

WATER QUALITY CERTIFICATION

(P.L. 92-500, Section 401)

In the matter of: Village of Swanton  
Swanton, Vermont  
Application for Highgate Falls  
Hydroelectric Project

The Water Quality Division of the Vermont Department of Water Resources and Environmental Engineering (the Department) has reviewed the Water Quality Certificate application dated April 6, 1983 and filed by the Village of Swanton (the applicant). The FERC license application (January, 1981) and a document prepared by Aquatec, Inc. titled "Water Quality Effects of Redevelopment of the Highgate Falls Hydroelectric Project" (April, 1983) were submitted to the Department in support of this application. Supplementary information filed with the Department since the application date has also been reviewed. The Department has made the following findings:

1. The Village of Swanton proposes to redevelop the Highgate Falls hydroelectric facility on the Missisquoi River in the Town of Highgate. The facility is located about seven miles upstream of the Swanton Village Dam and about eight miles downstream of the Sheldon Springs Dam. The applicant owns and operates the facility, which has been in operation since 1894.

2. The dam is a concrete gravity dam approximately 25 feet high and 240 feet long. The present dam crest is at

elevation 168.8' NGVD. Normal pool elevation is 170.8' NGVD with two feet of flashboards in place. At this elevation the impoundment is approximately 65 acres with a gross storage capacity of 500 acre-feet. The impoundment extends to a point about one mile upstream of the dam just below a set of rapids. The powerhouse contains three generating units with a total hydraulic capacity of 1,075 cfs.

3. Project redevelopment would increase the crest of the dam to 180' NGVD. Four bays of stanchion stoplogs and two tainter gate sections would raise the normal pool elevation to 200' NGVD. At this pool elevation, the impoundment would cover 360 acres and have a gross storage capacity of 6970 acre-feet. The impoundment would extend to East Highgate, about four miles upstream of the dam. This new impoundment would inundate a set of rapids just upstream of the present impoundment and a set at the bridge (Town Highway 6) in East Highgate.

4. Of the three existing generating units, the two smaller ones would be replaced and the third one would be rewound to accommodate the increase in head. The two new smaller units would each have an operating range of 115 to 204 cfs. A fourth unit would be installed, increasing the total hydraulic capacity of the project to 1800 cfs. The estimated output of the facility would be 9.4 MW.

5. Other development activities would involve modifications to the existing conduit, intake structure, powerhouse and tailwater elevation. The existing tailwater

elevation is 108.5' NGVD The proposed tailwater elevations for the two smaller units, the third and the fourth units would be 118.5', 111.5', and 108.5' NGVD respectively.

6. The facility presently operates in a peaking mode with a maximum drawdown of 2.5 feet from the top of the flashboards. Depending on inflow, this drawdown can occur more than once a day. Except for leakage, no water is discharged from the facility during periods of refilling the impoundment. Flows in excess of 1075 cfs are passed over the dam. During these high flows there is no reservoir drawdown. When flows are less than 1075 cfs, only leakage flows are discharged into the penstock bypassed section of stream.

7. On July 1, 1982 the Department measured a leakage flow of about 35 cfs at a point 15 feet downstream of the dam. The source of this flow was through the flashboards, dam, and bedrock.

8. The proposed facility will continue to operate in a peaking mode with a maximum drawdown of 2.5 feet. No minimum flow is proposed for the bypassed section. A minimum flow of 200 cfs is proposed below the tailrace at all times when available from inflow. If inflow falls below this minimum, a continuous flow below the tailrace would be maintained equal to instantaneous inflow to the impoundment. Flows in excess of 1800 cfs would be spilled at the dam.

9. The Highgate Falls impoundment supports a good smallmouth and rock bass fishery. The bypassed section below the dam is about 1100 feet long and 100-200 feet wide. Habitat

includes pools and riffles, with mostly a ledge and boulder substrate. It is a good holding area for adult smallmouth bass. It may also support a walleye fishery during the spring spawning season.

Just downstream of the Highgate Falls tailrace is a small pool about 400 feet in length. The next 400 feet is a small riffle area with water depths between one and four feet. This riffle area flows into the upstream end of the Swanton impoundment. This pool, riffle and impoundment area supports the only known native muskellunge population in the State. It also supports a good walleye and smallmouth bass fishery.

10. The U.S. Fish and Wildlife Service recommends a minimum instantaneous stream flow of 309 cfs, or inflow to the impoundment if less, be released at all times below the project to conserve aquatic habitat. They recommend a minimum instantaneous flow of 100 cfs, or inflow to the project if less, be released at the dam at all times for water quality and aquatic habitat purposes within the penstock-bypass reach.

11. A site inspection was made on September 6, 1983 by the Department, the Vermont Department of Fish and Game, and Aquatec, Inc. to determine if the applicant's proposed minimum flow of 200 cfs was adequate for the maintenance of fisheries downstream of the tailrace. At this inspection, observations of water surface area, depths, and available habitat below the tailrace were made at plant discharges of about 200 cfs and 400 cfs. Measurements of the change in water elevation made near the tailrace at these flows indicated that a 0.2 foot rise in

water elevation occurred. The water surface area did not increase substantially. Based on this qualitative evaluation, the applicant contends that a minimum flow of 200 cfs is adequate for maintenance of downstream fisheries habitat.

12. The drainage area of the Missisquoi River at the project site is 815 square miles. A USGS gaging station (#04293500) is located near East Berkshire and has been in operation since 1916. Records for the gaging station have been prorated based on drainage areas to estimate the following hydrologic values for the dam site:

<u>Parameter</u>	<u>Value (cfs)</u>
Mean Flow	1600 (26.17 in./yr.)
7Q10	100
95% Exceedance	170
50% Exceedance (Median)	780
10% Exceedance	3900

13. The Missisquoi River at the project site is rated Class B by the State of Vermont Water Resources Board. The river is rated Class C from the Boise Cascade Treatment Plant to a point 1.5 miles downstream. This treatment plant is located about four miles upstream of the upstream end of the proposed Highgate Falls impoundment. Class B waters are suitable for swimming, recreation, irrigation, and agricultural uses, good fish habitat, good aesthetic value, and are acceptable for public water supply with filtration and disinfection. Class C waters are suitable for recreational boating, irrigation of crops not use for consumption without cooking, habitat for wildlife and for common food and game fish indigenous to the

region, and such industrial uses as are consistent with other class uses.

The Missisquoi River at the project site is designated Water Management Type III for the protection and management of aquatic life. Dissolved oxygen content of Type III waters shall not be less than 5 mg/l.

14. The water quality report prepared by Aquatec, Inc. includes a survey of existing river conditions upstream and downstream of the Highgate Falls Dam during low flow conditions in the summer of 1982. The applicant feels that this survey should reflect nearly worst probable water quality conditions. Results indicated that even during this low flow period, dissolved oxygen concentrations in the river to a water depth of five feet were generally above 6 mg/l. Results also indicated that water entering the upstream end of the proposed impoundment should be nearly saturated with dissolved oxygen. This is because water in the Sheldon Springs impoundment was supersaturated with dissolved oxygen.

15. The applicant also made a comparison with existing conditions at Arrowhead Mountain Lake on the Lamoille River to predict water quality conditions that would exist in the proposed impoundment. The applicant states that the Lamoille and Missisquoi Rivers have similar climatology, physical characteristics, hydrology and water quality characteristics; because of these similarities, water quality conditions in Arrowhead Mountain Lake would better characterize the phenomena

anticipated in the proposed impoundment than even the most elaborate existing numerical simulators. The report concluded that although the larger impoundment at Highgate will increase the chance of monospecific algal blooms, it is anticipated that blooms would occur no more frequently than at Arrowhead.

16. The following data was obtained from the Aquatec, Inc. (1983) report, the Swanton Village Environmental Assessment Report for Highgate Falls Project (FERC application, January, 1981), a Department report on the 1982 Vermont Lay Monitoring Program, the Department's 1982 Vermont Hydropower Study, and a water quality study conducted by the Department on the Highgate Falls impoundment during the summer of 1983.

Comparison of water quality data for the existing Highgate Falls Reservoir and Arrowhead Mountain Lake  
 Values are June-September means (mg/m<sup>3</sup>).

<u>Reservoir</u>	<u>Year</u>	<u>Highgate Falls</u>	<u>Arrowhead</u>
Reservoir total phosphorus	1980	24	--
	1982	49	25
	1983	46	--
Inflowing total phosphorus	1980	36	17
	1982	--	--
	1983	37	--
Reservoir chlorophyll	1980	--	4.1
	1982	16	5.9
	1983	20	--

This data indicates that summer total phosphorus and chlorophyll levels for a given year were generally at least twice as high at Highgate Falls as they were at Arrowhead Mountain Lake. Comparison of this data shows that the proposed impoundment at Highgate would have substantially more algal growth than Arrowhead Mountain Lake.

17. Both the Department and the applicant estimate a concentration of 16 mg/m<sup>3</sup> for the mean summer chlorophyll level in the proposed impoundment. This level is equivalent to summer mean chlorophyll concentration in the existing impoundment as measured by the Department in 1982. The Department and the applicant, therefore, estimate summer mean chlorophyll concentration in the proposed impoundment to be no greater than what presently exists.

The applicant contends that a reservoir with the expected chlorophyll concentrations will not develop nuisance algal problems. The Department disagrees with this conclusion. It is likely that the proposed impoundment at Highgate Falls will be one of the more eutrophic waterbodies in the State. This conclusion is based on the fact that mean summer chlorophyll concentrations of around 16 mg/m<sup>3</sup> represent severe conditions of algal abundance in most Vermont lakes. The Department receives numerous complaints from the public about nuisance algal conditions in lakes with average chlorophyll levels in this range and, in some of these cases, the Department has undertaken expensive lake restoration efforts to correct the problem.

18. The Department finds that in spite of the potential for nuisance algal levels, impaired recreational use, and poor aesthetic value, the creation of the proposed impoundment would not constitute a violation of Vermont Water Quality Standards. The eutrophication potential of the proposed impoundment would

not be increased over the eutrophication potential of the existing impoundment.

19. Based on the water quality report prepared by Aquatec, Inc., the applicant also concludes that the proposed impoundment at Highgate Falls will probably stratify. Deep regions in the impoundment not involved in the main flow of water are likely to contain oxygen depleted water during the summer.

20. During the period from June 15 to September 15, when dissolved oxygen concentrations are apt to be the lowest in the bottom of the impoundment where the intake structure is located, the applicant proposes to avoid passing oxygen-deficient water downstream by passing flows through the two smaller turbines and over a reaeration structure, which would be located at the discharge point of these turbines and use the ten feet of available head for reaeration. This structure would raise dissolved oxygen concentrations by the turbulent entrainment of atmospheric oxygen. The applicant has demonstrated that they will be able to design a structure which will raise dissolved oxygen concentrations of incoming water to maintain downstream water quality standards.

The final engineering design of this proposed structure is not available at this time. The Village of Swanton prefers not to allocate the resources necessary for final engineering design until all necessary permits are received for the project. The proposed structure will be passive.

CONDITIONS

Based on its review, the Department certifies that the operation of the proposed facility will not violate Vermont Water Quality Standards provided the following conditions are met:

A. When available from inflow, a minimum instantaneous stream flow of 200 cfs shall be maintained below the tailrace at all times. If instantaneous inflow falls below this minimum, the instantaneous outflow at the tailrace shall equal instantaneous inflow to the impoundment. During the spring spawning season, March 31 through June 1, the facility shall be operated in a strict run-of-the-river mode where the instantaneous outflow at the tailrace shall be maintained equivalent to the instantaneous inflow to the impoundment.

B. The applicant shall pass a minimum flow of 200 cfs, or inflow to the impoundment if less, through the small turbines and reaeration structure at all times from the period June 15 to September 15.

C. Maximum daily reservoir drawdowns shall not exceed 2.5' (elevation 197.5' NGVD). During the period March 31 through June 1, there shall be no reservoir drawdown.

D. A minimum instantaneous flow of 35 cfs shall be maintained in the penstock-bypassed section at all times during and after project construction to maintain existing fisheries habitat and water quality in this area. A plan to maintain this flow shall be submitted to the Department for review and written approval prior to the start of project construction.

E. The applicant shall file with the Department for review and written approval, prior to the start of construction, a plan for maintaining a continuous minimum flow of 200 cfs, or inflow to the impoundment if less, below the tailrace during construction.

F. To mitigate the loss of potential walleye spawning habitat and holding areas for smallmouth bass which would otherwise be maintained with higher spring flows in the bypassed section, the applicant shall create fisheries habitat for walleye spawning and smallmouth bass in the riffle area located about 400' downstream of the tailrace. This habitat shall be created prior to the start of facility operation following construction. The applicant shall consult with the Vermont Department of Fish and Game in developing this habitat.

G. The applicant shall submit to the Department for review and written approval prior to the start of construction, the final engineering plans for the reaeration structure proposed at the discharge point of the two small turbines. This structure shall be passive and shall be designed to raise dissolved oxygen concentrations of incoming water to maintain downstream water quality standards. The structure shall be installed prior to the start of facility operation.

H. The applicant shall file with the Department for review and written approval, prior to the start of construction, a comprehensive erosion control plan to cover temporary and permanent measures to be taken to limit the discharge of sediment into State waters during construction and operation of the facility. This plan shall cover measures taken to control erosion in the proposed reservoir area, including

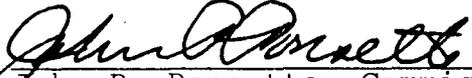
erosion problems along the shoreline which may develop due to the 2.5' fluctuation during facility operation. Special attention shall be given to the streambank on the right side of the river at the upstream end of the existing impoundment. This plan shall also cover erosion control measures associated with construction activities in the vicinity of the dam and the powerhouse.

I. Debris associated with project construction and operation shall be disposed of properly.

J. The applicant shall take every reasonable precaution to prevent the discharge of wet concrete and petro chemicals into State waters during construction.

K. Any significant changes to the project must be submitted to the Department for prior review and written approval.

L. The applicant shall provide the Department with an as-built set of plans for the record.

  
John R. Ponsetto, Commissioner  
Department of Water Resources  
and Environmental Engineering

Dated at Montpelier, Vermont  
this 9<sup>th</sup> day of Dec.,  
1983.

AMD/rh