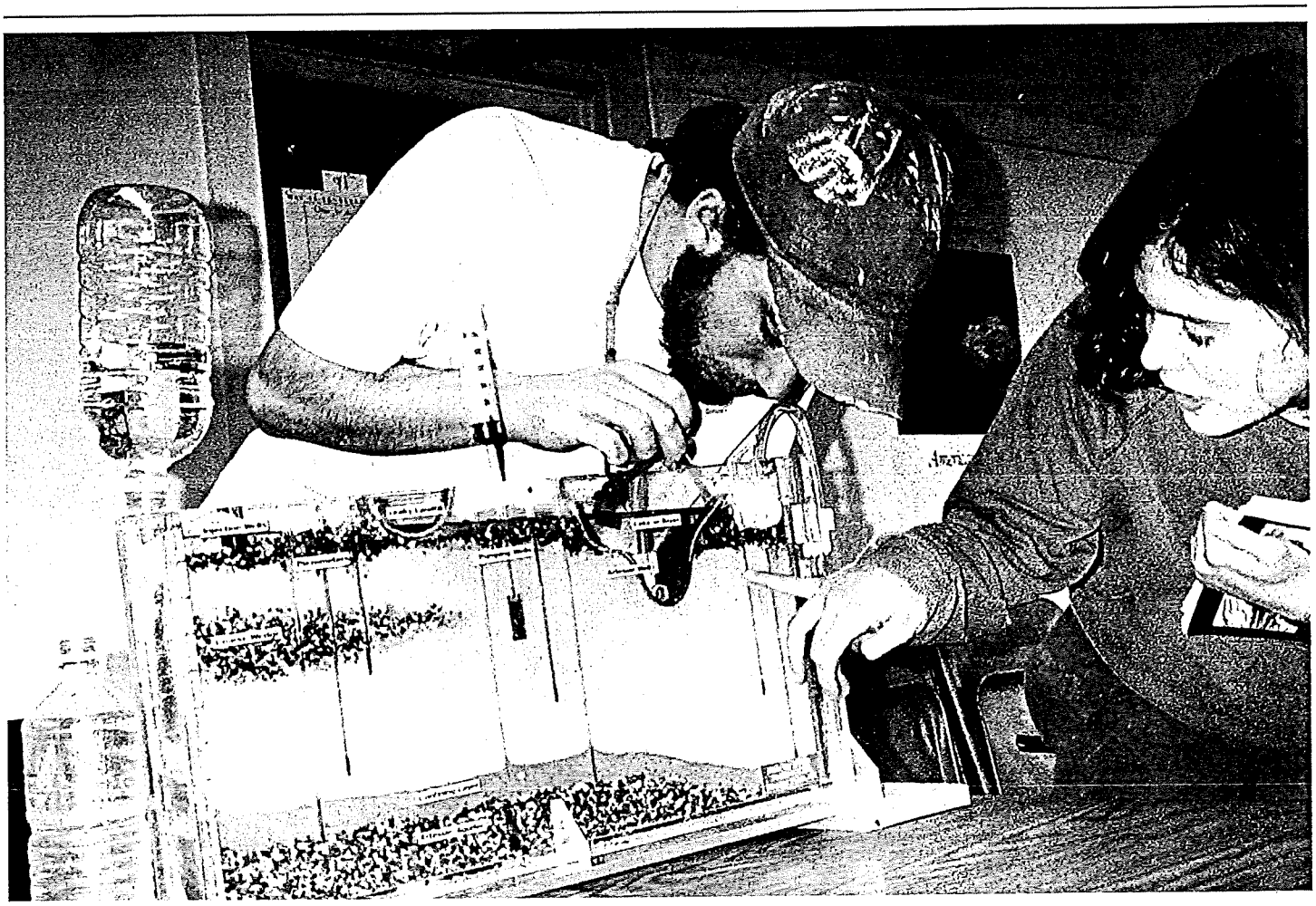
Many of these considerations, such as river dynamics, meandering, stream bank stabilization, and aquatic habitat improvement, are highly technical. Resource persons should be sought among knowledgeable people in town and in state and federal agencies, such as the Vermont Agency of Natural Resources (Water Quality Division, Fish and Wildlife Department) and the Natural Resources Conservation Service.

Reference

Agency of Natural Resources, Water Quality Division, *Recreation Path and Trail Planning— Values and Considerations for Water Quality and Aquatic Habitat,* 1994.

Appendix B—Topic Paper I

Education and protection



Katie Sullivan

Education and protection

I. Introduction

Education about the river was very high on the list of concerns expressed by river forum participants who responded to the question, "What would you like the Mad River to be like in the future?" There was concern about education for four groups: landowners, municipalities, students, and the general public. For each group, there are several existing educational programs that could be continued and enhanced, and new ideas that could be proposed. While the broad topic of "education" is included in most of the other topic papers, some specific ideas for each group have been suggested.

II. Landowners

Getting information to landowners whose practices impact the river is a major priority. An important aspect of this plan is educating folks about the values, consequences, and alternatives of such actions as leaving adequate buffer strips along the river; erosion control at construction-sites; and properly designed, constructed, and maintained sewage systems. Providing information enables those who impact the river to have a better understanding of the ecosystem, the issues involved, and the options available to them. Landowners would benefit from the following educational resources:

- articles in The Valley Reporter that target specific areas of interest to them, such as Mad River Watch data, and preventing erosion and runoff;
- events organized to promote understanding, appreciation, and celebration of the river;
- pamphlets outlining best practices, such as disposal of hazardous household wastes, general interest topics, and contacts for more information (the pamphlets could be distributed to landowners and made available in town offices, libraries, and at other locations);
- information kiosks at strategic river locations could display information about educational events and available resources.

III. Municipalities

Towns along the Mad River need information as well. Friends of the Mad River can assist in this process through articles in The Valley Reporter by facilitating meetings and workshops for planning commissions, the Agency of Transportation, health officers, and other municipal groups whose decisions and practices impact the river. These meetings should:

- include experts on various subjects, distribution of up-to-date information, and discussions of issues relating to responsible use of the river and watershed;
- Friends of the Mad River should encourage town planning commissions and selectboards to consider the river carefully in town plans, zoning and subdivision ordinances, and road maintenance policies; and
- provide towns with Mad River Watch data and other observations about the river.

Municipalities should also provide information on maintaining sewage systems, and make available copies of a model logging contract to ensure that logging jobs are done with the river and a long-term, sustainable forestry resource in mind; and that there is proper logging closeout to avoid erosion.

IV. Students

Mad River Valley schools have no standard river curriculum. Many schools and teachers are doing river units and studies, but they are random, inconsistent, and vary from school to school. Ideally, with the support of Friends of the Mad River, a comprehensive, rich, and integrated curriculum should be developed and implemented in area schools using existing resources and excellent materials already in use, as well as new material. The goal should be to foster appreciation and understanding of the Mad River and its watershed to help create informed, responsible citizens. The curriculum should include the following components.

What is a watershed?	Mapping and origins of streams Building watershed model Stream table exploration Erosion
Household hazardous wastes	What are they? How can they be disposed of safely? How can they be reduced?
River-site visits	Water biology stream studies: biotic index (what lives in the river?) and abiotic index (what chemicals are in the river?)
Water cycle	Acid rain, weather, groundwater flow
Folklore	Elders' stories/oral history History of the river Songs, stories, games
Social and political issues	Town meeting simulations Lifestyle choices Celebration of the river

This material should be well integrated, easy to read and implement, and accessible. There should be teachers' workshops to support these activities.

V. General public

Educating citizens of the valley could be based on many of the following tools, some of which are being used already:

- articles in The Valley Reporter;
- pamphlets and handouts;
- radio spots featuring oral histories, river stories, Mad River Watch data, and public service announcements;
- an education center, such as a nature center or museum, the development of which could be carried out with Friends of the Mad River and other interested groups, could include a self-guided interpretive trail, historical and cultural information (to be collected, stored, and shared with visitors), workshops on all topics relating to the watershed, special events and celebrations, and a community meeting place.

Information about protecting the river could be made available to tourists through river kiosks, a river resource center, articles in newspapers, pamphlets, radio spots, and special events. Information could also be provided at local Chambers of Commerce.

VI. Recommendations

1. Friends of the Mad River should continue to write articles for The Valley Reporter to target specific areas of interest about the river, such as preventing runoff and erosion, Mad River Watch data, and problems or issues in the watershed.

2. Friends of the Mad River, in cooperation with various sponsors in the watershed, should organize special events to promote understanding, appreciation, and celebration of various aspects of the river.

3. Friends of the Mad River should prepare pamphlets that outline best practices, such as safe disposal of hazardous wastes, and provide telephone numbers of resource persons for more information. These pamphlets should be distributed to landowners and made available in town offices, libraries, and other public locations. Existing publications, such as *Accepted Management Practices* (for forestry)*; Native Vegetation for Lakeshores, Streamside, and Wetland Buffers;* and *Wetlands Rules and Regulations* should be available at all town offices.

4. Friends of the Mad River, in cooperation with valley towns and businesses, should establish information kiosks at strategic river locations for posting pertinent data, as well as information resources and events.

5. Friends of the Mad River should facilitate meetings and workshops of planning commissions, the Vermont Agency of Transportation, town health officers, and local groups whose practices impact the river. These meetings should include subject matter experts, up-to-date information materials, and discussions of responsible use of the river and watershed.

6. With the support of Friends of the Mad River, state and federal agencies, and others, valley schools should develop a rich, integrated curriculum and implement it in the schools using existing resources and materials, as well as new material. For example, the elementary school gardening program could be expanded to include growing river and stream bank vegetation for educational as well as practical uses in the watershed.

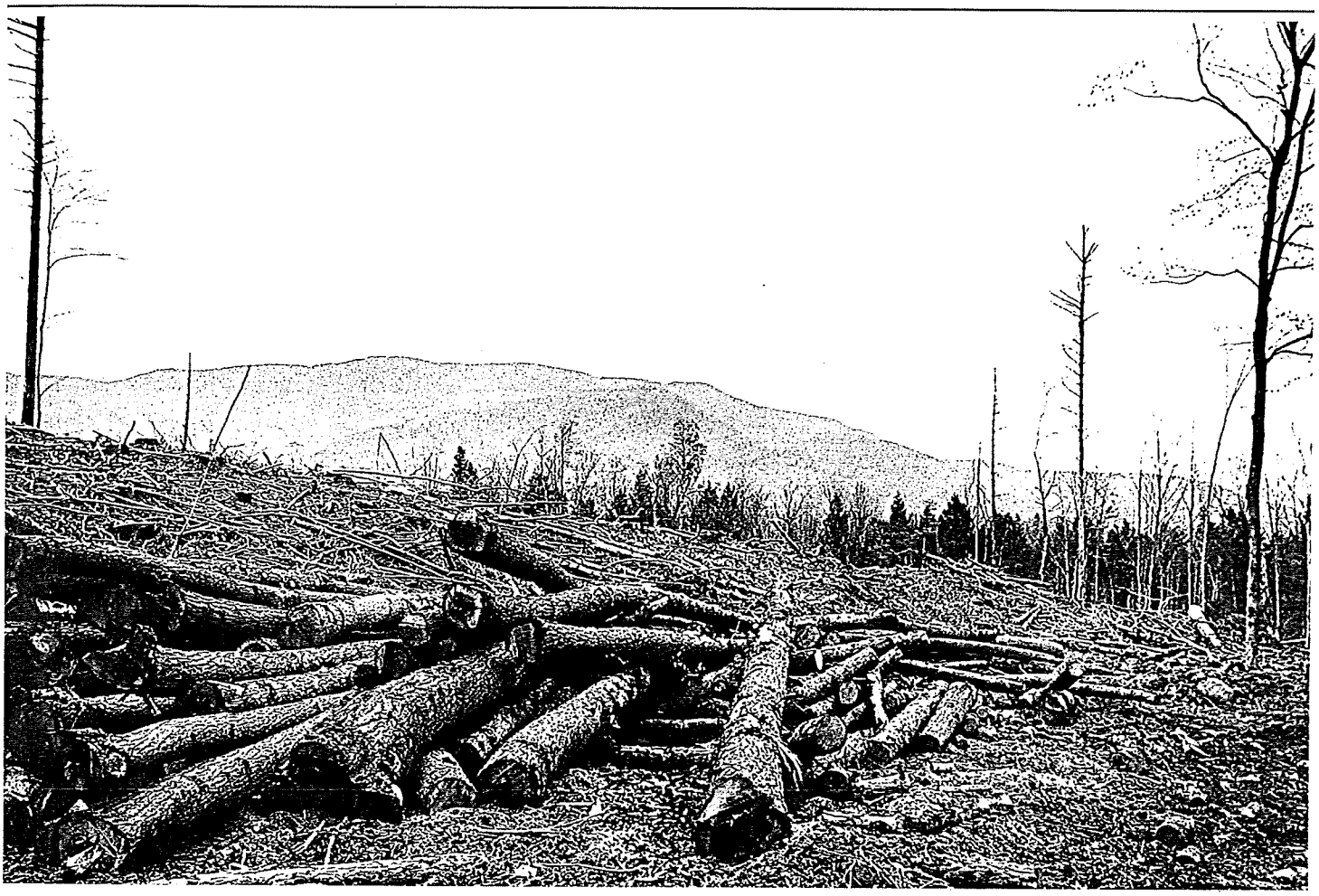
The goal would be to foster an appreciation and understanding of the ecosystem of the Mad River and its watershed to help create informed, responsible citizens. The curriculum should include components outlined in the topic paper on education, plus other subjects that may be identified, such as development of a recreational ethic that encourages the various river users to respect each other; methods of conflict-resolution; and an historical curriculum of the watershed that includes oral history.

7. Friends of the Mad River should organize radio and community cable television spots and shows that feature oral histories, river stories, Mad River Watch data, and public service announcements about the river.

8. Friends of the Mad River and other interested groups should create an educational center, such as a nature center or museum. It should include a self-guided interpretive trail, historical and cultural information, workshops on topics relating to the river and watershed, special events and celebrations, and a community meeting-place. The center should also include a green house and nursery for displaying examples of vegetation that can be planted to stabilize stream banks and create buffer strips against erosion, and for starting and growing trees and shrubs. It could be a valuable hands-on learning tool.

Appendix B—Topic Paper J

Logging and forestry



The Valley Reporter

I. Introduction

Since three fourths or more of the Mad River Watershed is covered with forests, it is logical to ask how forest lands contribute to the health and quality of the river and its tributaries.

Trees, shrubs, forest undergrowth, and forest duff protect the soil from the erosive forces of heavy rain and overland water flow. Forests hold the soil in place, protecting the river from sedimentation and an overload of nutrients. Forests, much like wetlands, but to a lesser degree, act as a sponge to slow runoff of water from the land, tempering heavy rainfall so that flooding and resulting changes and damage to stream banks and the river channel are less severe. Trees and forests provide shade to keep water temperatures cool—as the trout require—if adequate buffer strips are left along the river and the many small streams of the watershed.

Scenic beauty is contributed by healthy, growing, and mature forests. Also, there is the continuing economic benefit to local communities provided by the forestry resource if it is managed on a long-term, self-sustaining basis.

A recent land sale in the valley of over 9,000 acres (some 14 square miles) of New England Land Associates (formerly the Ward Lumber Company) lands, and the buyer's intention to sell all commercial timber and then resell the land for development lots should be cause for great concern. This may help crystallize efforts to put mechanisms in place to protect the river from poor logging practices.

If logging is done without regard to the erosive forces of nature, there is great potential for severe sedimentation of the river, which causes spaces between rocks and pebbles of the stream bottom to fill with silt and fine sand. This "embeddedness" severely reduces the quantity and quality of habitat for aquatic organisms on which fish depend for food. Erosion and sedimentation can also affect water clarity and may result in silt deposits in swimming holes, reducing their recreational value.

II. Laws governing logging and river protection

Several laws afford some protection against poor logging practices that cause erosion and sedimentation, but most of these laws are brought to bear only after pollution and sedimentation of the river have already occurred.

- Water pollution control—No person shall discharge any waste (liquid or solid material, whether or not harmful to water) into waters of the state . . . without a permit. A permit for logging activities is not required if "Acceptable Management Practices" are utilized in the operations (10 VSA [Vermont Statutes Annotated] 1259). Enforcement and fines of up to $10,000 for each day the violation continues (10 VSA 1274).

- Alteration of streams—A person shall not change, alter, or modify the course, current, or cross section of any stream with a drainage area greater than ten square miles by either movement, fill, or excavation of more than ten cubic yards of fill. Fines up to $1,000 per day (10 VSA 1021 and 1025).

- Deposit of sawmill waste in waters—It shall be unlawful for a person to deposit edgings, slabs, sawdust, shavings, or any other sawmill refuse in the waters . . . Fines up to $100 for each offence (10 VSA 1301).

- Logging operations above 2,500 ft.—Any logging activity over 2,500 feet elevation requires an Act 250 permit (10 VSA 6001 [Section 3] and 6081).

- Regulation of activities that can be expected to cause a discharge—The Secretary of the Agency of Natural Resources may issue an order establishing reasonable and proper methods and procedures for controlling an activity that can reasonably be expected to cause a discharge to waters of the state, including significant wetlands (10 VSA 1272).

These laws prohibit discharging waste of any kind into rivers and streams. This includes soil, silt, and sand, and other debris from logging activities. The problem with implementing the law has been that once the discharge occurs it is too late—the stream has been damaged with sedimentation and recovers only slowly

II. Laws governing logging and river protection—continued

after the discharge stops and the stream has begun to cleanse itself.

In 1987, the Department of Forests, Parks, and Recreation issued the "Acceptable Management Practices of Maintaining Water Quality on Logging Jobs in Vermont" (AMPs)—a set of practices to be used by loggers to prevent the discharge of sediment to rivers and streams.

If loggers use these practices they do not have to first obtain a permit from the Agency of Natural Resources for any sediment from the logging. If discharges do occur during logging operations being carried out in accordance with Acceptable Practices, the logger is still liable and subject to penalties for pollution, but the presumption is that state Water Quality Standards are being met. Where problems occur when Acceptable Practices are being used, the question becomes: "What more can and needs to be done to protect the river and meet Water Quality Standards?" The Agency of Natural Resources can issue an order authorized by Section 1272 of Chapter 47, VSA that would require use of further necessary practices. Using Acceptable Practices minimizes the likelihood of pollution, and reduces the risk of loggers being penalized.

When discharge of logging related sediment to the river is discovered, a Water Resources Investigator (enforcement officer), the County Forester, and a representative from the Vermont Forest Products Association will visit the site and enlist the logger's cooperation to initiate practices that will stop or reduce the sedimentation. If the agreed practices are installed, the logger will be judged to be in compliance with the law and will not be fined. This arrangement was set up in the 1980s and continues today.

There is an additional law that addresses the question of long-term management of Vermont's forests—Chapter 83 of the Vermont Statutes Annotated, Department of Forests, Parks and Recreation, Section 2601, Policy and Purposes. It states:

> (a) The conservation of the forests, timberlands, woodlands and soil and recreational resource of the state are hereby declared to be in the public interest. It is the policy of the state to encourage economic management of its forests and woodlands, to maintain, conserve and improve its soil resources and to control forest pests to the end that forest benefits, including maple sugar production, are preserved for its people, floods and soil erosion are alleviated, hazards of forest fires are lessened, its natural beauty is preserved, its wildlife is protected, the development of its recreational interests is encouraged, the fertility and productivity of its soil are maintained, the impairment of its dams and reservoirs is prevented, its tax base is protected and the health, safety and general welfare of its people are sustained and promoted.
>
> (b) The department shall implement the policies of this chapter by assisting forest land owners and lumber operators in the cutting and marketing of forest growth, encouraging cooperation between forest owners, lumber operators and the state of Vermont in the practice of conservation and management of forest lands, managing, promoting and protecting the multiple use of publicly owned forest and park land; . . .

Subchapter 2, Forest Conservation, Section 2621 (as amended in 1977) sets out the duties of forest landowners:

> It shall be the duty of a landowner or operator of forest land, whether public or private, to manage, operate and harvest forest crops which promote conditions favorable for regrowth consistent with the policies of this chapter. All forest land on which a lumbering operation is conducted should be left by the owner or operator in a favorable condition for regrowth by preserving trees of commercial species sufficient under normal conditions to maintain continuous forest growth or restocking so as to assure continuous or successive forest crops. So far as practicable, all desirable seedlings and saplings should be protected during logging operations. When necessary, reforestation practices should be employed to assure renewed forest growth after harvesting of forest crops.

The next section (2622. Rules: Harvesting timber, forests) mentions that the commissioner (of Forests, Parks, and Recreation) may adopt rules with respect to the foregoing section:

> The commissioner, subject to the approval of the secretary, may adopt rules in the name of the agency establishing by which the harvest and utilization of timber in private and public forest land will be consistent with continuous forest growth, including reforestation, will prevent wasteful and dangerous forestry practices and will conserve the natural resources consistent with the purposes and policies of this chapter, giving due consideration to the need to assure continuous supplies of forest products and to the rights of the owner or operator of the land. Such rules shall be advisory and not mandatory.

These laws specify that forests in Vermont shall be managed on a sustained-yield basis, but implementing the intent of the law appears to be far from workable. Acceptable Management Practices for logging operations have been issued to protect water quality, but no rules or acceptable practices have been promulgated to manage Vermont's public and private forests on a sustained-yield basis.

III. Future activities, and recommendations

The laws cited do not deal adequately with the larger question of managing Vermont forests with a long-term commitment to a sustainable forest resource that is not jeopardized by periodic fluctuations in the economy. The inadequately funded Current Use Program attempts to but does not bring property taxes on the land more in line with the land's actual use and income. Also, it is not effective in the long-term. That program only has a short-term effect of temporarily managing and improving forest stands.

There are a number of actions that local and state governments, conservation organizations, and individuals should take to help ensure the river is protected from logging activities.

1. Local town plans and zoning ordinances should call for forested buffer strips along the Mad River and its tributaries, and local zoning ordinances should require that logging on forest lands conform with Acceptable Management Practices.

2. Landowners who decide to have their land logged should use a model "Timber Sale Contract," such as the one used by the Department of Forest, Parks and Recreation. This should help ensure erosion control and proper closeout of logging to prevent erosion. The contract should require a review by a forester capable of applying Acceptable Management Practices. Model timber sale contracts, AMPs, and other educational materials should be available in town offices.

3. When large tracts of land are purchased with the intent of heavy logging—the case with the New England Land Associates sale, for example—the Department of Forests, Parks, and Recreation should notify the new landowner and loggers about the requirement for using Acceptable Management Practices, and should assign staff to ensure compliance.

4. Proper closeout of logged areas should be assured by the Vermont Department of Forests, Parks, and Recreation before loggers and their equipment leave the area.

III. Future activities, and recommendations—continued

5. Through use of workshops and education materials made available by towns, Friends of the Mad River, and the Mad River Valley Planning District, valley residents should become familiar with proper logging practices and actions they can take if they see that AMPs are not being applied, or observe water quality violations.

6. To ensure that Vermont maintains a sustainable, continuous-yield forest resource, the provisions of 10 Vermont Statutes Annotated (VSA) Chapter 83 should be implemented by the Agency of Natural Resources. Also, the law should be amended as necessary to provide for effective implementation of sustainable forestry in Vermont.

7. To provide funds to oversee and manage the forest resource as required by law, and to ensure that economic incentives are available to foster the forest resource, broad-based tax reform should be undertaken by the Vermont Legislature to ensure that forest lands are taxed on the income they generate. This tax reform should provide economic incentives for good, long-term forest management practices, and disincentives for owners' actions that jeopardize a sustainable and productive forest resource.

8. Biomonitoring/water quality sampling stations should be set up by the Vermont Department of Environmental Conservation in appropriate locations to determine the impact on Dowsville and Mill Brooks of the intensive logging that is to occur in those locations.

9. For the duration of logging operations, the Vermont Department of Forests, Parks, and Recreation, in cooperation with Friends of the Mad River, and the Mad River Valley Planning District, should monitor (via aerial photos and videos) weekly or as often as needed to determine how well Acceptable Management Practices (AMPs) are being applied to logging jobs in these locations. Correlations can be made about effectiveness of the AMPs in protecting water quality.

10. Students at Harwood Union High School who have been involved in the Mad River Watch program should monitor Dowsville Brook to determine the impact of logging operations on water quality. There should be daily sampling for turbidity, and weekly sampling for phosphorus. Weather and streamflow conditions should also be recorded.

11. State and local governments, with the cooperation of conservation organizations and land trusts, should plan for and acquire, in fee or in protective easements, high-elevation and headwaters lands to help protect the Mad River and its tributaries, and to help provide for a sustainable, productive forest resource.

References

Beattie, Mollie, Charles Thompson and Lynn Levine, *Working with your Woodland,* University Press of New England, 1983.

Vermont Department of Forests, Parks and Recreation, "Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont," August 15, 1987.

Vermont Department of Forest, Parks and Recreation "Model Timber Sale Contract," (from the County Forester's Office).

Vermont Statutes Annotated, Chapter 83; Department of Forests, Parks and Recreation, Subchapter 1, General Provisions and Subchapter 2, Forest Conservation.

Vermont Statutes Annotated, Chapter 47, Water Pollution Control.

Appendic B—Topic Paper K

Sludge and septage disposal

Ann Day

Appendic B—Topic Paper K

Sludge and septage disposal

I. Introduction

Municipal and commercial sewage treatment facilities use various techniques to separate sludge (biosolids) from purified liquid effluent. Similarly, in the septic tanks of on-site waste disposal systems, solids and liquids (septage) accumulate and must be pumped out regularly. Both sludge and septage have been applied as fertilizers to agricultural land in the United States and Europe for generations. This practice has several benefits:

- organic materials and nutrients are returned to the natural cycle, lessening the need for chemical fertilizers;
- the addition of organic solids enhances the soil structure, making it more friable; and
- disposal at landfills is avoided, thus reducing costs and saving space.

Sludge and septage contain beneficial nutrients (nitrogen, phosphorus, and potassium) as well as heavy metals (zinc, copper, cadmium, lead, and mercury), and may contain other compounds that are toxic. The following table compares metal and nutrient values from four sources—sludge, septage, commercial fertilizer, and cow manure.

Comparison of typical nutrient and heavy-metal concentrations in sludge and septage

Component	Sludge	Septage (wet)	Fertilizer	Manure	EPA limit
Nutrients					
Nitrogen—TKN %	5.10	.06	6.8	4.02	N/A
Phosphorus %	2.00	.02	4.8	0.73	N/A
Potassium	0.29	Unavail.	5.9	3.01	N/A
Heavy metals					
Lead mg/kg (dry)	114.00	5.20	30.0	<10.0	300
Zinc mg/kg (dry)	1053.00	27.4	106.0	237.0	3200
Copper mg/kg (dry)	864.00	8.3	8.0	239.0	1600
Cadmium mg/kg (dry)	7.00	0.27	8.5	0.08	39
Mercury mg/kg (dry)	1.8	0.23	N/A	<0.25	18

Note: mg/kg is equivalent to parts per million (ppm)

Applying sludge and septage to the land is controversial. On the one hand, these sewage treatment by-products contain nitrogen, phosphorus, and potassium, which are valuable nutrients for growing crops. On the other hand, sludge and septage can pollute rivers through runoff; and lands and crops can be contaminated if concentrations of heavy metals and toxic chemicals are too high, and/or the rate of application is excessive.

Metals in sludge are a concern because toxic accumulation can occur in the soil and in the crops grown. This situation can be avoided by regularly testing sludge and septage to determine safe application rates, usually about 10 per cent of the maximum advised metals accumulation. Municipal collection of hazardous household wastes (and pretreatment of industrial wastes in some areas) have greatly reduced the potential for metal and toxic contamination of sludge, septage, and the land.

Odor is another concern about land application of sludge and septage. Properly stabilized sludge has an earthy odor that is not as strong as that of septage or raw animal manure. Odors can be minimized by turning the sludge and septage into the soil soon after application. Both contain pathogens harmful to health that are reduced or eliminated by the action of soil bacteria; and by sludge stabilization through digesting, dry composting, or addition of lime.

II. Sludge disposal in the valley

The Mountain Wastewater treatment plant serves Sugarbush Village and Sugarbush Ski Resort. This plant has a special "clarifier" basin, where solids and phosphorus are precipitated from wastewater by adding alum and polymers. In spring and fall the sludge that has accumulated in the bottom of the clarifier is pumped out and hauled to Glen Falls, New York, where it is incinerated at a cost to Mountain Wastewater of $0.12 per gallon. Formerly, Mountain Wastewater disposed of its sludge by applying it to agricultural land under a permit from the Agency of Natural Resources, at a cost of $0.15 to $0.19 per gallon.

Sludge from the Ben and Jerry's wastewater treatment plant at Waterbury is spread on the Turner farm at Waitsfield.

Sludge disposal has not been a significant issue in the valley. However, both Warren and Waitsfield Villages are considering the feasibility of municipal wastewater treatment facilities. The regulation and proper disposal of sludge from these facilities will be one of the critical issues in those considerations.

III. Septage disposal in the valley

Septage can be disposed of on the land or it can be hauled to a wastewater treatment facility to be treated, where it ultimately becomes the sludge residue of the wastewater treatment process. Sewage treatment facilities are not always designed to accept septage, which is a very concentrated waste compared to a wastewater treatment plant's normal intake.

For example, in the late 1980s several towns on Cape Cod, Massachusetts discovered increasing indications of groundwater pollution from on-site systems. Emergency ordinances were passed to require annual pumping of all septic tanks. Unfortunately, there were insufficient facilities available to accept the resulting volume of septage. Haulers were forced to wait hours to dump their loads at local facilities, or to drive several hours to dump at municipal facilities off the Cape. Regrettably, some of the more unscrupulous among the haulers simply dumped their loads along remote roads.

Presently, there is one hauler based in the Mad River Valley—A-1 Reynells Septic Services, owned by Peter Reynells of Warren. From April through November, this company disposes of septage, under a permit from the Agency of Natural Resources, by applying it to the DeFreest farm. Application rates range (depending on the location) from 13,000 to 39,000 gallons per-acre per-year.

During winter months, Reynells is permitted to dispose of septage on a specific site on the Defreest farm at half the summer application rates. Since January 1990, Reynells has disposed of 1,784,000 gallons of septage on the Defreest property. The permit requires that the septage be stabilized with the addition of lime to reduce the pathogen count to background levels prior to land application. In addition, the permit calls for periodic soil and groundwater sampling by an approved testing laboratory to evaluate the safety of the process. When land application is not feasible owing to weather or soil conditions (frozen ground, snow cover, or high water table), Reynells hauls the septage to the Essex Junction wastewater treatment facility.

Failing on-site sewage systems have been identified as the major source of biological contamination of the Mad River. It is reasonable to assume that there is

III. Septage disposal in the valley—continued

attendant chemical pollution (e.g., from nitrates and phosphorous) that is adversely affecting the river's ability to sustain aquatic life. Better maintenance of existing on-site systems must be a vital component of any program to remedy this problem. However, the example of Cape Cod should be kept in mind. Valley towns must provide for safe and effective disposal of septage in concert with a program to improve septic system operation and maintenance.

IV. Recommendations and considerations for the future

Sludge and septage can be extremely harmful to natural watercourses unless their disposal is handled safely. Safe disposal is a necessary component of any program to clean up point source pollution, a prime reason why it is always better to prevent pollution at the source rather than clean it up. As the valley considers options for treating wastewater, and mitigating point source pollution of the Mad River, it is imperative that communities address this critical issue in their planning and rule making.

The following recommendations about sludge and septage are aimed at protecting the land and waters of the Mad River Watershed:

1 The ANR should continue overseeing disposal of sludge and septage, with sufficient monitoring of method and content to prevent contaminating the river, lands, and crops in the watershed.

2 Those who have on-site wastewater disposal (septic) systems should operate them to ensure the septage is free of toxic materials and chemicals, and is safe to apply to the land.

3 The Agency of Natural Resources should, if possible, require that wastewater treatment plants include facilities adequate for accepting septage from surrounding communities.

Appendix B—Topic Paper L

Cumulative impacts and river assimilative capacity

Ann Day

Cumulative impacts and river assimilative capacity

I. Definitions

The measure of a river's ability or capacity to accept and assimilate wastes without lowering or degrading quality below established water quality standards and specific water quality criteria is called the assimilative capacity of that specific stretch of river. Although rivers have a natural ability to purify themselves as precipitation occurs and as fresh surface water and groundwater flow into them, that ability to purify is limited by the physical nature and condition of the river.

Such factors as amount of flow; size and depth of the channel; steepness (riffles, rapids, and waterfalls); character of the bottom; temperature; amount of shading; and amount of algal growth all combine to define a river's finite ability to accept waste in each stretch of the river without degrading water quality below that needed to support various human uses.

Cumulative impacts on the river include those from all activities on the river and on the lands in the watershed that can affect water quality, wildlife habitat, and uses of the river.

II. Relation of assimilative capacity to water quality standards

To understand the concept of assimilative capacity and its significance in planning for the future of the Mad River, it is necessary to be clear about the meaning of "water quality standards." The Vermont Water Resources Board adopts water quality standards which set water management policies (such as providing for anti-degradation of waters, protection of high-quality waters, setting of conditions for and the allowance of discharges to the river) for all waters in Vermont. The standards also set specific water quality criteria, which are limits or ranges for such parameters as dissolved oxygen, temperature, nutrients, pH, and others. These criteria are selected to support various uses of waters, such as swimming, drinking, and assimilation of wastes. Water uses are designated geographically and sometimes by season of the year for all waters to which the water quality standards apply, and in a series of classifications for each of the 17 major river basins in Vermont.

The water quality standards are the goals and objectives for the waters of the state. The standards reflect the desires of the people as to what the quality of the waters should be now and in the future. In many cases, due to pollution sources and sometimes due to natural causes, water quality is degraded below the standards. For example, there are many places in the Mad River where the standard for *Escherichia coli* (a bacterium that indicates pollution by human or animal waste) is exceeded, and a risk to human health exists.

For Class B waters, the designation for all waters in the Mad River Watershed, the standard is not to exceed 77 *E. coli* organisms per 100 milliliters of water. Mad River Watch data obtained from sampling and analysis in July, 1994 found *E. coli* levels too numerous to count at sampling stations on Rice and Clay Brooks and below the Ward Lumber Mill in Moretown. This indicates severe bacterial pollution, and swimming that is very risky to human health. The *E. coli* standard was also exceeded in 15 other locations in the Mad River on the date samples were taken, also indicating risk to human health. See Topic Paper G on swimming in Appendix B for a more detailed discussion of swimming and *E. coli*.

III. Waste discharges and assimilative capacity

Of all the "assimilative capacities" that can be discussed, the one that is most often the subject of greatest concern is the river's capacity to absorb treated human and industrial wastes in the form of direct discharges to the river. If a reclassification of the waters were granted by the Water Resources Board to allow one or more discharges to the Mad River, and if permits to allow a discharge of treated municipal wastes were granted by the Agency of Natural Resources, the allowable use of the river would be changed in those stretches. The new river use would be to dispose of municipal wastes (waste management zones), and swimming as a use would be excluded.

Such changes would make possible more intense development of the land in those areas served by sewage treatment facilities. Only a hookup to a sewer line would be needed instead of an on-site waste disposal system, such as a septic tank/leach field or a mound system, which sometimes cannot be allowed because site conditions are too limiting to achieve proper treatment of the sewage and thereby protect ground and surface waters from pollution. See the topic papers On-Site Sewage Disposal (C), and River Health (A) for more information.

The Agency of Natural Resources conducts scientific studies to determine the assimilative capacity of rivers and streams to determine how much waste can be accommodated before river water quality is lowered below standards. With respect to the dissolved oxygen criterion, this determination is usually given in pounds of biochemical oxygen demand per day at the most limiting time of year (usually the low flow period in the summer, or the low flow period in the winter). In cases where there is water withdrawal, the limiting time period and amount of discharge may be determined by the time and amount of withdrawal for snowmaking or other uses. Such studies by the Agency of Natural Resources have not been done for the Mad River because the water quality standards do not allow any wastewater discharges to the river.

IV. Examples of a river's finite capacity to absorb waste

Where the water quality standard for *E. coli* levels is exceeded, the cumulative impact on the Mad River or its tributaries is too high to meet the *Escherichia coli* criterion that has been established to support the goal of using the river for swimming and other body contact recreation. When that criterion is exceeded such uses are not supported—it would be unsafe to swim in the river. A highly desired use of the Mad River would not be supported due to activities causing pollution in the watershed. See the topic paper on Swimming (G) for a more detailed discussion.

Similarly, the water quality of the river or its tributaries can fail to meet other criteria of the Water Quality Standards due to cumulative impacts. Dissolved oxygen in sufficient concentrations is necessary to support fish and other aquatic life. For the Mad River and its tributaries, the dissolved oxygen concentration is set at 7 mg/liter to support a cold- water trout fishery. Dissolved oxygen is removed from the water when wastes are discharged into the river and the wastes decay, using oxygen in the process. Depending on the quantity of river flow, the water temperature, and other factors, such as rapids and riffles in the river that re-oxygenate the water, only so much waste can be introduced to the river, be it from a discharging sewage treatment plant or from runoff of wastes from the land, before the dissolved-oxygen concentration is lowered to a point below the standard.

Similarly, the river's capacity to support beneficial uses can be exceeded in the following situations:

- when removal of trees from stream banks or warm-water runoff from parking lots increases the river water temperature to levels that will not support cold water fish habitat;
- when nutrients (phosphorus, nitrogen, and other fertilizers) are introduced into the river from land runoff or from point source discharges, such as direct or indirect discharges of sewage effluent, which cause algal growth, which in turn makes rocks slippery or slimy, or decreases the clarity of water to make the waters undesirable for swimming;
- when lack of erosion control measures (such as sedimentation basins, water bars, and mulching) at

IV. Examples of a river's finite capacity to absorb waste—continued

construction or road maintenance sites result in sand and sediment reaching the stream, causing embeddedness (filling in of the spaces between rocks in the river bottom, thereby reducing the habitat for aquatic organisms on which fish feed) so that the cold-water fishery is reduced or not maintained;

- when grease and oil and other petroleum products and toxic substances are introduced in quantities that further reduce river quality for swimming, fishing, and aquatic organisms; and
- when the stream bottom or the stream banks are disturbed, resulting in a continuing reaction of the river that causes loss of aquatic habitat that degrades the fishery.

V. The cumulative impacts of nutrients

In addition to the assimilative capacity of a river to absorb waste discharges, a second type of assimilative capacity that is often discussed, more in relation to lakes than rivers, is the capacity of a river or lake to absorb nutrients before the recreational uses of fishing and swimming are affected adversely. Nutrients that are discharged to the river, or that run off the land into the Mad River affect not only the immediate tributaries and main stem of the Mad River, but also the Winooski River and Lake Champlain, to which the Mad River drains. Lake Champlain is experiencing accelerated eutrophication (rapid increases in the amount of weed and algal growth) due to nutrients entering the lake from its watershed.

Limits have been set for the concentrations of phosphorus in the various distinct bays and areas of Lake Champlain in an attempt to slow this accelerated eutrophication. Municipalities operating sewage treatment plants in the Lake Champlain basin have been ordered to remove phosphorus from their discharges. Farmers have been installing manure-handling facilities with assistance from the NRCS and ASCS to reduce nonpoint source runoff of manure, and to provide for storage of manure to eliminate spreading in the winter when the land can't absorb liquids. This practice greatly reduces the quantities of nutrients (nitrogen and phosphorus) that run off into the lake. For more information see the topic paper on farming (Q).

VI. The river as integrator of cumulative impacts of human activities

To varying degrees, all activities in the watershed, and especially those in and immediately adjacent to the river, have an impact on the river's health. These impacts are cumulative—the capacity of the river to absorb the impacts of various activities is finite. For certain criteria, such as dissolved oxygen and nutrients, limits on the activities that affect these parameters can be determined accurately, and set to avoid adverse impact. For such criteria as temperature and aquatic habitat, it is difficult to determine the degree to which certain practices contribute to degradation of the river down to the minimum set by water quality standards. The effects of increased sedimentation and reduced shading are difficult to determine and even more difficult to control.

All watershed activities combine to achieve a total impact on the river. Usually we notice these effects only when they affect us directly—when the water is too polluted for drinking or swimming, when the fishing is not as good as it used to be, when the water is not so clear or becomes choked with weeds, or when the rocks on the river bottom become so slippery with algae that wading is unpleasant. Only so much pollution, only so much disturbance of the river and its banks, and only so much disturbance or activities on the land can occur before the health of the river is affected. See the topic paper on river health (A) for more information.

VII. Recommendations

1. When making decisions about their uses of the river or land in the watershed, governments, businesses, organizations, and individuals should review the impact of their activities in relation to all other activities in the watershed to ensure that the cumulative effects are not exceeding the assimilative capacity of the river and degrading its beneficial uses.

2. The Mad River Valley Planning District, and the Friends of the Mad River should explore the availability of funds from the U.S. Forest Service and other sources to develop a more detailed sustainable use/economic/natural resource plan for the Mad River Watershed.

Appendix B—Topic Paper M

Stormwater runoff

Richard Czaplinski

I. Introduction

Stormwater is the water that runs off the surface of the land via fields, forests, swales, and ditches when precipitation is sufficiently intense that all of it cannot be absorbed by the soil, subsoil, and underground rock formations.

With the occurrence of development, natural soil is disturbed and often replaced with buildings, roads, parking lots, and other features that reduce the land's capacity to absorb precipitation from storms. This, in turn, results in greater amounts and faster runoff of stormwater over the land, which causes more erosion and resulting sedimentation of streams, as well as the scouring of headwaters streams and enlargement of stream channel cross sections. This enlargement, once initiated, can continue until the stream attains a new stable point in its cross section that can carry the increased stormwater loads. During this time of adjustment, the stream may be more turbid in addition to carrying the materials inevitably associated with development—oils, salt, trash, debris, and toxic materials, all of which contribute to degradation of water quality.

In addition to potentially increased sedimentation from more stormwater runoff, there may be temperature increases in rivers and streams (thermal pollution) because parking lots, roof surfaces, and roadways warm the runoff more than that coming from forests and fields. This, in turn, can have a negative affect on cold water fish.

Depending on the size of the artificial surfaces, and depending on the size of the watershed involved, stormwater that flows off impermeable hallmarks of development, such as buildings, roadways, and parking lots, may be considered a discharge and require a discharge permit from the Agency of Natural Resources.

II. Laws governing stormwater runoff, and methods of control

Section 1264 of the Vermont Water Pollution Control Statute (10 VSA Chapter 47) calls for the Agency of Natural Resources to prepare a plan for collecting stormwater runoff that may be deleterious to waters of the state, and to issue permits to minimize adverse impacts of stormwater.

Vermont Water Quality Standards in "Section 2-05, Stormwater Management," set the policy for managing stormwater runoff. Discharges are labeled "major" if they are caused by roadways, parking areas, and other artificial surfaces that exceed ten acres in area (one acre if the artificial surface contributing to the runoff is one third or more the area of the watershed to which it is contributing), or if there is reasonable likelihood that toxic or other wastes may enter waters, causing an undue adverse affect on water quality.

It is the state's policy to control stormwater discharges through reliance on infiltration into the soil, using accepted erosion control practices, and control of peak stormwater flows where required. Where retention and infiltration of stormwater by grassed swales and vegetated buffer strips are inadequate to protect water quality, the use of engineered detention or settling basins is required by the stormwater permits issued by the Agency of Natural Resources.

Act 250 also applies to stormwater by virtue of Criterion 1B, Waste Disposal, which requires that projects be designed to provide treatment or proper disposal of wastes or toxic materials generated at a project site. Stormwater from parking lots and other contaminated surfaces is one such waste to be addressed.

III. The situation in the Mad River Valley

A total of 61 stormwater permits have been issued to developers and establishments in the watershed: Fayston—13; Moretown—10; Waitsfield—12, Warren—26; Duxbury— 0. The Agency of Natural Resources is now doing a state-wide study of stormwater devices and structures that have been installed since 1984 to determine their effectiveness in preventing water quality degradation. A report will be submitted to EPA.

Impacts from stormwater runoff and the specific sources of those impacts are hard to quantify owing to the many variables involved and the natural erosion processes that occur.

IV. Recommendations

1. All valley town plans and zoning ordinances should contain provisions that address stormwater runoff to minimize impact on the river, with emphasis on preventing stormwater problems by maintaining adequate vegetated buffer strips to streams and by dispersing stormwater rather than concentrating it.

2. For the larger and more critical stormwater discharges, the ANR should perform spot field inspections to ensure stormwater permit conditions are being met and that any engineered stormwater control measures are in good repair.

References

Agency of Natural Resources, "Stormwater Procedures," (How to determine if a permit is required and what kind and size of stormwater control device is required).

Vermont Statutes Annotated, Chapter 47, Water Pollution Control, Section 1264.

Vermont Water Resources Board, "Water Quality Standards," Section 2-05, Stormwater Management.

Act 250, Criterion 1B.

Boating

Ann Day

Boating

I. Introduction

With headwaters bubbling out of the ground at Granville Gulf, the Mad River flows north through the towns of Warren, Waitsfield, and Moretown. It completes its journey at Middlesex and empties into the Winooski River, which flows west into Lake Champlain at Burlington.

During the warm summer months, the Mad River meanders slowly over shallow rock beds, through deep swimming holes, and past fertile fields while being refreshed sporadically by ground seeps and trickling mountain streams. In winter, the river moves quietly under a blanket of thick ice. In spring, usually quite suddenly, the long awaited warmth breaks away winter's cover, clearing the way for what is soon to follow—millions and millions of gallons of runoff.

When snow in the mountains begins melting, the Mad River is transformed into a raging white water playground for advanced canoeists and kayakers. For the better part of April the river remains swollen, gradually receding as the days grow longer and warmer. With the majority of mountain snow melted, the months of May and June offer a more user-friendly environment for paddlers of all abilities.

From April through June the Mad River offers boatable conditions ranging from slow-moving water to Class IV rapids, where precise maneuvering is required in constricted passages. Access points along the Mad are numerous, while even more access is available with landowners' permission. Several sections of rapids require good scouting at least, if not the assistance of someone familiar with that particular stretch. Depending on water levels, one can run from the Natural Bridge in Warren all the way to the Winooski with only a few portages required.

Come the latter part of June and into the dog days of summer, water levels in the river drop so low that boating is virtually impossible, except when very infrequent, multi-day, torrential downpours might swell the river to boatable levels.

II. Boating on the Mad River

Boaters have enjoyed the Mad River for as far back as older residents can remember. Nineteen years ago, Clearwater Sports, Inc. of Waitsfield started its business by renting canoes to people who wished to paddle the river. The Sugarbush Triathlon (formerly the Tucker Hill Triathlon) has been using portions of the Mad River for 17 years. Mad River Canoe, one of the World's finest canoe manufacturers, took its name from the river 23 years ago when the company first started building canoes. Every spring, hundreds of boaters flock to the Mad to run its waters. The river offers boaters of all ages and abilities natural, scenic, and exciting experiences second to none.

Boating on the Mad River is still very good. Boaters enjoy an aesthetically pleasing trip down the river. From put in to takeout, boaters find themselves paddling in postcard-like scenes of rural Vermont—covered bridges, lush fields, mountain views, and lots of cows. There is no industrial or structural eyesore which is characteristic of many of the rivers in the U.S. The only unpleasant sight is stream bank erosion.

III. Boating issues

One factor that has affected river paddling worldwide is the construction of dams. This is sometimes good for boating, because it allows for scheduled releases of water when natural levels are too low for boating. However, it can also turn once good river runs into lakes, or dry up stretches downstream of a dam that were once boatable. Fortunately, the Mad River has only two dams (at Moretown and Warren) and is not threatened by construction of new dams. In fact, an old dam that was located behind the Ward Clapboard Mill in Moretown breached a number of years ago, making that section navigable by experienced boaters. Although portages are required around the U.S. Geological Survey gauge and the recently reconstructed dam in Moretown, these structures have been in place for as long as current boaters can remember, and really do not present serious impediments to boaters. However, the portage around the dam in Moretown is difficult and could be improved.

Boating access to the Mad River is plentiful but not excessive. The major access points to the river are:

- Lareau's Swimming Hole;
- the covered bridge at Waitsfield;
- the Pines Rest Area north of Waitsfield;
- the bridge at S.G. Phillips and Meadow Road;
- the Pines gravel bar on the back road to Moretown just south of Moretown;
- the pull in just north of the Ward Clapboard Mill; and
- below the Moretown dam.

In addition to these put ins, there are many others that boaters use which are accessed mostly by crossing private land. Permission is required to beach on and cross private land. On the five-mile stretch of river from Warren Village to Lareau's Swimming Hole, 95 percent of the access is via private land. These sites will not be discussed in this paper out of consideration for landowners. It is important to note, though, that there have been no reported incidents between boaters and landowners. Those wishing to paddle sections of the river where they are uncertain about access should contact Clearwater Sports in Waitsfield to inquire about how best to access the Mad, and where and when it is appropriate to get landowners' permission.

Water quality is probably the most monitored, reported, and media-focused issue concerning the past, current, and future states of the Mad River. Certainly, water quality is of major concern to boaters. Fortunately, during most of the boatable periods, water quality is acceptable. Boaters have the same concerns as swimmers, and one can read the topic papers on swimming and on-site sewage disposal for more information about water quality conditions.

Unfortunately, it is when water levels are at their highest during the early spring runoff and during heavy summer rains, that manure, fertilizer, waste fuels, and the like are all washed into the river. One avid boater of the Mad can remember many times during late spring and early summer rainstorms when the river turned brown and smelled like cow manure. This is a health concern which might warrant some attention.

While gravel removal really is not a major concern to boaters, what is a concern is any proposed removal of structures (boulders, entire banks) from the river, or channelization. Removing gravel from the river to deepen channels for better boating is unrealistic. The river is always boatable when water is plentiful (in spring). Once the water level drops to a certain point, boating is impossible. It is unrealistic to think the river could be dredged sufficiently to provide a longer boating season.

IV. Conclusions

The implications of observations made thus far suggest that nearly all is well for boating on the Mad River. Other than the issue of polluted runoff, boaters have one of the finest boating experiences in New England available to them right here in the valley.

Boating on the river should continue to be encouraged because it leaves little trace on the environment, brings revenue to the valley, and is something of which local residents can be proud. It is the responsibility of residents to monitor this resource and preserve it from future harm. Boaters need to maintain good relationships with landowners to ensure adequate access to the river. Water quality standards must be maintained to reduce the risk to boaters' health. There are a number of actions listed in the 1991 River Watch Network publication, *Watching the River's Health,* which should be followed to help ensure good water quality.

V. Recommendations

1. Valley businesses, towns, and organizations should encourage boating because it is an activity that has little impact on the environment and brings revenue to the valley.

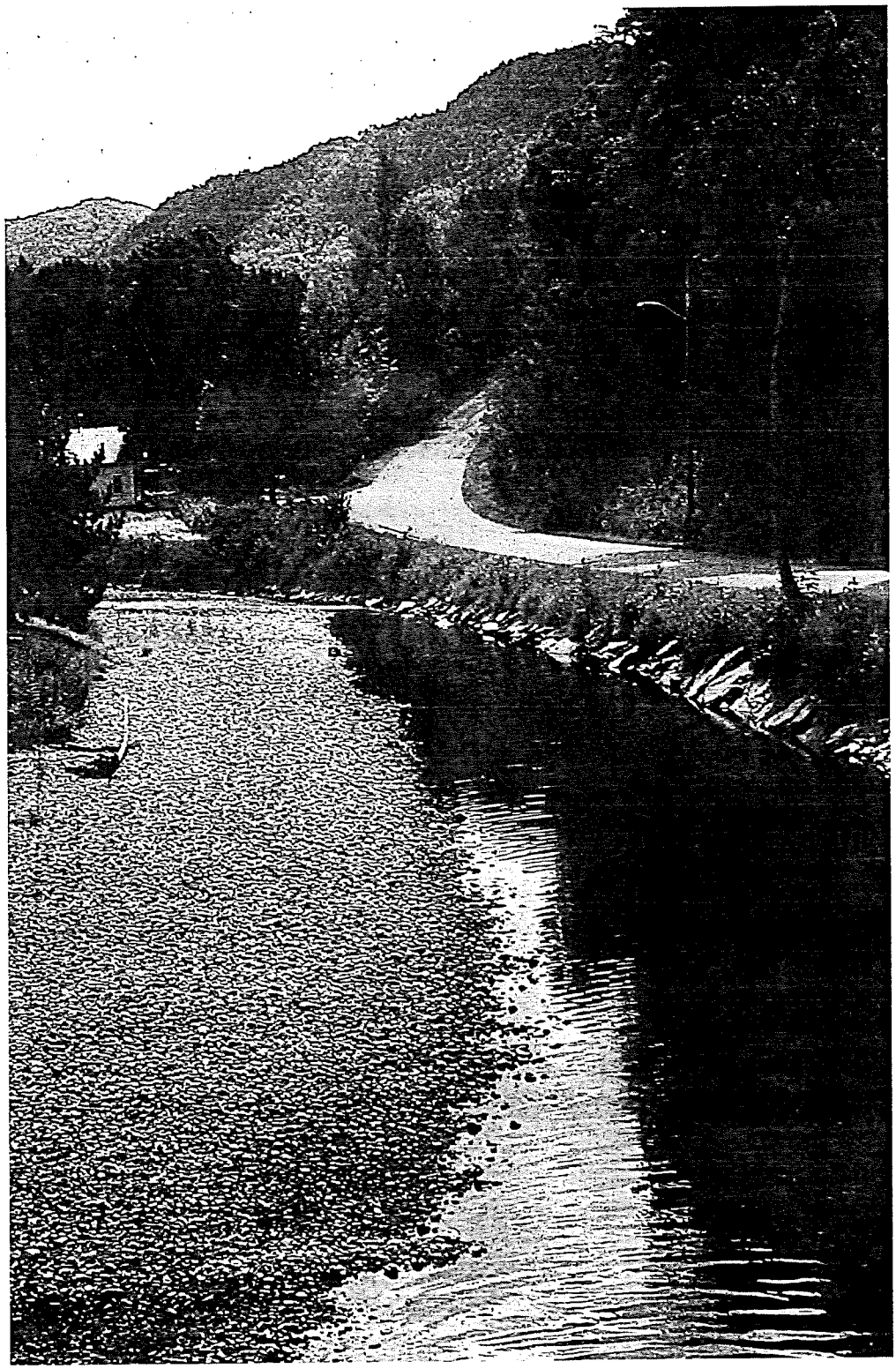
2. Boaters should continue to maintain good relationships with landowners to ensure adequate access to the river.

3. Valley residents should be aware of the boating resource of the Mad River, monitor it, and help to preserve it from future harm.

4. Friends of the Mad River and other conservation groups, in cooperation with canoe and related businesses in the valley, should organize interpretive canoe trips on the river to foster boating and appreciation of the river. Part of this educational effort should recognize that boating can conflict with other uses, such as fishing.

Appendix B—Topic Paper O

Roads



Mad River Valley
Planning District

Appendix B—Topic Paper O

Roads

I. Introduction

Many roads in Vermont are located very close to streams and rivers out of necessity, or for ease of placement and construction. Highways; dirt, gravel, or paved roads and parking lots; bridges; culverts; ditches; and swales all contribute to the erosion and sedimentation of streams. In fact, any disturbance of the landscape will accelerate the erosion and sedimentation process unless precautions are taken to reduce the effects of disturbance.

Nonpoint source sediment is soil eroded from the land and carried to the river by runoff. Runoff carries soil particles, gasoline, oil, and other undesirable pollutants, such as pesticides and phosphorus, into the river. There they cause clean water to become cloudy, suffocate plant and animal life, destroy valuable spawning areas, and accelerate the filling in of pools. Major sources of sediment and accelerated erosion are human activities and development, including runoff from roads, road sanding, and gravel roads.

Some of the problems caused by road maintenance are inappropriate placement or sizing of culverts; vulnerable erosion spots, such as exposed faces of embankments, road shoulders, and drainage ditches; and certain types of winter maintenance.

Maintaining a road system is generally a town's second largest annual expense next to schools. In 1993 that expense was approximately $1,038,300 for the three upper watershed towns, with $200,700 contributed by state aid to highways and bridges. The roads listed in Table 1 do not include the numerous private roads not maintained by towns and the state.

Roads are not only expensive, they have a significant impact on the environment. Of particular concern is their impact on the river and its tributaries. Dirt roads may contribute to stream erosion due to their susceptibility to rill and gully erosion. While paved surfaces may not erode in the same way, they are impervious to water and add to runoff.

Table 1. Roads in the Watershed

Roads department (miles)	*Paved roads* (miles)	*Dirt roads*
Duxbury	See VT 100	11.3
Fayston	5.6	32.1
Moretown	7.2	23.7
State Agency of Transportation:		
VT 17 from VT 100 to Buel's Gore	6.1	
VT 100 from Warren to 100/100B	14.4	
VT 100 from US 2 Duxbury to 100	4.3	
Waitsfield	8.3	27.3
Warren	17.1	35.8
Totals	**63.0**	**130.2**

Table 2. Winter road maintenance

Roads department	*Sand (cubic yards)*	*Salt (in tons)*
Duxbury	Not avail.	Not avail.
Fayston	3,000	400
Moretown	3,200	16
State Agency of Transportation		
VT 17 from VT 100 to Buel's Gore	1,580	300
VT 100 from Warren to 100/100B	398	323
VT 100 from US 2 Duxbury to 100	246	371
Waitsfield	3,000	250
Warren	5,000	500
Totals	**16,424**	**2,160**

II. Potential problems

Table 3. Summer maintenance

Roads department	*Gravel* (cubic yards)
Duxbury	Not avail.
Fayston	14,000
Moretown	7,500
Waitsfield	8,000
Warren	12,000
Total	**41,500**

Table 4. 1995 Bridge work

Town	*Structural renovations*	*Replacement bridge*
Duxbury	None proposed	Dowsville—South Duxbury VT 100
Fayston	Not avail.	Not avail.
Moretown	Rehabilitation of Bridge #40 on TH #11	None proposed
Waitsfield	Village covered bridge Widening Bridge #181 on VT 100 (0.1 mile south of town)	Butternut Hill bridge East Warren Road box culvert Bridge #38 over Mill Brook Bridge #22 onTH #29 over Mad River
Warren	Access road bridge	Kingsbury iron bridge (#173)

Source: VT Agency of Transportation, Statewide Transportation Improvement Program: *Town Highway Bridge Replacement and Rehabilitation Program,* 9/9/94

A. Winter maintenance

The Vermont Groundwater Assessment (1988) found that salt products used for winter-road deicing were a significant source of groundwater contamination. Recent investigations by the Vermont Agency of Transportation revealed that approximately 93 percent of private wells contaminated by road salt had to be replaced. Vermont's policy on salt storage and application does not apply to municipal winter-road maintenance programs. State programs and policies need to be extended to cover local programs.

There are several watershed communities that still dump collected snow into the river or its tributaries. Snow by itself produces little or no pollution as it melts in the spring. However, in the course of removing it from the streets, bits of asphalt, articles of clothing, animal feces, salt, and various other debris are picked up also. Alternatives need to be examined to direct disposal of snow into the river and streams. Snow debris and its runoff should be confined to a dump site, and residues removed to a suitable location after the snow melts in the spring.

During an average winter (Table 2) the valley and state road departments use more than 16,000 cubic yards of sand and 2,100 tons of salt. In general, the runoff from this treatment ends up in surface waters.

B. Summer maintenance

Not to be overshadowed by winter maintenance work, road crews are equally busy in the summer maintaining and improving the road network. In fact, the spring and summer months are the times when the faces of embankments, road surfaces and shoulders, and drainage ditches are most vulnerable to erosion. Of all maintenance practices, the most important in controlling erosion and sedimentation is maintaining good ground cover, which will not only minimize erosion, but reduce back road maintenance.

As to summer maintenance, Table 3 indicates the amount of gravel used by town road crews for resurfacing and improving existing roads.

C. Bridges

In general, bridges minimize disturbances to stream bottoms, but they may cause changes in habitat if streamflow is restricted. Bridges and bottomless plate-arch culverts provide a more natural stream bottom than standard culverts, but should be used only where a waterway is naturally resistant to erosion.

Bridges and bridge improvement projects are expensive, and seem ubiquitous at the state and local levels. These projects include structural renovations and complete replacement of bridges. Table 4 presents the 1995 schedule for bridge repair and replacement.

D. Culverts

Culverts usually consist of concrete or corrugated-metal pipes. Larger installations may be concrete box culverts, concrete arches or timber. Culverts should be designed to carry the maximum anticipated amount of water, and placed to take advantage of existing contours,

II. Potential problems—continued

and existing channels, if possible. Since culverts carry surface runoff from a drainage area, changes in development in the area may cause significant changes in the effectiveness and life span of a culvert, unless those changes were anticipated in its design.

Different shapes of culverts may affect the overall environment as well as affecting fish. Culverts that constrict water flow and are improperly placed may prevent fish from passing. Circular culverts generally result in the most significant loss of fisheries habitat. Pipe arch, elliptical, and box-shaped culverts may interfere more with streamflows because they are susceptible to ponding at the upstream end, which may cause blockage. To minimize problems, culverts have been placed below the level of the stream bed, made larger than otherwise needed, and/or may have baffles installed inside them to slow water speed.

Culverts require periodic cleaning to maintain full capacity. As with ditches, when culverts become clogged, washouts can occur from water flowing over or along the road. Maintaining vegetation on the roadside and in the ditches helps to limit the sediments entering a culvert and eventually entering a stream.

E. Ditches and swales

Ditches and swales are used to collect water from roads or construction sites and move it to natural waterways. The shape of a ditch is important for safety, cleaning, and maintenance. When road runoff is not drained properly, when ditches are not constructed properly, or when sediment has not been cleaned out, accelerated water speed during storms may cause overflowing and washouts. When this occurs near streams, there is greater likelihood that stream banks, streambeds and/or adjacent areas will be eroded. Ditches resist erosion when covered with vegetation. A low-growing grass may not need mowing. In other instances, crushed rock, riprap or pavement may be needed to curb erosion. Swales or vegetative depressions along roadsides may help control runoff and increase infiltration. In these situations, salt-tolerant grasses are recommended.

F. Sedimentation basins

Sedimentation basins are another means of reducing the amount of sediment that enters streams. Sedimentation basins, or traps, are holding areas to store and settle out particulate runoff (sediment) to protect downhill areas from damage. The basin or trap temporarily stores water, and sediment carried by the water settle to the bottom of the basin while the water continues on. Basins or traps are also useful for dissipating heat. Impervious surfaces, such as pavement, store a lot of heat in warm summer weather, and runoff from those surfaces may elevate stream temperatures.

To reduce the amount of sand, salt, and potentially warmed water flowing directly into mountain streams, Sugarbush recently constructed sedimentation basins in their parking lots. The new collection system not only offers improved conditions for the streams, but may be a means of recycling sand to be used for other purposes.

G. Road design standards

Roads and bridges found in the watershed's transportation network should reflect the rural character of the area. When reconstruction of any element in the system is proposed, consideration should be given to the quality of the trip experience, and impact on the surrounding area. Roads out of scale with their environment (portions of Route 100, for example) unnecessarily compromise the rural landscape that gives the watershed its unique character. Special state and local standards should be developed on a case-by-case basis. Such standards should respect the natural contours of the land, stone walls, views of the natural environment, and the health of our rivers and streams.

III. Recommendations

The following recommendations are offered to decrease the impacts of roads on the watershed.

1. Valley towns, in cooperation with the Vermont Agency of Transportation, should develop a single set of standards for controlling erosion and sedimentation from road construction, maintenance, and repair; and for vegetative buffer strips along roads and streams. All town plans and local zoning and subdivision regulations should include these standards.

2. Valley towns should implement local road-maintenance and construction standards, such as those contained in the handbooks *Maintaining the Backroad,* and *Vermont Backroad Erosion and Sediment Control.*

3. Valley towns should use the state's policies and best-management practices concerning application, storage, and siting of road-salt products, particularly combined applications of sand and salt.

4. The Vermont Agency of Transportation maintenance shed and salt storage area that is located within 20 feet of the Mad River should be relocated immediately.

5. Valley towns, working with the Natural Resources Conservation Service, should check sites for direct snow disposal into streams, and implement alternatives where possible.

6. Selectboards and road commissioners should keep current on road maintenance by utilizing the Vermont Roads Scholar Program.

References

Henzel, Linda J., *Erosion, Land Use, and Stream Ecology,* Technical Report #3, 1992.

St. Michael's College, *Maintaining the Vermont Backroad* (Fact Sheet T-205).

St. Michael's College, *Effects of Drainage Design on Road Performance* (Fact Sheet T-610).

Vermont Agency of Natural Resources, *The Vermont Backroad, Erosion Control Handbook,* 1979.

Vermont Agency of Natural Resource, *The Vermont Backroad, Maintenance Handbook,* 1979.

Vermont Agency of Transportation, *Statewide Transportation Improvement Programs: Town Highway Bridge Replacement & Rehabilitation Program,* September 8, 1994.

Appendix B—Topic Paper P

Construction practices

The Valley Reporter

I. Introduction

Erosion from construction sites, because of intense disturbance of the land, is about 10 times higher than erosion from cultivated agricultural land, and about 2000 times higher than erosion from forest land. Erosion and the resulting sedimentation of streams and rivers occurs when rain falls with sufficient intensity and duration to transport sand and silt to watercourses. Sedimentation causes degradation of the habitat of fish and other aquatic life by increasing embeddedness, which is a measure of the degree to which spaces between rocks, stones, and pebbles in a stream bottom are filled with silt and sand. The more spaces that are filled with silt means the greater the loss of habitat for bottom dwelling aquatic organisms, and the greater the degradation of stream bottom habitat. More embeddedness of the stream bottom means fewer trout, fewer fishermen, and eventually a less viable natural resource economy for the valley.

Poor construction practices that lead to erosion and sedimentation reduce water quality as well. Turbidity increases, reducing the water clarity. Increased turbidity also stresses fish by fouling and damaging their gills, which makes them more vulnerable to diseases. Erosion and sedimentation can also reduce water depth by filling pools with sand and sediment, thus making swimming impossible or less desirable due to decreased water depth. Reduced water clarity and an unpleasant silty or muddy stream bottom also reduce the quality of the stream for swimming. In addition, sediment adds significantly to the nutrient load in streams, causing increased algal growth, both in streams of the Mad River and in Lake Champlain.

II. Laws governing erosion on construction sites

The problems of soil erosion from construction sites and its impact on water quality have been recognized for some time. Vermont's Land Use and Development Law, Act 250, has provisions to protect water quality from detrimental effects of development. Before an Act 250 permit is granted for a development, the Environmental Board or District Commission must find that 10 criteria have been met. Criterion number one covers erosion and sedimentation from construction sites generally by requiring that the development "will not result in undue water or air pollution."

Criterion number four of Act 250 deals specifically with soil erosion, requiring that the development "will not cause unreasonable soil erosion or reduction in the capacity of the land to hold water so that a dangerous or unhealthy condition may result." Before an Act 250 permit is granted, the District Commission solicits comments from Agency of Natural Resources personnel concerning the adequacy of the project's erosion control plans. If the developer's plans are inadequate, the Commission requires revisions before the Land Use Permit is granted.

Once a permit has been granted and the construction site is active, daily vigilance is necessary to ensure that soil erosion is minimized. Two practices are particularly important. Bare soil should be mulched at the end of each construction day. Equally important each day is making sure that both off-site and on-site stormwater is diverted away from any disturbed soil. Failure to apply the practices called for in an Act 250 permit is grounds for enforcement action. If soil and sediment reach the river or stream and increase turbidity above the water quality standard, that constitutes a water quality violation that can result in work stoppage and fines.

A significant number of development projects do not come under the jurisdiction of Act 250. In such cases, the responsibility to protect the river and its streams from sedimentation falls on the town concerned. A review of the five valley town zoning and subdivision ordinances shows that there is a wide variation in requirements for erosion control measures on development sites. Some of the town ordinances state specifically that one of the purposes of the

II. Laws governing erosion on construction sites—continued

ordinance is to prevent soil erosion and water pollution. Others do not have this stated purpose. Most town ordinances have a required setback from the river or stream to provide some filtering of sediment from the building site.

The Waitsfield Subdivision Ordinance has perhaps the most specific language concerning erosion control, stating that for major subdivisions a stormwater drainage plan is required. Section 6 gives the Planning Commission authority to require temporary and permanent drainage and erosion control techniques. Phasing of construction may be required to limit the amount of land disturbed at any one time. The Planning Commission may also request that a determination be made of the effect of the subdivision on existing downstream drainage capacity, and may require measures be taken to improve that capacity.

III. Farm conservation practices and techniques

To assist developers in planning projects to meet criterion number four of Act 250, a handbook has been prepared by the Vermont Geological Survey and the Agency of Natural Resources. Called the *Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites,* this publication provides both planning and specific site-control measures to minimize erosion. It advances four principles to minimize soil erosion:

- fit the development to the site—avoid steep slopes, poorly drained and highly erodible soils, and disturbance within 50 feet of water bodies;
- preserve existing natural drainage patterns and vegetation as much as possible;
- keep the period of soil disturbance short—plan the sequence of construction activities so that disturbed areas can be graded and seeded as soon as possible after disturbance;
- keep disturbed areas small.

Prevention is the overriding principle of erosion control. Once an unexpected rainstorm occurs, and soil and sediment have been washed to a stream it is too late. Planning to prevent that happening is paramount in controlling erosion at construction sites. The Handbook provides a checklist to help the developer and those reviewing the site plans ensure the proper application of control measures for a particular site.

In addition to giving routine measures to control erosion, the Handbook also gives specific methods to control erosion from problems sites. These measures include surface roughening, application of sod, check dams, sediment traps and basins, and perimeter diversions. Special precautions are given for winter construction, when it cannot be avoided.

If erosion and sediment control measures are planned carefully and installed from the beginning of a development through to completion, soil loss can be reduced greatly. Accomplishing that is of immediate economic benefit to a developer, because much less time and money must be spent repairing damage caused by erosion and sedimentation. One study shows that carefully applied erosion control measures reduce

soil loss from construction sites by 90 to 96 per cent, at costs of from half to one-thirtieth of cleaning up sediment on and off a site owing to poor protection during construction.

IV. Concerns in the Mad River Valley

A review has not been carried out of how effectively criterion number four of Act 250 is applied at developments that have been issued permits in the valley, nor was such a review completed for town zoning and subdivision permits that have been issued. But is clear from even casual observation of streams in the valley that in areas of intense development, streams are severely embedded with sand and silt. This situation can continue even after construction has been completed. The causes range from changed drainage patterns and increased stormwater runoff to inadequate maintenance of ditches, roads, and parking lots in developed areas. As more and more development occurs, the problem of stream sedimentation will continue to worsen unless more attention is paid to preventing erosion both during and after construction.

V. Recommendations

1. All construction projects in the valley, whether under local, state, or federal jurisdiction, should follow Accepted Management Practices for Erosion Control, such as those contained in the Agency of Natural Resources' *Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites.*

2. The ANR and towns should increase the amount of compliance monitoring and enforcement of the erosion control provisions of permits issued for critical construction sites.

3. Valley towns should disseminate educational materials on erosion control practices on construction-sites, especially the need to minimize the amount of earth exposed, explain the impacts of season and duration of exposure, and the benefits of immediate mulching of disturbed earth.

4. Contractors and others involved in construction should attend Department of Environmental Conservation training sessions on erosion control methods.

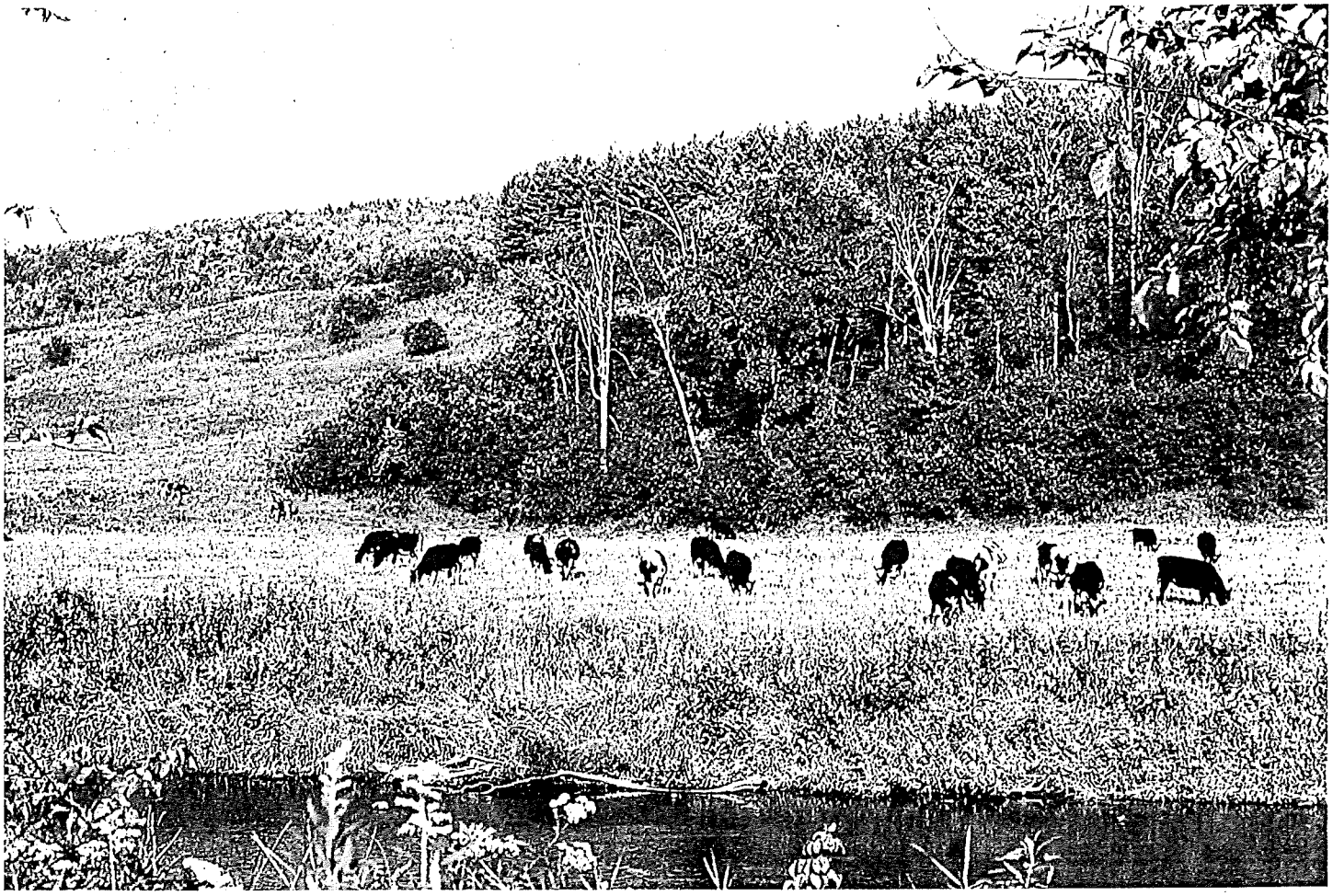
References

Vermont Geological Survey and the Vermont Agency of Natural Resources, *Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites,* Revised September 1987.

Vermont Statutes Annotated, Title 10, Chapter 151, Vermont's Land Use and Development Law, III, Erosion Control.

Appendix B—Topic Paper Q

Farming



Ann Day

Appendix B—Topic Paper Q

Farming

I. Background

Towns in the Mad River Valley have long supported the preservation of agriculture as a means of fostering the aesthetic, social, and economic benefits of an agrarian landscape. The extent of this support is well documented by the fact that 87 percent of respondents to the Valley Resident Questionnaire either encouraged or strongly encouraged agriculture in the valley. However, certain agricultural practices may seriously impact the health of the river. While dairy farming is an especially important means of preserving our social heritage and scenic resources, it poses unique threats to water quality, as well as a number of challenges and opportunities for protecting water quality:

- Erosion and sedimentation may result from some crop management techniques.
- Higher water temperatures, and reduced aquatic food supplies and spawning habitat may result when cultivation or cutting firewood does not leave adequate buffer strips along riverbanks. Removing stream side vegetation may also destabilize stream banks and threaten adjacent land with erosion during periods of high water.
- Spreading manure, especially during winter months, or lack of attention to the timing and amount of fertilizers applied to the land may cause nutrient loading, or bacteria laden runoff to enter the river directly.
- Human and river health may be threatened by improper application of pesticides, herbicides, and other farm chemicals.
- Vegetation may be damaged, stream water contaminated, and aquatic habitat disrupted by concentrations of livestock along stream banks and in the river.

Agricultural practices have a potentially large impact on the river due to the extensive riparian land holdings controlled by farmers. This is especially true along the main stem of the river. As a result, the most significant human interaction with the river is the responsibility of very few farmers.

This presents an excellent opportunity for farmers, Friends of the Mad River, town governments, and land-conservation organizations, such as the Vermont Land Trust, to work together on complimentary objectives. The first step in forging such partnerships is for river advocates and farmers to achieve trust based on mutual respect for needs and objectives.

Obviously, agricultural practices that recognize potential downstream impacts are critical to the long-term health of the Mad River system.

II. Existing conditions

The valley's agricultural ventures include seven dairy operations (although at least one actually comprises several farms); five beef operations; two sheep farms; three vegetable farms; two commercial stables; two greenhouse operations; and many small, semi-commercial or private agricultural operations. It has been estimated that 13 percent (18.6 square miles) of the watershed is made up of open lands.

The majority of intensive agriculture in the valley is located adjacent to the Mad River below Warren Village, and especially between Waitsfield Village and Moretown Village. Significant activity also takes place along the broad plateau of the Northfield Range in East Warren, Waitsfield Common, and Moretown Common. Some farming also occurs on Bragg Hill in Fayston, and in North Fayston, although these activities are much more limited than in the past, and will probably become even less active.

Each of the valley's town plans strongly encourages the preservation of farmland and the continued viability of agriculture. While the plans emphasize the protection of surface waters, not one addresses the relationship between agricultural practices and water quality.

There has been a great deal of stream bank stabilization along the Mad River over the years. An aerial photograph provided by the Natural Resources Conservation Service (NRCS) shows that most of the Mad River's stream banks have been riprapped with stone since the mid-1940s. Riprapping is also quite common along major tributaries. Such stabilization efforts limit erosion and subsequent sedimentation while safeguarding against the loss of cropland. However, removing stream bank vegetation and relying on riprap can damage fish habitat and the stream's aquatic biota. Fortunately, preventing stream bank sedimentation provides an excellent opportunity for partnerships between farmers and organizations interested in improving the health of the river and enhancing fisheries through habitat enhancement efforts.

The valley is fortunate in that current agricultural practices are generally responsible and considerate of water quality issues. The NRCS recommends integrated crop management as a cost effective means of limiting any adverse environmental impacts. One valley farm, operated by the Neill family in Waitsfield, has used this program to reduce the impact of agricultural practices on water quality. Other farmers have expressed an interest and could follow suit.

Largely due to cost-sharing offered by the NRCS, stream bank stabilization efforts are far more prevalent on farmland than elsewhere. One result is that the most severe stream bank erosion problems in the valley are not associated with agriculture, but are found elsewhere along the Mad River and its tributaries. The absence of riparian vegetation, however, is widespread along many flood plain farm fields. This is true in areas of extensive riprapping, as well as in areas characterized by stable stream banks.

Livestock management is also generally responsible in the valley, although there have been some incidents of livestock grazing up to and in the Mad River. This situation is exacerbated in one case by the location of a barn on a narrow band of land between a busy road and the river, making access to the adjacent pasture difficult. Further, the proximity of the barn to the river makes manure storage and disposal potentially problematic with respect to water quality. Encouraging improvements to manure storage and disposal, and methods to better control stream crossings could improve the condition of the river significantly.

While there is great deal of manure spreading in the valley, there is little problem with spreading on frozen ground. In fact, according to representatives of the NRCS, instances of irresponsible manure spreading are rare or nonexistent in the valley, It is uncertain how close to the river manure is spread, although many stretches of the Mad River are cultivated to the edge of the bank, with vegetated buffer strips along the river being absent or minimal.

In addition to manure spreading, septage is applied to a Warren farm, dairy waste is spread on a Waitsfield farm, and until recently sludge from Sugarbush was spread on another Waitsfield farm. However, it has since become more cost effective for Sugarbush to dispose of its sludge through other means. These practices are regulated by the Agency of Natural Resources, and ongoing monitoring has identified negligible impacts on water quality.

III. Farm practices and water quality

Very little data exists on the impact of agriculture on water quality in the Mad River Valley, although some presumptions may be made. Stream bank stabilization continues to be a serious concern along the river and some tributaries, especially Mill Brook at Fayston, and Stetson Brook at Warren, although neither of these problems is related to farm practices. In fact, stabilization problems adjacent to farmland are not necessarily caused by farm practices, although the loss of stream side vegetation, and nonexistent or narrow buffer strips have likely exacerbated erosion, resulted in increased water temperatures and limited trout habitat and food supplies along much of the river. While additional riprap will address some of the erosion and sedimentation problems, adequate buffer strips and stream bank vegetation are needed to address others.

Sludge and septage disposal appears to be more of a problem of perception than of reality, likely due to stringent management requirements and the level fields and well-drained soils along much of the river. The same is true of manure spreading, which is much more widespread and somewhat more benign than spreading sludge and septage. Manure storage is an isolated problem for at least one farm, although efforts to correct this through the assistance of the NRCS are under way. The related issue of livestock management that would keep cows out of the stream channel should also be pursued. Given the current movement away from ground application of septage and sludge in Vermont, it is unlikely that management practices will change significantly in the near future.

IV. Future conditions

In 1994 the State of Vermont drafted new Acceptable Agricultural Practices (AMPs) as a means of bringing agriculture into compliance with the Federal Clean Water Act. AMPs are intended to reduce nonpoint source pollution originating from the following practices (taken verbatim from the Proposed Rules, Section 3.2):

a) The confinement, feeding, fencing, and watering of livestock.

b) The handling of livestock wastes and by-products.

c) The collection of maple sap and production of maple syrup.

d) The preparation, tilling, fertilization, planting, protection, irrigation and harvesting of crops.

e) The ditching and subsurface drainage of farm fields and construction of farm ponds.

f) The stabilization of farm field stream banks constructed in accordance with the USDA, Natural Resources Conservation Service standards and specifications or other standards approved by the commissioner.

g) The construction and maintenance of farm structures, farm ponds and farm roads provided that where these activities occur in a flood plain, they conform to Federal Flood Insurance Management Program standards.

h) The on-site production of fuel or power from agricultural products produced on the farm.

i) The on-site storage, preparation and sale of agricultural products principally produced on the farm.

j) The on-site storage of agricultural inputs including, but not limited to, lime, fertilizer and pesticides.

Certain practices will be mandated for all Vermont farmers to reduce or eliminate nonpoint source water pollution. Specific guidelines in the proposed rules include standards for handling waste, pesticide and nutrient management, and minimum 25-foot stream-buffer zones.

The NRCS is extremely active in assisting area farmers with management problems, and funding for such improvements as manure storage and stream bank stabilization. This presents an excellent opportunity for partnerships between area farmers and Friends of the Mad River. As a local group concerned with river conservation, the Friends could take the lead in increasing public awareness of good farming practices. The NRCS also serves as a funding source for stream bank stabilization. This program, currently offering 50/50 cost sharing with eligible farmers, provides technical support as well as funding for stabilization projects.

Numerous examples of fisheries-habitat enhancement exist on the White River to the south of our valley. Sponsored in part by the U.S. Forest Service, the White River enhancement projects demonstrate how stream bank stabilization can be combined with habitat enhancement quite effectively. Sugarbush Resort developed a habitat enhancement plan for a small section of the Mad River, although that plan has yet to be implemented.

A similar effort on an expanded scale could provide guidance to assist Friends of the Mad River, towns, and farmers in joint efforts. The Friends could take a lead role by contacting farmers to discuss mutual objectives and explore opportunities for enhancement projects on farmland.

The Vermont Land Trust, Vermont Housing and Conservation Board, and the towns of Warren and Waitsfield have all funded the purchase of development rights on active farms as a means of preserving farmland. Little or no consideration has been given to encouraging desirable management practices, such as buffer strips. Most farm conservation projects have involved a conservation easement as the legal means of removing development rights. Future projects could include provisions for a buffer strip along the Mad River or other tributaries in return for public funding, or the assistance of Friends of the Mad River.

V. Recommendations

The following recommendations—through the joint efforts of farmers and towns, state government, NRCS, Friends of the Mad River, the Vermont Land Trust, and others in the valley—are aimed at minimizing harmful impacts that agricultural practices may have on the river.

1. The Vermont Department of Agriculture, Winooski Conservation District, and the Agency of Natural Resources should cooperate to help farmers implement the Accepted Agricultural Practices to be adopted soon, and the Best Management Practices (BMPs) that are to be adopted as requirements for cost sharing.

2. Friends of the Mad River should take a lead role in increasing public awareness of good farming practices.

3. The Natural Resource Conservation Service and the Consolidated Farm Services Agency should continue to provide farmers with technical and financial assistance to solve management problems, such as manure storage, livestock watering, and stream bank stabilization.

4. Where appropriate, stream bank stabilization should utilize biological stabilization (trees and other vegetation) instead of or in conjunction with riprap. Also, consideration should be given to creating stream bank and in-stream fish habitat when any stream bank work is carried out.

5. Revegetate riprapped areas that are devoid of vegetation.

6. Friends of the Mad River, in cooperation with towns, should take a lead role in contacting farmers to discuss mutual objectives of farmers and river health, and to explore opportunities for habitat enhancement projects on farm land.

7. When farmers elect to sell their land or remove development rights to preserve it for agriculture, the Vermont Land Trust and the Vermont Housing and Conservation Board should establish conservation

V. Recommendations—continued

easements as a means of establishing buffer strips along the river, and of instituting other river and habitat enhancement measures, including use of the Accepted Agricultural Practices.

8. Broad-based tax reform should be initiated by the Vermont Legislature to ensure that agricultural lands are taxed on the amount of income generated, not on fair market value to help preserve agricultural land in the state.

References

Vermont Department of Agriculture, Food and Markets, "Proposed Accepted Agricultural Practice Rules," December 23, 1994.

Appendix B—Topic Paper R

Wildlife

Darrell Eagles

Appendix B—Topic Paper R

Wildlife

We are fortunate to share the Mad River Valley with a diversity of wildlife species. However, this relationship is tenuous, in that our activities can have devastating impacts. Greater awareness of the needs of local wildlife populations can help us mitigate or avoid conflicts.

The major functions of wildlife corridors are to provide food plants and protective cover for feeding and travel. In landscapes where natural areas are increasingly fragmented by human activity, maintenance or restoration of habitat has become a central goal of conservation.

Of the many kinds of natural corridors in the valley, riparian ecosystems—the interface between land and water—are vitally important to wildlife. Usually, aquatic and terrestrial wildlife species are most diverse and abundant in such habitats.

Riparian ecosystems intercept sediment, nutrients, and other materials coming from upland areas. Also, they supply streams with vital materials, such as fish food. A stream's health depends largely on its response to these influences.

Stream side plant communities have running water, moist and fertile soil, and well-developed vegetation—they're dynamic environments that have many complex functions.

Natural areas—buffers—located between a stream and degraded portions of the landscape can lessen the effects of upland disturbances and help maintain healthy aquatic processes.

Numerous types of wildlife, both game and non-game species, are found in the Mad River Valley. Larger mammals, including moose, appear to be more common in wilder portions of Duxbury, Fayston, and Warren. White-tailed deer are common, providing sport and food for hunters and enjoyment for viewers. While deer easily accommodate human populations, they do have specific habitat needs. For example, in winter they may seek food in cedar swamps, and use coniferous forests on south-facing slopes for weather protection.

Black bear may be found in the southern portion of the Northfield Range and in the western portion of the Green Mountains, especially in the Green Mountain National Forest and the eastern part of Camel's Hump State Park.

Coyote are becoming more common in the Mad River Valley, filling the void created by local extinction of large predators, such as wolves. While many people are pleased with the growing presence of coyote, others, including some deer hunters and farmers, view them as a nuisance.

Eastern mountain lion (catamount), long presumed to be extinct in Vermont, are thought to have been seen in the Northfield Range by knowledgable residents. While the Department of Fish and Wildlife has declined to confirm the presence of catamount, recent evidence suggests that a limited number of these great cats exist in Vermont, and may range into the valley.

Several kinds of birds are seen in the valley, including the goshawk, osprey, kestrel, red-tail hawk, and an occasional bald eagle. Sawhet, great-horned, snowy, and barred owls have been seen and heard; as well as black, mallard, old squaw, and white-winged scoter ducks. The great blue heron is seen frequently, and sometimes the black-crowned night heron, and green heron. There are grouse, woodcock, and snipe; and many migratory songbirds, such as warblers.

Recommendation

The following recommendation is made with the aim of preserving wildlife habitat and utilizing the watershed effectively to provide for the movement of wildlife.

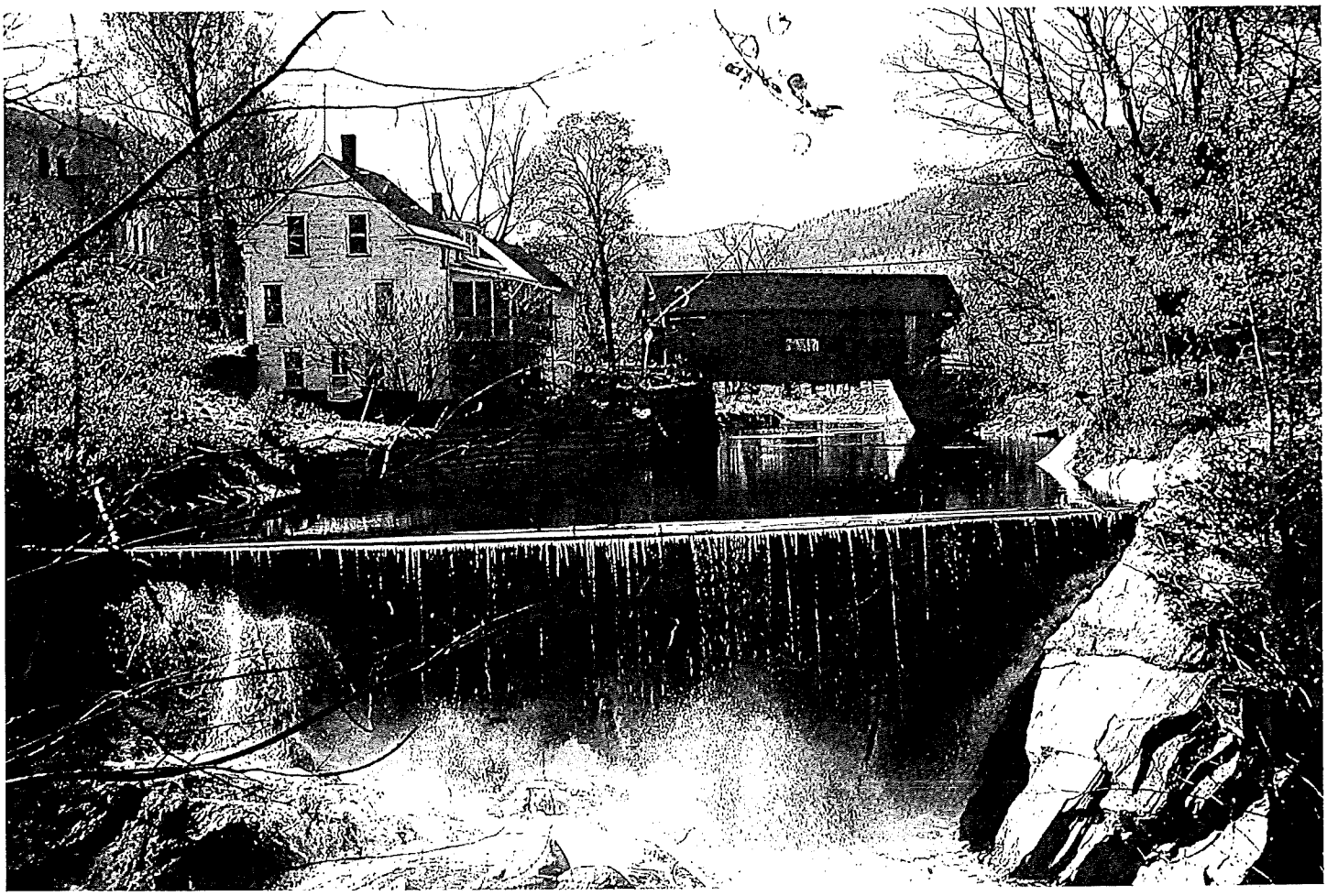
1. Town planning commissions, in cooperation with Friends of the Mad River, should inventory wildlife in the watershed, including migratory species, and develop guidelines for supporting wildlife habitat and corridors. Subsequently, town planning commissions should prepare maps showing the areas and cover needed. Towns should incorporate wildlife corridor information in town plans.

Reference

Waitsfield Town Plan, 1993.

Appendix B—Topic Paper S

A brief natural and cultural history of the Mad River Valley



Ann Day

Appendix B—Topic Paper S

A brief natural and cultural history of the Mad River Valley

I. Introduction

History can give us the benefit of perspective. Dreaming of the future can guide us while the most pressing problems of today grab our attention. Hopefully, with all this in mind we will make decisions today that respect the past and lead us to our visions. In the Mad River Watershed, named for a river that is known to change its character rapidly, it is not surprising that change in a human lifetime has been dramatic as well.

A history of the Mad River Valley can encompass geologic history, Native American history, the settlers and their livelihoods, and the effects all these have had on the watershed. The perspective we gain depends on the distance, and the lens through which we choose to look: whether it be the theories of Pangea or the remembrances of an octogenarian neighbor.

This paper gives only a brief overview of what has affected the health and character of the Mad River. Like the conservation plan itself, this overview is a framework to which numerous examples and specifics can be added. Our goal is to conserve our natural resources: to preserve their health so that they can withstand the unknown changes ahead. In 1864, a renowned Vermonter, George Perkins Marsh, clearly, ". . . urged people to realize that our resources are not infinite and that nature works with countless interdependencies." (Johnson, p. 48)

II. Natural history

The groundwork that would attract people to the Mad River Valley was set millions of years ago. The movements of plate tectonics thrust up the Green Mountains, part of the larger Appalachian system. It has been built up a few times—900 million years ago and again 375 million years ago—with the crashing together of the plates forming Pangea. Now the mountains have been softened by weathering and erosion.

The glaciers' movements over the landscape of Vermont, scouring and leaving deposits, can explain why woolly mammoth bones have been unearthed in Mount Holly, and why whale skeletons have been found near Lake Champlain. How remarkable to think that Lake Champlain was once connected to the Atlantic Ocean. The reason for the Mad River flowing north can be explained by the heavy ice of the glaciers melting first in the south as the environment warmed. As the ice retreated, the compressed land began springing up, tilting the land toward the north.

The Mad River Valley lies in the physiographic region of Vermont known as the Green Mountains. At 4,083 ft., Mount Ellen is the third highest peak in the state after Mt. Mansfield (4,393 ft.) and Killington Peak (4,235 ft.) With the Green Mountains to the west and the Roxbury Range to the east, the valley has been isolated.

The mountains also experience the coldest temperatures, heaviest precipitation, and the shortest growing season in the state. This of course has been helpful for the ski industry. However, we are all too aware how changeable the weather is, and this seems to have been the case in the late 1940s when "Lincoln gap was slated for a ski area. Construction was ready to begin. But due to a serious lack of snow that year the corporation's plans were changed. What would have become Warren's first resort was moved to Fayston, and Mad River Glen Ski Area was built." (*1979 Waitsfield Fayston Telephone Book*, p. 30)

The mountains were also used for their igneous mineral deposits, found on the eastern slopes of the Green Mountains. Talc was mined in Fayston for a time near Shepard's Brook.

III. Cultural history

The wooded hills and lush valley full of wildlife may have attracted some prehistoric peoples north to Vermont after the retreat of the last glacier. The archeological study prepared in 1989 for the Mad River Valley Planning District by Anne S. Dowd and Mary Beth Trubitt sets a base for further prehistoric and historic study and discovery in the watershed. It has been observed that the "The Paleo-Indian period (10,000-7,500 B.C.) in Vermont is known mainly by isolated finds of distinctive fluted projectile points . . . A fluted point found in the project area, known as the 'Moretown point' . . . provides direct evidence for the presence of Paleo-Indians in the Mad River Valley." (Dowd, p. 14)

It was during this early period that the Paleo-Indians camped together in family groups of 10 to 30 people, usually along rivers or on the shores of the Champlain Sea, which was still salt water. Weaving a picture of the lives of people who inhabited Vermont for thousands of years is based on finds throughout the state. What happened in the Mad River Valley can be determined if we are careful to protect the most likely sites where the Indians lived. These sites are most likely along the river.

"In the floodplain, upper alluvial sediments are of recent origin, the result of accelerated soil erosion and deposition brought about by man-made changes to the landscape (for example, lumbering activities) during historic times." (Dowd and Trubitt, p. 4)

It has been suggested that archeological deposits may be found as much as six feet below the sediment. Another view is that with the changing landscape after the glaciers, higher sites should be explored. "Until 7000 years ago a series of landscape adjustments occurred, accommodating shifts in lake level, rises in surfaces by geological rebounding and the formation of present drainage patterns. These events should lead archeologists to look for Paleo-Indian, Early and possibly Middle Archaic sites along higher remnant terraces (at elevations above 700 feet above sea level) in the Mad River Valley, rather than in the present floodplain. Preliminary indications are that sites dating to the Late Archaic (ca. 5000) and subsequent periods may be contained within the contemporary alluvial deposits, except for upland campsites or special purpose sites." (Dowd and Trubitt, p. 4-5)

By protecting possible sites from further erosion, it will be fascinating to compare lives of the early inhabitants of the valley with those along Lake Champlain and other rivers. We know from other sites in Vermont that people adapted to the warming trend during the Archaic Period (9500-3000 years ago)—gathering, hunting and fishing with different projectile points, and sometimes building wood structures with coverings of bark or animal skins. It was late in this period that people started to carve soapstone pots for cooking utensils, and perhaps the talc mine site in Fayston may reveal that as a source of soapstone used for this purpose. The Woodland Period (3000 years ago) saw the advent of pottery and the use of bows and arrows. Sometimes permanent villages were settled along rivers, and farming was introduced. With the coming of Europeans to Vermont, disease, trade wars, and expansion changed the lives of the Abenakis' way of life radically.

Affects of humans on the watershed

The Indians were not numerous and left little impact on the land and waterways—unlike the settlers. "In the twenty-eight years from 1763 to 1791 Vermont went from a wilderness to statehood, from a population of 300 to 85,000, a phenomenal development indeed." (Johnson, p. 42)

Trapping of mammals for their pelts was common even before the settlers arrival, and then with the influx of farmers, clearing of the land began for small, self-sufficient farms. Also, logging was an important industry in itself. Sheep farming was more suited than cattle to the rocky terrain, and by 1840 there was a thriving business for wool in Vermont. "Then in the 1850s Vermont's economic growth met with a sudden reversal, most strikingly in the sheep farming, which fell as quickly as it had risen to prominence. All types of farming now dwindled, and families began to abandon their land and homes. It happened so fast that their leaving has often been referred to as an exodus.

"A number of causes were responsible. The same agricultural methods that impoverished soils in southern New England had not changed here. The expanding logging industry had moved deep into the untouched

III. Cultural history—continued

forests and cut practically everything, but taking only what was marketable, then left when the trees were gone. Under the combined effects of farming and heavy logging, 70 to 75 percent of Vermont by the 1850s was open land in the form of clear-cut areas, pastures, or croplands, and the hills and mountains, stripped of their protective trees, could no longer hold on to the soil. The streams and rivers became muddy with the runoff. The ill-farmed land became harder to work and less productive, or else simply washed away into the rivers. Hunting and trapping continued unabated, with few conservation laws and little or no enforcement of those that existed. Wildlife of the forests grew scarce, and fish that depended on clear, cold streams diminished or vanished.

"The Green Mountains of Vermont, in short, had become a biological wasteland, offering little for people to live upon—a dramatic change from the bounty of a century earlier." (Johnson, p. 44).

With the demise of so much forest land there was a diminishment of animals that depended on wooded habitat. So much so that deer had to be imported from New York for restocking. "In 1878, seventeen deer were brought from New York state to Vermont to restore the species; today Vermont supports the highest deer density in New England." (Beattie et al., p. 11)

The Mad River was particularly important for moving and processing wood. Sometimes, boulders were removed to make it easier for the lumber to pass downstream.

In their archeological study of the Mad River Valley, Dowd and Trubitt show once again the incredible importance of the river and tributaries in shaping the lives and livelihoods of valley inhabitants. In Warren, Waitsfield, and Fayston there were 51 mills of various types: clapboard, saw, grist, shingle, bobbin, and cider. There were also clothespin factories, a cooper's shop, tanneries, a sash and door factory, carriage shops, wooden bowl manufacturing, wool carding, and blacksmith shops. Most of the mills (28) were in Warren, with 14 in Waitsfield and 9 in Fayston. Once again, it should be stressed that historically significant sites such as these mill sites must be protected by stream bank restoration methods to avoid losing any more of our history.

"By 1840, much of the New England landscape was like a photographic negative of itself before settlement: not a thick forest punctuated by small openings, but a shorn landscape with scattered tufts of trees. Sixteen million acres of forest had been cut to run factories, make steam, charcoal, and potash, or simply to clear the land for farming and a growing sheep industry." (Mollie Beattie et al., p. 10) This picture of New England was also evident in the valley. There are archives of pictures in the *Commemoration of Warren's Bicentennial 1789-1989* showing bare hills that are now deeply wooded.

Early settlement

In the early days of settlement there were hardships that we may have a hard time imagining. The first four-wheeled wagon was brought into the valley in the 1830s, first by "barge to Burlington and then was brought to Starksboro, the nearest point to Fayston on the other side of the mountain range. Maxwell's father left Fayston each day for Starksboro, returning with a wheel, an axle, or another piece of the wagon until he had carried all the parts over. After ten days of strenuous activity, he reassembled all the pieces and had the first four wheeled lumber wagon in the valley." (Beck, p.5)

Small subsistence farms were the norm in the early days of settlement in the Mad River Valley. People were hardy and produced almost everything they needed for themselves. They grew their own food, raised their animals, cut wood for heat, made maple syrup; some had honey trees.

Each town was separate and had its own flavor. It is interesting that Fayston was largely made up of Irish immigrants and was known for its potatoes. Raising sheep made sense on the steep and rocky slopes. "Sheep raising in Vermont was encouraged and a taxpayer was entitled to a deduction for each sheep which he owned and was shorn by him between May 10 and June 20." (*1979 Waitsfield-Fayston Telephone Book*, p. 10)

By the 1900s, sheep farming in Waitsfield was changing into dairy farming. During the 1920s and 1930s some of the sugar places were sold for their lumber. Markets changed, and the farmers were often diversified enough to adapt to the changes. Ed Eurich

recalls, "When I was younger, most of those farms were small, like ten, twelve, fifteen, twenty cows . . . They not only had the dairy part of it, but most places had sugar orchards, and they depended on that: most places had acreage enough so that they had a lumber operation so that in the wintertime they were always getting up wood . . . At that time everyone heated with wood. You had what you called your summer wood and you had your winter wood. So you had to get the lumber out, and of course you did it all with horses, and then you had to get wood up for the sugar operation too, and usually they would cut some timber logs that went to the mills . . . That was a means of income, so it was somewhat diversified at that time . . . That was about the size of those farms until the '20s when they began to ship milk rather than cream. Then of course they had to have the coolers and of course electricity." (Beck, p. 7)

Back in those days school was closed during the sap runs so that children could help with the sugaring. There were more farmers then and more of them did sugaring. Slowly the farms became more specialized, larger, and fewer. The advent of electricity, the telephone, and better means of travel improved connections between the valley and the outside world.

Populations of valley towns diminished as farming became more difficult, and after the flood of 1927 that ended the era of water-powered mills in Warren. Here is one account of the flood seen from the top of a hill in Moretown by Theron Austin, who was nineteen. "We saw plenty that night . . . I don't know how many bridges there was. There must of been five or six covered bridges that went out here. One bridge in front of our house, that went too. Yeah, that went about midnight. We saw that going right down across and there was a whole mess of elm trees along the side of the river. It broke every one of them right over. That bridge went right over them and broke them right down . . ." (Beck, p. 22)

The 1927 flood caused an enormous amount of damage throughout the region. Although many mills had succumbed to fire in the past, they were often rebuilt and modified to serve another purpose, such as changing from a clothespin factory to a clapboard-sawing operation. However, the 1927 flood caused irreparable damage because not only were the mill buildings washed away, but so were the mill dams. Other floods have been catastrophic as well. "What is now known as Route 100 was originally called the Mad River Turnpike and according to Mae Blair, Rupert Blair's mother 'a Mr. Fenton hung himself because he was so grieved that the river cut across his meadow in the flood of 1869.' At that time his was the last farm in Warren on Route 100." (Beck, p. 2)

As an example of population swings in the valley, Moretown had 1,263 inhabitants in 1880, 930 in 1920, and 375 in 1940. Since then there has been an increase, with 1,415 inhabitants reported in 1990. "From 1798 through the next century and a half Warren was alive with the activities which expanded a promising agricultural village to a busy mill town. As new world developments drew its youth to foreign shores and city lights, both population and progress subsided in Warren. Quiet country life was the rule. When its natural resources were recognized as a potential for the recreation industry, Warren became the bustling town we see today." (1979 *Waitsfield-Fayston Telephone Book,* p. 32)

Modern developments

The steep and beautiful mountains were seen as a boon to the economy for the ski industry. Change once again was rapid. First, Mad River Glen Ski Area opened in 1947, Sugarbush followed in 1958, and Glen Ellen, now Sugarbush North, opened in 1963. With the ski industry came tourism as a business in the valley with inns, restaurants, and shops springing up. "The Valley went through unprecedented growth which touched every aspect of life. Some like Merle Long who went into the real estate business made small fortunes as land prices soared. Farmers who had continued to struggle found it difficult to look an apparent gifted horse in the mouth and sold out. Even those who were successful, encountered repercussions. Ed Eurich felt it with his potato business. A number of people whose help he had depended on for picking and putting up potatoes now had the opportunity to work for higher wages at the ski areas. The result was that the labor situation became such a problem that although the potato business was very profitable, they elected to give it up." (Beck, p. 27)

III. Cultural history—continued

Other businesses besides downhill and cross-country skiing have been drawn to the valley because of its landscape and natural resources. Warren Ketcham started the airport in East Warren in 1963. Gliding at the Warren airport is some of the best in the east because of updrafts from the ridges on the east and west. Horseback riding, fishing, canoeing, tubing, swimming, hiking, biking, leaf peeping, fishing, wildlife viewing, and photography all benefit from the natural beauty of the valley, as do polo, tennis, and golf. Others have started businesses that do not depend directly on natural resources. They choose to live here for the community and the beauty—the "quality of life."

Many find the valley pleasing because of its rural character: wooded areas, farms, and rich history. The villages of Waitsfield and Warren are listed in the National Register of Historic Places. Both villages have historic structures from a range of periods that are concentrated in classic village settings that are typical of many New England historic districts. The Mad River Valley Rural Historic District was added to the National Register in 1994 to recognize not only the architecture, but the entire 2,000-acre landscape for its historic agricultural significance. (VT Division for Historic Preservation, 1983, 1992, and 1994)

Like an aquatic ecosystem or a valley farm that depends on diversity for its health, so do the people who choose to live here and seek an economically viable lifestyle.

And now we are facing some perplexing challenges: water withdrawal for snowmaking, lumbering of thousands of acres, large influxes of people for concerts and parades, and having a larger population in this valley than it has supported previously. A sense of balance and good old common sense is needed to sort out and meet these changes and challenges. Respect for the natural beauty, the historic built environment, and the changing opportunities in the valley can be the basis for the tourist and recreational values on which so many depend.

IV. Recommendations

We must understand that the river and watershed are a dynamic system that responds to both human activity and natural events. Learning from our past failures and successes can set a foundation for what we do today and in the future. The recommendations that follow are an attempt to begin some efforts to learn from the history of the river:

1. Friends of the Mad River, in cooperation with valley towns (including the historical societies of each town), as well as valley businesses and other interested groups, should create a Mad River natural and historical resource center. It would provide opportunities to learn about and be responsible for good stewardship of the watershed. The resource center should include:

a) maps and models of the watershed showing historical and future land uses and conditions (forests, agriculture, mills, and intended land use with zoning-build-out maps);

b) interactive, hands-on, changing displays on such topics as mill and skiing artifacts, the Ward Lumber Company watershed model, and Mad River Watch information and data;

c) a library of river related historical materials including books, tapes (oral histories and radio programs), and videos;

d) materials provided in cooperation with town historical societies on such topics as flooding history, agriculture, logging, music, and changes in land use in the valley;

e) an interpretation center for residents, students, and visitors to find answers to questions about the river, and a place to train volunteers for river and watershed work.

2. Valley schools should develop an historical curriculum of the watershed, including an oral history.

3. The place chosen for the resource center should be located centrally (Waitsfield), very near or on the river. It should include a river monitoring station for educational purposes, and a nursery for growing trees and shrubs to revegetate barren portions of the river.

References

Beattie, Mollie, Charles Thompson and Lynn Levine. *Working with Your Woodland,* Hanover, NH; University Press of New England, 1993.

Beck, Jane, *Report for Mad River Valley Planning District of Mad River Valley Oral History Project,* December 31, 1992.

Brown, Cindy Kilgore, *Wildlife Viewing Guide,* Helena, Montana; Falcon, 1994.

Cammann, Peter F., *Fishing Vermont's Streams and Lakes,* Woodstock, Vermont; Backcountry Publications, 1994.

Dowd, Anne S. and Mary Beth Trubitt, *Archeology in Vermont's Mad River Valley From Paleo-Indian Times to the Present,* West Chester, PA; John Milner Associates, Inc., 1990.

Johnson, Charles W., *The Nature of Vermont,* Hanover, NH; University Press of New England, 1984.

Meeks, Harold A., *Vermont's Lands and Resources,* Shelburne, Vermont; The New England Press, 1992.

Tree, Christina and Jennison, Peter S., *Vermont, An Explorer's Guide,* Woodstock, Vermont: The Countryman Press, 1992.

The Waitsfield-Fayston Telephone Directory, 1979, 1991, 1992, 1993, 1994.

Vermont Division for Historic Preservation, *National Register for Waitsfield Village Historic District,* Montpelier, Vermont, 1983.

Vermont Division for Historic Preservation, *National Register for Warren Village Historic District,* Montpelier, Vermont, 1992.

Vermont Division for Historic Preservation, *National Register for the Mad River Valley Rural Historic District,* Montpelier, Vermont, 1994.

Appendix C

Watershed associations: their activities and needs and how they involve people

River Watch Network

This list of watershed association activities, needs, and methods for involving people was prepared from discussions at four meetings of the Mad River Project Advisory Committee which took place in Middlebury, Vermont during the first five months of 1994.

The Mad River Project is funded by the Lake Champlain Basin Program as a demonstration project to foster a local effort to identify river values and uses, as well as threats to assets, and to develop solutions to problems in a collaborative process with residents, landowners, businesses, organizations, and all levels of government.

These lists are more than just ideas. They contain actual ways and means being used by watershed associations to carry out projects and involve people. They reflect actual experiences of persons working in watershed associations. The list of watershed association needs reflects very pressing situations that must be met if watershed associations are to continue to play an increased and effective role in restoring and protecting the vital assets of rivers and watersheds.

I. Watershed association activities

1. River Watch activities:

a) Monitoring water quality (fecal coliform and *E. coli*, dissolved oxygen, total phosphorus, orthophosphate, pH, temperature, specific conductivity, benthic macroinvertebrates, total suspended solids). Since Vermont has no ambient water quality monitoring program, and since New York monitors rivers on a seven-year cycle, River Watch activities fill a large void in monitoring and providing a more complete data base. River Watch efforts can be even more valuable if samples are split, with one being sent to a certified laboratory to corroborate results, or to obtain certification of the River Watch laboratory.

b) Inventory of the resource (fish habitat—spawning areas and over wintering pools, fish population surveys with state personnel; wildlife habitat; wetlands; stream bank erosion and stability (and areas of accelerated, human induced erosion); land cover (buffer strips); and land use characteristics).

c) Learning about and tracking development applications that might affect the resource.

d) Research on sediment collection and transport; embeddedness of stream substrate.

e) Establish certified laboratory with low-cost analysis for towns in the watershed (Boquet River Association).

f) Information obtained is interpreted and provided to the public.

2. Stream bank stabilization to prevent erosion and sedimentation. (Lewis Creek Association has done projects in Hinesburg and Charlotte; Mount Mansfield River Watch has planted over a mile of stream banks; Boquet River Association has built approximately 500 feet of riprap and log cribbing structures, and has planted over 200,000 seedlings).

3. Setting up and running nurseries to propagate willows for stream bank plantings (Mount Mansfield River Watch, and Boquet River Association).

I. Watershed association activities—continued

4. Working with and providing support to towns and town conservation commissions (park and trail designs; obtaining low-interest loans for septic system improvements, and mitigation of nonpoint source pollution—$250,000 committed by Champlain National Bank in Essex and Clinton Counties, New York; investigating possibilities of septage and sludge disposal and phosphorus removal from wastewater treatment plants; working with road crews—training on ditching and seeding; wetlands reclassification, riparian-corridor bike paths, interpretive signs, and eco-tourism planning).

5. Publishing newsletters to inform members and others in the watershed.

6. Developing and distributing educational materials to schools (workshops for teachers, exhibits and watershed board games; traveling education programs to aid communication between teachers, students, professionals). The New Haven River Anglers Association provides fly-tying demonstrations and shows movies.

7. Publishing information materials for landowners (e.g., for farmers on stream bank stabilization, including a videotape—Lewis Creek Association; public fishing rights and Adirondack Park Agency regulations—Boquet River Association).

8. Commenting and participating in development permit decisions (Mount Mansfield River Watch has developed a particularly effective approach that emphasizes patience, non-aggressiveness, thoroughness, and an attitude of working together to solve problems).

9. Conducting field trips to systematically record observations of land use and vegetation along stream corridors (See item 1-B).

10. Developing and submitting wetland and stream reclassification petitions and Outstanding Resource Waters designations to the Vermont Water Resources Board to provide for protection and additional protection as needed for the resource.

11. Supporting the creation of "Community Documents." A Community Document is a continually updated list of a community's feelings and concerns about their specific watershed from scientific/natural, cultural, and recreational/scenic standpoints.

12. River Cleanups. These efforts not only result in cleaning up of portions of rivers to make them more aesthetically pleasing, they also focus attention on the river and make people more aware of the benefits and possibilities that the river provides.

13. Fish Habitat Restoration. Several methods to restore and improve fish habitat have proven to be effective. Such work is taking place in the Mad River Watershed in conjunction with the Sugarbush water withdrawal plans. The Boquet River Association is doing log cribbing, fish weir, and plunge pool projects.

14. Watershed planning, and public participation and involvement.

15. Educational efforts involving programs to look at the history of the river (Montpelier Conservation Commission and Boquet River Association—"Historic Boquet River Bike Trails").

16. Working with landowners (repair of stream fencing for farmers—New Haven River Anglers Association.

17. Working with local, state, and federal agencies and other organizations (land trusts, Water Resources Board, fish and wildlife departments, and other groups). For example, the Boquet River Association is working with the Champlain Valley Heritage Network, which is attempting to revitalize rural communities through interpreting and emphasizing natural and cultural resources to preserve unique and valuable natural areas and to assist in guiding management of the water resource. By coordinating and networking, or bringing together diverse interests and various levels of government, projects otherwise dormant or impossible can be carried out.

18. Rearing of trout species for stocking and assistance in stocking—NHRAA.

19. Working with lake associations within watershed boundaries. The Boquet River Association monitors water and milfoil for the Lincoln Pond Association.

20. Working with the Lake Champlain Management Conference's Technical Advisory Committee. Subcommittees assist with the Action Plan, determine projects for funding, and assist specific review teams.

21. Working with other river associations in and out of the basin (meetings, discussions, joint proposals).

22. Assist in developing and implementing a nonpoint source pollution strategy.

23. Obtaining pro bono services and materials for more leverage to make a project more cost effective and thorough; filling gaps left by economically strapped state agencies. This was done by the Poultney River Association in its successful effort to have the Lower Poultney River designated an Outstanding Resource Water by the Vermont Water Resources Board.

II. Watershed association needs

1. Funds for specific, identified needs in each watershed association, including a watershed association newsletter. Also, materials, equipment, and training for water quality monitoring, especially for sedimentation, bacteria, phosphorus, and benthic macroinvertebrates.

Of particular importance is funding and other assistance to help get a watershed association started—that is, incorporated as a legal entity, so it can be eligible and able to apply for funding that is or might become available for watershed association efforts (see number 4 below).

2. Land to develop nurseries to propagate plants for stream bank stabilization projects.

3. Training in communication skills, leadership, research, networking, and other effective approaches (see the articles "Streambank Stabilization" and "Cows in the River" from the Mount Mansfield Newsletter).

4. Identification and funding for a diverse group of "Volunteer Professionals" who are willing to assist watershed association efforts. Very often, watershed association members do not have the expertise in certain areas needed to ensure effective involvement of the association. Volunteer professionals donating or providing at-cost service can make the difference between ineffective and effective involvement of watershed associations in issues and problems that arise.

5. More (and maybe formalized) technical assistance from the Agency of Natural Resources to watershed associations.

6. Networking between watershed associations to exchange ideas and experience on successes and failures on their projects. This should include a periodic watershed association newsletter and a project description notebook (which fully describes watershed projects, including methods and results, and makes the description available to watershed associations) with regular funding as necessary to get them out. This

II. Watershed association needs—continued

should also include periodic workshops on specific topics, such as sampling protocols.

7. Quality control/quality assurance training in river monitoring and laboratory analysis activities so that data of watershed associations can be used confidently by state agencies to determine if designated uses of a river are being supported.

8. General support of watershed associations to assist them in the various activities they undertake on behalf of the river and its watershed (see the "Activities" list above).

9. Town assistance with trucks and loaders for the heavy work of river cleanup and stream bank stabilization and erosion control.

III. How to involve people in watershed association activities

This list contains more methods than can be used in one particular project or at any one time in a project's duration. Watershed association members can pick and choose, and use methods that suit their specific efforts.

1. Invite specific interest groups to your activities. Use personal invitations.

2. Coordinate your efforts with other events, such as Earth Day or Green Up Day.

3. Put on special events (such as fly tying, barbecues, a movie, fishing) to draw certain people.

4. Get children involved. This will then draw their parents into the activities. An example of this is from the Mount Mansfield River Watch, where a kid's art show was put on.

5. Poster contests during a clean water week with prizes.

6. Involve town officials that have a responsibility in the areas with which you are concerned, such as the road crew, and the health or sewage officer.

7. Start with a "citizen inventory" of a river. This can be done in cooperation with a town conservation commission. See Linda Henzel's survey procedures.

8. Set up special workshops. The Lewis Creek Association's "Road Maintenance Program" is a good example.

9. Work with teachers. This can be very effective because the structure is in place, and many teachers have the motivation and skills to do programs. However, due to the heavy academic workload of advanced students, it may be better to work with pupils in lower grades who have more time to devote to extra projects.

10. Structuring programs around controversial issues will usually result in good attendance.

11. Have an annual celebration or event (tradition). Friends of the Poultney River stage an annual canoe trip on the river. It's a way to get information about the river to the community.

12. Try to make an emotional connection with people, such as "this is our place, we live here." Develop a sense of place.

13. Make connections with historical societies. Friends of the Mad River, in cooperation with the Vermont Folklife Center in Middlebury, prepared a Mad River Valley Oral History. This approach gives people a way to connect with the river and watershed other than through water quality protection.

14. Set up projects that have continuity, such as school classes mapping swimming holes. This can then be carried on and expanded by classes that follow.

15. Use quotes from people in the community in the invitations you send to others. People may be motivated to come through recognition of the person quoted, or to argue their own position in contrast to what has been stated.

16. Point out which communities are in the watershed. Sometimes people do not realize that they are connected to a stream or river, but when they realize this they are more prone to become involved.

17. Use community service organizations and projects and have them plan river activities into their programs (such as helping with fish stocking, and giving members tours on rivers). An example of this approach is Friends of the Mad River obtaining the help of 180 students of the Green Mountain Valley School to work on and clean up the recreation path.

18. Use newsletters and networks of existing organizations, such as the Chamber of Commerce, and Rotary Clubs.

19. Get clubs and organizations to take on a project.

20. Take care to let people know in detail about the activity—when, where, what, and how long it will go on. What is the end point? Don't bombard people too much, just lay out what is to happen and where their input and effort are needed.

21. Form a group of organizations to share in the effort of carrying out a project or activity. This way, each of the organizations can incorporate the project and meetings into its own activities with little extra effort. With several organizations taking turns at setting up meetings, and with the emphasis on how that particular organization is involved with the river, effort is reduced, and impact is increased by virtue of several other organizations being involved.

22. Do a build-out of zoning regulations. This is a very graphic way of showing where the town is heading.

23. In the spring of 1994, the Mad River Project used an "Open House/Public River Forum" technique to get people involved in the river conservation planning effort. The first hour of three evening meetings was an open house of educational and information displays and materials ranging from the basics of on-site sewage disposal, River Watch activities, and GIS maps to river trivia questions, a graffiti wall, and a voluminous display of river and related books.

The second part of the evening forum utilized a nominal group technique for small groups of 7 to 10 people to foster a visioning process. Each individual could freely and without judgment answer the question: "What do you want the Mad River to be like in the future?" After all ideas were presented, the groups voted for their top five "visions" for the River. This information and process will help guide work of the project as well as keep people involved as volunteers on parts of the project that they find interesting and vital.

24. Ask for volunteers, with sign-up sheets having various categories of activities. Continue asking for volunteers because new people will come forward as they have more time or as they develop an interest in the activity.

III. How to involve people in watershed association activities—continued

25. Always thank people for their efforts by publishing a thank-you in the local newspaper or in your newsletter. Also, by giving "Certificates of Appreciation" or by making persons a "Complimentary Member," you increase the chances that they will volunteer again or stay involved with your activities.

Members of the Advisory Committee and others who participated in and/or contributed to this effort:

Bill Butler, Mount Mansfield River Watch Network

Kinny Connell, President, Friends of the Mad River

Richard Czaplinski, Mad River Project Coordinator

Anita Deming, Essex County Extension

Steve Dickens, River Watch Network, S. Burlington

Pete Diminico, New Haven River Anglers Association

Linda Henzel, Lewis Creek Association

Bill Johnston, Lake Use/Land Use Committee Chair, Essex County Planning

Mike Kline, River Planner, Vermont Department of Environmental Conservation

Kim Locke, Plan Coordinator, Lake Champlain Basin Program

Susanna McIlwaine, Board Member, Friends of the Mad River

Eric Perkins, Coordinator, Lake Champlain Basin Program

Robin Ulmer, Boquet River Association, New York

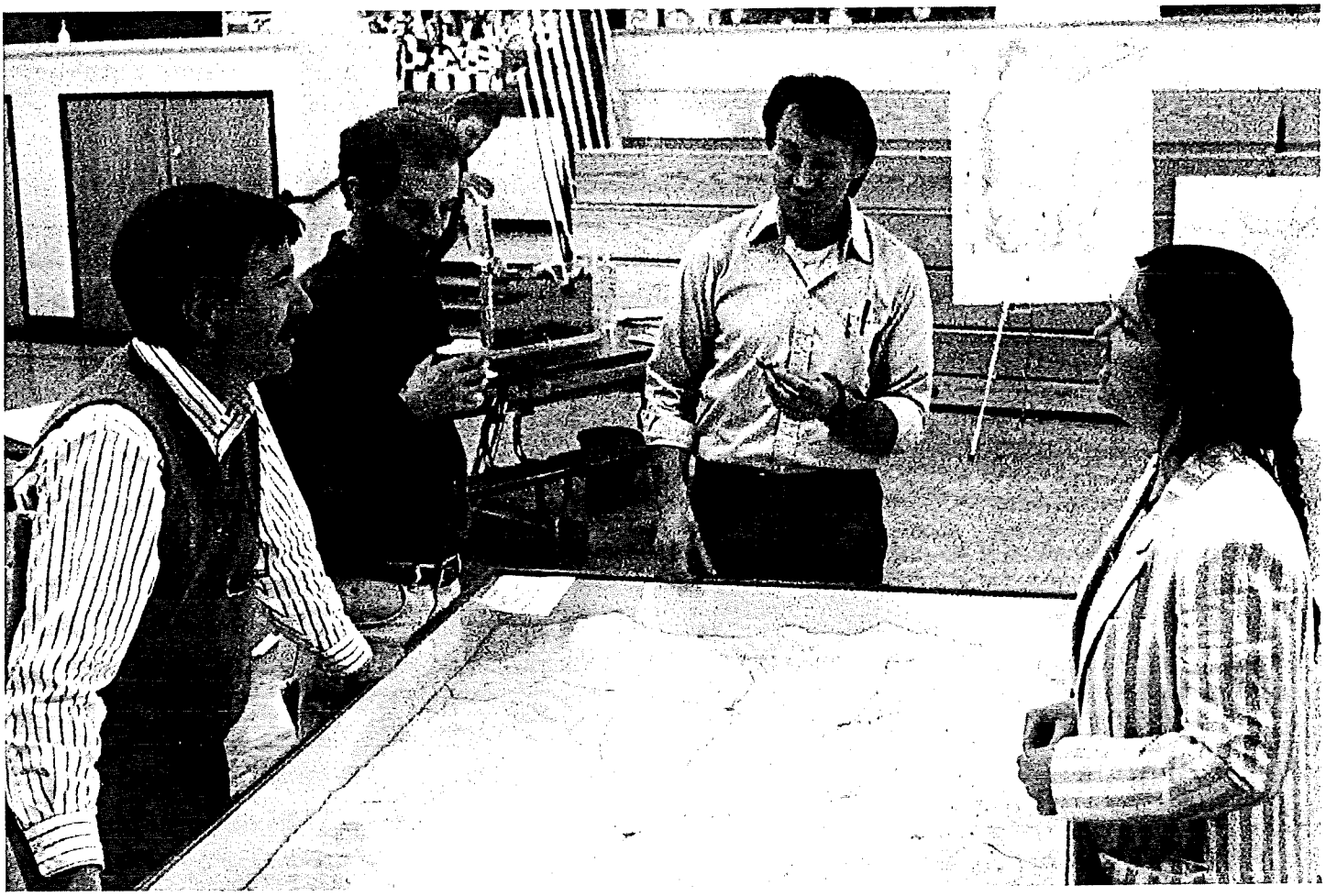
Joanna Whitcomb, Executive Director, Mad River Valley Planning District

Heidi Willis, Otter Creek River Watch, Middlebury

Sandy Young, Executive Director, Addison County Regional Planning Commission

endix D

Preparing the Mad River conservation plan



Susanna McIlwaine

Appendix D

Preparing the Mad River conservation plan

The planning effort to develop a Mad River conservation plan was undertaken jointly by the Mad River Valley Planning District and Friends of the Mad River. A small grant was obtained from the Lake Champlain Basin Program which enabled the hiring of a part-time (12 hours per week) Project Coordinator for the 16-month duration of the project.

Several committees were formed very early in the process—a Public Outreach Subcommittee to publicize the project's efforts, seek volunteers, and organize events; a River Subcommittee to work on river issues; and a Land use Subcommittee to work on river related land use issues. To make decisions about how the project should proceed, a Planning Committee was formed, which consisted of the chairs of each of the Subcommittees, the President of Friends of the Mad River, and the Executive Director of the Mad River Valley Planning District.

To draw on the wider experience of other watershed organizations in New York and Vermont, and to provide those organizations with experience gained from the Mad River project, an Advisory Committee was formed, which met monthly (except in April) for the first five months of 1994. About a dozen organizations participated actively in the Advisory Committee.

The following annotated chronology of events will give an idea of how and why the project proceeded as it did.

May, 1993 In response to a "Request for Proposals" issued by the Land Use/Lake Use Committee of the Lake Champlain Basin Program, the FMR and MRVPD submitted a proposal for a model demonstration project.

December, 1993 Grant is obtained from the EPA through the Lake Champlain Basin Program. 14-month contract signed with Project Coordinator. Project is designed; and Subcommittees, Planning Committee, and Advisory Committee are set up.

January 6, 1994 First Advisory Committee meeting is held in Middlebury, Vermont.

January-April, 1994 Four Advisory Committee meetings are held, resulting in a list of watershed organization activities and needs, and a list of ideas about how to involve people in watershed activities.

Period of intense activity by the Public Outreach Subcommittee to prepare for the spring river forums (volunteers are identified and trained as facilitators, and open house materials are prepared and/or collected).

River and Land Use Subcommittees meet at least once monthly to begin work on issues and to identify and seek volunteers. The idea of preparing "issue topic papers" is hatched. Friends of the Mad River Board and the Planning Committee meet monthly or more often to discuss and make decisions about the project.

February/March, 1994 Meetings are held with all five valley town planning commissions to explain the Mad River project and to find out what their needs are with respect to river protection and planning.

March/April, 1994 Preparation for river forums. Planning of open house on river education materials and demonstrations. Training of facilitators in the nominal group process.

April 27, May 3 & 5, 1994 River forums and open houses are held in Warren, Moretown, and Waitsfield. About 100 people attend and participate in small, nominal groups, visioning: "What you would like the Mad River to be like in the future?" and "Imagine the best river ever." The open houses prior to the visioning featured a working groundwater model, Mad River Watch materials, on-site sewage information, color infrared aerial photos, aerial photos of NRCS riprap projects, a 3-D model of the watershed, and more.

May and June, 1994 A summary of responses from the river forums is prepared and distributed to all those attending. Twenty issue-area topics are identified, and work begins to gather information about the condition of the Mad River with respect to these twenty areas using volunteers, Friends of the Mad River, the project coordinator, and Executive Director of the Mad River Valley Planning District to take the lead in various topic areas.

July, 1994 Meetings with all five valley town planning commissions are held to present the results of

the river forums and the topic areas being studied, and to solicit their ideas about topics.

July 6, 1994 An all day "River Survey and Walk" is held to bring together people from the community and watershed, and state and federal river experts to discuss river dynamics, threats and problems, and potential solutions. About 16 people attend.

July 30, 1994 Lareau Swim Hole Design and River Concert. The public is invited to help design public access to the Lareau Swim Hole and to listen to "River Music" provided by folk singer Lynn Noel. About 30 people attend.

July and August, 1994 Work continues on preparation of the topic papers.

August 4, 1994 Article appears in The Valley Reporter discussing Mad River *E. Coli* counts and risks at swimming holes.

August 23, 1994 Meeting held with state Agency of Natural Resources personnel to discuss the gravel removal issue.

September and October, 1994 Work continues on preparation of the topic papers.

September 1, 1994 Article appears in The Valley Reporter about the river walk.

September 8, 1994 A meeting is held in Waitsfield for all five town zoning administrators, health officers, and some planning commission members to discuss the draft on-site sewage disposal topic paper. Ten people attend.

September 15, 1994 Article appears in The Valley Reporter on the topic of on-site sewage pollution of the Mad River.

September 22, 1994 Article appears in The Valley Reporter on the topic of swimming, and an analysis of the fecal coliform and *E. coli* violations in the river.

September 29, 1994 Article appears in The Valley Reporter about the Mad River project and what has happened so far.

October 13, 1994 Article appears in The Valley Reporter on gravel removal.

October 1, 1994 A walk along the Mad River greenway is held to foster an awareness of the path and its relation to the Mad River. About 25 people attend.

October 2, 1994 Articles appear in The Valley Reporter on the topics of recreational access to the Mad River, and the river path.

October 26, 1994 A public meeting is held in Waitsfield to discuss six of the twenty topics. Presentations were made on river health, fishing, on-site sewage disposal, gravel removal, water withdrawal, and public access. Small group sessions were then held on each of the six topics to receive comments and ideas for recommendations from the public. Topic papers on 12 of the 20 topics were available to the public. An attendance sheet was available so that people could request that other topic papers be sent to them. About 50 people attended.

November, 1994 Most topic papers are finalized.

November 3, 1994 Article appears in The Valley Reporter on logging in the Mad River Valley.

November 10, 1994 Article appears in The Valley Reporter on the topic of fishing and how trout are the early warning system for damage to the Mad River.

November 20, 1994 A half day meeting is held with the Mad River project coordinator, the Executive Director of the Mad River Valley Planning District, and Friends of the Mad River Board Members to finalize recommendations to be included in the draft Mad River conservation plan.

November 24, 1994 Article appears in The Valley Reporter about the logging workshop to be held on December 3.

December 1, 1994 Article appears in The Valley Reporter about the draft Mad River conservation plan, highlighting some of the 102 recommendations.

Preparing the Mad River conservation plan—continued

December 2, 1994 The draft Mad River conservation plan is sent to all those who have participated in the project so far—over 200 people.

December 3, 1994 Workshop on Forestry "Acceptable Management Practices" held for the public and loggers, with a visit to a logging site to see the practices installed. About 30 people attend.

December 8, 1994 Article appears in The Valley Reporter about the Mad River conservation plan nearing completion, and the public meeting on the draft plan.

December 14, 1994 Public meeting to receive comment on the draft Mad River conservation plan. About 35 people attend. Comments are first received on five "priority recommendations," then on all others. A total of 46 comments is recorded.

January 1, 1995 Additional comments on the draft plan are received from the Agency of Natural Resources (Water Quality Division, Dept. of Forests, Parks and Recreation, and the Fish and Wildlife Dept.), NRCS, and Sugarbush Ski Resort.

January, 1995 Appendix E to the Mad River conservation plan is prepared which records all comments, and documents resolution of the comments. The revised plan is sent to all Friends of the Mad River Board Members for review and comment.

February, 1995 The Mad River conservation plan is finalized and forwarded to the Land Use/Lake Use Committee of the Lake Champlain Basin Program.

March 19, 1995 FMR Board members and MRVPD Executive Director participate in a facilitated meeting to begin the process of setting implementation priorities and strategies.

March, 1995 The format of the plan is finalized and sent to a professional for final editing, design, and layout.

April 12, 1995 The Mad River conservation plan is presented to and endorsed by the Lake Champlain Basin Program LandUse/Lake Use Committee.

May 3, 1995 The Mad River conservation plan is presented to the Lake Champlain Basin Program Technical Advisory Committee.

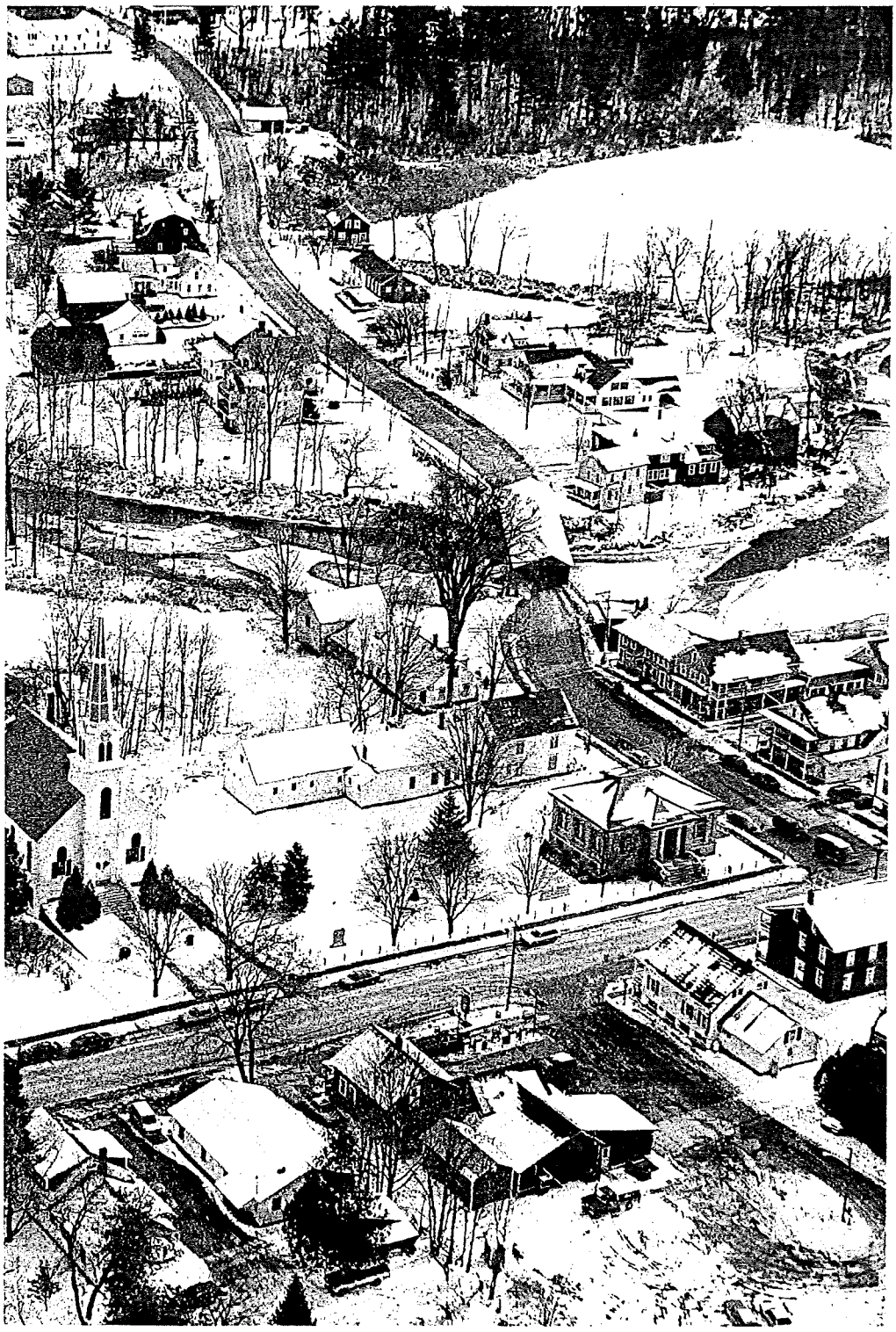
May 31, 1995 The Mad River conservation plan is endorsed by the LCBP Technical Advisory Committee.

Summer, 1995 The Plan is distributed to all those who have been involved in the project. The plan is presented to town, state and federal governments, and businesses.

The future Implementation and tracking of progress and river changes. Revisions to the plan as additonal information becomes available and as conditions change.

Appendix E

Maps of the Mad River Watershed



Keith Davidson

MAD RIVER WATERSHED

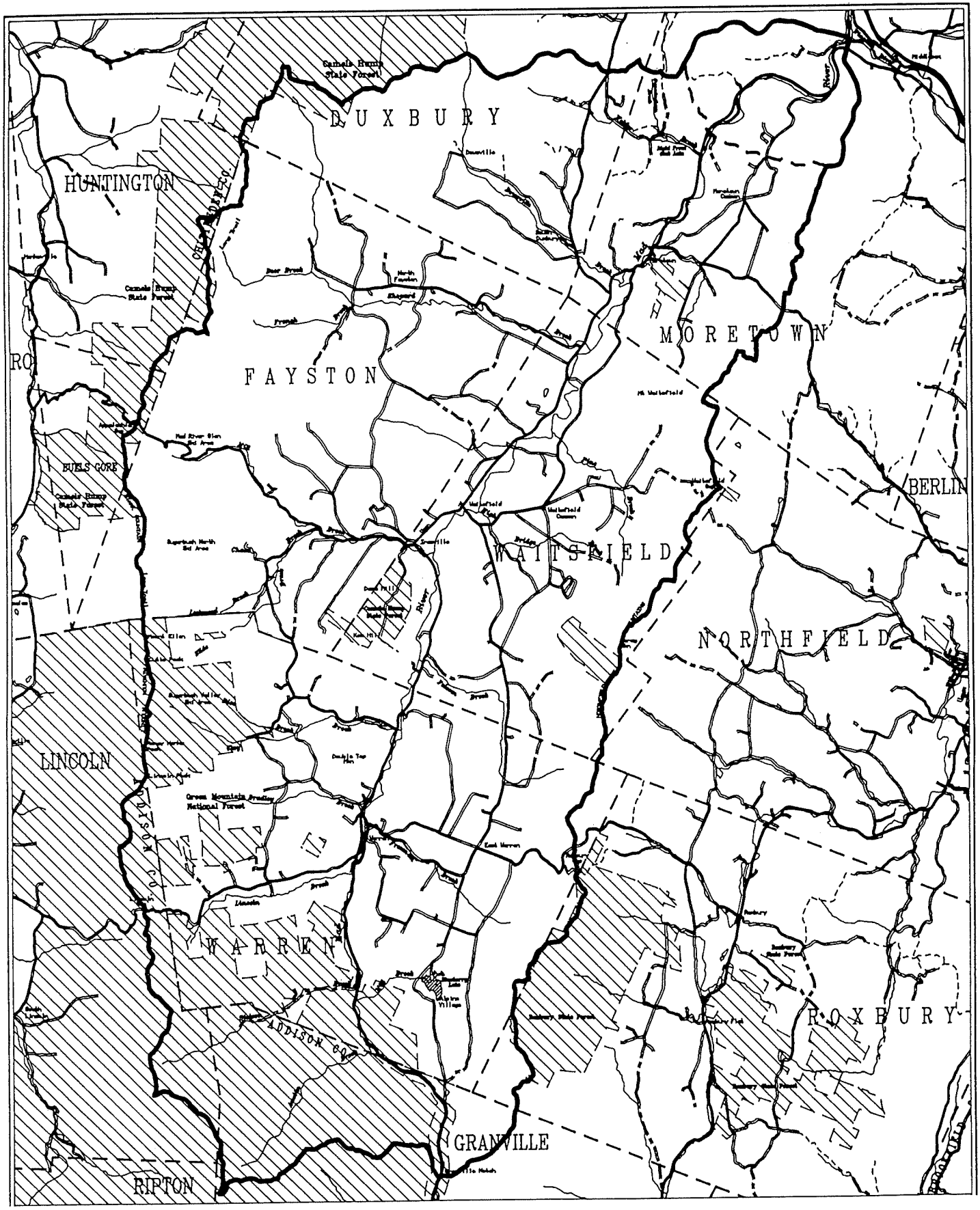
Watershed Boundary
Public Land Boundary
State Or Federal Route
Class 1 Town Highway
Class 2 Town Highway
Class 3 Town Highway
Class 4 Town Highway
Legal Trail
Town Boundary

Miles 0 1 2 3 4
Kilometers 0 1 2 3 4 5 6

GIS
VERMONT GEOGRAPHIC INFORMATION SYSTEM

SOURCE: VGIS 1:5,000 Roads, ANR GIS Public Lands, USGS Watershed Data.

JFC 03/21/9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BERLIN
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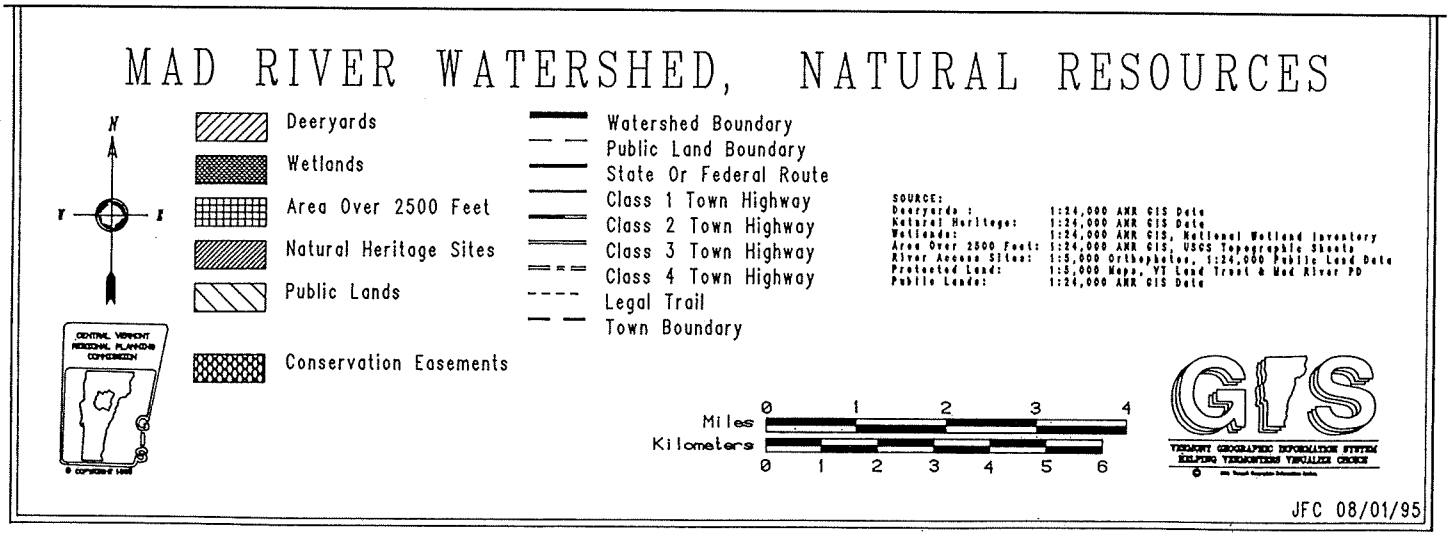
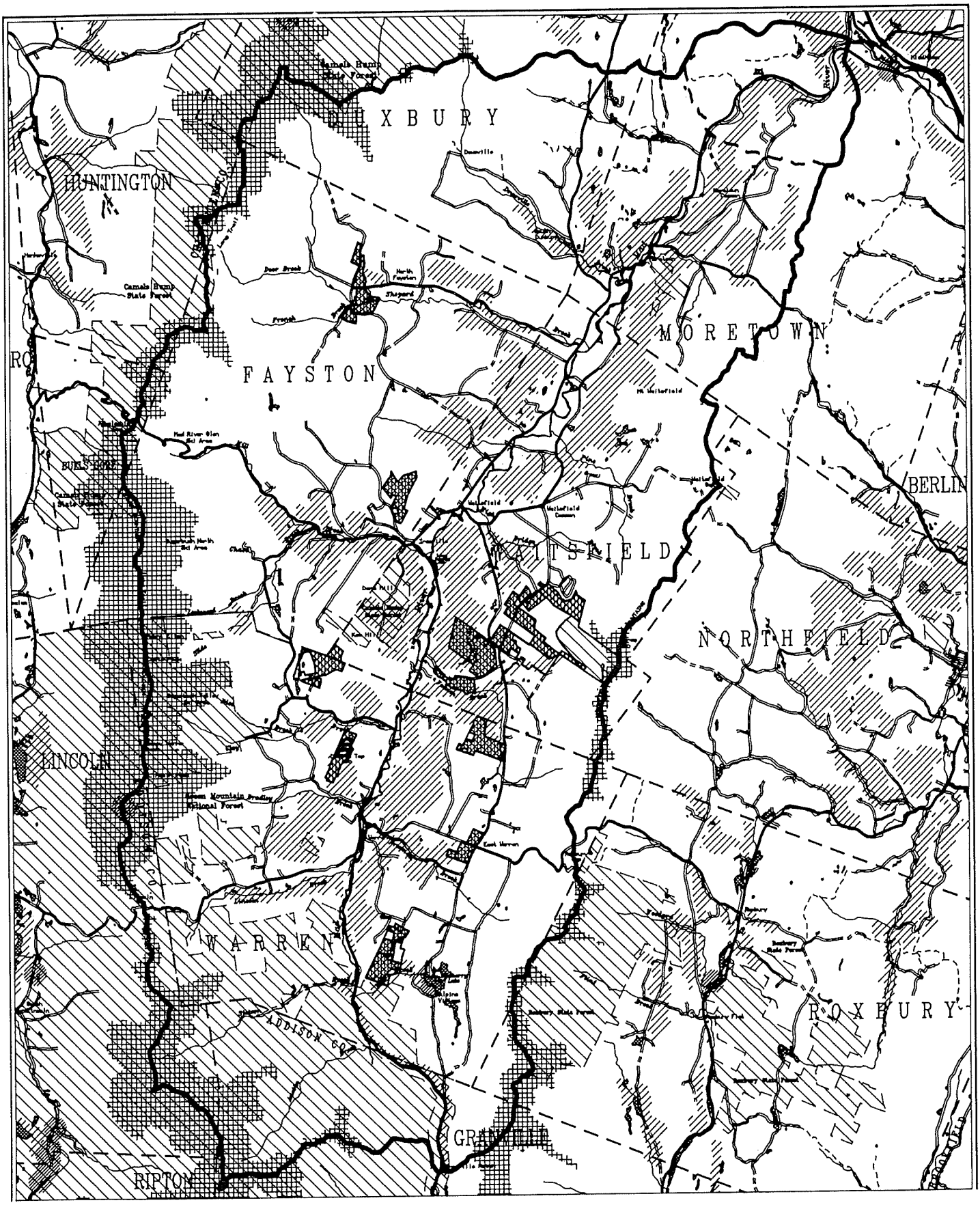
ROXBURY
GRANVILLE
RIPTON
BUELS GORE
ADDISON CO.

Maps of the Mad River Watershed—continued

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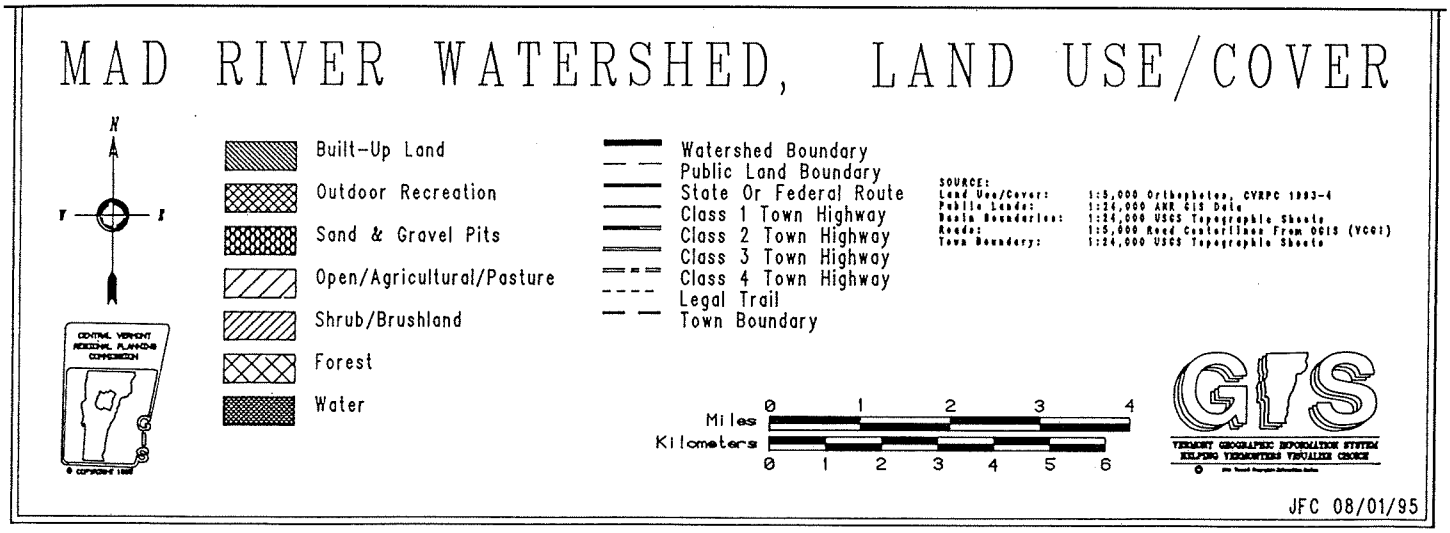
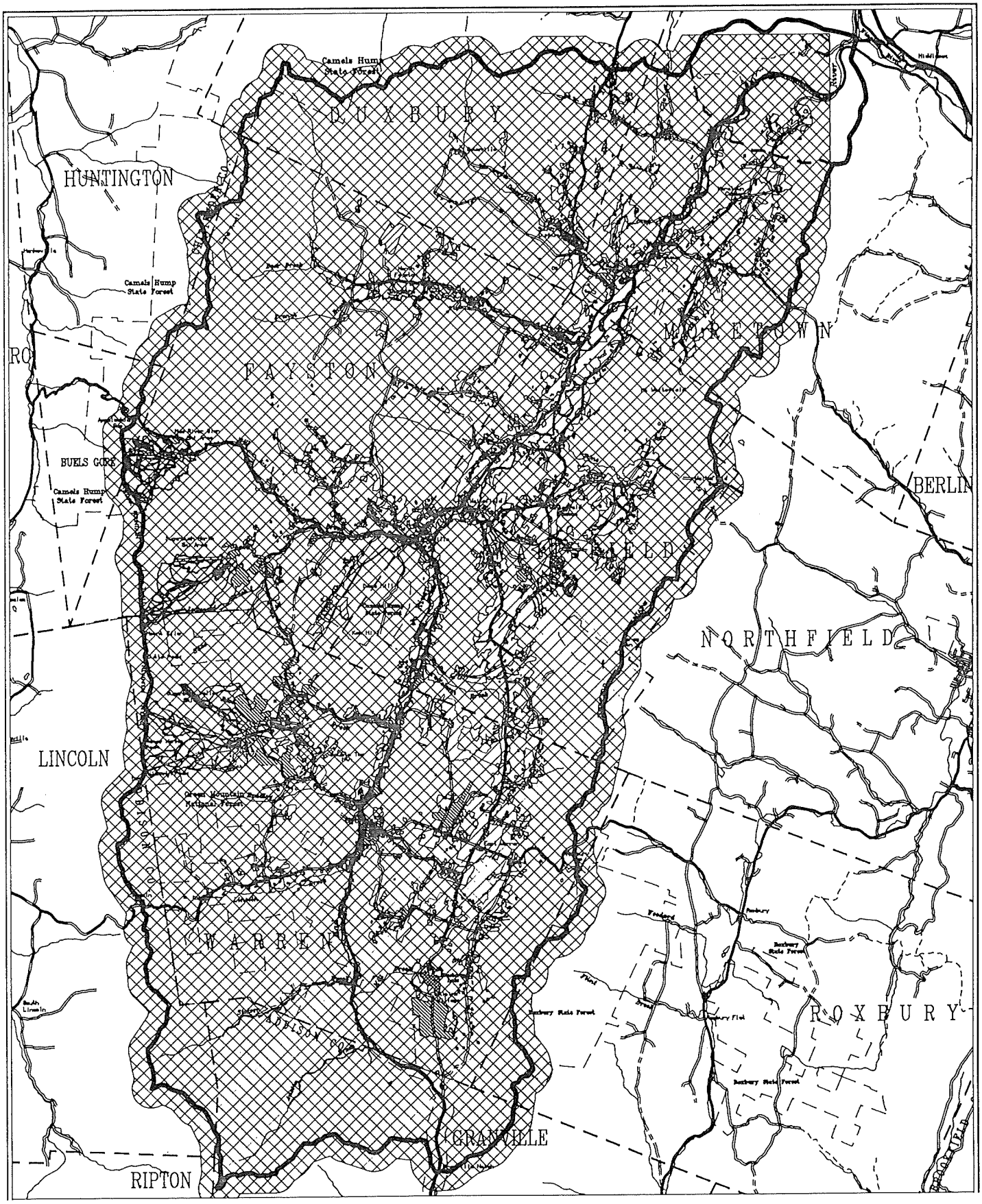
WARREN
ROXBURY
GRANVILLE
RIPTON
Camels Hump State Forest
Camels Hump State Forest
Mad River Glen Ski Area
Sugarbush North Ski Area
Green Mountain National Forest
ADDISON CO.

Maps of the Mad River Watershed—continued

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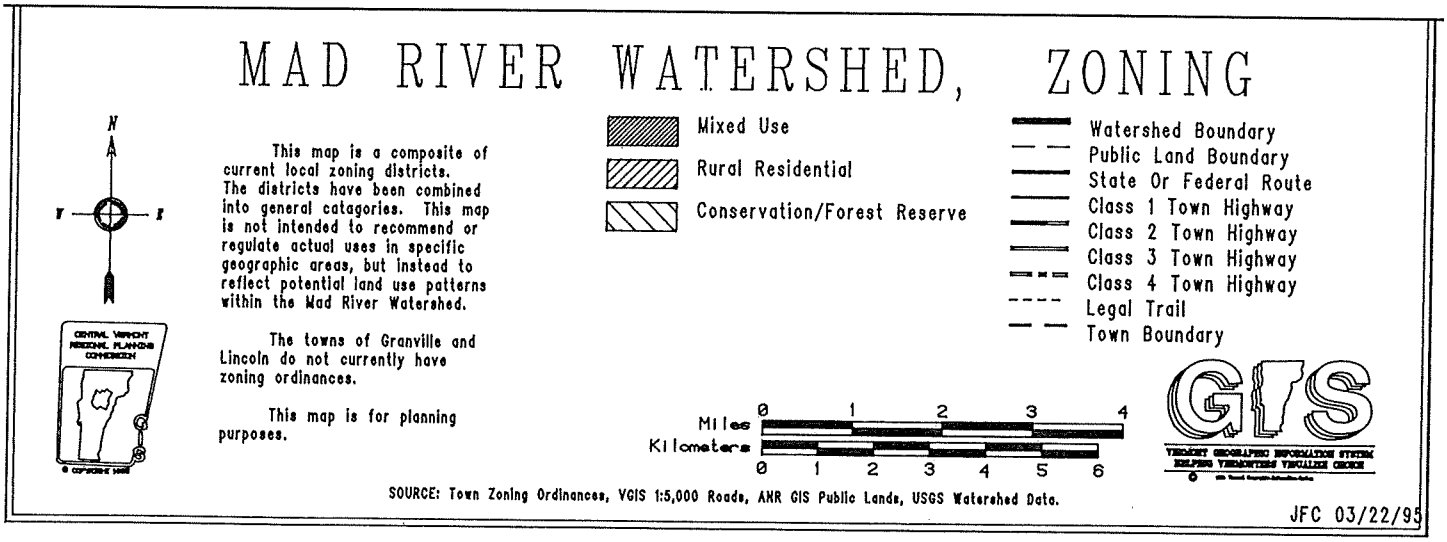
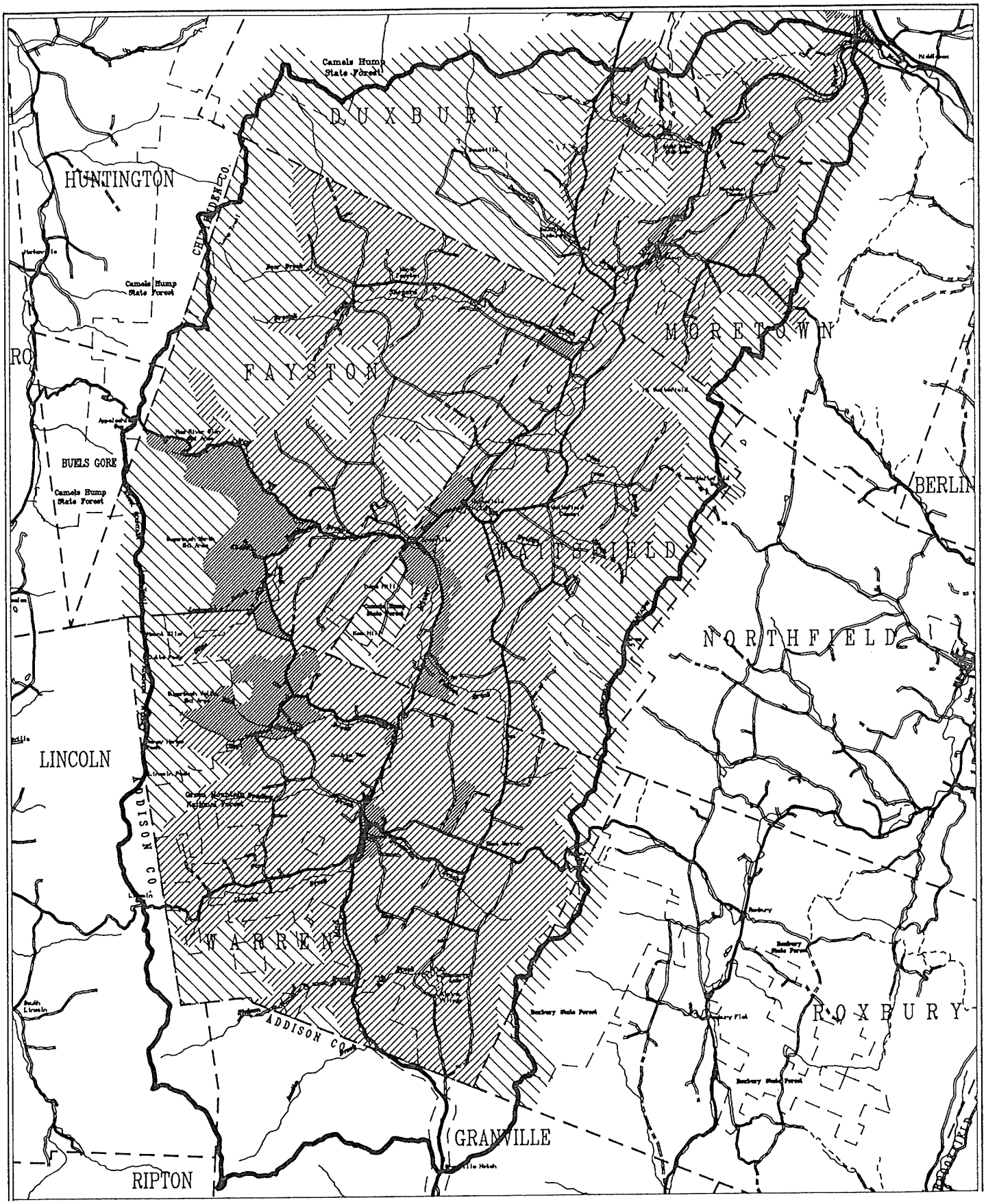
Camels Hump State Forest
BERLIN
NORTHFIELD
LINCOLN
Green Mountain Nat'l Forest
WARREN
ADDISON CO.
Roxbury State Forest
ROXBURY
GRANVILLE
RIPTON

Maps of the Mad River Watershed—continued

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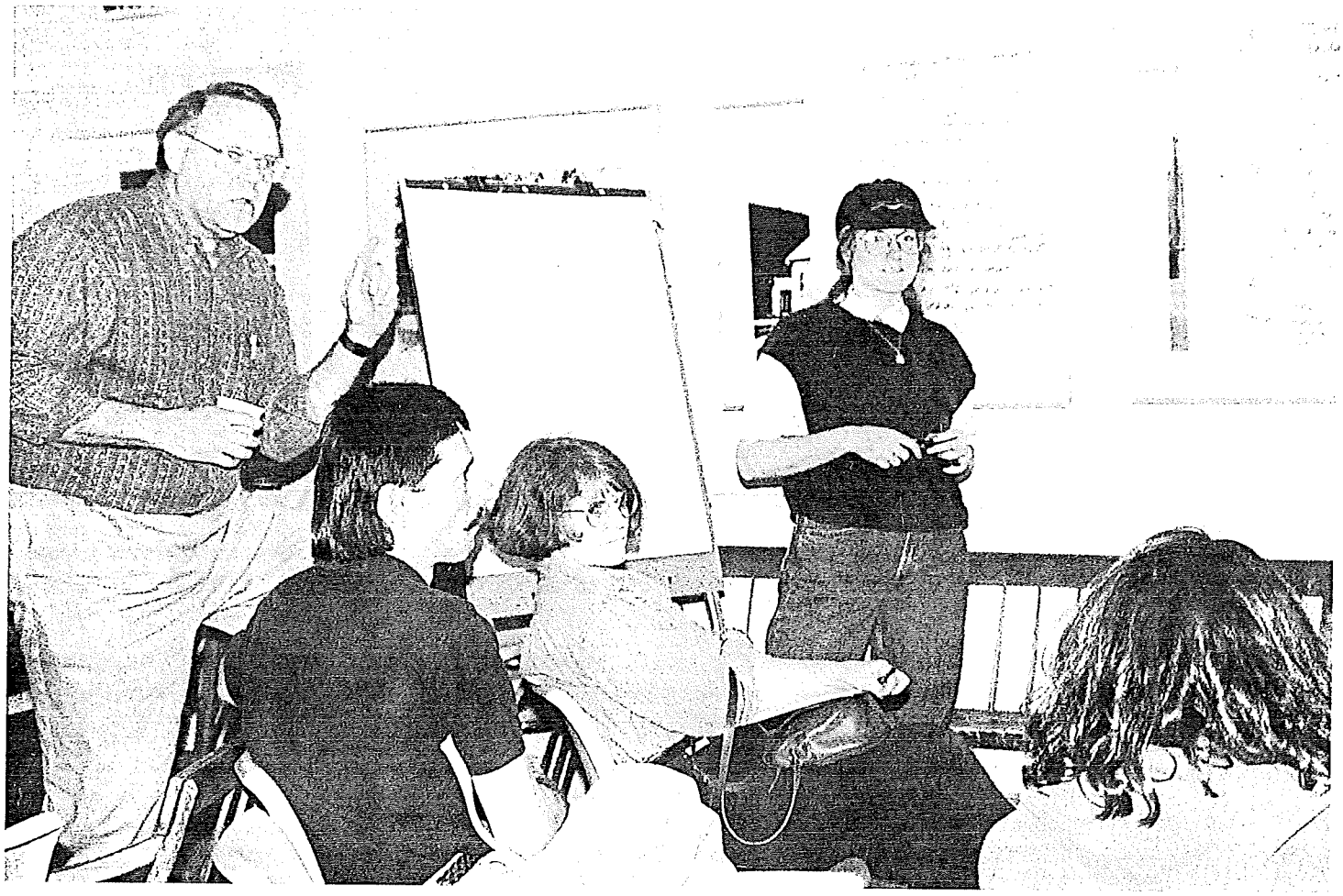
Camels Hump State Forest
MORETOWN
FAYSTON
BUELS GORE
Camels Hump State Forest
BERLIN
WAITSFIELD
NORTHFIELD
LINCOLN
ADDISON CO.
WARREN
ROXBURY
ADDISON CO.
GRANVILLE
RIPTON

Appendix F

Summary of public comments and their resolution



Ellen Strauss

Comments received at a public meeting at the Waitsfield Elementary School on December 14, 1994

The public meeting on the evening of December 14, 1994 focused primarily on obtaining public comment on the recommendations contained in the draft plan. Specifically, comments were requested on what was missed, ways to carry out the recommendations, who should carry them out, and ways to fund implementation. Five "hot" recommendations were discussed first, and then comment was opened to other recommendations.

Following is a summary of written comments received. Resolution of each comment is presented in parentheses after the comment.

Recommendation F-2—All valley towns develop a capital budget to acquire access areas and recreation easement.

1. Development of the capital budget should include an educational component to get town support and to convince people to do it. An example was given of Moretown Gorge, where the proposal for acquisition failed to get town support. There was fear that the tax rate would be hurt; there was too much information to digest in one meeting. *(Included in Recommendation F-2)*

2. Consider access to the river, safety, and town liability. See comment 39 also. *(Consideration of risk and liability added to Rec. F-3)*

Recommendation A-1—Establish a river resource center.

3. Erect an information kiosk. Reference is made to the Chamber of Commerce information booth. *(Plan already contains this suggestions, see Rec. I-4, Education.)*

4. Expand the elementary schools' gardening program to include growing river vegetation. *(Added to Rec. I-6, Education.)*

5. Order seedlings and plants from the state nursery in Essex that is closing. Order now for spring delivery. *(Good suggestion, no change in plan necessary.)*

6. Salt shed at Lareau's suggested as a location for a nursery and river resource center. *(Included in Recs. A-1 and A-4.)*

7. Find someone who will lease land for a nursery. Virginia Houston land suggested. *(Added to Rec. A-4.)*

8. A larger resource center would be a tourist attraction as well as an ecological education center and would provide opportunities for business alliances and possible funding from business. *(Good observation, no change in plan necessary.)*

10. Work with the U.S. Forest Service (U.S.F.S.) on the River Resource Center. *(U.S.F.S. and the Agency of Natural Resources (ANR) added as cooperators in Rec. A-1.)*

11. Consider conversion of a historical building for this purpose. General Wait House was suggested. *(Added to Rec. A-1.)*

Recommendation B-1—Phase out fish stocking program and divert funds to habitat protection.

12. There is a lot of red tape when transferring funds from one agency or department to another for this purpose. *(No change in plan necessary.)*

13. Stock or Protect: It's not an either or situation. The Vermont Fish and Wildlife Department has been involved with protection in regulatory proceedings (water withdrawal, gravel removal, Act 250 permits) and routinely requests buffer strips, proper culvert placement, and protection of habitat at stream crossings. Habitat protection is the highest priority of the Fish and Wildlife Department. The lower river from Waitsfield down is not wild trout habitat. If stocking is stopped we'll lose a recreational resource, and there will be fewer people fishing to support all the efforts to improve the fishery. Very little if any funds will be realized by ceasing to stock. If you want more funds for protection, go for those funds separately. High stream temperatures and poor habitat are a problem, but it is a long-term process to improve the situation. Rich Kirn, ANR, Fish and Wildlife Department comments. *(Rec. B-1 has been changed to add the*

Comments received at a public meeting at the Waitsfield Elementary School on December 14, 1994—continued

words "as such efforts prove successful." Rec. B-5 has been changed to include appropriation of funds to implement the "Mad River Watershed Fish Habitat Protection, Restoration and Enhancement Plan.")

14. The Fish and Wildlife Department has not done enhancement, which should be done so stocking is unnecessary. This should be the long-range goal. Protection is inadequate, enhancement is needed. *(See comment 13.)*

15. What is habitat enhancement? We should maintain habitat before it is broken. Examples of "broken" habitat—Clyde River Dam washed out and to be removed to restore landlocked salmon run, and culvert replacement on the White River. *(See comment 13.)*

16. There should be more education about the fishery. *(An educational component has been incorporated in Rec. A-5.)*

17. Have a catch and release on certain sections of the river. On some sections have a kids' fishery—14 years and younger, and combine this with education about the river. Freeman and Mill Brooks may already be kids' fishing brooks. *(Added to Rec. A-5.)*

Recommendation J-7—
Tax reform for sustainable forestry.

18. What is the definition of sustainable? Response by Connie Motyka, Commissioner, Department of Forests, Parks and Recreation: The Current Use Program obligates participants to use accepted silvicultural practices to maintain the resource over generations. This goal is lost because of the tight state budget. One million acres are in Current Use which is 25-35 percent of private lands in the state. The foundation of sustainability is there. *(Discussion, no change in plan is needed.)*

19. Changing tax policy is a legislative initiative—dim prospect. *(Let's hope that the 1995 legislature grapples productively with the basic tax issues!)*

20. New Hampshire tax policy is: the more you cut the higher the tax. *(Information, no change in plan needed.)*

21. Add farming to the tax reform issue also. We are seeing a system that is not sustainable. The Current Use Program is funded at only 60 percent. For sustainability we must find a reform to Use Value Appraisal. Focus on economic incentives. Keep heat on legislature to do this—Kathy Beyer comments. *(Rec. Q-8 added to include agricultural land in the legislative tax reform initiative.)*

22. Blaming shortcomings in tax policy is an easy out for American Wilderness Resources (who are responsible for the massive non-sustainable cutting). We need a "Forestry Practices Act." One is now being drafted by the Northeast Vermont Development Association. *(Already included in the plan. See Rec. J-6.)*

23. Tax the income from the land instead of having property taxes. *(Already included in the plan. See Rec. J-7.)*

24. There is an opportunity to form alliances with agro/forestry organizations to promote appropriate legislation, i.e., adjusting taxes. *(Cooperation of all parties should be a routine part of the efforts of Recs. J-6 & J-7.)*

25. The U.S. Forest Service has funds and planning expertise for rural development/community collaborative planning. The focus is to work with communities to develop sustainable use economic and natural resources plan. Kari Dolan, NWF. *(Rec. L-2 added for FoMR and MRVPD to seek funds for such effort.)*

26. A group of people is buying land to keep as a conservation area, but a great concern is local government taxing at a rate for highest and best use—in this case, 38 house lots. *(Covered. See Recs. J-6, J-7, & J-11.)*

Recommendations A-7, A-9, F-4—Start an "adopt-a-river" and "river volunteer corps" for river conservation efforts.

27. Training of volunteers is needed. What to look for. Once per year observations to establish a baseline for observing changes in the river. *(Rec. A-7 expanded to include training. See also Rec. A-9.)*

28. Apply for an "AmeriCorps team"—team of college graduates working off their tuition/loans. This may be a good source of talent. *(Included in Rec. A-7.)*

29. Encourage forest land owners to participate in the "COVERTS" program (educates owners on wildlife value of the land and forest). Neighbors are then recruited to expand the education. Thom McEvoy at UVM is contact. This principle could be used or extended to create a RIVER COVERTS. *(Included in Rec. A-7.)*

Open discussion on all recommendations.

30. Meet with town selectboards and planning commissions with requests to implement six to eight specific recommendations. *(This will be part of the process of plan implementation. See the Introduction to the plan.)*

31. Do an intensive (fish) habitat assessment reach by reach. What is missing? What is needed? This is necessary for making proposals for habitat restoration on a priority basis. *(This will necessarily be handled under Rec. B-5, development of a "Fish Habitat Plan.")*

32. Do wildlife inventories. Beavers are having a large impact on the river, and are mostly a detriment to trout. They impound water, silt is trapped behind dams, and trout habitat is lost; shading is reduced, flat water is created, and water temperatures increase. State policy on beavers is if they are a nuisance they can be "taken out." Lewis Creek is doing a wildlife inventory with biologist Sue Morse assisting. *(Wildlife inventory is covered by Rec. R-1. The "beaver problem" will necessarily be handled under other specific issues such as the "fish habitat plan," river path, and stream bank stability.)*

33. Use the carrot versus stick approach for getting failed on-site sewage systems fixed. People feel that they have inherited the problem of failed systems. *(Covered by Rec. C-8.)*

34. The State Revolving Loan Fund can be used for a community type solution for failed on-site sewage systems. Towns would apply for funds and administer them to upgrade systems. *(Included in Rec. C-8.)*

35. Some points on water withdrawal (like using water conservation) made at the October 26 public meeting were not included in the draft plan. *(Consideration of water conservation added to Rec. E-3.)*

36. Historical perspective on the gravel problem below the Warren Bobbin Mill (Dirt Road Company) to the Warren Dam: In the 1930s the river was 8 to 10 feet deep, now it is full of gravel, including the reser-

Comments received at a public meeting at the Waitsfield Elementary School on December 14, 1994—continued

voir behind the dam. There is a different set of circumstances operating in this stretch of river. Would gravel removal here be appropriate? Warren did hire an engineering firm to study the issue, and gravel removal was recommended. It was submitted to the state and was denied. *(All three recommendations under the issue of gravel removal address this comment. Monitoring, historical, and continuing observations, and complete understanding of the dynamics at work must come before action is taken in specific situations.)*

37. Recommendation # 3 under Gravel Removal is an excellent idea but habitat observations should be included with professionals (fluvial geomorphologist) working to train observers of the river. It might be good to have amateur observations of the river before the experts come in. *(The "adopt-a-river" program recommended in B-6 would provide for amateur observers before experts become involved.)*

38. Try to get funds for river observation from the Lake Champlain Basin Program. *(All possible sources of funding will be considered in the implementation phase of the plan.)*

39. What is the liability at public access points? The state and towns have insurance policies for liability (the Lareau Swim Hole is covered by Waitsfield Town insurance policy). Insurance premiums will reflect the risks involved. Have any suits been brought for the deaths at Warren Falls? Court is practical. Vermont sees very few cases. *(See comment # 2.)*

40. In trading U.S. Forest Service land for Sugarbush land, the land adjacent to the Long Trail is being considered as well as riverside property. Land does not have to be adjacent to Forest Service lands. *(No change in plan necessary.)*

41. Include the application of pesticides/herbicides as a topic. The Accepted Agricultural Practices being proposed by the Vermont Agriculture Department are inadequate in this area. Spell out the AAPs in the plan. There are better practices called "Best Management Practices" (BMPs) issued by the federal government. *(The Vermont AAPs do cover pesticide and herbicide application. The AAPs are summarized in the topic paper on farming. Adoption of more comprehensive measures, called BMPs, will follow adoption of the AAPs.)*

42. Develop and include in the plan a "recreational ethic." The Water Resources Board has scores of petitions on recreational conflicts (e.g., Batten Kill River boater versus fishers, resolved out of legal proceeding). As the river is used more, there will be more conflicts. The "ethic" should include one recreation user learning to appreciate the other. Develop a procedure to work out conflicts. *(Added to Rec. I-6.)*

43. There is a strong argument that good water resources policy is good economic policy. Recreation and tourism are enhanced by water quality benefits. It is good economic sense. Comments by Kari Dolan, New England Wildlife Resources Center, Montpelier. *(See comment # 25.)*

44. Develop a case study of economic assessment for the Mad River. (Kari Dolan will work on this with the Friends). VNRC and CLF also have projects—Ecological Resources/Preservation (hot spots) and Water Efficiency Opportunities for Municipalities, respectively. *(This may be considered for a new chapter in a future revised Mad River conservation plan. See comment # 25.)*

45. Comments on keeping people involved: Pick small, pithy subjects. Package as a crisis! Get people on the river instead of just viewing the river. Follow-up on implementation—what got where? *(These items will be part of the implementation phase of the plan.)*

46. Many statements about what state government should do are impossible for the state to do. There should be a formal plan adoption process if these things are expected. *(As part of the plan implementation process, the plan will be presented to those who have the authority to and are expected to play a role in river protection efforts outlined in the plan. Those governmental entities, organizations, and businesses will be asked to formally adopt the plan, or as much of it that they are able to adopt.)*

47. Letter from the Department of Fish and Wildlife, Rich Kirn, District Fisheries Biologist, December 8, 1994. *(The comments expressed in this letter are essentially the same as those expressed in comment 13 above.)*

48. Memo from the Forests, Parks, and Recreation Department, Ray Toolan, Forester, 12/15/94. The comments discuss the apparent inconsistency in the plan between recommendations that encourage more recreation and the overall object of the plan, which is to protect the Mad River. More activity, more "exploitation," more recreation will have an effect on the river. The point is made that all activities should be examined for compliance with "the best interests of the environment." An additional comment is that public access means handicap accessibility, and some features of public access do not readily lend themselves to handicap accessibility, such as "Port-o-lets." *(The point that increased human activity will affect the river is well taken. In response, Topic Paper L of the Plan has been revised to cover "cumulative impacts" as well as "assimilative capacity" and Rec. L-2 has been added. Handicapped accessibility must necessarily be addressed on a case-by-case basis as the issue arises.)*

49. Letter from Elizabeth Walker, 12/31/94. The comments of this letter can be summarized as follows:

- The recommendations on water withdrawals go beyond the regulatory capacity of the Agency of Natural Resources and do not take into account systems that are grandfathered, permitted, and/or operate under the public good. These recommendations would place a burden on an already understaffed state agency. Consideration should be given to putting the burden on towns and Friends of the Mad River for some of these issues. *(It is felt that Friends of the Mad River and towns do not have the authority and would not have the expertise to monitor the water withdrawals. Also, see B below.)*

- All recommendations on water withdrawal should be deleted with the exception of E-4. *(Yes, the recommendations do go beyond the present regulatory framework of the Agency, but it is felt that to gain long-term protection of the river, we must monitor to gain information to see if the decisions made, and the restrictions imposed or not imposed are in fact protecting the various beneficial uses provided by the river. Good information makes for better use and resource decisions, and choices. The agency, in reviewing these recommendations, must decide how to respond, how to allocate its scarce resources in the face of many pressing needs.)*

- Certain comments and recommendations made at the October 26 public meeting on the plan do not appear in the draft plan—for example, using water conservation measures, recycling, and reuse of water and storage ponds, and encouraging research on acceptable minimum flows. *(Included in Rec. E-3. See also comment 35.)*

50. Letter from the Agency of Natural Resources, Michael Kline, Water Resources Planner, 12/16/94. The comments of this letter are summarized below:

- Provide an overview of the vision (Appendix A) and the topic papers (Appendix B) in the text of the plan. Include more information on the assets of the river (Section III. B). *(A summary of the vision of the river is included in the Introduction. The short introductions to the recommendations serve as a summary of the topic papers. The topic papers in Appendix B can be consulted for more detailed information. As observations about the river continue and as our knowledge increases, the information on the assets of the river will be included in the plan.)*

- What authority will the plan have? *(Included in the Introduction.)*

- Have a separate section on "stream banks." *(This was considered, but because stream banks are such a large factor in "river health" this topic was included there and elsewhere, as stream banks came up in other issues.)*

Written and other comments received before January 1, 1995—continued

- Recognize and state that gravel removal is related to flooding, ice jams, fish habitat, erosion, and stream bank instability; and that other factors may affect the hydrologic equilibrium of the river and aggradation and degradation of the river channel bottom, including erosion/sedimentation, removal of riparian vegetation, and channelization. *(Included in the topic paper on gravel removal (D).)*

- Some recommendations under "River Path" seem to be working at cross-purposes. Recommendation # 1 calls for avoiding or minimizing encroachment, while Recommendation # 5 calls for stabilizing eroding banks that may threaten the path. *(Rec. H-5 has been changed to be consistent and calls for working with landowners to stabilize stream banks before the path is aligned.)*

- Consider the desirability of keeping forestry and agriculture as viable business enterprises in the valley and as alternatives to housing and commercial development, which would change all of the natural resources of the valley. *(This is mentioned briefly in the topic paper on farming and has been added to the topic paper on forestry.)*

- The application of "assimilative capacity" has been applied too broadly in the plan. It is a concept that is applied only to legally permitted discharges to the waters of the state. *(The point is well taken. This section has been changed to deal with both "assimilative capacity" and "cumulative impacts," and to include all the diverse activities that combine to affect the river in a cumulative manner.)*

- The boating section should mention that this recreational pursuit may conflict with others, such as fishing, and that there should be education on the conflicts to minimize the issue before it becomes a conflict. *(Included in Rec. N-4.)*

- Include flooding as part of river related history and education. What are and were our values and perceptions with respect to flooding, and what will they be in the future? *(Included in Rec. S-1-d.)*

- Wetlands and groundwater are not discussed in the plan, and there should be separate sections for these issues since these are the transition from uplands to the river. Otherwise they should be discussed in existing sections where appropriate. Similar comment for hydropower development, hazardous wastes, and solid wastes. *(Yes, these are not and should be addressed in any complete plan to protect the river. Future revisions to the plan will include these topics as resources and information become available to do so.)*

- Miscellaneous editorial comments. *(These have been included in the plan.)*

51. Soil Conservation Service, Bruce Chapell. NRCS comments are summarized below:

- The plan seems to give riprap a negative connotation in the summary. It is not always bad. *(Summary and Rec. Q-4 have been edited to place riprap in proper perspective.)*

- NRCS is concerned that water withdrawal not be too complicated for farmers. *(See comment 49. Good information is needed concerning all withdrawals so it can be used to make good decisions.)*

- Discuss plant nursery growing techniques with the Essex Nursery personnel. What to do and not to do. *(No change in plan needed.)*

- Concerning access to the river, Friends of the Mad River should work in conjunction with towns. *(Included in the plan, Recs. F-1 and F-7.)*

- NRCS is willing to help with time and funds to fix the Ward Access erosion problem. *(Noted in Rec. G-5.)*

- It is asking a lot for a farmer to give up 50 feet as a buffer strip between the river and a river path. Perhaps farmers should be compensated for giving up usable land in this way. *(Included in Rec. H-2.)*

- Concerning snow disposal directly to rivers, NRCS will work with towns to correct this problem. *(Included in Rec. O-4.)*

Notes

- Section IV of the plan was reorganized into subsections, each of which consolidates the numerous recommendations of the plan into solution categories for the problems and threats to the Mad River.

- Also Section V, Conclusion; and Appendix C, Watershed Association Activities and Needs, were added.

Notes

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