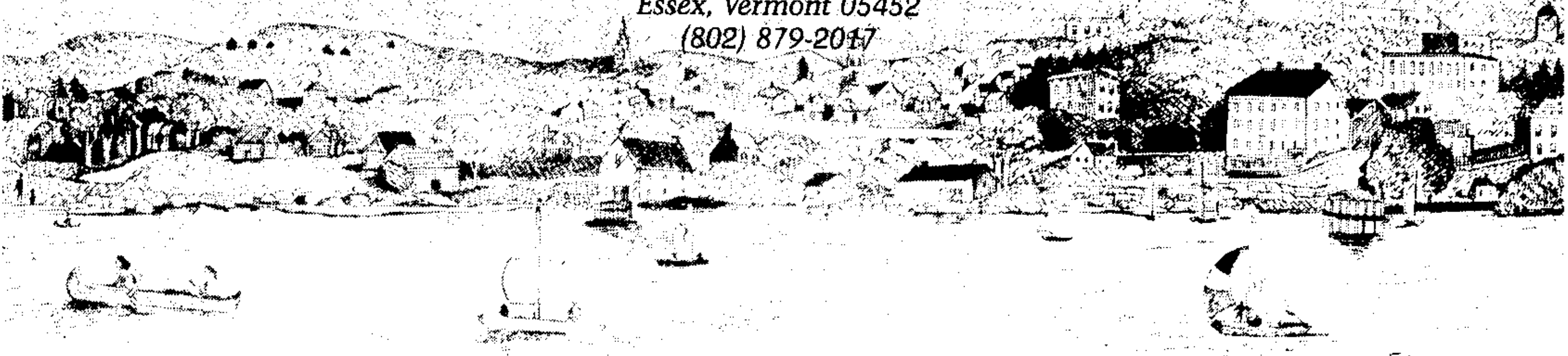
Archaeology Consulting Team, Inc.
57 River Road • Suite 1020
Essex, Vermont 05452
(802) 879-2017



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FEDERAL ENERGY REGULATORY COMMISSION

September 22, 1999

Mr. David Boergers, Secretary
Federal Energy Regulatory Commission
Mail Code: D.C., HL-11.2
888 First Street, N.E.
Washington, D.C. 20246

Re: Passumpsic Hydroelectric Project (the Pierce Mills, Arnold Falls, Gage, and Passumpsic Hydroelectric Facilities, FERC Nos. 2396, 2399, 2397 and 2400)
Revised Cultural Resource Management Plan
Caledonia County, Vermont

022 023 019 018

Dear Mr. Boergers:

Enclosed please find eight copies of the Cultural Resource Management Plan (CRMP), revised September 1999, for the hydroelectric projects referenced above.

Please contact me at (802) 879-2017 if you have any questions.

Sincerely,

Douglas S. Frink

Douglas S. Frink
Principal Investigating Archaeologist

cc. John Greenan, P.E., Central Vermont Public Service Corp.

FERC DOCKETED
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ORIGINAL

CULTURAL RESOURCE MANAGEMENT PLAN

for Archaeological and Historic Resources within the Pierce Mills, Arnold Falls, Gage, and Passumpsic Hydroelectric Facilities

St. Johnsbury, Waterford and Barnet in Caledonia County, Vermont

(FERC Nos. 2396, 2399, 2397 and 2400)

PREPARED FOR:
CENTRAL VERMONT PUBLIC SERVICE CORPORATION
77 GROVE STREET
RUTLAND, VERMONT 05701

PREPARED BY:
DOUGLAS FRINK
PRINCIPAL INVESTIGATING ARCHAEOLOGIST,
ARCHAEOLOGY CONSULTING TEAM, INC.
57 RIVER ROAD, SUITE 1020
ESSEX, VERMONT 05452

SEPTEMBER 1998
REVISED, SEPTEMBER 1999

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ESSEX, VERMONT 05452

SEPTEMBER 1998
REVISED, SEPTEMBER 1999

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PREAMBLE

The Vermont State Historic Preservation Officer (SHPO) and the Central Vermont Public Service Corporation (CVPS) are working together to develop a management plan that will satisfy the regulations of the Federal Energy Regulatory Commission (FERC), and those of the Advisory Council on Historic Preservation (Council). Pursuant to Section 106 of the National Historic Preservation Act and its regulations under 36 CFR 800, these parties are acting in accordance with the Programmatic Agreement (Appendix A) executed on November 25, 1994 for the Pierce Mills, Arnold Falls, Gage and Passumpsic hydroelectric facilities, FERC Nos. 2396, 2399, 2397 and 2400, respectively (collectively, the Project), located within the towns of St. Johnsbury, Waterford, and Barnet in Caledonia County, Vermont. The stipulations in the 1994 Programmatic Agreement require that CVPS will:

- develop a Cultural Resource Management Plan (CRMP) in consultation with the SHPO and in compliance with 36 CFR 800 and the Secretary of the Interior's *Standards and Guidelines*, and submit the CRMP and associated SHPO documentation to the FERC for review and approval,

- file annual reports of actions taken regarding the CRMP with the FERC and SHPO, and

- consult with the SHPO in compliance with 36 CFR 800 if ground-disturbing activities or structural additions or changes are planned, or if erosion caused by facility operations occur, to determine whether historic properties will be affected.

For the purposes of this CRMP, the Project is defined as the contiguous riverbank area surrounding and including the impoundments (inclusive of, but not limited to, the facilities' area of effect). CVPS has developed this CRMP in cooperation with the SHPO and in compliance with 36 CFR, Section 800.3 to enhance streambank stewardship by CVPS, conservation organizations, and private landowners, to educate the public about the historic and archaeological values of this Project, and to coordinate the protection of Passumpsic River riparian areas from below the Passumpsic hydroelectric facility upstream for twelve (12) miles. CVPS and the SHPO agree that although the individual facilities' upstream areas of potential effect involve distances ranging from 2,200 feet to 1.6 miles from the various dams, CVPS will implement this CRMP along the entire twelve (12) miles of riverbank encompassing all four hydroelectric facilities and their impoundments. This CRMP uncouples the issue of responsibility from the issue of liability, and will not attempt to establish *a priori* liability for causes of effects on resources.

This CRMP outlines procedures that are intended to continuously protect and maintain historic properties during the terms of CVPS's FERC licenses to operate the Pierce Mills, Arnold Falls, Gage and Passumpsic hydroelectric facilities. The CRMP for this Project will not be based solely on reactive measures to preservation issues that appear (for example, bank erosion). Instead, the plan will take a proactive approach, managing the twelve-mile river reach as a unified system. This approach will involve programs designed to limit or prevent bank erosion, and thereby protect historic properties in conjunction with other resources.

In summary, the CRMP for the CVPS Pierce Mills, Arnold Falls, Gage and Passumpsic facilities is based on the following principles:

- The river is managed as a unified system to protect many types of resources, including, but not limited to, historic properties. This CRMP seeks to consider protection and treatment of historic properties and lands that may contain historic properties within the river system encompassing the four hydroelectric facility impoundments of the Project under consideration without defining or ascribing liability for potential or actual facility effects.

- The Pierce Mills, Arnold Falls, Gage, and Passumpsic powerhouses, dams and other components are eligible for inclusion in the National Register of Historic Places.

- Identified archaeological sites with good integrity are assumed to be eligible for the National Register of Historic Places.

- CVPS intends to foster partnerships with, and learn from, government, community, and non-profit organizations that have common interests to protect the resources along the twelve miles of the Passumpsic River defined as the Project that include the four facilities.

- CVPS is committed to fostering public participation in and support for riverbank stabilization efforts, as well as greater public understanding and appreciation of the recorded or potential historic properties along the twelve-mile stretch of the Passumpsic River that is defined as the Project.

- CVPS will develop an interdisciplinary educational outreach program as described in this CRMP that appropriately uses historic properties located on CVPS's lands within the 12-mile long Project. Properties of other landowners along the Passumpsic River may also be included in this program if necessary landowner consent is obtained.

I. INTRODUCTION

In general, compliance regulations seek to determine cause and implement procedures to mitigate effects as a normal way of managing public resources. However, easy determinations of cause and effect and of responsibility can rarely be made in situations involving complex environmental systems such as the Project. This management plan will go beyond the limitations inherent in compliance regulations, and consider the greater context of the river system that includes other public resources.

1.1. Description of Physical Structures and Project Operations

The Passumpsic River Watershed, which supplies water to CVPS's hydroelectric facilities in St. Johnsbury, Waterford, and Barnet, Vermont, contains a wide range of natural resources and historic properties that benefit and are used by a large sector of the population. While the potential energy of the water flow is of commercial interest to CVPS, the river also provides agricultural benefits for neighboring farmers, and recreational benefits for boaters, sport fishers, hunters, naturalists, and tourists. For thousands of years, the environments formed by this river and adjacent banks have provided habitats for fish, birds, reptiles, amphibians, and mammals, including humans. The river has served as an environmental context for Vermont's human history (for nearly 11,000 years). The long term health and stability of this river system are major concerns for Vermonters.

CVPS owns five hydroelectric facilities in series on the Passumpsic River. The most downstream of CVPS's facilities is the East Barnet hydroelectric facility (FERC No. 3051, Exemption Order dated May 11, 1982) which is located at river mile (RM) 0.5 and not addressed by this CRMP. The Passumpsic hydroelectric facility (FERC No. 2400) is located upstream of the East Barnet hydroelectric facility at RM 5.5. Located at RM 7.2 is the Gage hydroelectric facility (FERC No. 2397). Arnold Falls hydroelectric facility (FERC No. 2399) is located at RM 9.5 on the Passumpsic River just upstream of the confluence with the Moose River. The most upstream of the projects is the Pierce Mills Hydroelectric Project at RM 14.9.

The facilities operate as run-of-river projects to minimize their cumulative effect on the Passumpsic River and available river water governs the operation of the hydroelectric facilities. CVPS normally operates each facility independently and remotely from its dispatch center in Rutland, however, each can operate locally if necessary. Each facility provides a variety of recreation opportunities. CVPS, in conjunction with a number of groups and individuals, published the *Passumpsic River Canoeing and Recreation Guide* in 1996 to promote the opportunities available along and outside of the twelve-mile section of the river that is addresses in this CRMP.

To further reduce the dams' effects on the river, CVPS has installed downstream fish passage facilities at the hydroelectric facilities. CVPS designed unique fish passage to suit the individual configurations of each facility. There are also equally unique flow management plans that include seasonal minimal water releases. The combined operating procedures enhance fisheries, water quality, aesthetics and vegetation along the river.

1.1.1. Pierce Mills, FERC No. 2396

The drainage area above the Pierce Mills hydroelectric facility is approximately 237 square miles. Inflows to the facility's impoundment are regulated by the Great Falls hydroelectric facility (FERC No. 2839), owned and operated by the Lyndonville Municipal Electric Company, located approximately 1.6 miles upstream. The Pierce Mills facility is located at River Mile 14.9 on the Passumpsic River, approximately two miles (three kilometers) upstream from the village of St. Johnsbury Center (Figures 1 and 2). Major components of the facility were constructed in 1924 and 1928, and have operated since that time. Principal historic components of the facility include a concrete gravity dam, flashboards, an intake structure with trashracks that forms the left abutment, a steel penstock, a powerhouse with a single vertical-shaft turbine and generator, and a substation (Table 1; Figures 3 and 4). The facility is eligible for inclusion in the National Register under both Criteria A and C.

1.1.2. Arnold Falls, FERC No. 2399

The drainage area above the Arnold Falls facility is approximately 254 square miles and is 5.3 miles downstream from the Pierce Mills facility. The Arnold Falls facility is located in the village of St. Johnsbury, at River Mile 9.5, situated below Pleasant Street (Figures 2 and 5). Arnold Falls has produced electricity for distribution and end-use in Vermont since its construction in 1928. Principal historic components at the Arnold Falls facility include two timber-crib dams with flashboards, an intake structure with trashracks, a powerhouse with integral intake containing a vertical turbine and generator, and a substation (Figures 6 and 7; see also Table 1). The facility is eligible for inclusion in the National Register under both Criteria A and C.

1.1.3. Gage, FERC No. 2397

The drainage area above the Gage facility is approximately 413 square miles, and, unlike the Pierce Mills and Arnold Falls facilities, its watershed includes the Moose River watershed. The Gage facility is located on the Passumpsic River about 2.2 miles south (downstream) from the village of St. Johnsbury, Vermont, adjacent to US Route 5 and south of Interchange 20 on Interstate 91 (Figures 5 and 8). This hydroelectric facility has been in operation since 1921, and was rebuilt in 1929 after the 1927 flood event. Principal historic components at the Gage facility include a three-section concrete gravity dam with flashboards, an intake structure with headgates, a power canal, trashracks, a powerhouse with two vertical shaft turbines and generators, a substation, and a cableway including towers and anchorage and a winch house (Figures 9 and 10; see also Table 1). The facility is eligible for inclusion in the National Register under both Criteria A and C.

1.1.4. Passumpsic, FERC No. 2400

The drainage area above the Passumpsic facility is approximately 428 square miles, and is located approximately two miles downstream from the Gage hydroelectric facility (FERC No. 2397).The Passumpsic facility is located on the Passumpsic River in Barnet, Vermont, adjacent to US Route 5 (Figure 8). The facility has been operating since 1929. Principal historic components at the Passumpsic facility include a two-section concrete gravity dam with flashboards, an intake structure with headgates, a power canal, trashracks, a powerhouse with one vertical shaft turbine and generator, and a substation (Figures 11 and 12; see also Table 1). The facility is eligible for inclusion in the National Register under both Criteria A and C.

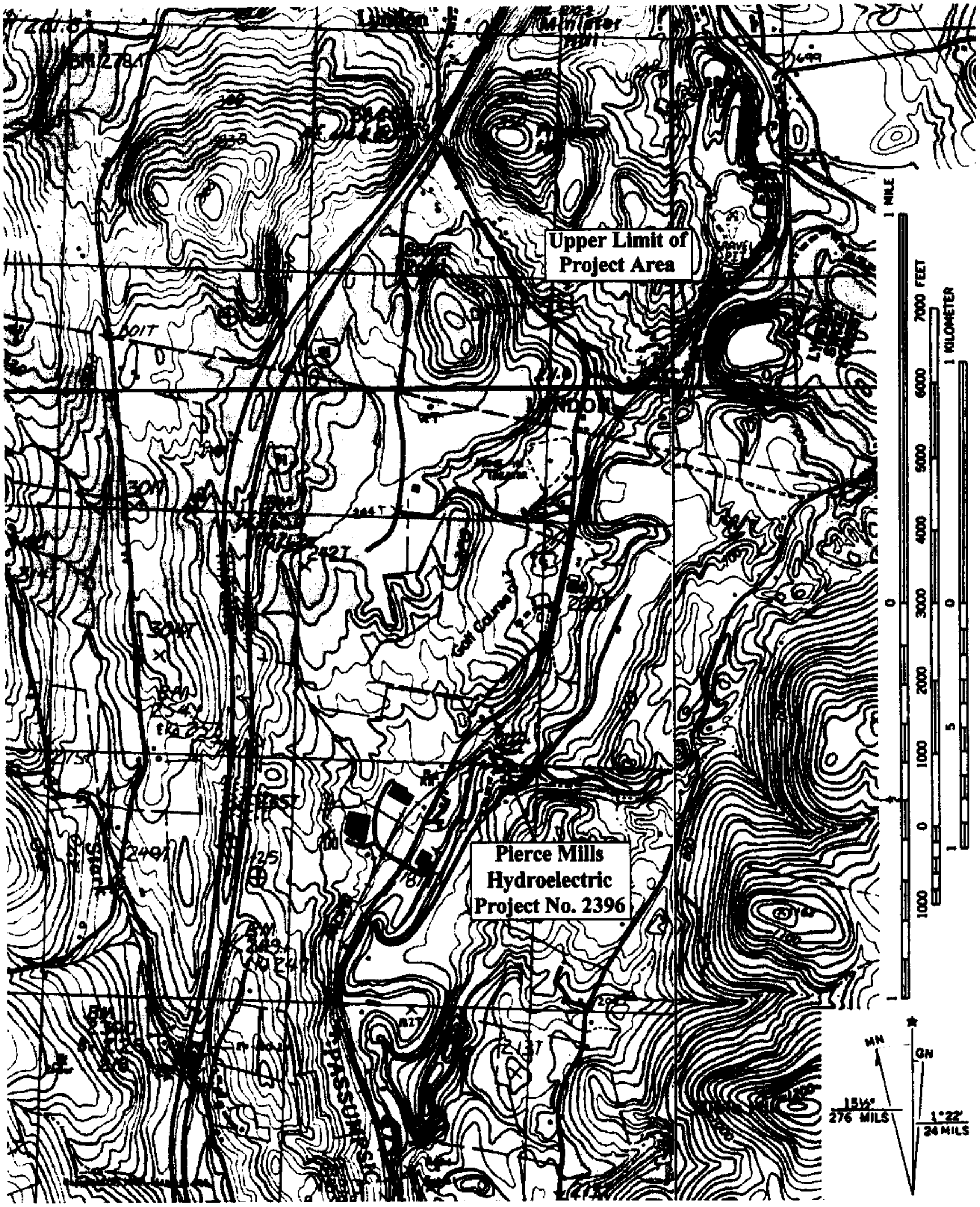

Figure 1: Location of the CVPS Pierce Mills facility (FERC No. 2396) on the Passumpsic River in St. Johnsbury, Vermont (USGS 7.5x15 minute *St. Johnsbury, VT*, 1983 provisional ed. quadrangle; USGS 7.5 minute *Concord, VT*, 1965, photorevised 1983, *Burke Mountain, VT*, 1988 provisional ed., and *Lyndonville*, 1986 provisional ed., quadrangles)

Figure 2: Location of CVPS Pierce M
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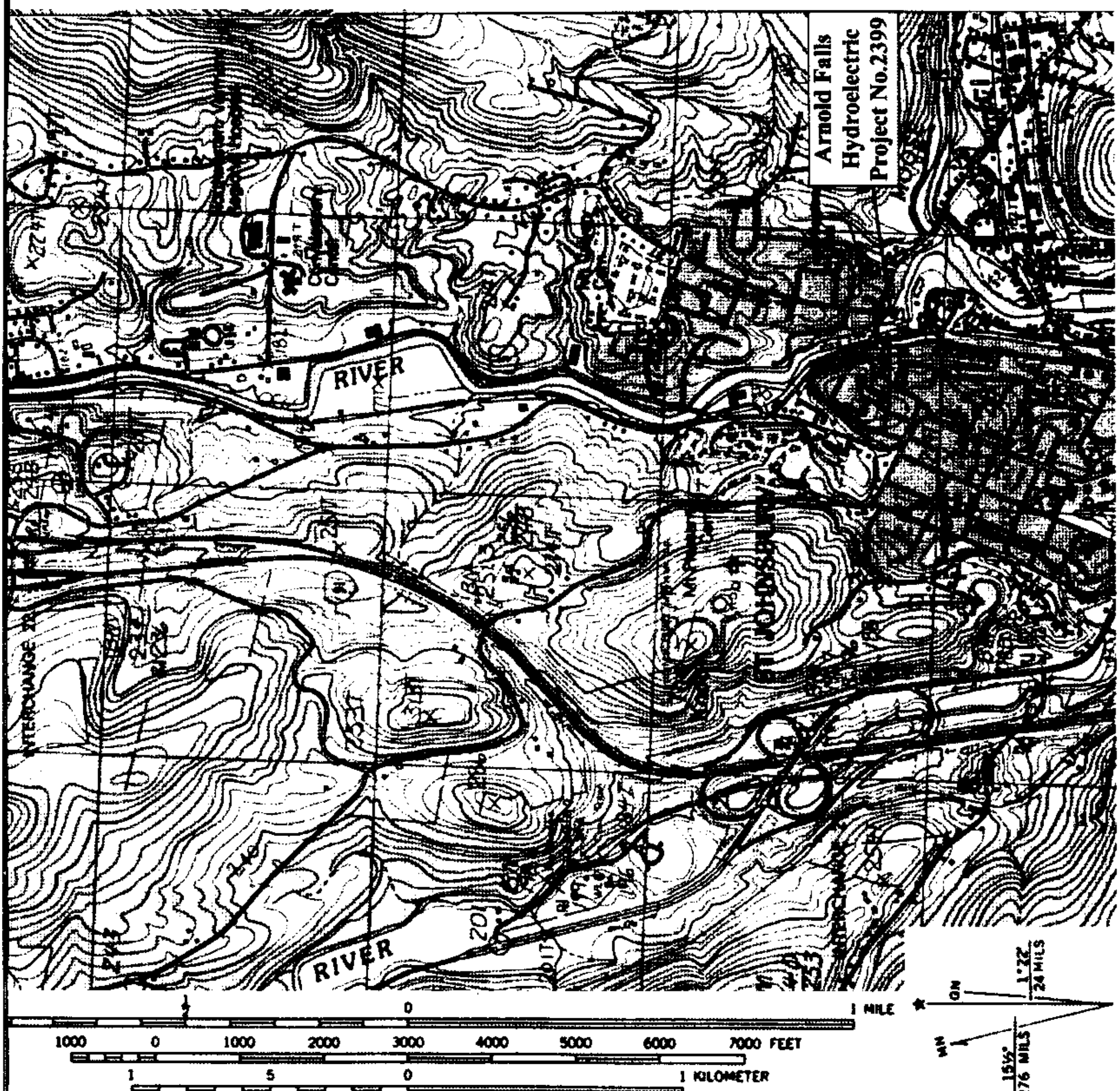

lls (FERC No. 2396) and Arnold Falls
Passumpsic River, St. Johnsbury,
nsbury, VT, 1983 provisional ed. quadrangle)

Table 1: Characteristics of CVPS-owned hydroelectric facilities within the Project

	Pierce Mills	Arnold Falls	Gage	Passumpsic
Number of Generating Units:	1	1	2	1
Type of Generator:	General Electric Vertical	General Electric Vertical	General Electric Vertical	General Electric Vertical
Capacity of Generator:	No. 1: 250 kW	No. 1: 350 kW	No. 1: 300 kW No. 2: 400 kW	No. 1: 700 kW
Type of Hydraulic Unit:	S. Morgan Smith, Vertical Francis	S. Morgan Smith, Fixed-blade Propeller	S. Morgan Smith, Vertical Francis	James Leffel, Vertical Francis
Estimated Average Annual Generation:	1,588,000 kWH	1,580,000 kWH	2,765,800 kWH	3,868,500 kWH
Normal Headwater Elevation (MSL):	605.0 feet	572.8 feet	539.9 feet	520.98 feet
Normal Tailwater Elevation (MSL):	586.7 feet	556.12 feet	524.9 feet	496.98 feet
Average Gross Head (feet):	18.3	18	15	24
Length of Dam(s) (feet):	93	N: 189; S: 66	N: 176; C: 30; S: 43	N: 126; S: 122
Flashboard Height	18 inches	18 inches	N: 6 feet; S: 1 foot	1 foot
Normal Reservoir Elevation (MSL):	605± feet	574.3± feet	539.39± feet	526.98 feet
Reservoir Surface Area:	24.7 acres	7.2 acres	15.2 acres	18.3 acres
Reservoir Net Storage Capacity:	not applicable to run-of-river operations	not applicable to run-of-river operations	not applicable to run-of-river operations	not applicable to run-of-river operations
Estimated Hydraulic Capacity of Plant:	185 cfs	262 cfs	700 cfs	460 cfs
Average Flow of the River at the Plant:	403 cfs	432 cfs	704 cfs	704 cfs

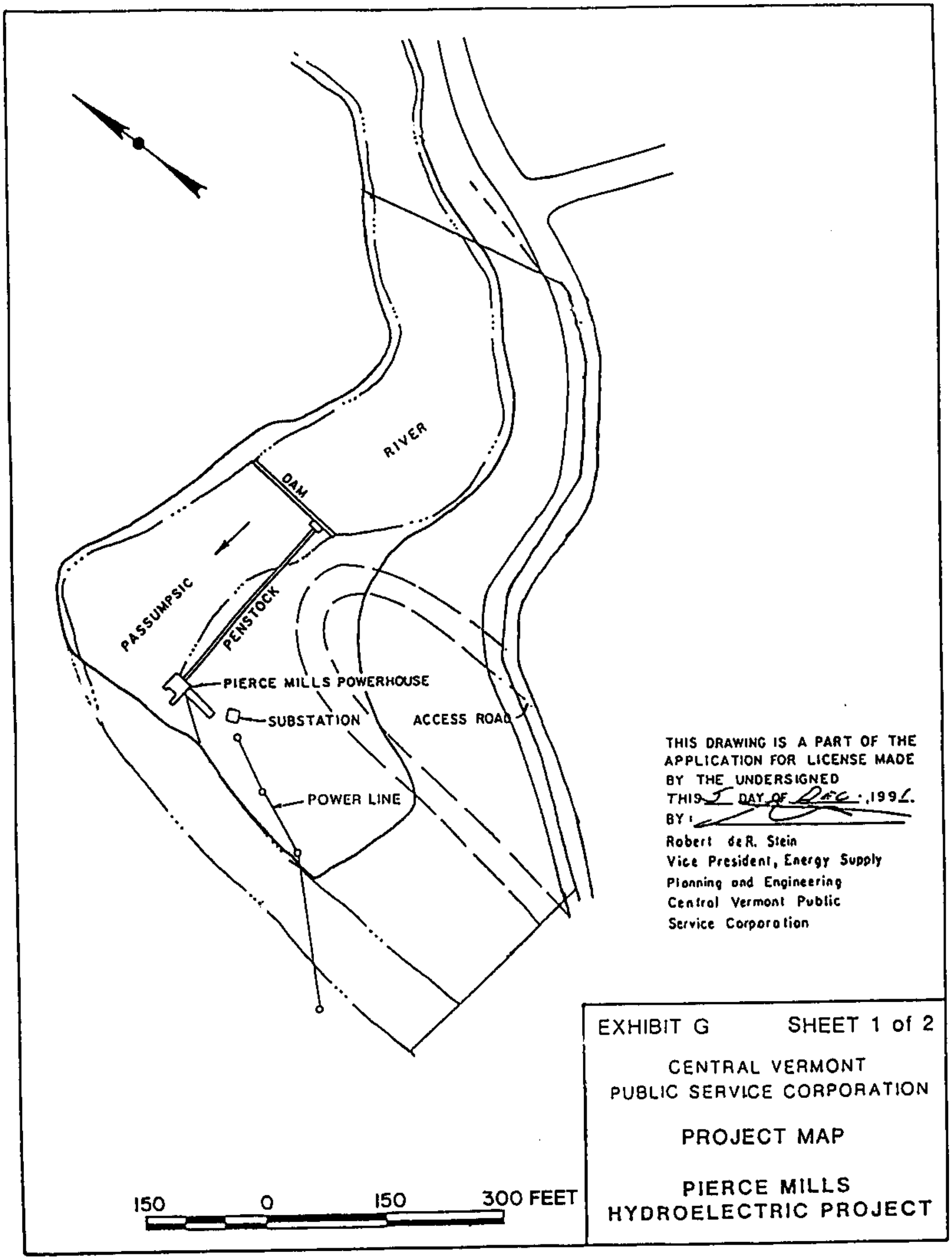

Figure 3: CVPS Pierce Mills hydroelectric facility (FERC No. 2396) on the Passumpsic River, St. Johnsbury, Vermont.
(Exhibit G, Sheet 1 of 2, CVPS project map for FERC application, December 5, 1991).

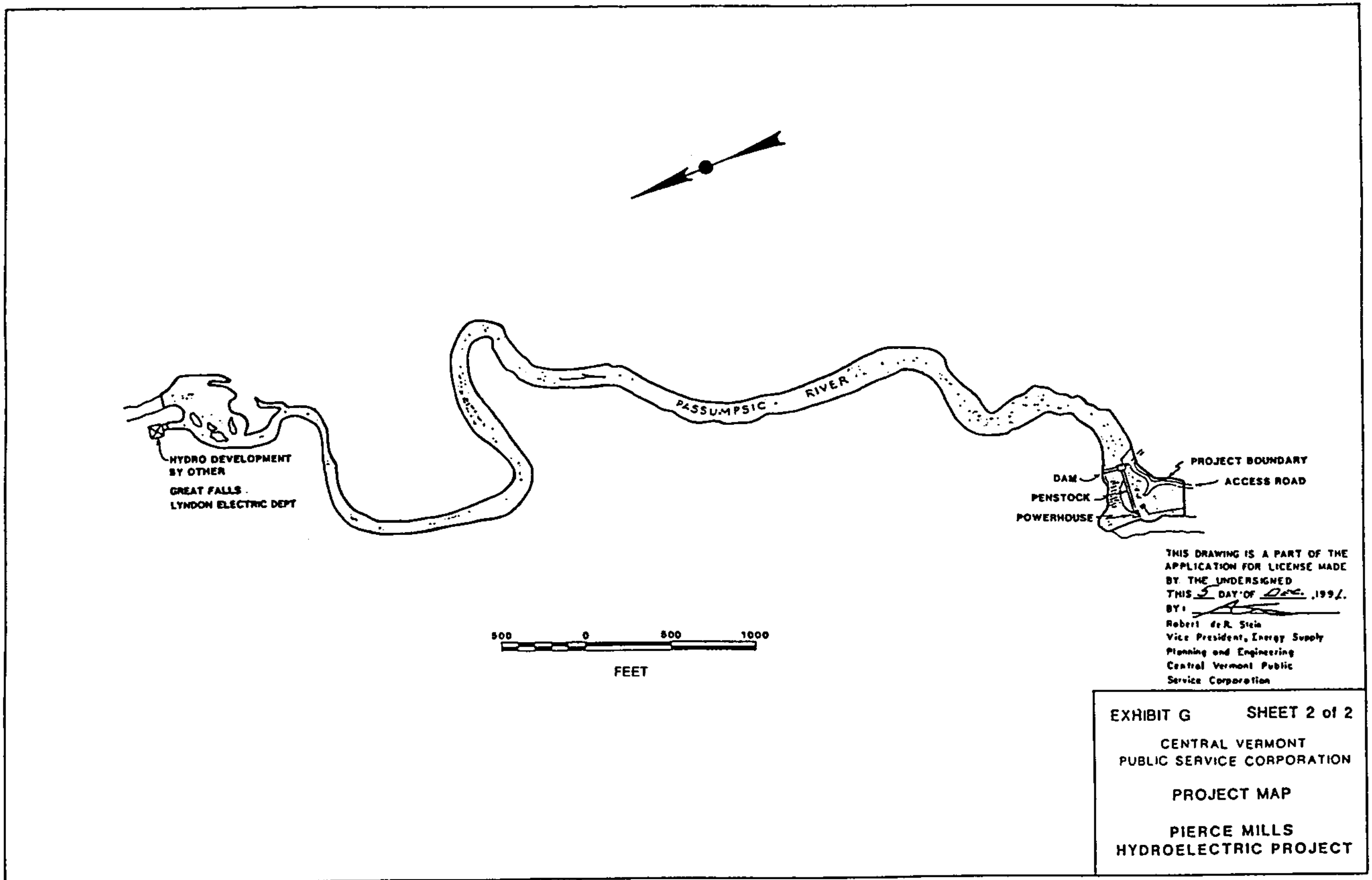

Figure 4: CVPS Pierce Mills hydroelectric facility (FERC No. 2396) on the Passumpsic River, St. Johnsbury, Vermont.
(Exhibit G, Sheet 2 of 2, CVPS project map for FERC application, December 5, 1991).

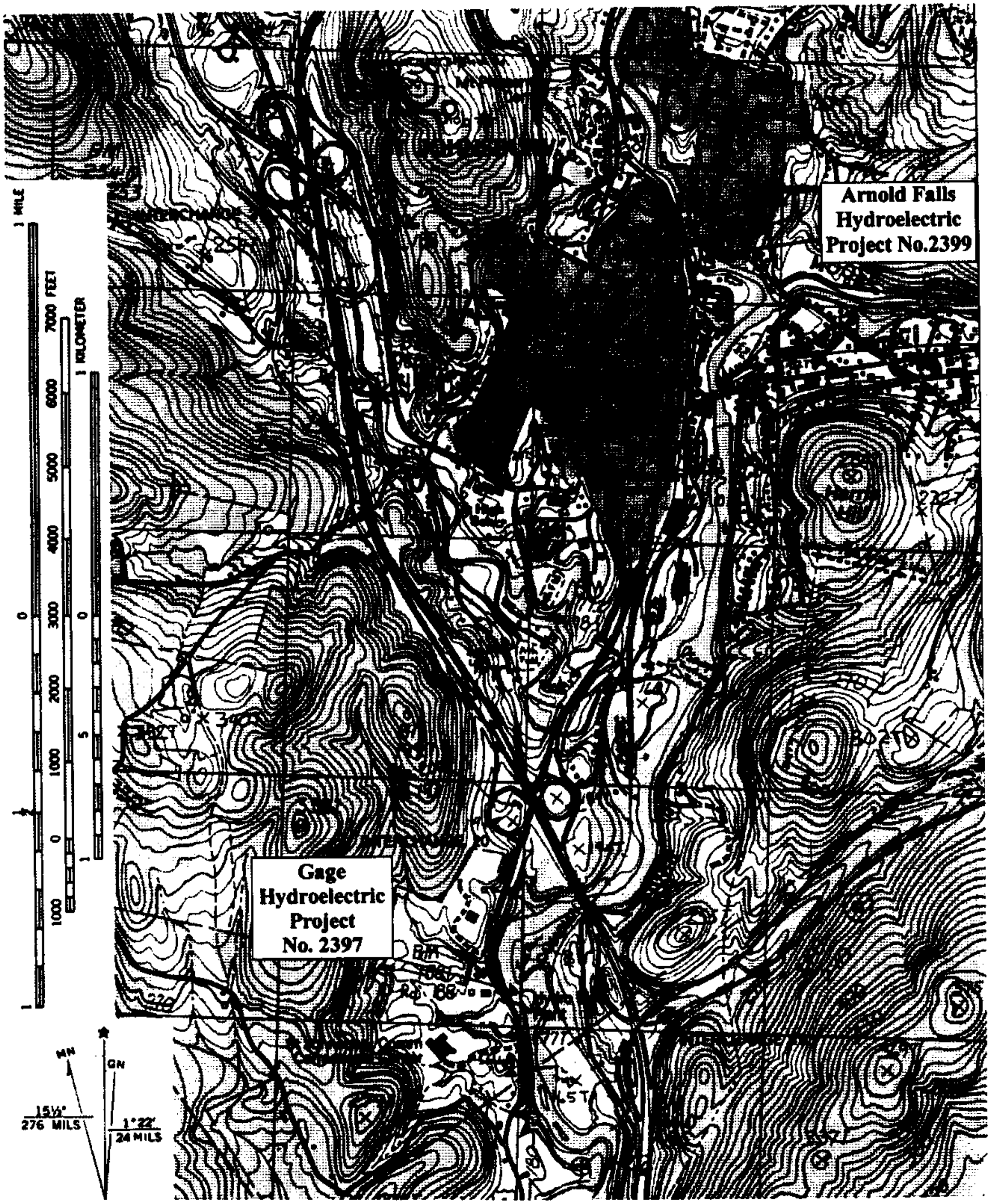

Figure 5: Location of CVPS Arnold Falls (FERC No. 2399) and Gage (FERC No. 2397) facilities on the Passumpsic River in St. Johnsbury, Vermont.
(USGS 7.5x15 minute *St. Johnsbury, VT.*, 1983 provisional edition quadrangle)

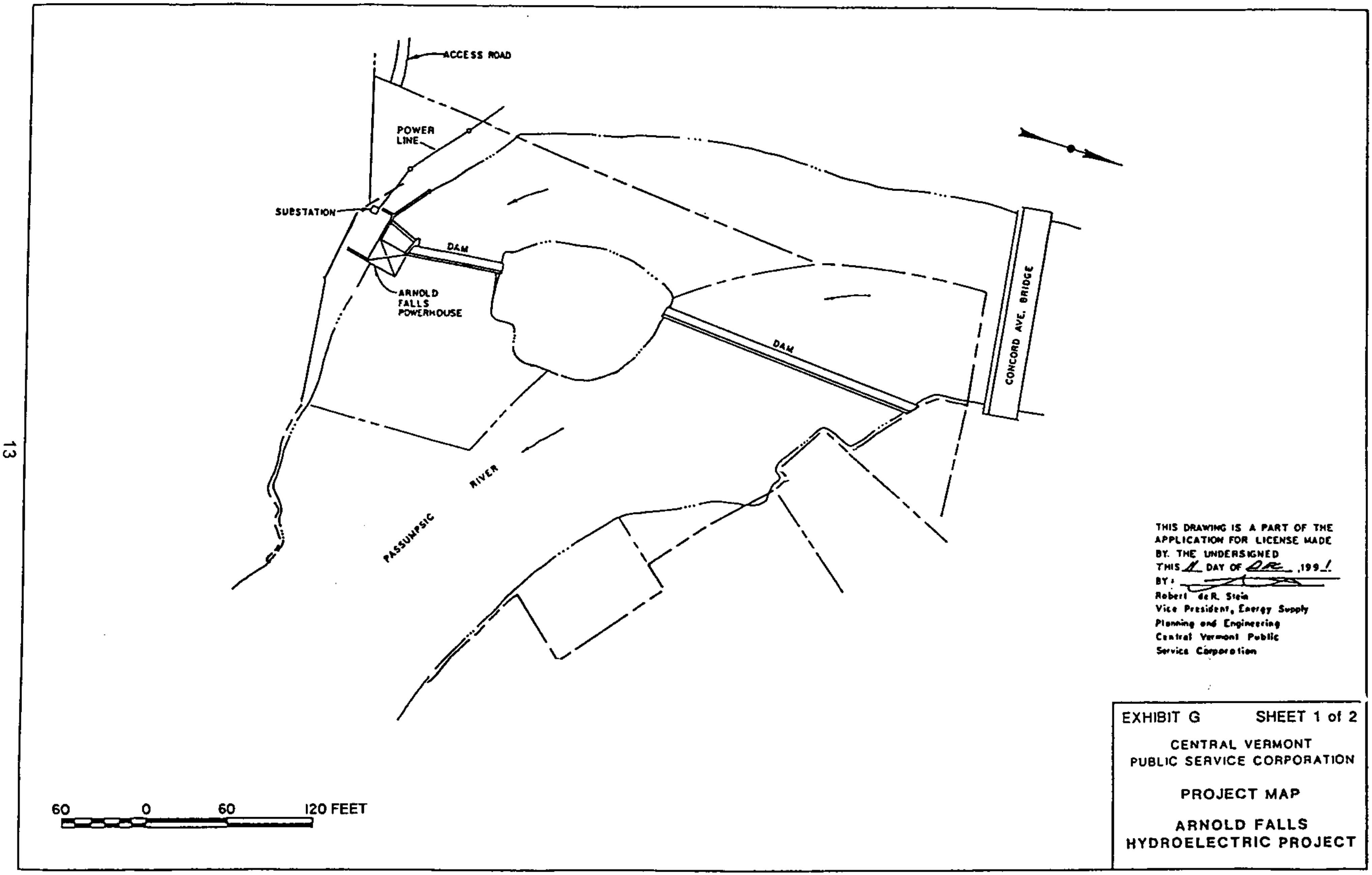

Figure 6: CVPS Arnold Falls hydroelectric facility (FERC No. 2399) on the Passumpsic River, St. Johnsbury, Vermont.
(Exhibit G, Sheet 1 of 2, CVPS project map for FERC application, December 11, 1991).

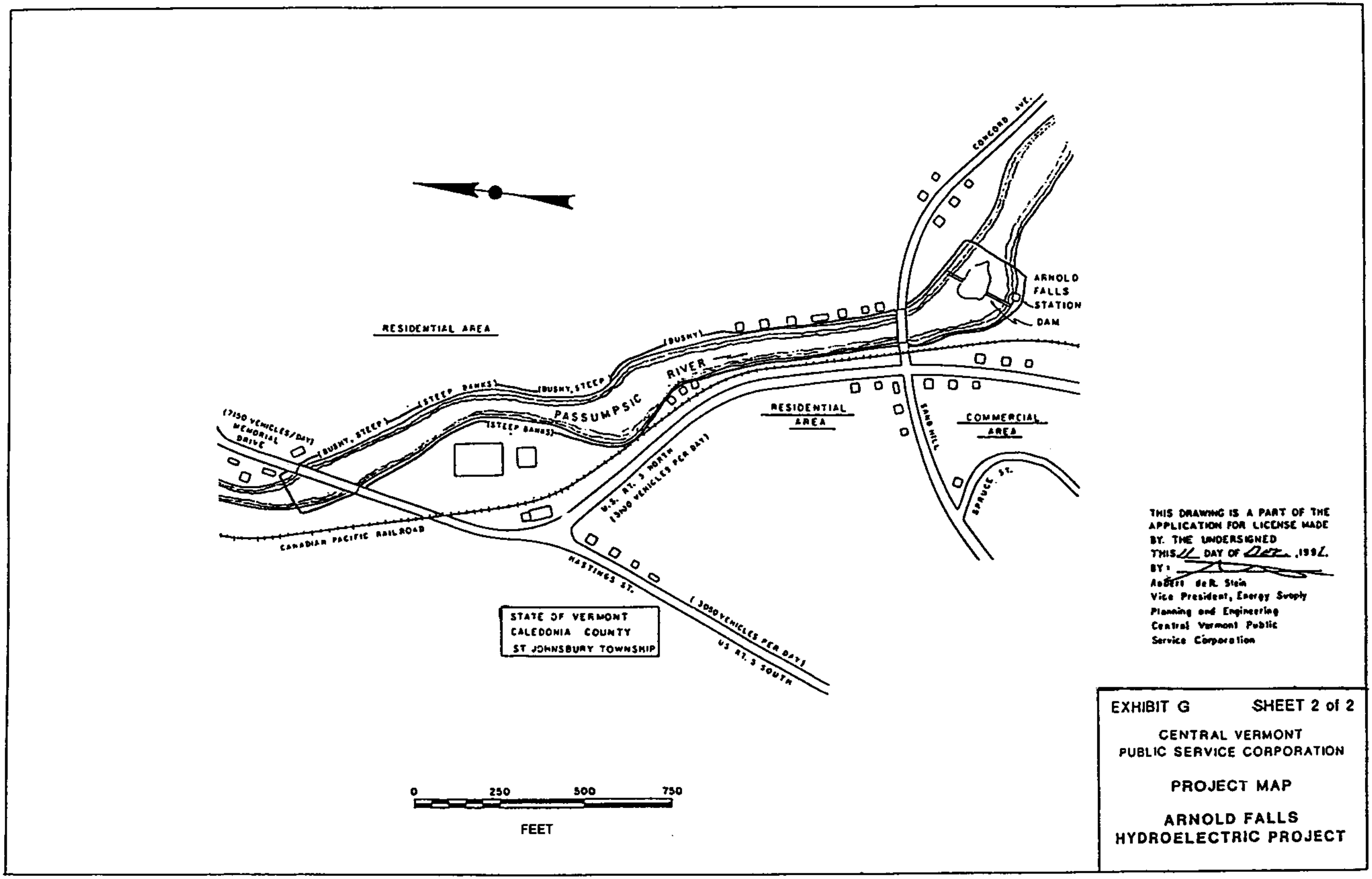

Figure 7: CVPS Arnold Falls hydroelectric facility (FERC No. 2399) on the Passumpsic River, St. Johnsbury, Vermont.
(Exhibit G, Sheet 2 of 2, CVPS project map for FERC application, December 11, 1991).

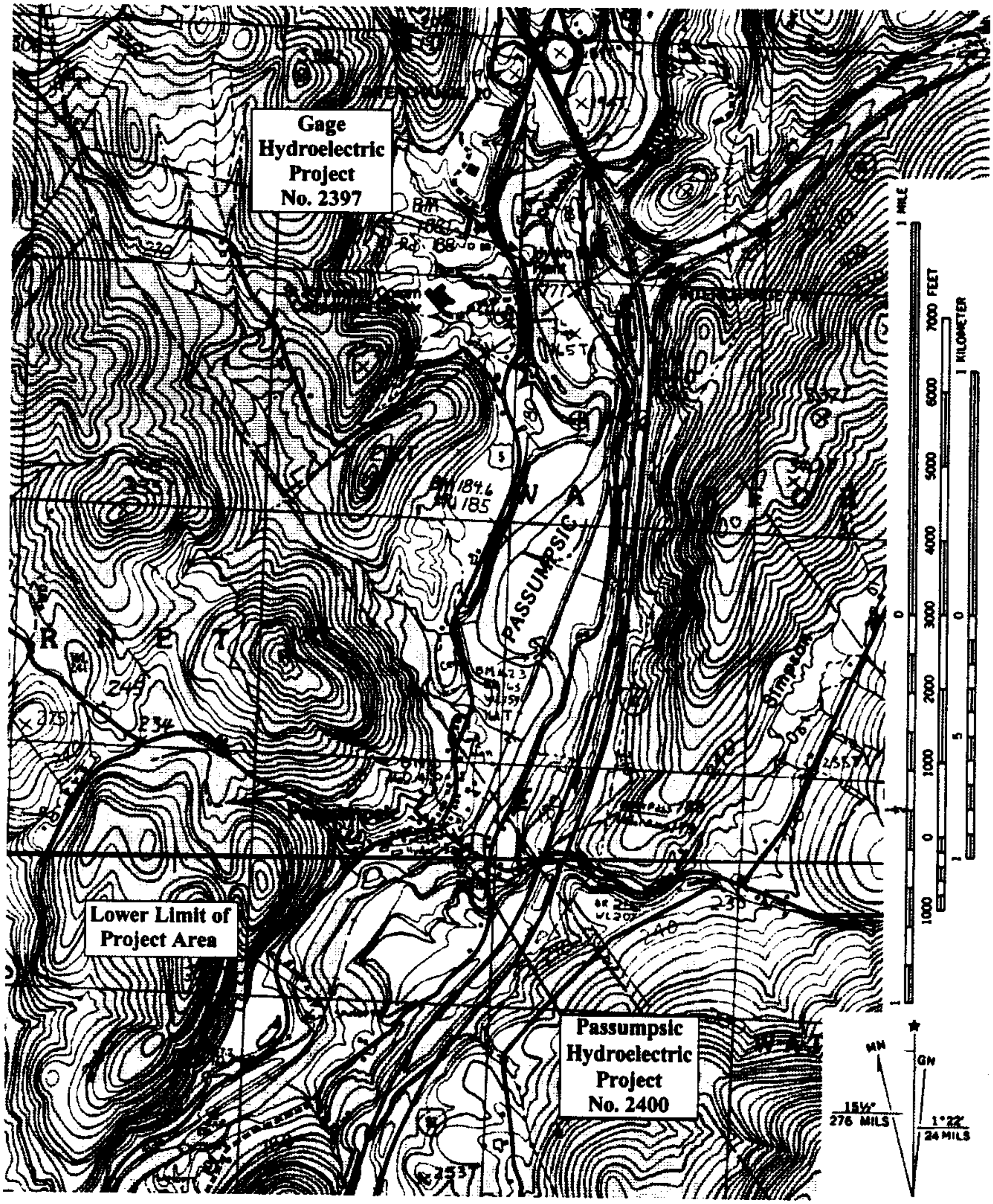

Figure 8: Location of CVPS Gage (FERC No. 2397) facility in St. Johnsbury, Vermont and the Passumpsic (FERC No. 2400) facility in the village of Passumpsic, Barnet, Vermont. (USGS 7.5x15 minute *St. Johnsbury, VT*, 1983 provisional edition and *Barnet, VT - NH*, 1983 provisional edition quadrangles)

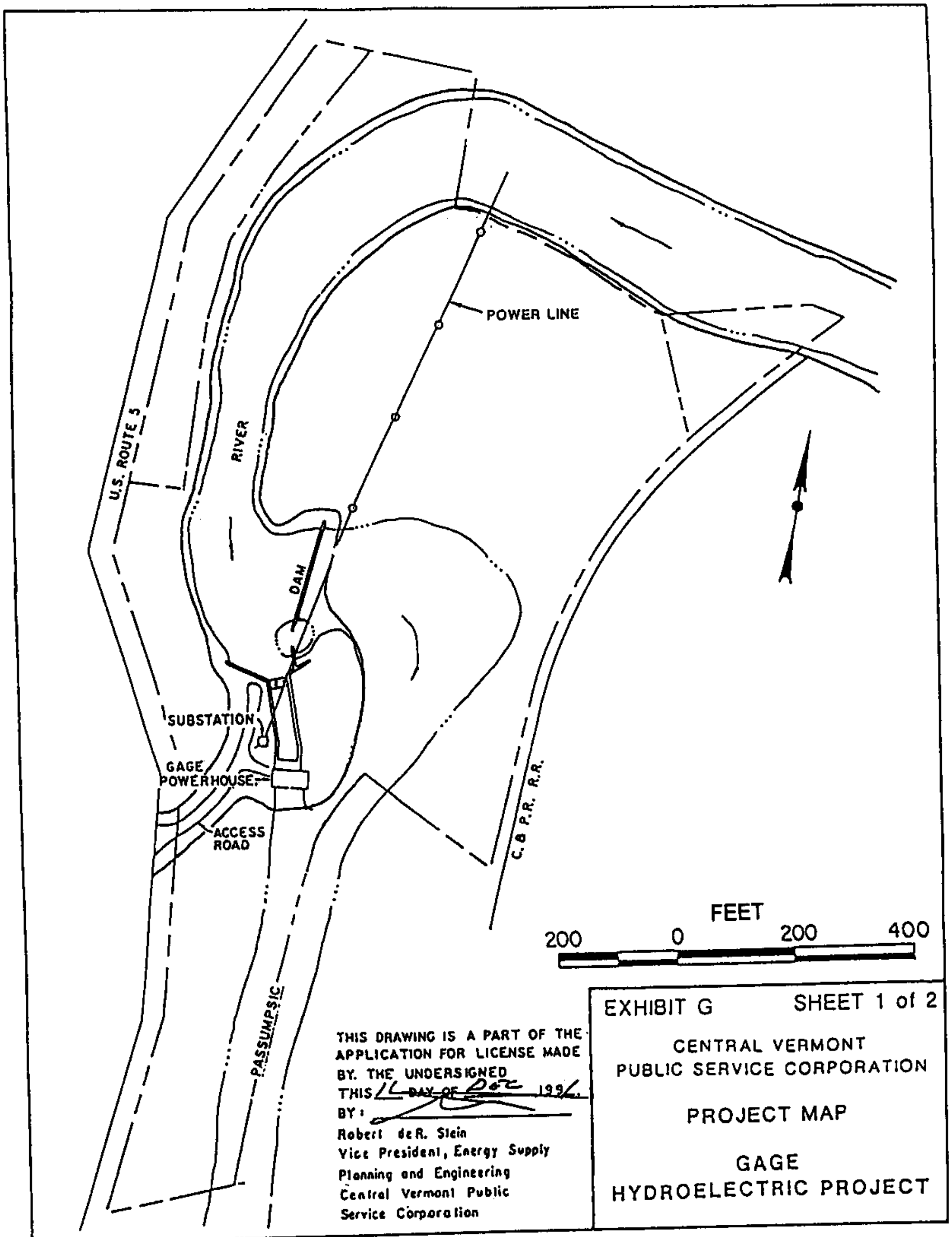

Figure 9: CVPS Gage hydroelectric facility (FERC No. 2397) on the Passumpsic River in St. Johnsbury, Vermont.
(Exhibit G, Sheet 1 of 2, CVPS project map for FERC application, December 11, 1991)

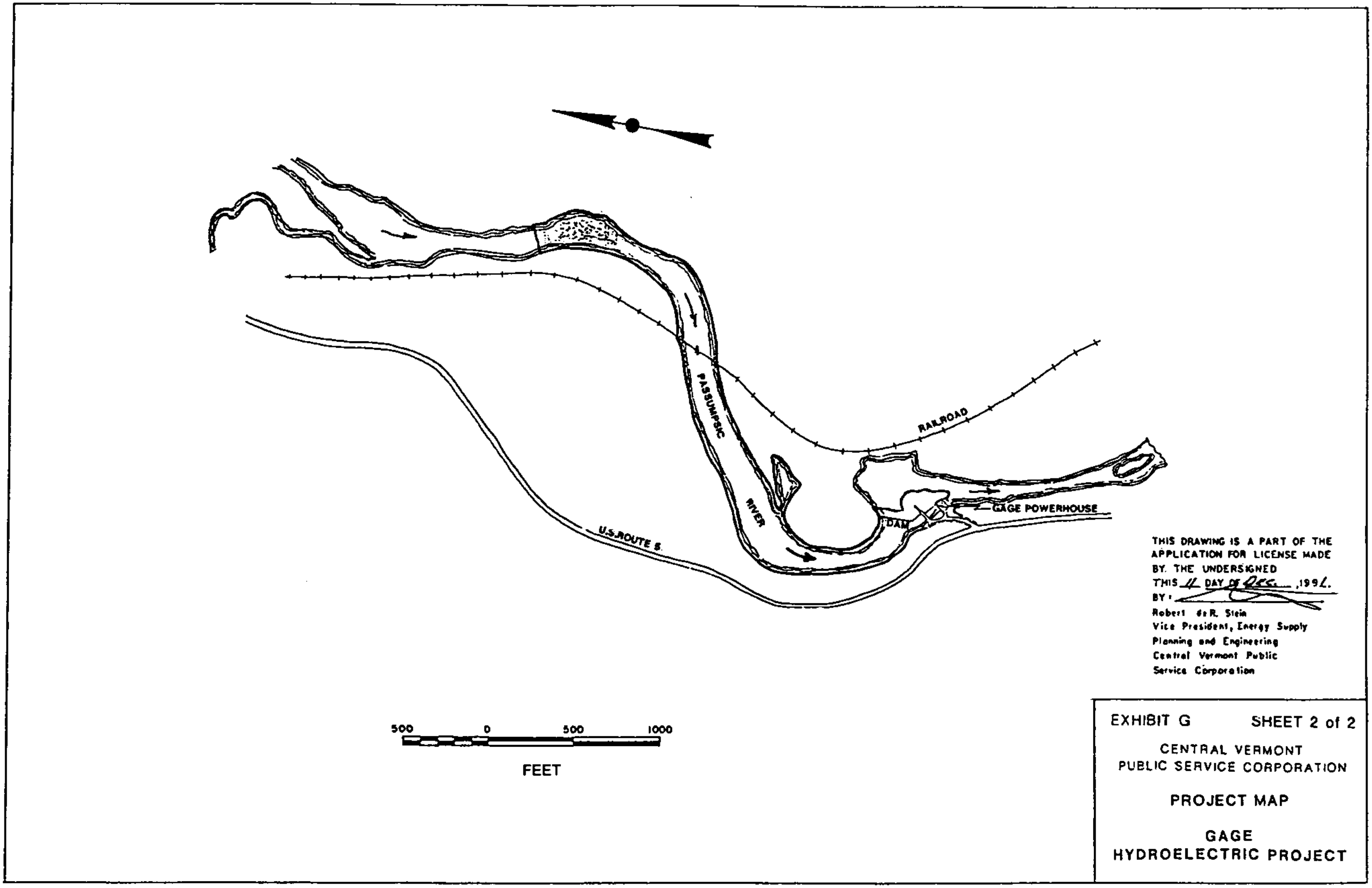

Figure 10: CVPS Gage hydroelectric facility (FERC No. 2397) on the Passumpsic River in St. Johnsbury, Vermont.
(Exhibit G, Sheet 2 of 2, CVPS project map for FERC application, December 11, 1991)

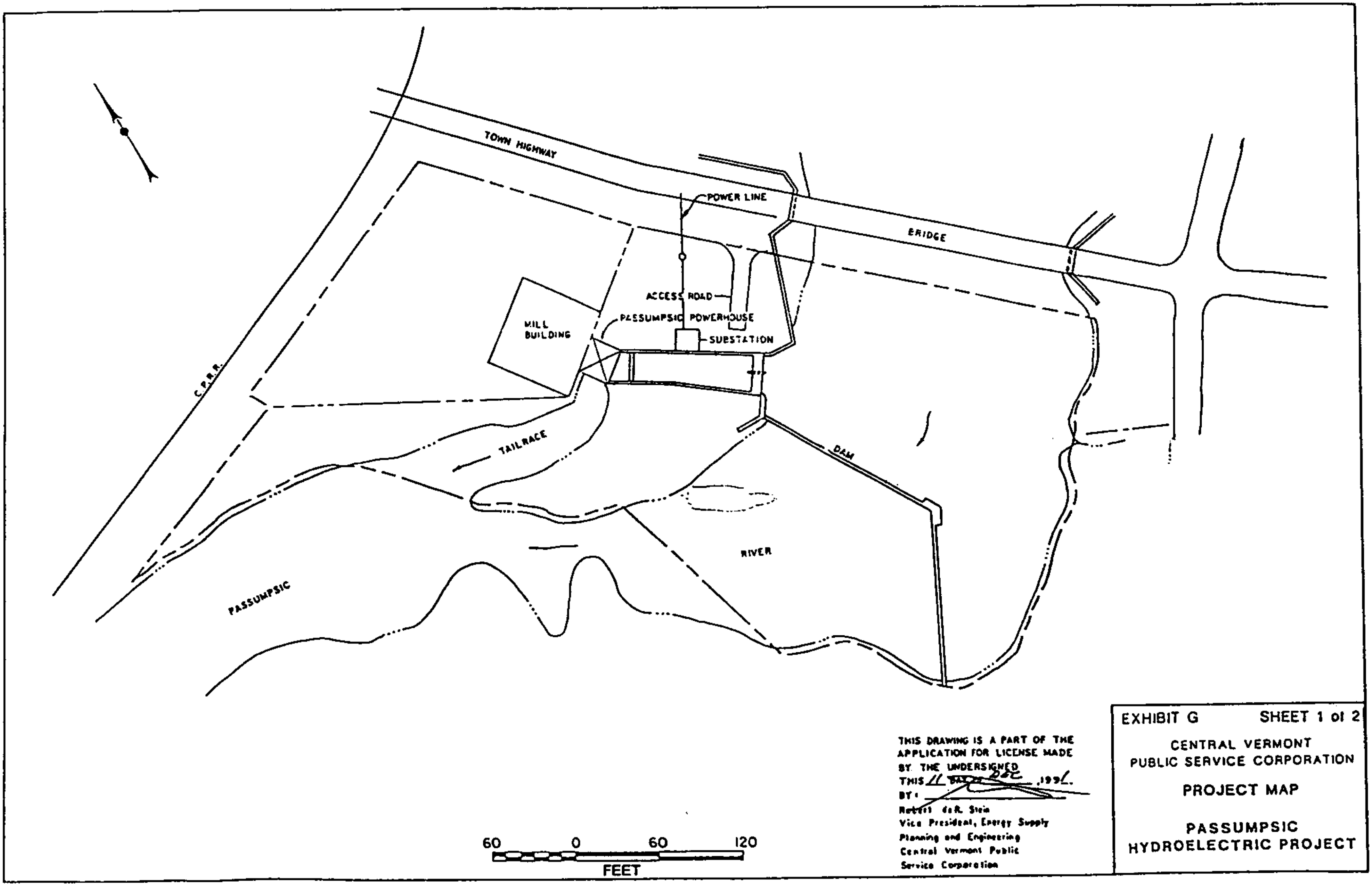

Figure 11: CVPS Passumpsic hydroelectric facility (FERC No. 2400) on the Passumpsic River in the village of Passumpsic, Barnet, Vermont.
(Exhibit G, Sheet 1 of 2, CVPS project map for FERC application, December 11, 1991)

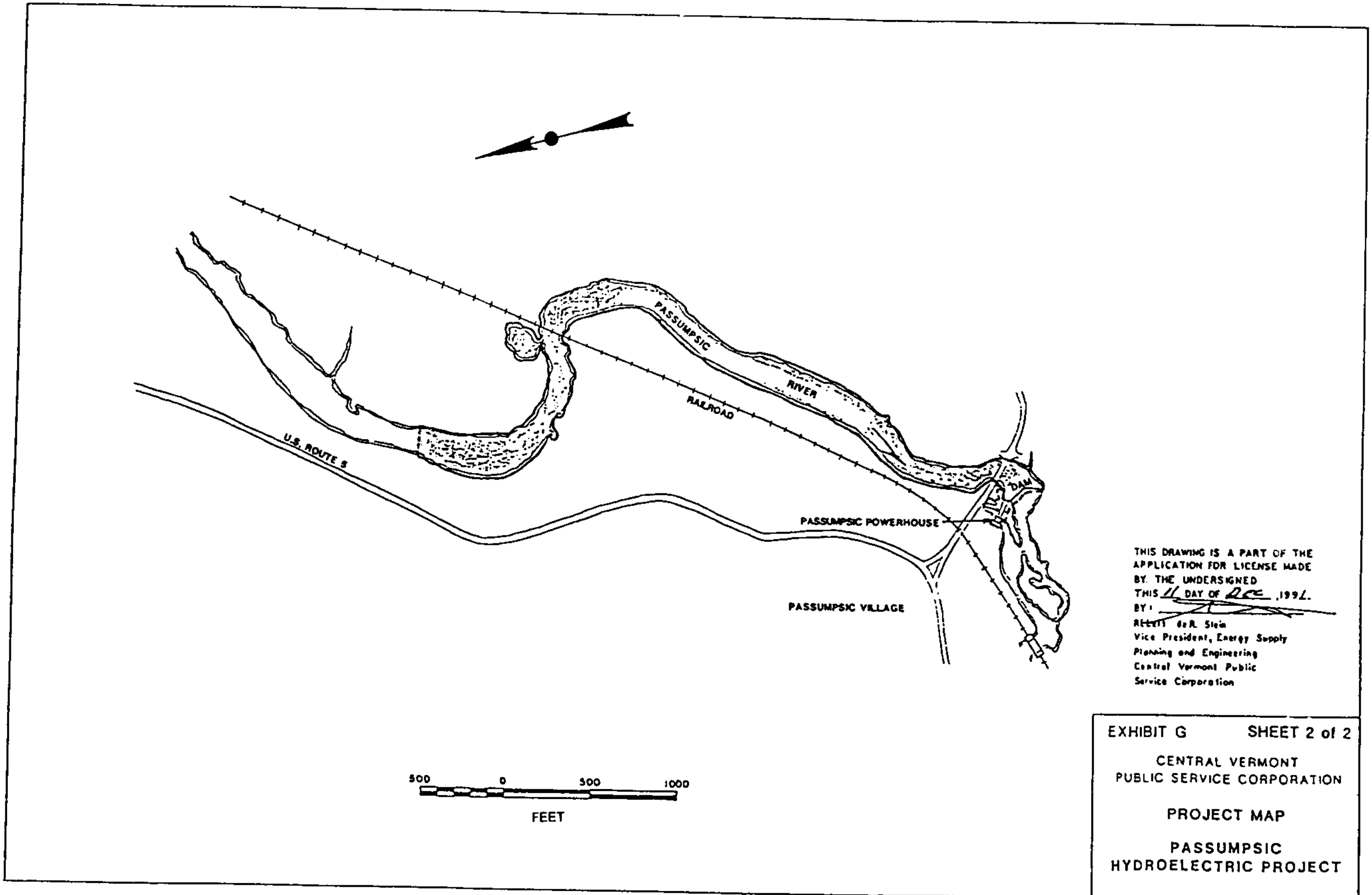

Figure 12: CVPS Passumpsic hydroelectric facility (FERC No. 2400) on the Passumpsic River in the village of Passumpsic, Barnet, Vermont.
(Exhibit G, Sheet 2 of 2, CVPS project map for FERC application, December 11, 1991)

1.2. Philosophical Approach for Proposed River System Management Plan

This section describes the philosophical basis for this CRMP.
The specific procedures for implementing the CRMP are set forth in chapters III and IV.

A river system should not be viewed in static terms, but rather as a dynamic, self organizing system, maintaining itself at a level of organization far from equilibrium. In classical physics, the term "equilibrium" implies a condition of total entropy or lack of organization. River systems are highly organized and tend to maintain themselves within definable parameters at what may be described as a "meta-stable" state. The health and stability of such a system need to be viewed in terms of optimal conditions for sustainable wildlife and human use. Rivers are dynamic systems, down-cutting or meandering across varied landscapes and environments. Through time, however, the system trends toward a meta-stable state within definable spatial (and temporal) parameters. Erosion, stream sediment loads, and soil deposits are all part of one integral process of evolution.

Forest communities and the resulting animal habitats, which have co-adapted with the river system over the past 12,000 to 14,000 years since the melting of the last glaciers in Vermont, comprise a feedback system with the river. Feedback systems are the mechanisms by which the system regulates itself. For example, a thermostat is a feedback system which switches on heat when temperatures drop below a preset level and switches off heat when temperatures rise to the preset level. The mixed vegetation of trees, shrubs, and grasses colonizes vulnerable riverbanks and floodplains, slowing the rate of meandering and riverbank erosion and removing stream sediment loads to backwater siltation ponds during seasonal floods. Low density human populations during earlier time periods also co-adapted with the river systems by restricting their occupations to stable landforms along the river.

The river systems were destabilized during the European colonization and settlement of Vermont. Deforestation, agricultural practices and dam construction to create water-powered industries collectively altered the previous co-adapted feedback systems that kept the river systems near a meta-stable state. Defoliated riverbanks and plowed hillsides were subject to massive erosion. Associated floodplains, filled in or built upon, could no longer assimilate the increased stream sediment loads. The sediments were instead carried far downstream before settling out as siltation behind the dams. The loss of forest community habitats caused a drop in number and diversity of wildlife, and the loss of surface soils through accelerated erosion quickly resulted in lowered agricultural productivity.

Cultural behavior regarding river use was recognized as a major problem and threat to the quality of human life in Vermont as early as the mid-nineteenth century (Marsh 1865). However, no significant changes were made until the early twentieth century. Many early changes were only cursory and were the result of negative feedback from the river system itself. Soils with low productivity were abandoned as agricultural fields and allowed to return to a forested condition. Seasonal flooding, made more severe by the loss of buffering floodplains and riverbank vegetation, washed away houses and croplands that occupied the destabilized landforms along rivers.

By the mid-twentieth century, cultural practices changed with the enactment of environmental laws and resource management programs. These changes have restricted construction activities within floodplains, regulated stream channel alterations, and controlled non-point source pollutants. The combined effects of abandonment along the river floodplains and the enactment of environmental programs to protect these fragile areas have allowed the river systems to partially recover.

Although the river system has begun to approach a new stable state, both natural and cultural processes continue to affect riverbank stability. Riverbank erosion and subsequent stream sediment loads limit aquatic habitats, threaten historic properties, and are deposited behind dams. Some of the agents that currently affect riverbank stability include seasonal and storm floods, ice jams and flows, wind-induced wave action, cattle paths and watering areas, hydroelectric impoundment fluctuations, and waves created by recreational boating. Each of these agents affect the meta-stability of the river system.

Traditionally, the archaeological studies conducted as part of the environmental review process provide one of several fragmented ecological reviews. In her book entitled, *The Dynamic Nature of Ecosystems,* Claudia Pahl-Wostl's opening statement on the discipline of ecology poignantly addresses the scope of resource management directives for river systems. She writes that the ecology disciplines have not significantly contributed to theoretical or actual solutions to environmental problems. This lack of progress, she observes, may be due to the complexity of the environment itself. The complex nature of the river system may result in divided areas of interest within the discipline as well as unpredictable environmental factors that make management decisions difficult (Pahl-Wostl 1995:1).

The management of historic properties cannot be satisfactorily performed in a vacuum and at the expense of other resources. A proactive approach, designed to manage multiple resources, should be the ultimate goal. The optimal management of wildlife, recreational, historic, and potential power resources is dependent on a river system at or near a steady state, with minimal channel down-cutting and streambank erosion. Dynamic systems at or near a steady state maintain stable and diverse subsystems for self-regulation. Destablized systems manifest a decline in the total number of functioning subsystems, while new subsystems replace some of the failing ones. For rivers, the result is expressed as a decrease in the biodiversity in the system. If streambanks are stable, fish and wildlife will have optimal habitat conditions, recreationalists are afforded premium surroundings, historic properties (both identified and as-yet unknown) are preserved *in situ*, and the potential water power is maintained.

Critical topics to be addressed in a general resource management plan for a river system include:

- Resource identification: both diversity and population size
- Potential threats to specific resources
- Methods of limiting negative effects without adversely affecting other resources
- Manageable and predictable costs of resource management
- Value and benefit to the local community

This CRMP for the Pierce Mills, Arnold Falls, Gage and Passumpsic hydroelectric facilities will address the regulatory concerns for historic properties within the greater context of public concerns for resources within the system as a whole. This CRMP will not attempt to establish *a priori* liability for causes of effects on resources, but will instead outline CVPS's short and long term efforts relative to the needs of the system as a whole. In this plan, the issue of responsibility is uncoupled from the issue of liability. CVPS will establish an annual budget to enable it to:

- Monitor riverbank erosion within the Project limits and pursue appropriate remedial stabilization programs,
- Assume direct responsibility for managing those historic properties within its legal landholdings, and
- Assume a coordinating role in river stewardship by assisting property owners, the local community, and non-profit organizations in the development of public outreach, educational, and riverbank stabilization programs to manage historic, archaeological, and natural resources.

This coordinating role will involve diverse groups, including property owners and private and non-profit organizations with interests in history, archaeology, and the environment, as well as state and federal agencies. Resources will be managed in consultation with this organized partnership to meet the common goal of stabilizing this twelve-mile length of the river system. The multiple interests represented within the partnership will reflect the complexity of the river system itself, and will result in management policies, procedures, and actions that reflect similar and related adaptive processes within the river system. Several assumptions have been made in the development of this plan:

1. That many of CVPS's efforts will be focused on public involvement in the implementation of the CRMP. Public involvement assumes ongoing public educational programs to raise awareness of the specific issues of resource value and management. Furthermore, through the process of public involvement, CVPS hopes to increase (both in terms of commitment and of spatial extent to portions of the river system not covered by this plan) the public investment in the future health of the river system and its integrated resources.

2. That all of the various resources are considered valuable, and that management decisions will be undertaken with the goal of maximizing the protection of all resources. Specific to historic properties, all identified archaeological sites having reasonable integrity will be considered potentially eligible for nomination to the National Register, without undertaking additional studies to prove such eligibility.

3. That it is not possible to guarantee the stability of the river system. The dynamic nature and diverse interrelated systems remain largely unknown. Instead, this CRMP will be implemented as a work-in-progress that will gather information to determine appropriate management actions, both for this CRMP and for future management tools. All aspects of this CRMP will be reviewed and critiqued annually by CVPS in consultation with the SHPO, and alternative actions for future implementation will be discussed where and when appropriate, with due consideration of potential impacts on all types of resources.

II. ACTIONS COMPLETED

2.1. Background Reports

Several studies relevant to this CRMP have been prepared in conjunction with CVPS's FERC licenses that were issued in 1994. These reports serve as a background for this CRMP and should be consulted for greater detail on any of the items discussed herein. The reports, available at both CVPS and SHPO offices, include:

1. *Phase IA Reconnaissance Archaeological Survey of the Pierce Mills, Arnold Falls, Gage, Passumpsic, Taftsville, and Cavendish Hydroelectric Projects Caledonia and Windsor Counties, Vermont.* Prepared by The Cultural Resource Group, Louis Berger & Associates, Inc., East Orange, New Jersey. 1991.

2. *Phase IB Archaeological Survey of the Gage and Passumpsic Hydroelectric Projects Town of St. Johnsbury and Village of Passumpsic Caledonia County, Vermont.* Prepared by The Cultural Resource Group, Louis Berger & Associates, Inc., East Orange, New Jersey. 1994.

3. *Hydroelectric Generating Facilities in Vermont* [Hydroelectric Power in Vermont, 1882-1941]. National Register of Historic Places Multiple Property Documentation Form. Prepared by Martha Bowers, Louis Berger and Associates, Inc., Waltham, Massachusetts. 1992.

4. National Register documentation for Twin State Gas & Electric Co. Hydroelectric Station District. Prepared by Martha Bowers, Louis Berger and Associates, Inc., Waltham, Massachusetts. 1992.

5. National Register documentation for Gage Hydroelectric Station. Prepared by Martha Bowers, Louis Berger and Associates, Inc., Waltham, Massachusetts. 1992.

At the present time, the four facilities appear eligible for inclusion in the National Register under both Criteria A and C, and identified archaeological sites within the Project are likely eligible under Criterion D.

2.2. Historic Resources

A multiple property document form (MPDF), entitled *Hydroelectric Generating Facilities in Vermont*, has been prepared as a joint effort by all the utilities pursuing relicensing in Vermont (Bowers 1992a). The Pierce Mills, Arnold Falls, Gage and Passumpsic hydroelectric facilities are among those described in the MPDF as representing the historic period of hydroelectric power development in Vermont (1882-1941). Some of the structures contributing to the significance of these facilities include the dams, intake structures, generating units, and powerhouses. FERC has determined that issuing the operating licenses for the four facilities "may affect properties included in or eligible for inclusion in the National Register of Historic Places" (FERC 1994).

2.3. Archaeological Resources

CVPS has undertaken a phased study approach to determine whether any archaeological sites are being adversely affected by the presence and operation of the Pierce Mills, Arnold Falls, Gage and Passumpsic hydroelectric facilities. This approach was used to determine the potential for archaeological sites, as well as the potential for facility-induced erosion.

A Phase IA archaeological site sensitivity study was conducted to determine locations of potential archaeological significance and to design a program to sample these defined locations (Louis Berger and Associates 1991). The study included preliminary information about the cultural history and environmental setting of the facilities. The background cultural information included the potential and known locations of early Native American sites in the Lower Passumpsic River drainage, as well as the nineteenth-century development surrounding the falls at the Pierce Mills, Arnold Falls, Gage and Passumpsic facilities. This cultural information was presented with a preliminary macro assessment of historic sedimentation and erosion to identify locations susceptible to ongoing erosion within the Gage and Passumpsic impoundments.

Louis Berger and Associates performed Phase IB site identification studies along the impoundment shorelines at the Gage and Passumpsic facilities in 1992 (Louis Berger and Associates 1994). No significant archaeological properties were recorded as a result of the Phase IB studies.

III. PROPOSED FUTURE ACTIONS

3.1. Historic Resources

The management plan for historic resources within the Project, encompassing the Pierce Mills, Arnold Falls, Gage and Passumpsic facilities (FERC Nos. 2396, 2399, 2397 and 2400, respectively), is as follows:

3.1.1. Continuity of Use

Operation of the facilities will be guided by the concept of management known as "continuity of use." This concept derives from the fact that without continued "use" (*i.e.*, operation) since their periods of construction, the hydroelectric facilities would not exist. Thus, continued operation is critical to the preservation of the facilities as National Register-eligible properties and to the conservation and care of their contributing structures and features. As noted in the Programmatic Agreement (Appendix A) for the four facilities (described in the excerpt as individual "Projects"):

> The proposed issue of subsequent licenses to Central Vermont [Public Service] for the Projects could have both adverse and beneficial effects. Inasmuch as the Projects are Historic Properties, issuing Central Vermont [CVPS] a subsequent license to continue operating and maintaining them under the protection afforded by Section 106 of the National Historic Preservation Act, is generally to be considered a beneficial effect, but in itself does not ensure that adverse effects would not ensue. Adverse effects could inadvertently occur during routine daily activities, at the Projects, in the absence of operation and maintenance plans designed to hold intact their historic integrity (FERC 1994).

The nature of a hydroelectric facility is such that it requires continuous improvement in terms of material endurance to maintain economic viability, and in terms of changes necessary to guarantee the safety of individuals associated with the facility. This regular maintenance can also help to protect environmental resources. This type of management is often most appropriate for operating facilities such as these, where simple worn or broken part replacement may not be the most appropriate.

Thus, the management of the Project facilities by continuity of use will be based on continued operation of the facilities, during which the prime management objective will be safe, efficient, cost-effective maintenance of contributing structures and features in relation to the facilities as a whole. Replacement in kind, as well as other preservation activities such as rehabilitation, re-use or stabilization *in situ*, will be undertaken to the extent that they are consistent with continuity of use. CVPS operating personnel will be given maintenance guidelines to safeguard the facilities' historic characteristics.

3.1.2. Project Modifications

Definition

Project modifications covered by this CRMP are those which do not require amendments to the CVPS facilities' licenses. Modifications to historic structures or features (contributing to the historic significance of the facility) that require a license amendment will be undertaken in conformance with legal requirements in effect at that time.

Consultation

CVPS will consult with the SHPO in the event that a planned activity or project modification may affect a historic structure or feature. The consultation will include discussion of possible alternatives, including, but not limited to, replacement in kind (see Appendix B).

Documentation

In the event that there is no reasonable and feasible alternative to removal or replacement of a historic structure or feature, CVPS will meet National Park Service and SHPO requirements for documentation and will consult with the SHPO about the affected structure or feature.

Internal Communication

A list of the historic structures and features contributing to the significance of the hydroelectric facilities will be provided to John Greenan, Environmental Engineer(Appendix C). When modifications are planned for any of these structures and features, CVPS will initiate consultation with the SHPO when appropriate. CVPS personnel will also be provided a checklist of maintenance principles as set forth in Appendix B.

Monitoring

All structures and features will be subject to field surveys on a five-year official schedule by a 36 CFR 61 qualified professional architectural historian to assess their condition and potential eligibility for the National Register. CVPS will notify the SHPO in the event that unanticipated impacts affect any of these structures or features.

Decommissioning

In the event that FERC or any other authorized agency orders the decommissioning of one or more of the facilities, CVPS will document the adverse effects of this action on historic properties. Neither CVPS nor any other entity is currently proposing to decommission any facility; therefore the corresponding documentation of adverse effects is not required at this time.

CVPS, in an agreement with the Vermont Agency of Natural Resources and the Vermont Natural Resources Council, developed a report on Dam Removal Alternatives in October 1997. The report was the primary product that the above mentioned parties agreed would trigger the dismissal of an Appeal of the Project's water quality certificate.

The attached report (Appendix D) summarizes the complex issues that decommissioning would evoke. The report addresses the need to restore and preserve historic structures associated with the dams, and agrees to consult with the SHPO on this issue. However, this report does not discuss potential effects on known or as-yet unidentified potentially significant archaeological sites that may exist on the riverbanks along the twelve-mile length of the Project.

The Dam Removal Alternatives report also addresses the environmental impact that dam removal would have on the current river channel of the Passumpsic River. The report does not, however, discuss the natural and ongoing geomorphic processes that occur within river systems, and the potential destabilization of the riverbanks that might result from the proposed action. The philosophical approach of this CRMP, as presented in Section 1.2., maintains that a holistic approach is necessary to promote the overall health of the river system without compromising natural or cultural resources.

Two dams were removed from the Passumpsic River between 1940 and 1950, and today, approximately 50 years later, the effects of these actions are still visible within the Project. Sediments that were released when the dams were removed still form drifting channel bars downstream from the former dams. As excess sediments from the dams filled in the river channel, the river maintained its cross-sectional area by laterally cutting its banks. It is likely that following the removal of additional dams within the Project, the Passumpsic River system would further destabilize and bank erosion would result. Any potential acceleration of streambank erosion within the Project could have devastating consequences on existing transportation corridors (for example, highways and railroads) that closely border the Passumpsic River.

For further discussion of the Passumpsic River's geomorphic history within the Project, see the Geomorphological Study in Appendix E. Inclusion of the Dam Removal Alternatives report within this CRMP is not intended as an endorsement of the report. Broader studies addressing all existing and potential historic properties would be required prior to implementing a removal plan.

3.1.3. National Register Nomination

If SHPO determines it is appropriate, CVPS will pursue nomination of the four facilities to the National Register of Historic Places as one discontiguous district. Hugh Henry, a qualified architectural historian, completed component matrix tables for each facility and designated major project components as either contributing or non-contributing (Appendix C). CVPS will uses these matrices (Appendix C) and the Historic Preservation Guidelines for Routine Maintenance Activities (Appendix B) to manage maintenance and repair activities.

3.2. Archaeological Resources

3.2.1. Future Improvements

Should CVPS propose any improvements to the four facilities within the Project that will result in ground-disturbing activities, CVPS will consult with the SHPO to determine whether such activities will affect potentially significant archaeological resources. If there is a potential effect to archaeological resources, CVPS will not undertake such activities until proper modifications or accommodations have been made pursuant to consultation with the SHPO.

3.2.2. Action Plan for Riverbank Stabilization

The objective of stabilization is not to tame and control the river. This objective has been attempted and has failed in the past. Rather, stabilization will be designed to minimize erosive events within the river's present normal channel. The best approach for preserving the integrity of the riverbank will attempt to protect all of the river system's diverse resources.

With attention to the dynamic evolutionary nature of the river, various depositional and erosional surfaces will be identified and their contribution to the river system as a whole will be defined. These identified surfaces will provide the basis for determining both the needs and specific actions required to obtain system equilibrium. For example, erosion within a recent temporary sand bar deposit may be defined as a natural, healthy aspect of the river system that does not require intervening action. Bank slumpage along an older relict terrace, however, may indicate instability in the system that requires intervention.

In its role as a steward of the river, CVPS is proposing to work with the SHPO in the management of the potential resources on these lands. To protect resources from the adverse effects of erosion and other activities, CVPS will actively seek out and try to form partnerships with existing organizations whose missions include river conservation. CVPS will support the efforts of organizations such as the Passumpsic Valley Land Trust and the St. Johnsbury Beautification Committee to plan and implement river protection and restoration projects, including bank stabilization and riparian buffer establishment.

This supporting and advisory role will be realized by a committee including, but not limited to, a 36 CFR 61 qualified archaeologist, a riverine botanist, and a natural resources planner. This core committee will be primarily responsible for carrying out this CRMP on behalf of CVPS. The core committee will report directly to John Greenan, Environmental Engineer, who will work on a collaborative basis with others at CVPS. The intent of this CRMP is to assist in managing those aspects of the river system that can be effectively managed by cooperating parties, including CVPS, in accordance with the terms of this CRMP. This approach will protect, to the extent possible, those resources that may exist on private lands adjacent to the Project.

The core committee will assist in designing proposed actions, and will collaborate with various federal and state agencies, public groups, and adjacent landowners with an interest in the river's resources. Depending on the nature of the proposed action, the core committee will be collaborating with the US Fish and Wildlife Service, the US Natural Resources Conservation Service, the Vermont Agency of Natural Resources, Trout Unlimited, the Passumpsic Valley Land Trust, Lyndon State College, the Vermont Department of Corrections, the regional planning commission, local and regional conservation commissions, the Passumpsic River Network, and the Town of St. Johnsbury Beautification Committee, as well as individual private landowners adjacent to the river. Copies of this CRMP will be made available to potential partners.

The intent of this CRMP is to give additional support and direction to organizations that have knowledge of and experience with the Passumpsic River and its associated resources. The CRMP will build on their past work and facilitate their missions as they relate to the protection and restoration of riverbanks and riparian integrity. This plan will increase the effectiveness of the various interests through coordinated efforts--not replace or usurp their positions of interest. CVPS recognizes that the long term health and stability of the river system will depend on increased public involvement and participation, and not on a concentration of control by a single entity. The core committee will provide input to river conservation groups to balance immediate concerns and effects with potential long term changes in the river system.

Remedial short term actions will be facilitated by the core committee within the year (if appropriate) following the core committee's recommendation of such action in consultation with SHPO and in conjunction with other concerned groups, when pertinent, in identified erosion areas. Remedial activities on non-CVPS owned land will be subject to receipt of landowner consent, and will be undertaken in conjunction with the landowner and/or other community groups. Most remedial actions will consist of planting new, or additional, plant cover (to include, but not limited to, grasses, shrubs, vines and trees). In the event of severe erosion due to major flooding along CVPS property, CVPS may facilitate more extreme remedial actions and assist others with the installation of geotech-fabric, or, as a last resort, bank rip-rapping. Additional techniques will be considered as they become available.

Typical long term actions may include, but not be limited to, helping local conservation organizations negotiate with adjacent landowners to stabilize streambanks using, among other things, bioengineering techniques and expanding streambank vegetation buffers. The Natural Resources Conservation Service and the US Fish and Wildlife Service both offer support for bank stabilization in combination with buffer strips. Riparian buffers have the potential to control erosion and to improve water quality, fish and wildlife habitats, and aesthetic value as well. Comprehensive conservation systems may involve a combination of buffer types along waterways.

The Natural Resources Conservation Service (NRCS) of the US Department of Agriculture provides several kinds of technical and financial assistance that can be used to preserve riparian areas. Under these programs, local offices of the NRCS and Natural Resources Conservation Districts help private landowners develop their restoration or preservation plans. Two NRCS programs may apply to the Project: (1) The Wildlife Habitat Incentives Program (for any private landowner) offers funding of up to 75% of the costs of implementing wildlife practices, such as creating buffer strips, and (2) the Watershed Protection and Flood Prevention Program (for landowners working through local government sponsors) provides cost-sharing for water-related projects, including erosion and sediment control.

The US Fish and Wildlife Service's (USFWS) Partners for Wildlife Program provides assistance to private landowners for the restoration of various habitats, including riparian areas. Under this program, the landowner must enter into a cooperative agreement for 10 to 25 years, and can receive funding for up to 60% of restoration costs.

3.2.3. Monitoring

CVPS will coordinate annual monitoring reviews of the 12-mile river reach encompassing its four Passumpsic River facilities. Monitoring will be conducted in collaboration with identified partners who will assist in prioritizing riparian restoration strategies and will evaluate past remedial actions. Special attention will be given to locations surrounding all identified and potential archaeological sites. All areas of bank erosion and bank destabilization will be identified. Remedial actions planned by concerned groups will be reviewed by the core committee for both CVPS-controlled and privately owned lands throughout the Project (with the concurrence and cooperation of private landowners).

Any cultural material identified during the bank monitoring program will be documented by the 36 CFR 61 qualified archaeologist on the core committee. Appropriate management recommendations will be promptly submitted to the SHPO for review and comment.

3.2.4. Public Outreach and Education

All proposed actions will address the potential for education-oriented public involvement. The conceptual framework of this plan defines twelve miles of the Passumpsic River as a potential laboratory for research and long term studies on such varied topics as biology, physics, earth sciences, history, archaeology, and recreation. While the core committee will assist the effort to gather data regarding these various topics of interest, the data will need to be appropriate for the common goal of this plan. CVPS will encourage area schools, businesses, funding organizations, and other interested parties to use this natural laboratory *(e.g.,* Boy and Girl Scout workshops for merit badges in archaeology). These programs will increase the quantity and breadth of data acquisition from this laboratory and fulfill the CRMP's goals to involve the public. Copies of this CRMP will be made available to potential partners.

3.2.5. Data Collection and Reports

Annual reports describing all aspects of the work outlined above will be filed with the SHPO by April 1 of the following calendar year, commencing the year subsequent to FERC approval. These reports will document the findings of the monitoring program, the plans of action (proposed and implemented), the outcomes of such actions, the progress of educational programs, and the actions taken to support, facilitate, and include the public in these various activities. The annual report will also include recommendations for agendas, actions, and goals for the upcoming year and a distribution list. CVPS will endeavor to distribute the annual report to appropriate public repositories (for example, develop a world wide web site). Collected data will be maintained in electronic media for use in GIS or other appropriate applications.

The SHPO and CVPS will meet each April to review and discuss the annual report unless both parties waive the requirement of this meeting.

All proposed actions will be submitted to the SHPO for review and comment in the annual report, except when emergency measures require immediate review. The SHPO will have 30 days to respond to the proposed actions. Should no comments be received from the SHPO after 30 days, concurrence by the SHPO will be assumed and CVPS will proceed with the proposed action. If a disagreement arises concerning a proposed action, the SHPO and a designated representative of CVPS will consult in an attempt to resolve the disagreement before the dispute is brought before FERC.

3.2.6. Annual Budget

CVPS and the SHPO agree that during the remainder of the forty-year term of the Project's current FERC facilities' licenses, CVPS will annually budget $ 3,000 to perform the actions described in this CRMP (commencing the year subsequent to FERC approval and adjusted annually thereafter as provided below in this section). This amount will be used to perform CVPS's obligations under this CRMP, including short and long term riverbank stabilization actions, public outreach, and additional necessary archaeological research. This budgeted amount, however, will not be used for (1) the services of the core committee in performing the annual monitoring activities and preparing reports as described in Sections 3.2.3 and 3.2.5, or (2) annual capital projects for the historic structural components of the Project. The anticipated expenditures of amounts budgeted, which are subject to allocation upon recommendation of the core committee, are set forth in Appendix F.

If the full budgeted amount ($ 3,000) is not used in a given year, the cumulative unused budgeted amount shall be available for use in subsequent years in addition to the current annual budget. If recommended activities under this CRMP exceed the budgeted funds available in a given year (including any accrued surplus), such activities will either be deferred until sufficient budgeted funds are available or CVPS will attempt to obtain the required funds from a network of interested public and private organizations or individuals. In this event, CVPS will undertake reasonable efforts to secure this additional financial support. CVPS will not be obligated to expend funds in excess of the cumulative budgeted funds to implement this CRMP. The cumulative unspent funding remaining at the termination of the Project's current FERC licenses in 2034 will be used for appropriate CVPS CRMP-related programs determined at the discretion of CVPS in consultation with the SHPO within two years of the termination of the current licenses.

CVPS's budgeted amount of $ 3,000 shall be adjusted annually for each calendar year subsequent to the first calendar year following FERC approval to account for inflation during the remainder of the current term of the FERC licenses for the Project in the following manner:

a) The Consumer Price Index (the "Index") For All Urban Consumers, 1982-84 Base Year, All Items, US city average (CPI-U), as published by the Bureau of Labor Statistics of the United States Department of Labor (the "Bureau") which is the last Index published prior to the first month of the calendar year for which the adjustment is to be made (the "Adjustment Index") shall be compared with the Index which was last published prior to December 31, 1996 (the "Beginning Index"). If the Adjustment Index has increased over the Beginning Index, then the percentage increase between the Beginning Index and the Adjustment Index shall be determined as the percentage that is equal to the sum of one plus the ratio equal to the quotient of the numerator, which is the Adjustment Index minus the Beginning Index, divided by the denominator, which is the Beginning Index.

   $ 3,000 shall be multiplied by the percentage increase determined in subsection (a) above to arrive at the amount of the increase in the annual budgeted amount. In no event shall the budgeted amount in any year be less than $ 3,000.

b) If the Index is changed so that a base year other than 1982-84 is used, the Index shall be converted in accordance with the conversion factor published by the Bureau. If the Index is discontinued or otherwise revised during the remainder of the term of the Project's current FERC licenses, then such other government index or computation with which it is replaced shall be used by CVPS in order to obtain substantially the same result as would be obtained if the Index had not been discontinued or revised.

IV. GENERAL OBLIGATIONS

CVPS will ensure that all archaeological surveys are conducted in a manner consistent with the standards identified in the following sources: the Secretary of the Interior's *Standards and Guidelines for Identification and Evaluation*, and the Vermont *Guidelines for Archeological Study*. The surveys will also take into account the National Park Service publication, *Archaeological Survey: Methods and Uses*.

All surveys will be conducted in consultation with the SHPO. As appropriate with each study, CVPS will provide the SHPO with a scope of work and a draft report for review. Fifteen to fifty copies of the final report (depending on the level of study) will be made available for distribution. The actual number of report copies will be prescribed in the specific scope of work. If a survey results in the identification of properties that are eligible for inclusion on the National Register, CVPS will develop a scope of work for review by the SHPO. If CVPS and the SHPO agree on the scope of work, CVPS will execute the agreed upon plan subject to budget availability.

CVPS will determine the National Register eligibility of specific properties in consultation with the SHPO. If the SHPO agrees with CVPS's determination of eligibility, such concurrence will be deemed conclusive for purposes of this CRMP. If the SHPO fails to respond within 45 days of receipt of the request for concurrence, CVPS's determination will be deemed conclusive for purposes of this CRMP. If the SHPO disagrees with CVPS's determination within 45 days, or if the Council or the Secretary of the Interior so requests, the FERC will request a determination of eligibility from the Keeper of the National Register in accordance with 36 CFR Part 63.

CVPS will adhere to the following requirements in all instances of archaeological data recovery:

1. CVPS will consult with the SHPO to develop and implement any scope of work for the recovery of archaeological data, and will ensure that the scope of work is consistent with the *Secretary of the Interior's Standards and Guidelines for Identification and Evaluation*, and the Vermont *Guidelines for Archeological Studies*. The Council's 1980 publication, *Treatment of Archaeological Properties*, will also be consulted.

2. At a minimum, the scope of work for the recovery of archaeological data will specify:

- The property where data recovery is to be conducted,
- The research questions to be addressed through data recovery, and an explanation of its relevance and importance,
- The methods to be used, with an explanation of relevancy to the research questions,
- The methods to be used in data analysis, management, and appropriate public involvement strategies,
- The proposed costs for data analysis and report preparation,

- The proposed schedule for the implementation and completion of fieldwork, data analysis and report preparation, and
- The description of how the final report will be made available to the professional archaeological community and to the general public.

3. CVPS will ensure that all archaeological reports resulting from actions taken pursuant to this CRMP are provided to the SHPO and the FERC for their review and comment. All such reports will adhere to the contemporary professional standards of the *Secretary of the Interior's Standards and Guidelines for Archaeological Documentation* and the Vermont *Guidelines for Archeological Studies*. CVPS will, upon request and subject to budget availability, provide copies of the reports to other interested parties. Precise locational data will be withheld, if necessary, to protect the specific archaeological site.

4. CVPS will use reasonable efforts to ensure that all materials and records resulting from actions taken pursuant to this agreement are curated within the State of Vermont in accordance with 36 CFR Part 79. Moreover, CVPS will ensure that any human remains and associated grave artifacts encountered during any action pursuant to this agreement are treated in accordance with the Vermont Statutes (Title 13, Sections 3761 and 3764, and Title 18, Sections 5211 and 5212, VSA) and/or the Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. Part 3001 *et seq.*).

CVPS will ensure that all historic preservation work carried out pursuant to this CRMP, including annual and long term monitoring, is conducted by or under the direct supervision of a qualified archaeologist or persons meeting the Secretary of the Interior's professional qualification standards.

The SHPO may, at any time, review activities carried out pursuant to this CRMP. CVPS will cooperate with the SHPO in its review of activities that are carried out pursuant to this CRMP. If the SHPO, the Council, or CVPS object within 45 days to any action pursuant to this CRMP, the FERC will consult with the objecting party to resolve the objection.

The provisions of this CRMP will not be amended, except upon an agreement in writing by FERC, the Council, the SHPO and CVPS.

REFERENCES

Advisory Council on Historic Preservation (the Council)
1980 *Treatment of Archaeological Properties.* Washington, D.C.

Bowers, Martha H.
1992a *Hydroelectric Generating Facilities in Vermont* [Hydroelectric Power in Vermont, 1882-1941]. National Register of Historic Places Multiple Property Documentation Form. Louis Berger and Associates, Inc. Waltham, Massachusetts. May 1992.

1992b National Register documentation for Twin State Gas & Electric Co. Hydroelectric Station District. Prepared by Louis Berger and Associates, Inc., Waltham, Massachusetts.

1992c National Register documentation for Gage Hydroelectric Station. Prepared by Louis Berger and Associates, Inc., Waltham, Massachusetts.

Federal Energy Regulatory Commission (FERC)
1994 *Programmatic Agreement among the Federal Energy Regulatory Commission, the Advisory Council on Historic Preservation, and the Vermont State Historic Preservation Officer; for Managing the Historic Properties that may be Affected by a License Issuing to Central Vermont Public Service Corporation for the Continued Operation of Four Hydroelectric Projects on the Passumpsic River in Vermont.* executed November 25, 1994.

Kleinschmidt Associates
1997 *Passumpsic River Projects--Report on Dam Removal Alternatives.* Final Report. Prepared for Central Vermont Public Service Corporation, Rutland, Vermont. Kleinschmidt Associates, Pittsfield, Maine.

Louis Berger and Associates, Inc.
1994 *Phase IB Archaeological Survey of the Gage and Passumpsic Hydroelectric Projects Town of St. Johnsbury and Village of Passumpsic Caledonia County, Vermont.* Louis Berger and Associates, Inc., Waltham, Massachusetts.

1991 *Phase IA Reconnaissance Archaeological Survey of the Pierce Mills, Arnold Falls, Gage, Passumpsic, Taftsville, and Cavendish Hydroelectric Projects, Caledonia and Windsor Counties, Vermont.* Louis Berger & Associates, Inc., East Orange, New Jersey.

Marsh, George Perkins
1865 *Man and Nature; or Physical Geography as Modified by Human Action.* Charles Scribner, New York.

Pahl-Wostl, Paula
1995 *The Dynamic Nature of Ecosystems: Chaos and Order Entwined.* John Wiley & Sons, Inc., New York.

United States Geological Service (USGS), using *TopoScout*, version 2.01, Maptech, Inc., Greenland, NH. 1997.
1988 *Burke Mountain, VT* 7.5 minute quadrangle, provisional edition.

1986 *Lyndonville, VT* 7.5 minute quadrangle, provisional edition.

1983 *Barnet, VT - NH* 7.5x15 minute quadrangle, provisional edition.

1983 *Concord, VT* 7.5 minute quadrangle, 1965, photorevised.

1983 *St. Johnsbury, VT* 7.5x15 minute quadrangle, provisional edition.

The parties to this Cultural Resource Management Plan have reviewed the terms of the CRMP as specified above, and by signature below acknowledge their concurrence in adoption of this CRMP.

VERMONT STATE HISTORIC PRESERVATION OFFICE	CENTRAL VERMONT PUBLIC SERVICE CORPORATION
By:__________________________	By:__________________________
Date: __________________________	Date: __________________________
ADVISORY COUNCIL OF HISTORIC PRESERVATION	FEDERAL ENERGY REGULATORY COMMISSION
By:__________________________	By:__________________________
Date: __________________________	Date: __________________________

APPENDIX A: 1994 Programmatic Agreement

FEDERAL ENERGY REGULATORY COMMISSION
Office of Hydropower Licensing
Washington, DC 20426

November 4, 1994 (Friday) 8:12am

MEMORANDUM

TO: The Restricted Service List

FROM: James T. Griffin, East Branch Archaeologist
(202) 219-2799

SUBJECT: **AGREED-UPON** Programmatic Agreement for Central Vermont Public Service Corporation's Four Passumpsic River Projects, Project Nos. 2396, 2397, 2399, and 2400, in Vermont

The final Programmtic Agreement for the four Passumpsic River projects is attached hereto. Mr. Springer has signed it and directed me to send it to the parties for signature.

It goes first to:

Eric Gilbertson, Director
Vermont Division for Historic Preservation
135 State Street, 4th Floor
Drawer 33
Montpelier, VT 05633-1201

telephone: (802) 828-3226
FAX: (802) 828-3206

It goes next to:

Robert G. Kirn
Vice President of Division Operations
Central Vermont Public Service Corporation
77 Grove Street
Rutland, VT 05701

telephone: (802) 773-2711
FAX: (802) 747-2199

Finally, Central Vermont should send it back to me (by overnight mail, please):

James T. Griffin
Federal Energy Regulatory Commission
810 First Street, NE, Room 1049
Washington, DC 20426

telephone: (202) 219-2799
FAX: (202) 219-0125

I will see that the Programmatic Agreement is taken to

Robert D. Bush, Executive Director
Advisory Council on Historic Preservation
Old Post Office Building, Suite 809
1100 Pennsylvania Avenue, Northwest
Washington, DC 20004

telephone:	(202) 606-8505
FAX:	(202) 606-8672

for Dr. Bush's signature.

I have received comments on the draft circulated during the week after our meeting in Montpelier from Central Vermont and the Advisory Council on Historic Preservation. Copies of these comments are included herewith.

While the original goes to the Vermont SHPO for signature; each of the parties listed above has been simultaneously served with a copy.

Thank you for your participation.

PROGRAMMATIC AGREEMENT

AMONG

THE FEDERAL ENERGY REGULATORY COMMISSION,

THE ADVISORY COUNCIL ON HISTORIC PRESERVATION, AND

THE VERMONT STATE HISTORIC PRESERVATION OFFICER;

FOR MANAGING HISTORIC PROPERTIES THAT MAY BE AFFECTED

BY A LICENSE ISSUING TO

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

FOR THE CONTINUED OPERATION OF

FOUR HYDROELECTRIC PROJECTS

ON THE PASSUMPSIC RIVER

IN VERMONT

WHEREAS, the Federal Energy Regulatory Commission (hereinafter, "Commission") proposes to issue licenses to Central Vermont Public Service Corporation (hereinafter, "Licensee" or "Central Vermont") to operate or continue operating the

» Pierce Mills Hydroelectric Project, Project No. 2396,

» Gage Hydroelectric Project, Project No. 2397,

» Arnold Falls Hydroelectric Project, Project No. 2399, and

» Passumpsic Hydroelectric Project, Project No. 2400

(hereinafter, "Pierce Mills", "Gage", "Arnold Falls", and "Passumpsic" respectively, or, collectively, "Projects"), as authorized by Part I of the Federal Power Act, 16 U.S.C. Sections 791(a) through 825(r), as amended; and,

WHEREAS, the Commission has determined that issuing any or all such licenses may affect properties included in or eligible for inclusion in the National Register of Historic Places (hereinafter, "Historic Properties"); and

WHEREAS, Appendix A of this Programmatic Agreement provides a description of the Projects, Historic Properties identified as of the date of this Programmatic Agreement, and anticipated effects; and

WHEREAS, the Commission has consulted with the Advisory Council on Historic Preservation (hereinafter, "Advisory Council") and the Vermont State Historic Preservation Office (hereinafter, "SHPO") pursuant to 36 C.F.R. Section 800.13, implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470F; hereinafter, "Section 106"); and

WHEREAS, Central Vermont has participated in the consultation and has been invited to concur in this Programmatic Agreement; and

WHEREAS, the Commission will require the Licensee to implement the provisions of this Programmatic Agreement as a condition of issuing a new license for any of these Projects;

NOW THEREFORE, the Commission, the Advisory Council, and the SHPO agree that, if licensed, the Projects will be administered in accordance with the following stipulations in order to satisfy the Commission's Section 106 responsibilities during the terms of the Projects' licenses.

Stipulations.

The Commission will ensure that, upon a license issuing for any of these Projects, the Licensee implements the following stipulations as a condition of accepting such a license. All stipulations that apply to the Licensee will similarly apply to any and all of the Licensee's successors. Compliance with any of the following stipulations does not relieve the Licensee of any other obligations it has under the Federal Power Act, the Commission's regulations, or its license.

I. CULTURAL RESOURCES MANAGEMENT PLAN

A. Within one year of a license issuing for any of these Projects, the Licensee will submit for the Commission's approval a Cultural Resources Management Plan (hereinafter, "CRMP") specifying how Historic Properties will be managed in the Project's area of potential effect, as defined in 36 C.F.R. Section 800.2(c), during the term of the license.

B. During development of a CRMP, the Licensee will consult with the SHPO and interested persons, as defined in 36 C.F.R. Section 800.1(c)(2). The Licensee will seek the SHPO's concurrence in each of the four CRMPs required under this Programmatic Agreement.

C. The Licensee will ensure that every CRMP submitted to the Commission pursuant to this Programmatic Agreement is consistent with "Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines" (see Federal Register, September 29, 1983, Vol. 48, No. 190, Part IV, pp. 44716-44740; hereinafter, "Secretary's Standards"). Moreover, CRMPs will be developed by or developed under the direct supervision of a person or persons who meet, at a minimum, the professional qualifications standards for architectural history and archeology in the Secretary's Standards (48 FR 44738-39).

D. Every CRMP submitted to the Commission pursuant to this Programmatic Agreement will, at a minimum, include principles and procedures to address the following:

1. the delineation of the Project's area of potential effects -- an area defined at 36 C.F.R. Part 800, section 800.2(c) as "the geographic area or areas within which an undertaking may cause changes in the character or use of Historic Properties, if any such properties exist" -- sufficient to allow for good planning and treatment of Historic Properties;

2. completion, if necessary, of identification of Historic Properties within the area of potential effect;

3. continued use and maintenance of Historic Properties;

4. protection of Historic Properties threatened by shoreline erosion, Project-related ground-disturbing activities, and vandalism;

5. mitigation of unavoidable adverse effects on Historic Properties;

6. treatment and disposition of any human remains that may be discovered on lands other than Tribal or Federal lands, taking into account any

applicable state laws and the Advisory Council's "Policy Statement Regarding Treatment of Human Remains and Grave Goods" (September 27, 1988, Gallup, NM);

7. discovery of previously unidentified properties during Project operations;

8. public interpretation of the historic and archeological values of the Project;

9. coordination with the SHPO and interested persons during implementation of the CRMP.

II. CRMP REVIEW AND IMPLEMENTATION

A. The Licensee will submit every CRMP, along with documentation of the views of the SHPO and interested persons, to the Commission for review and approval.

B. If, in the case of any CRMP submitted under this Programmatic Agreement, the SHPO has concurred in the CRMP, and the Commission determines that the CRMP is adequate, the Commission will forward a copy of the CRMP to the Advisory Council, which will have 30 days to review the CRMP.

1. If the Advisory Council does not object to the CRMP, the Commission will proceed to ensure that the Licensee implements the CRMP.

2. If the Advisory Council objects to the CRMP, the Commission will consult with the Advisory Council in an effort to reach agreement on the CRMP. If agreement cannot be reached, the Commission will request that the Advisory Council comment pursuant to Stipulation IV.B of this Programmatic Agreement.

C. If, in the case of any CRMP submitted under this Programmatic Agreement, the SHPO has not concurred in the CRMP, or the Commission finds the CRMP inadequate, the Commission will consult with the Licensee and the SHPO to seek agreement on the CRMP. If concurrence is not reached within 30 days, the Commission will request that the Advisory Council enter into consultation to seek agreement on the CRMP.

1. If agreement is reached on the CRMP, the Commission will forward a copy of the revised CRMP to the Advisory Council for review pursuant to Stipulation II.B.

2. If agreement on the CRMP cannot be reached among the Commission, the SHPO, the Licensee, and the Advisory Council, the Commission or the SHPO will request that the Advisory Council comment pursuant to Stipulation IV.B of this Programmatic Agreement; or the Advisory Council may terminate consultation and comment sua sponte.

D. For each of the Projects subject to the stipulations of this Programmatic Agreement, the Licensee will, on every anniversary of a license issuing for any of the Projects, file a report with the Commission and the SHPO of activities conducted under the CRMP pertinent to that license.

III. INTERIM TREATMENT OF HISTORIC PROPERTIES

A. For any Project subject to the stipulations of this Programmatic Agreement, for which review and implementation of a CRMP are pending, pursuant to Stipulation II of this Programmatic Agreement, the Licensee will, during such pendency, consult with the SHPO and interested persons regarding the impact of the following:

1. all activities, including recreational developments, that require ground-disturbance;

2. new construction, demolition, or rehabilitation of Project facilities;

3. active erosion of archeological sites due to Project operations.

B. Consultation will be in accordance with 36 C.F.R. Sections 800.4 and 800.5(a) through (c), with the Licensee acting as the Agency Official. If the Licensee and the SHPO agree that the activity will not adversely effect Historic Properties, the Licensee may proceed in accordance with any agreed-upon treatment measures or conditions.

C. If either the Licensee or the SHPO determines that the activity will have an adverse effect, and the affected property is a National Historic Landmark, the Licensee will submit the matter to the Commission, which will initiate the process set forth at 36 C.F.R. Section 800.5(e). Otherwise, the Licensee and the SHPO will consult to develop a strategy for avoiding or mitigating such adverse effects. If the Licensee and the SHPO can reach agreement, the Licensee will implement the agreed-upon strategy. If they disagree, the Licensee will submit the matter to the Commission, which will initiate the process set forth at 36 C.F.R. Section 800.5(e).

IV. DISPUTE RESOLUTION

A. If at any time during implementation of this Programmatic Agreement and any resulting CRMP, the SHPO, the Licensee, the Advisory Council, or an interested person objects to any action or any failure to act pursuant to this Programmatic Agreement or a CRMP, they may file written objections with the Commission.

1. The Commission will consult with the objecting party, and with other parties or interested persons, as appropriate, to resolve the objection.

2. The Commission may initiate <u>sua sponte</u> such consultation to remove any of its objections.

B. If the Commission determines that the objection cannot be resolved, the Commission will forward all documentation relevant to the dispute to the Advisory Council and request that the Advisory Council comment. Within 30 days after receiving all pertinent documentation, the Advisory Council will either:

1. provide the Commission with recommendations, which the Commission will take into account in reaching a final decision regarding the dispute; or

2. notify the Commission that it will comment pursuant to 36 C.F.R. Section 800.6(b) and Section 110(1) of the National Historic Preservation Act, and proceed to comment.

C. The Commission will take into account any Advisory Council comment, provided in response to such a request, with reference to the subject of the dispute, and will issue a decision on the matter. The Commission's responsibility to carry out all actions under this Programmatic Agreement that are not the subject of dispute will remain unchanged.

V. AMENDMENT AND TERMINATION OF THIS PROGRAMMATIC AGREEMENT

A. The Commission, the SHPO, the Licensee, or the Advisory Council may request that this Programmatic Agreement be amended, whereupon these parties will consult in accordance with 36 C.F.R. Section 800.13, to consider such amendment.

B. The Commission, the SHPO, or the Advisory Council may terminate this Programmatic Agreement by providing 30 days written notice to the other parties, provided that the Commission, the SHPO, the Licensee, and the Advisory Council consult during the 30-day notice period in order to seek agreement on amendments or other actions that would avoid termination. In the event of termination, the Commission will comply with 36 C.F.R. Sections 800.4 through 800.6, with regard to individual actions covered by this Programmatic Agreement.

Execution and implementation of this Programmatic Agreement evidences that the Commission has satisfied its responsibilities pursuant to Section 106, National Historic Preservation Act, as amended, for all individual actions carried out under the new license.

FEDERAL ENERGY REGULATORY COMMISSION

By: [signature] Date: 11/2/94
Fred E. Springer, Director
Office of Hydropower Licensing

VERMONT STATE HISTORIC PRESERVATION OFFICE

By: ______________________ Date: 11/8/94

Eric Gilbertson, Director
Vermont Division for Historic Preservation, and
Deputy State Historic Preservation Officer

ADVISORY COUNCIL ON HISTORIC PRESERVATION

By: ______________________ Date: ______________________

Robert D. Bush, Ph.D.
Executive Director

CONCUR: CENTRAL VERMONT PUBLIC SERVICE CORPORATION

By: ______________________ Date: 11/16/94

Robert G. Kirn, Vice President of Division Operations

Appendix A To

PROGRAMMATIC AGREEMENT AMONG THE FEDERAL ENERGY REGULATORY COMMISSION, THE ADVISORY COUNCIL ON HISTORIC PRESERVATION, AND THE VERMONT STATE HISTORIC PRESERVATION OFFICER, FOR MANAGING HISTORIC PROPERTIES THAT MAY BE AFFECTED BY A LICENSE ISSUING TO CENTRAL VERMONT PUBLIC SERVICE CORPORATION FOR THE CONTINUED OPERATION OF FOUR HYDROELECTRIC PROJECTS ON THE PASSUMPSIC RIVER IN VERMONT

PROJECTS, HISTORIC PROPERTIES, AND EFFECTS

The purpose of this appendix is to specify the factual basis of the Programmatic Agreement. Here, we

- review relevant facts concerning Pierce Mills, Arnold Falls, Gage, and Passumpsic, and modifications to these Projects proposed under the Commission's relicensing procedures,

- identify, in part, Historic Properties subject to the Programmatic Agreement's stipulations, and

- disclose the anticipated effects of issuing the proposed licenses.

Central Vermont, on December 27, 1991, applied to the Commission for renewed licenses for Pierce Mills, Arnold Falls, Gage, and Passumpsic.[1] The Commission, the SHPO, and the Council have reviewed these proposed relicensings and have jointly determined and agree that the Projects may affect Historic Properties and that certain aspects of the anticipated effects may be adverse, but that adverse effects can be taken into account by executing the Programmatic Agreement.

I. PROJECTS

A. Pierce Mills: Central Vermont proposes to ▪continue operating and maintaining the 1927-vintage, 250-kilowatt Pierce Mills,[2] ▪improve the visual appearance of project facilities, and ▪develop a canoe portage at the project.

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[1] All four Projects are in Caledonia County, Vermont, in or near the town of St. Johnsbury. Pierce Mills, furthest upstream, is at River Mile 14.9. Arnold Falls is at River Mile 9.5 just above the confluence with the Moose River. Gage is upstream at River Mile 7.2. Passumpsic is at River Mile 5.5.

[2] Also known as St. Johnsbury No. 0.

1. Facilities

a. Principal facilities at Pierce Mills include ■a concrete gravity dam [3] with a crest elevation of 603.5 and 18-inch flashboards, ■an intake structure forming the left abutment, with a 6-foot square entrance and trash rack, ■a penstock, [4] ■a powerhouse [5] with a single vertical shaft turbine and generator, [6] ■a substation, and ■an impoundment with a normal headwater elevation of 605 [7] and 1,075,000 cubic feet of useable storage.

b. The bypass reach is about 330 feet long.

c. The existing project has a hydraulic range of 90 to 200 cubic feet per second and an average annual generation of about 1,610 megawatthours.

d. Since its construction in 1927, the project has produced electricity for distribution and end-use in Central Vermont's service area in Vermont.

2. Operating Regime: Central Vermont operates Pierce Mills semi-automatically and when water levels are between elevations 603.5 and 605. [8] The turbine uses flows in the range of 90 to 200 cubic feet per second, with excess flows released over the spillway. At flows below 200 cubic feet per second or when the impoundment level is controlled below the crest of the dam, the only flow in the bypass reach is leakage and local drainage. Flows through the powerhouse return to the river through the tailrace.

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3 The dam is about 93 feet long and 18 feet high (maximum).

4 The penstock is six feet in diameter and 246 feet long.

5 The powerhouse is about 22 feet wide and 22 feet long.

6 The turbine and generator are rated at 271 and 250 kilowatts, respectively.

7 At this elevation, the impoundment has a surface area of 24.7 acres and extends upstream about 1.6 miles to the Great Falls dam.

8 The latter elevation corresponds to the height of the flashboards.

3. <u>Project Modifications</u>

a. Central Vermont proposes [9] to ■enhance water quality, vegetation, fisheries, and aesthetics by converting its operating regime to a run-of-river mode and spilling a minimum of 13 cubic feet per second into the bypassed reach at all times, ■install System Control and Data Acquisition equipment to record unit output and water level, ■enhance recreational opportunities by constructing a recreation area with parking, picnic tables, and river access, and ■develop and implement a landscape plan.

b. The Commission staff recommends [10] that Central Vermont ■implement soil erosion and sediment control prior to disturbing any land, ■install interim and permanent downstream fish passage facilities, ■install "Danger Dam" signs and signs directing paddlers to the portage from the impoundment, ■install an interpretive sign, ■enhance aquatic habitat in the bypassed reach and aesthetic value at the dam by releasing an instantaneous minimum flow of 88 cubic feet per second over the crest of the dam at all times, ■when the impoundment is refilling, release downstream of the Project instantaneous minimum flows of 118 cubic feet per second (June 1 to September 30), 237 cubic feet per second (October 1 to March 31), and 948 cubic feet per second (April 1 to May 31), [11] and ■construct two overnight camping sites for canoeists in the vicinity of the project.

<u>B. Arnold Falls</u>: Central Vermont proposes to ■continue operating and maintaining the 1927-vintage, 400-kilowatt Arnold Falls, [12] ■provide flows over the northern dam crest at all times, and ■develop a canoe portage, public access, and parking area to improve recreation at the project.

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[9] See Central Vermont's 1991 Application for a Subsequent License for a Minor Water Power Project -- Pierce Mills Hydroelectric Project.

[10] The Commission staff's recommendations were entered into the record on these cases May 23, 1994, in its Draft Environmental Assessment.

[11] When natural inflow to the project cannot meet these requirements while filling the impoundment, the release requirement would shift to 90 percent of the instantaneous inflow at all times.

[12] Also known as St. Johnsbury No. 1-1/2.

1. Facilities

a. Principal facilities at Arnold Falls include ■two timber crib dams, [13] each of which is equipped with 18-inch flashboards, ■a 20-foot-wide intake with trashracks, ■an integral powerhouse [14] containing a vertical turbine and generator, [15] a substation adjacent to the intake, and ■an impoundment with a normal headwater elevation of 574.3, [16] and about 470,000 cubic feet of useable storage.

b. The bypass reach is about 300 feet long.

c. The project has a hydraulic range of 150 to 262 cubic feet per second and an average annual generation of about 1,580 megawatthours.

d. Since its construction in 1927, Arnold Falls has produced electricity for distribution and end-use in Central Vermont's service area in Vermont.

2. Operating Regime: Central Vermont operates Arnold Falls semi-automatically with headwater elevation fluctuations between 572.8 and 574.3. The turbine uses flows in the range of 150 to 262 cubic feet per second, with excess flows released over the spillway. At flows below 262 cubic feet per second, or when the impoundment is refilling, the only flow in the bypassed reach is leakage and local drainage. Flows through the powerhouse return to the river through the tailrace. Arnold Falls' inflow is currently controlled on a daily basis by outflow from Pierce Mills.

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13 There is a north dam, about 189 feet long and 18 feet high with a crest elevation of 572.72, and a south dam, about 66 feet long and 15 feet high with a crest elevation of 572.8.

14 The powerhouse measures 21 feet wide and 18 feet long.

15 The turbine and generator are rated at 335 kilowatts and 350 kilowatts, respectively.

16 At this elevation, the impoundment has a surface area of 7.2 acres and extends upstream about 2,200 feet.

3. Project Modifications

a. Central Vermont proposes [17] to enhance water quality, vegetation, fisheries, and aesthetics by converting its operating regime to a run-of-river mode and spilling from the crest of the north dam into the bypassed reach a minimum of 20 cubic feet per second at all times, and recreation by developing a canoe portage trail, river access area, and parking area.

b. The Commission staff recommends that Central Vermont ■implement soil erosion and sediment control prior disturbing any land, ■install interim and permanent downstream fish passage facilities, ■install "Danger Dam" signs and signs directing paddlers to the portage from the impoundment, ■install an interpretive sign, ■spill a year-round minimum instantaneous flow of 78 cubic feet per second to the north channel bypass reach for aquatic habitat enhancement and 17 cubic feet per second over the south dam from April 1 to November 30 for aesthetic enhancement, ■when the impoundment is refilling, release downstream of the project instantaneous minimum flows of 127 cubic feet per second (June 1 to September 30), 254 cubic feet per second (October 1 to March 31), and 1,016 cubic feet per second (April 1 to May 31), [18] and ■release an instantaneous minimum flow of 21 cubic feet per second to the tailrace channel when the project is not generating.

C. Gage: Central Vermont proposes to ■continue operating and maintaining the 1921-vintage, 700-kilowatt Gage, [19] ■convert its operation of Gage from daily pondage to run-of-river, ■pass flows over the dam, and ■improve recreational facilities.

1. Facilities

a. Principal facilities at Gage include ■a

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[17] See Central Vermont's 1991 Application for a Subsequent License for a Minor Water Power Project -- Arnold Falls Hydroelectric Project.

[18] When natural inflow to the project cannot meet these requirements while filling the impoundment, the release requirement would shift to 90 percent of the instantaneous inflow at all times.

[19] Also known as St. Johnsbury No. 3.

concrete gravity dam with a north section, [20] a center section, [21] and a south section, [22] a 6-foot-wide sluice in the south section, flashboards, [23] ■a 51-foot-wide headgate entrance to the power canal, ■a power canal, [24] ■an integral intake with an inclined trashrack, ■a powerhouse [25] with two vertical shaft turbines [26] and generators, [27] ■a substation adjacent to the power canal, ■cableway and winch house, and ■an impoundment with a normal headwater elevation of 539.9, [28] and about 600,000 cubic feet of useable storage.

b. The bypassed reach at Gage includes a two-acre plunge pool and about 120 feet of riffle habitat.

c. The project has a hydraulic range of 170 to 700 cubic feet per second and an average annual generation of about 2,766 megawatthours.

d. Since its construction in 1921, the project has produced electricity for distribution and end-use in Central

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[20] The north section is 176 feet long with a crest elevation of 534.2.

[21] The center section is 30 feet long with a crest elevation of 542.1.

[22] The south section is 43 feet long with a crest elevation of 538.9.

[23] Flashboards are six feet high, on the north section, and one foot high, on the south section.

[24] The power canal is 90 feet long, 44 feet wide, and 16 feet deep.

[25] The powerhouse is 27 feet wide and 60 feet long.

[26] The turbines are rated at 365 kilowatts, unit 1, and 522 kilowatts, unit 2, respectively.

[27] The generators are rated at 300 kilowatts and 400 kilowatts, respectively.

[28] At this elevation, the impoundment has a surface area of 15.2 acres and extends upstream about 3,400 feet.

Vermont's service area in Vermont.

2. Operating Regime: Central Vermont operates Gage semi-automatically with headwater elevation fluctuations between 538.9 and 539.9. The turbine uses flows in the range of 170 to 700 cubic feet per second, with excess flows released over the spillway. At flows below 700 cfs or when the impoundment is refilling, the only flow in the bypassed reach is leakage and local drainage. Flows through the powerhouse return to the river through the tailrace. Gage's inflow is currently controlled on a daily basis by outflow from Arnold Falls.

3. Project Modifications

a. Central Vermont proposes [29] to enhance water quality, vegetation, fisheries, and aesthetics by converting its operating regime to a run-of-river mode and spilling a minimum of 32 cubic feet per second into the bypassed reach (October 1 to May 1) and 17 cubic feet per second (remainder of the year); and recreation by developing canoe portage and day use picnic areas.

b. The Commission staff recommends that Central Vermont ▪implement soil erosion and sediment control prior to disturbing any land, ▪install interim and permanent downstream fish passage facilities, ▪install "Danger Dam" signs and signs directing paddlers to the portage from the impoundment, ▪install an interpretive sign, ▪provide a minimum instantaneous spillage of 32 cubic feet per second (October 1 to May 31) and 17 cubic feet per second (June 1 to September 31) for aquatic enhancement, and ▪when the impoundment is refilling, release downstream of the project instantaneous minimum flows of 207 cubic feet per second (June 1 to September 30), 413 cubic feet per second (October 1 to March 31), and 1,652 cubic feet per second (April 1 to May 31). [30]

D. Passumpsic: Central Vermont proposes to ▪continue operating and maintaining the 1929-vintage, 0.7-megawatt

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[29] See Central Vermont's 1991 Application for a Subsequent License for a Minor Water Power Project -- Gage Hydroelectric Project.

[30] When natural inflow to the project cannot meet these requirements while filling the impoundment, the release requirement would shift to 90 percent of the instantaneous inflow at all times.

Passumpsic,[31] ■provide flows over the dam crest at all times, and ■improve recreational facilities.

1. Facilities

a. Principal facilities at Passumpsic include ■a concrete gravity dam with north and south sections,[32] and a spillway section cresting at elevation 519.98 feet National Geodetic Vertical Datum,[33] and 1-foot-high flashboards, ■a 27-foot-wide headgate with two gates, ■a power canal[34] with a sluice and overflow spillway, ■an integral intake powerhouse with an inclined trashrack, ■a powerhouse[35] with one vertical shaft turbine and a generator,[36] ■a substation adjacent to the power canal, and ■an impoundment with a normal headwater elevation of 520.98[37] and about 800,000 cubic feet of useable storage.

b. The bypassed reach is about 350 feet long.

c. The project has a hydraulic range of 195 to 460 cubic feet per second and an average annual generation of about 3,868 megawatthours.

d. Since its construction in 1929, the project has produced electricity for distribution and end-use in Central Vermont's service area in Vermont.

2. Operating Regime: Central Vermont operates Passumpsic semi-automatically with a normal headwater elevation

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31 Also known as St. Johnsbury No. 4.

32 The north and south sections are 126 and 122 feet long, respectively.

33 All elevations in this appendix are measured in feet from the National Geodetic Vertical Datum.

34 The power canal is from 19 to 22 feet wide and 87 feet long.

35 The powerhouse is 24 feet square.

36 The turbine and generator are rated at 708 and 700 kilowatts, respectively.

37 At this elevation, the impoundment has a surface area of 18.3 acres and extends upstream about 4,600 feet.

of 520.98. The turbine uses flows in the range of 195 to 460 cubic feet per second, with excess flows released over the spillway. At flows below 460 cubic feet per second or when the impoundment is refilling, the only flow in the bypass reach is leakage and local drainage. Flows through the powerhouse return to the river through the tailrace.

3. Project Modifications

a. Central Vermont proposes [38] to enhance water quality, vegetation, fisheries, and aesthetics by converting its operating regime to a run-of-river mode and spilling a minimum of 26 cubic feet per second into the bypassed reach at all times; and recreation by developing a canoe access site and picnic area, and improving parking and landscaping.

b. The Commission staff recommends that Central Vermont ▪implement soil erosion and sediment control prior to disturbing any land, ▪install interim and permanent downstream fish passage facilities, ▪install "Danger Dam" signs and signs directing paddlers to the portage from the impoundment, ▪install an interpretive sign, ▪provide a year-round instantaneous spillage of 74 cubic feet per second for aquatic and aesthetic enhancement, ▪when the impoundment is refilling, release downstream of the project instantaneous minimum flows of 214 cubic feet per second (June 1 to September 30), 428 cubic feet per second (October 1 to March 31), 1,712 cubic feet per second (April 1 to May 31), [39] ▪develop and implement a landscaping plan, ▪revise plans for a proposed picnic area to accommodate the disabled, and ▪acquire an easement to construct, operate, and maintain a canoe portage trail and put-in.

II. HISTORIC PROPERTIES IDENTIFIED

The area of potential effect for this study includes all four Central Vermont Passumpsic River Projects. The results of current research in this area have been documented in the following reports.

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[38] See Central Vermont's 1991 Application for a Subsequent License for a Minor Water Power Project -- Passumpsic Hydroelectric Project.

[39] When natural inflow to the project cannot meet these requirements while filling the impoundment, the release requirement would shift to 90 percent of the instantaneous inflow at all times.

- Louis Berger & Associates 1991. Phase IA Reconnaissance Archaeological Survey of the Pierce Mills, Arnold Falls, Gage, Passumpsic, Taftsville, and Cavendish Hydroelectric Projects, Caledonia and Windsor Counties, Vermont

- Louis Berger & Associates 1991. Final Draft Text for National Register of Historic Places Multiple Property Documentation Form: Hydroelectric Generating Facilities in Vermont

- Louis Berger & Associates 1994. Phase IB Archaeological Survey of the Gage and Passumpsic Hydroelectric Projects, Town of St. Johnsbury and Village of Passumpsic, Caledonia County, Vermont

A. Archaeological Sites in the Passumpsic River Basin: The background research for these projects suggests the Passumpsic River watershed may contain eligible prehistoric and historic archaeological resources. Current studies have identified two historic archaeological sites -- VT-Ca-31 and VT-Ca-32 -- at Arnold Falls, but these have not been evaluated for National Register eligibility. The only known archaeological resource at Gage is VT-Ca-33, a nineteenth or early twentieth century structure that presently serves as the foundation for the cableway tower.

B. Twin State Gas & Electric Company Hydroelectric Station Historic District: Passumpsic, Pierce Mills, and Arnold Falls satisfy the National Register of Historic Places criteria for evaluation [40] as contributing elements in the nominated Twin State Gas & Electric Company Hydroelectric Station Historic District. The three stations have many components that contribute to the National Register eligibility of the historic district. These contributing components will be listed in the CRMP.

C. Gage Hydroelectric Project Historic District: Gage's hydroelectric facilities, consisting of the dam and powerhouse, are an historic district. As a whole, the station possesses integrity of design, workmanship and materials. The arrangement of its primary elements has not been altered, nor has the basic manner in which the station functions. Gage's contributing components will be listed in the CRMP.

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[40] See 36 C.F.R. Part 60.4.

III. ANTICIPATED EFFECTS

The proposed issue of subsequent licenses to Central Vermont for the Projects could have both adverse and beneficial effects. Inasmuch as the Projects are Historic Properties, issuing Central Vermont a subsequent license to continue operating and maintaining them under the protection afforded by Section 106 of the National Historic Preservation Act, is generally to be considered a beneficial effect, but in itself does not ensure that adverse effects would not ensue. Adverse effects could inadvertently occur during routine daily activities, at the Projects, in the absence of operation and maintenance plans designed to hold intact their historic integrity. Since it is not currently known whether Historic Properties, other than the Projects, occur in the Projects' areas of potential effects, we are unable to determine whether project effects on such unidentified resources may occur.

APPENDIX B: Historic Preservation Guidelines for Routine Maintenance Activities

The historic resources of the four CVPS facilities on the Passumpsic River (FERC Nos. 2396, 2399, 2397, and 2400) include the dams, intake structures, penstocks, powerhouses and generating components. The operators will not conduct any maintenance or repair activities with respect to these historic components without first consulting with CVPS's System Operations Engineers or Supervisors unless the maintenance or repair activity is listed below.

The following maintenance activities to the historic project components listed above will not require review by CVPS's **Environmental Engineer** or the Vermont Division for Historic Preservation:

Mechanical Systems. Repair, replacement and installation of electrical work, plumbing pipes and fixtures, heating systems, fire and smoke detectors, ventilation systems and operating systems where such work does not affect the exterior of the structure. Routine care for generating equipment, such as winding rotors and replacing runners, does not require review. **Major replacement or removal of historic components such as the historic generating equipment (generators, governors, slate switchboards, etc.) requires consultation.**

Exterior Painting. Repainting of previously painted exterior surfaces provided that destructive surface preparation treatments, including, but not limited to waterblasting, sandblasting and chemical cleaning are not used.

Exterior Repairs. Repair or partial replacement of exterior elements when such repair or replacement matches existing or historic material and form. **Total replacement or removal of exterior elements requires consultation.**

Windows and Doors. Caulking, weather-stripping, reglazing, repainting, and installation of new window jambs or jamb liners and replacement or installation of storm windows matching the historic shape and size of the prime windows are considered routine. Repair of historic windows and doors that replicate original detail with in-kind materials shall be considered to have no adverse effect. **Consultation is required for replacement or removal of historic windows and doors, even if replication is proposed, and shall be considered to have a potential adverse effect.**

Roof Repair. Roof repair or replacement of historic roofing with material that closely matches the existing material and form. Repair, replacement or installation of gutters.

Insulation. Insulation in ceilings, attics, walls and basement spaces provided it is installed with appropriate vapor barriers.

Interior Surfaces (floors, walls, ceilings). Repainting, refinishing, replacing sheetrock or plaster, laying flooring, replacing ceiling tiles, repairing cracks in concrete, replacing wooden framing or trim in kind or repointing with mortar similar in texture and hardness as original.

Site Improvements. Repair of existing roads, driveways, sidewalks, and curbs, provided that repairs are done with no changes in dimension or configuration of these features. Ground disturbance must remain within the existing footprint of the existing road, driveway, sidewalk, and curb. Any construction of roads beyond those already in existence at the time of this plan requires consultation.

Utilities. Repair or replacement of water, gas, storm and sewer lines if it occurs within the original trench.

Handicapped Access Ramps. Ground paths that provide access to a building providing that there is no grading and that no more than 12" of fill is used.

Lead Paint Abatement. Interior and exterior lead paint abatement by the washing, scraping and repainting of lead painted surfaces, installation of new window jambs, jamb liners or metal panning in the window wells.

APPENDIX C: Hydroelectric Station Major Components

PIERCE MILLS MAJOR PROJECT COMPONENT MATRIX

PROJECT COMPONENTS	APPLICABLE (Y/N)	CONTRIBUTING Yes- C No- NC	YEAR Type modification
DAM	Y	C	1924
FLASHBOARDS	Y	C	1924
INFLATABLE CREST	N		
POWER CANAL	N		
PENSTOCK	Y	C	1928 – concrete saddles 1990 – steel pipe
SURGE TANK	N		
INTAKE	Y	C	1924
HEADGATE	Y	C	1924, 1936
TRASHRACK	Y	C	1936
BRIDGE	N		
COMPRESSOR SHED	Y	NC	1998
CONTROL HOUSE	Y	C	1928
POWERHOUSE	Y	C	1928
WINDOWS	Y	C	1928
DOORS	Y	C	1928
TURBINE(S)-1	Y	C	1928
GENERATOR(S)-1	Y	C	1928
EXCITER(S)-1	Y	C	1928
GOVERNOR(S)-1	Y	C	1928 (1914 patent)
SWITCHBOARD	Y	C	1928
SWITCHGEAR & CONTROLS	Y	C	1928, later
GARAGE	N		
STOREHOUSE	N		
SUBSTATION	Y	C	1928
OTHER-TELEPHONE BOOTH	Y	C	1928

ARNOLD FALLS MAJOR PROJECT COMPONENT MATRIX

PROJECT COMPONENTS	APPLICABLE (Y/N)	CONTRIBUTING Yes- C No- NC	YEAR Type modification
DAM(S) – 2	Y	C	1926, 1928 1970s -- log crib rebuilt
FLASHBOARDS	Y	C	1926
INFLATABLE CREST	N		
POWER CANAL	N		
PENSTOCK	N		
SURGE TANK	N		
INTAKE	Y	C	1928
HEADGATE	Y	C	1928
TRASHRACK	Y	C	1928
BRIDGE	N		
STORAGE SHED	N		
CONTROL/GATE HOUSE	N		
POWERHOUSE	Y	C	1928
WINDOWS	Y	C	1928
DOORS	Y	C	1936
TURBINE(S)-1	Y	C	1928
GENERATOR(S)-1	Y	C	1928
EXCITER(S)-1	Y	C	1928
GOVERNOR(S)-1	Y	C	1928 (1914 patent)
SWITCHBOARD	Y	C	1928 – slate 1945 -- metal
SWITCHGEAR & CONTROLS	Y	C	1928, later
GARAGE	N		
STOREHOUSE	N		
SUBSTATION	Y	C	1928?
OTHER-TELEPHONE BOOTH	Y	C	1928

GAGE MAJOR PROJECT COMPONENT MATRIX

PROJECT COMPONENTS	APPLICABLE (Y/N)	CONTRIBUTING Yes- C No- NC	YEAR Type modification
DAM	Y	C	1928-29 1972 – little dam rebuilt
FLASHBOARDS	Y	C	1929 1990 – steel boards
INFLATABLE CREST	N		
POWER CANAL	Y	C	1921
PENSTOCK	N		
SURGE TANK	N		
INTAKE	Y	C	1921
HEADGATE	Y	C	1921
TRASHRACK	Y	C NC	1921 1996 -- fish racks
BRIDGE	N		
STORAGE SHED	Y	NC	c. 1980
WINCH HOUSE	Y	C	1928
POWERHOUSE	Y	C	1921
WINDOWS	Y	NC	1988
DOORS	Y	C NC	1921 -- equipment 1988 -- pedestrian
TURBINE(S)-2	Y	C	1921
GENERATOR(S)-2	Y	C	1921 1960 – No. 2 redesigned
EXCITER(S)-2	N		
GOVERNOR(S)-2	Y	C	No. 1 – 1914 patent No. 2 – c. 1950?
SWITCHBOARD	Y	NC	1991 – steel cabinet
SWITCHGEAR & CONTROLS	Y	NC	1991
GARAGE	Y	C	1921 c. 1973 – enlarged
STOREHOUSE	N		
SUBSTATION	Y	C	c. 1940
OTHER-CABLEWAY	Y	C	1928

PASSUMPSIC MAJOR PROJECT COMPONENT MATRIX

PROJECT COMPONENTS	APPLICABLE (Y/N)	CONTRIBUTING Yes- C No- NC	YEAR Type modification
DAM	Y	C	1929 1988 – partly rebuilt
FLASHBOARDS	Y	C	1929 1988 – steel boards
INFLATABLE CREST	N		
POWER CANAL	Y	C	1929 1983 – partly rebuilt
PENSTOCK	N		
SURGE TANK	N		
INTAKE	Y	C	1929
HEADGATE	Y	C	1929 c. 1980 -- steel gates
TRASHRACK	Y	C NC	1929 1996 -- fish racks
BRIDGE	Y	NC	1996
COMPRESSOR SHED	Y	NC	1998
CONTROL/GATE HOUSE	N		
POWERHOUSE	Y	C	1929
WINDOWS	Y	C	1929
DOORS	Y	C	1929
TURBINE(S)-1	Y	C	1929
GENERATOR(S)-1	Y	C	1929
EXCITER(S)-1	Y	C	1929
GOVERNOR(S)-1	Y	C	1929 (1914 patent)
SWITCHBOARD	Y	NC	1991 – steel cabinet
SWITCHGEAR & CONTROLS	Y	NC	1991
GARAGE	N		
STOREHOUSE	N		
SUBSTATION	Y	C	1929
OTHER			

APPENDIX D: 1997 Report on Dam Removal Alternatives

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

Rutland, Vermont

PASSUMPSIC RIVER PROJECTS - REPORT ON DAM REMOVAL ALTERNATIVES

FINAL REPORT

OCTOBER 10, 1997

Prepared by:
KLEINSCHMIDT ASSOCIATES
Consulting Engineers
Pittsfield, Maine

CENTRAL VERMONT PUBLIC SERVICE CORPORATION
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CENTRAL VERMONT PUBLIC SERVICE CORPORATION
Rutland, Vermont

PASSUMPSIC RIVER PROJECTS - REPORT ON DAM REMOVAL ALTERNATIVES

FINAL REPORT

1.0 BACKGROUND

The Passumpsic River Projects are owned and operated by Central Vermont Public Service Corporation (CVPSC) and include four hydroelectric projects located on the Passumpsic River in the general vicinity of St. Johnsbury, Vermont. The Passumpsic River runs through the "Northeast Kingdom," a highland plateau region of the state. The projects are licensed by the Federal Energy Regulatory Commission (FERC) and, from upstream to downstream are the Pierce Mills (FERC No. 2396), Arnold Falls (FERC No. 2399), Gage (FERC No. 2397), and Passumpsic (FERC No. 2400) projects. The projects were licensed by the FERC on December 8, 1994, and the licenses were based partly on Section 401 water quality certifications issued by the Vermont Agency of Natural Resources (ANR).

The water quality certifications were appealed by the Vermont Natural Resources Council (NRC). That appeal asserts that the applications for certification did not contain sufficient information relative to potential removal of the projects. As part of a proposed settlement of the appeal, CVPSC has agreed to evaluate alternatives for dam removal. This report describes the alternatives for dam removal and will describe specific removal plans for each of the projects (specific plans will be added to the final report).

The overall purpose of this study is to determine the most appropriate method to remove the dams and restore the riverway. Two major assumptions that precede the study are: (1) that the process determined appropriate for removal should minimize the environmental impacts associated with the removal, while considering the cost of the removal activities, and (2) that we can adequately define what constitutes restoration of the river.

For the purposes of the report, we have assumed that the overall purpose of the removal would be to re-establish a riverine condition in the project area, to the extent that it is reasonably possible. Under this definition, work would be limited to the immediate vicinity of the dam and the impoundment (the work area). River conditions outside the work area will not be evaluated as part of the Removal Plan. We assume for this project that re-establishing a riverine condition means obtaining a river channelization and morphology with characteristics similar to the river immediately up and downstream of the work area, as appropriate. Also, we assume that the restored riverbank in the work area should be consistent with its surroundings.

2.0 SCOPE OF WORK

The scope of work that KA proposes to complete this project was outlined in a "Work Plan for Developing a Dam Removal Plan" which was made a part of the agreement to conduct this study (see Appendix A). This report provides an overview of the context of the study (Section 1.0), a summary of the work scope (Section 2.0), a description of the facilities (Section 3.0), a general description of the removal alternatives (Section 4.0), specific removal options (Section 5.0), and a summary and conclusions (Section 6.0).

Briefly, CVPSC agreed to develop a preliminary removal plan that will be reviewed with interested parties. After the review, final removal plans will be developed for each of the facilities. The preliminary removal plan identifies applicable project data, the potential removal methods, and the environmental impacts that would be associated with the removal (Section 4.0). It also describes sedimentation effects of the removal options, the shoreline stabilization that could be needed, and the relative costs of the alternatives. The review process, subsequent to this Preliminary Report, will determine the appropriate removal option for each project. The final plan (Section 5.0), to be incorporated after a review meeting, will provide detailed descriptions of the removal options, including preliminary design plans, silt removal/disposal options, project-specific environmental measures, cost opinions, and possible schedules for the removal.

3.0 DESCRIPTION OF EXISTING FACILITIES AND GENERAL SETTING

3.1 Watershed and General Setting

As previously stated, the overall purpose of dam removal for the Pierce Mills (FERC No. 2396), Arnold Falls (FERC No. 2399), Gage (FERC No. 2397) and Passumpsic (FERC No. 2400) projects, hereinafter referred to as the Projects, would be to reestablish a riverine condition in the project area, to the extent that it is reasonably possible. To define a riverine setting, KA looked at the locations of the Projects' facilities and the general character of the area and surrounding land uses at the Projects. The setting of each project is described below, and site specific details are provided in Sections 3-2 through 3-5. Since the intent of the removal process will be restoration of the river channel itself, primarily for fish-passage and aesthetic considerations, we have limited the planned removals to the waterway. For purposes of this report, the waterway is defined as the river channel between banks, approximately to the level of the mean annual flood (without the dams in place).

All four of the projects are located on the Passumpsic River, in Caledonia County, Vermont. The County is in a generally rural highland plateau region and is sparsely populated. Rivers in the region generally have high gradients and flashy run-off characteristics. A map of the vicinity is shown in Figure 1.

There is no significant storage capacity in the Passumpsic River watershed. All four stations are operated in run-of-river mode, with little normal fluctuation of their headponds except for variations caused by losses of flashboards or repairs.

The Pierce Mills Project is located in an undeveloped area. There are no primary homes or industrial areas on the impoundment or below the dam.

The Arnold Falls Project is located in downtown St. Johnsbury which supports a residential and business population of approximately 15,000 persons. There are primary residential areas on the east and west shores of the impoundment and commercial business areas along the west shore of the impoundment. In particular, the area near the powerhouse is highly developed.

The Gage Project is south of St. Johnsbury in an undeveloped area. There are no primary residential areas or commercial businesses located on the impoundment or below the dam. Public access to the project waters is limited due to steep banks.

The Passumpsic Project is located in a small residential village with a population of approximately 500 persons. Adjacent to the project powerhouse is an historic machine shop. Land uses around the project include residential and commercial activities.

Hydrologic information for the sites was based on proration of records from two USGS gaging stations: the Passumpsic River at Passumpsic, Vermont, No. 01135500 (436 square mile drainage area), and the Moose River at St. Johnsbury, Vermont, No. 01135000 (120 square mile drainage area). The Moose River flows into the Passumpsic River between the Arnold Falls and Gage dams, and the Passumpsic gage is located downstream of the Passumpsic Project.

The descriptions below for each of the four projects were primarily derived from the FERC license applications (CVPSC; 1991a, b, c, d). References to right and left are for a viewer looking downstream, unless noted otherwise. Elevations refer to the National Geodetic Vertical Datum of 1929 (NGVD, also known as "USGS" datum).

3.2 Pierce Mills Project

The Pierce Mills Hydroelectric Project, located about 2 miles upstream from the Village of St. Johnsbury Center, began operation in 1928. The current gross head between the project's normal impoundment and tailwater levels is 18.3 ft, including 1.5 ft of flashboards. The impoundment surface area is approximately 24.7 acres. The plant is located at river mile (RM) 14.9 (above the Passumpsic's confluence with the Connecticut River). The drainage area above the dam is approximately 237 square miles. The average streamflow at the site is 403 cfs (based on the period 1928 to 1984).

The segment of the river downstream of the project and above the headpond of the Arnold Falls Project is about 2 to 2.5 miles in length and has a cobble and boulder substrate and a riffle-run configuration. The bypassed section of river, between the dam and the powerhouse tailrace, is about 300 ft long (DesMeules and Parks, 1988). Facilities at Pierce Mills include a concrete dam, intake structure, penstock, powerhouse, tailrace, and powerhouse substation (Figures 2.1 and 2.2). According to recent inspections of the project, the facilities are in good condition. The only maintenance needs noted were a utility pole in need of replacement and a small leak near the left side of the intake that needs to continue to be monitored.

The dam is a concrete gravity structure founded on bedrock. The rock face of the river channel serves as the right abutment, and the intake structure forms the left abutment. The dam has an overflow spillway 93 ft long and topped with 18-inch flashboards. The maximum height of the concrete portion of the dam above its foundation is approximately 18 ft, with the crest at Elev. 603.5'.

The intake structure is approximately 37 ft long (perpendicular to the flow of the river) and serves as the left abutment for the dam. The abutment consists of a concrete retaining wall approximately 17 ft long and a concrete gravity non-overflow section approximately 20 ft long, which serves as the intake. The retaining wall section of the abutment ties the structure to the left bank of the river. The top of the abutment is at Elev. 610.5'. The entrance to the penstock is 6 ft in diameter, as is the penstock itself. A manually operated 10 ft wide by 10 ft high bulkhead gate, used to close off and dewater the penstock, is directly upstream of the entrance. A steel trashrack is located between concrete training walls further upstream. The steel penstock is approximately 246 ft long and is supported on concrete cradles founded on bedrock.

The powerhouse, with a concrete substructure and brick superstructure, is approximately 22 ft wide by 22 ft long. It houses a single S. Morgan Smith vertical-shaft, Francis-type hydroelectric turbine and General Electric direct-coupled alternating-current generator. The turbine-generator combination is rated at 250 kW. The station's discharge capacity through the unit is approximately 185 cfs (CVPSC, 1991d).

3.3 Arnold Falls Project

The Arnold Falls Hydroelectric Project, located in the Village of St. Johnsbury, also began operation in 1928. The plant is located at RM 9.5. The drainage area above the station is approximately 254 square miles. The reservoir surface area is approximately 7.2 acres. The gross head at the plant is currently 18.2 ft, including 1.5 ft of flashboards. The normal headwater and tailwater elevations at the project are 574.3' (with flashboards) and 556.12', respectively. The average streamflow at the site is 432 cfs. The length of the bypassed reach has been estimated at about 100 ft by the Vermont DEC (DesMeules and Parks, 1988). Facilities at Arnold Falls include north and south timber crib dams, a powerhouse, tailrace, and powerhouse substation (Figures 3.1 and 3.2). According to recent inspections of the project, the civil facilities are in relatively good condition. Portions of the wood planking on the upstream face of the dam (above the silt line) were replaced about five years ago. Some settlement of portions of the timber crib dam sections has occurred over the years, but it appears to have stabilized and has not progressed appreciably in the past few years.

The two timber crib dams are founded on bedrock and constructed with timber cribbing filled with rock, faced with wood planking on the upstream slope. The two segments are required to impound the flow on each side of an island in the river. The north timber crib dam is approximately 189 ft long and extends from the left bank of the river to the right bank at the island; the south timber crib dam is approximately 66 ft long and extends from the left bank at the island to the powerhouse at the right bank of the river. The crest of the north dam is at Elev. 572.72', with a total height of about 18 ft.

The south dam's crest is at Elev. 572.8', and its total height is about 15 ft. Wood flashboards 18 inches tall are placed on both dams to raise the normal water surface to approximately Elev. 574.3'.

The powerhouse, with an integral intake structure skewed to the powerhouse for better alignment of flows, is about 20 ft wide at the intake and 21 ft wide at the tailrace. The average upstream-to-downstream length of the intake is about 12 ft, and the length of the powerhouse is 18 ft. The intake includes a steel trashrack and a manually operated timber bulkhead gate. The powerhouse has a concrete substructure and a brick superstructure. The powerhouse contains a single S. Morgan Smith vertical-shaft, fixed-blade propeller-type turbine and direct-coupled General Electric alternating-current generator. The turbine-generator combination is rated at 335 kW. The station's discharge capacity through the unit is approximately 262 cfs (CVPSC, 1991a).

3.4 Gage Project

The Gage Hydroelectric Project began operation in 1921 and was rebuilt in 1929 after the Flood of 1927. The plant is located at RM 7.2, approximately 2.2 miles downstream from the Village of St. Johnsbury. The dam for the Passumpsic Project is located about 2 miles downstream from the Gage dam. The drainage area above the Gage station is approximately 413 square miles.

The reservoir surface area is approximately 15.2 acres. The gross head at the plant is currently 15 ft, including flashboards of various heights. The normal headwater and tailwater elevations at the project are 539.9' (with flashboards) and 524.9', respectively. The average streamflow at the site is 704 cfs. The bypass reach length is reported to be a "minimum" of 90 ft (DesMeules and Parks, 1988). Facilities at Gage include a concrete gravity dam; headgate structure, power canal, powerhouse, tailrace, and powerhouse substation (Figures 4.1 and 4.2). According to recent inspections of the project, the facilities are in good condition. The only maintenance needs noted were some areas of concrete that have had minor spalling and delamination, none of which was recommended to be repaired immediately.

The overflow concrete gravity dam is founded on bedrock and consists of three sections: north, center, and south. The north dam is approximately 176 ft long with its crest at Elev. 534.2', varying in height from 3 to 13 ft. The center section, constructed on a rock-outcrop island, is approximately 30 ft long, approximately 4 ft high, and has its crest at Elev. 542.1'. The south dam is approximately 43 ft long and has its crest at Elev. 538.9'. The height is estimated to vary from 3 to 5 ft. The south dam also includes a 6-ft wide trash/ice sluice controlled by stoplogs and located at the abutment adjacent to the headgate structure.

The north and south dams have flashboards to maintain the headpond at Elev. 539.9'. The 6-ft high boards on the north dam are hinged and are dropped during floods to increase spillway capacity; the boards are operated from the cableway. The 1-ft high flashboards on the south dam fail automatically when overtopped during floods.

The headgate structure regulates flow to the power canal. It is approximately 51 ft wide and contains four headgates, each of which is approximately 10 ft wide and is manually operated. The gates limit the amount of debris entering the power canal and also provide a means of dewatering the power canal for inspection or maintenance. The power canal is approximately 44 ft wide, 90 ft long, and 16 ft deep.

The powerhouse has a substructure and a superstructure both made of concrete. The structure, which includes the intake at its upstream end, is approximately 27 ft wide and 60 ft long. The intake includes an inclined steel trashrack and gate slots upstream of the turbine water passages for the placement of a bulkhead to close off and dewater the turbine water passage. The powerhouse contains two S. Morgan Smith vertical-shaft, Francis-type turbines and direct-coupled General Electric alternating-current generators.

The two turbine-generator combinations are rated at 300 and 400 kW, for a total of 700 kW at the plant. The station's discharge capacity through the units is approximately 700 cfs (CVPSC, 1991b).

3.5 Passumpsic Project

The Passumpsic Hydroelectric Project began operation in 1929. The plant is located at RM 5.5, in the Village of Passumpsic. The drainage area above the Passumpsic station is approximately 428 square miles. The riverine segment of the river downstream of the project (above the headpond of the next-downstream East Barnet Project) is about 1.8 miles in length.

The reservoir surface area is approximately 18.3 acres. The gross head at the plant is currently 24 ft, including 1.0 ft of flashboards. The normal headwater and tailwater elevations at the project are 520.98' (with flashboards) and 496.98', respectively. The average streamflow at the site is 704 cfs. The length of the bypass reach is about 500 ft (DesMeules and Parks, 1988). Facilities at Passumpsic include a concrete gravity dam, headgate structure, power canal, powerhouse, tailrace, and powerhouse substation (Figures 5.1 and 5.2). According to recent inspection reports for the project, the facilities are in good condition, and no significant maintenance needs were noted.

The overflow concrete gravity dam is founded on bedrock and consists of two sections separated by a "dogleg" change in alignment. The north section is approximately 126 ft long, and the south section is approximately 122 ft long; both sections have their crests at Elev. 519.98'. The dam height varies from 2 to 10 ft above the foundation. One-ft high flashboards are normally placed on the crest to maintain the headpond at Elev. 520.98'. The flashboards fail automatically when overtopped during floods.

The headgate structure regulates flow to the power canal. It is approximately 27 ft wide and contains two headgates, each of which is approximately 7.67 ft high by 11.67 ft wide and is manually operated. The gates limit the amount of debris entering the power canal and also provide a means of dewatering the power canal for inspection or maintenance.

The power canal is approximately 87 ft long and varies in width from approximately 22 ft at the upstream end to 19 ft at the downstream end. The canal invert varies from approximately Elev. 513' to 505', from the upstream to the downstream end, respectively. The canal also has a stoplog-controlled trash/ice sluice and a 24-ft long overflow spillway in the outboard wall.

The powerhouse has a concrete substructure and a brick superstructure. The structure, which includes the intake at its upstream end, is approximately 24 ft square. The intake includes an inclined steel trashrack. There is no provision for stoplogs or bulkhead gates at the intake; thus, the headgates at the head of the power canal must be used to dewater the turbine water passage, which also requires dewatering the canal. The powerhouse contains a single James Leffel vertical-shaft, Francis turbine and direct-coupled General Electric alternating-current generator. The turbine-generator combination is rated at 700 kW. The station's discharge capacity through the unit is approximately 460 cfs (CVPSC, 1991c).

4.0 DAM REMOVAL ALTERNATIVES - GENERAL

In this section, we describe three methods - mechanical, chemical and natural - for removing the major civil features at the Pierce Mills, Arnold Falls, Gage, and Passumpsic Projects, hereinafter referred to as the Projects. This report assumes that removal of the Projects includes the dams and abutments. Additionally, the cost of removing portions of the penstock at the Pierce Mills Project that are in the waterway will be evaluated. For all the Projects, we recommend leaving the powerhouses in place as some are not in the river channel and most, if not all, may be considered historic structures according to criteria set by the State Historic Preservation Office, the Advisory Council on Historic Preservation, and the National Park Service. The proposal to leave the powerhouses in place is based on the assumption that they do not significantly alter the riverway (or that they can be considered separate from the river). Therefore, it seems appropriate to leave the structures in place to reduce the removal costs and impacts, and also to retain the historic significance of the sites.

For each dam removal method, we also discuss the removal process (immediate or staged removal) and the general environmental consequences of each method. The environmental analysis was limited to a discussion of the impacts caused by the removal activities. We did not evaluate the need for removal or the long-term environmental consequences of removal (*e.g,* we did not evaluate how removal would affect overall salmon production in the drainage basin or erosion events following removal). Based on the background of this report, we assumed that the need to remove the dams would be analyzed separately based on watershed management criteria set forth by the State, the dam owners and other interested parties. Finally, we examine the relative costs associated with each removal method.

4.1 Mechanical Methods

Mechanical methods for dam removal include using large equipment such as backhoes, bulldozers, cranes, concrete saws, and jackhammers. Demolition work would involve breaking or cutting the dam into pieces and transporting the rubble and associated debris to an off-site location. This method would include construction of a cofferdam, in order to get the equipment on-site to do the demolition work, and a staging area for performance of the work.

4.1.1 Immediate vs. Phased Removal

An immediate removal of the facilities using mechanical methods would not be practical since a lowering of the impoundment would be necessary to get the equipment close enough to the dam to complete the demolition work in a cost-effective manner. A full height cofferdam could be used to facilitate immediate removal, but such an approach would be very costly, and would have traumatic environmental impacts similar to those described under Section 4.2. Therefore, this report instead focuses on phased removal. A phased approach would likely begin with a gradual lowering of the impoundment, but should result in a single-season demolition schedule to remove the dam and the resulting rubble and debris. The gradual lowering of the impoundment would be achieved through removal of flashboards, and through the use of gates (at the Gage Project). At the projects with no gate structures, either the turbine-generator units would be salvaged and removed and river flows would be directed through the powerhouses, or an opening in the dam would be created to lower the water levels by spilling into the bypass.

4.1.2 Environmental Consequences

Environmental consequences - both positive and negative - would occur as a result of dam removal. Soils; water quantity and quality; fisheries resources; wildlife and terrestrial resources - including wetlands, recreational and land use resources; and cultural resources would be affected.

Dam removal would result in an increase in erosion and exposure to sediments immediately following dam removal. Dewatered areas would be unvegetated and, depending on the slope and composition of substrates, could be subject to an increase in erosion. There also could be some bank slumping during and after dam removal as the excess water in the bank material drains, particularly if the impoundment is drawn down too quickly. There also could be an increase in river turbidity and sediment load as sediments are washed downstream. An erosion and sediment control plan containing engineered and bio-engineered stabilization measures would be implemented to reduce the overall impact to downstream resources as a result of dam removal and increased sedimentation.

With the removal of the dams, downstream transport of woody debris would occur. Woody debris that previously was blocked by the dams and removed would be permitted to flow downstream, and could provide additional habitat. During low-flow periods, woody debris may accumulate and cause a natural blockage in the river, but this would be considered a normal and temporary condition.

Currently the Projects are operated in a run-of-river mode, such that operation mimics natural river flow (flow coming into the Projects approximates outflow from the Projects). Except in the bypassed reaches, instream flow would not likely be affected since the Projects do not augment the natural streamflow during low flow periods or store water during high flow periods. Water quantity and timing of flows would not be affected by dam removal since these Projects do not have a substantial storage capacity. The river would revert to a riverine flow regime with no impounded water.

Fish habitat and type would be changed as a result of dam removal. Fish species would be relatively free to move up- and downstream to find different habitat; the fish still would be subject to the natural barriers present in the river (waterfalls and the larger rapids). There would be a reduction in wetted area (*i.e.*, habitat) and reduced lacustrine habitat for impoundment-dwelling species and an increase in lotic habitat for riverine species. The newly formed river channel is likely to slightly decrease overall wetted area and, subsequently, to reduce habitat.

Wetlands that would be affected most by dam removal include those that are lacustrine *(i.e.*, those associated with the impoundments). It is likely that these wetlands would be dewatered as the riverine flow forms a new channel or is diverted to the historic channel. Some wetlands that are not dependent on the impoundment waters *(i.e.*, those dependent on ground water) would be unaffected by dam removal. New wetlands may be created due to the exposure of sediments as the river forms a channel and exposes sediments allowing different types of vegetation to develop naturally. This natural succession would be dependent on the amount of available moisture in the exposed area. The mechanical method of removal may impact wetlands that would be disturbed by the equipment and staging areas. Care would be taken to minimize those impacts.

Mechanical equipment (bulldozers, cranes, jackhammers, and backhoes) would have a temporary adverse impact on wildlife that are sensitive to human disturbance (mainly noise and trampled habitat). Plant species also may be temporarily impacted adversely by the demolition equipment and staging areas.

Public access to the river may be affected by dam removal in that residential and commercial property previously located with access to the water no longer may have access in a riverine condition. Impoundment fishing opportunities, still-water canoeing, and flat-water boating opportunities would cease. There no longer would be access points maintained by the licensee. Access to the river would be available only through State or locally maintained access points and private property.

Recreational activities that would be available after dam removal would be primarily riverine fishing and boating. The fishery would change from lacustrine to riverine.

Regarding land uses in the Projects' areas, impoundment land uses would be affected since shoreline residential properties that had immediate access to the impoundment would be located further from the water's edge. Public access points, such as boat launching facilities, also would be further removed from the water's edge. Dam removal would eliminate the existing impoundments, drop the water elevations within the old impoundment area, and expose additional shoreline area.

The mechanical dam removal option with a staged removal would result in a significant temporary increase in noise and traffic around the Projects during the removal process, due to the demolition equipment and large trucks that would transport sediments and demolition debris to approved disposal sites. Construction activities also would produce a short-term adverse effect on the aesthetic quality of the area, particularly at the two Projects that are in undeveloped areas (Pierce Mills and Gage).

Since more area would be available for various land uses as a result of dam removal (*i.e.*, the impoundments reverting to the river channel), these lands could be used for recreation, wildlife habitat, or conservation easements. After removal of the Projects, the river landscape would be more riverine and undeveloped in areas that are currently not developed. At all four Projects, however, the powerhouses and selected other appurtenant structures may remain as visible evidence of the previous development.

Because each of the Projects' powerhouses may be eligible for listing on the National Register of Historic Places, we recommend that the powerhouses remain in place. If this is not agreeable, detailed photo documentation would be needed before dam removal to record the historic property. Lowering the impoundments during a staged dam removal may expose archaeological properties that will need to be recorded or properly archived. The mainstem of the Passumpsic River as far upstream as Lyndonville has been identified as an area of "expected archeologic sensitivity" (VAEC, 1986).

Agencies stated that a single season of demolition would be the preferred removal option, perhaps following an earlier drawdown. The agency preference is based on the agencies' data that suggests that aquatic ecosystems can recover more quickly from single traumatic changes than they can from more subtle changes that span a longer term.

4.1.3 Cost

The cost of mechanically removing the dams is highly dependent on the management of the water levels because the cost of cofferdamming is a significant portion of the overall costs. If the impoundment can be drawn down prior to removal, then the cost of mechanical removal should be considered moderate to high. If no drawdown is possible, then costs would be high to very high.

4.2 Chemical Methods

Chemical methods for dam removal include using expansive devices and explosives. The chemical devices would scatter the rubble over a larger area than would occur with the mechanical or natural dam removal method.

4.2.1 Immediate vs. Phased Removal

Chemical methods are designed for an immediate removal. Environmental impacts would be significant even if "poppers" were used prior to the dam removal to scare away fish and wildlife from the immediate impact zone. Removal could be phased by partially demolishing the structures in stages. However, we did not consider this feasible because debris would need to be removed following each phase of demolition. The ensuing mobilization and clean-up costs would be exorbitant. Further, chemical devices may scatter debris and rubble over a larger area than would mechanical demolition, which may affect a greater number of fish and wildlife species and their habitat.

Alternatively the debris could be left in the river to provide additional fish habitat, although the concrete may affect chemical water quality parameters.

4.2.2 Environmental Consequences

The environmental consequences of dam removal using chemical devices are similar to the consequences listed above for the mechanical method. However, immediate dam removal would focus environmental impacts over a shorter period of time than a staged dam removal. During an immediate removal, fish and wildlife species in the river may not have adequate time to adjust to the changing environment and would be more likely to experience significant adverse impacts caused by the sudden siltation of aquatic habitat, sediment loading and significant increase in debris in the river. There would be no time for natural adjustment of existing species to new habitat (*i.e.*, shifts in species composition).

As noted above (Section 4.1.2), agencies stated that a single season of demolition would be the preferred removal option, perhaps following an earlier drawdown. The agency preference is based on the agencies' data that suggests that aquatic ecosystems can recover more quickly from single traumatic changes than they can from more subtle changes that span a longer term.

4.2.3 Cost

The relative cost of demolishing the dams using chemical methods would be low. The overall removal cost would be heavily influenced by the costs associated with debris removal and disposal. So, if the debris could be left in the river (*e.g.*, river run rock materials from within a timber crib dam) costs would be low to moderate. If all the debris needs to be removed, costs would be high.

4.3 Natural Methods

Natural methods involve creating a small breach in each of the Projects' dams to encourage and expedite deterioration. The amount of time to complete the deterioration and subsequent removal of the dams would depend on the existing condition of the dams, and the type of dam, and the sequence and timing of flood events. For instance, the Arnold Falls Project dam is a timber crib dam that is partially deteriorated. For this dam, the amount of time needed to complete the deterioration process would be shorter than the time needed to unravel a concrete dam or an intact timber crib dam. Also, little "natural" deterioration will occur during "normal" river flows, but the process will be greatly accelerated by higher, more forceful flood conditions, especially if maintenance activities are not conducted between events.

4.3.1 Immediate vs. Phased Removal

The "natural" method of dam removal would involve a staged removal over a substantially longer time period than would occur for the mechanical or chemical dam removal methods. A breach in each of the dams would allow the impoundments to revert to a completely riverine system at a slower rate and consequently, would give the environment (fish and wildlife, plants) a longer period to adjust to the change in water levels. As mentioned above, the deteriorating process for each dam would be different and may take a substantial amount of time (over 10 years). Further, as pieces of the dam fall into the river, they would get washed downstream and could affect river conditions for recreational users (*i.e.*, obstacles to boats, swimmers, and anglers). Since the deterioration would not be controlled, an additional hazard would be the possible failure of large segments of a dam in a short time, creating a momentary flood wave traveling downstream or an unsafe condition for the public visiting or passing through the damsite.

4.3.2 Environmental Consequences

The environmental consequences of the "natural" method of dam removal would only involve demolition equipment or a staging area during an initial breaching of the dam. Any environmental impact would be seen over time and may be less severe than the mechanical or chemical methods, since the physical and biological environment would have a substantial amount of time to adjust to incremental changes in the river water levels and morphology. However, the changes to the river could take years, or even decades, to occur. Leaving portions of the dams in the river could increase habitat for riverine species (*e.g.*, velocity refuges), but may be detrimental aesthetically and from a safety perspective.

4.3.3 Cost

The cost of the "natural" method of dam removal would be very low. The low cost is balanced by a very slow (potentially decades) reversion to the natural river conditions.

4.4 Treatment of Sediments

The issue of what to do with accumulated sediments behind a dam prior to dam removal is primarily dependent on whether the sediments are contaminated. The issue of contaminated sediments also affects the type of dam removal method and the necessary environmental protection measures to be put in place prior to dam removal.

If the sediments are contaminated, at one or more of the Projects, the contaminated sediments could be capped, or the sediments could be removed and disposed of at a certified landfill or other approved site. The capping would require significant engineering and construction expenses. Removal would require significant expenditures for dredging and disposal. Under either scenario, the costs and the disturbance to the surrounding areas would be very high.

If the sediments behind the Projects' dams are not contaminated three alternatives could be pursued. First, the sediments could be dredged and disposed of at a nearby upland site. This method could cause significant disruption of the environment (*i.e.*, the most existing habitat would be altered or destroyed), and would be very costly.

Second, the sediment could be allowed to move freely. For example, if the natural method of dam removal is selected, sediments would be permitted to re-distribute downstream as they flow through the breaches in the Projects' dams. To alleviate the potential for mass sediment flow, clogging, and increased turbidity as a result of breaching all the dams at the same time, the most downstream Project dam would be breached first to allow those sediments to re-distribute downstream before breaching the upstream Projects' dams. This method would be low cost, but would affect downstream environmental resources commensurately with the amount of sediment discharged.

Finally, a stabilization program could be undertaken to prevent significant erosion of the sediments. Stabilization could include bio-engineered solutions, such as plantings or natural revegetation if substrate and other environmental conditions are appropriate. Alternatively, engineering solutions such as regrading or reconstruction (riprap, etc.) could be used to stabilize the sediments. This method would minimize environmental disturbance, and would have moderate costs.

5.0 PASSUMPSIC RIVER PROJECTS - REMOVAL ALTERNATIVES

The estimated material quantities that would need to be removed for each of the major project components are presented in the following sections. In each case, the table identifies the quantity for demolition and/or removal, regardless of the method selected. As a starting point for analysis, the listed quantities are "totals" for the indicated structures and have not been limited to the "river channel" portions of the projects. Additionally, CVPS agreed to conduct preliminary investigations into the level of siltation behind each of the dams, in order to improve the accuracy of sediment quantity estimates.

5.1 Pierce Mills Project

See Table 1 for the estimate of material quantities to be removed.

5.2 Arnold Falls Project

See Table 2 for the estimate of material quantities to be removed.

5.3 Gage Project

See Table 3 for the estimate of material quantities to be removed.

5.4 Passumpsic Project

See Table 4 for the estimate of material quantities to be removed.

6.0 SUMMARY AND CONCLUSIONS

As part of a settlement agreement with VANR and VNRC, CVPS agreed to develop a plan for the removal of four dams on the Passumpsic River. The dams are part of CVPS's Pierce Mills, Arnold Falls, Gage and Passumpsic hydroelectric developments. The approach for the removal plan was developed in coordination with the settlement parties. The goal is to develop a plan that balances the cost and the environmental impacts of dam removal.

Based on input from all the parties, the approach outlined in the removal plan will incorporate appropriate elements of chemical or mechanical removal. Natural removal would require too long for removal of the dam and stabilization of the environment. In fact, based on agency recommendations, the removal plan will be designed for removal of each structure during one construction season and possibly all four during one season. The ANR stated that minimizing the duration of the construction would minimize the long-term environmental impacts associated with the removal. The plan will provide the costs for removing the dams and penstocks (where appropriate), but all parties agreed that the powerhouses would not be considered for removal. The plan will also account for any salvage that can be recovered from the projects (*e.g.* turbines with a remaining service life).

Accumulated sediments behind the dams may be released, or removed prior to the dam removals. If the sediments are contaminated, then they will be removed. If not contaminated, then the quantity of accumulated deposits will dictate the need to remove sediments. CVPS agreed to conduct preliminary investigations of the impoundments to determine the extent of the sedimentation. Any results of the investigation that provide useful clues to the quantity of sediment will be incorporated into the final plan.

Following the approach discussed above, CVPS will develop a plan that minimizes cost and minimizes unreasonable environmental impacts associated with dam removal. The dam removal plan will specify access requirements, the quantities of materials to be removed, removal methods and costs, and environmental measures that should be used to minimize construction impacts.

7.0 REFERENCES CITED

CVPSC (Central Vermont Public Service Corporation). 1991a. Application for a subsequent license for a minor water power project: Arnold Falls Hydroelectric Project, FERC No. 2399. Before the Federal Energy Regulatory Commission. Prepared by CVPSC. Rutland, Vermont. December.

CVPSC. 1991b. Application for a subsequent license for a minor water power project: Gage Hydroelectric Project, FERC No. 2397. Before the Federal Energy Regulatory Commission. Prepared by CVPSC. Rutland, Vermont. December.

CVPSC. 1991c. Application for a subsequent license for a minor water power project: Passumpsic Hydroelectric Project, FERC No. 2400. Before the Federal Energy Regulatory Commission. Prepared by CVPSC. Rutland, Vermont. December.

CVPSC. 1991d. Application for a subsequent license for a minor water power project: Pierce Mills Hydroelectric Project, FERC No. 2396. Before the Federal Energy Regulatory Commission. Prepared by CVPSC. Rutland, Vermont. December.

DesMeules, A.M. and C. Parks. 1988. Hydropower in Vermont, an assessment of environmental problems and opportunities. 2 volumes. Vermont Agency of Natural Resources. Waterbury, Vermont. May.

VAEC (Vermont Agency of Environmental Conservation). 1986. Vermont rivers study. With the assistance of the National Park Service, Mid-Atlantic Regional Office. February.

TABLE 1

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

PASSUMPSIC RIVER PROJECTS- REMOVAL

ESTIMATED QUANTITIES - PIERCE MILLS SITE

ITEM	ITEM DESCRIPTION	UNITS	QUANTITY
1	SILT REMOVAL (@ DAM)	CF	2,160
2	DAM & INTAKE REMOVAL	CY	830
3	FLASHBOARDS	SF	140
4	TRASHRACKS	SF	440
5	GATE SYSTEM	SF	100
6	PENSTOCK	LBS	107,000
7	POWERHOUSE		
A	SUBSTRUCTURE	CY	195
B	SUPERSTRUCTURE	SF	765
C	ROOF	SF	506
D	EQUIPMENT	LOT	1

Removal Tasks

1. Remove dam, silt, flashboards, walls, slabs, gates,trashracks, and operators,
2. Salvage mechanical & electrical equipment before demolishing powerhouse
3. Leave penstock saddles in place
4. Haul all construction debris to suitable disposal site
5. Silt quantities base on assumed average 4ft depth,8 ft wide across entire dam length

TABLE 2

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

PASSUMPSIC RIVER PROJECTS- REMOVAL

ESTIMATED QUANTITIES - ARNOLD FALLS

ITEM	ITEM DESCRIPTION	UNITS	QUANTITY
1	SILT REMOVAL (@ DAM)	CF	5,100
2	TIMBER CRIB REMOVAL	CF	79,200
3	CONCRETE PIERS & WALLS	CY	290
4	FLASHBOARDS	SF	385
5	TRASHRACKS	SF	234
6	GATE SYSTEM	SF	144
7	POWERHOUSE		
A	SUBSTRUCTURE	CY	90
B	SUPERSTRUCTURE	SF	1,092
C	ROOF	SF	395
D	EQUIPMENT	LOT	1

Removal Tasks

1. Remove dam, silt, flashboards, walls, slabs, gates,trashracks, and operators,
2. Salvage mechanical & electrical equipment before demolishing powerhouse
3. Haul all construction debris to suitable disposal site
4. Silt quantities base on assumed average 5 ft depth,8 ft wide across entire dam length

TABLE 3

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

PASSUMPSIC RIVER PROJECTS- REMOVAL

ESTIMATED QUANTITIES - GAGE SITE

ITEM	ITEM DESCRIPTION	UNITS	QUANTITY
1	SILT REMOVAL (@ DAM)	CF	1,320
2	DAM REMOVAL	CY	580
3	CANAL CONCRETE	CY	465
4	FLASHBOARDS	SF	1,050
5	TRASHRACKS	SF	900
6	GATE SYSTEM	SF	400
7	POWERHOUSE		
A	SUBSTRUCTURE	CY	785
B	SUPERSTRUCTURE	SF	4,710
C	ROOF	SF	2,160
D	EQUIPMENT	LOT	1

Removal Tasks

1. Remove dam, silt, flashboards, walls, slabs, gates,trashracks, and operators,
2. Salvage mechanical & electrical equipment before demolishing powerhouse
3. Leave retaining walls and structures on left bank, tailrace training wall, old substation training wall and tailrace in place.
4. Haul all construction debris to suitable disposal site
5. Silt quantities base on assumed average 4 ft depth,8 ft wide across entire dam length

TABLE 4

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

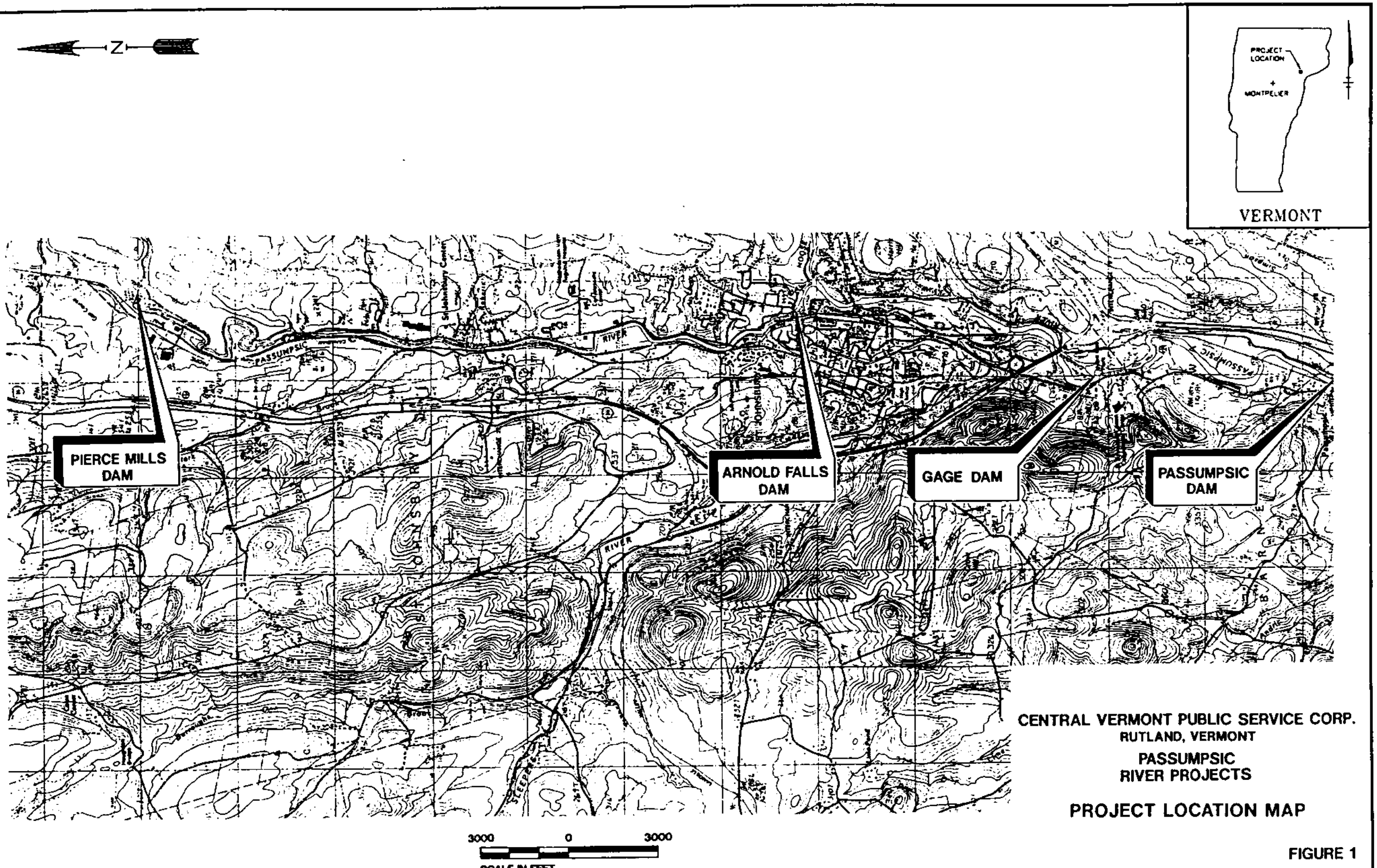
PASSUMPSIC RIVER PROJECTS- REMOVAL

ESTIMATED QUANTITIES - PASSUMPSIC SITE

ITEM	ITEM DESCRIPTION	UNITS	QUANTITY
1	SILT REMOVAL (@ DAM)	CF	4,000
2	DAM REMOVAL	CY	450
3	CANAL CONCRETE	CY	1,190
4	FLASHBOARDS	SF	250
5	TRASHRACKS	SF	360
6	GATE SYSTEM	SF	179
7	POWERHOUSE		
A	SUBSTRUCTURE	CY	410
B	SUPERSTRUCTURE	SF	2,055
C	ROOF	SF	530
D	EQUIPMENT	LOT	1

Removal Tasks

1. Remove dam, silt, flashboards, walls, slabs, gates,trashracks, and operators,
2. Salvage mechanical & electrical equipment before demolishing powerhouse
3. Haul all construction debris to suitable disposal site
4. Silt quantities base on assumed average 4 ft depth,8 ft wide across entire dam length



CENTRAL VERMONT PUBLIC SERVICE CORP.
RUTLAND, VERMONT

PASSUMPSIC
RIVER PROJECTS

PROJECT LOCATION MAP

FIGURE 1

KLEINSCHMIDT ASSOCIATES
CONSULTING ENGINEERS

KA 006-131 8/97

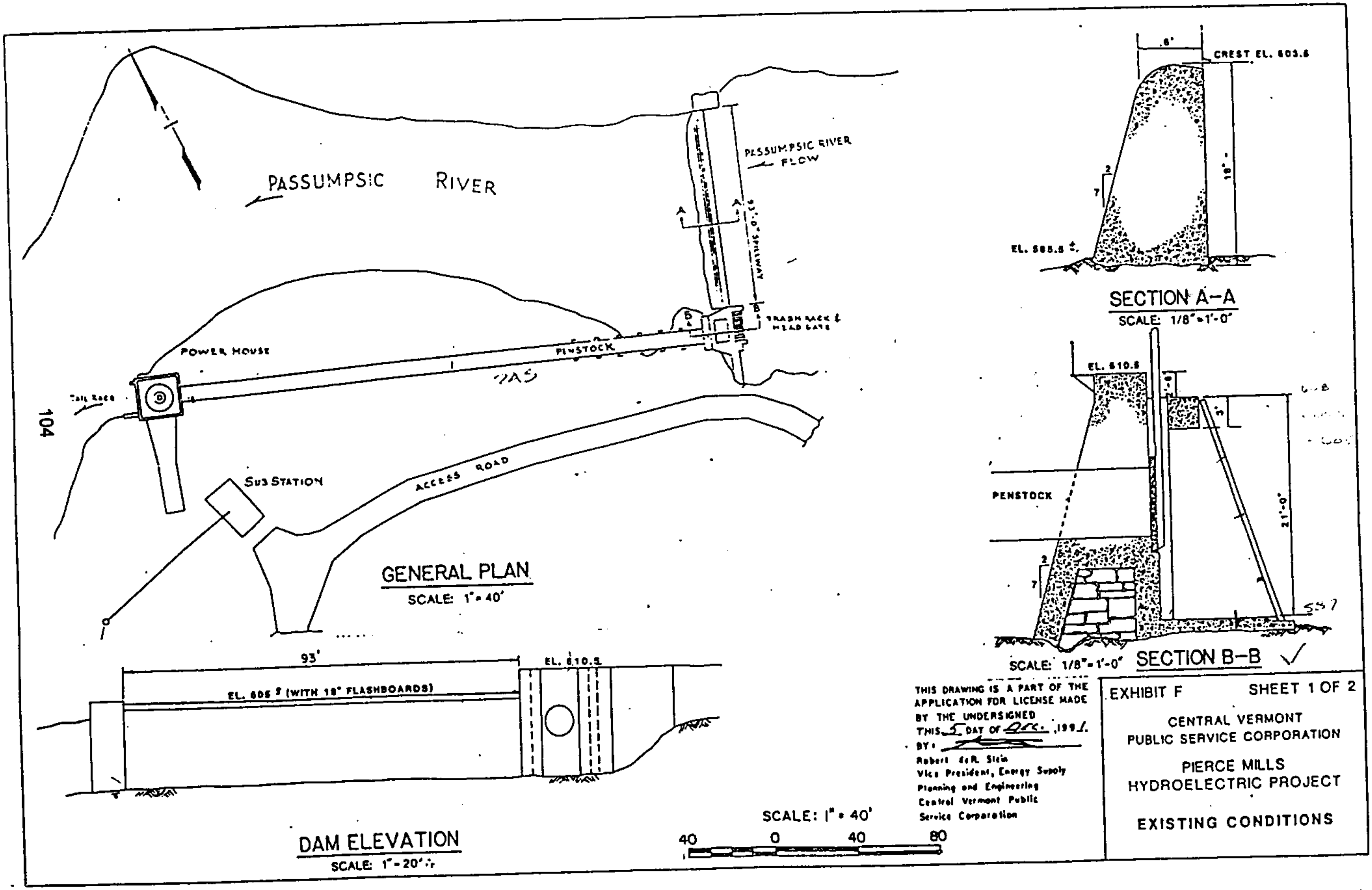
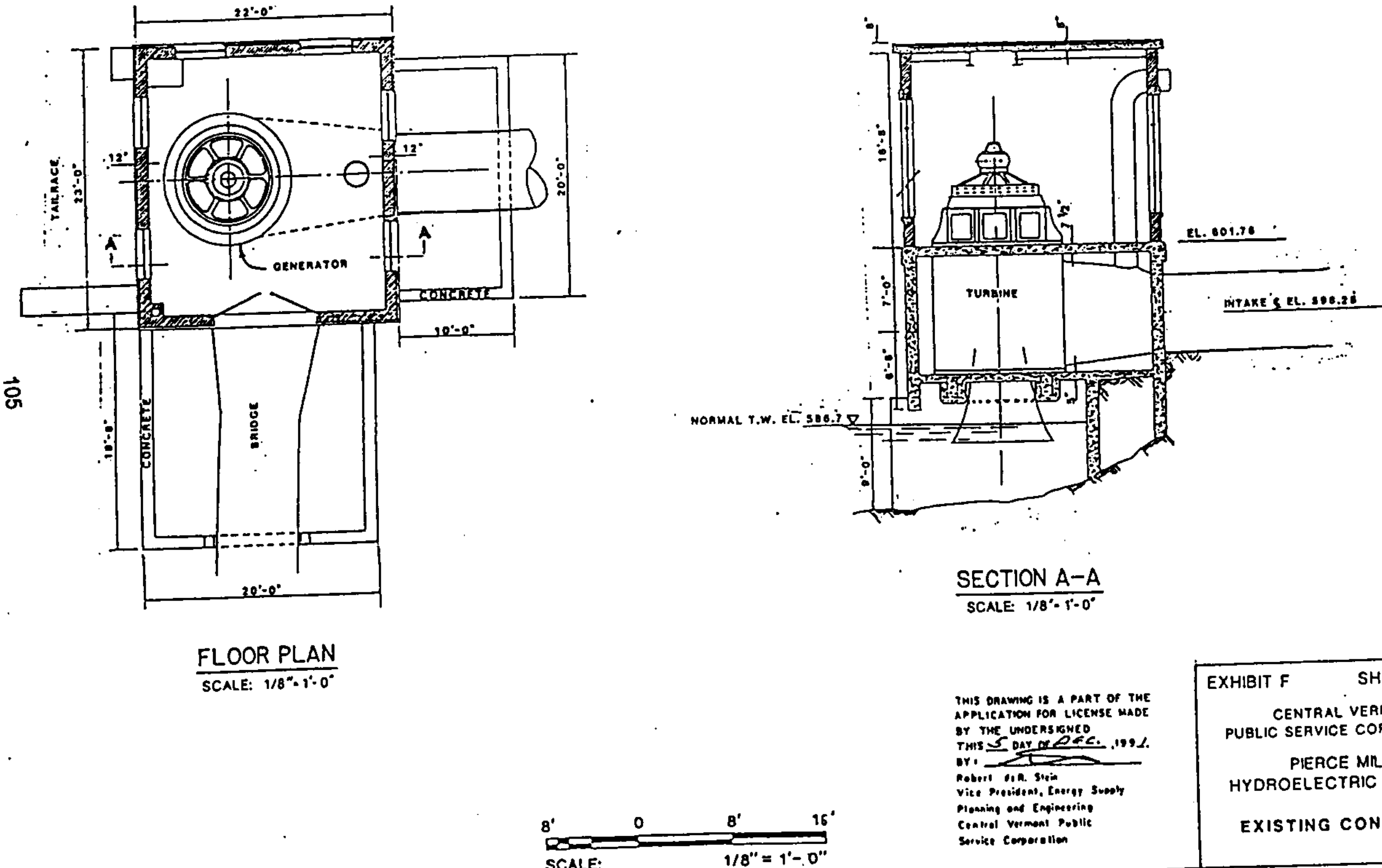

PASSUMPSIC RIVER
PASSUMPSIC RIVER FLOW
93'-0" SPILLWAY
TRASH RACK & HEAD GATE
PENSTOCK
POWER HOUSE
TAIL RACE
SUB STATION
ACCESS ROAD
GENERAL PLAN
SCALE: 1" = 40'
93'
EL. 610.5
EL. 605 ± (WITH 18" FLASHBOARDS)
DAM ELEVATION
SCALE: 1" = 20' ±
SCALE: 1" = 40'
40 0 40 80
CREST EL. 603.6
EL. 585.5 ±
18'
SECTION A-A
SCALE: 1/8" = 1'-0"
EL. 610.5
PENSTOCK
21'-0"
SECTION B-B
SCALE: 1/8" = 1'-0"
THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THIS 5 DAY OF Dec. 1991.
BY:
Robert deR. Stein
Vice President, Energy Supply
Planning and Engineering
Central Vermont Public Service Corporation
EXHIBIT F
SHEET 1 OF 2
CENTRAL VERMONT PUBLIC SERVICE CORPORATION
PIERCE MILLS HYDROELECTRIC PROJECT
EXISTING CONDITIONS

FIG 2.1



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BY:
Robert deR. Stein
Vice President, Energy Supply Planning and Engineering
Central Vermont Public Service Corporation

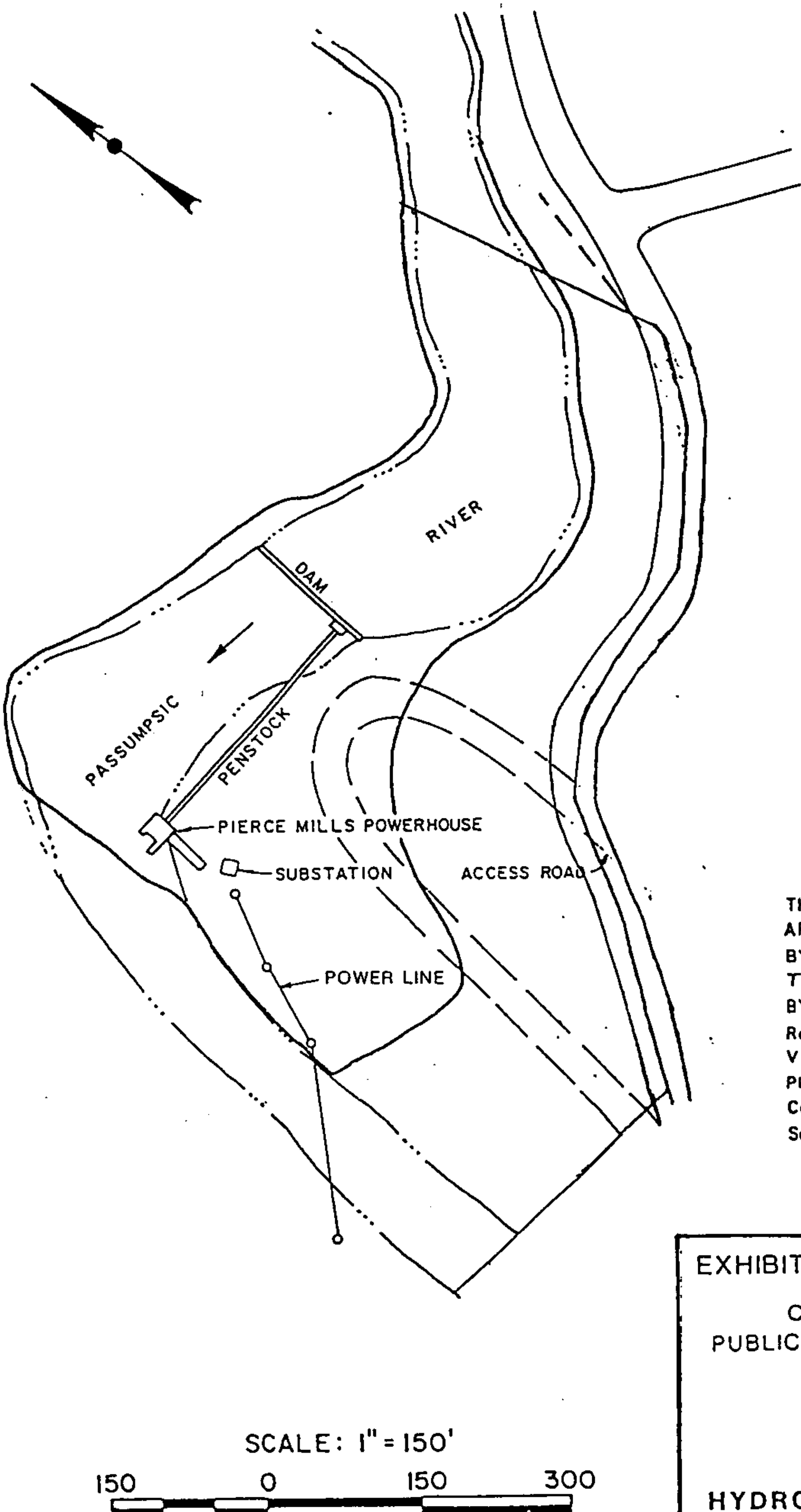
EXHIBIT F SHEET 2 OF 2

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

PIERCE MILLS HYDROELECTRIC PROJECT

EXISTING CONDITIONS

FIG 2.1



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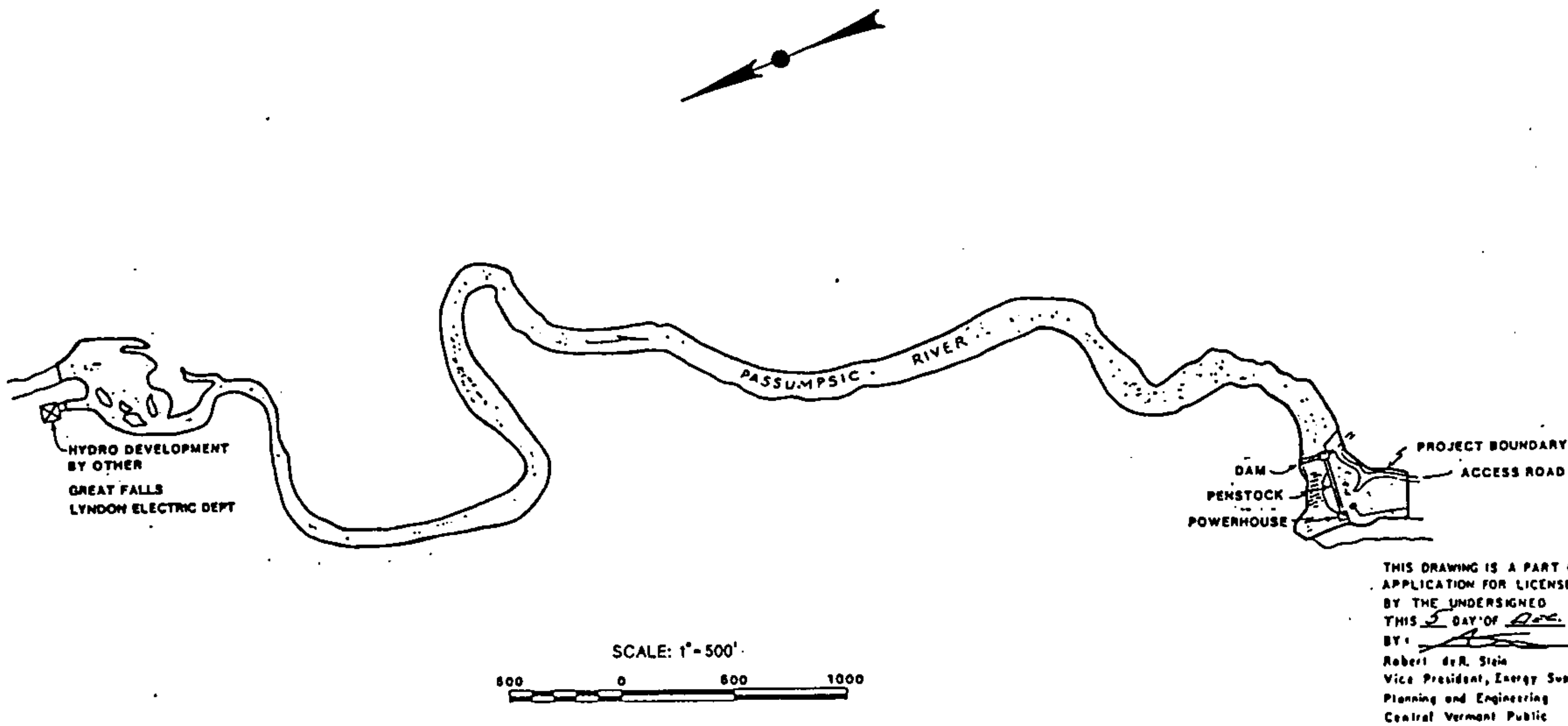
Robert deR. Stein
Vice President, Energy Supply Planning and Engineering
Central Vermont Public Service Corporation

EXHIBIT G SHEET 1 of

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

PROJECT MAP

PIERCE MILLS HYDROELECTRIC PROJECT



THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THIS 5 DAY OF Dec. 199[illegible].

BY:

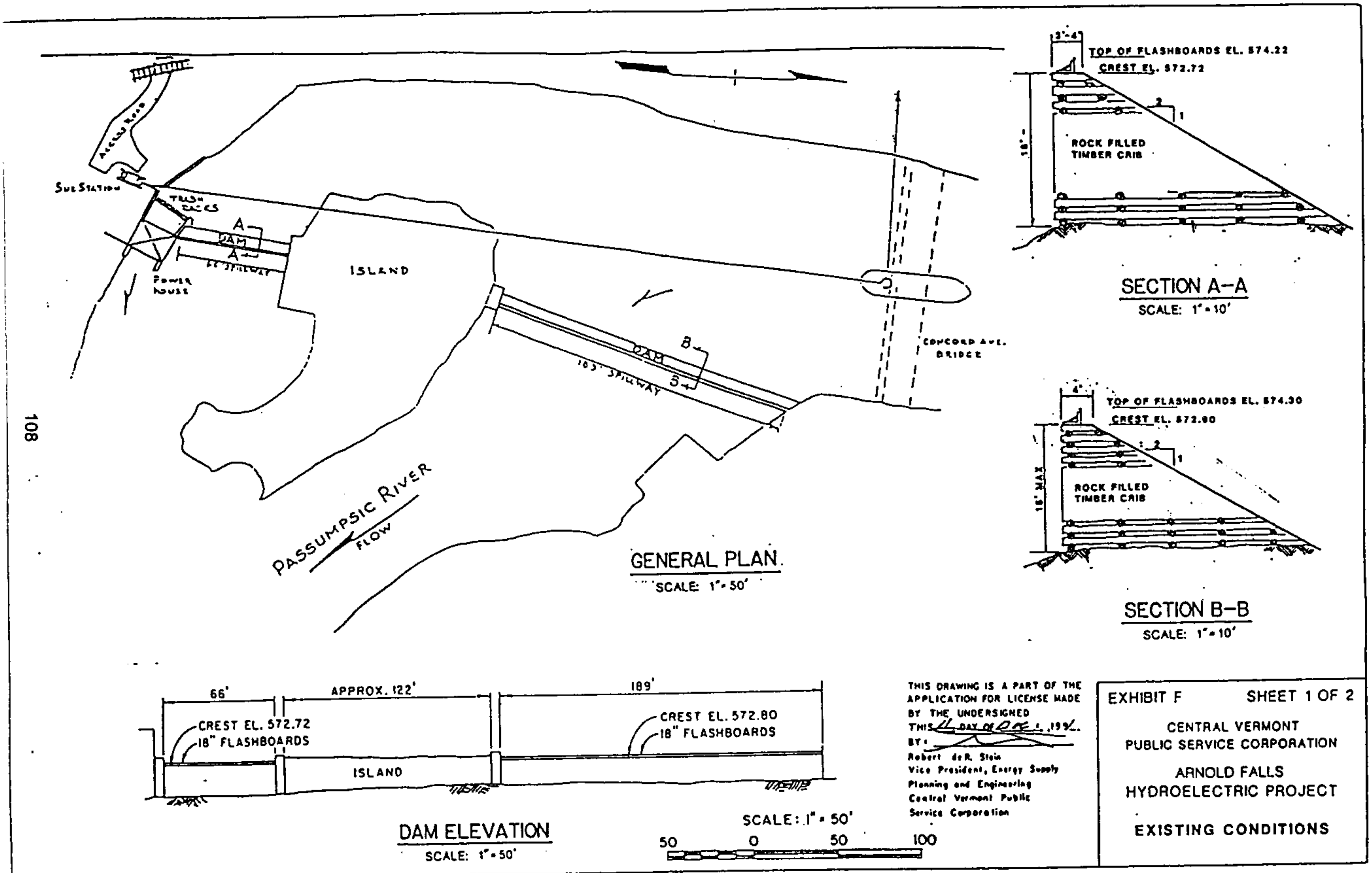
Robert deR. Stein
Vice President, Energy Supply
Planning and Engineering
Central Vermont Public
Service Corporation

EXHIBIT G — SHEET 2 of 2

CENTRAL VERMONT
PUBLIC SERVICE CORPORATION

PROJECT MAP

PIERCE MILLS
HYDROELECTRIC PROJECT



TOP OF FLASHBOARDS EL. 574.22
CREST EL. 572.72
ROCK FILLED TIMBER CRIB
SECTION A–A
SCALE: 1" = 10'
TOP OF FLASHBOARDS EL. 574.30
CREST EL. 572.80
18' MAX
ROCK FILLED TIMBER CRIB
SECTION B–B
SCALE: 1" = 10'
SUBSTATION
ACCESS ROAD
TRASH RACKS
DAM
POWER HOUSE
ISLAND
DAM
163' SPILLWAY
CONCORD AVE. BRIDGE
PASSUMPSIC RIVER
FLOW
GENERAL PLAN
SCALE: 1" = 50'
66'
APPROX. 122'
189'
CREST EL. 572.72
18" FLASHBOARDS
ISLAND
CREST EL. 572.80
18" FLASHBOARDS
DAM ELEVATION
SCALE: 1" = 50'
SCALE: 1" = 50'
50 0 50 100
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BY:
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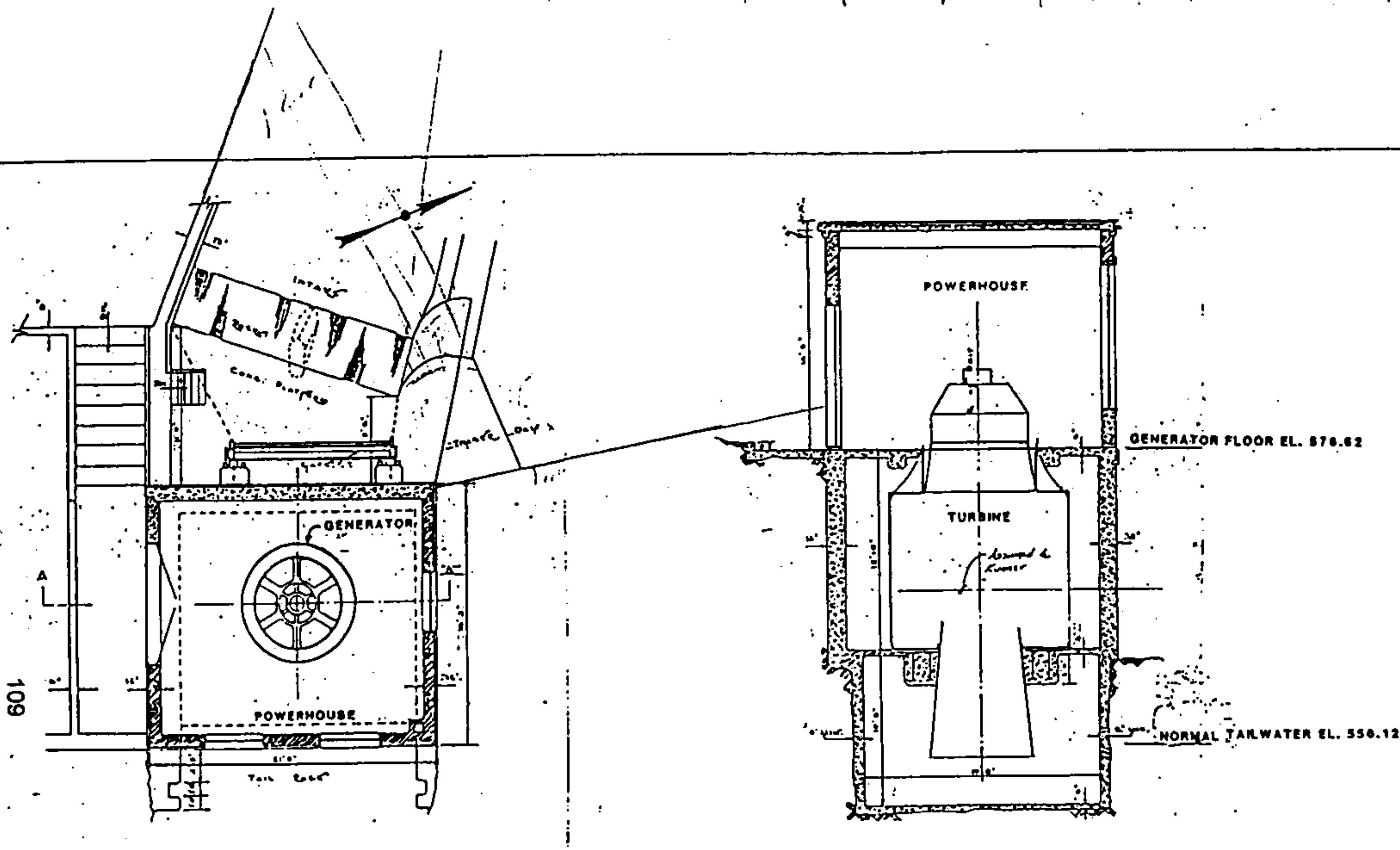
Planning and Engineering
Central Vermont Public Service Corporation
EXHIBIT F
SHEET 1 OF 2
CENTRAL VERMONT PUBLIC SERVICE CORPORATION
ARNOLD FALLS HYDROELECTRIC PROJECT
EXISTING CONDITIONS

FIG 3



FLOOR PLAN

SCALE: 1/8" = 1'-0"

SECTION A–A

SCALE: 1/8" = 1'-0"

8' 0 8' 16'

SCALE: 1/8" = 1'- 0"

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Central Vermont Public
Service Corporation

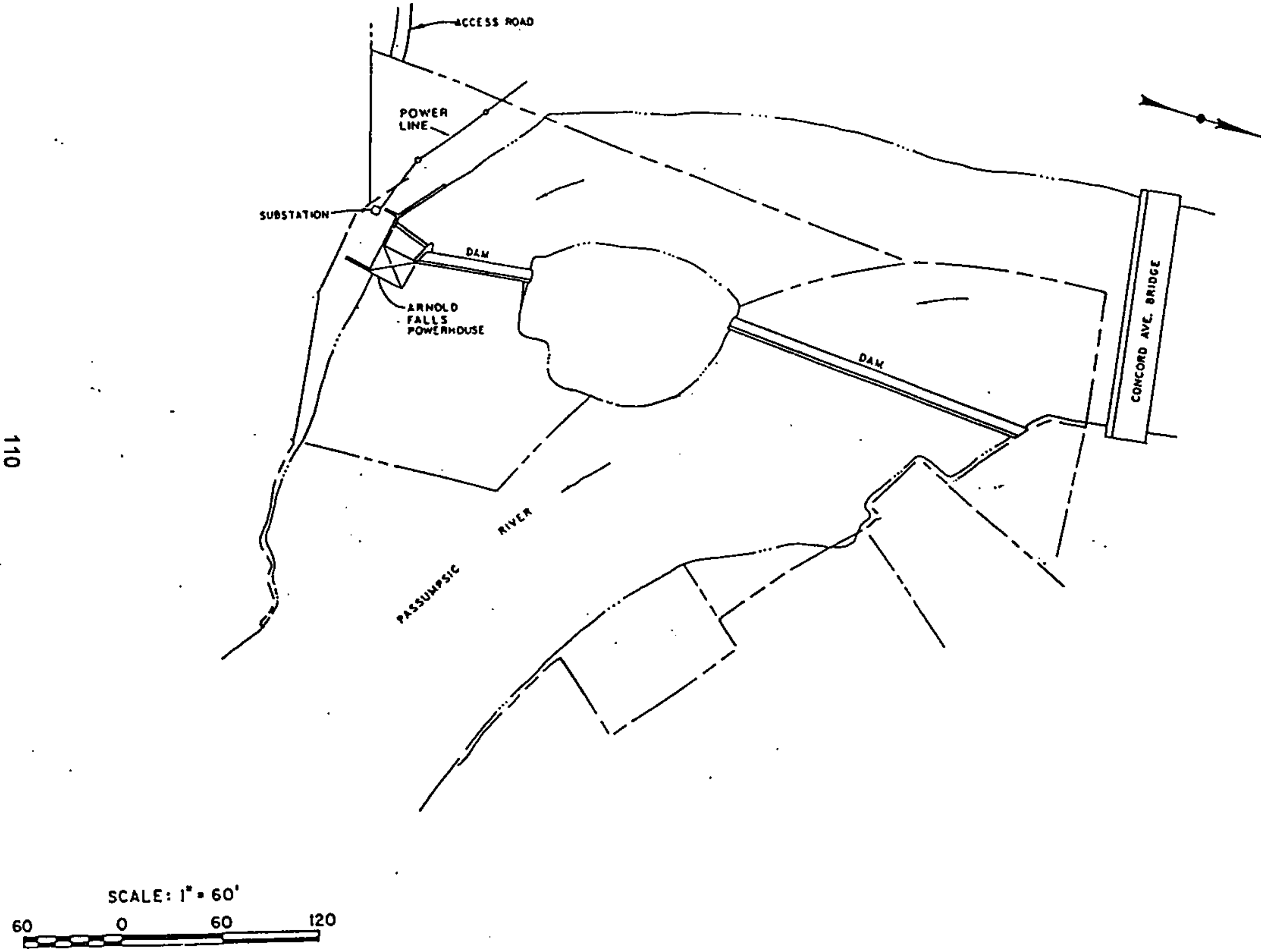
EXHIBIT F SHEET 2 OF 2

CENTRAL VERMONT
PUBLIC SERVICE CORPORATION

ARNOLD FALLS
HYDROELECTRIC PROJECT

EXISTING CONDITIONS

FIG. 3.1



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Vice President, Energy Supply Planning and Engineering
Central Vermont Public Service Corporation

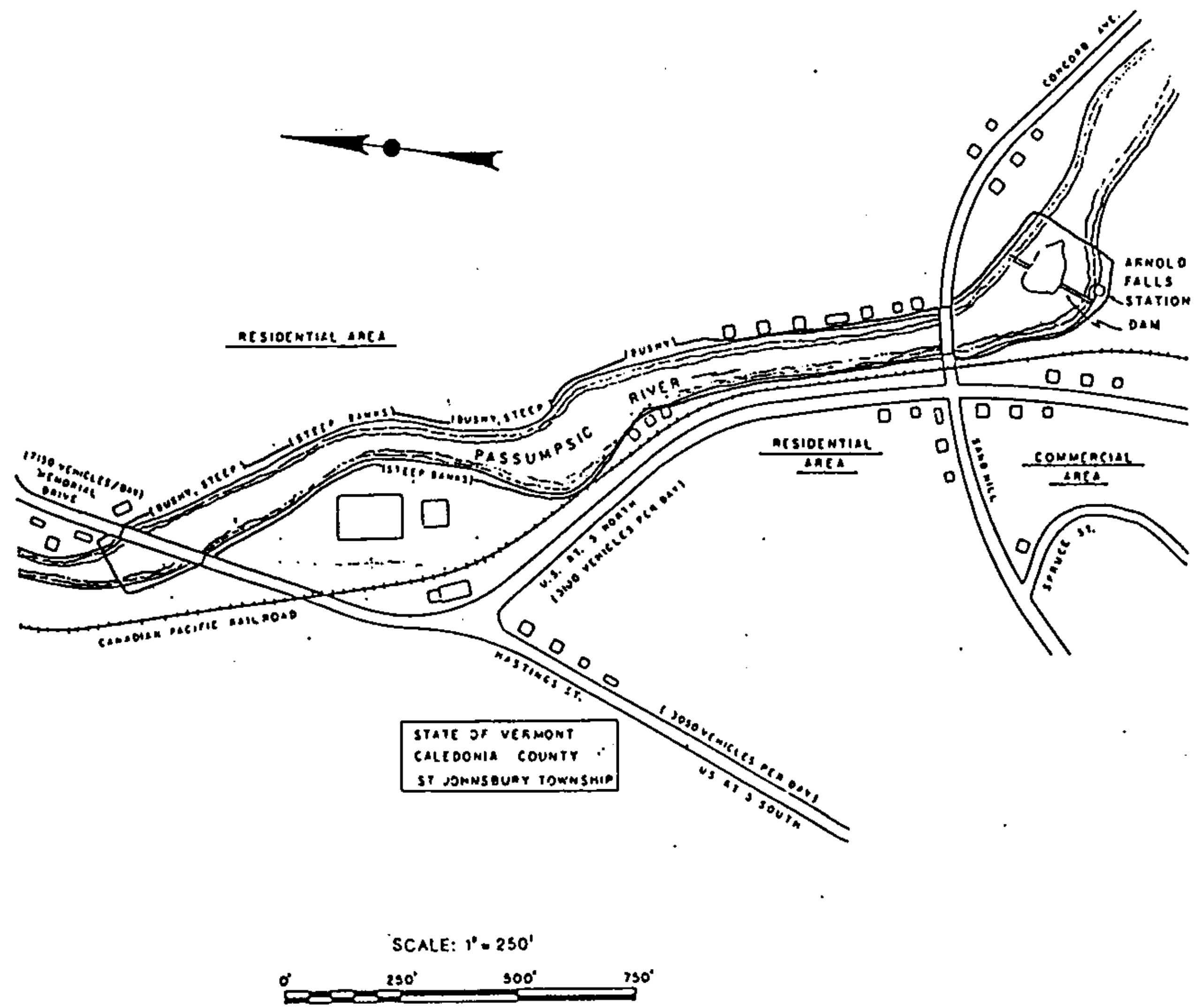
EXHIBIT G SHEET 1 of 2

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

PROJECT MAP

ARNOLD FALLS HYDROELECTRIC PROJECT

Fig. 2



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Vice President, Energy Supply Planning and Engineering
Central Vermont Public Service Corporation

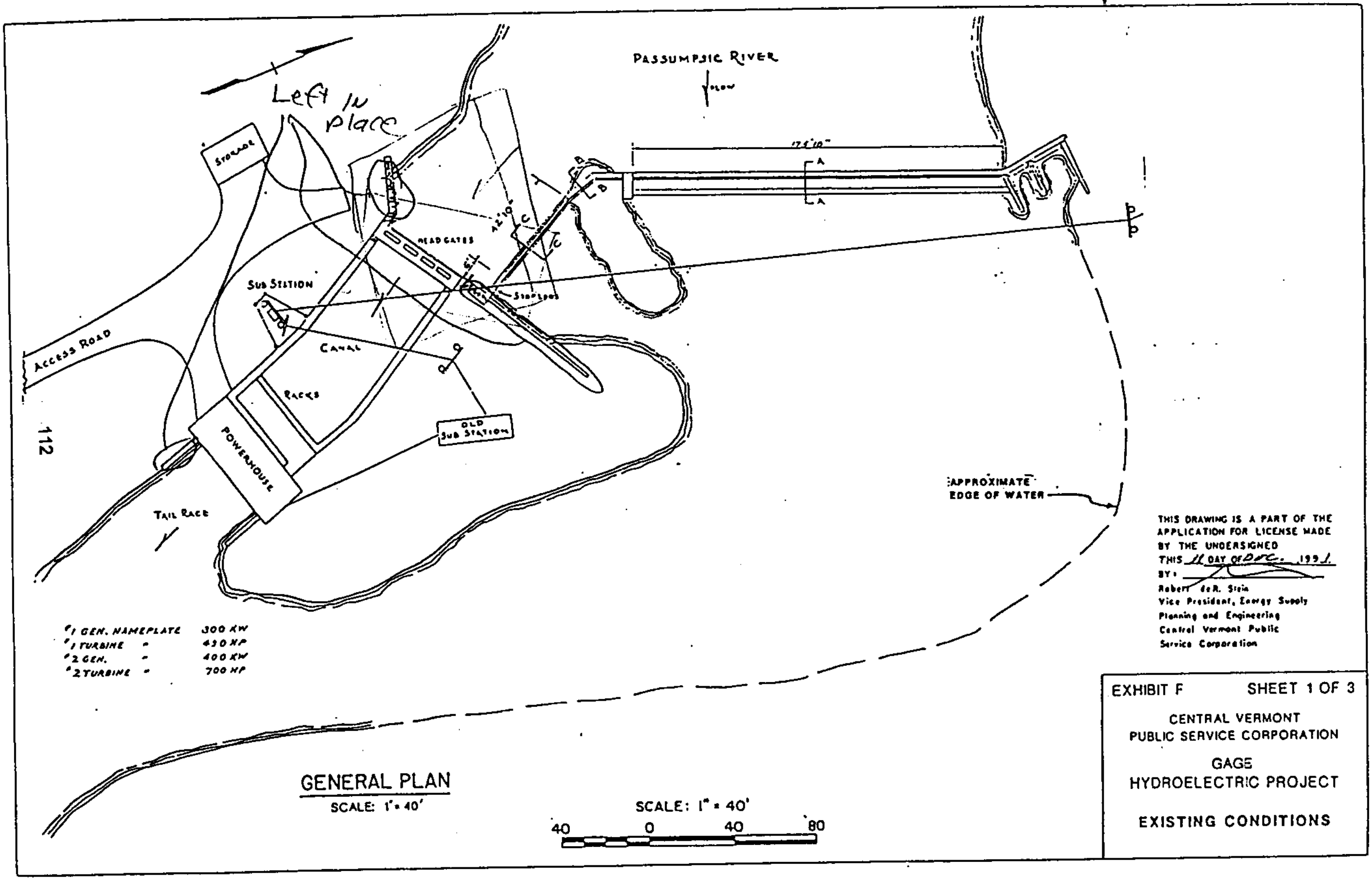
EXHIBIT G SHEET 2 of 2

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

PROJECT MAP

ARNOLD FALLS HYDROELECTRIC PROJECT

FIG. 3.2



PASSUMPSIC RIVER
FLOW
175'10"
A
A
B
B
C
C
42'10"
HEADGATES
STOPLOGS
SUB STATION
CANAL
RACKS
OLD SUB STATION
POWERHOUSE
STORAGE
ACCESS ROAD
TAIL RACE
APPROXIMATE EDGE OF WATER
Left in place
#1 GEN. NAMEPLATE 300 KW
#1 TURBINE = 430 HP
#2 GEN. = 400 KW
#2 TURBINE = 700 HP
GENERAL PLAN
SCALE: 1" = 40'
SCALE: 1" = 40'
40 0 40 80
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THIS 11 DAY OF DEC. 1991.
BY:
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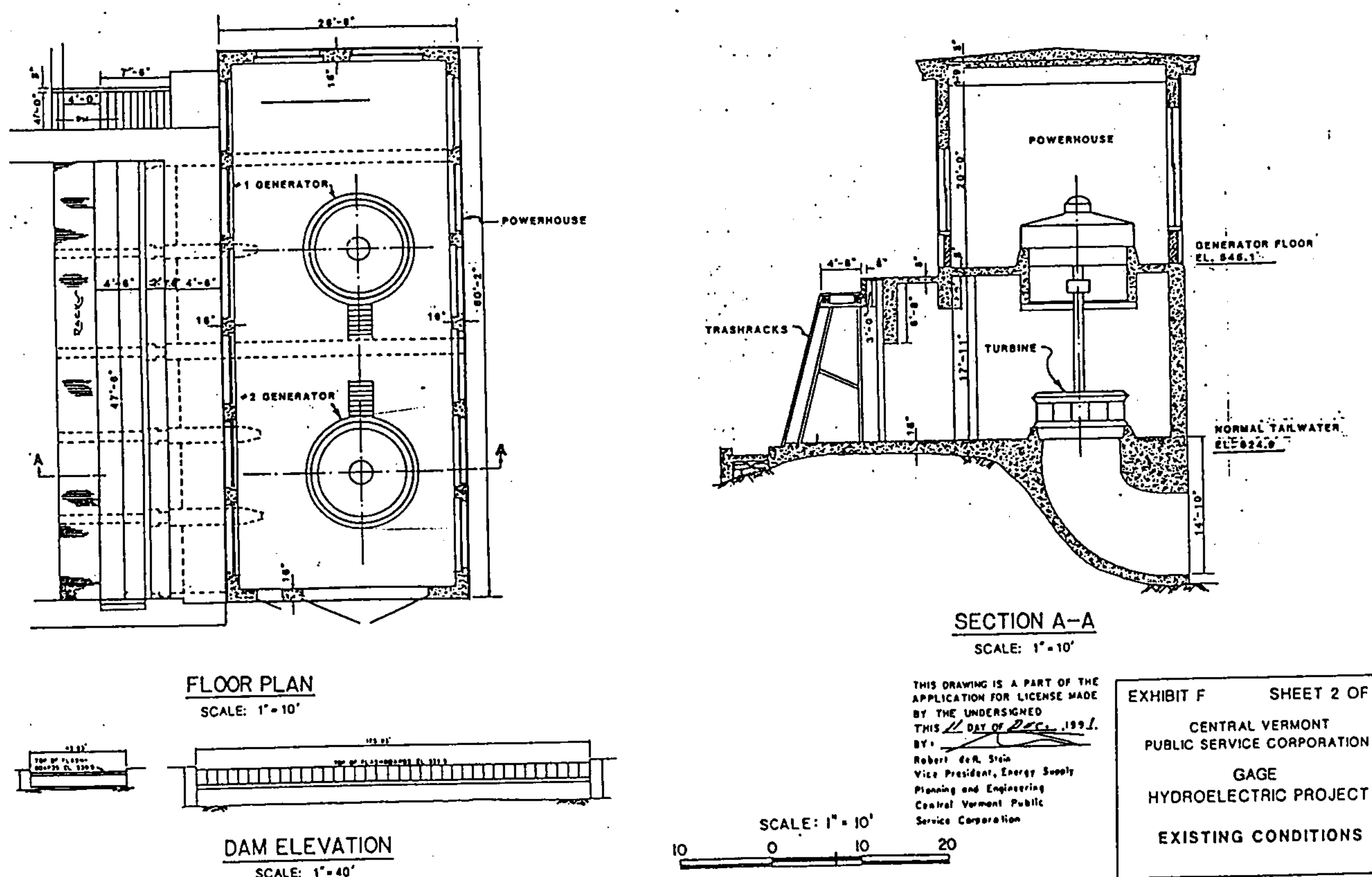
Vice President, Energy Supply
Planning and Engineering
Central Vermont Public
Service Corporation
EXHIBIT F
SHEET 1 OF 3
CENTRAL VERMONT
PUBLIC SERVICE CORPORATION
GAGE
HYDROELECTRIC PROJECT
EXISTING CONDITIONS

FIG. # 41



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Vice President, Energy Supply
Planning and Engineering
Central Vermont Public
Service Corporation

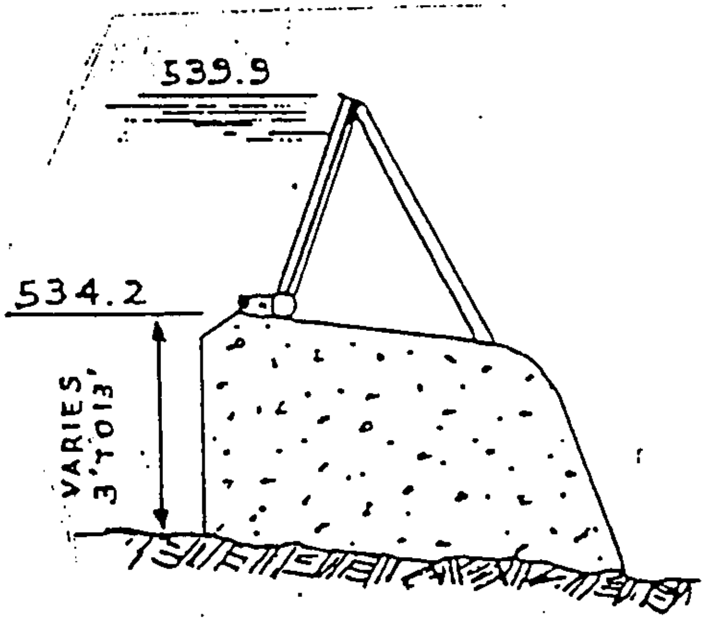
EXHIBIT F SHEET 2 OF 3

CENTRAL VERMONT
PUBLIC SERVICE CORPORATION

GAGE
HYDROELECTRIC PROJECT

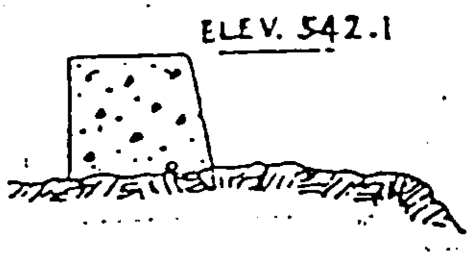
EXISTING CONDITIONS

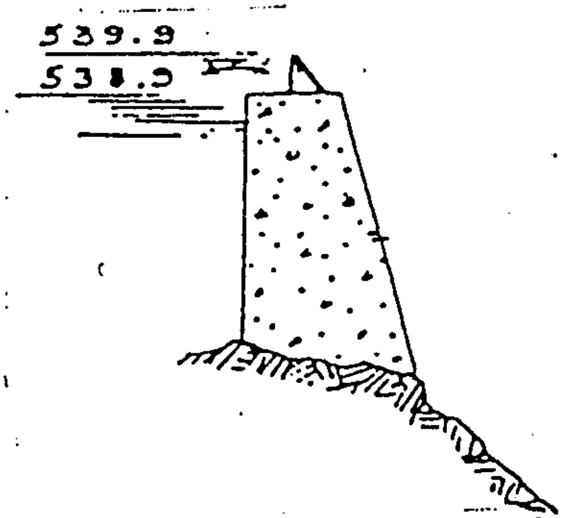
FIG. 4.1



SECTION A–A

SCALE: 1" = 5'





SECTION B–B

SCALE: 1" = 5'

SECTION C–C

SCALE: 1" = 5'

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Vice President, Energy Supply Planning and Engineering
Central Vermont Public Service Corporation

5' 0 5' 10'

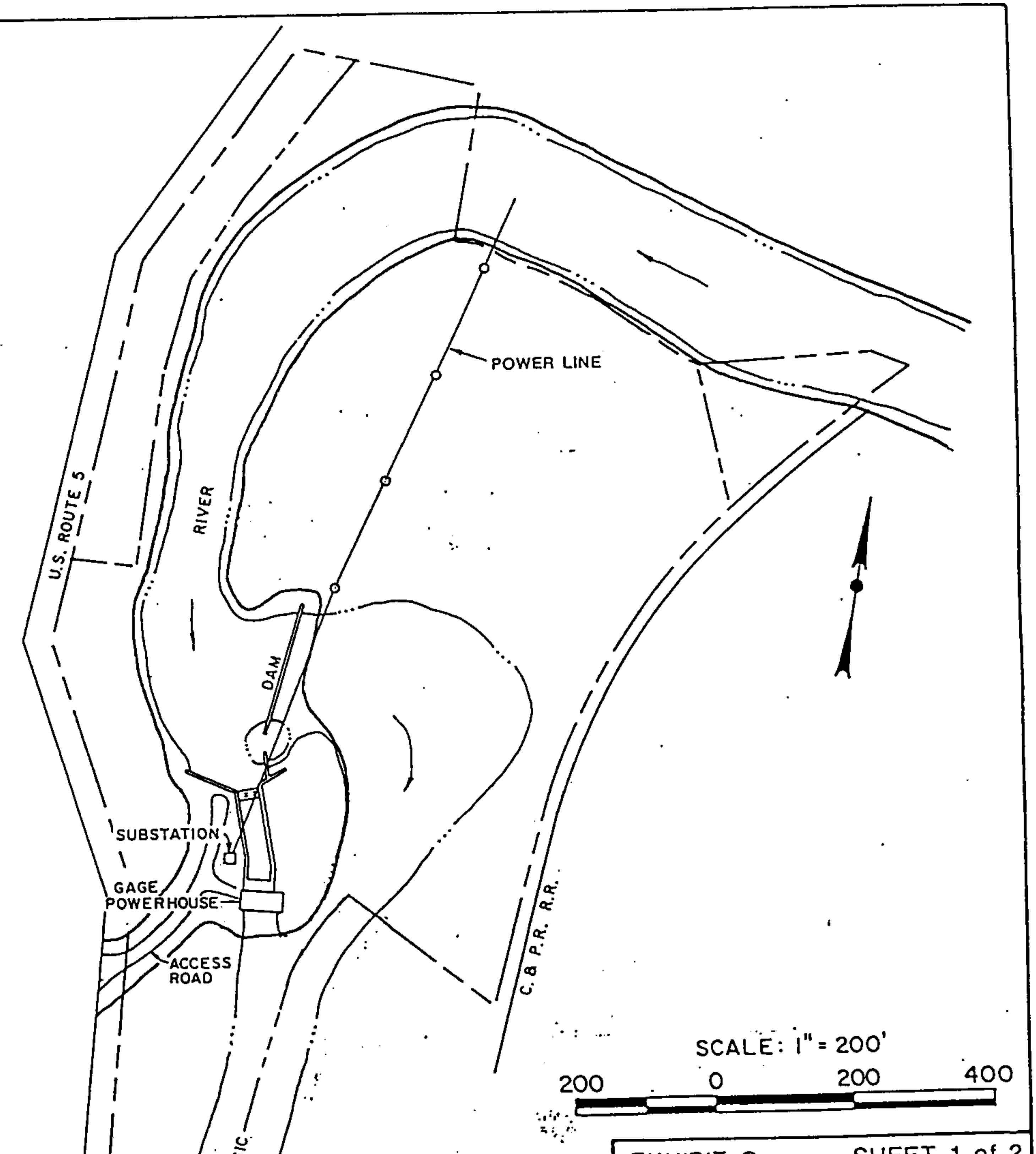
SCALE: 1" = 5'

EXHIBIT F	SHEET 3 OF 3

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

GAGE HYDROELECTRIC PROJECT

EXISTING CONDITIONS



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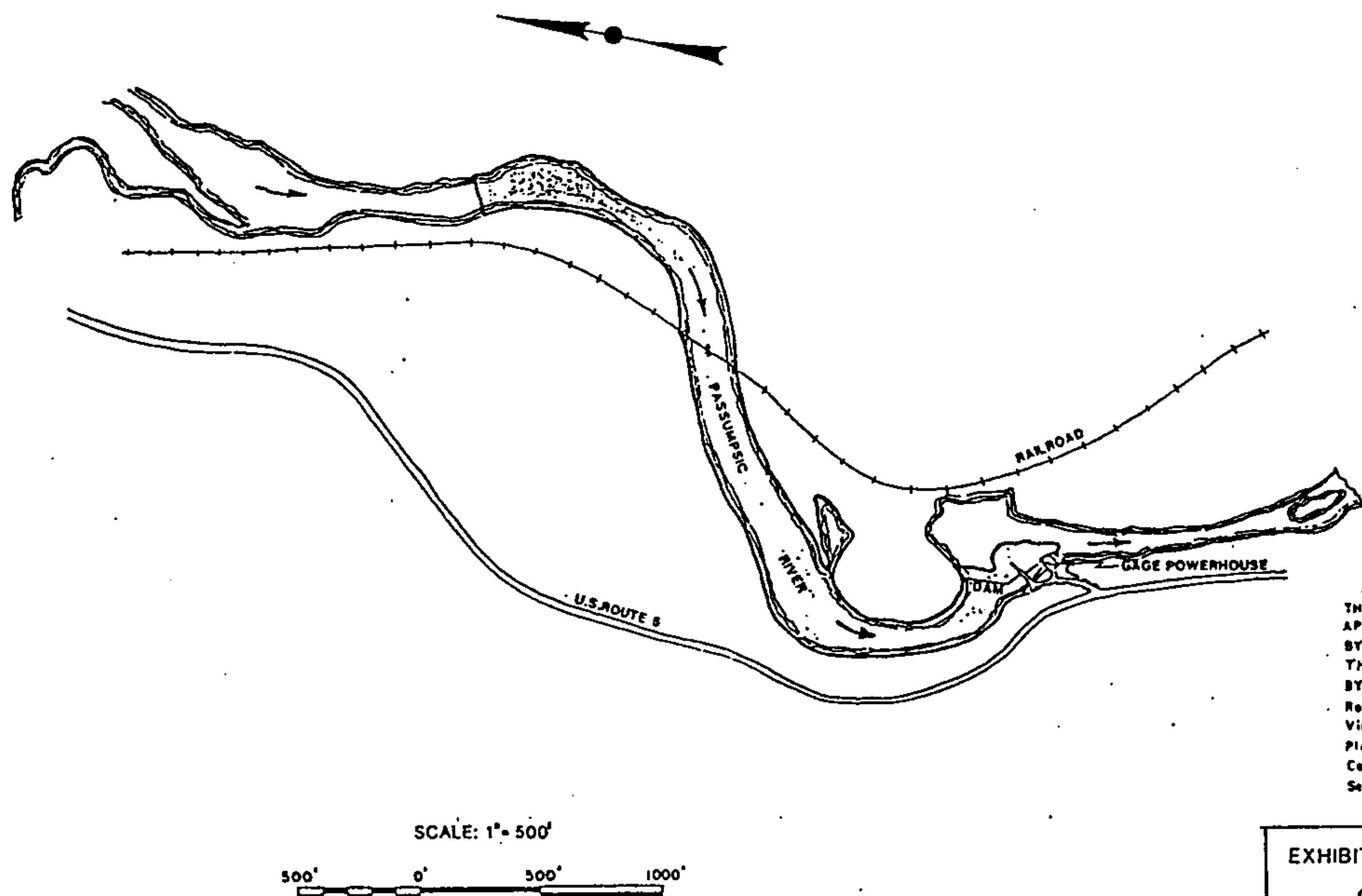
THIS 16 DAY OF DEC 1996.
BY: [signature]
Robert deR. Stein
Vice President, Energy Supply
Planning and Engineering
Central Vermont Public
Service Corporation

EXHIBIT G SHEET 1 of 2

CENTRAL VERMONT
PUBLIC SERVICE CORPORATION

PROJECT MAP

GAGE
HYDROELECTRIC PROJECT



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Central Vermont Public
Service Corporation

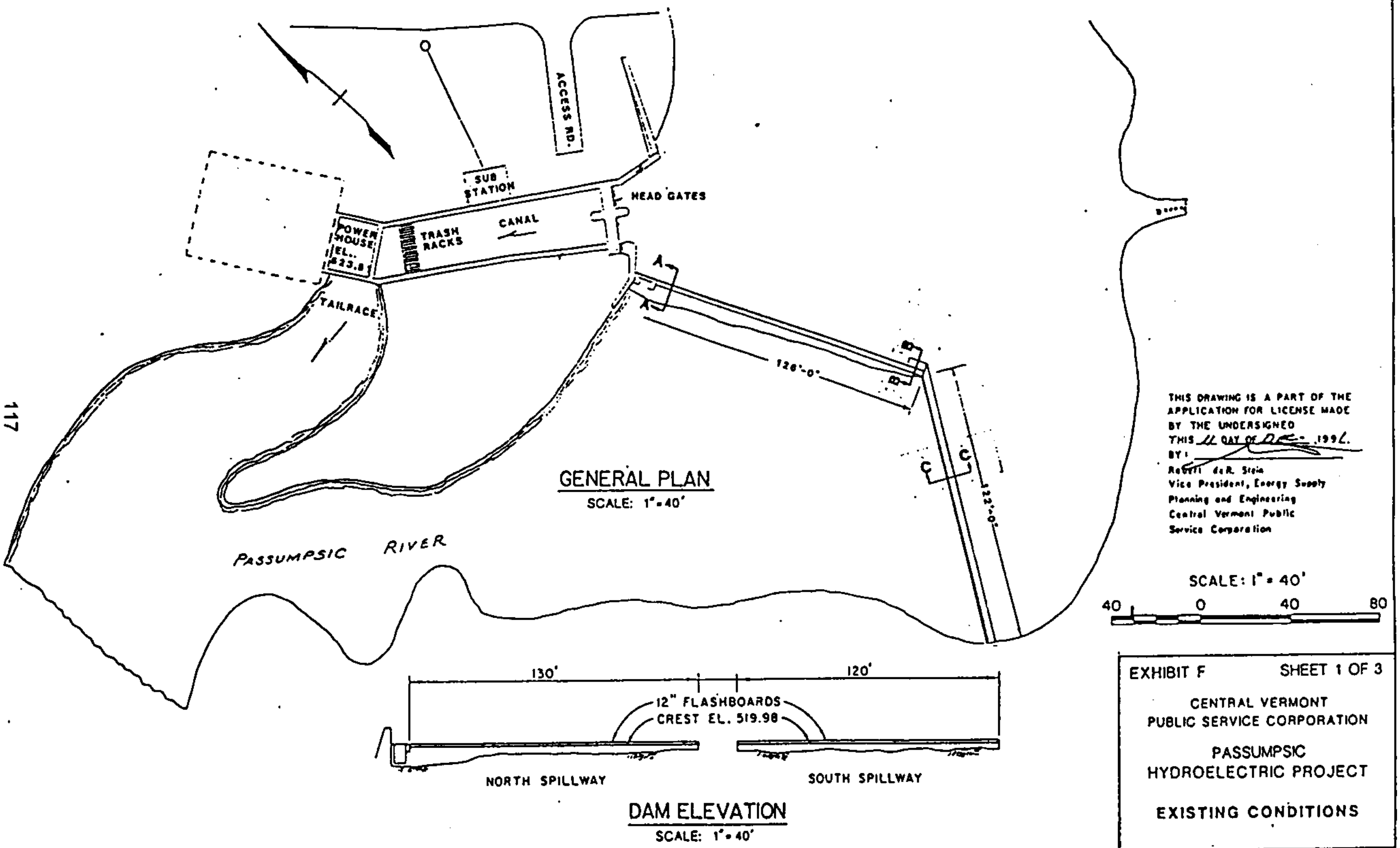
EXHIBIT G SHEET 2 of 2

CENTRAL VERMONT
PUBLIC SERVICE CORPORATION

PROJECT MAP

GAGE
HYDROELECTRIC PROJECT

FIG. E2


ACCESS RD.
SUB STATION
HEAD GATES
CANAL
TRASH RACKS
POWER HOUSE EL. 523.8
TAILRACE
128'-0"
122'-0"
GENERAL PLAN
SCALE: 1"=40'
PASSUMPSIC RIVER
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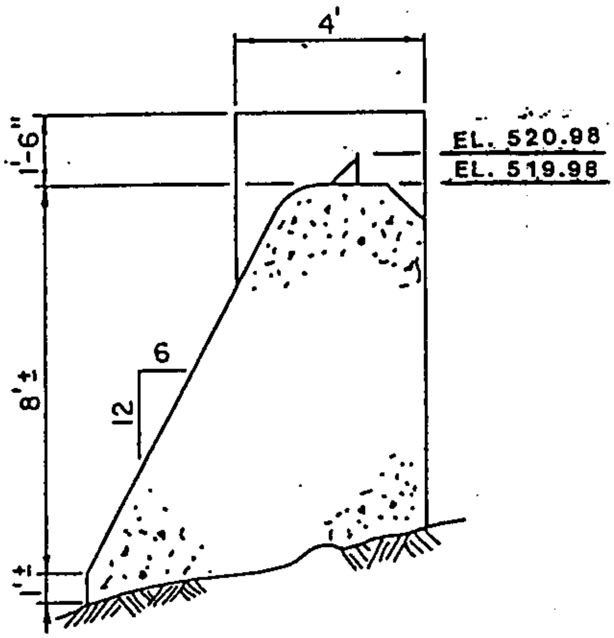
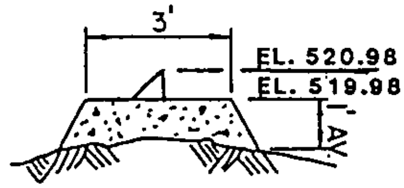
BY:
Robert deR. Stein
Vice President, Energy Supply
Planning and Engineering
Central Vermont Public
Service Corporation
SCALE: 1" = 40'
40 0 40 80
130'
120'
12" FLASHBOARDS
CREST EL. 519.98
NORTH SPILLWAY
SOUTH SPILLWAY
DAM ELEVATION
SCALE: 1"=40'
EXHIBIT F
SHEET 1 OF 3
CENTRAL VERMONT
PUBLIC SERVICE CORPORATION
PASSUMPSIC
HYDROELECTRIC PROJECT
EXISTING CONDITIONS

FIG. 5.1



SECTION A-A

SCALE: 1/4"=1'-0"



SECTION C-C

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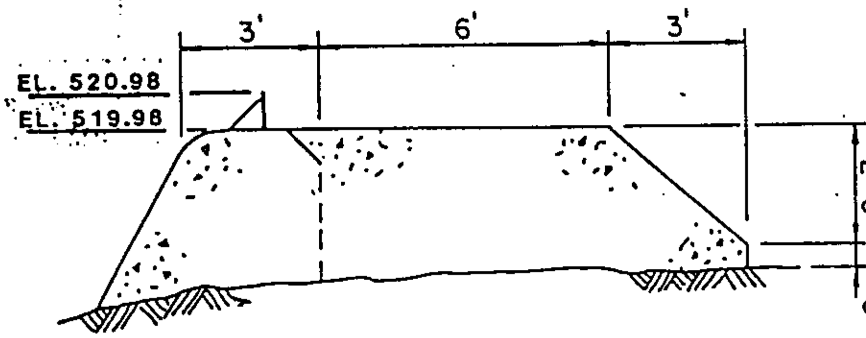


SECTION B-B

SCALE: 1/4"=1'-0"

THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THIS 11 DAY OF DEC 1991.

BY:

Robert deR. Stein
Vice President, Energy Supply Planning and Engineering
Central Vermont Public Service Corporation

SCALE: 1/4" = 1'- 0"

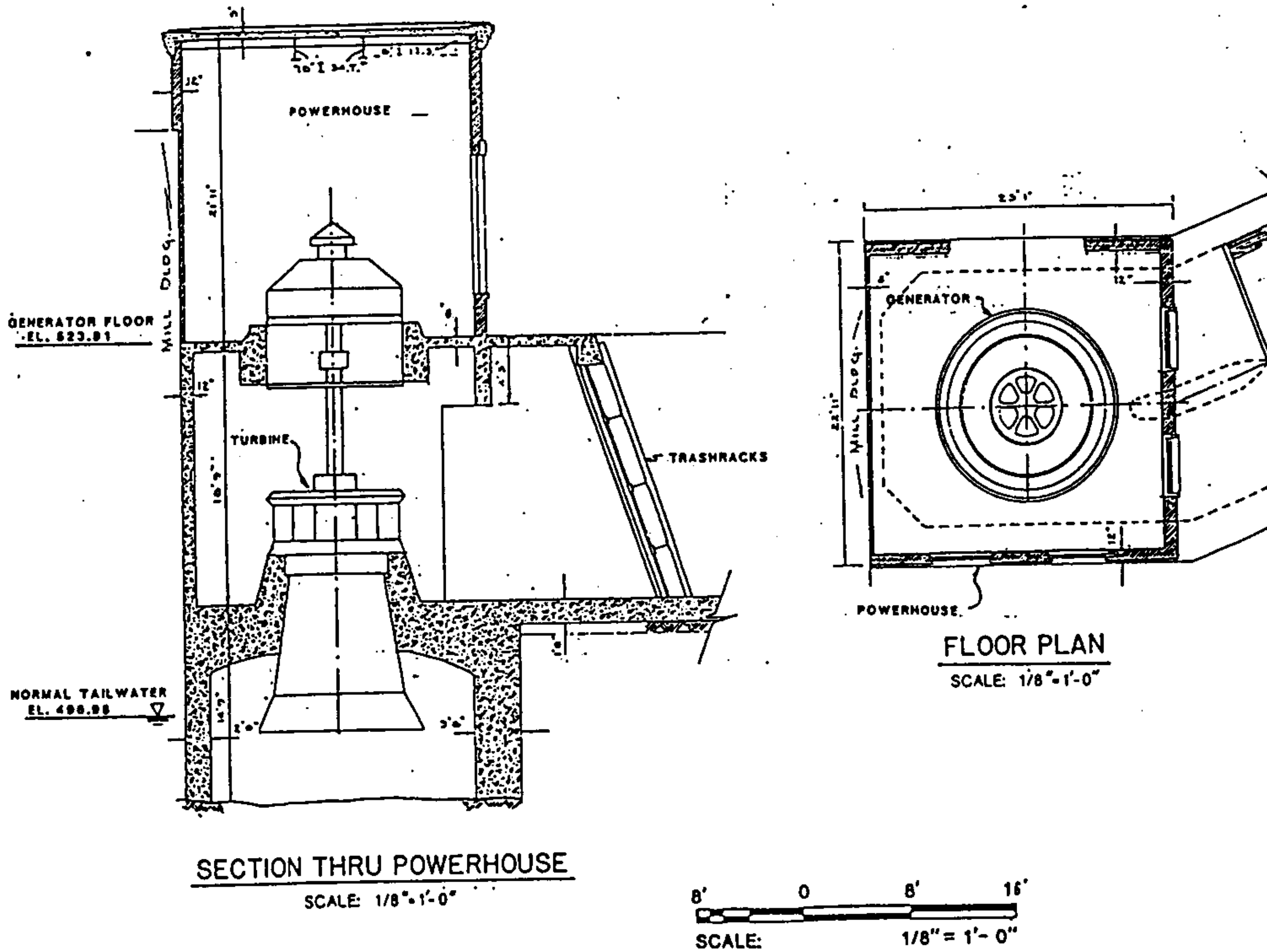
EXHIBIT F SHEET 2 OF 3

CENTRAL VERMONT PUBLIC SERVICE CORPORATION

PASSUMPSIC HYDROELECTRIC PROJECT

EXISTING CONDITIONS

FIG 5.1



THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THIS 11 DAY OF Dec. 1991.
BY:
Robert deR. Stein
Vice President, Energy Supply
Planning and Engineering
Central Vermont Public
Service Corporation

EXHIBIT F SHEET 3 OF 3

CENTRAL VERMONT
PUBLIC SERVICE CORPORATION

PASSUMPSIC
HYDROELECTRIC PROJECT

EXISTING CONDITIONS

FIG. 5.1

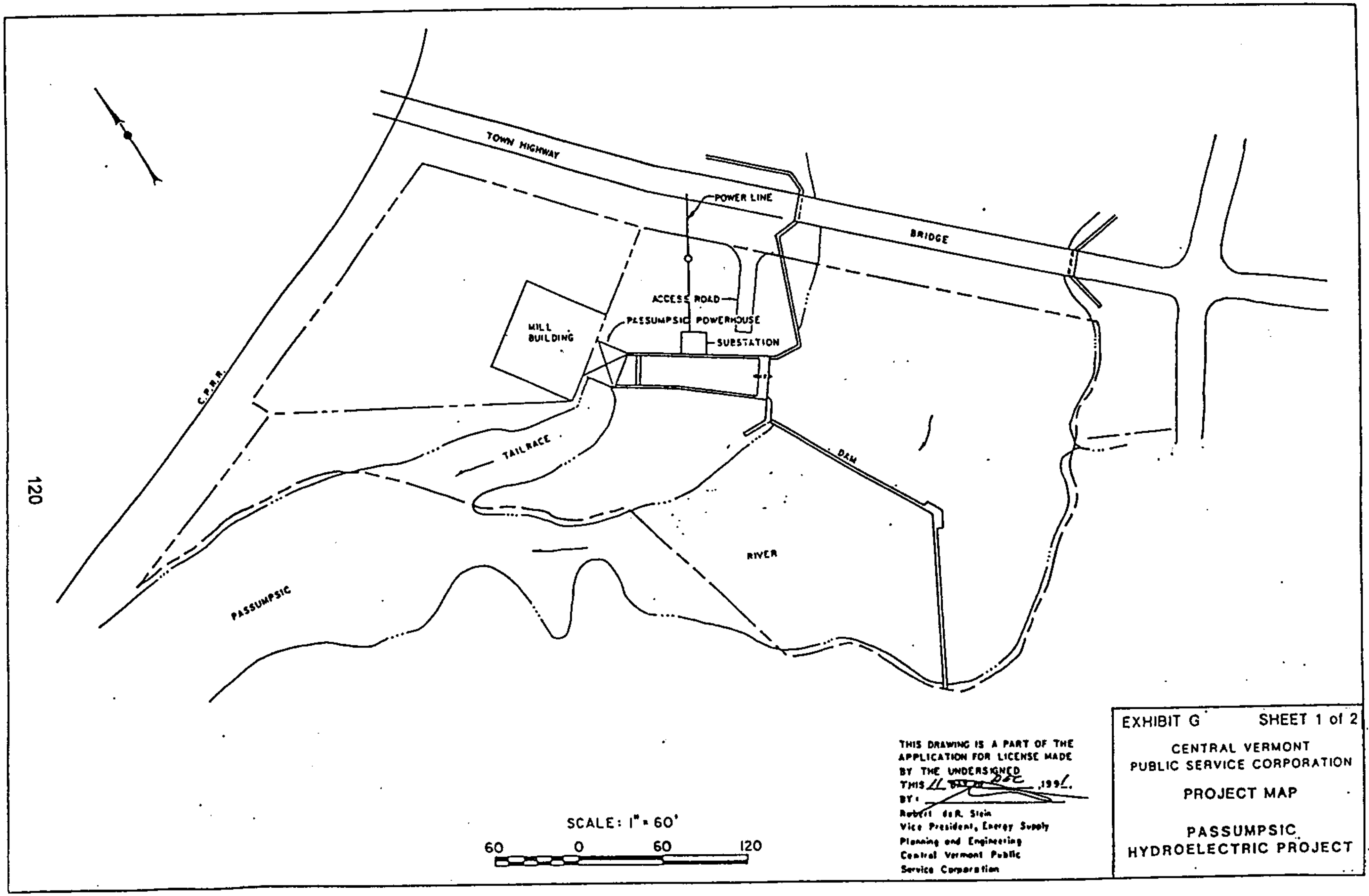

TOWN HIGHWAY
POWER LINE
BRIDGE
ACCESS ROAD
PASSUMPSIC POWERHOUSE
SUBSTATION
MILL BUILDING
C.P.R.R.
TAILRACE
DAM
RIVER
PASSUMPSIC
SCALE: 1" = 60'
60 0 60 120
THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED
THIS 11 DAY OF DEC, 1991.
BY:
Robert deR. Stein
Vice President, Energy Supply
Planning and Engineering
Central Vermont Public
Service Corporation
EXHIBIT G SHEET 1 of 2
CENTRAL VERMONT PUBLIC SERVICE CORPORATION
PROJECT MAP
PASSUMPSIC HYDROELECTRIC PROJECT

FIG. 5.2

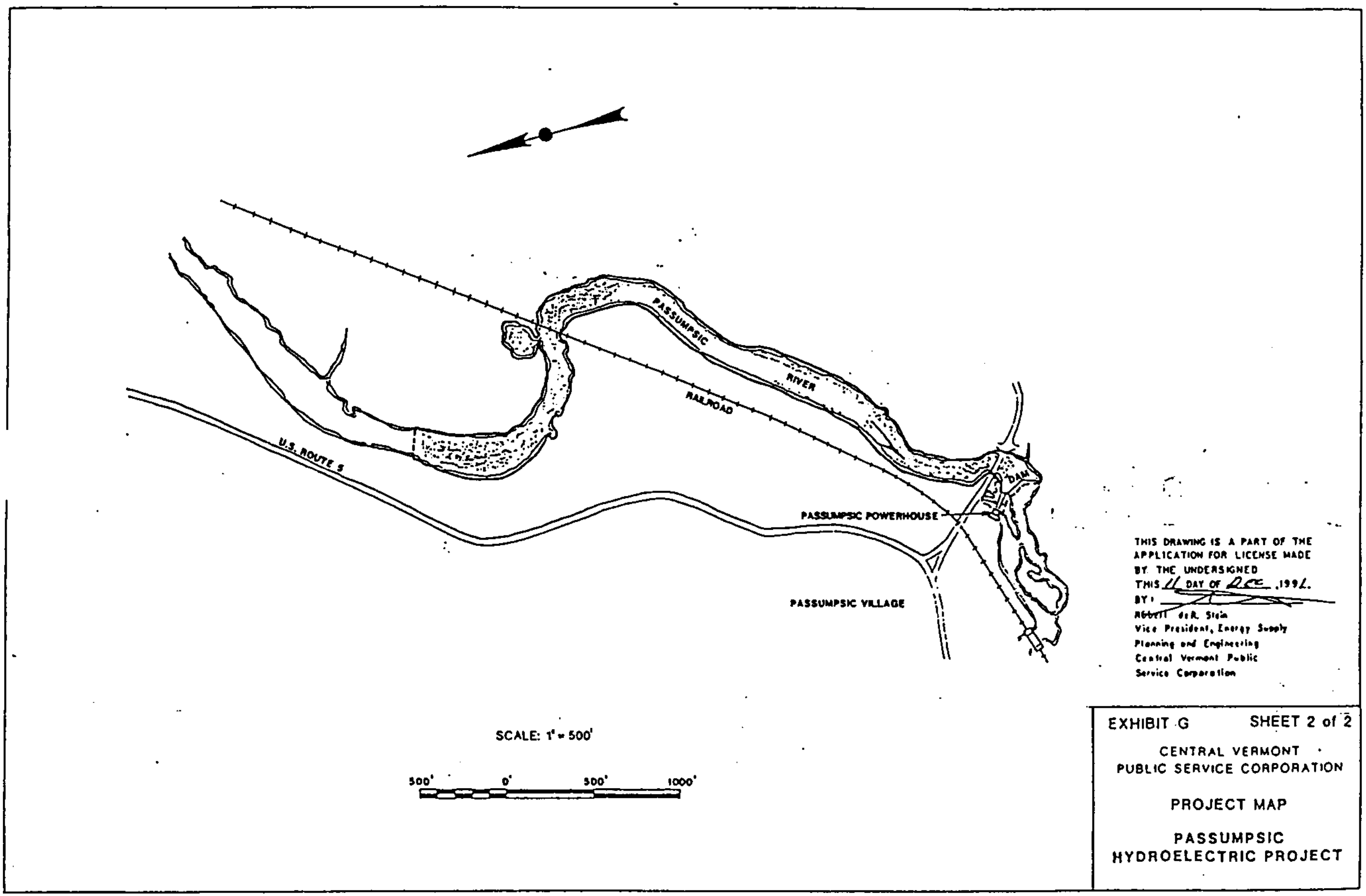

PASSUMPSIC
RIVER
RAILROAD
U.S. ROUTE 5
DAM
PASSUMPSIC POWERHOUSE
PASSUMPSIC VILLAGE
SCALE: 1" = 500'
500' 0' 500' 1000'
THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THIS 11 DAY OF Dec, 1992.
BY:
Robert deR. Stein
Vice President, Energy Supply
Planning and Engineering
Central Vermont Public Service Corporation
EXHIBIT G
SHEET 2 of 2
CENTRAL VERMONT PUBLIC SERVICE CORPORATION
PROJECT MAP
PASSUMPSIC HYDROELECTRIC PROJECT

FIG. 5.2

AGREEMENT.

This Agreement is made as of the 10th day of June, 1997 by, among and between the Vermont Natural Resources Council ("VNRC"), the Central Vermont Public Service Corporation ("CVPS"), and the Vermont Agency of Natural Resources ("ANR").

WHEREAS, VNRC has taken an appeal of the issuance to CVPS by the ANR of a so-called § 401 Water Quality Certification, which appeal is pending before the Vermont Water Resources Board in the matter captioned In Re: Passumpsic River Hydroelectric Project (CVPS), Docket No. WQ-94-09 (the "Appeal");

WHEREAS, the parties desire to resolve the Appeal and to document the agreement by which the Appeal will be resolved and dismissed;

NOW, THEREFORE, the parties hereto, intending fully to be bound hereby and in consideration of the premises and the undertakings to be performed hereunder, hereby agree as follows:

1. Upon the execution and delivery of this Agreement, CVPS will engage Kleinschmidt Associates of Pittsfield, Maine, or other engineering firm acceptable to CVPS and capable of performing hereunder (the "Engineers"), to perform the Scope of Work set forth and attached hereto as Exhibit A relating to the removal of the four Passumpsic River Hydroelectric Projects (the "Projects") licensed to and owned and operated by CVPS.

2. Within thirty (30) days of engagement, the Engineers will deliver to CVPS the Preliminary Report detailing (as called for in Part II of the Scope of Work) various alternatives for the removal of the Projects and the Engineers' recommended preferred alternative from among those proposed in the Preliminary Report.

3. Promptly following receipt of the Preliminary Report, CVPS will provide a copy of same to VNRC and to ANR. The parties, with the attendance of the Engineers, shall meet, at a mutually agreeable time and place but in no event later than thirty (30) days following the date the Preliminary Report is provided to VNRC and to ANR by CVPS, to review the Preliminary Report and to seek consensus on a preferred alternative. Within fourteen (14) days following the meeting of the parties, the Engineers shall prepare a Final Report (as called for in Part II of the Scope of Work), including a conceptual removal plan, based upon the consensus position of the parties, if one is reached. If consensus regarding the preferred alternative is not reached by the parties, the Engineers shall select the preferred alternative on which to base the Final Report, and also shall include in the Final Report a discussion that notes the alternatives preferred by each of the parties. The Final Report shall be provided to CVPS promptly upon its completion by the Engineers, and CVPS shall provide same promptly to VNRC and to ANR.

4. Within fourteen (14) days of the date the Final Report is provided to VNRC by CVPS, VNRC shall request the Vermont Water Resources Board ("WRB") to dismiss the Appeal on the basis of the agreed settlement, documented herein, by, between, and among the parties in accordance with WRB Rule of Procedure 21 and 3 V.S.A. § 809(d). ANR and CVPS will join with VNRC in such request and in a stipulation to dismiss the appeal by informal disposition.

5. Upon dismissal of the Appeal, CVPS will instruct the Engineers to proceed with the Dam Removal Plan, encompassing the balance of the Scope of Work, that is, Parts III, IV, V, VI and VII thereof. CVPS shall pay the cost of the Engineers to perform the Scope of Work, all of which shall be performed in accordance with standard construction and consultant practices.

6. CVPS will use its good faith efforts to cause the Engineers to distribute the Dam Removal Plan to VNRC and to ANR within sixty (60) day's of the dismissal of the Appeal.

7. Each of the undersigned warrants that he or she is an authorized representative of the party designated, is authorized to bind such party, and accepts this Agreement on behalf of the party represented thereby.

In Witness Whereof, the parties hereto have caused to be affixed the signature of a duly authorized representative of each of them.

Vermont Natural Resources Council

By: [signature]

Date: June 2, 1997

Central Vermont Public Service Corporation

By: [signature]

Date: June 10, 1997

Vermont Agency of Natural Resources

By: [signature]

Date: June 3 1997

F:\USERS\VAN\CVPS\PASSUMPSIC\SETLAGR3.WPD

Central Vermont Public Service. Corporation
Rutland, Vermont

Passumpsic River Projects

Work Plan for Developing a *Dam Removal Plan*

Kleinschmidt Associates (KA) proposes to follow this work plan to prepare a study of the feasibility of removing the Passumpsic (FERC No. 2400), Gage (FERC NO. 2397), Arnold Falls (FERC No. 2399) and Pierce Mills (FERC No. 2396) Dams, located on the Passumpsic River in Vermont, and owned and operated by Central Vermont Public Service Corporation. (1) For the purposes of this study, dam removal is assumed to include a) demolition and/or removal of the dam and abutments (the major civil features), b) desilting the impounded area behind the dam as needed to re-establish the river channel, and c) implementing appropriate environmental measures during and following construction to prevent adverse environmental impacts from the removal. (2) This work plan does not contemplate removal of facilities outside of the river, such as penstocks, powerhouses, substations, etc.

The overall purpose of the dam removal will be to re-establish a "natural" river condition in the project area, to the extent that it is reasonably possible. Under this definition, work would be limited to the immediate vicinity of the dam and the impoundment (the work area). River conditions outside this work area will not be evaluated as part of the Removal Plan. We assume for this work that re-establishing a "natural" river condition means obtaining a river channelization and morphology with similar characteristics to the river immediately up and downstream of the work area, as appropriate.

The following sections describe the contents of the proposed dam removal plan, based on input received from the Vermont Natural Resources Council. The sections also describe how the work will be conducted, and major sources of information that will be used. KA can provide CVPS, VANR, and the VNRC with the report within 60 days of receiving authorization to proceed.

I. Description of the Existing Facilities

KA will prepare a description of the existing project works, including the dam and impoundment, water conveyance structures, powerhouse and appurtenant facilities. Our descriptions of the structural components of the project will include a brief description of their condition. The morphology of the impoundment, bypassed reaches, tailraces and upstream and downstream river segments will also be described. This description will be based on a review of existing literature available to describe the sites (license application, EA, license, Vermont Rivers, etc), and on site data gathered by KA during previous site visits.

REPORT ON DAM REMOVAL ALTERNATIVES

II. Analysis of Dam Removal Engineering and Construction Alternatives

KA will describe engineering and construction alternatives for the removal of the dams, and river restoration options that are considered feasible for the projects. This assessment will include a description of site access options, flow diversion (cofferdamming) requirements during demolition of the dam, dam removal/disposal, dredging options, post-demolition site stabilization measures, impoundment desilting alternatives, and possible measures that could be used to re-establish a "natural" river condition. The alternatives will be summarized in a Preliminary Report.

Within thirty (30) days of receiving authorization to proceed, KA will provide to CVPS the Preliminary Report, which will include KA's recommendations for a preferred alternative for dam removal of the Passumpsic River Project dams. KA, CVPS, VANR, and VNRC shall meet (within thirty (30) days of the date the Preliminary Report is provided to VNRC and to VANR by CVPS) to review the Preliminary Report and to seek consensus on a preferered dam removal alternative. KA shall prepare a Final Report, including a conceptual removal plan, based upon the consensus position of CVPS, VANR, and VNRC, if one is reached. If consensus regarding the preferred alternative is not reached, KA shall select the preferred alternative on which to base the Final Report, and also shall include in the Final Report a discussion that notes the alternatives preferred by each of CVPS, VANR, and VNRC. KA will provide the Final Report to CVPS within fourteen (14) days of the meeting.

The Final Report will describe the alternatives available for dam removal, but will propose a single removal strategy based on the results of the meeting. The Dam Removal Plan will be based upon the dam removal alternative that provides the least cost method for meeting the removal criteria. Removal criteria include a) re-establishing a "natural" river condition within the limits of the work area, as described earlier, b) being permittable, and c) being least environmentally intrusive.

DAM REMOVAL PLAN

III. Preparation of Functional Preliminary Design Plans

Under this task, KA will prepare preliminary design plans for the demolition and removal of the dams, and for the post-demolition stabilization. The design plans will be provided on drawings, as well as in written format. Existing drawings will be used as base maps for the preliminary design drawings. KA proposes to sketch the proposed implementation measures onto the existing drawings. A copy of the base map will be provided for reference. The drawings will be prepared in a sufficient level of detail to allow quantity estimates for the major civil features. The designs will employ Best Management Practices for work in and around a waterbody, and other appropriate environmental measures.

Two sketches are proposed: 1) a proposed Demolition Plan , and 2) a proposed Site Restoration Plan. The Demolition Plan will show site access, cofferdamming requirements (phased if needed), assumed dredging (silt removal) locations, and any special removal considerations (*e.g.* temporary storage of contaminated silt).

The proposed post-demolition Site Restoration Plan will be prepared to show bank stabilization measures (*e.g.* riprap, plantings) required to prevent significant erosion. The proposed site plan will show an assumed restored river channel, based on historic information if available, and best professional judgment where no information is available. The Site Restoration Plan will also show backfill locations and regrading as appropriate.

A. Preparation of Quantity Estimates for Disposal and Restoration

Based on the drawings prepared above, and other applicable existing information, KA will prepare quantity estimates of the major civil features of the plan, including existing structures, temporary structures that will be used during the project, excavation and fill, and site restoration materials.

IV. Impoundment Silt Removal and Disposal Options

Planning for the impoundment silt removal would be implemented in three steps. First, KA would propose a testing protocol to identify any contaminants. Testing would be implemented during the construction phase. The plan would identify disposal options and costing for contaminated materials, and for non-contaminated materials. We would also determine methods for estimating the extent of silt deposition and removal methods for either contaminated or clean silt.

V. Identify Environmental Impacts and Protection Measures

KA proposes to identify the range of potential environmental impacts that could be associated with a) the removal b) any desiltation and c) longer term impacts from the fact that there would be no dam at the site. Removal impacts would be primarily construction related impacts (*e.g.* cofferdams, site access, sedimentation, etc.). Desilting could have ramifications for disposal, for transport, etc. Longer term impacts would identify whether any significant changes in the flora and fauna of the impoundment would be expected (*e.g.* a move from a lacustrine to riverine fishery, changes in wetlands, changes in runoff characteristics, etc.) This analysis will be somewhat theoretical, since it will be based on a number of variables that could be subject to revision after dam removal. Therefore, we will identify likely impacts, and any mitigation that might be necessary to mitigate those impacts.

Under this task, KA would also identify permitting requirements for removal of the structures, for desilting, and for implementing the stabilization measures. This will include a list of agencies that must be consulted, their authority for permitting the proposed action, and the type of permit or authorization required.

VI. Cost Opinions

KA will develop an opinion of the fair market value of the projects, and will develop opinions of the probable costs for implementing the activities described above. We propose to determine the fair market value using the "income approach" to valuation. In essence, this is the net present value of the project income, less the net present value of costs. This valuation approach represents how the projects would be valued by any potential purchaser. We assume that CVPS will supply appropriate energy values (*e.g.* capacity or non-capacity), and estimates of operating costs. KA will determine appropriate inflation and discount rates based on current economic conditions, and model the results for all four stations.

KA will also prepare opinions of probable construction costs for the demolition and removal of each of the dams, and the stabilization measures needed following the removal. The opinions will be based on the quantity take-offs developed above, and on materials and construction labor rates that are applicable to the project area. The costs of environmental protection measures required during removal will also be estimated using similar methods.

VII. Possible Schedules and Timeframes

KA will prepare estimated schedules for the demolition and removal of the project, and for implementing stabilization and environmental protection measures. The schedules may extend over a number of years to include all the demolition and removal activities, and to include the implementation and monitoring of the stabilization and environmental measures.

APPENDIX E: Geomorphology Study

Description of the Passumpsic River

The Passumpsic River drainage basin encompasses 507 square miles in the Vermont Piedmont and Northeast Highlands (Figure 1). The Passumpsic River is 43 miles long, extending from the headwaters in Newark, Vermont, south to the Connecticut River (Meeks 1986). The upper part of the river system, north of Lyndonville, is divided into three main branches, Miller Run, West Branch, and East Branch, with many dendritic tributaries. These three branches merge into a single channel in Lyndonville. From Lyndonville, the Passumpsic River flows nearly due south in a narrow river valley to East Barnet where it empties into the Connecticut River. The river segment between Lyndonville and East Barnet has four main tributaries, Moose River, Sleepers River, Water Andric Brook, and Joe's Brook, as well as several smaller tributaries.

Archaeology Consulting Team, Inc. (ACT) has been retained by Central Vermont Public Service Corporation (CVPS) to develop and implement a Cultural Resource Management Plan (CRMP) for the four hydroelectric generating stations on the Passumpsic River owned by CVPS in accordance with the FERC Licensing Programmatic Agreement. The area covered by this CRMP (the Project) extends twelve (12) miles along the Passumpsic River from below the Lyndon Dam, just north of the St. Johnsbury–Lyndon town line, to the Canadian Pacific Railroad trestle south of the CVPS Passumpsic hydroelectric facility (Figure 2). Two main tributaries enter the Passumpsic River within the Project: Moose River and Sleeper River. Both rivers empty into the Passumpsic within the Village of St. Johnsbury between the Arnolds Falls and the Gage hydroelectric facilities.

Within the Project, the Passumpsic River drops approximately 148 feet from an upper elevation of 640 feet above the national geodetic vertical datum (ngvd) to a lower elevation of 492 feet above ngvd (USGS 1983 and 1988). Thirty-seven percent of the drop (54 feet) occurs within the first two miles of the Project, from below the Lyndon Dam to the Pierce Mills facility. The remainder of the drop is distributed along the lower ten miles of the Project, as shown in Table 1 and Figure 3.

Table 1: Passumpsic River length and elevation changes within the Project.

Section	Drop (ft.)	% of Drop	Run (mi.)	% of Run	Slope
Below Lyndon Dam to Pierce Mills	54	36%	1.6	13%	0.64%
Pierce Mills to Arnold Falls	30	20%	5.3	44%	0.11%
Arnold Falls to Gage	34	23%	2.3	19%	0.28%
Gage to Passumpsic	18	12%	2.1	18%	0.16%
Passumpsic to railroad trestle	12	8%	0.7	6%	0.32%
TOTAL	**148**	**100%**	**12.0**	**100%**	**0.23%**

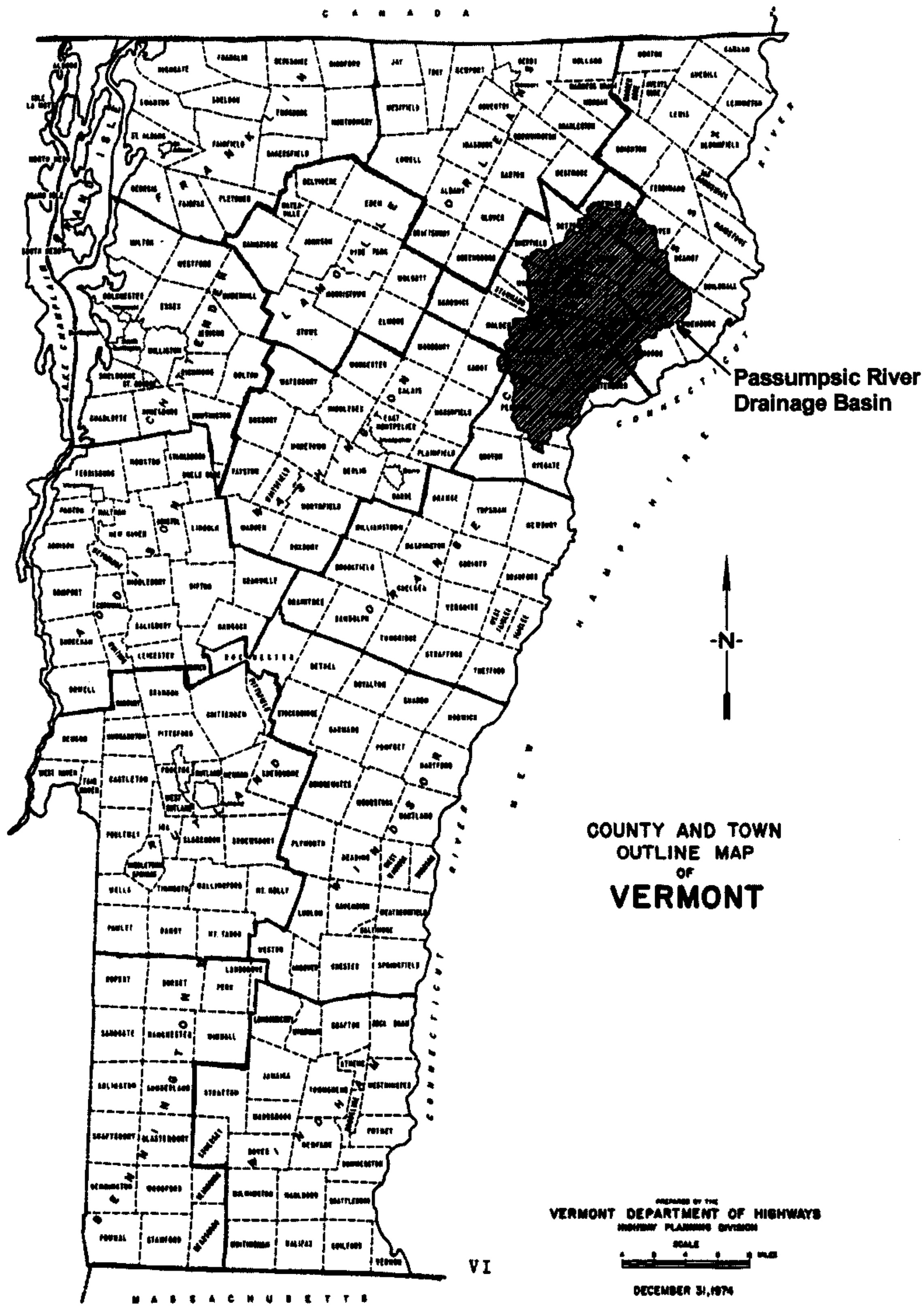


Figure 1: Map showing the location of the Passumpsic River drainage basin in Vermont.

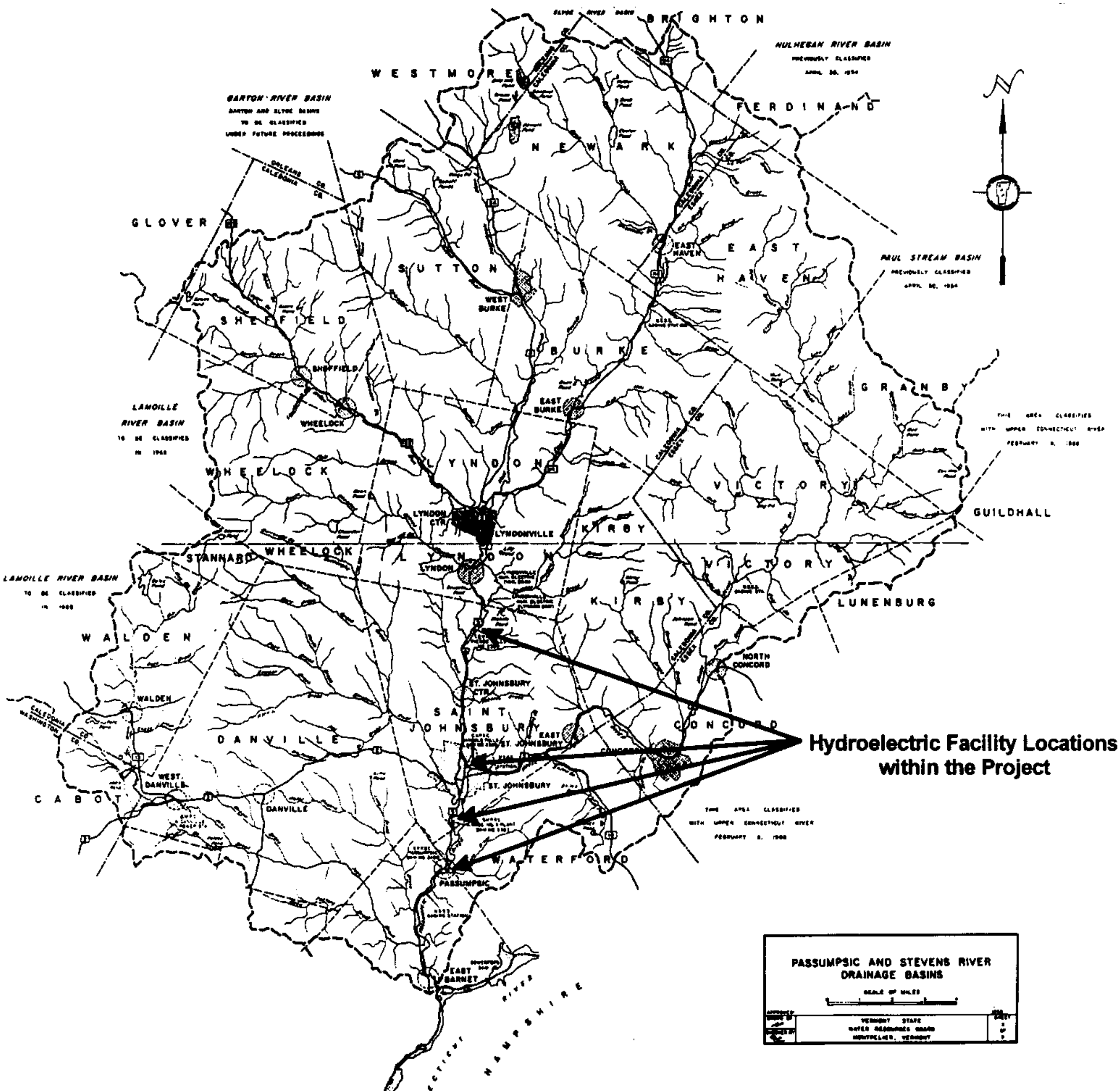


Figure 2: Map showing the locations of hydroelectric facilities in the Project within the Passumpsic River Drainage Basin.

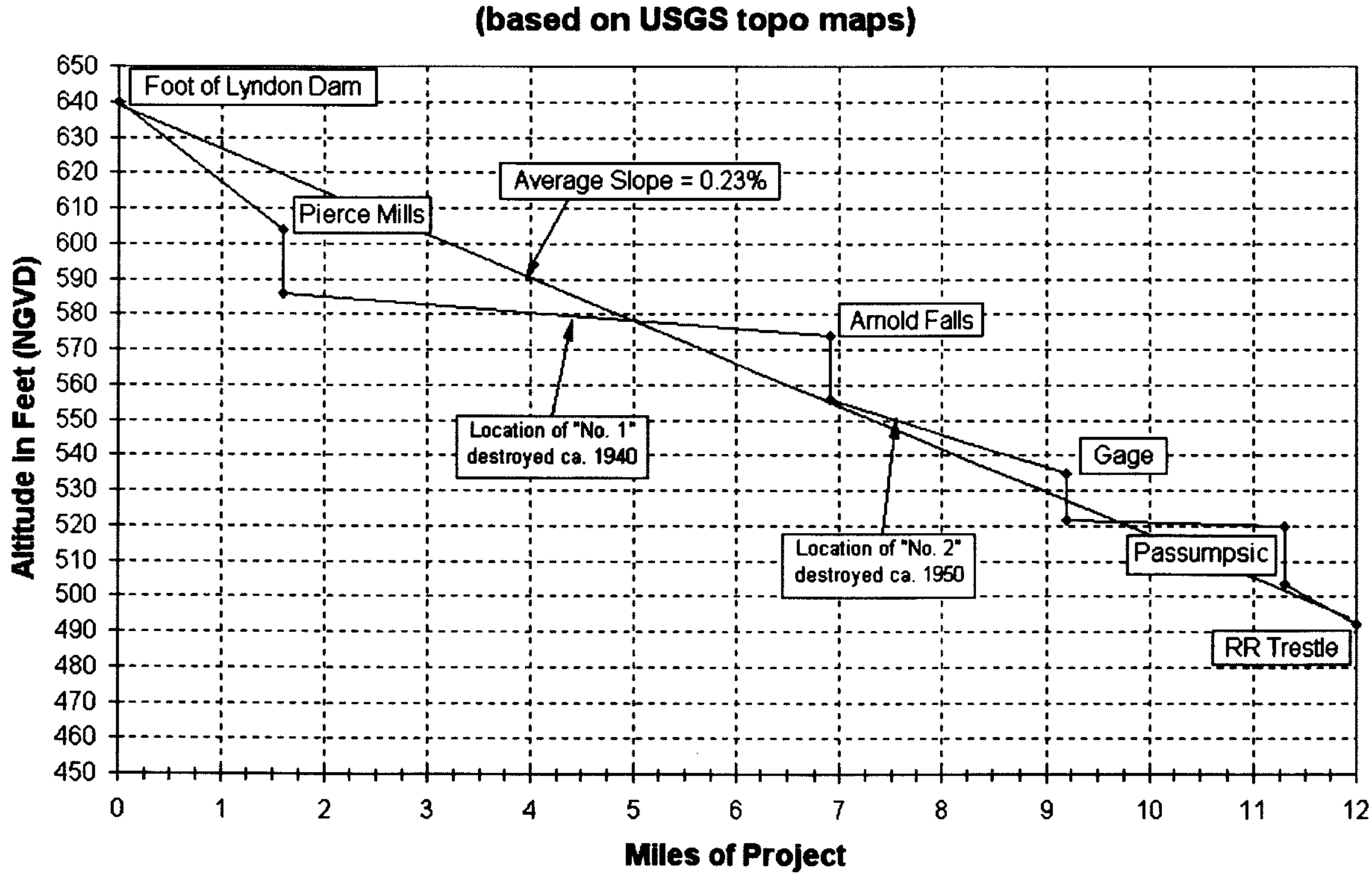


Figure 3: Elevations of the hydroelectric facilities in the Project illustrating relative slope.

The degree to which a river deviates from "straight" is measured by the ratio between the length of a river's channel (lrc), and the length of its meander belt (lmb). This ratio (lrc/lmb) is called the Sinuosity Index (SI). The length of the river channel ("A" in Figure 4) is measured down the centerline of the water, around its various bends, meanders, and oxbows, while the length of the meander belt ("B" in Figure 4) is measured down the centerline of the active channel belt. Rivers may be classified according to the value of their SI. The river is "meandering" with an SI greater than 1.5, "sinuous" with an SI between 1.05 and 1.5, and "straight" with an SI less than 1.05 (Mount 1995). The SI has a lower limit of 1.0 because a river can never be shorter than its meander belt.

The length of the Passumpsic River meander belt within the Project is ten miles. The sinuosity index (SI) is the length of the river channel, twelve miles, divided by the length of the meander belt. The resulting SI=1.2 classifies the river segment within the Project as sinuous.

Approximately 425 acres of floodplain are associated with the Passumpsic River within the Project. Currently, approximately 81 acres (19%) of the floodplain have been separated from the river by roadway and railway grades, and are no longer available to the river for meandering. Additionally, approximately one mile of riverbank has been restricted from meandering by roadway and railway grades.

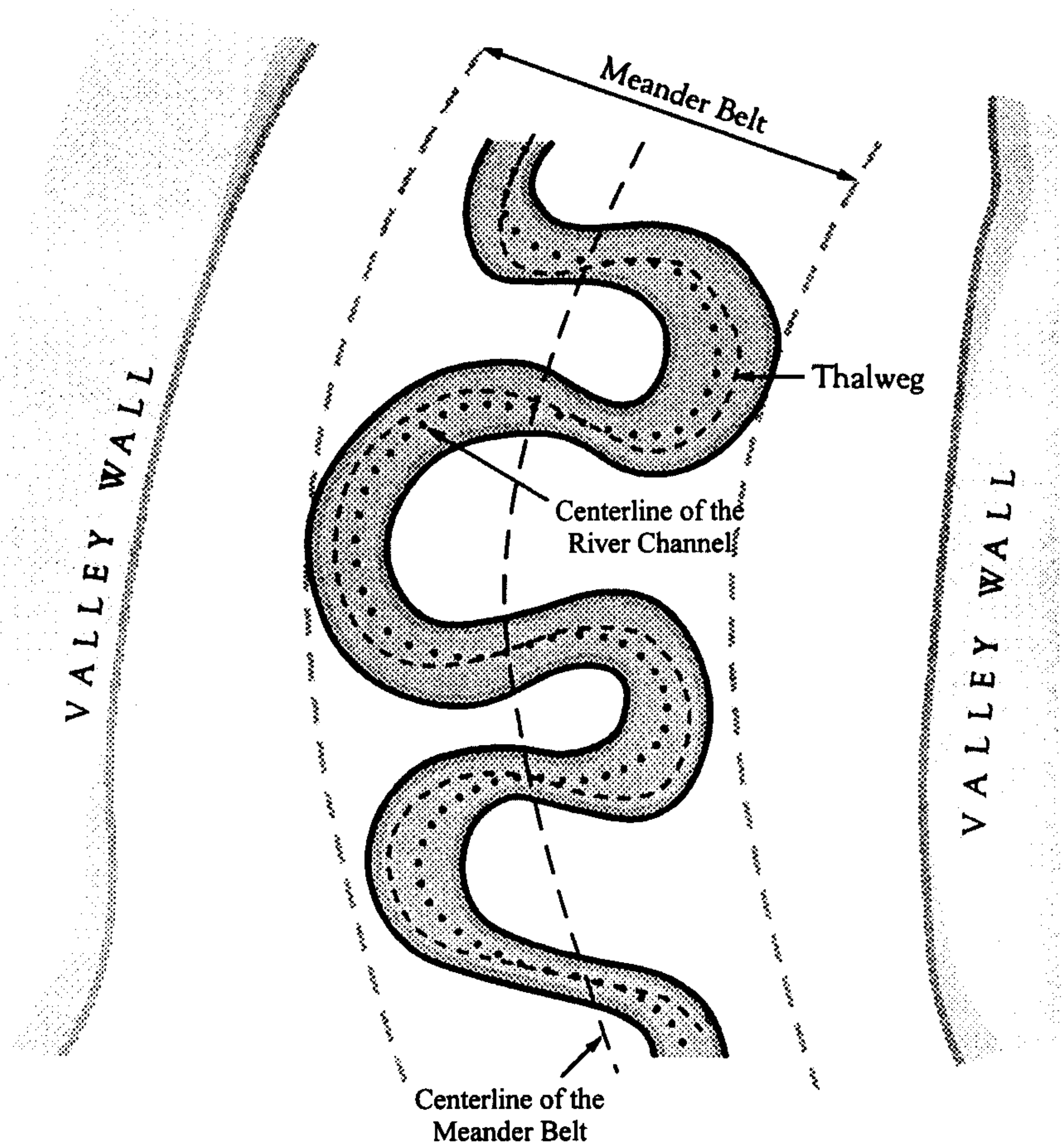
Pleistocene History

The Pleistocene glacial epoch is divided into several periods with colder climates, called stades, that caused the glaciers to advance. The intervening periods of warmer climates, called interstades, caused the glacier(s) to stall and the southern edge of the ice sheet to melt back.

The Passumpsic River drainage basin was glaciated during the Bennington Stade (Figure 5). Bennington Stade till is exposed in locations near St. Johnsbury. During the West Norwich Interstade, the ice sheet melted north and left many extensive glacial lakes. The Passumpsic River drainage was covered by one of these lakes, as evidenced by lacustrine gravel, sand, and clay that overlie the Bennington Stade till.

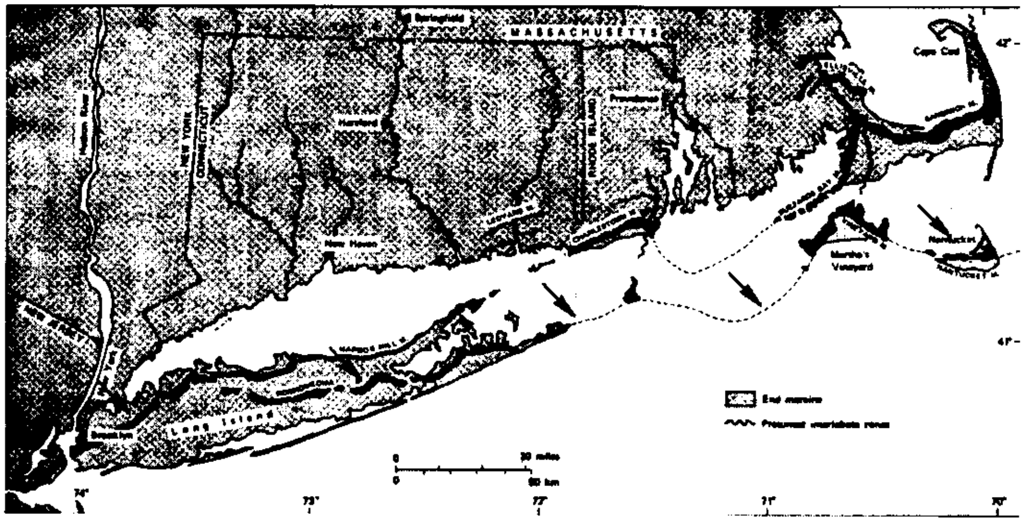
The area was reglaciated during the Shelburne Stade, which deposited more till over the West Norwich lacustrine deposits (Figure 5). It was apparently during this phase that extensive eskers formed along the valleys of the Passumpsic River drainage. When the Shelburne Stade ice sheet melted north, it left a moraine in the Connecticut River Valley in Middletown, Connecticut, which caused melted glacial water to back up in the valley and form Lake Hitchcock (Stewart and MacClintock 1969).

Lake Hitchcock extended up the Connecticut Valley as far as the Canadian border, and extended up tributary valleys as long narrow finger-like coves (Stewart and MacClintock 1969). Lake Hitchcock extended up the Passumpsic Valley as far as East Burke on the East Branch, Calendar Brook on the West Branch, and Fall Brook on Miller Run (Stewart and MacClintock 1970). Lake Hitchcock may have formed as early as 14,000 years before the present (ybp) and remained as late as 10,700 ybp (Flint 1971).

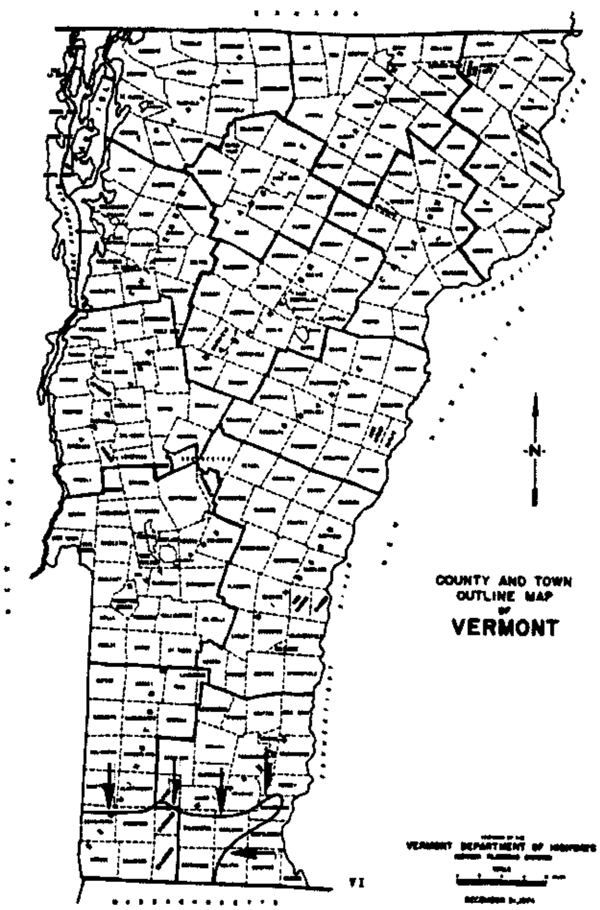


Sinuousity Index = Length of Centerline of River Channel ÷ Length of Centerline of Meander Belt

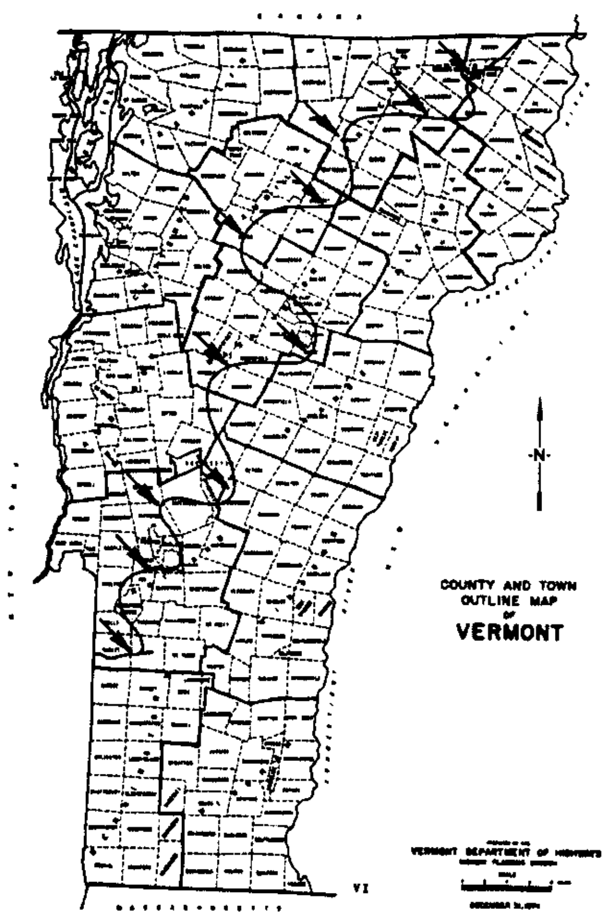
Figure 4: Schematic diagram showing how the lengths of river channels and meander belts are measured to determine the Sinuousity Index. (From Mount 1995)



Maximum Southern Extent of Glacier During the Bennington Stade - ca. 28000 YBP (Flint 1971)



Maximum Southern Extent of Glacier During the Shelburne Stade - ca. 18000 YBP (Stewart and MacClintock 1969)



Maximum Southern Extent of Glacier During the Burlington Stade - ca. 14000 YBP (Stewart and MacClintock 1969)

Figure 5: Maps showing the approximate southernmost extent of glacial ice during the Bennington, Shelburne, and Burlington stades of the late Pleistocene epoch.

The Passumpsic Valley seems to have remained unaffected by the third and final glacial advance during the Burlington Stade (Figure 5), with the possible exception of sediments deposited by runoff from high-level glacial lakes in the area of Barton (currently Crystal Lake and Lake Willoughby) flowing through Sutton River and West Branch. At the end of the Burlington Stade, those lakes began to drain northward into Lake Memphremagog and glacial activity had no further impact on the Passumpsic Drainage Basin (Stewart and MacClintock 1969).

Holocene History

After Lake Hitchcock drained, the Passumpsic River settled into the typical river pattern of downcutting and floodplain building. The glacial till, glacio-lacustrine, and glacio-fluvial sediments left in the drainage basin consist of predominantly fine-particle materials (very fine sands, silts, and clays). The resistance of fine-grained sediments to fluvial changes, combined with the relatively narrow and steep-walled Piedmont drainage valleys which do not allow the river to develop full meanders and ox-bows, has led to a fairly stable river system with small meanders that slowly migrate downstream.

The first major change to the character of the Passumpsic River Valley, after the glaciers, began in 1787 with the arrival of Jonathan Arnold (Fairbanks 1914). During that year, Jonathan Arnold cleared 43 acres of woodland for farming. In the same year, Arnold also built a dam across what is now known as Arnold Falls for a saw mill, and later added a grist mill. From this time, the evolution of the Passumpsic Drainage Basin was heavily linked with cultural influences. Within 100 years, five more dams were built across the Passumpsic River within the Project (with other dams both upstream and downstream of the Project), and an additional four dams were erected on tributaries within the Passumpsic drainage system (Table 2). According to E.T. Fairbanks (1914), the deforestation of the Passumpsic Drainage Basin continued until the floodplain and surrounding hills were completely cleared by 1850.

The Passumpsic River, like most rivers, is subject to periodic flooding. There have been eight major flood events (defined as causing extensive damage) recorded in the 170-year period since 1828. These flood events are categorized as 20-year or higher events. Smaller flood events have occurred more frequently--as often as every five years (USGS 1998)--but are not noted in the town histories. Additionally, the river is subject to localized flooding due to frequent ice packs. Fairbanks (1914:520) records that "the biggest ice pack ever known in town" flooded St. Johnsbury Center and parts of St. Johnsbury in March of 1896, just two months prior to a major flood event in May of the same year (Table 3).

Table 2: Dams on the Passumpsic River and Tributaries

Year Installed	Location of Dam
1772[1]	Stevens Falls [*i.e.*, Passumpsic] (Childs 1886:137-138 [in Berger 1991])
1787	Arnold Falls (Fairbanks 1914:146)
1789[1]	Stevens Falls [*i.e.*, Passumpsic] (F.P. Wells' 1923 *History of Barnet, Vermont* [in Balestra 1992a])
1793	Goss Hollow [Sleeper's River]
ca. 1800	lower end of Trout [*i.e.*, Stark] Brook
ca. 1800	St. Johnsbury Center "Sanger Dam" (Fairbanks 1914:148) *N.B., this is the Twin State Gas and Electric No. 1 dam demolished circa 1940.*
1815	Fairbanks Mills [Sleeper's River] (Fairbanks 1914:150)
1820s	"Ely" Falls [Moose River]
1828	Belknap Dam [Sleeper's River near the Passumpsic Turnpike] (Fairbanks 1914:152)
ca. 1850[2]	Belknap Dam on Passumpsic [*i.e.*, Gage] (Fairbanks 1914)
1854	"Head of Portland Street" [Moose River]
Prior to 1875	Pierce Mills straw board mill (Beers 1875)
1876	Village Water Works established at Arnold Falls (Fairbanks 1914:302)
1888[2]	St. Johnsbury Electric Light and Power [*i.e.*, Gage] (Balestra 1992b)

[1,2] References cite different construction dates for these two dam locations.

Table 3: Major Flood Events on the Passumpsic River

Date(s)	Cause	Source
September 5, 1828	heavy rains	Fairbanks 1914
April 25, 1866		Fairbanks 1914
October 2-3, 1869	storm	Fairbanks 1914
May 11, 1896		Fairbanks 1914
July 24, 1897		Fairbanks 1914
November 3-4, 1927	heavy rains	Johnson 1928
March 13, 1936		USGS 1998
July 1, 1973		USGS 1998

Discussion

Many factors influence the stability of a river system. Those factors which affect the river system most include peak discharge events, sediment load, deforestation of the watershed, manmade flow modifications (*e.g.*, dams, bridges, rip-rap installation), and the riparian border.

Peak discharge events

A "peak discharge event" is when a river reaches or exceeds the top of its banks. Most water and sediments are transported by the river system during peak discharge events. Peak discharge is generally caused by snowmelt in the spring while the ground is still frozen and impermeable to water, by heavy and widespread rainfall in excess of the ground's ability to absorb it, or by a combination of both. Peak discharge events last for relatively short time periods (usually several days), but they exert a controlling influence on the shape and stability of a river's course.

The sudden influx of large amounts of sediment can overwhelm the carrying capacity of the river and cause the sediments to be deposited on the river bottom. Gravel beds can slow the water's velocity due to fluid friction, causing sediments to settle into the gravel (Mount 1995).

Once fine sediments have infiltrated the gravel beds, they become particularly difficult to dislodge. The finer sediments are stabilized by the gravels, while the gravels are protected from plucking due to the mortar-like effect of the finer sediments. As a result, much greater force of current is needed to dislodge the combined coarse gravel and fine sediments than is required to transport either component individually (Brown 1997; Mount 1995).

Sediment load

Sediment load is determined by the velocity of the water, which establishes the river's carrying capacity, and the nature of the soils in the drainage basin. The majority of soils in the Passumpsic River Valley range from fine sands to coarse silts, derived from glacial till, glacio-fluvial, and glacio-lacustrine deposits. These soils tend to erode easily during high runoff events, especially if unprotected by vegetation.

Deforestation of the watershed

The amount of forest cover in a watershed influences the nature of runoff during a storm and the amount of sediment introduced into the river system. Logging exposes and compresses the soil, decreasing its permeability, and reduces evapotranspiration with the removal of vegetation. The net effect is an increase in storm runoff and erosion of unprotected soils into the drainage system. Figure 6 illustrates the effect of logging on a conceptual hydrograph. Generally, small drainages in an area cleared of trees do not have sufficient carrying capacity to transport all eroded sediments into the river, and the sediments are deposited in low-order tributaries until a peak discharge event occurs. During a peak discharge event, the stored sediments are dislodged from the low-order tributaries and transported to the river. Figure 7 diagrams the complex interactions between environmental variables that occur as a result of logging operations.

Manmade flow modifications

Dams

Dams affect river development in three ways. First, by introducing an artificial knickpoint (abrupt change in river gradient), a dam alters the effective slope of the riverbed and the corresponding water velocity. Second, the reservoir capacity of a dam impoundment tends to reduce the effects of peak discharge events (see Figure 5). Third, the reduced velocity of water in the impoundment decreases the sediment carrying capacity of the river, causing the river to deposit its sediments behind the dam and sending water with a reduced sediment load over the dam (Mount 1995). This "clean" water below the dam has an increased capacity to transport sediments, and may acquire sediments through bank erosion.

Bridges

Bridge pilings and abutments affect the river by interrupting the natural current flow and introducing turbulence. The river current generally maintains a laminar flow that twists along the river channel. The bridge pilings disrupt this laminar flow, causing flow separation. Channel bars often form immediately downstream of bridge pilings due to loss of carrying capacity resulting from this flow separation. As the water resumes laminar flow downstream of the disruption, the increased turbulence and energy, combined with the decreased sediment load, can cause erosion of unprotected banks (Mount 1995).

Rip-rap

Rip-rap is installed to stabilize an eroding bank by shielding it with rock. This protects the bank that has been rip-rapped, but the erosive force is not dissipated. The river's energy is deflected downstream and erodes unprotected portions of the bank (Mount 1995).

Riparian Border

The riparian border acts as a buffer against changes in a river's channel. The roots of trees in the riparian border tend to stabilize and protect the bank soils from erosion, and grasses and brush trap sediments that form natural levees during over-bank discharge events. These conditions tend to maintain a river's metastable state within its current channel (Mount 1995).

Conclusion

All of the described factors that influence river system stability are present along the Passumpsic River. Deforestation on a massive scale during the late 1700s and early 1800s, as well as ongoing logging on a smaller scale, early damming of the river, bridge construction for roads and railroads, bank rip-rapping, and reduction or elimination of the riparian border in favor of agricultural activities, have all affected the Passumpsic River. However, the Passumpsic River has adjusted to the changes over time and is approaching a metastable state, as evidenced by its current sinuosity index of 1.2 and the lack of any appreciable change in river course over the last 55 years (USGS 1943, 1983).

The stability of a river system is a function of the interaction of peak discharge events, sediment load, deforestation of the watershed, manmade flow modifications (*e.g.*, dams, bridges, rip-rap), and the riparian border. The effects of these factors on river stability can be conceptualized in the following dimensionless formulas:

Factors that affect the energy level (erosive force) of a river system:

$$f(e) = \left(\frac{W \cdot U_2}{D}\right)$$

Factors that buffer the ability of the river to erode or avulse:

$$f(b) = \left(\frac{R \cdot U_1}{F}\right)$$

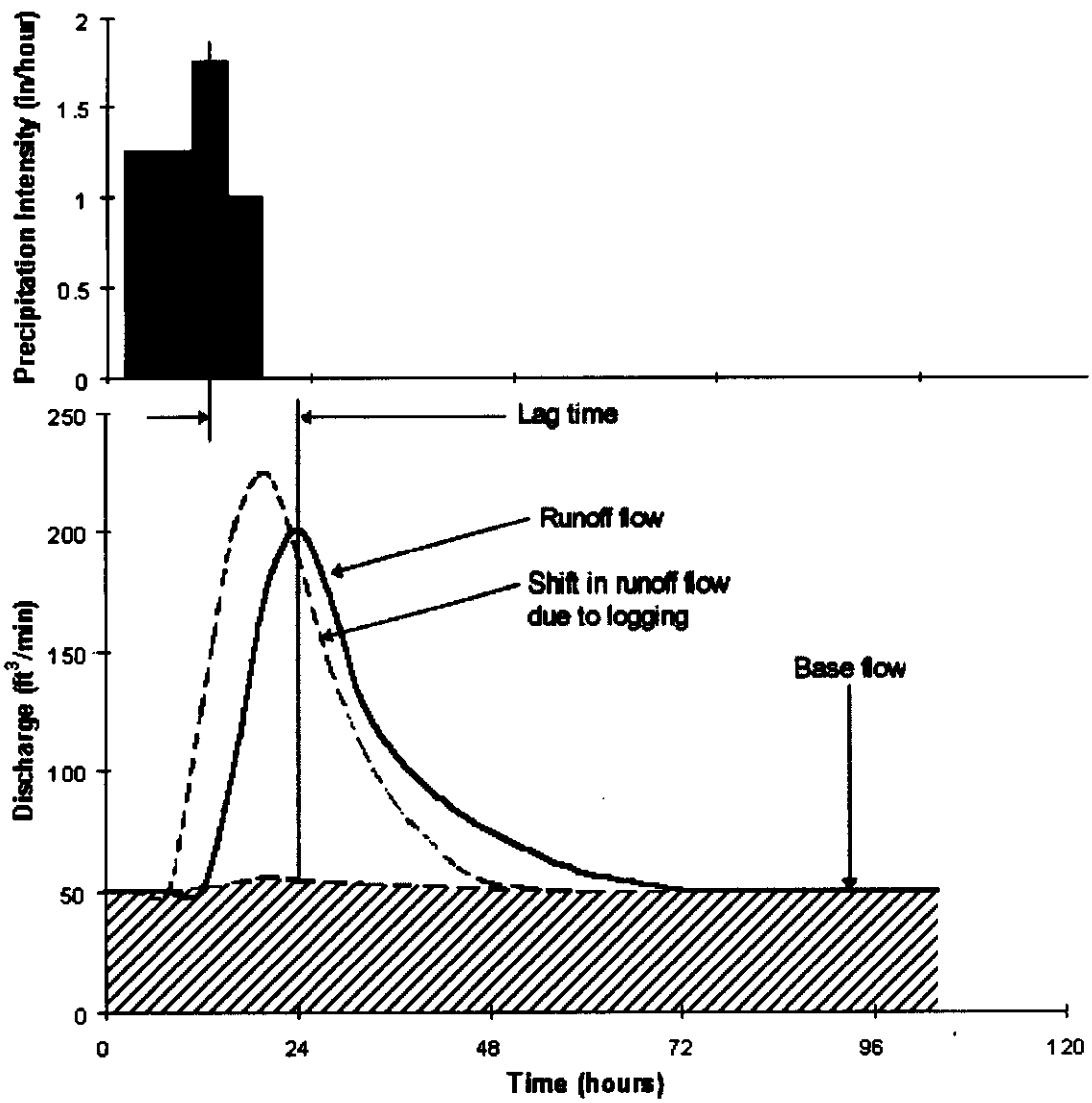


Figure 6: Idealized hydrograph showing the effect of logging on precipitation runoff. (From Mount 1995)

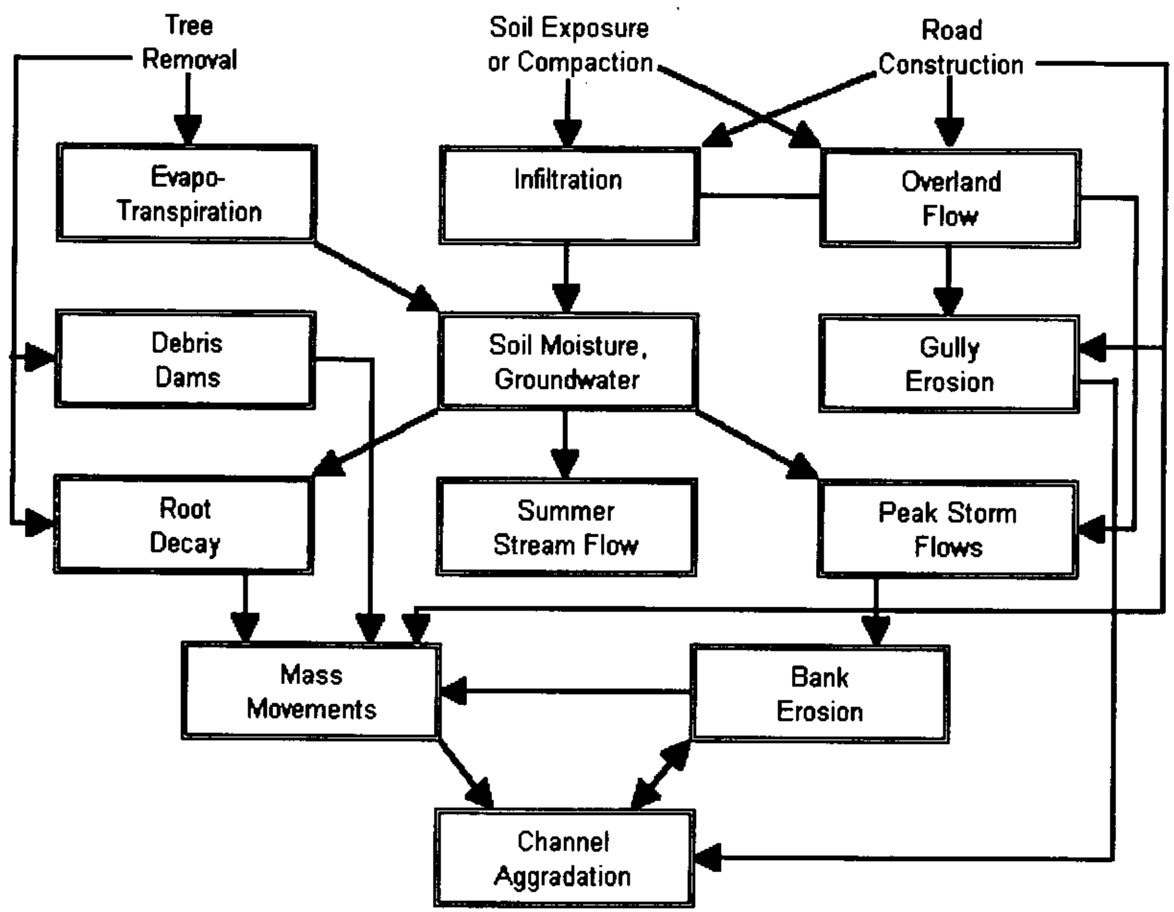


Figure 7: Diagram showing the interactions between environmental variables that occur as a result of logging. (Adapted from Mount 1995)

River system stability as a function of these factors:

$$f(stability) = \left(\frac{f(b)}{f(e)}\right) = \left(\frac{R \cdot U_1 \cdot D}{W \cdot U_2 \cdot F}\right)$$

Where: $f(e)$ = Energy function
$f(b)$ = Buffer function
f(stability) = Stability function
W = Watershed deforestation
R = Riparian zone
D = Dam levels
U = Upstream dams
U_1 = Tendency to regulate flow
U_2 = Tendency to retain sediments
F = Flow modifications (bridges, rip-rap, etc.)

The formulas illustrate the effect that changes in these factors may have on the energy level (potential erosive force) of a river. Increases in watershed deforestation or flow modifications increase the energy level and decrease stability of the river system. Increases in the riparian zone or local dam impoundments (more dams or increased dam heights) decrease the energy level and potential erosive force of the river system. Upstream dams have both a positive and negative influence on the local river system.

Over time, the Passumpsic has adjusted to its modified flow regime, and the energy and buffer functions in the above equation have reached a metastable state. Changes in any of the factors in the equation will affect that balance and the river will likely deviate from its current metastable state. This deviation may involve a slow process of expanding or decreasing sinuosity, or it may occur as a catastrophic avulsion resulting in major destabilization of the riverbank.

Between 1940 and 1950, two dams were removed from the Passumpsic River in St. Johnsbury: Twin State Gas and Electric's Generating Stations No. 1 and No. 2. The removal of these two dams released their stored sediments into the river system. Today, approximately 50 years later, those sediments still form shifting channel bars in the river a short distance downstream from the original positions of both dams. While this has not resulted in significant changes in the course of the river, it may be a contributing factor to observed bank erosion and slumpage. By aggrading the river bottom with large sediment loads in excess of the river's ability to transport them (see discussion of Deforestation and Figure 7), the river would tend to compensate by side cutting its banks to maintain the channel cross-sectional area. The remaining river system may be more sensitive or prone to destabilization if other dams are removed in the future.

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1998 *Peak Flow Data. Station name: Passumpsic River At Passumpsic, Vt. Station number: 01135500.* Peak flow data were retrieved from the National Water Data Storage and Retrieval System (WATSTORE). 5/20/1998. <http:waterdata.usgs.gov/nwis-w/VT>

APPENDIX F: Anticipated Expenditures of Amounts Budgeted

As the actual historic and archaeological resources within the Project are unknown prior to discovery, a detailed budget cannot be defined at this time. Prior studies indicate the probability that none of the known historic properties are presently threatened by streambank erosion. As the river system within the impoundment appears to have reached homeostasis with minimal erosion, the early years of this CRMP will contain funds for setting up long term riverbank stabilization programs that incorporate educational programs.

Proposed General Annual Budget	
Long Term River System Stabilization Programs:	$ 3,000
• Development and Implementation (include the design of cooperative activities between existing federal, state, and local programs and CVPS) • Educational Programs	
Total:	**$ 3,000**

The costs associated with the Annual Review and Report and any additional research to be conducted by a qualified architectural historian will be in addition to the General Annual Budget.