A FLOOD PLAIN MANAGEMENT STUDY

For the Town of Strafford, Vermont

PREPARED IN COOPERATION WITH

- Town of Strafford
- White River Natural Resources Conservation District
- Vermont Department of Environmental Conservation

FOREWORD

The Soil Conservation Service, U.S. Department of Agriculture, prepared the information in this flood plain management report. Officials of the Vermont Agency of Natural Resources and Department of Environmental Conservation, the White River Natural Resources Conservation District, and the Town of Strafford cooperated in compiling the report.

The flood hazard and land use information should serve as a technical base for flood plain management programs. State and local governments, as well as the public, will benefit from knowledge of flood information on the Ompompanoosuc River and its tributaries. A program to minimize future flood damages can be developed from this information. Describing the legal aspects and methods of conducting management programs is not within the scope of this report. However, some general recommendations are included.

We thank the many people who contributed information for the study. We also thank the landowners who gave permission for field surveys.

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FLOOD PLAIN MANAGEMENT STUDY
TOWN OF STRAFFORD
ORANGE COUNTY, VERMONT

Introduction

The Vermont Agency of Natural Resources (VT-ANR), the Town of Strafford, and the White River Natural Resources Conservation District (NRCD) coordinated in this flood plain management study and report preparation. The VT-ANR provided overall coordination for the study and assisted with the field surveys. The Town of Strafford has provided public participation, made necessary arrangements for field surveys, provided base maps, and duplicated and distributed this report. The NRCD has also cooperated in the effort.

The state and local entities requested the flood plain management study to provide detailed flood frequency characteristics and other analyses for a major portion of the flood plain system within the Town of Strafford. The town was experiencing increasing pressures for development of flood prone areas and lacked detailed flood plain information.

The U. S. Department of Agriculture, Soil Conservation Service (SCS) participated in the study and preparation of this report under the authorities of Section 6, Public Law 83-566, as amended; Executive Order 11988, Flood Plain Management, dated May 24, 1977; Recommendation 3, a Uniform National Program for Flood Plain Management, Water Resources Council, September 1979; and U. S. Department of Agriculture's Secretary's Memorandum Nos. 1606 and 1607, November 7, 1966.

The Vermont Department of Environmental Conservation, a department within the VT-ANR, is responsible for making studies, policies, and plans for the use, development, and protection of Vermont's water resources under Chapter 37, Title 10, of the Vermont Statutes Annotated.

This report provides a description of the flood plain system including its natural values, flood-frequency-stage-inundation relationships, and alternatives for flood plain management consideration.

Study Area Description

The Ompompanoosuc River Watershed is located in east central Vermont in the Connecticut River basin (Hydrologic unit number 01080103040).

It has a drainage area of more than 87,000 acres and includes parts of ten towns: Norwich, Sharon, Thetford, Strafford, West Fairlee, Fairlee, Veshire, Tunbridge, Chelsea, and Corinth. The main populated areas are West Fairlee, Post Mills, Thetford Center, Union Village, South Strafford, and Strafford with a combined population of about 3,500 people.

The headwaters of Ompompanoosuc River begin at the Piedmont Foothills of Strafford, Tunbridge, Chelsea, Veshire, Corinth, and West Fairlee and flow in an easterly direction emptying into the Connecticut River. The watershed has several lakes and ponds. They include Lake Fairlee (463 AC), Miller Pond and Lake Abenaki. The river has numerous tributaries with the principal streams being Algerine Brook, Middle Brook, Blood Brook, Barker Brook, Avery Brook, Jackson Brook, Lord Brook, Abbot Brook, Downer Brook, Old City Brook, Clover Hill Brook, and Drew Cemetery Brook.

There is a flood control structure in this watershed on the main stem of the Ompompanoosuc River, operated by the Corps of Engineers, at Union Village, known as the Union Village Dam. The flood levels in Strafford are not affected by the Union Village Dam.

This report provides detailed information on 7.5 miles of the West Branch of the Ompompanoosuc River, within the town of Strafford, Vermont. The Sheet Index Map provides locations of this studied stream reach. The drainage area of the West Branch of the Ompompanoosuc River in this study is 38.5 square miles.

The Town of Strafford is located at 43° - 52′ north latitude, 72° - 23′ longitude. It has a cool, humid climate. Average annual precipitation is 36 inches, which includes an average of 75 inches of snowfall. The mean annual temperature is 41° F with a winter minimum of -29° F and a summer maximum of 94° F.

Natural and Beneficial Values

The Vermont State water quality classification is Class B for the West Branch of the Ompompanoosuc River and all of its major tributaries. This designation implies that the waters are suitable for bathing, recreation, fish habitat, irrigation, and public water supply with filtration and disinfection. Generally, Class B waters also have good aesthetic values. Some impairment of water quality on the West Branch has been identified east of South Strafford. This degradation in water quality is apparently due to an old copper mine on Copperas Brook. No significant aquifer protection areas have been delineated in the town of Strafford.

There is local canoeing and kayaking on the river from above Strafford Village to the point where the river exits the town. This recreation occurs during spring runoff and provides intermediate white water boating for about 5.0 miles of stream.

The West Branch and Old City Brook tributary provides some high grade brook-brown trout fishing. The other tributaries also support native brook trout populations. The only open waterbody in the town is Miller Pond located in the headwaters of Abbott Brook. There are no other natural or man-made impoundments in Strafford along the West Branch or any of its tributaries. Old City Brook is also classified as an undeveloped corridor by the State.

Currently underway is an inter-agency project to restore Atlantic Salmon to the Connecticut River and its tributaries. At this time Salmon have been restored upriver to the Wilder Dam, approximately 6.5 miles below the mouth of the Ompompanoosuc River. Future plans call for additional fish ladders and other access, which would extend the fishery throughout the basin.

The West Branch Watershed is dominated by northern hardwoods, interspersed with open farmlands and small wetlands. This mixture of vegetation provides habitat for deer, moose, bear, songbirds, furbearing mammals, and waterfowl. There are approximately 5.25 mi. of high quality deer yards located along the West Branch. The State of Vermont owns and manages two Wildlife Management Areas (Kibling Hill and Clover Hill) in the headwaters of the West Branch.

The Old City Falls and Ravine is a locally renowned geologic feature and is recognized on Vermont State lists of special geologic features.

Based upon topographic features and knowledge of prehistoric man's habitat, the West Branch watershed is not expected to contain significant archaeological sites. In addition, no prehistoric sites are currently known to exist in the watershed.

Four historic resources are on the national or state registers. Strafford Village, South Strafford Village, the Smith Farm, and the Dublin Farm are Historic Districts located along the West Branch and Old City Brook.

Factors Affecting Flooding

Obstructions to floodflows can have a tremendous impact on flood elevations. Obstructions can be either natural or man-made. Natural obstructions that impede floodflows may be sharp bends in stream alignment, channel constrictions due to topography of adjacent terrain, shoaling, rock outcrops in the stream or on the flood plain, ice jams, and vegetation such as grass, brush or trees. As floodflow is impeded, the velocity of the water decreases and the depth of flow increases; this results in flooding along streams. Man-made obstructions include bridges, culverts, dams, docks, levees, and earthfills. These man-made obstructions may severely hamper flow and cause a backwater condition, which creates more flooding than what would normally occur with only natural obstructions present.

During floods, trees, brush, and other debris may be washed downstream to collect on bridges and other obstructions to flow. This is often referred to as a "log jam". As the floodflow increases, masses of debris break loose and a wall of water and debris surges downstream until another obstruction is encountered. Debris may collect against a bridge until the load exceeds its structural strength and causes the bridge to fail.

The limited capacity of obstructed bridges, debris plugs at bridge waterway openings, or a combination of these factors cause flooding upstream and erosion around bridge approach embankments. This erosion can cause damage to the overlying roadbed. In general, obstructions restrict floodflows and result in overbank flows. Unpredictable areas of flooding, destruction of or damage to bridges, and an increased velocity of flow immediately downstream can also occur from obstructed bridges.

It is impossible to predict the degree or location of debris accumulation. Therefore, in the development of flood profiles for this report, it was necessary to neglect the possibility of log-jams and the possiblity of debris to block bridges or culverts.

Flood Problems

The Town of Strafford has experienced severe flooding this century during November 1927, March 1936, September 1938, June 1973, and August 1976. The Town experienced major streambank and property damage during these floods.

Within the study area approximately eight residential structures would experience flooding in the 100 year storm event. Most of the damage would be restricted to basement flooding.

In general the residences that would be exposed to flooding at the 100 year frequency would experience relatively minor damage. Flooding would generally be confined to the basement, with some shallow depths expected on the first floor of several homes. Precise dollar damages would be difficult to quantify without close examination of the properties threatened. Table 1 provides a further description of the flood hazard.

Although the existing flood damage potential is not great, the Town of Strafford is experiencing development pressures from the nearby Hanover-Lebanon region. The flood plain needs to be properly managed to avoid high flood damage potential in the future.

Depths of flow in the West Branch of the Ompompanoosuc River range from 3.3 feet at section T1 to 13.6 feet at section WB28 with velocities of about 1.5 fps at section WB28 to 11.8 fps at section WB41.

Figures 1 through 4 show the water surface level of the 100 and 500-year flood at selected localities.

Table 1 Characteristics of Potential Flood Damages
Town of Strafford, Vermont

Stream	Type of Land Use	Acres by Flood Frequency 100-Year	500-Year
			(Additional Acres)
West Branch Ompompanoosuc River	Open	253	8
	Woodland	26	0
	Residential and Structural	5	2
	Total	284	10

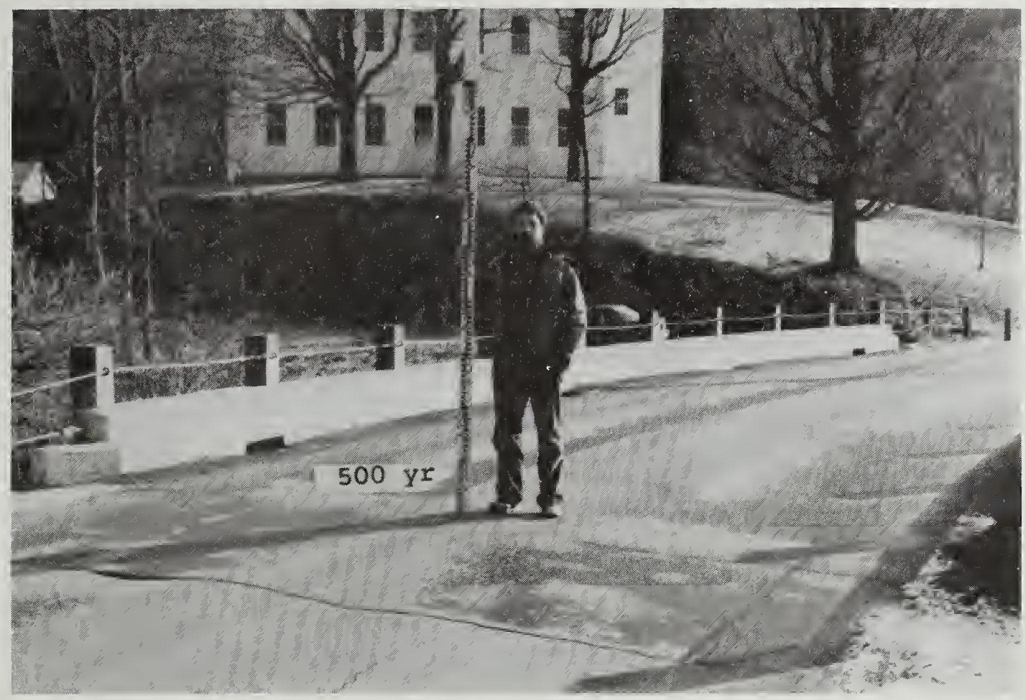


Figure 1. Bridge in Strafford over the West Branch of the Ompompanoosuc River at section WB14

Figure 2. Bridge in Strafford over the West Branch of the Ompompanoosuc River at section WB17

Figure 3. On Rt. 132 in Strafford near Huntington Farms at section WB24

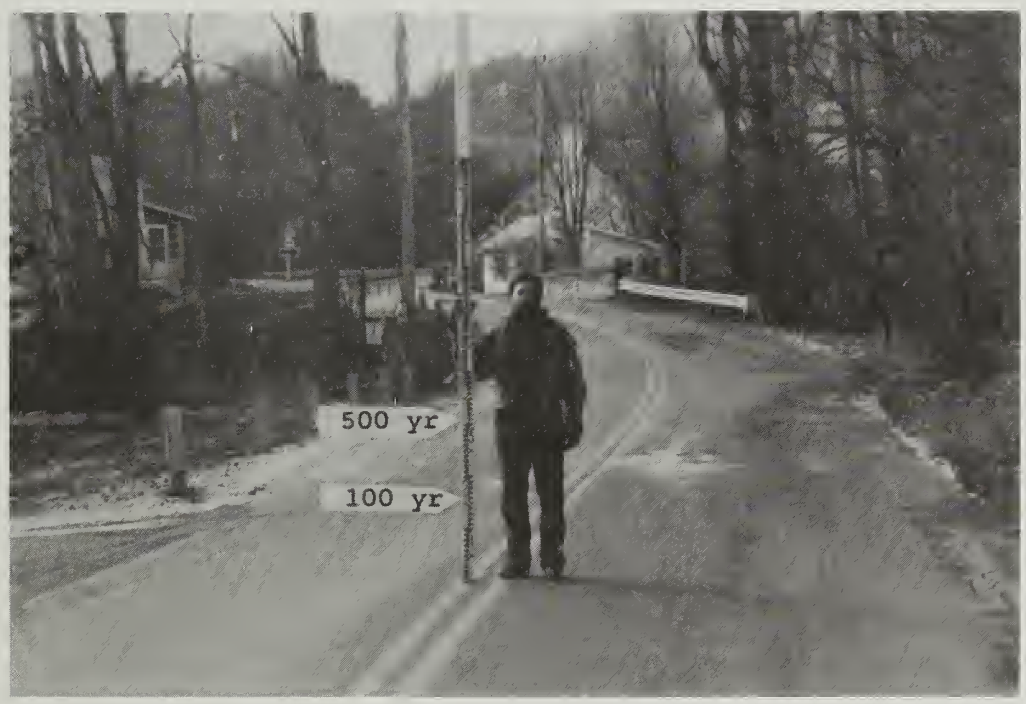


Figure 4. On Rt. 132 in South Strafford near Corburn's Store at section WB32

Existing Flood Plain Management

In Vermont, municipalities have the authority to regulate development in flood hazard areas under Title 24 VSA chapter 91. Title 10 VSA chapter 32 authorizes the Secretary of the Agency of Natural Resources to designate flood hazard areas and to assist the towns with flood hazard regulations. Title 25 VSA subsection 4409 requires towns to submit a report to Environmental Conservation before issuing a permit for development in a designated flood hazard area.

Several other Laws and regulations administered by the state contain special requirements for development in flood hazard areas. Some of these are:

Act 250 (10 VSA chapter 151) administered by the Environmental Board and District Environmental Commissions;

Health Regulations administered by the Protection Division of the Agency of Natural Resources;

Storage of Flammable Liquids (20 VSA section 2721) administered by the State Fire Marshal;

Stream Alteration (10 VSA chapter 28) administered by the Department of Environmental Conservation;

Dam Construction (10 VSA chapter 29) administered by the Department of Environmental Conservation.

Alternatives for Flood Plain Management

Present Condition

Allowing the current flooding situation to continue is a possibility although undesirable alternative. Essentially the flood damages enumerated in Table 1 would continue. Lack of control over development in the flood plain could result in further encroachment by development with the accompanying increases in flood damages.

Land Treatment

Inclusion of conservation practices for erosion and runoff control in new developments and building areas would help to assure protection against induced flooding from this source. Control of erosion and sedimentation, to protect stream capacities is an important consideration.

Nonstructural Measures

Floodproofing of buildings and other high value property in the flood plain is a particularly appropriate measure for reducing losses to individual properties. A flood warning system or plan would be of limited value as a nonstructural measure because the time to respond with emergency protection activities is only a matter of a few hours. Relocation of some residences and buildings or acquisition to eliminate risks may be appropriate in some instances. The Town of Strafford plans to adopt formal flood plain regulations which will be very helpful in assuring development in the future will not sustain frequent, severe flood losses. The national flood insurance program has made affordable flood insurance available to flood-prone property owners through private underwriters. Owners of existing flood prone property should consider flood insurance as a means of reducing their flood loss risk. Other nonstructural approaches such as emergency preparedness and building or development codes should be considered.

Structural Measures

There appears to be little opportunity for modifying floods through headwater impoundments (dams) or channel enlargement.

Combinations of Alternatives

Several of the above alternatives could be combined in a number of ways to provide a plan to address the flooding problem.

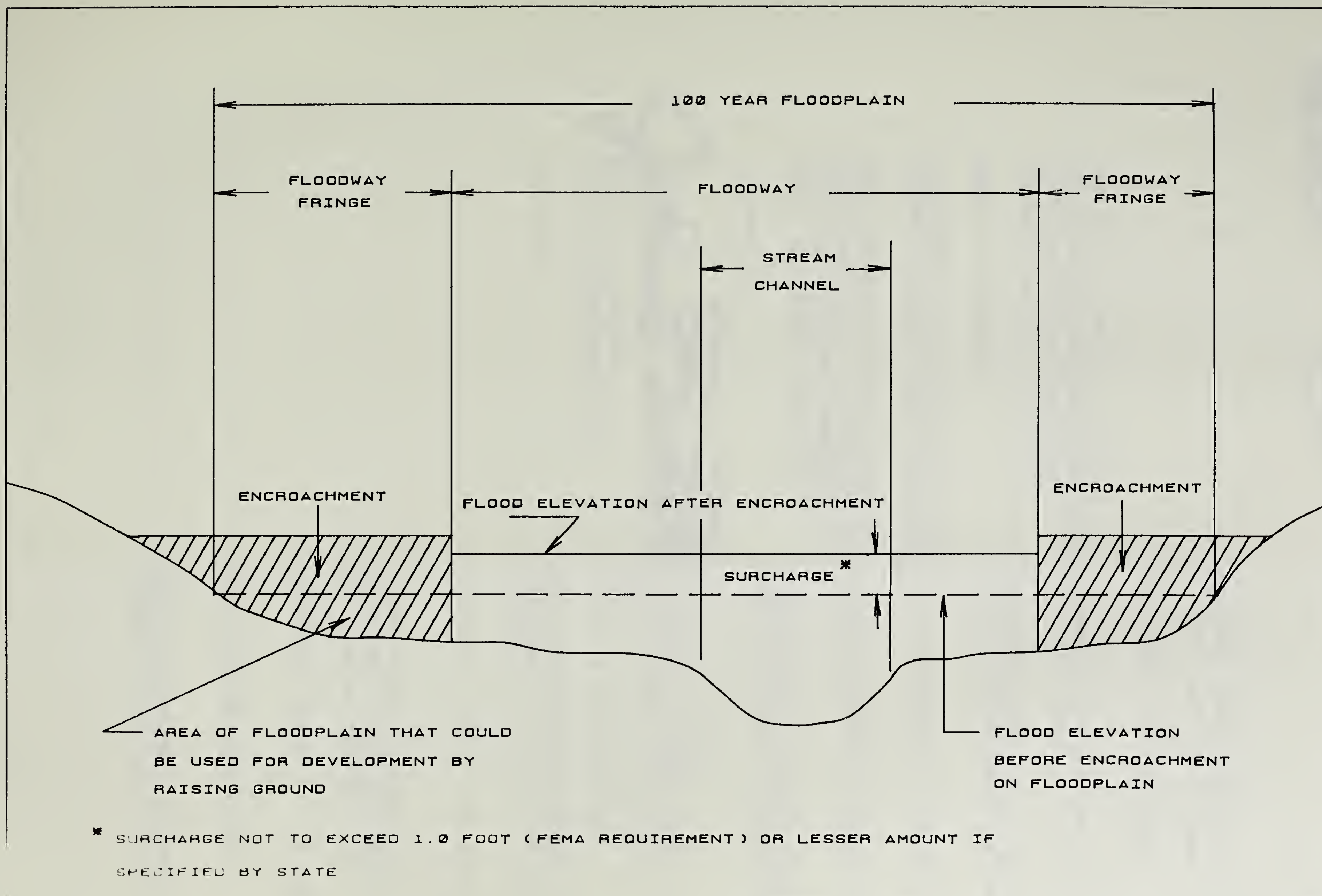
Floodway Determination

Any development activity that raises the elevation of the flood plain will restrict flow and increase flood heights. Communities have found benefits from allowing carefully controlled development to occur in the flood plain fringe provided resulting increases in flood hazard can be tolerated. The National Flood Insurance Administration uses the concept of floodway as an aid in evaluating such situations. This concept partitions the 100-year flood area into a floodway and a floodway fringe. The floodway fringe is the portion of the flood plain that can be completely obstructed without increasing the water-surface elevation of the 100-year flood more than one foot at any point. The floodway is the remaining portion of the channel and the flood plain (See Figure 5).

Flood Hazard Maps

The photomaps entitled "Flood Hazard Areas" (sheets 1 through 6 in Appendix A) show the 100-year and 500-year flood areas. These areas are depicted based on present land use and management conditions. The flood boundaries show the approximate location on the ground for general reference purposes. The 500-year flood boundary is to be interpreted as being close to the 100-year flood boundary where it is not separately mapped. The reason for this is that the valley side slopes along many reaches of stream are steep and the map scale small. This yields a 500-year boundary which is nearly contiguous with the 100-year boundary. Along such reaches it is therefore not mapped.

Flood boundaries were taken from the profiles and <u>may</u> not be mapped as accurately as the profiles themselves. For this reason it is recommended that you locate the property of interest on the profiles and establish the flood boundary (for desired frequency) on the property by field survey. Appendix A provides a tabulation of elevation reference marks that can be used in connection with this activity.



FLOODWAY SCHEMATIC

Figure 5

United States
Department of
Agriculture

Soil
Conservation
Service

Vermont SCS State Office
69 Union Street
Winooski, Vermont 05404

February 28, 1991

Joseph H. Howard, Director
National Agricultural Library
10301 Baltimore Boulevard
Bettsville, MD 20705-2351

Dear Mr. Howard:

Enclosed is a copy of the final Flood Plain Management Study Report for the Town of Strafford, Vermont.

This report has been prepared by the Soil Conservation Service under section 6 of Public Law 83-566, et al and in cooperation with the Vermont Department of Environmental Conservation, the Town, and local sponsors.

Sincerely,

John C. Titchner

John C. Titchner
State Conservationist

Enclosure

Glossary of Terms

backwater. High water caused by downstream obstruction or restriction, or by high stage on an intersecting stream.

BM. Benchmark of established elevation used for vertical reference.

bottom of culvert. Elevation of the lowest flow surface of a culvert (or pipe) through which flood flows pass.

cfs. Cubic feet per second - a unit of discharge that is equal to the flow of one cubic foot per second past a given point.

cross section. Shape and dimensions of a channel and valley perpendicular to the line of flow.

elev.-bridge deck. Elevation of a roadway across a bridge or culvert.

elev.-low chord. Elevation of lowest structural "beam" that limits the height of the bridge opening; or may indicate the top of a culvert opening.

elev.-low road. Elevation of low point on a roadway approaching or crossing a bridge or culvert - shown only if lower than elev.-bridge deck at a particular road section.

fps. Feet per second - units of velocity of stream flow.

flood. An overflow of lands not normally covered by water; a temporary increase in streamflow or stage; or the discharge causing the overflow or temporary increase.

flood frequency. An expression of how often a flood of given magnitude can be expected.
Examples:
10-year frequency flood. The flood which can be expected or exceeded on an average once in 10 years; or which would have a 10 percent chance of being equaled or exceeded in any given year.
100-year frequency flood. ....one percent chance....in any given year.

flood peak or peak discharge. Highest discharge attained during a flood.

flood plain or flood-hazard area. Lands adjoining a stream (or other body of water) which has been or may be covered with water.

flood profile or profile. A plotted or imaginary line defining the highest water surface elevations along a stream during a particular flood.

flood-hazard area. See flood plain.

flood routing. Computation of the changes in the rise and fall in streamflow as a flood moves downstream. The results provide hydrographs of discharge versus time at given points on the stream.

floodway. The portion of the stream channel and flood plain that must be kept free of encroachment to prevent flood stages from rising more than 1 foot higher than natural conditions.

frequency-discharge curve. A plotted line showing the recurrence interval (or flood frequency) of discharges at a stream gage, surveyed cross section, or other station along stream. (Used with a stage-discharge curve to determine the high water elevations resulting from selected flood discharges at that station on the stream.)

hydrograph. A curve showing the rise and fall of flood discharge with respect to time at a specific station on the stream.

land use. Classification of type of vegetation or other surface cover conditions on a watershed - used (with a similar classification of soils) to indicate the rate and volume of flood runoff.

NGVD. National Geodetic Vertical Datum, the normal standard of elevation reference.

peak discharge or flood peak. The highest rate of runoff (discharge) attained during a flood.

profile. See flood profile.

runoff. That portion of the total storm rainfall flowing across the ground or other surface and contributing to the flood discharge.

stage-discharge curve. A plotted curve showing elevations resulting from a range of discharges at a surveyed cross section, stream gage, or other point on a stream.

top of culvert. Elevation of the uppermost flow surface of a culvert (or pipe) through which flood flows pass.

TBM. Temporary benchmark used for vertical reference.

watershed. A drainage area which collects and transmits runoff to the outlet of the drainage basin.

REFERENCES CITED

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2. Water Resources Data for New Hampshire and Vermont, Water Year 1977, Report No. NH-VT-77-1, U.S. Geological Survey, Boston, MA; August 1978.

3. A Unified National Program for Flood Plain Management, U.S. Water Resources Council, Washington, D.C., September 1979.

4. Regulation of Flood Hazard Areas to Reduce Flood Losses, (two volumes), U.S. Water Resources Council, Washington, D.C., 1971 and 1972.

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6. Guide for Flood and Flash Flood Preparedness Planning, U.S. Department of Commerce, National Weather Service, Silver Spring, MD, February 1977.

7. Flood Flow Frequency, Bulletin 17B, U.S. Water Resources Council, Washington, D.C., September 1981.

8. Computer Program for Project Formulation, Hydrology, Soil Conservation Service Technical Release No. 20, May 1983.

9. WSP2 Computer Program, Soil Conservation Service Technical Release No. 61, May 1976.

10. Floodway Determination Computer Program, Soil Conservation Service Technical Release No. 64, June 1978.

11. National Engineering Handbook, Section 4, Hydrology; U.S. Department of Agriculture, Soil Conservation Service; Washington, D.C.; November 1954, Revised August 1980.

12. Vermont Agency of Environmental Conservation. 1986, Vermont River Study, Waterbury, VT.

13. Vermont Fish and Game Department. 1962 Vermont Stream Survey. Montpelier, VT.

14. Flood Plain Information, Corps of Engineers.

APPENDIX A

USE OF APPENDIX

This appendix provides the data needed to use this report. Included in this appendix are:

<u>Flood Plain area Photomaps</u>

The Flood Plain Area Photomaps can be used for decisions where precise elevations are not required; for example, a brief check of the appropriate photomap may indicate that a proposed building site is obviously in or out of the flood plain.

<u>Flood Profiles</u>

On the reverse of each photomap are flood profiles, water surface elevation tabulations. These can be used with the photomaps to determine flood elevations at any point along the streams in the study area as follows:

1. On the appropriate photomap find the point on the stream where the proposed building is to be located; then scale the distance along the stream to the nearest cross section.

2. On the appropriate flood profile sheet, scale the distance determined in Step 1 from the cross section back to the original stream location, and read the elevation of the desired flood frequency line.

3. Transfer the elevation determined in Step 2 to the ground from the nearest established benchmark.

   If the point on the ground is at one of the surveyed cross sections, the elevation can be read directly from the tabulation of water surface elevations.

<u>Investigation and Analysis</u>

Investigations conducted and analysis used are described.

<u>Safety and Protection</u>

Steps that can be taken by individuals during a flood are discussed.

<u>Tabulated Data</u>

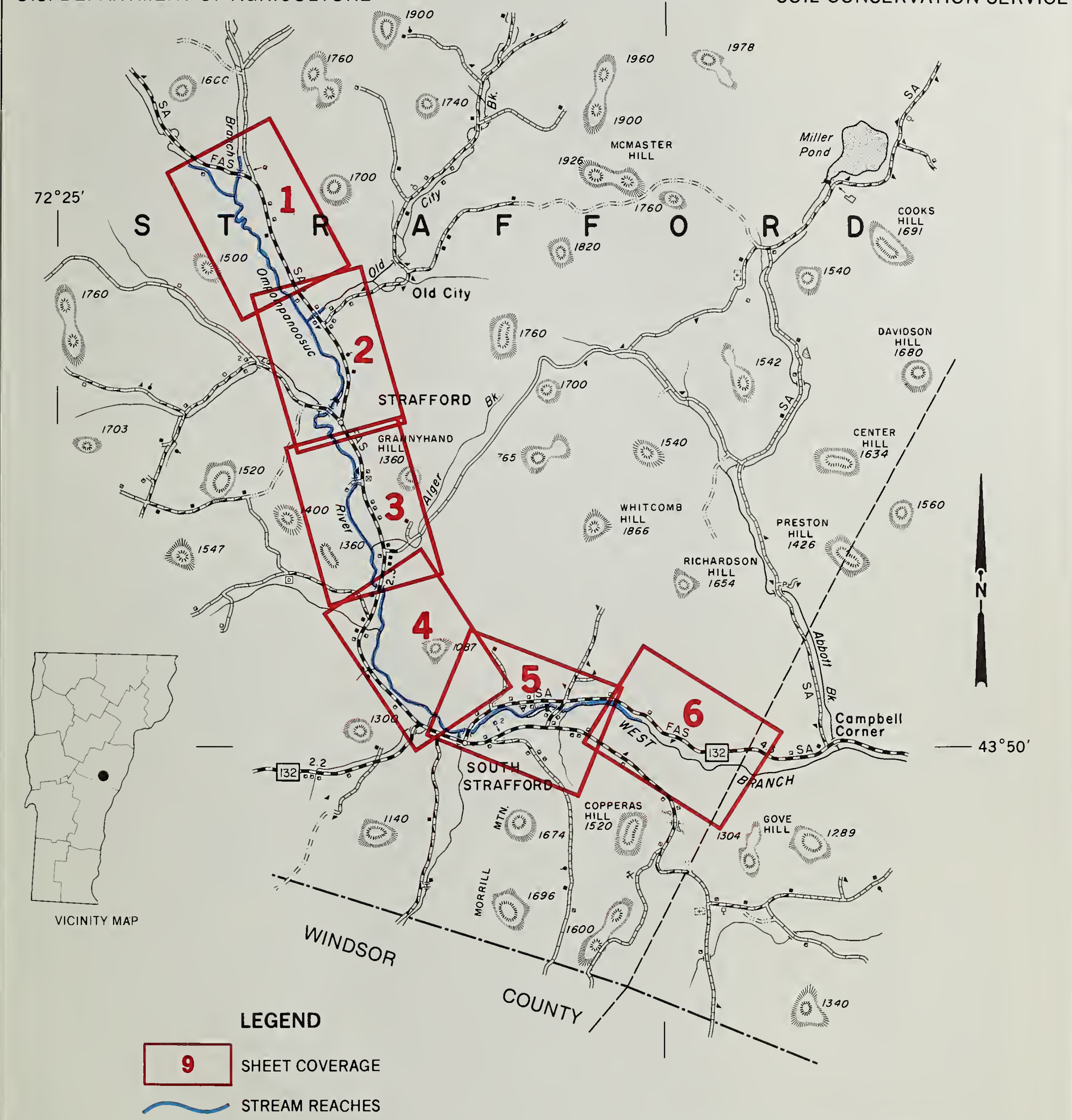
Tabulated elevations and discharges for each cross section of the 10, 50, 100, and 500 year storms.

<u>Benchmark Data</u>

Description and elevation of reference marks used in the study.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



SHEET INDEX MAP

FOR THE

STRAFFORD FLOOD PLAIN MANAGEMENT STUDY

WEST BRANCH OMPOMPANOOSUC RIVER

ORANGE COUNTY, VERMONT

0 1 2 MILES

0 1 2 3 KILOMETERS

BASE SOURCE:
ORANGE COUNTY GENERAL HIGHWAY MAP
PREPARED BY THE DEPARTMENT OF HIGHWAYS,
HIGHWAY PLANNING DIVISION, VERMONT.
POLYCONIC MAP PROJECTION BASED ON
U.S. GEOLOGICAL SURVEY MAPS.

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1991

MAY 1988 1003566-01

100 YEAR FLOOD AREA	STREAM CHANNEL	SCALE 0 500 1000 FEET
500 YEAR FLOOD AREA	× RM 20 BENCH MARK	0 100 200 300 METERS APPROXIMATE
WB 7 SURVEYED CROSS SECTION	Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.	SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC.

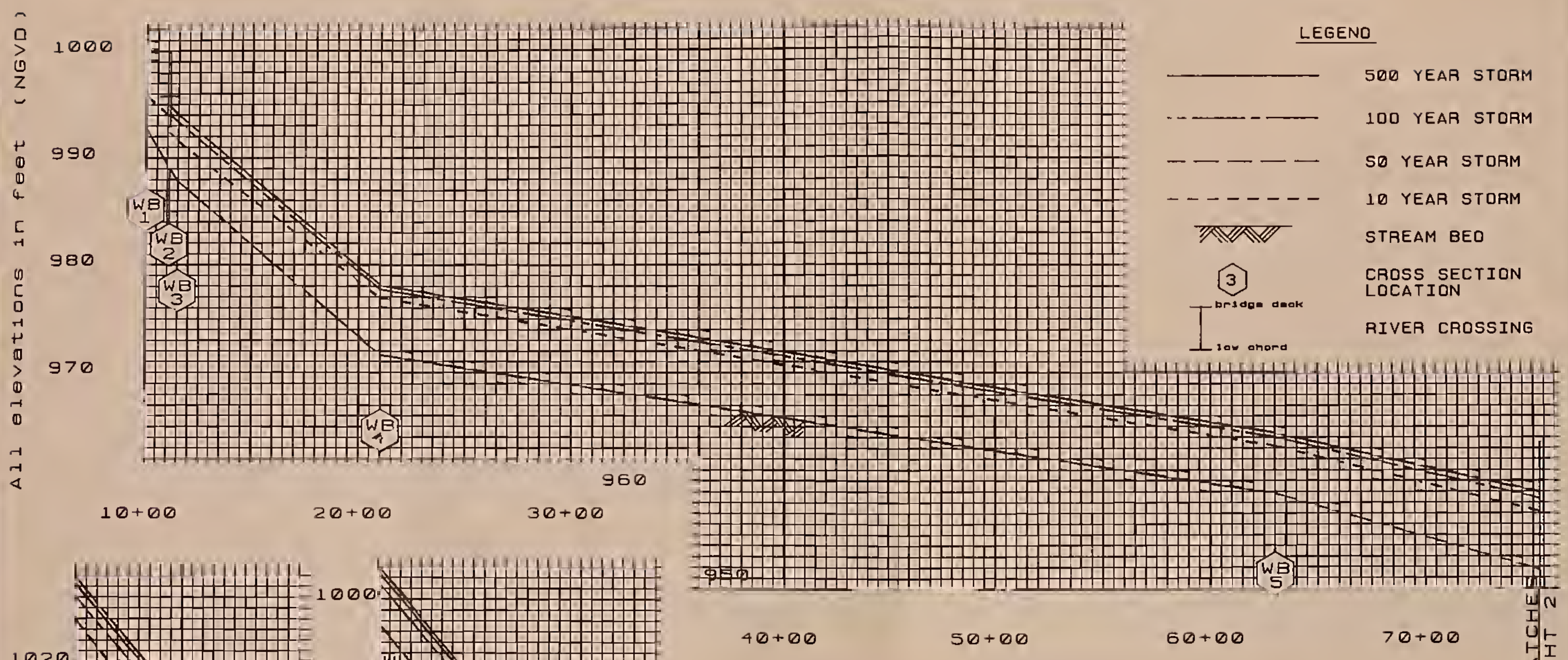
SHEET 1 OF 6

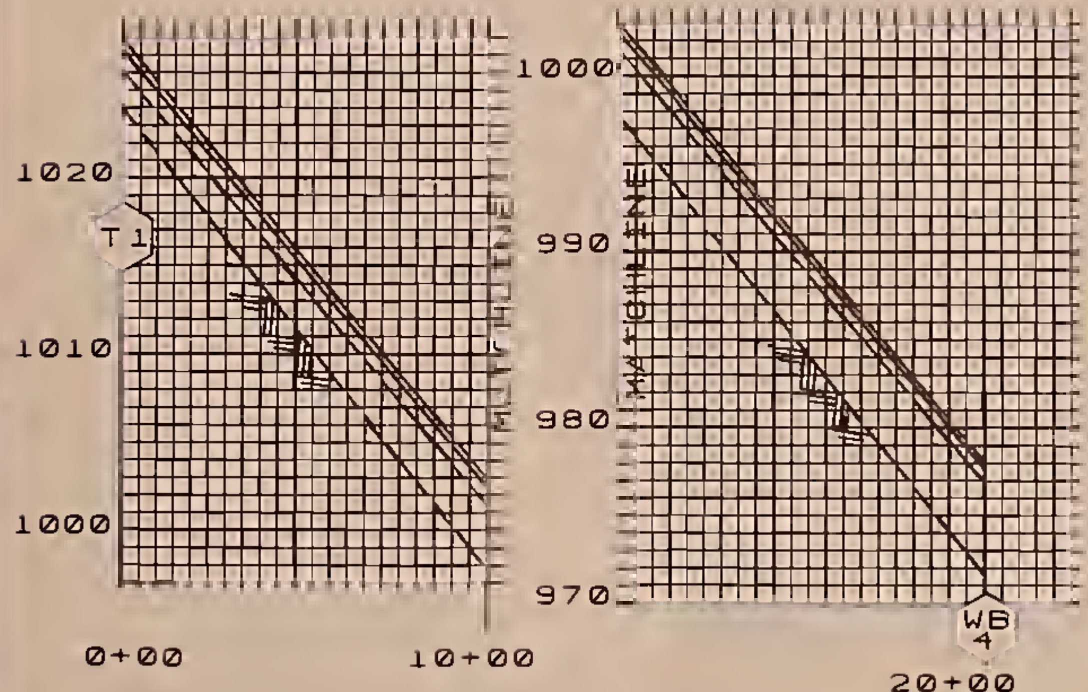
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STRAFFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

WEST BRANCH OMPOMPANOOSUC RIVER

West Branch Ompompanoosuc River





Tunbridge Branch

FLOOD PROFILES

OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
— STRAFFORD —
FLOOD PLAIN MANAGMENT STUDY
ORANGE COUNTY, VERMONT

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

WB 1 SURVEYED CROSS SECTION

STREAM CHANNEL

RM 19 BENCH MARK

Note. Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

SCALE 0 500 1000 FEET

0 100 200 300 METERS

APPROXIMATE

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC.

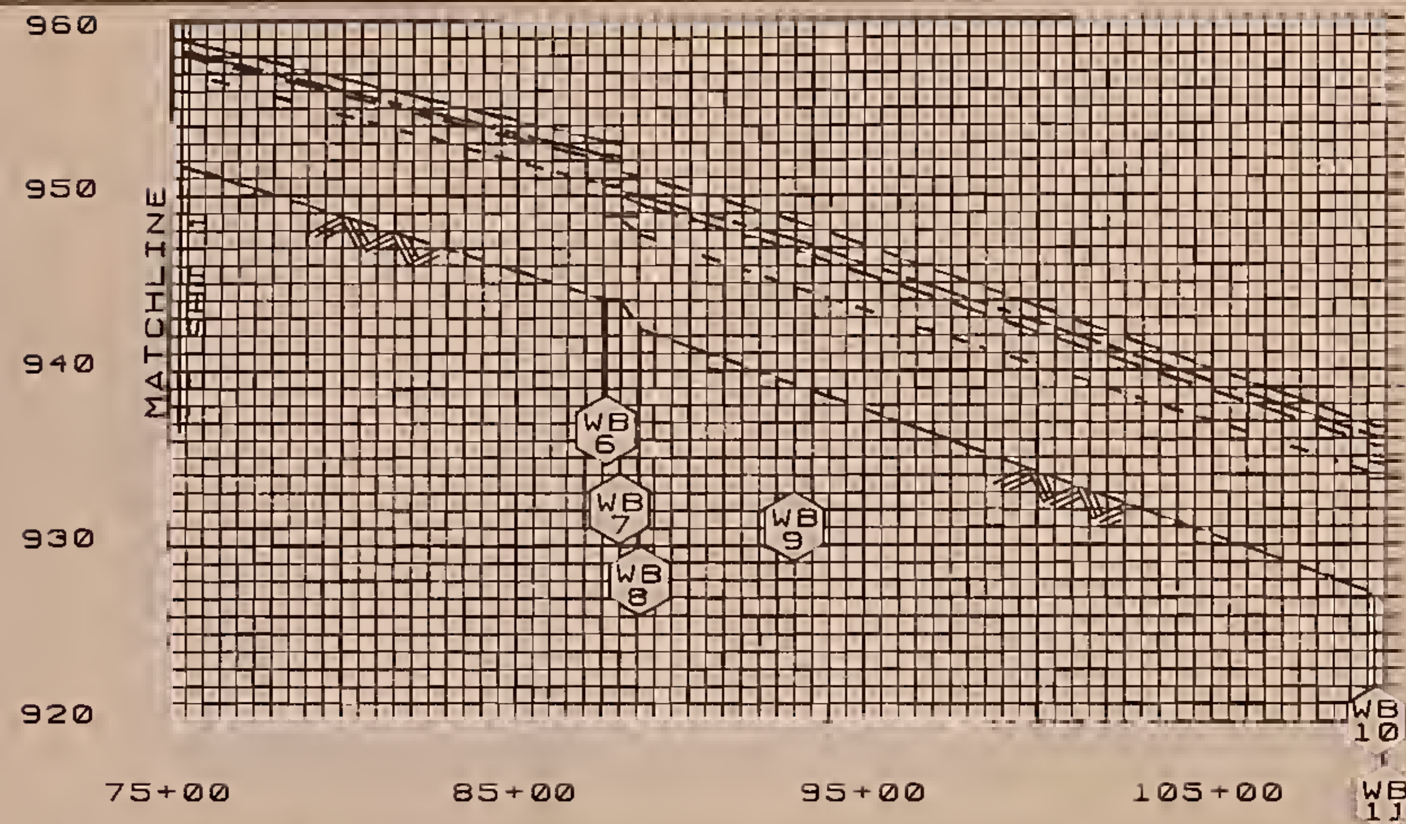
SHEET 2 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STRAFFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

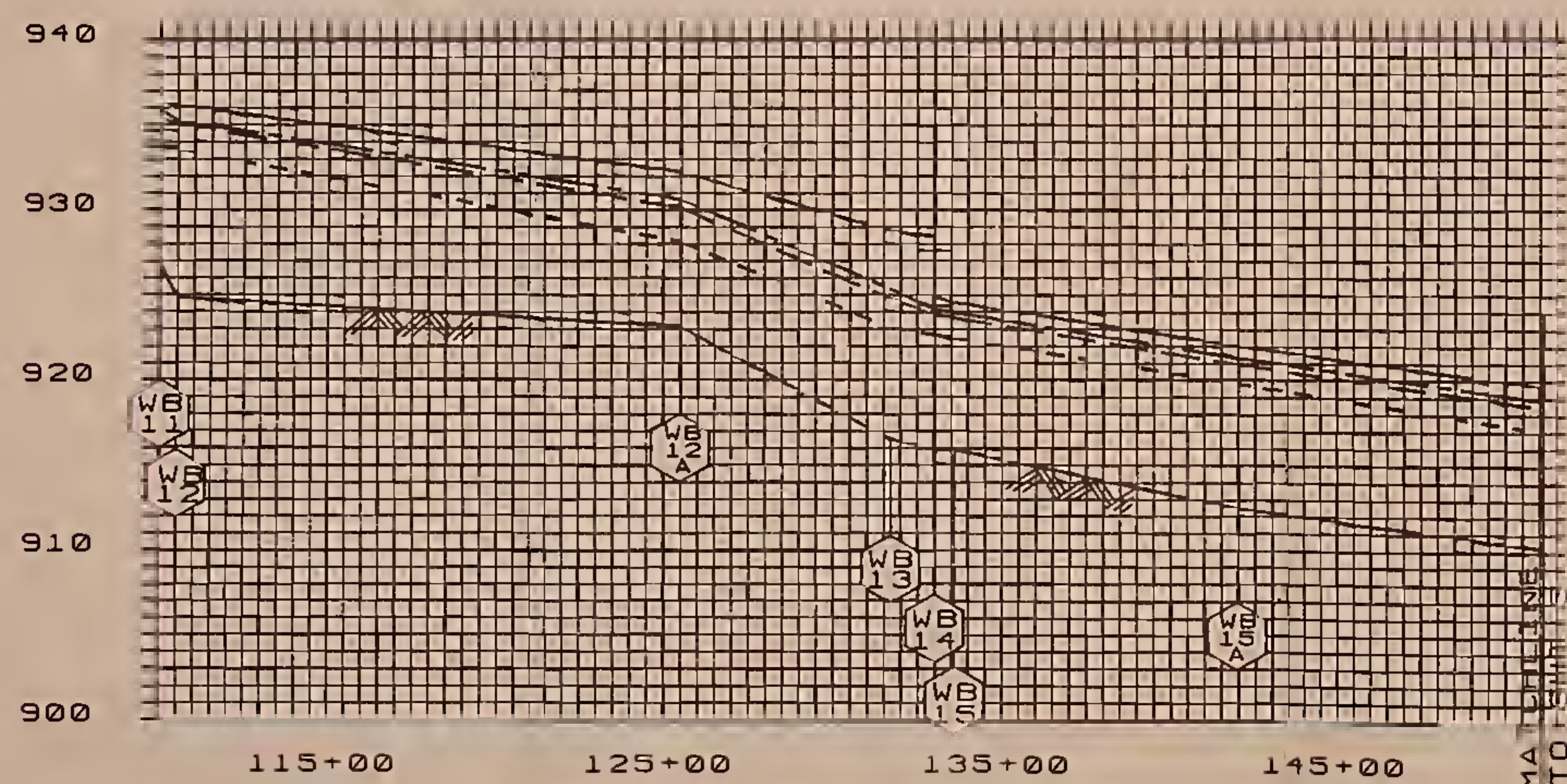
FLOOD HAZARD AREA

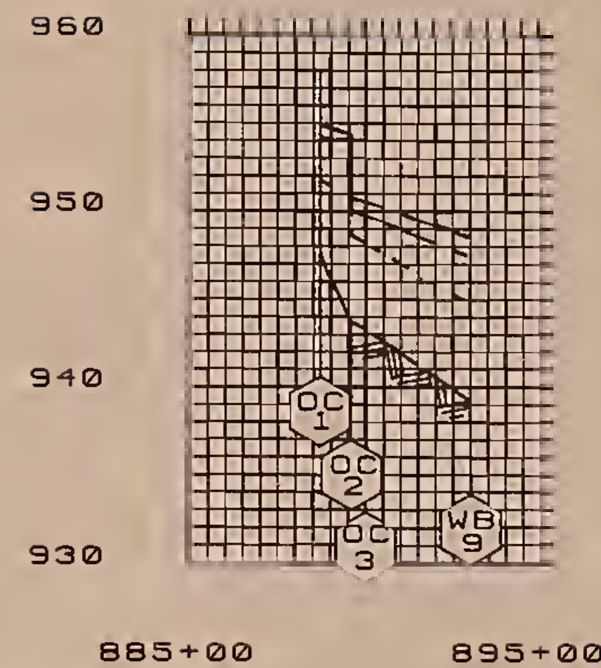
WEST BRANCH OMPOMPANOOSUC RIVER

All elevations in feet (NGVD)



West Branch Ompompanoosuc River





Old City Falls

LEGEND

———	500 YEAR STORM
-·—·-	100 YEAR STORM
— — —	50 YEAR STORM
- - - -	10 YEAR STORM
	STREAM BED
(3)	CROSS SECTION LOCATION
bridge deck / low chord	RIVER CROSSING

FLOOD PROFILES

OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
— STRAFFORD —
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

WB 3 SURVEYED CROSS SECTION

STREAM CHANNEL

RM 24 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data

SCALE 0 500 1000 FEET

0 100 200 300 METERS

APPROXIMATE

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC.

SHEET 3 OF 6

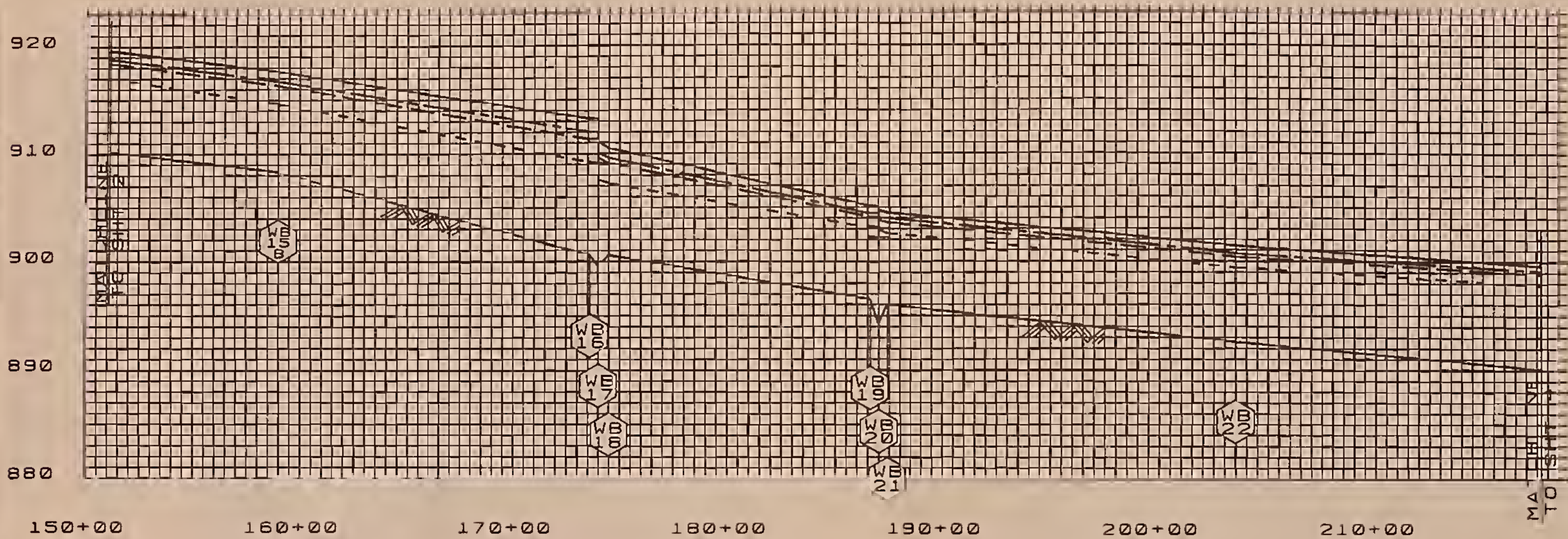
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STRAFFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

WEST BRANCH OMPOMPANOOSUC RIVER

MAY 1988 10035 6

West Branch Ompompanoosuc River



LEGEND

500 YEAR STORM

100 YEAR STORM

50 YEAR STORM

10 YEAR STORM

STREAM BED

3 CROSS SECTION LOCATION

bridge deck / low chord RIVER CROSSING

All elevations in feet (NGVD)

FLOOD PROFILES

OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
— STRAFFORD —
FLOOD PLAIN MANAGMENT STUDY
ORANGE COUNTY, VERMONT

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

WB 2 SURVEYED CROSS SECTION

STREAM CHANNEL

RM 23 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

SCALE 0 500 1000 FEET
0 100 200 300 METERS
APPROXIMATE

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC

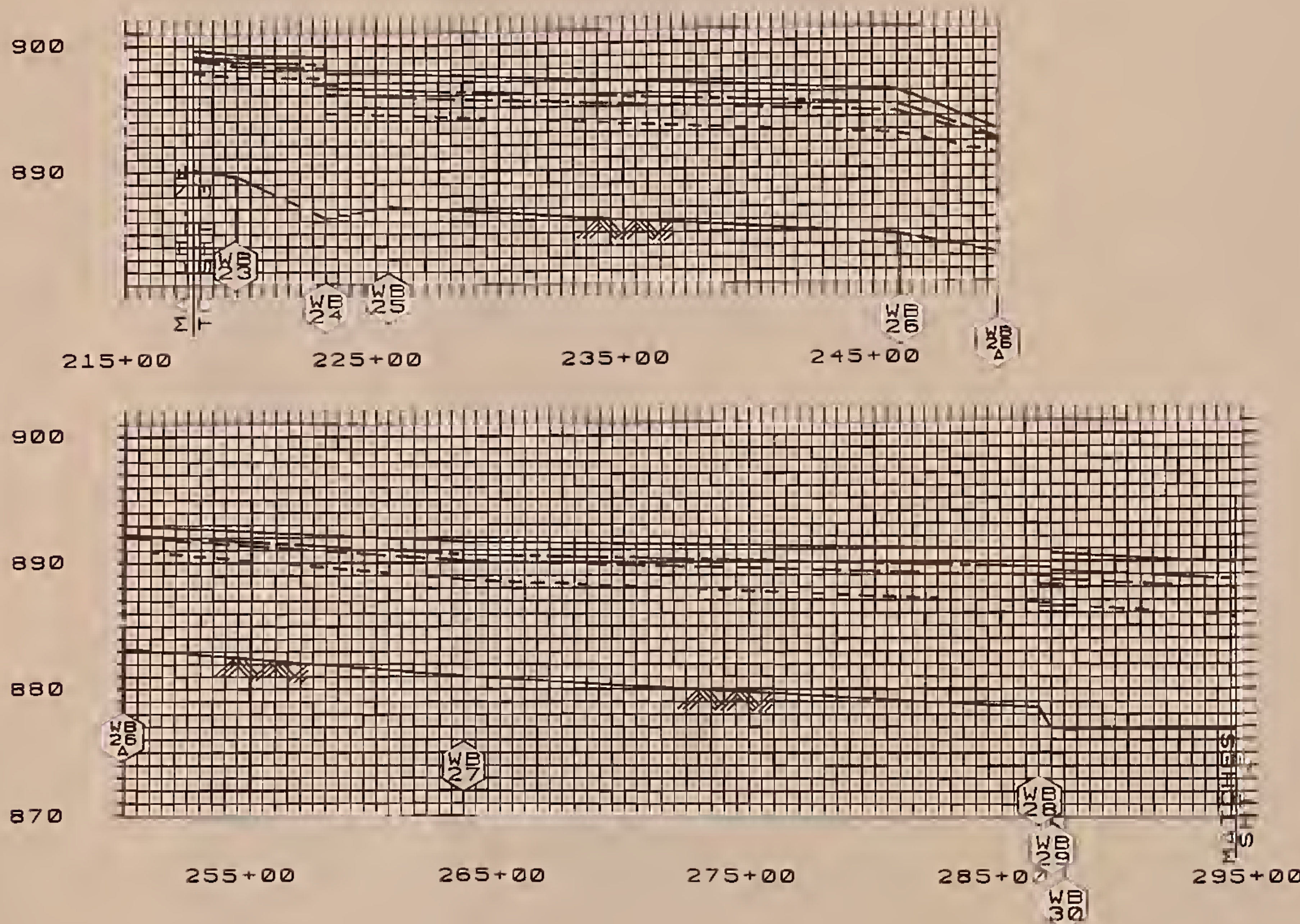
SHEET 4 OF 6

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STRAFFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

WEST BRANCH OMPOMPANOOSUC RIVER

West Branch Ompompanoosuc River



LEGEND

500 YEAR STORM

100 YEAR STORM

50 YEAR STORM

10 YEAR STORM

STREAM BED

CROSS SECTION LOCATION

bridge deck

low chord

RIVER CROSSING

All elevations in feet (NGVD)

FLOOD PROFILES

OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

— STRAFFORD —
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX

100 YEAR FLOOD AREA	STREAM CHANNEL	SCALE 0 — 500 — 1000 FEET; 0 — 100 — 200 — 300 METERS APPROXIMATE
500 YEAR FLOOD AREA	RM 19 BENCH MARK	
WB 5 SURVEYED CROSS SECTION	Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.	SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

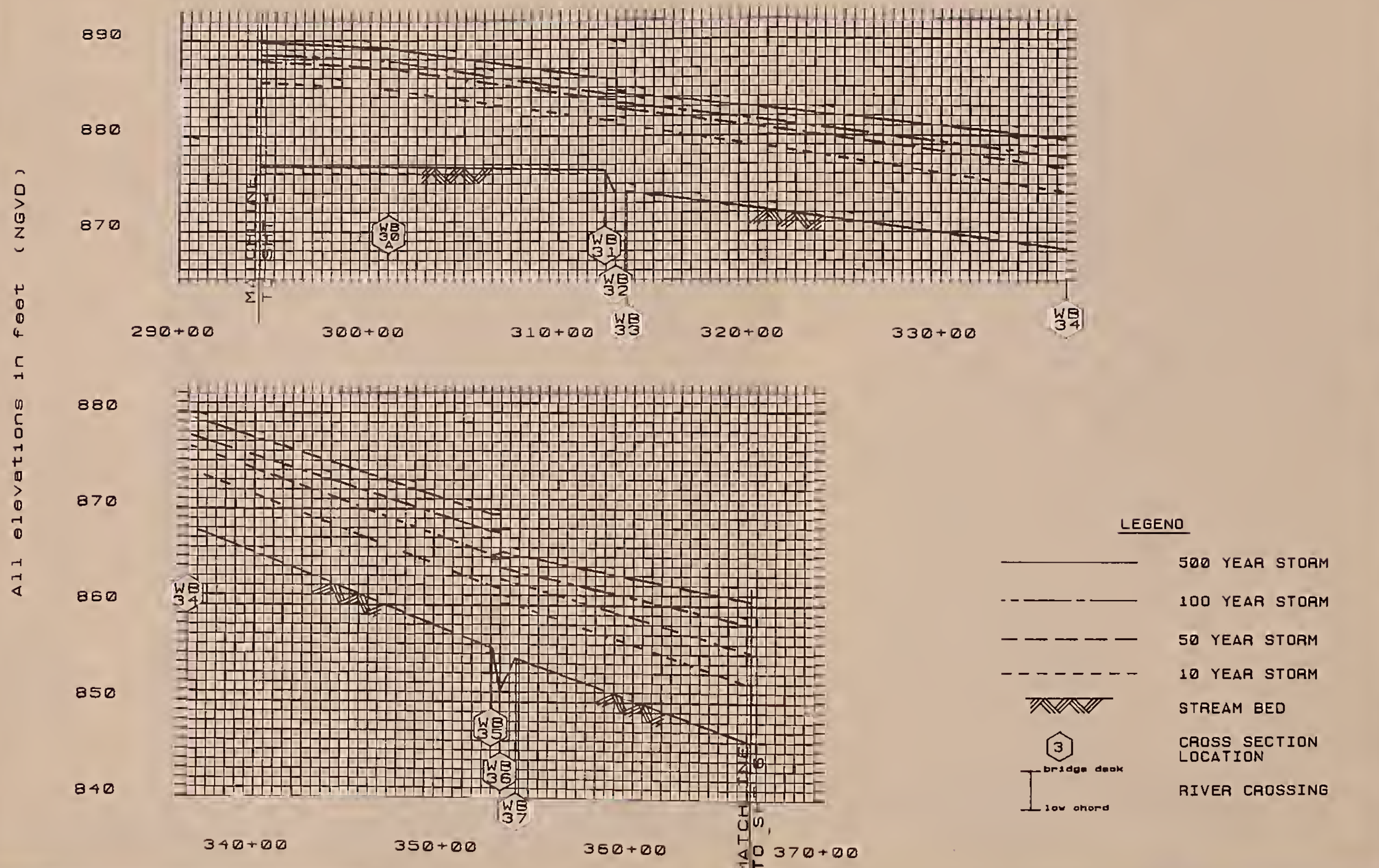
STRAFFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

WEST BRANCH OMPOMPANOOSUC RIVER

MAY 1988 1003566

West Branch Ompompanoosuc River



FLOOD PROFILES
OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
— STRAFFORD —
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

WB 1 SURVEYED CROSS SECTION

STREAM CHANNEL

RM 18 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data.

SCALE 0 500 1000 FEET

0 100 200 300 METERS

APPROXIMATE

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC.

SHEET 6 OF 6

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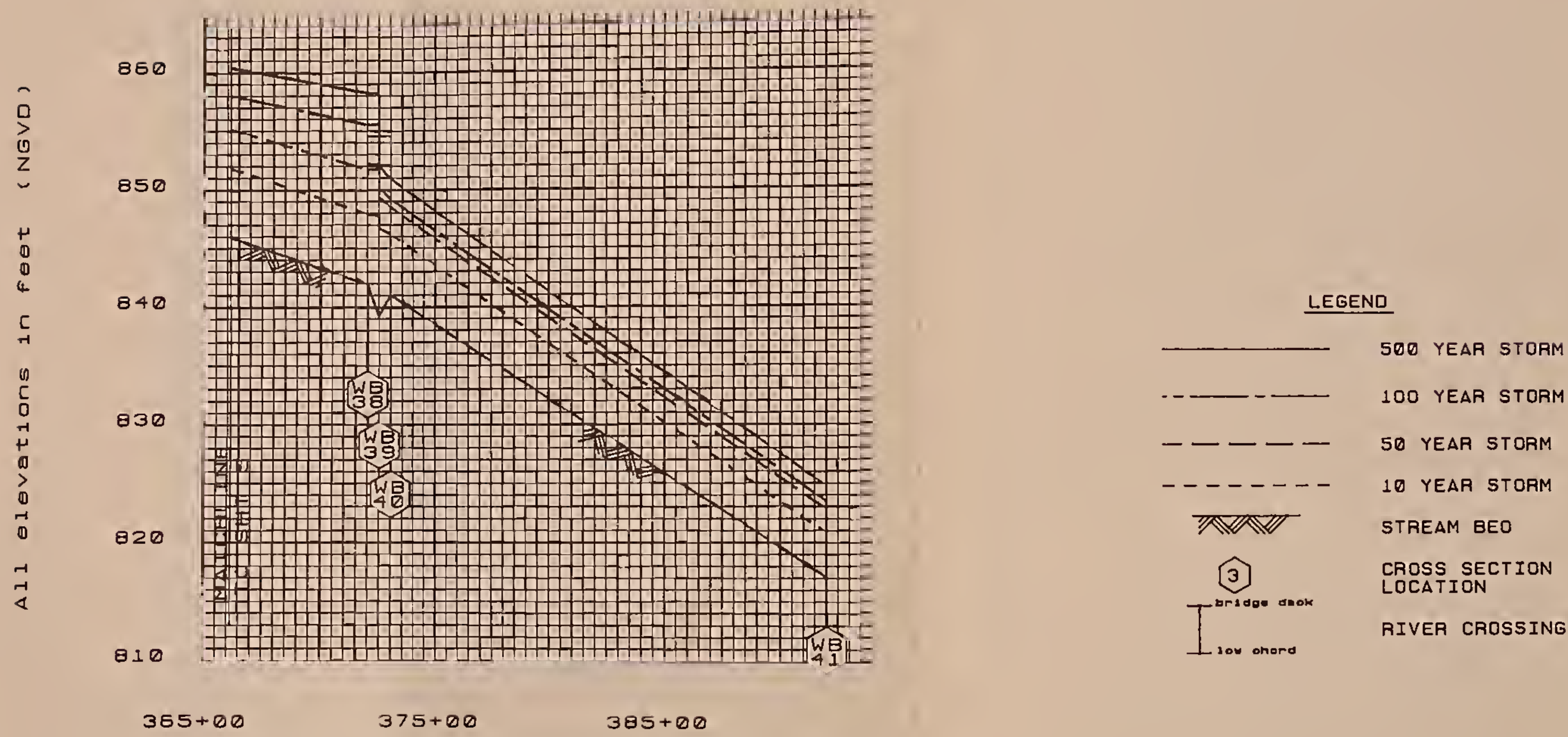

FLOOD PROFILES

OMPOMPANOOSUC RIVER

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Investigations and Analysis

Approximately 8 miles of differential levels to establish vertical control and 53 cross sections were surveyed for this study. Surveys are referenced to National Geodetic Vertical Datum (NGVD) of 1929. Reference mark Descriptions and Elevations are listed in preceding tables and located on appropriate photomaps.

Flood runoff volumes and flow rates were developed using the SCS computer model described in Technical Release No. 20 (Reference No.8). Flow-frequency values from this hydrologic model were adjusted as necessary in analyzing them along with values from similar gaged watersheds. Flood plain geometry and hydraulic characteristics were acquired by field surveys along the river systems. Flood-frequency surfaces were computed using the adjusted flows from the hydrologic model as inputs to water surface profile development, using the Soil Conservation Service's Technical Release No. 61 (Reference No.9). The products of these analyses are the basis for much of the boundary elevation and profile information contained in this report. This report's information reflects coordination with evaluations made by others.

The flood stages provided for selected storm frequencies should be considered as minimum elevations for the prescribed uses of this report. Certain indeterminate factors and conditions affecting future flood flows could cause higher flood stages than indicated. These include ice and debris, clogging of bridges and culverts, sediment, ice and debris jams along the channel and flood plain, and changes in the vegetative character of the channels and flood plain.

Analysis of the hydraulic characteristics of streams were carried out using the SCS computer program WSP-2 (Ref. 9). Cross section data for the streams and structural geometry of bridges and culverts were obtained by transit surveys. From stage-discharge curves, elevations and flood boundaries could be determined at the cross sections. Straight line interpolations of the elevations were used for flood profiles between cross sections. Flood boundaries between cross sections were drawn on the photomaps using USGS topographic maps and aerial photos as a guide. The results were reviewed with state and town officials to eliminate any obvious errors.

The photomaps were assembled as strips from spring 1974, 1:5000 scale,Vermont Mapping program, Orthophoto Maps by the USDA-SCS Fort Worth, Texas Cartographic Unit.

Safety and Protection

This flood plain management study is an aid to persons living in flood prone areas. If your home is within the flood plain, the following information should serve as a guide for dealing with floods.

Being well informed is your best protection. It is extremely important to know where to go in the event of a flood. Remember that roads are often built in valleys where floodwaters will most likely go. You should reach higher ground, and it may be easier and safer to do this on foot, rather than by car.

The major causes of floods are melting snows and rainfall. Listen to the weather reports and be aware of the chance of flooding. Never ignore a flood warning. Listen for emergency instructions and follow instructions given.

If it is necessary for you to evacuate your home, do so quickly and cautiously. Follow evacuation instructions that are given. Do not try to take all of your belongings with you. Take necessary personal items such as eyeglasses or medicines, flashlights, a small supply of canned food, a can opener and several blankets.

If you are traveling by car you may encounter these hazards:

- washed-out roads or bridges
- undermined roadway
- landslides
- fallen rocks
- downed powerlines
- floating debris

Watch out for these hazards carefully.

If it is not necessary to evacuate your home, there are precautions you should proceed with.

Fill large containers with water and after doing so shut off the main water valve to protect the clean water already in your water system. Be certain to shut off your water heater since no water will be going to it.

As long as electric service is available it may be used safely unless the main circuits are flooded. In such a case you will reduce the risk of electrical shock and short circuits if you turn the power off. Do not touch the switch if you are wet or standing in water. Unless you detect a gas leak, you may continue to use gas systems.

Be aware that floods often produce fire hazards. Watch for broken or leaking gas or oil lines, flooded electrical circuits, flooded furnaces and other appliances, and inflammable or explosive materials which may come from upstream.

Anchor or move inside any belongings such as trash cans, toys, lawnmowers, etc. They may become hazards to people downstream if they are washed away.

Move livestock to high, open ground and if possible keep them from drinking flood water or eating feed soaked with flood water.

The following items could help improve your chances of survival if a flood occurs:

- portable radio and spare batteries
- first aid kit
- flashlights and spare batteries
- foods which require little or no cooking and no refrigeration
- blankets
- rope
- hand tools
- drinking water

Precautions taken to reduce losses from flooding are called floodproofing.

The basement walls of your home are probably not built to withstand the additional pressures of water-soaked soils. You will have less damage if you allow floodwaters to come in. When you receive a flood warning, remove articles from the basement and open a basement window. Fuse boxes and other equipment should not be located in the basement.

Floodproofing for homes with adequately reinforced basement walls could include: sealing cracks in walls and floors with hydraulic cement, installation of a sump pump with a reliable power source, placing heavy screens over windows to prevent breakage from floating objects, and placing valves on main drain lines to prevent backup of water.

It is important to remember that floodproofing can help reduce damages, it does not make it safe to remain in your home during a flood.

After a flood, reenter buildings with caution. Watch for fire hazards and falling debris. Do not use appliances until they have been checked for damage. Do not use any food or water which may be contaminated.

Normal home insurance does not cover flooding. Ask your insurance agent about federally subsidized flood insurance. Not all agents handle flood insurance and you may have to contact several of them.

Many people are hurt or killed during or after a flood by their own carelessness. Know before hand what to do if a flood occurs. Your local Civil Defense Agency can help you with any questions you may have.

WEST BRANCH OF THE OMPOMPANOOSUC RIVER
Elevations (NGVD), Velocities (FPS), Discharge (CFS)

		10-YR STORM			50-YR STORM			100-YR STORM			500-YR STORM		
CROSS SECT.	CHANNEL ELEV.	ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS
WB1	992.6	995.8	6.0	540	998.5	5.7	1200	999.3	6.1	1500	1000.4	7.2	2220
WB3	987.8	991.5	5.4	540	992.9	7.1	1200	993.3	7.8	1500	994.0	8.8	2220
WB4	971.8	976.9	2.0	790	977.4	2.7	1760	977.7	2.5	2200	978.1	2.9	3250
WB5	958.8	963.2	3.8	720	963.8	3.5	1600	964.0	3.6	2000	964.4	3.8	2960
WB6	944.0	950.5	2.5	610	951.9	3.0	1360	952.2	3.3	1700	953.0	3.9	2520
WB8	942.3	947.7	4.4	610	949.4	4.5	1360	949.9	4.7	1700	951.0	4.9	2520
WB9	939.2	944.7	5.0	1260	946.8	6.6	2800	947.4	7.0	3500	948.5	7.6	5180
WB10	927.2	934.0	3.2	1190	935.6	2.3	2640	936.1	2.3	3300	936.7	2.7	4880
WB12	924.8	933.5	3.8	1150	935.0	3.2	2560	935.2	3.4	3200	936.1	3.2	4740
WB12A	923.1	928.1	5.2	1150	930.1	6.5	2560	930.6	7.0	3200	932.2	6.2	4740
WB13	916.5	923.0	4.6	1150	924.7	7.2	2560	925.3	8.1	3200	928.7	6.7	4740
WB15	915.9	922.4	3.8	1150	923.6	4.9	2560	923.9	5.3	3200	924.5	6.4	4740
WB15A	912.5	919.8	2.9	1150	920.9	3.2	2560	921.3	3.3	3200	922.0	3.5	4740
WB15B	908.3	914.6	4.1	1260	916.3	4.4	2800	916.7	4.7	3500	917.6	5.0	5180
WB16	900.6	909.2	2.5	1300	911.3	3.6	2880	912.0	3.5	3600	913.2	4.0	5330
WB18	900.6	907.2	5.7	1300	909.1	6.7	2880	909.6	7.1	3600	910.5	7.8	5330
WB19	896.5	903.1	2.2	1300	904.1	2.6	2880	904.4	2.8	3600	905.1	3.3	5330
WB21	896.0	902.6	3.7	1300	903.6	3.8	2880	904.0	3.7	3600	904.5	4.2	5330
WB22	892.6	899.4	2.5	1260	900.4	2.8	2800	900.7	3.2	3500	901.4	3.5	5180
WB23	889.5	897.4	2.0	1220	898.3	2.4	2720	898.6	2.5	3400	899.2	2.7	5030
WB25	887.1	894.4	1.6	1220	895.8	1.8	2720	896.4	1.9	3400	897.7	2.0	5030
WB26	884.7	892.6	4.5	1330	894.3	6.5	2960	894.9	7.2	3700	896.0	8.7	5480
WB26A	883.2	891.0	3.1	1330	892.0	3.7	2960	892.2	4.1	3700	892.9	4.4	5480
WB27	881.0	888.6	1.7	1300	890.1	1.8	2880	890.6	1.9	3600	891.6	1.9	5330
WB28	878.5	886.7	1.8	1260	888.8	1.5	2800	889.5	1.5	3500	890.9	1.6	5180
WB30	876.8	886.5	2.0	1260	888.5	2.0	2800	889.2	2.0	3500	890.5	2.1	5180
WB30A	876.8	884.8	2.8	1300	887.0	3.6	2880	887.8	3.7	3600	889.1	3.9	5330
WB31	876.4	881.6	3.4	1400	883.7	5.0	3120	884.3	5.7	3900	885.9	6.6	5770
WB33	874.2	881.0	2.2	1400	882.7	2.5	3120	883.3	2.3	3900	884.3	2.5	5770
WB34	868.2	874.1	5.1	1400	876.6	6.4	3120	877.7	6.5	3900	879.6	7.2	5770
WB35	855.5	861.9	3.8	1440	865.2	3.8	3200	867.6	2.9	4000	869.4	3.0	5920
WB37	854.5	860.0	4.3	1440	862.3	5.2	3200	863.5	4.9	4000	865.2	5.4	5920
WB38	841.9	847.9	5.3	1440	851.7	6.0	3200	855.5	4.8	4000	858.2	5.5	5920
WB40	841.0	846.2	6.5	1440	848.5	8.7	3200	849.2	9.6	4000	850.9	11.1	5920
WB41	817.1	820.8	9.2	1440	822.8	11.1	3200	823.5	11.7	4000	824.8	12.9	5920

OLD CITY FALLS BROOK, TUNBRIDGE BROOK, AND DOWNER BROOK
Elevations (NGVD), Velocities (FPS), Discharges, (CFS)

		10-YR STORM			50-YR STORM			100-YR STORM			500-YR STORM		
CROSS SECT.	CHANNEL ELEV.	ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS	ELEV. FT.	VEL. FPS	DSCHG CFS
OC1	947.5	951.8	6.9	650	953.8	8.1	1440	954.2	8.5	1800	954.9	9.3	2660
OC3	943.3	948.2	5.0	650	949.5	3.8	1440	949.7	3.9	1800	950.5	3.5	2660
T1	1023.9	1026.0	5.6	170	1026.9	7.4	380	1027.2	8.0	470	1027.8	8.6	700
D1	882.9	885.7	6.5	210	886.9	8.0	460	887.4	8.4	580	888.4	8.9	860

Tabulation of Elevation Reference Marks

Reference Mark	Description of Elevation (ft. msl. NGVD 1929)
#18	1.6 miles east of South Strafford Post Office on Vermont Route 132; 1.1 miles west of Campbell Corner; at deserted village of Copper Flat; 25 feet southwest of center of highway; 250 feet northwest of junction of town highway southwest; in embedded boulder; USC & GS standard tablet stamped "JB-1-1942". Elevation 829.772
#19	1.5 miles east of South Strafford Post Office on Vermont Route 132; 1.3 miles west of Campbell Corner on north side of highway at curve, 20 feet north of center line on top of boulder; chiseled square. Elevation 838.812
#20	1.2 miles east of South Strafford Post Office on Vermont Route 132; 1.6 miles west of Campbell Corner and on southeasterly side of road to Huntington Fence Co., a nail in utility pole #33-7/6, 3632/6. Elevation 857.013
#23	At the intersection of Town Highway 37 and Vermont Route 132; 0.8 mile east of South Strafford Post Office and 2.0 miles west of Campbell Corner; go southwesterly along Town Highway 37 about 200 feet to northwest corner of bridge [B 61] over West Branch of Ompompanoosuc River and a chiseled square in north abutment. Elevation 868.728
#25	0.6 miles east of South Strafford Post Office on Vermont Route 132; 2.2 miles west of Campbell Corner at bridge [B 3] over small brook flowing from north; 250′ northwest of Strafford Volunteer Fire Department, South Strafford Sub-station on top of concrete railing, south side of highway; chiseled square. Elevation 878.346
#26	0.4 mile east of South Strafford Post Office on Vermont Route 132; 2.4 miles west of Campbell Corner; nail in utility pole #11/144 by house and playground sign north side of highway. Elevation 897.88
#27	About 400 feet east of South Strafford Post Office on Vermont Route 132; at northeast corner of East Barrett Memorial Bridge on north abutment a chiseled square. Elevation 888.38

Tabulation of Elevation Reference Marks

Reference Mark	Description of Elevation (ft. msl. NGVD 1929)
#29	About 600 feet west of South Strafford Post Office on Vermont Route 132 at Town Garage on west side of road a bench spike in utility pole #6. Elevation 894.64
#30	About 0.3 mile west of South Strafford Post Office on Vermont Route 132 at southwest corner of West Barrett Memorial Bridge on wing wall a chiseled square. Elevation 912.87
#32	0.5 mile northwest of South Strafford Post Office on Town Highway 2 [towards Strafford] to a nail in utility pole #169 on west side of highway. Elevation 914.91
#33	0.6 mile northwest of South Strafford Post Office on Town Highway 2 [towards Strafford] to a nail on pole #174 on west side of highway. Elevation 898.83
#35	1.0 mile northwest of South Strafford Post Office on Town Highway 2 [towards Strafford] to a nail in utility pole #183 on west side of highway. Elevation 905.30
#36	1.1 miles northwest of South Strafford Post Office on Town Highway 2 [towards Strafford] to a nail in utility pole #189 on east side of highway. Elevation 906.69
#38	1.5 miles northwest of South Strafford Post Office on Town Highway 2 [towards Strafford] to southwest corner of bridge; 75 feet from utility pole #197 near utility pole #198 in concrete footing of south abutment; chiseled square. Elevation 896.48
#40	1.8 miles northwest of South Strafford Post Office on Town Highway 2 [towards Strafford]; 1924 bridge over Alger Brook; on top of east concrete railing a chiseled square. Elevation 911.487
#41	Nail in utility pole #216 west side of Town Highway 2. Elevation 914.28

Tabulation of Elevation Reference Marks

Reference Mark	Description of Elevation (ft. msl. NGVD 1929)
#43	2.2 miles northwest of South Strafford Post Office on Town Highway 2 [towards Strafford] and junction of Town Highway #51; thence southerly to southwest corner of new bridge [B 72] over West Branch Ompompanoosuc River on west abutment a chiseled square. Elevation 908.47
#45	At Strafford; 150 feet south of junction of highways to northeast and northwest; 45 feet east of centerline of highway; in rock ledge beside driveway to house; standard USC & GS table stamped "BC-6-1935-930". Elevation 929.517
#47	*Nail in utility pole #246, with light. Elevation 947.17 *Nail has been pounded flush but still may be used..
#48	Nail in utility pole #252. Elevation 947.02
#50A	0.9 mile northwest of Strafford on Town Highway 2; 425 feet north of junction of highway northeast [TH #6]; on footing of southeast wing wall of concrete bridge over Old City Brook; chiseled square. Elevation 948.38
#51	On top of boulder 5 feet west of utility pole #266/9 and on west side of highway; chiseled square. Elevation 967.335
#53	1.5 miles northwest of Strafford on Town Highway 2; nail in 16" white pine on east side of highway. Elevation 982.37
#54	Nail in utility pole #284 at junction of Town Highway 2 and Town Highway 7 [gravel road]. Elevation 1016.39
#55	0.1 mile northwesterly along Town Highway 2 from junction of Town Highway 7, about 2.0 miles northwest of Strafford; bridge [B 24] over West Branch of Ompompanoosuc River at northwest corner on west abutment at wing wall; chiseled square. Elevation 996.285

Tabulation of Elevation Reference Marks

Reference Mark	Description of Elevation (ft. msl. NGVD 1929)
#56A	In Strafford, on Town Highway 2, 0.3 mile northwest of junction of Town Highway 7, on the southerly side of Town Highway 2; a nail and disk in a 2 foot diameter stump. Elevation 1039.94
#60	0.16 mile northwest of the junction of Town Highways 2 and 5, 0.1 mile east of Strafford Post Office at the northwest corner of bridge over West Branch of Ompompanoosuc River on north abutment a chiseled square. Elevation 927.381