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AGENCY OF NATURAL RESOURCES
Department of Environmental Conservation
WATER QUALITY DIVISION
103 South Main Street
Building 10 North
Waterbury, VT 05671-0408

802-241-3770

November 9, 1993

Mr. Eugene L. Shlatz
Assistant Vice President
Green Mountain Power Corporation
25 Green Mountain Drive
P.O. Box 850
South Burlington, Vt 05403-0850

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003

Re: Essex No. 19 Hydroelectric Project - FERC #2513
Water Quality Certification

Dear Mr. Shlatz:

Enclosed please find the water quality certification for which Green Mountain Power made application on November 13, 1992 for the Essex No. 19 Hydroelectric Project under Section 401 of the Federal Clean Water Act. Also enclosed is a copy of the responsiveness summary for the formal comments filed when the certification was on public notice and a copy of the attendance list for the public hearing. Please review the certification conditions carefully and contact the Department if there is any need for clarification.

The certification is appealable to the Vermont Water Resources Board under 10 V.S.A. Section 1024, and any appeal must be filed within fifteen days of issuance of this notice of action.

Thank you for your cooperation.

Sincerely,

Jeffrey R. Cueto

Jeffrey R. Cueto
Principal Hydrologist

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Water Quality Certification
(P.L. 92-500, Section 401)

In the matter of: Green Mountain Power Corporation
Green Mountain Drive
Box 850
South Burlington, VT 05402

APPLICATION FOR THE ESSEX NO. 19 HYDROELECTRIC PROJECT

The Water Quality Division of the Vermont Department of Environmental Conservation (the Department) has reviewed a Water Quality Certification application dated November 10, 1992 and filed on November 13, 1992 by the Green Mountain Power Corporation (the applicant). This application has been supplemented by a copy of the Federal Energy Regulatory Commission (FERC) license application filed with the FERC on December 23, 1991 and an October 30, 1992 response to a FERC additional information request (AIR). The Department held a public hearing on October 7, 1993 under the rules governing certification and received public testimony during the hearing and, as written filings, until October 15, 1993; attached is a copy of the Department's responsiveness summary, which shall be incorporated into this certification as findings by reference. Additionally, the Department, based on the application and record before it, makes the following findings and conclusions:

I. Background/General Setting

1. On December 23, 1991, the applicant applied to FERC for relicensure of the Essex No. 19 Hydroelectric Project located on the Winooski River, in the towns of Essex and Williston. The project is located at river mile 17.6, 0.5 mile south of the village center of Essex Junction.

2. The Winooski River, with its origins east of the Green Mountains in Cabot and Marshfield, flows through the Green Mountain range. The Lower Winooski is generally defined as the river below Bolton Falls Dam in Bolton to the river's mouth in Colchester. In this reach, the river primarily flows through the Champlain Valley.

3. The total area of the Winooski basin is 1,065 square miles; the drainage area at the project dam is 1,011 square miles. The total length of the mainstem of the river is 82.5 miles. The upper half of

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the Winooski is characterized by a steeply graded streambed with an average slope of 13 feet/mile. The lower half of the river from river mile 40 to the Essex No. 19 project exhibits a moderate slope averaging four feet per mile. Below the Essex No. 19 Powerhouse to Gorge No. 18, the average gradient is 3.5 feet per mile. Below the Gorge No. 18 powerhouse to below the American Woolen Mill Dam in Winooski, the river has a steep gradient of 50 feet/mile. Below the American Woolen Mill Dam to the mouth of the river, the slope is a gentle 0.8 feet/mile.

4. The project (as described in Waterfalls, Cascades and Gorges of Vermont) is located at the Williston Gorge, which is approximately 800 feet long with rock walls from 15 to 30 feet high. The river is approximately 75 to 100 feet wide at its narrowest location and contains a rock island, just below the dam, 150 to 200 feet long. In the gorge, the stone islands are nearly devoid of soil or vegetation because of intense scouring in springtime. The rock of the gorge is a dolomite and hence very limy, creating conditions favorable for calciphilic plants. The lower part of the larger island is vegetated.

5. Another island, in and below the gorge, is approximately 800 feet in length.

6. Green Mountain Power is the only public utility that owns hydroelectric facilities in the Winooski Basin. These projects include: Peacham Pond, which provides storage for the Mollys Falls facility; the Mollys Falls Project in Marshfield; the Middlesex No. 2 Project in Middlesex; Little River No. 22, which provides some measure of storage for projects on the Lower Winooski; Bolton Falls; Essex No. 19; and Gorge No. 18 located 6.4 miles downstream of Essex No. 19 in South Burlington and Colchester.

7. From Bolton Falls to Lake Champlain, almost two thirds of the river's drop has been harnessed for electrical power production (about 186 feet out of the total drop of about 300 feet). This has resulted in the impoundment of 13 out of 42 miles of river length.

8. Water power at this location was originally developed in the late 1700's by Abram Stevens for Ira Allen. The site was then known as Hubble Falls. After this dam washed out in 1798, other dams succeeded it both directly upstream and directly downstream of the falls. The first was built about 800 feet upstream in 1799 to serve sawmills and a carding machine plant. This dam was reconstructed

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in 1815 and 1830, and removed in 1913 after construction of the Essex No. 19 dam. Downstream, a low timber dam was constructed opposite the existing powerhouse by Chauncey Wells Brownell sometime after 1830. This dam powered a sawmill and several woodworking shops and, in 1893, electric generators were installed to serve residents of Essex Junction. The Essex No. 19 project was constructed at the falls site by the Winooski Valley Electric Company between 1913 and 1917. (License Application, Appendices E-8 and E-9)

Based on a 1912 topographic map contained in Appendix E-9 (Figure 5), the lower dam flooded Hubble Falls to an elevation of 228 feet. Hubble Falls is identified as the drop from elevation 220 to 208 feet, under the present dam.

9. The facility was licensed by FERC on January 21, 1969. The present license expires on December 31, 1993.

10. The Lower Winooski River passes through the most densely populated area in Vermont, Chittenden County. In the vicinity of the project, both Essex Junction and Williston are commercial and industrial centers as well as bedroom communities east of the City of Burlington. One of the state's largest private employers, IBM is sited directly to the north of the Essex No. 19 impoundment.

II. Project and Civil Works

11. The dam consists of a south concrete abutment, an uncontrolled overflow concrete gravity spillway, and a north abutment section which serves as the intake structure to the powerhouse. The spillway section curves 150 feet from the south abutment until it parallels the river in the vicinity of the intake at the north abutment. The total length of the dam is 495 feet with the spillway section being 345 feet long. The dam is founded on rock, has a crest elevation of 270.0 feet NAVD, and has a total height of 45 feet above its foundation.

12. The crest of the dam is fitted with wooden flashboards 5.0 feet high with a tip section 84 feet long fitted with flashboards 6.5 feet high. The tip section is located along part of the curved section of the spillway.

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13. The reservoir created by the flashboards is 352 acres when full. At elevation 275, the reservoir has a gross storage capacity of 1,950 acre-feet. Useable storage capacity between elevations 275 and 272 is 905 acre-feet and 335 acre-feet between elevations 270 to 268 feet. The backwater influence of the dam at elevation 275 feet is approximately seven miles.

14. The headwater elevation fluctuates between 275 and 272 feet NAVD when flashboards are in place and between 270 to 268 feet NAVD when flashboards are down. The normal tailwater elevation ranges from 207.5 to 209.9 feet NAVD between the lowest and highest turbine discharges.

15. The flashboards are typically in place except during the spring and other periods when flows are high. During the spring, flashboards are usually down from late March or early April and through late May or early June. Flashboards are lost on the average 3 to 5 times per year.

16. The applicant proposes to replace all three sections of the wooden flashboards with a rubber dam flashboard system.

17. With the rubber dam, the frequency of flashboard failure is expected to be reduced to an average of less than a single occurrence each five years. The actual probability of failure in a given year is unknown.

18. The intake structure consists of a headwall 36 feet high, with two concrete wing walls, a steel trashrack, timber platform, and vertical sliding wooden gates.

19. Four 9-foot diameter penstocks drive the four turbines in the powerhouse. Normally unused hydraulic exciters are supplied by two 3-foot diameter penstocks. Each of the six penstocks is approximately 400 feet long.

20. The powerhouse contains four S. Morgan Smith, horizontal Francis turbines. The turbines are rated at 2,223 kw with a total nameplate capacity of 7,200 kw, however the maximum sustainable operating capacity is 7,800 kw. The powerhouse also contains four 1,000 kw diesel units used for peak power operations. The hydraulic units have adjustable wicket gates operated by headwater float control. The estimated average annual generation is 36,319,000 kwh. Except

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for routine monitoring, inspection, and maintenance, the plant operates automatically and unattended.

21. A substation is located 300 feet north of the powerhouse. A transformer adjacent to the powerhouse steps up the generator output from 2.4 Kv to 34.5 Kv. From this transformer, one overhead 34.5 kV line extends north to the substation. From the substation, there are three 34.5 kV transmission lines that extend to the west, one 34.5 kV line that extends to the east, and one 34.5 kV line that extends to the southeast and is not part of the project. There are also local distribution lines from the substation.

III. Flow Regime and Reservoir Management

22. The project hydraulic capacity is 220 cfs to 2000 cfs.

23. The project is partially regulated by Waterbury Reservoir, an applicant-operated storage reservoir located on a tributary of the Winooski. The applicant operates the Essex No. 19 project as a daily peaking plant. Typical peaking operation is up to 16 hours per day. When less than 220 cfs is available for the operation of one turbine, the applicant spills water over the Essex No. 19 Dam. (With a leakage of 50 cfs, this would be an inflow condition of 270 cfs.) When flows exceed the plant capacity of 2000 cfs, the project generates continuously at maximum output, and the excess is spilled.

24. **Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities,** Volume II, 1988, indicates that under low-flow conditions the project operates Monday through Friday from 8 a.m. to 12 p.m. with an average drawdown of two feet, and under moderate flows, the project operates Monday through Friday from 7 a.m. to 4 p.m. with an average drawdown of four feet.

25. The applicant's operations model (FERC AIR No. 18, Page 23) indicates that summer on-peak periods are from 6 a.m. through 10 p.m., Monday through Friday and that winter on-peak periods are from 6 a.m. through 10 p.m. seven days a week.

26. The hydrograph entitled "Winooski River Flow at the USGS Gage, Essex Junction, July 29 to August 7, 1975," from Lower Winooski River Wasteload Allocation Study. Part A: Report of Data, December 1980, generally indicates one daily peaking event of 6 to 8 hours ranging from 1200 to 1400 cfs.

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27. The general maximum drawdown is 3 feet (License Application, Volume 7). Average daily fluctuation for the normal operating years, 1987 and 1990, was 2.2 feet. During 1987 and 1990, daily fluctuations of 3.1 - 4.0 feet occurred 11% of the time; 4.1 - 5.0 feet occurred 5% of the time; and fluctuations greater than 5 feet occurred 5 percent of the time.

28. The applicant indicated, in information submitted for a meeting of September 11, 1992, the reasons for fluctuations of 5 feet or greater. Ordered from the most occurrences to the fewest, they are: discharging water to accommodate high incoming flows; high incoming flows; minor peaking; refilling the reservoir; drawing the reservoir to replace missing flashboards; aerial photos scheduled and taken; cleaning trashracks and working on the dam; and NEPOOL requesting all possible generation.

29. During maintenance to resurface the dam in 1989, the impoundment was drawn down to elevation 256 feet, or 14 feet below the dam crest.

30. The maximum recent impoundment elevation of 279.5 feet, reached in 1987 and 1990, was due to heavy rains.

31. The Gorge No. 18 facility, which has only minimal storage capacity, is operated in tandem with Essex No. 19. That facility has a hydraulic range of about 533 cfs to 1707 cfs (AIR No. 18 response). The Chace Mill Project (Winooski One Development: FERC Project No. 2756) also operates in tandem with the Essex No. 19 Project.

32. In a meeting held April 9, 1993, the applicant proposed to maintain the reservoir at not less than 272 feet elevation during normal operations. The applicant stated, at that time, that they would retain the right to temporarily draw the elevation below elevation 272 feet for maintenance, for emergency conditions, and for purposes of making room for incoming water from flooding or major rains. Based on the August 1993 FERC filing Reply Comments to the Comments, Recommendations, Terms and Conditions, and Prescriptions, the applicant will reduce pond levels below elevation 272 for emergency maintenance, including incipient or actual failure of the rubber dam, annual maintenance, and scheduled major construction.

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33. Lag times have occurred where the impoundment is drawn below the top of the flashboards and incoming flows are insufficient to run one turbine. If one unit fails, lag time is limited to the time it takes for another unit to be brought on line (10 to 20 minutes). Deviations from normal operations can occur because of audits, emergency operating periods, or special operations. Normally in such a circumstance, downstream flows would not be reestablished until the pond refills and spillage occurs. Passage of minimum flows would be necessary at all times during project operation.

34. In 1987, the applicant voluntarily modified its project to pass a minimum downstream flow of 167 cfs (the 7Q10 flow as measured at the downstream U.S. Geological Survey gaging station); prior to that time, downstream flows were normally limited to only dam leakage during non-generation periods. In practice, to maintain 167 cfs downstream, the applicant has been releasing a flow of 220 cfs by keeping one turbine on line in order to use the minimum flow release for generation.

35. Currently, the only flow normally released into the bypassed reach is leakage. Based on 1977 data, dam leakage was estimated to average 55 cfs[1] (Low Flow Augmentation Study, Lower Winooski River, Vermont, Dubois and King, February 1981). In 1982, the applicant estimated that, at the maximum pond level of 275 feet NAVD, leakage was 140 cfs with all generators shut down (Hydropower in Vermont: An Assessment of Environmental Problems and Opportunities, Department of Environmental Conservation, May 1988).

    Based on Fall 1987 measurements, the Johnson Company estimated total leakage as 45.6 cfs with the pond at the top of the flashboards (Dam Leakage on the Winooski River, Green Mountain Power, Stage II, Johnson Company, January 1988, Figure 3). Of this, the source of the majority of the leakage, 36.8 cfs, was through the flashboards; 1.8 cfs was estimated as structural dam leakage, and 7.0 cfs was gate leakage at the powerhouse. The latter leakage discharges downstream rather than into the bypass. With the impoundment down three feet, the total leakage at the dam was estimated at 28.4 cfs.

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[1]The same source cited 63 cfs as the leakage at Gorge No. 18.

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During the flow demonstration of August 27, 1992, the applicant rated leakage into the bypass at 55 cfs with the pond at the top of the flashboards.

From this information, it can be concluded that when the facility is operating normally, about 2 cfs is discharged into the bypass with the boards down and roughly 30 to 50 cfs with the boards up and in good condition.

36. Under extreme flood conditions, with all flashboards down, the spillway will discharge 19,700 cfs at a pond elevation of 276.5 feet NAVD.

37. A gaging station has been operated by the U.S. Geological Survey on the Winooski River in Essex Junction since water year 1929. The gage is located 1.5 miles below the project and 0.5 mile below the confluence with Muddy Brook. The drainage area at the gage is 1,044 square miles; 33 square miles of land contribute additional flow between the dam and the gage. Several flow statistics for the dam site have been estimated using the daily gage data and are shown in the following table. Some of the parameters may be influenced by the artificial flow regulation caused by upstream hydroelectric and flood-control dams.

Table 1. Flow Parameters at Project Site

Parameter	Value
Mean runoff	1,670 cfs
7Q10	162 cfs
95% Exceedance	246 cfs
50% Exceedance	920 cfs
10% Exceedance	3,960 cfs

38. The applicant proposes to continue to operate the project as a daily peaking station; however, downstream minimum flows would be modified in accordance with the following table:

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Table 2. Applicant Minimum Flow Proposal for Below Project

Period	Flow
April 1 - May 15	true run-of-the-river
May 16 - June 15	1,000 cfs, or inflow
June 16 - March 31	340 cfs, or inflow

The applicant has agreed to apply the minimum flows proposed for Essex No. 19 to Gorge No. 18 as well.

39. The Chace Mill Project is licensed as a true run-of-the-river project and will not re-regulate flows. As such, flow conditions below the Chace Mill Project will be essentially the same as those produced below the Essex and Gorge plants.

40. Recently (Reply Comments to the Comments, Recommendations, Terms and Conditions, and Prescriptions, August 1993), the applicant amended its FERC license application to include the passage of 50 cfs year round through a single-source outlet.

41. The Department requested that the applicant investigate alternative flashboard designs that would control headpond variability while allowing the release of a fixed minimum flow over the crest.

42. The applicant responded to this request in an additional information request response to FERC in October, 1992. On June 8, 1993, the applicant provided a further investigation of releasing spillway minimum flows. The alternatives considered in both reports were: existing wooden flashboards; a piped distribution system on the downstream side of the dam (pressurized); an open downstream distribution trough; a pipe collection system on the upstream side of the dam with downstream discharge from pipes installed through the spillway at 10 foot intervals; intermittent openings under the flashboard system (concrete grooves; baseplate notches or holes); hydraulic crest gates; air-inflated rubber flashboards; water inflated rubber flashboards; steel panel supported by air-inflated bladder; a weir or sluice gated discharge; and a point discharge by valved pipe.

43. The applicant rejected the majority of the alternatives for a variety of reasons. The applicant concluded that the independent distribution systems, which include the trough distribution approach, the closed (pressurized) distribution system, and independent

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openings are too maintenance intensive, requiring the frequent removal of debris from intake screens.

44. The applicant concluded that the shape of the crest and the location of existing rock anchors make the trough distribution system technically unfeasible. Grooving the top of the spillway concrete or notching the baseplate of an inflatable rubber dam were judged infeasible since the water flow would be blocked by the bladder supported on the concrete. The intermittent opening approach was judged undependable since the openings would be susceptible to plugging by ice and debris. The unregulated pipe approach presented additional generation losses, assuming the pipe would be sized for the lowest level of the headpond cycle.

45. Of the independent distribution systems, the closed pressurized pipe system was found to have the highest probability of dependable operation, but the applicant believed it would interfere with the rock anchor compressive zone, be inaccessible for maintenance, and would leave the top 6 feet of the spillway dry.

46. Automatic flashboard systems that can pass top-discharge flows using either mechanical crest gates, a water-inflated, all-rubber flashboard system, or steel panels supported by air-inflated bladders are technically possible. However, the applicant is concerned that there are no operating peaking installations similar to Essex No. 19 that pass minimum flows while a headpond tracks with an automatic flashboard system. Also, accurate control of a headpond that tracks with the movement of automatic flashboard systems was judged to be more difficult.

47. Retention of the existing wooden flashboard system was rejected because of the lost benefits of better headpond control with the automatic flashboard system and because slots at the bottom of the flashboards to pass the minimum flow would vary in discharge depending on head.

48. A point discharge to pass a minimum flow was judged by the applicant as the most advantageous approach because it would, in the applicant's opinion, offer the highest system reliability and accuracy and would be a predictable and economical alternative to the uniform spillway veil flow.

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49. Of the several alternatives studied, the water-filled, all-rubber flashboard system would have the best likelihood of achieving a continuous spill over the dam crest, under the conditions of a cycling impoundment. No research has been done under winter conditions, however, when freezing would be a concern. Based on a July 16, 1993 telephone conversation between the Department (Thomas Willard) and Roger Campbell, Territory Manager for Bridgestone Engineering Productions Company, the probability of freezing appears to be minimal and could be dealt with through the use of a brine solution or cycling the bladder water through a heater. The dark color of the bladder and the fact that it would be separated from air contact by the spillage flow would tend to limit the freezing potential.

IV. Bypass

50. Substrate in the bypass has been investigated and mapped by the applicant using an aquatic habitat coding system (ref. response to AIR 4, Figure IV-1). This map contains an error in failing to accurately represent the low-flow channel in the lower portion of the bypass. About 70% of the bypass has been characterized as a combination of cobble, ledge, boulder, sand, gravel, and silt, and the remainder has been characterized as exclusively ledge. This does not include substrate found in the high flow channel to the south, nor are the numbers corrected to reflect the aforementioned mapping error.

51. The applicant has conducted several flow studies in the bypassed reach in order to determine the flow needs for year-round fisheries habitat, walleye spawning, aesthetics, and dissolved oxygen concentrations.

V. Impoundment

52. The project incorporates an 84-foot tip section of 6.5-foot flashboards and five feet of boards over the remainder of the crest. The boards are designed to fail under high flows when surcharged by 2 to 3 feet of water. Loss of the boards reduces the spillage crest by five feet and affects the seven-mile reach of the Winooski River above the dam. Reinstallation of boards can only be done after flows have receded.

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53. The licensing proposal, with the installation of the rubber dam, is to manage the impoundment in a 3 foot operating band between elevations 272.0 and 275.0.

VI. Standards Designation

54. The river segment in the vicinity of the project is designated as a Class B - Waste Management Zone (previously referred to as Class C). This change in classification designation was a result of recent legislation. The lengths of waste management zones are being reviewed by the Department and will be reset based on rules to be promulgated by the Water Resources Board.

55. Class B stream reaches are managed to achieve and maintain a high level of quality compatible with certain beneficial values and uses. Values are high quality habitat for aquatic biota, fish and wildlife and a water quality that consistently exhibits good aesthetic value; uses are public water supply with filtration and disinfection, irrigation and other agricultural uses, swimming, and recreation. (Standards, Section 3-03)

56. Waste management zones, although Class B waters, present an increased level of health risk to contact recreational users due to the discharge of treated sanitary wastewater.

57. Above the project dam, the Water Resources Board has designated the river as a cold water fishery habitat.

58. The minimum dissolved oxygen standards for cold water streams are 6 mg/l or 70 percent saturation unless higher concentrations are imposed for areas that serve as salmonid spawning or nursery areas important to the establishment or maintenance of the fishery resource. The temperature standard limits increases from background to 1.0°F. (Standards, Section 3-01(B)) The turbidity standard is 10 ntu. (Standards, Section 3-03(B))

59. Downstream of the project dam to the river's mouth, the river is designated as a seasonal warm water fishery habitat during the period June 1 through September 30 and a cold water fishery habitat for the remainder of the year.

60. The dissolved oxygen standards for warm water streams are 5 mg/l or 60 percent saturation. The temperature standard allows a

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variable increase of 1° to 5° based upon background temperature. (Standards, Section 3-01(B)) The turbidity standard is 25 ntu. (Standards, Section 3-03(B))

61. Under the general water quality criteria, all waters, except mixing zones, are managed to achieve, as in-stream conditions, aquatic habitat with "[n]o change from background conditions that would have an undue adverse effect on the composition of the aquatic biota, the physical or chemical nature of the substrate or species composition or propagation of fishes." (Standards, Section 3-01(B)(5))

62. Section 2-02 Hydrology of the Vermont Water Quality Standards requires that "[the] flow of waters shall not be controlled or substantially influenced by man-made structures or devices in a manner that would result in an undue adverse effect on any existing use, beneficial value or use or result in a level of water quality that does not comply with these rules." The project dam is a man-made structure that artificially regulates streamflow.

63. In 10 V.S.A. §1250, the legislature has enumerated the State water quality policy. The State's policy is to upgrade the quality of its waters and reduce existing risks to water quality over the long term and to protect and enhance the quality, character and usefulness of its surface waters. Further, it is the State's policy to allow beneficial and environmentally sound development.

64. The Department considers existing hydroelectric projects to be beneficial developments in terms of serving the public good, but only if properly controlled for consistency with Standards and general water policy such that they can be considered environmentally sound.

VII. Water Quality

a. Chemical

65. The Winooski River experiences frequent dissolved oxygen deficits due to high wasteloads from municipal and industrial wastewater discharges as well as large diurnal fluctuations due to respiration from periphyton. The increase in dissolved oxygen concentrations as a result of spillage of water at the dam is a potential important benefit to the aquatic life, particularly important at times of the day

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when waste discharge volumes are peaking, during times of the night when the impact of plant respiration is greatest, and during those periods when river flows are low and the project is operating.

66. There are five municipal and one industrial wastewater treatment facility discharges to the Lower Winooski (IBM, Essex Junction, South Burlington, Burlington - Riverside, Winooski, and Burlington - North End). These facilities provide advanced wastewater treatment during the warm, summer low-flow months to protect and enhance dissolved oxygen concentrations in the Lower Winooski River. This advanced treatment includes the removal of phosphorus to reduce algal-induced diurnal dissolved oxygen variations and restrictions on the discharge of oxygen-demanding wastes.

67. A special survey for dissolved oxygen at key locations in the Winooski River was performed in August 1974. Because of the wide swings in flow below Essex No. 19, there was a correspondingly wide variation in dissolved oxygen levels. Low dissolved oxygen levels reflected those times when no power was being generated and the river was allowed to pond behind the dam. Flows as low as 47 cfs were measured under this condition. (Winooski River Basin Water Quality Management Plan, 1976)

68. In 1988, a wasteload allocation order was issued for the lower Winooski River. This allocation order was required due to the limited assimilative capacity of the river and the fact that water quality standards would not be met if all treatment plants were at capacity and the river was at low flow. This allocation was based upon an assumption that 7Q10 flows would be passed at both facilities, Gorge No. 18 and Essex No. 19. The critical season in the order, during which treatment UOD limits are prescribed, is June 1 through October 31.

69. The Agency Procedure for Determining Acceptable Minimum Stream Flows (July 14, 1993) provides guidance to the Department in setting minimum stream flows at hydroelectric projects. With regard to project bypasses, the procedure states:

> Bypasses shall be analysed case-by-case. Generally, the Agency shall recommend bypass flows of at least 7Q10 in order to protect aquatic habitat and maintain dissolved oxygen concentration in the bypass and below the project. In assessing values, consideration shall be given to the length of the bypass; wildlife and fish habitat potential; the aesthetic and recreational values; the relative supply of the bypass resource values in the

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project area; the public demand for these resources; and any additional impacts of such flows upon citizens of the State of Vermont. Bypass flows shall be at least sufficient to maintain dissolved oxygen standards and wastewater assimilative capacity. Where there are exceptional values in need of restoration or protection, the general procedure shall be followed. In most cases, a portion or all of the bypass flows must be spilled over the crest of the dam to reoxygenate water, provide aquatic habitat at the base of the dam and assure aesthetics are maintained.

70. The Department has modeled the benefits of providing a spill of 7Q10 at the project dam. Spillage is not necessary to maintain minimum standards for dissolved oxygen at the river's sag point (the modelled location of the lowest dissolved oxygen concentration under design discharges of wasteload for all wastewater facilities); however, the dissolved oxygen regime in the reach of river between No. 19 and No. 18 is enhanced by spillage at No. 19. The objective of the modeling was to determine at what flow the benefits of spilling 7Q10 become insignificant. As modeled flows are increased, two factors reduce the benefit of a fixed spillage of 7Q10. First, the river dissolved oxygen deficit decreases because of greater dilution of the wasteload; reduced significance of algal respiration; and increased oxygen entrainment in the free-flowing river reaches. Second, the proportion of the more highly oxygenated spillage flow in the total mix of flow below the tailrace becomes less.

For the purposes of modeling, the Department assumed a constant background concentration of dissolved oxygen of 7.46 mg/l at the IBM discharge and a water temperature of 80°F (dissolved oxygen saturation value of 8 mg/l).

71. Under 7Q10 conditions (167 cfs), wasteload decay from the IBM outfall to the project dam causes the river's dissolved oxygen concentration to drop to 6.6 mg/l. As the project is not operating, all flows spill and reach a dissolved oxygen concentration of

7.6 mg/l at the base of the dam. Subsequent decay of the UOD wasteload causes the river dissolved oxygen concentration to drop to 6.2 mg/l before becoming reoxygenated through spillage at the Essex No. 18 dam. The following table provides the modeling results, including the dissolved oxygen regime for the applicant's proposal.

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Table 3. Dissolved Oxygen Modeling Results

Flow (cfs)	Spillage (cfs)	Dissolved Oxygen Conc. (mg/l) (percent saturation in parentheses)		
		No. 19 u/s dam	After mix 0.2 mi. below tailrace	No. 18 u/s dam
167	167	6.6 (81)	7.6	6.2
220	220	6.8 (84)	7.7 95)	6.5 (80)
270	50 (GMP)	7.0 (86)	7.1 (88)	6.6 (81)
	270		7.8 (96)	6.7 (83)
386	50 (GMP)	7.2 (89)	7.2 (89)	6.8 (84)
	386		7.8 (96)	7.0 (86)
387	50 (GMP)	7.2 (89)	7.2 (89)	6.8 (84)
	167		7.5 (92)	6.9 (85)
500	50 (GMP)	7.2 (89)	7.3 (90)	7.0 (86)
	167		7.4 (91)	7.0 (86)

72. Maintaining the dissolved oxygen concentrations at a level which protects and improves the beneficial values and uses associated with the classification is a requirement of state and federal law.

73. Under the project proposal of peaking with a storage-period release of 340 cfs, the applicant would artificially produce a condition through the summer and early fall where a flow of 340 cfs is created much more frequently than would naturally occur.[2] The downstream flow of 340 cfs would be a mix of the 50 cfs gated discharge through the bypass and 290 cfs generation. Under the

[2]The applicant represented in a meeting on August 27, 1993 that normal operation is to peak to its full capacity of 2,000 cfs on a daily basis when inflows allow. Based on monthly flow duration curves provided in Volume 1 of the license application, during the months of August and September, daily flows are in the range of 340 cfs to 2,000 cfs on about 64% of the 61 days. Actual operating details have not been provided; however, it is reasonable to assume that the applicant would create an artificial low flow of 340 cfs on at least half of the days during those two months.

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modeling assumptions, there is 0.6 mg/l reduction in the dissolved oxygen deficit directly below the tailrace when comparing the 167 cfs spill scenario (assuming that all flows are spilled up to 387 cfs) to the project proposal; the benefit reduces to 0.2 mg/l at the Gorge dam.

74. Imposition of a minimum flow of 500 cfs would prevent the artificial increased frequency of flows equivalent to 340 cfs.

75. The applicant has proposed installation of a rubber dam/flashboard system which would eliminate spillage flows which presently exist as a result of flashboard leakage. The leakage would be replaced through the installation of a single source outlet constructed at the project intake; this outlet would be designed to accommodate downstream fish passage as well. Depending on the design, the aeration may be even less efficient than has occurred under present conditions of flashboard leakage.

76. When inflows drop below 270 cfs and all inflows are released at the dam, dissolved oxygen levels in the downstream reach to Gorge No. 18 will improve during the critical period of June through October.

77. The minimum flow proposed by the applicant should be sufficient to preclude a violation of the temperature standards.

78. Because river flows will be continuously available downstream, the impact of the project on concentrations or levels of the following chemical/physical water quality parameters will not be significant:

Phosphorus
Nitrates
Settleable, floating or suspended solids
Oil, grease, and scum
Alkalinity
pH
Toxics
Turbidity
Escherichia coli
Color
Taste and odor

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b. Aquatic Biota

79. Aquatic biota are defined in Standards Section 1-01(B) as "organisms that spend all or part of their life cycle in or on the water." Included, for example, are fish, aquatic insects, amphibians, and some reptiles, such as turtles.

80. The Lower Winooski River supports a diversity of fishes, including both coldwater and warmwater species. A limited species list based on angler reports and sampling includes: smallmouth bass, walleye, landlocked Atlantic salmon, brown trout, rainbow trout, rock bass, yellow perch, pumpkinseed, fallfish, white sucker, and common carp. The river is a major tributary of Lake Champlain.

81. Upstream of the project, the Agency stocks approximately 5,000 brown trout yearlings annually from Bolton Falls to Richmond. Rainbow trout were stocked up until 1973. Brown, rainbow, and brook trout are all stocked in upstream tributaries.

82. Based on fish collection work done by the Agency in 1988, smallmouth bass and fallfish are abundant in the river reach at the head of the Gorge No. 18 impoundment. Adult brown and rainbow trout are occasionally caught below Essex No. 19. Walleyes also reside in this reach.

83. The Lower Winooski is a targeted spawning tributary in a cooperative effort between Vermont, New York, and the U.S. Fish and Wildlife Service to develop Lake Champlain's salmonid fishery (A Strategic Plan for Development of Salmonid Fisheries in Lake Champlain, October 4, 1977, a comprehensive river plan). The Winooski would be used in the program's initiatives to improve the steelhead rainbow trout fishery and to reestablish a landlocked Atlantic salmon fishery. In recent years, the Agency has stocked Atlantic salmon and steelhead smolts in the reach from the river's mouth to the American Woolen Mill Dam (the Chace Mill Project). This past spring, the new trap-and-truck operation was operated at the Chace Mill Project for the first time; this facility enables the distribution of the adult migrants upstream throughout the river system. In the past, juvenile steelhead and landlocked salmon have been stocked in the Winooski River upstream of the project and passed through this section of stream as they migrated to Lake Champlain.

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84. As indicated in the Fisheries Management Summary for Essex No. 19 and Gorge No. 18 Hydroelectric Projects (License Application Volume 3, Appendix E-1, Attachment 3 to letter of May 3, 1991 from Agency to Eugene Shlatz), the Agency will be assessing the potential for introducing and developing a muskellunge fishery in the section between Essex No. 19 and Gorge No. 18, as well as the possibility of using certain reaches above Chace Mill for sturgeon nursery habitat as part of a contemplated Lake Champlain restoration program.

85. Limited runs of lake sturgeon, the only state-listed endangered fish species, continue to occur in major tributaries of Lake Champlain, including the Winooski. Anecdotal sightings have been recorded by the Department of Fish and Wildlife for the last ten years. Two sightings in the Winooski occurred in 1986. In addition, an angler reported snagging a sturgeon in the Salmon Hole (directly below the Chace Mill Project) in May 1992. The fish was brought up to shore and then broke free. The length of the fish was about four feet. Another sturgeon was caught and released by an angler fishing at the river mouth this spring.

1. Downstream

86. Under the project proposal for relicensing, the project would operate out of storage, typically cycling flows to a generation release of up to 2,000 cfs and releasing a minimum flow of 340 cfs during replenishment of storage (non-spring period).

87. In its review of the project proposal and the biological consequences of downstream flow regulation, two issues have been focal. First is the setting of appropriate minimum flows below the project that would meet the Class B management objective of providing high quality habitat for the fish species and other aquatic organisms for which the river is managed. Second is to determine what, if any, constraints on daily peaking are necessary to insure that the project does not unduly disrupt habitat conditions for organisms that cannot adapt to changes in the location of suitable habitat when the project flow releases artificially vary during the course of a day. The peaking assessment is done with the recognition that habitat conditions are dynamic even under natural conditions; however, in natural systems and especially when dealing with large watersheds,

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flows seldom vary substantially on an hourly basis. Peaking at Essex No. 19 results in substantial hourly variations in flow during the non-spring period.

88. The U.S. Fish and Wildlife Service Flow Recommendation Policy for the New England Area and the Agency Procedure for Determining Acceptable Minimum Stream Flows prescribe minimum flows for the perpetuation of indigenous fish species. The presumptive minimums are 4.0 csm for spring spawning and incubation, 1.0 for fall/winter spawning and incubation, and 0.5 csm for the remaining period and in cases where spawning and incubation is not applicable. When instantaneous inflows are less than these values, the inflow must be passed. In the alternative, under these procedures, an applicant may elect to perform site specific hydrological or biological studies to support different minimum flow values.

89. In 1982, the Agency conducted an instream flow study below Essex No. 19, targeting rainbow trout, smallmouth bass, and food production (macroinvertebrates). The results of this study are contained in the report Hydropower in Vermont: An Assessment of Environmental Problems and Opportunities, Volume II, a comprehensive river plan. Quoting from page 154 of that plan:

> Figures 19a and 19b demonstrate a flow of 550 cfs would be optimum for food production and rainbow trout adults. Considering the fish passage plan for the Winooski River and the fact that the potential for this plan to be successful is very high in this river reach, this flow is preferred with a flow of 340 cfs being the absolute minimum. A flow of 340 cfs would also be adequate for all life stages of smallmouth bass.

90. In 1991, the applicant conducted a habitat study using the U.S. Fish and Wildlife Service Instream Flow Incremental Methodology (IFIM) in the 2.5 mile segment between the Essex No. 19 powerhouse and the Gorge No. 18 impoundment, and at the Salmon Hole below the Chace Mill Project. For Reach 1, which is directly below the project powerhouse and about 2,550 feet long, smallmouth bass, rainbow trout, walleye, fallfish and invertebrates were selected as the target organisms. For Reach 2, which is directly below the Salmon Hole and about 595 feet long, target species were rainbow trout, walleye, sturgeon, and landlocked salmon.

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91. The applicant evaluated the effect of peaking on habitat conditions using two different evaluation tools available through IFIM modeling--habitat mapping for immobile life stages and habitat duration curves. In addition, the Agency has used the input data files from the IFIM study to complete a third assessment approach called a dual flow analysis[3], which was developed by the U.S. Fish and Wildlife Service National Ecology Research Center. The species and life stages analysed are tabulated below:

Table 4. Target Species and Life Stages for Peaking Assessment

Species	Life Stage	Assessment Technique		
		Habitat Mapping	Habitat Duration	Dual Flow
Smallmouth bass	spawning/inc.	x	x	
	black fry	x	x	x
	young-of-year	x		
	adult		x	
Rainbow trout	adult		x	
Walleye	spawning/inc.	x	x	
Invertebrates		x		x

92. Habitat mapping and dual flow analyses are useful in assessing the impact of a daily peaking project, particularly with respect to immobile organisms. The two approaches are closely related in that the mapping is visually interpreted, while the output of the dual flow analysis is actually a way of quantifying the same information--the spacial changes in habitat and the changes in individual cell suitabilities. The applicant's emphasis has been on the habitat duration analysis, which has been used to quantify the benefits derived from increasingly more benign operating scenarios (response to AIR 1, October 1992). The habitat duration curves were integrated over the 20 to 90 percent exceedance range in order to quantify habitat in units of square feet-hours. Unfortunately, a

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[3] Milhous, R.T. 1992. Determining the minimum flow below hydro peaking projects. (Hydro Review, October 1992. pages 67-74.)
Theumler, T.F., G.E. Whelan and J.D. Fossum. 1991. Assessment of the effects on aquatic habitat from a hydroelectric peaking project using the instream flow incremental methodology. (Instream Flow Chronicle, VIII(1):1-3.)

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habitat duration analysis using an hourly time step only quantifies the time availability of habitat and does not deal with habitat disruption due to daily peaking. It is especially of limited utility when assessing impacts on immobile organisms. Further, severe impacts outside the 20 to 90 percent exceedance range may be overlooked with this analysis. For example, if the channel were dry 10% of the time, no effects would be measured. One option would be to combine the dual flow and habitat duration approaches in a daily time step; neither the Agency nor the applicant have attempted to do this.

93. Projects that fluctuate flows on a daily basis subject aquatic organisms to both high and low flows on a rapidly changing basis. The locations of suitable habitat often shifts spatially between the two flows as the distribution of preferred depths and velocities shift. Immobile species and life stages are particularly vulnerable as they cannot relocate to suitable habitat if the habitat shifts in location between the minimum and generation flows. Macroinvertebrates, fish eggs, and small fish are generally assumed to be immobile within the context of a daily peaking environment. For immobile organisms, it is reasonable to assume that an organism is controlled by whichever flow (minimum or generation) provides the poorer habitat conditions at the organism's physical location; this is, therefore, the premise of the dual flow analysis.

94. Forcing fish to relocate frequently exposes them to predation, expends additional energy that might otherwise go into growth, and may have behavioral effects as well. While these influences are real, they as yet cannot be quantified and are not included in the IFIM model. Therefore, the modeling results underestimate the effect of peaking on mobile organisms. A simplified method to consider the effects of peaking on habitat for fully mobile organisms is to compare habitat shown on the weighted useable area curve at the high and the low flow, and assume the lower habitat quantity is the effective habitat. Thuemler et al. refer to this as a "two flow" analysis. The two flow analysis results in higher effective habitat quantities than the dual flow approach because it accepts spacial shifts in habitat. In their study, Thuemler et al. stated a belief that the actual impact of peaking on smallmouth bass juvenile habitat and adult habitat lies near the mean of the effective habitat values produced by the two flow analysis that assumes full mobility and the dual flow analysis that assumes immobility.

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95. The applicant proposes no controls on peaking to reduce its impact on habitat. Peaking would continue to produce wide spreads in flow over short time frames. The spread between the proposed minimum flow and maximum generation is 488%.

Walleye

96. An existing walleye fishery exists between Gorge No. 18 and Essex No. 19 and below Chace Mill. The Agency intends to place walleyes from the Chace Mill Project trap for spawning purposes between the Chace Mill Project and Gorge No. 18.

97. For the range of flows modeled in the IFIM study conducted by the applicant, walleye spawning and incubation habitat is close to a direct linear function of flow. The highest modeled flow is for 3,340 cfs (license application, Volume I, Table E(3)-6, Reach 1 below powerhouse). A flow of 1,000 cfs provides about one half the habitat available under the highest flow modelled. Typical spring operation is to generate almost continuously at full plant capacity of 2,000 cfs. Most high spring runoff has occurred by mid-May. Percent exceedances for 2,000 cfs for April and May are 90% and 54%, respectively.

98. Unnaturally low flows during the actual walleye spawning period would threaten spawning. Sufficient minimum flows for incubation are needed during the latter half of May. In about half of the years of record, the flow in May has dropped to or below 1,000 cfs. The applicant's proposal to operate run-of-the-river from April 1 through May 15 and release a flow of 1,000 cfs or inflow, whichever is less, from May 16 to May 31 will be adequate to protect walleye spawning and egg incubation below the project tailrace and below the Chace Mill Project.

Sturgeon

99. The Department of Fish and Wildlife is evaluating the feasibility of a lake sturgeon restoration program for Lake Champlain in the near future. The Department has contracted with the University of Vermont Fish and Wildlife Cooperative Unit to do the feasibility study. In addition, the Department recently sent its Director of Fish Culture Operations to Wisconsin to observe that state's sturgeon

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culture and egg procurement procedures. Results thus far indicate that sturgeon culture appears viable for use in a restoration effort.

100. The Agency requested that the applicant extend the 1,000 cfs (or inflow, if less) minimum flow through June 15 in order to protect lake sturgeon spawning and incubation, and that is now part of the relicensing proposal, although couched in conditions related to the success of the restoration program (Reply Comments to the Comments, Recommendations, Terms and Conditions, and Prescriptions, August 1993). Hydrological information supplied by Stetson-Harza by letter dated October 7, 1991 indicates that a flow of 1,000 cfs is a common spring base flow into the first half of June. Assuming that the applicant released 1,000 cfs at its Gorge plant, the minimum flow would be continuously available below Chace Mill as the Chace Mill facility operates in a true run-of-the-river mode. There is adequate evidence to conclude that sturgeon continue to use the Winooski River for spawning and incubation.

101. Given the endangered status of this lake resident, it is particularly important that project operation not interfere with its propagation. Should the sturgeon become extirpated and restoration efforts cease, the special spring flow for sturgeon spawning and incubation would be suspended until either there is evidence of the fish not having been extirpated or a restoration program is re-initiated. This certification is being so conditioned. Suspension of minimum flows will only occur after consultation with the Department of Fish and Wildlife and the U.S. Fish and Wildlife Service.

102. The spring flow regime to accommodate sturgeon through June 15 also benefits a number of other species and life stages, including bass and fallfish spawning, by providing a more stable flow regime.

Macroinvertebrates - Insects

103. The applicant's original IFIM output for macroinvertebrates indicates generally that the available habitat is of poor quality. In addition, the weighted useable area curve shape was somewhat unusual, possibly reflecting the narrow suitability ranges of the depth and velocity suitability index (SI) curves.

104. The Department of Fish and Wildlife re-examined the SI curves originally recommended and the source study used to prepare the

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curves. The original data came from a study by Gore on the Tongue River, a tributary to the Yellowstone River in Montana. In this study, none of the depths in the riffles surveyed exceeded 1.5 feet in depth. As a result, no depths greater than 1.5 feet were assumed to be suitable; these physical conditions are dissimilar to the Winooski River, where depths greater than 1.5 feet at higher flows are common.

105. The Agency reran the IFIM analysis using modified suitability criteria more applicable to the Winooski River. New useable-area curves were generated using the binary depth and velocity criteria for invertebrates from the Agency's Fishery Flow Needs Assessment (FFNA) methodology and the same substrate suitability indices initially recommended by the Agency and used in the applicant's study.

106. The substrate criteria appear to be broadly applicable as they cover a range of substrate sizes. The depth and velocity criteria, while general, are based on a number of references cited in the FFNA report. All transects were included in the analysis. The depth and velocity criteria are shown below:

Table 5. Habitat suitability criteria for macroinvertebrates

Depth (ft.)	SI	Velocity (fps)	SI
<0.5	0	<1.0	0
0.5	1	1.0	1
3.0	1	3.5	1
>3.0	0	>3.5	0

107. The habitat/flow results differ considerably from those produced from the former SI curves. Based on the low-flow model, the weighted useable area continuously increases from 150 to 850 cfs, with little change from 850 to 1,300 cfs. The rate of increase in weighted useable area with increasing flow is much less above 550 cfs. The high flow model results indicate that weighted useable area increases from 530 cfs to a maximum at 1,340 cfs and declines at flows above 1,540 cfs. These curves are somewhat inconsistent where the range of flows they cover overlaps. The low flow model is most applicable for decision making on the minimum flow.

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108. The applicant has criticized the Agency's use of binary coding, but has agreed that the original SI curves are inappropriate for the study reach. The applicant reran the analysis using SI curves developed by Niagara Mohawk Power Corporation for six genera of macroinvertebrates. The resulting weighted useable area curves are strikingly similar to those developed by the Agency and described above. (Reply Comments to the Comments, Recommendations, Terms and Conditions, and Prescriptions, August 1993)

109. The output from the dual-flow analysis can be used to estimate the theoretical habitat loss on a given operating day when below-project flows vary from a certain base flow, or minimum flow, to a peak generation flow. This net habitat quantity in turn could also have been compared to what would have been available under the intermediate natural-flow conditions (e.g. run-of-the-river); such an analysis would have shown greater losses of physical habitat, unless the weighted useable area curve was virtually flat.[4]

110. As in the steady state analysis, the dual flow results show that habitat rapidly declines for minimum flows below 500 cfs, regardless of the peak flow. However, habitat is also substantially affected by the peaking releases even at higher minimum flows. At a minimum flows of 340 and 500 cfs, the percentage of habitat reduction resulting from peaking is shown below for several generation flows.

Table 6. Impact of generation flows on macroinvertebrate habitat

Flow (cfs)		Habitat Loss (%)
Minimum	Peak	
340	1,000	34
	1,500	56
	2,000	69
500	1,000	22
	1,500	42
	2,000	63

[4]The natural-flow comparison analysis has been completed and is discussed in the responsiveness summary.

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111. Habitat is best protected by maintaining a base flow that provides good habitat conditions for the target organism and a mix of suitable cells that do not substantially change in quality between artificial flow extremes. Based on the habitat mapping and dual flow analysis, control of peaks is necessary to accomplish this.

Macroinvertebrates - Mussels

112. A freshwater mussel survey was conducted on October 24, 1991 in the Winooski River just upstream of the Muddy Brook and below the Essex No. 19 powerhouse.

113. The conditions for the survey were generally good, although the river was slightly above normal and clarity was not 100 percent. The water temperature was about 50°F. Relatively common species such as Ellipto complanata and Lampsilis radiata were found. A species that is apparently quite rare now, Lasmigona compressa, was located. Anodonta c. cataracta is uncommon in the lower Winooski River section.

114. Some stress may be occurring to E. companata as many fresh dead shells were found. A decline in diversity may have occurred because Strophitus undulatus and Alasmidonta undulata, which were historically noted in the river and may still be in the river, were not located during the survey.

Smallmouth Bass

115. The provision of the spring flow regime through June 15 as proposed by the applicant will protect bass spawning and incubation, especially with respect to the effects of cycling.

116. The weighted useable area curves indicate that black fry habitat is best at the low end of the modeling range and approximately constant from 300 to 550 cfs. Habitat quantity and quality decline significantly at generation flow levels, creating a circumstance where cycling is more problematic than minimum flows for this life stage. The applicant's habitat mapping suggests that, while there is some spatial shift of habitat as flows change, the primary problem is that both habitat quality and quantity decline significantly at generation flow levels; the mapping shows that much of the better quality habitat is eliminated at 2,000 cfs. The habitat duration analyses for

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125. The applicant has stated an opinion that management for a year-round rainbow trout fishery below Essex No. 19 is an unrealistic goal because of summer low flows and high temperatures. The applicant measured the water temperature regime above and below the project during summer months of 1990 and 1991.

126. The summer temperature data was intended to measure worst case conditions of greatest temperature stress to trout. The temperature results show a few temperature excursions above the incipient lethal limit for rainbow trout (25°C), with most temperatures falling below this limit but above the optimum temperature range (12-18°C). The character of the Lower Winooski River temperature regime is not exceptional when compared to many of Vermont's larger trout streams. Summer water temperatures are seldom optimal during the low flows of summer, especially in heavily regulated systems.

127. During such stressful periods, trout typically seek out thermal refugia (spring seeps, tributary mouths, deep pools). Trout are able to survive adverse temperature conditions as long as the frequency and duration of such events are not excessive. For example, trout can withstand temperatures above the incipient lethal limit during daytime as long as temperatures decline again at night. Many of Vermont's streams, including the Winooski River above the project, support self-sustaining trout populations despite periodic above-optimum summer temperatures. While the temperature regime below the project is less than ideal, it does not preclude the Agency goal of managing for a year-round trout fishery. Further, the temperature measurements taken by the applicant were under the present artificial flow regime, and project changes away from severe reductions in flow over extended periods should improve the river's temperature regime. (Agency memorandum from Roderick Wentworth to Laurence Becker, June 28, 1993)

128. The weighted useable area curves for adult rainbow trout suggest that flows of 1,000 cfs or higher are optimal. Since rainbow trout are fairly mobile, spatial shifts in habitat that result from peaking should be manageable as long as stranding does not occur. Therefore, the minimum flow value is the more important decision-making variable. Because of food chain considerations, the selection of a flow regime that assures good conditions for macroinvertebrates is also important to trout.

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129. The greatest amount of habitat, measured as weighted useable area, occurs in Reach 1 (below the powerhouse) at 1,840 cfs. In Reach 2 (below the Salmon Hole), weighted useable area continues to increase with increasing flow over the entire modeling range (130 to 2,830 cfs). For Reach 1, the amount of weighted useable area, expressed as a percent of the maximum weighted useable area, for a range of flows is tabulated below.

Table 8. Relationship of minimum flow to optimum rainbow trout adult habitat at Reach 1

Flow (cfs)	% of Maximum WUA Rainbow Adults
340	58
400	64
450	68
500	72

130. Based on this analysis, a minimum flow of 500 cfs provides 24% more rainbow trout adult habitat than 340 cfs.

131. Since flows near or above 1,000 cfs cannot be sustained outside of the spring period, the hydrologic availability of water must be considered. The minimum flow of 500 cfs is naturally sustained about 76% of the time during the non-spring period. The applicant's proposed 340 cfs would naturally be exceeded 87% of the time.

Fallfish

132. The fallfish weighted useable areas for spawning/incubation and for fry are nearly constant over the range of flows modelled. The provision of a special spring flow regime through June 15 would protect spawning and incubation from the problems associated with flow fluctuation. The same is true for fallfish fry except that the spring flow regime only covers the first quarter of the fry period (the first half of June). Subsequent flow fluctuation is a potential problem for fry during the remaining 1½ months. Fry are especially a concern since they are essentially immobile.

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133. The applicant did not produce habitat maps for fallfish for assessment of peaking effects.

134. The habitat/flow relationships for fallfish adult and juvenile life stages are similar to the relationship for the juvenile life stage of smallmouth bass. The findings for juvenile bass, therefore, also apply to adult and juvenile fallfish.

Balancing the Minimum Flow Between Species and Life Stages

135. To help select a non-spring-period minimum flow that reasonably accommodates all the target species and life stages, some of which have differing flow preferences, the Agency has recommended considering the results of mathematically "averaging" the various weighted useable area curves and assessing which flow provides the greatest amount of habitat overall for all the selected species and life stages. This optimization technique was used by the Agency to determine which flow best accommodates all species/life stages by minimizing the habitat loss (relative to the maximum) as summed for all species/life stages. (Agency memorandum from Roderick Wentworth to Laurence Becker, June 28, 1993)

136. In the Agency analysis, selected species and life stages were assumed to be considered equally important. No assumption about relative spatial requirements is made. Since data on the relative needs of the various life stages is lacking, habitat ratios for different life stages were not considered. For bass and fallfish, spawning and incubation stage was not included since it occurs during the spring period and is accommodated by the proposed spring flow regime. The habitat "loss" for subsequent life stages for each of these two species are averaged. While this approach has its weaknesses due to the assumptions made, it is a useful analytical technique when used with consideration of seasonal hydrology and impact of flows on specific life stages.

137. The table below summarizes the habitat loss, relative to optimum conditions, associated with a range of minimum flows from 340 to 500 cfs for the fish species of concern and macroinvertebrates.

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Table 9. Balancing flow recommendation among target species

Minimum Flow(cfs)	Mean Habitat Loss (%)				
	Bass	Fallfish	R. Trout	Inverts	All
340	8	13	42	36	25
400	8	9	36	28	20
450	8	7	32	22	17
500	8	6	28	16	14

138. The results of this analysis show that habitat gains can be made by increasing the minimum flow above 340 cfs. Habitat conditions would improve for macroinvertebrates, rainbow trout adults, smallmouth bass adults, and fallfish juveniles and adults. Flows above 340 cfs, in the range shown, do not become excessive for life stages where lower flows offer more habitat. Further, the higher flows better balance available habitat between all species and lifestages. Also, the setting of a low minimum flow makes the addressing of habitat degradation issues related to flow fluctuation more difficult to resolve.

Effects of Peaking

139. Ameliorating the habitat loss from peaking would necessitate constraining maximum fluctuation in flow to about 500 cfs. During the summer, this would result in a typical operating cycle between 500 cfs off peak and 1000 cfs on peak. Such a constraint appears viable during the lower flow months since peaking much in excess of 1,000 cfs is infrequent. However, this peaking constraint would likely be very costly at other times of year and less warranted biologically.

140. Too rapid a transition between the minimum flow and the peak generation flow is disruptive to aquatic life and dangerous to anglers. For public safety reasons, the applicant has indicated that it is willing to review options to control the rate at which the transitions between the two flows is made.

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3. Bypass

Walleye

141. Suitable habitat for walleye spawning exists in the bypass's left channel when bypass flows are maintained at a level of 1,000 cfs or higher. Based on spring hydrographic information (April - May) provided by the applicant, natural flows would provide such conditions in most years. Under regulated conditions, such flows are only available when inflows exceed 3,000 cfs. Provision of a flow of 1,000 cfs or greater in the bypass though the month of May is feasible, but only with a significant reduction in project output in most years.

142. During high flows in the spring the bypass would be watered regardless of license conditions. The spawning habitat in the bypass is less than 5% of the total available as wetted area.

143. Since the large majority of the spawning habitat exists in the main river channel below the project and the applicant has proposed an adequate spring below-project regime, maintenance of spawning flows in the bypass is an acceptable loss. However, because walleye can be expected to move into the bypass under suitable flows and spawn, a mitigation/contingency plan is needed in order to prevent significant fish stranding or the loss of walleye production in those years when spawning occurs in the bypass during uncontrolled spillage.

Fish Access to the Bypass

144. Upstream access to the reach by smallmouth bass is limited by steep ledge drops at the downstream end of the bypass. Smallmouth and other fishes are expected to access the bypass from upstream via the downstream passage facility or high-flow spillage.

145. The bypass, based on the flow demonstration conducted August 27, 1992, provides good to excellent adult smallmouth bass habitat over a range of flows from 55 cfs to 350 cfs (the flow range for the demonstration). Demonstration flows of 162 cfs and above were judged excellent; 55 cfs was judged as good.[7]

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[7] Further elaboration on this is provided in the responsiveness summary.

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146. Adult salmonids can ascend the ledge drops at the downstream end of the bypass under spring flow conditions. Rainbow trout that enter the bypass in the spring are not expected to reside there through summer conditions.

147. The bypass is principally populated by invertebrates and warmwater species that access the bypass from upstream.

Macroinvertebrates

148. With sufficient flows, the bypass reach would be capable of supporting macroinvertebrates, given the suitable substrate that is identified in the applicant's substrate mapping (response to AIR 4, Figure IV-1). Besides supporting warmwater fish that reside in the bypass, macroinvertebrate production would provide downstream drift that would benefit the below-project fishery.

149. The minimum flow proposal is marginally acceptable for the support of organisms that reside in the bypass. The bypass flow proposal of 50 cfs is close to equivalent to the 55 cfs that was characterized as providing good habitat conditions for bass.

4. Impoundment

150. The lower reach of the impoundment is heavily silted, and drawdowns inhibit the establishment of aquatic plants along the shoreline. The June 26, 1991 report by Ichthyological Associates (Volume 7, Appendix C) indicates that the upper third of the seven-mile impoundment is more riverine and still supports fish species typical of lotic environments. All of the rainbow and brown trout collected in the Ichthyological Associates sampling (license application, Table E(3)-2) were from the upper portion of the impoundment. Habitat quality diminishes moving down the impoundment, as the substrate becomes dominantly sands and silts, with less cover in the form of boulders, cobbles, snags and undercut banks. The Ichthyological Associates investigators also noted that emergent vegetation exists and is available as nursery and cover at full pond.

151. Flashboard loss and the magnitude of the associated drawdown rapidly exposes a substantial amount of aquatic habitat upstream and has resulted in stranding of aquatic organisms and, depending

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on the time of year, areas that have been used for spawning. Special flow management is necessary to refit the dam with flashboards while maintaining the required downstream flows.

152. The issue of the impact of water level fluctuations in the impoundment on bass spawning is raised in the license application. The applicant stated that the population level is of adequate strength and proposed no mitigation at that time. The Department indicated that seasonal constraints may be necessary to protect bass spawning.

153. Ichthyological Associates found one smallmouth bass less than 180 mm in its June 1991 sampling. The lack of recruitment may be attributable, at least in part, to the recent repair drawdowns during the spring spawning period.

154. In terms of impoundment water level management, the applicant's proposal to install a rubber dam and operate in a range of 272 to 275 feet is a significant improvement over historical operation, provided that excursions below 272 feet are minimal. The amount of surface area dewatered is small under the applicant's proposal. In addition, the magnitude of the water level change decreases as one moves upstream from the dam vicinity.

155. The establishment of a littoral zone, which is very important to lakes and reservoirs, is less influential in the Essex No. 19 impoundment because it is more riverine in nature. However, the applicant's proposal is expected to allow for a partially functioning littoral zone with some new establishment of aquatic plants. However, the applicant's proposed drawdowns in excess of 272 feet for the purposes of annual maintenance, for emergency maintenance, and for scheduled major construction would continue to impact aquatic habitat and diminish the value of the modified storage operation. The applicant has stated that it would work with the Agency to develop a protocol for notification and scheduling of these planned drawdowns. (Reply Comments to the Comments, Recommendations, Terms and Conditions, and Prescriptions)

5. Fish Passage

156. Downstream passage facilities for landlocked salmon and steelhead rainbow trout will be necessary when the progeny of spawners,

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trucked above the project, migrate downstream. Passage facilities would include structures or devices to safely convey fish downstream of the dam. This may include screening designed to minimize entrainment and impingement and a conveyance conduit. Adequate flow to operate these facilities is also required.

157. The Agency is seeking provisions for both upstream and downstream fish passage as part of project relicensing. Construction of the Chace Mill Project is complete and the project fish trap is operational. The applicant has signed an agreement with the Chace Mill licensees for the operation and administration of the trap-and-truck program.

158. Because the Chace Mill trap is now operational; benefits are expected from the sea lamprey control program; and hatchery production of salmonids has increased, upstream transport of fish that run the Winooski River is anticipated in the fall of 1993. Anglers have been catching salmon below Winooski during the fall run in past years, suggesting that a significant number of adult fish may be transported upstream in 1993. Natural reproduction from adults would generate a smolt run in the spring of 1996. The adult fish also need passage for their return to Lake Champlain, and would not be accommodated for runs in 1993-1995. These initial runs are expected to be smaller than those in subsequent years.

159. Natural reproduction from adults would generate a smolt run in the spring of 1996. Because downstream passage facilities will not be available, the adult fish, which also require passage for their return to Lake Champlain.

160. Hatchery surplus steelhead (age 0+ parr) were stocked above Essex No. 19 in the fall of 1991. These fish are not available on a consistent basis as they are a result of excess production in the smolt rearing program. The Agency is currently considering stocking smolts above the projects instead of below as is current practice, so as to improve imprinting. Therefore, downstream passage is a present need.

161. About two percent of the project design flow (40 cfs) will be needed for operation of the downstream fish passage facility.

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6. Threatened and Endangered Species

162. The eastern pearl mussel (Margaritifera margaritifera) has been proposed for threatened status in Vermont under 10 V.S.A., Chapter 123. There are both an historic record of the species from the lower Winooski River and current records for this species from the upper Winooski. Margaritifera was not found during the 1991 mussel survey.

163. Good river water quality and the institution of a consistent flow below the project with spillage would protect the biological integrity in the lower Winooski River below the Essex No. 19 facility, including macroinvertebrates, fish, and other aquatic organisms.

164. The water use as proposed, with the conditions imposed below, will not impair the viability of the existing population of aquatic biota and fish. The use will neither significantly impair growth or reproduction nor cause an alteration of the habitat which impairs the viability of the existing population.

c. Wildlife and Wetlands

165. Vermont Water Quality Standards require the Agency Secretary to identify and protect existing uses of state waters. Existing uses to be considered include wetland habitats and wildlife that utilize the waterbody.

166. Within the project area there are approximately 27 acres of emergent wetland; 9.5 acres of scrub/shrub wetland; 49 acres of forested wetland; and 12 acres of mixed-type wetlands. The areas normally inundated are basically mud-and-sand flats, and consist of approximately 77 acres.

167. Certain wetlands were found to be dominated by reed canary grass, a plant that is tolerant of water level changes but provides less desirable wildlife habitat. If areas of reed canary grass are inundated or saturated to the surface for longer periods of the growing season, new vegetation may be established and create wetlands more conducive to wildlife habitat.

168. The wetlands at Essex No. 19 containing reed canary grass are not mono cultures, but have some other desirable species present. The

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emergent wetlands located immediately upstream of the dam were field inspected by the Department.

169. A more constant pool level that fluctuates between elevation 275 to 272 would raise the water level in the reed canary grass wetlands either through direct inundation or through an associated rise in groundwater levels behind the natural levies. As a result, a mix of plant species more desirable for wildlife habitat would be expected to become established.

170. Occasional drawdowns below elevation 275 feet are a continuing concern. Lowering of the impoundment elevation can have a detrimental effect on fish and wildlife resources associated with the impoundment or the upstream wetland, especially during critical seasons of the year, such as times of fish spawning and incubation or waterfowl nesting, and periods of hibernation of reptiles and amphibians.

171. Vermont Water Quality Standards require the Agency Secretary to identify and protect existing uses of state waters. Existing uses to be considered include wetland habitats and wildlife that utilize the waterbody. Institution of an operating mode which provides a consistent flow below the project would protect any downstream wetlands that may exist. Wildlife that use the riparian zone and river would be better supported. Typical wildlife would include furbearers such as otter, beaver, muskrat, mink, and deer and birds such as kingfisher, herons, ducks, and osprey.

172. The water use as proposed, with the conditions imposed below, will not impair the viability of the existing population of wildlife. The use will neither significantly impair growth or reproduction nor cause an alteration of the habitat which impairs the viability of the existing population.

d. Shoreline Erosion

173. In Volume 8 of the license application, a report on reservoir bank erosion investigations indicates that minor undercutting and slumping of banks were found in a few areas. These areas were generally located on the outside of bends, common areas of erosion in a typical meandering river. Some ice scarring was also noted on the lower trunk of trees. Also, shallow benches below the high water

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level were observed. These benches were attributed to water-level fluctuations and the effect of wind-induced waves lapping on the shoreline. The Cultural Resources Management Plan for Archeological and Historical Resources Impacted by the Essex No. 19 Hydroelectric Project, September 29,1992 indicates that three archaeologically sensitive areas in the impoundment are eroding. The impact on water quality from these sites is unknown.

174. The applicant used a HEC-2 backwater model in order to address project influence on erosion during flood periods. Such a model is appropriate to identify the upstream river reach influenced by the project dam; however, backwater models, in and of themselves, cannot be used to project the morphological effects of a dam.

175. The applicant presents a study of the geomorphology of the reservoir by Dr. Brakenridge. The applicant concludes from the study that the majority of shoreline erosion since 1906 is attributable to a couple of major floods.

176. In Vermont, the majority of annual channel erosion normally occurs during the extended period of bankfull flows in the spring. Extreme floods can cause rapid and dramatic changes in channel configuration; however, on an annual basis, single storm events are not normally the major causes of channel erosion.

177. The applicant's proposal to reduce the fluctuations in the impoundment level will only contribute to reducing the erosion rate through the upstream reach.

e. Recreation

178. The Winooski River provides diverse recreational opportunities and settings along the length of the river and is one of the few rivers in Vermont that provides summer-long boating opportunities. The Winooski River flows through Vermont's most heavily populated corridor (from Marshfield to Montpelier to Waterbury to Burlington).

179. The Lower Winooski River is popular for a variety of recreational uses, including fishing, swimming, sunbathing, boating, photography, viewing, nature study, hunting, hiking, walking and picnicking.

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180. The river is a navigable and boatable water of the State.

181. The Williston Gorge and surrounding riparian lands are natural areas located in a rapidly urbanizing landscape.

182. The site is located on the Winooski River on the Essex and Williston town line. It is bisected by the heavily travelled Route 2A which connects Tafts Corners and the Five Corners area of Essex Junction, two busy commercial areas.

183. Adjacent land uses on the Essex Junction side include a residential neighborhood along Route 2A, and quiet residential streets to the east and west. The access road to IBM is nearby and follows the river upstream towards the IBM plant. There is an existing village park on the downstream side of the project area. Work has started to establish a bike path through this area as part of the Chittenden County Greenway Plan. Future land uses in Essex Junction call for residential development along Route 2A with some special provisions to occupy residential structures with professional offices.

184. Vermont Water Quality Standards require the protection of existing water uses, including the use of the water for recreation. The Standards also require the management of the waters of the State to improve and protect water quality in such manner that the beneficial values and uses associated with a water's classification are attained.

185. Beneficial values and uses of Class B waters include water that exhibits good aesthetic value and swimming and recreation. Section 2-02 of the Standards prohibits regulation of river flows in a manner that would result in an undue adverse effect on any existing use, beneficial value or use.

186. Walleye anglers use the river from the Salmon Hole down to Lake Champlain. Anglers fish from Bolton Falls to IBM. Fishing for smallmouth bass occurs from the Essex No. 19 impoundment to the Lake. Seasonal fishing for salmon and steelhead occurs from the Salmon Hole to the Lake. (The Lower Winooski River Basin, An Inventory of Uses, Values, and Goals, April 1992)

187. The proposed mode of operation, with the conditions imposed below, is compatible with the recreational uses that have been identified.

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188. The applicant proposes to upgrade the existing Overlook Park facility. Specific improvements include: raising parking and picnic areas to ease the grade for parking and make the area more identifiable as a park from Route 2A; clearly defining the edge between parking and picnic areas by establishing grass in the picnic area; replacing the current roadside sign with a larger one; providing an asphalt pavement apron from Route 2A to the gravel parking area; and landscaping the picnic area to provide shade and a sense of privacy.

189. A new access path is proposed from Overlook Park down to the bypass. The path will accommodate disabled persons, meeting Challenge Level 1 as defined in the "Design Guide for Accessible Outdoor Recreation". Sanitary facilities at Overlook Park, accessible to the physically disabled, are proposed.

190. A path for canoeists to the tailrace area below the powerhouse is also proposed. If the existing primitive path is extended 200 feet farther downstream, the slope is reduced to a range of 3 percent near the parking lot to 8.3 percent at the tailrace area. This meets the Challenge Level 1 criteria and would provide access near the tailrace for recreational activity.

191. There are two formal car-top boat launching facilities located on the Winooski River immediately upstream of the project impoundment. One is the State of Vermont Agency of Transportation facility, and the second is a town owned site located in Jericho.

192. The portage from the south side of the river leaves the channel approximately 200 feet upstream of the dam. It is designated with signage and the route travels through an open field adjacent to the VELCO line past the applicant's substation and down the substation driveway to and across Route 2A at Overlook Park. From this area, the trail extends along a rocky footpath to a point downstream of the project. This portage is well marked but difficult and long. This portage will continue to be maintained, and the second portage on the north side of the river will be added.

193. The applicant proposes to make a portion of land available for a recreational trail linkage through the applicant's property from IBM to River Street. The applicant is proposing a recreation trail linkage with the planned Village of Essex Junction trail systems that would go across the applicant's property. An easement would be issued to

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the Village six months after the issuance of the license. The applicants notes the interest of the towns of Essex and Williston in similar trail development.

194. On October 7 and October 28, 1992, Mr. Ray Gonda of Northern Vermont Canoe Cruisers tested various flow releases below the project. Mr. Gonda canoed the straight section of the river behind the station powerhouse and Class II sections in the powerhouse tailwater and beyond the Muddy Brook confluence, approximately 1¼ miles downstream of the project.

    Both Class II downstream stretches were considered to be excellent for instructional purposes. At the powerhouse tailwater, Mr. Gonda described the river flow of 1,000 cfs to be extremely well suited for a beginner to practice ferry and eddy turns. Mr. Gonda believed that 1,500 cfs was the likely upper end of the ideal range for the Class II downstream sections. He assessed the useable range of instructional quality flows to be between 750 and 1,700 cfs with the optimal flows ranging from 1,000 to 1,500 cfs.

195. The downstream river island owned by the applicant would lend itself to an overnight camping area for canoeists. The applicant is not proposing any overnight canoe camping facilities; however, primitive camping would be allowed.

196. The project boundary is very limited, encompassing the project civil works, tailrace, dam, and the impoundment flowage. In order to provide a reasonable level of recreational opportunities, the boundaries should be extended.

197. In the absence of the conditions below, the proposed project would result in continued significant degradation of existing use of water for recreation in or on the water and for fishing. These uses depend on the preservation of the existing level of water quality.

f. Aesthetics

198. The primary scenic resources associated with the facility include: the river, the dam, the riverbed and wooded and open embankments, the powerhouse, Overlook Park, rocky outcroppings, and the trail system for pedestrians and recreational boating.

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199. Insuring that the river is an apparent and visible part of the landscape is critical to maintenance of the site's aesthetic qualities. Measures that reduce the level of visible water lessen the overall aesthetic quality of the area. This includes all aspects of the river--the water as it passes over the dam, the bypass channel, and the waterway below the powerhouse.

200. Past extreme impoundment drawdowns have created extensive exposed mudflats that adversely affected river aesthetics. The proposed reservoir management scheme will substantially reduce this impact.

201. The wooded embankments create a picturesque quality for the river corridor and assist in maintaining stable soils and other vegetation. The existing woods are overgrown with a mixture of moderate size deciduous trees such as: oak, birch, locust and ash, coniferous trees such as: cedars, spruce and hemlock, and numerous invasive species have crowded into the wooded fringes along the riverbanks, roadways, and powerlines. These include sumac, pin cherry, poison ivy, poplar and alder.

202. The areas of open embankments offer views across and down the river as well as provide a contrasting visual character to the dense overhanging woods.

203. The powerhouse is a substantial historic structure that is attractive architecturally and with apparent historical value. Its presence in the area is positive as an artifact and its ability to serve both a modern function as well as be a source of historical and visual interest. Its location below Route 2A makes it less apparent to the viewer and the existence of woods on the south side obscure it from being more visibly prominent.

204. Overlook Park, in its location, is an ideal recreational and aesthetic resource. Visitors are provided with separation from Route 2A and a convenient place to park, picnic, and view the area. Paths from the park provide access to the river and the bypass' spectacular rock outcroppings for viewing and exploration.

205. The laydown area at the intake is used for maintenance and storage. It is enclosed by a chain-link fence and screened from the highway by a row of cedars. The laydown area design, fencing, and screening

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prevent access to a prime vantage point for viewing the upstream river reach.

206. Provision of adequate spillage would dramatically improve the appearance of this highly visible project, including both the dam structure and Williston Gorge. The applicant's recreational study indicates that the site receives a substantial amount of public use. A constant flow release would partially restore the appearance of the river. The dam itself is a dominant part of the landscape and viewed by the many people that drive over the Route 2A bridge. Spillage would also improve the dam's appearance markedly. Installation of the rubber dam as proposed, with 50 cfs of gated discharge at the intake abutment, would dewater the dam and not enhance the gorge above present conditions.

207. Bypass aesthetics were assessed during the habitat flow demonstration on August 27, 1992. Six flows from 55 to 350 cfs were observed, from highest to lowest. The study vantage points were from Overlook Park and Route 2A. No perspectives from the bypass area proper were included. The noise and drama of moving water in the channel diminished as flows dropped below 275 cfs. Limited support of visual resources was provided by the flows less than 162 cfs (55 and 82 cfs).

VIII. Other Uses

208. Downstream, the river will be used for the generation of hydropower at the Chace Mill and Gorge No. 18 hydroelectric facilities. The proposed project, as conditioned below, is compatible with this use. This use depends on the preservation of the existing level of water quality and will not be degraded by the proposed use.

IX. Other Applicable State Laws

Vermont Endangered Species Law (Title 10, Sections 5401 to 5403)

209. The Vermont Endangered Species Law governs activities related to the protection of endangered and threatened species. Generally, a person shall not "take, possess or transport wildlife or plants that are members of an endangered or threatened species." (Title 10, Section

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5403(a)) Disturbance of a endangered or threatened species is considered a taking. (Title 10, Section 4001)

210. At Williston Gorge, the steep riverbanks are sparsely forested with young deciduous trees and a variety of plant species. Two species rare in Vermont are found in Williston Gorge: Erigeron hyssopifolius , hyssop-leaved fleabane, which grows on the Williston shore of the river, on ledges both above and below the Vermont 2A bridge over the Winooski and Podostemun ceratophyllum , riverweed, found in river shallows about 1/2 mile below the dam. A wood mint, Blephilia hirsuta , a rare species once found in the gorge is apparently extinct.

211. The applicant's consultant, William Countryman, located E. hyssopifolius and P. ceratophyllum as well as Shepherdia canadensis, buffalo berry. E. hyssopifolius was located at seven sites and buffalo berry is located at three sites on ledges below the dam. The applicant states that suitable habitat is maintained under current project operations, and reproduction appears to be sufficient to maintain the existing viable population. P. ceratophyllum was located near the mouth of Muddy Brook about 1.3 miles downstream of the Essex No. 19 Dam. The species grows submerged on rocks in rapidly flowing rivers. The applicant states the riverweed grows well under current project operations and its survival does not appear to be threatened.

212. A floodplain forest is located on an island approximately 3,500 feet downstream of the Essex No. 19 dam. The river side outcrop community in the gorge, below the Essex No. 19 dam, includes the rare hyssop-leaved fleabane and buffalo berry discussed above and once held the now extirpated Blephilia hirsuta . More common species such as the harebell and ragwort are found here.

213. The applicant does not propose any construction or operational activities at the site that would be incompatible with the protection of the habitat for the E. hyssopifolius , P. ceratophylluin and Shepherdia canadensis.

214. No species protected under the Act are know to be within the influence of the project.

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Agency Regulatory Powers over Fish and Wildlife

215. Under 10 V.S.A. Chapter 103, "[i]t is the policy of the state that the protection, propagation control, management and conservation of fish, wildlife and fur-bearing animals in this state is in the interest of the public welfare, and that safeguarding of this valuable resource for the people of the state requires constant and continual vigilance."

216. The water use as proposed, with the conditions imposed below, will be consistent with this state policy.

X. State Comprehensive River Plans

The Agency, pursuant to 10 V.S.A. Chapter 49, is mandated to create plans and policies by which Vermont's water resources are managed and uses of these resources are defined. These plans implement the Agency policy. The Agency must, under Chapter 49 and general principles of administrative law, act, when possible, consistently with these plans and policies.

Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities

217. The Department's publication Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities is a state comprehensive river plan. The hydropower study, which was initiated in 1982, indicated that hydroelectric development has a tremendous impact on Vermont streams. Artificial regulation of natural stream flows and the lack of adequate minimum flows at the sites were found to have reduced to a large extent the success of the state's initiatives to restore the beneficial values and uses for which the affected waters are managed.

    Two specific recommendations of the plan are that minimum flow requirements be established at this project in order to improve the downstream fishery, water quality, and aesthetics, and that impoundment water levels be stabilized to protect upstream fisheries resources.

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Lower Winooski River Basin Plan

218. The Department recently completed a comprehensive river planning process for the Lower Winooski River Basin. The management goals and recommendations contained in the Comprehensive River Plan for the Lower Winooski River Basin are derived from state law, written state policies, the Alternative Future Scenario Project, the Lake Champlain Citizens Advisory Committee's Action Plan, the applicant Corporation's license application and the public interest as determined through a three-year public participation project. Basin citizens who participated in the planning process, expressed as major issues of concern the restoration of the river's water quality, improvement of the fishery, protection of the river's natural, cultural and scenic resources, continuation of the river's commercial uses and enhancement of recreational opportunities.[8]

219. Anglers participating in the comprehensive rivers planning process expressed an interest in natural fish production. According to anglers using the project area, the fishery is impacted by low and unstable flows. The fishery is of fair to moderate quality and has room for improvement. Lake sturgeon, a state endangered fish, may have used the river historically for spawning and incubation. The Department of Fish and Wildlife has contracted with the Vermont Cooperative Fish and Wildlife Research Unit to conduct a lake sturgeon restoration feasibility study for Lake Champlain and its tributaries, including the Winooski River.

1988 Vermont Recreation Plan

220. The 1988 Vermont Recreation Plan, another comprehensive river plan, recommends actions for Vermont rivers and streams including: local public involvement; basin planning and river workshops with an emphasis on citizen monitoring; inventory of major river access points and ownership status; riparian landowner surveys to pinpoint problems; and assessment of river-use conflicts. The plan recommends a continuation of acquiring rights of way to public lands and waters that are blocked from reasonable public access; consideration of the development of alternative strategies for river easement acquisition, including landowner incentives such as current

[8]The responsiveness summary contains further discussion of the Plan and the Alternatives Future Project specifically.

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use tax reduction; and studies to determine the feasibility of utilizing fishing access areas for other appropriate water recreation activities and for increasing recreational access. The plan promotes formal agreements between recreation groups, outfitters, and landowners to ease conflicts in areas and during certain high use periods as well as rivers and streams information and education programs. Enhanced access and the provision of a portage would be compatible with this plan.

221. The Recreation Plan, through extensive public involvement, identified water resources and access as top priority issues. The planning process disclosed that, while Vermonters and visitors focus much of their recreational activities on surface waters, growing loss of public visual and recreational access to those waters causes substantial concern to the users. The plan projects that access is "likely to become the cri.ical river recreational issue of the 1990s." The need for development of portage trails and canoe access sites is cited as among the major issues relative to canoe trails in Vermont.

222. The Water Resources and Access Policy is:

> It is the policy of the State of Vermont to protect the quality of the rivers, streams, lakes, and ponds with scenic, recreational, and natural values and to increase efforts and programs that strive to balance competing uses. It is also the policy of the State of Vermont to provide improved public access through the acquisition and development of sites that meet the needs for a variety of water-based recreational opportunities.

223. Enhancement of access, provision of a portage, and improved flow management would be compatible with this policy and balance competing uses of the river for recreation and hydropower. Restriction of access or failure to provide a convenient portage trail would exacerbate a critical state recreational problem.

224. Another priority issue identified in the Recreation Plan is the loss or mismanagement of scenic resources. The plan notes "[few] recreational activities in Vermont would be the same without the visual resources of the landscape," and that protection of those resources is "necessary if the state is to remain a desirable place to live, work, and visit."

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225. The Scenic Resources Protection and Enhancement Policy is:

> It is the policy of the State of Vermont to initiate and support programs that identify, enhance, plan for, and protect the scenic character and charm of Vermont.

226. Landscaping, provision of dam spillage, and maintenance of bypass and downstream flows will protect the scenic characteristics of the shoreline area and river.

Vermont Comprehensive Energy Plan

227. Pursuant to Executive Order No. 79 (1989), the Department of Public Service produced the Vermont Comprehensive Energy Plan, January 1991. This plan sets out an integrated strategy for controlling energy use and developing sources of energy. Several goals of the plan are to reduce global warming gases and acid rain precursors by 15% by the year 2000 through modified energy usage; to reduce by 20% by the year 2000 the per capita consumption of energy generated using non-renewable energy sources; and to maintain the affordability of energy. Continued availability of electricity generated by this renewable source, with proper environmental constraints in place, is consistent with the State energy plan.

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ACTION OF THE DEPARTMENT

Based on its review of the applicant's proposal and the above findings, the Department concludes that there is reasonable assurance that operation and maintenance of the Essex No. 19 Hydroelectric Project as proposed by the applicant and in accordance with the following conditions will not cause a violation of Vermont Water Quality Standards and will be in compliance with sections 301, 302, 303, 306, and 307 of the Federal Clean Water Act, P.L. 92-500, as amended, and other appropriate requirements of state law:

A. The applicant shall operate and maintain this project as set forth in the findings of fact and conclusions above and these conditions.

B. The project shall be operated in accordance with the minimum-flow schedule tabulated below. Minimum flows shall be released on a continuous basis and not interrupted.

Period	Minimum Flow (cfs)	
	Bypass	Below Project
April 1 - May 15	50	r-o-r
May 16 - June 15	50	1,000
June 16 - March 31	50	500

Note: Minimum flows are values listed, or instantaneous inflow if less.

The run-of-the-river condition noted shall be outflow equal to inflow on an instantaneous basis. Within 90 days of the issuance of this certification, a description, hydraulic design calculations, and plans for the measure to be used to release the bypass flow shall be filed with the Department for its review and approval. No construction shall commence until Department approval is received.

The project shall be managed such that no lag times occur that would result in a minimum flow violation. The method for controlling lag time shall be filed with the Department within 90 days of the issuance of this certification.

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C. Whenever the project is not operating, all flows shall be uniformly spilled over the dam crest, except for those flows necessary to seasonally operate the fish passage facility.

D. The minimum flow requirement of 1,000 cfs from June 1 to June 15 may be discontinued and a minimum flow requirement of 500 cfs instituted upon a determination by the Department, after consultation with the Department of Fish and Wildlife, that sturgeon runs in the Winooski River no longer occur and that the flow release is not needed to support the remnant population and that the higher flow is not needed for the planned restoration program. The Department may, after suspension of sturgeon spawning flows, re-institute the requirement at any time it determines such action is warranted for support of lake sturgeon.

E. Peaking on any calendar day shall not result in differences between the high and low artificial flows, as measured directly below the project, greater than those tabulated below:

Period	Low Flow for Calendar Day (cfs)	Maximum Allowed Fluctuation in Flow (cfs)
April 1- May 15		None (r-o-r)
May 16 - June 15	<1,000	None (r-o-r)
	≥1,000	No limit
June 16 - September 30	<500	None (r-o-r)
	≥500	500
October 1 - March 31	<500	None (r-o-r)
	≥500	No limit

F. The applicant shall develop and file with the Department, on or before October 1, 1994, a ramping plan for controlling the rate of transition between generation and ponding flows.

G. Within six months of a written request by the Department, the applicant shall develop and file with the Department a contingency plan for prevention of walleye mortality in the bypass during the spring spawning run, under events where project operation results in diminished flows in areas used by the walleye for spawning. Such a

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request will only be made if the Agency has determined that walleye attempt to use the bypass for spawning.

H. The impoundment shall not be drawn below elevation 272.0 feet without prior written approval by the Department.

I. The applicant shall file for review and approval, within 90 days of the issuance of this certification, a plan for monitoring instantaneous flow releases at the project, both downstream and in the bypass. Following approval of the monitoring plan, the applicant shall then measure instantaneous flows and provide records of discharges at the project on a regular basis as per specifications of the Department. Upon receiving a written request from the applicant, the Department may waive, all or in part, this requirement for flow monitoring at this project provided the applicant satisfactorily demonstrates that the required flow will be discharged at all times.

J. The applicant shall provide the Department with a copy of the turbine rating curves, accurately depicting the flow/production relationship, for the record within one year of the issuance of this certification.

K. The applicant shall submit a plan for downstream fish passage to the Department of Fish and Wildlife for review. Downstream passage shall be provided 24 hours per day, April 1 - June 15 and September 15 - December 15 and shall be functional at all operating impoundment levels, with the period subject to adjustment based on knowledge gained about migration periods for migratory salmonids. Downstream fish passage facilities shall be installed so as to be operational in the spring of 1996. This plan shall include provisions to:

1. minimize passage of fish into the generating unit(s) if injury or morality can result;

2. minimize impingement of fish on devices or structures used to prevent entrainment; and

3. convey fish safely and effectively downstream of the facility.

L. Within 90 days of the issuance of this certification, the applicant shall submit a plan for proper disposal of debris associated with

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project operation, including trashrack debris, for written approval by the Department.

M. Any proposals for project maintenance or repair work involving the river, including desilting of the dam impoundment, impoundment drawdowns to facilitate repair/maintenance work, and tailrace dredging, shall be filed with the Department for prior review and approval.

N. The applicant shall provide a canoe portage on the right (north) side of the impoundment and river at Essex No. 19 Dam by May 1, 1995. The applicant shall also provide a cartop boat put-in area to the impoundment. The applicant shall consult with the Recreation Section of the Department of Forests, Parks and Recreation, the Department of Environmental Conservation, and the Towns of Essex and Williston in the planning, siting, and design of the portage and boat put-in. Design and maintenance plans shall be filed with the Department of Environmental Conservation and the Department of Forests, Parks and Recreation for review and approval before construction of either facility.

O. The applicant shall allow public access to the project area for utilization of public resources, subject to reasonable safety and liability limitations. Such access should be prominently and permanently posted so that its availability is made known to the public. Any proposed limitations of access to State waters to be imposed by the applicant shall first be subject to written approval by the Department. In cases where an immediate threat to public safety exists, access may be restricted without prior approval; notification of the Department and a request for approval, if the restriction is to be permanent or long term, shall be provided within 14 days of the restriction of access.

P. The applicant shall install and have operational by May 1, 1994 a telephone flow notification system that informs callers as to approximate volumes of water being released or spilled at the dam.

Q. The applicant shall allow the Department to inspect the project area at any time to monitor compliance with certification conditions.

R. A copy of this certification shall be prominently posted within the facility.

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S. Any change to the project that would have a significant or material effect on the findings, conclusions, or conditions of this certification, including project operation, must be submitted to the Department for prior review and written approval.

T. The Department may request, at any time, that FERC reopen the license to consider modifications to the license necessary to assure compliance with Vermont Water Quality Standards.

Chuck Clarke
Secretary
Agency of Natural Resources

Dated at Waterbury, Vermont
this 8th day of November, 1993

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Essex No. 19 Hydroelectric Project
Water Quality Certification
Public Responsiveness Summary

The Department of Environmental Conservation conducted a public hearing on October 7, 1993 at the Essex Junction Village offices on Lincoln Street in Essex Junction for the purpose of receiving oral testimony or written statements and data bearing on the issuance of a water quality certification to Green Mountain Power Corporation (GMP or the applicant) for the continued operation of the Essex No. 19 Hydroelectric Project located on the Winooski River in the towns of Williston and Essex. In addition to the hearing, written comments were accepted through the end of business day on October 15, 1993.

A total of twelve persons, representing themselves or organizations, presented oral testimony at the hearing. Written testimony was received from twelve persons and organizations.

Following is a summary response to the comments received; many of the comments are paraphrased. The commenters are cited in parentheses following the paraphrased comment. The full text of these comments is available for inspection or copying at the Department's office of the Water Quality Division. The Department of Fish and Wildlife assisted in this response through a memorandum dated November 3, 1993.

1. WATER QUALITY STANDARDS

a. Hydroelectric generation as an existing use

Comment: The Vermont Natural Resources Council (VNRC) comments that Essex No. 19 should not be considered an existing use qualified for protection in accordance with Section 1-03(B) of the anti-degradation provisions of the Standards. VNRC argues that Essex No. 19 is not a commercial activity that depends directly on the preservation of an existing level of water quality (reference Section 1-03(B)(1)(d)).

Comment: The applicant believes that the project, as well as downstream hydroelectric facilities, should be provided with the special protection afforded existing uses under Section 1-03(B).

☛ Response: The Department must consider whether or not the activity proposed for certification, which is Essex No. 19 in this case, would degrade any existing uses, whether or not those uses are designated uses. Candidate existing uses include commercial activities that depend directly on the preservation of an existing level of water quality (Section 1-03(B)(1)). The Department does not believe that the Board intended that hydropower projects, which generally tend to degrade water quality, merit protection as existing uses.

The Standards specifically requires that determinations of what constitutes an existing use shall be made by the Secretary on a case-by-case basis. The operation of hydropower projects, which generally tend to degrade water quality behind the dam, in the bypass, and downstream of the project, is not dependent on, and is unaffected by the river's level of water quality.

Use of the water body to receive or transport discharges of waste is explicitly not considered to be an existing use for the purposes of the anti-degradation policy. (Standards, Section 1-03(B)(1)(d)) Similarly, the Standards are not intended to consider hydropower facilities as an existing use.

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Even were hydroelectric facilities to qualify as existing uses, state statute (10 V.S.A. § 1250) and the Standards (Section 1-03(A)) provide statements indicating that Vermont clearly intends to preferentially restore, protect and maintain beneficial uses and values in a manner consistent with the classification of the water:

> The Secretary shall manage the waters of the State in accordance with the Water Quality Standards to protect, maintain, and improve water quality in such a manner that the beneficial values and uses associated with their classification are attained. All waters, except mixing zones, shall be managed so that, at a minimum, a level of water quality compatible with all beneficial values and uses associated with the assigned classification are obtained and maintained. (Standards, Section 1-03(A))

b. The Public Trust Doctrine

Comment: The applicant states that it has been made clear that the spillage for aesthetics is not in the best interests of the public trust.

Comment: A determination that the Essex No. 19 project is an existing use under the relevant sections of the anti-degradation standards could be violative of the public trust doctrine. (VNRC)

☛ Response: The river is a public trust resource of the state. Issues related to the appropriateness of the Department's proposed decision in the context of the public trust doctrine are beyond the scope of this responsiveness summary.

c. Water Chemistry

Comment: Table 3 of the draft certification shows that the proposed operating mode provides more than sufficient dissolved oxygen levels to meet standards without the special spillage requirement contained in Condition A of the draft certification.

Vermont's water quality standards list the highest year round dissolved oxygen criteria as being for salmonid spawning and nursery areas in cold water streams. Although neither of these descriptions apply to the Lower Winooski River, the dissolved oxygen concentrations and saturation levels at Essex and Gorge plants are at or above the 7 mg/l (milligram per liter) or 75% saturation criteria for coldwater salmonid spawning and nursery areas under both the applicant and the Agency's proposals. Under both proposals, the optimum dissolved oxygen concentrations for the dominant game species, smallmouth bass, are greater than or equal to 6.0 mg/l. The literature indicates that 7-day mean minimum dissolved oxygen concentrations as low as 5.0 mg/l result in slight to no production impairment for fish such as rainbow trout and smallmouth bass.

Based on the literature and the fact that the dissolved oxygen concentrations calculated by the Agency are based on river flows, river temperatures, and wastewater treatment plant loadings that rarely, if ever occur, it can be concluded that both proposals allow for the Class B value of "high quality habitat for aquatic biota, fish and wildlife" to be achieved based on dissolved oxygen concentrations. (GMP)

☛ Response: The Essex No. 19 dam is at the upper end of a water quality limited segment of the Winooski River, a segment that terminates at the river's mouth. Under design wastewater loadings and critical flow, temperature, and algal respiration conditions, the river reaches critical dissolved oxygen levels near the mouth. However, even though the reach from Essex No. 19 to Gorge No. 18 dams does not approach minimum standards for dissolved oxygen (5 mg/l and 60% saturation), the river's aquatic community is benefitted

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physiologically (reduced stress, improved growth rates, etc.) by the additional dissolved oxygen entrained through dam spillage. It is clear from Table 3 that significant increases in dissolved oxygen concentrations occur when the station is off line during low flow periods. This is a characteristic of the applicant's project as proposed for relicensing--full spillage at any time the inflow is less than 270 cfs. The value to stream community of spilling a portion of the flow when inflow exceeds 270 cfs may not be significant, and no documentation, such as research findings, has been provided to support a conclusion that continuation of spillage of more than 50 cfs when flows exceed 270 cfs is merited. The certification has been revised to reflect this.

Comment: Hydroelectric facilities should not be asked to pass flows to improve dissolved oxygen and subsidize wastewater treatment plant operations.

☛ Response: Both wastewater treatment plants and hydroelectric facilities detrimentally affect the concentration of dissolved oxygen in the river and both must ameliorate their impacts on the river.

d. General

Comment: The use of the river which has been granted to the applicant is conditioned upon fulfilling obligations to the people of Vermont, among them maintaining adequate water quality and aesthetics. (Krassner)

☛ Response: The Department agrees that compliance with standards and compatibility with designated and existing uses must be demonstrated for certification.

2. DOWNSTREAM FLOWS

a. Fisheries management

Comment: Both the applicant's 340 cfs and the Agency's 500 cfs proposal for rainbow trout are enhancements to a new recreational use. While recreation is a designated use, a rainbow trout fishery would be a new and experimental recreation use that would have a detrimental impact on an existing hydropower use. (GMP)

Comment: The differences in minimum flow proposals should be viewed in the context that rainbow trout are currently not actively managed for in this reach; future rainbow trout management will be somewhat experimental; the expected temperature regime will be less than optimum for rainbow trout; and there is no significant rainbow spawning habitat in this reach.

Comment: Creation of a spring put-and-take fishery for rainbow trout should be considered in place of attempting to support a put-grow-and-take fishery.

Comment: How much is actually known about temperature refuge availability in the affected reach? (GMP)

☛ Response: Outside of Lake Champlain, the northwestern quarter of the state offers fewer stream trout fishing opportunities than much of the rest of the state. A put-and-take fishery would not provide the same level of quality recreation as a put-grow-and-take fishery. The Winooski River is large, fertile and capable of growing large trout. There is a high demand for large trout and for trout that are either wild or have been in the stream long enough take on some of the attributes of wild fish. Put-grow-and-take management would provide these additional benefits.

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Trout are currently stocked above the Essex No. 19 impoundment, and some of the stocked fish survive over the summer and the winter. GMP has indicated that there is no difference in temperatures up and downstream of the project. If that is the case, it can be concluded that the rainbow trout management plan has every likelihood of success. Furthermore, anglers have reported catching large rainbow trout in the reach below the Essex No. 19 dam. Rainbow trout apparently already reside in this reach without the benefit of a stocking program.

Although the water temperature regime is not ideal for trout, less-than-optimum temperature conditions are the case for most of Vermont's trout streams. This does not preclude trout survival or management. No record of locations of thermal refugia within the reach has been provided to the Department.

Comment: A minimum flow of 340 cfs provides in excess of 88% of the maximum habitat possible for all life stages of smallmouth bass and fallfish except for juvenile fallfish. The minimum flow of 340 cfs provides 75% of the maximum habitat for juvenile fallfish. Habitat values of this magnitude constitute high quality habitat. (GMP)

☛ Response: A minimum flow of 340 cfs does not provide high quality habitat for the aquatic species the river is being managed to support. Based on the IFIM results, a minimum flow of 500 cfs, coupled with peaking constraints, is considerably better for macroinvertebrates and bass fry (a detailed discussion follows). It also provides better habitat for the juvenile and adult stages of fallfish and smallmouth bass.

Comment: Rainbow trout and smallmouth bass are not indigenous to the project area.

☛ Response: The project area is within the range of the smallmouth bass, and there is no reason to believe it is not indigenous. Historically, salmonids such as brook trout and Atlantic salmon probably occupied the area; although rainbow trout are not indigenous, the Standards do not discriminate between indigenous species and introduced species.

Comment: There is uncertainty about what level of macroinvertebrate production is needed to support the optimum level of fish production. One school of thought is that if a minimum flow is established to take care of fish populations, macroinvertebrates will be taken care of. (GMP)

☛ Response: Macroinvertebrates are an important part of the food chain; however, under the Standards, macroinvertebrates are protected under their own right, not just for their value as fish food. The flow management restrictions contained in the draft certification provide better habitat conditions for the aquatic community as a whole.

Comment: The Department should be required to reassess the sturgeon restoration program every two years. This review should include a formal finding by the Department as to the viability of the restoration program. (GMP)

☛ Response: Fish culture efforts with lake sturgeon in the midwest indicate that it is a viable program. After one season of growth, sturgeon reach sufficient size to limit predation, resulting in very high survival. The primary goal of a restoration effort would be to re-establish a self-sustaining population. Since females do not mature until about age 25, this effort is a long-term one. The draft of the report, Lake Champlain Lake Sturgeon Restoration Study, includes recommendations that call for assessments every 10 years. A biannual assessment would be inconsistent with the time frame and nature of this program.

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b. Peak flow control

Comment: VNRC recommends a maximum generation flow of 1000 cfs from June 16 to September 30 unless exceeded by inflow. Even this peaking flow, it is argued, will adversely affect immobile species and life stages of certain biota, such as macroinvertebrates and smallmouth bass black fry.

Comment: The studies and resulting data for macroinvertebrate habitat clearly demonstrate that there is no need for a year-round flow constraints. The macroinvertebrate habitat at the design flow of 2000 cfs is equivalent to 85% or greater of the maximum habitat available for all macroinvertebrates and greater than 95% for many. For the majority of macroinvertebrates analyzed, the suitable habitat available for low flows is in the same stream location for a flow of 2000 cfs. Provision for 85% of the maximum habitat meets the Class B designated use of high quality habitat. (GMP)

☛ Response: The bulk of scientific literature indicates that peaking is problematic. A review article by Cushman[1] describes effects that have been documented, including changes in species composition, reduced diversity, abundance, and growth, increased drift in response to peak flows, and reduced river productivity. Additional references are listed. Bovee[2] stressed the importance of not overlooking effects of fluctuating flows on a river's food base and used a dual flow analysis to address the issue at a specific project.

Hydropower projects vary considerably in terms of the difference in magnitude between the minimum and generation flows, the frequency and duration of the store-and-release cycle, and the nature of the affected river channel configuration and biotic community. As a result, site-specific information must be brought to bear in an impact analysis.

Department of Environmental Conservation Population Study

The Department sampled invertebrate populations in the vicinity of the IFIM study Reach #1 during the summers of 1986, 1987 and 1991. Only channel areas that were wetted on a continual basis were sampled. Other similar surveys have shown that streambed areas that are dewatered on a frequent basis (such as on a daily basis, as is typical of this project's operation) are drastically affected and cannot be considered to contribute to macroinvertebrate productivity. The surveys of the continually wetted channel showed a reasonable assemblage of invertebrates. Ephemeroptera, Plecoptera, and Tricoptera species (mayflies, stone flies, and caddis flies) dominated over chironomids (midges). While some species were less abundant than might be expected (such as the swimmer type of macroinvertebrate), the sampling did not indicate that a major problem existed.

IFIM Wetted Area Analysis

The IFIM study provided data on the total wetted area that exists at various flows. In reach #1, total area is reduced by about 11% when flows are reduced from the maximum on-peak release (2000 cfs) to the minimum flow proposed by GMP. The increase in minimum flows to 500 cfs, with peaking controls during the summer, reduces this change in wetted area. With an adequate minimum flow, the potential impact on macroinvertebrate results more from changes in habitat quality than from dewatering.

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[1]Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management 5:330-339.

[2]Bovee, K.D. 1985. Evaluation of the effects of hydropeaking on aquatic macroinvertebrates using PHABSIM. Pages 236-241 in Proceedings of the Symposium on Small Hydropower and Fisheries, Aurora, Colorado.

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IFIM Steady State Analysis

The applicant has criticized the Agency's use of binary habitat suitability criteria to assess impacts on macroinvertebrates. As referenced in the draft certification, GMP had recently developed habitat/flow curves for six specific macroinvertebrate genera using habitat suitability criteria from a Niagara Mohawk study. Results relative to the minimum flow issue are summarized below. (Habitat quantities have been estimated from the GMP graphs.)

Target Organism	Maximum Weighted Useable Area (s.f./1000 ft.)	Weighted Useable Area as a % of Maximum	
		340 cfs	500 cfs
Acroneuria	105,000	63	78
Cheumatopsyche	137,000	66	80
Baetis	96,000	70	83
Stenonema	134,000	71	85

These data show that 19% to 24% more habitat is available at 500 cfs than at 340 cfs.

IFIM Dual Flow Analysis

Subsequent to the public notice on the draft certification, Fish and Wildlife conducted a dual flow analysis using the Niagara Mohawk criteria for *Acroneuria* (stone fly), which was selected as a relatively sensitive organism, as opposed to the caddis genera which tend to be more tolerant of stressful conditions; however, the habitat/flow relationship is similar for all seven target organisms. It can be concluded from this new analysis that the use of binary criteria overstated the loss of habitat due to peaking effects. However, the case remains that much less effective habitat exists with a minimum flow of 340 cfs as opposed to 500 cfs, regardless of the generation flow. The results are provided in the following table. The habitat loss is the percentage habitat is reduced by hydro peaking from what would have been available under natural flows.

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Percent Habitat Loss for *Acroneuria* due to Peaking

Natural Flow (cfs)	Habitat Quantity (sf/1000 ft)	Peaking Condition (cfs)	Habitat Loss (%)	Peaking Condition (cfs)	Habitat Loss (%)
500	79,700	340 to 1000	30	Not allowed	0
		340 to 1500	40	Not allowed	0
		340 to 2000	47	Not allowed	0
800	93,600	340 to 1000	41	500 to 1000	22
		340 to 1500	49	500 to 1500	32
		340 to 2000	55	500 to 2000	39
1200	100,300	340 to 1500	52	500 to 1500	36
		340 to 2000	58	500 to 2000	43
1500	101,600	340 to 2000	58	500 to 2000	44

The *Acroneuria* analysis indicates that peaking has a substantial effect on habitat as measured for Reach #1 and that raising the minimum flow and limiting the total fluctuation (minimum to peak) significantly reduces the impact. For example, under a natural flow regime of 800 cfs, 93,600 square feet of habitat per 1000 feet of stream length is available. Cycling as proposed by GMP would result in an effective habitat quantity of 42,500 square feet per 1000 feet, or a loss of more than half of the habitat. Raising the minimum flow to 500 cfs and limiting the fluctuation to 500 cfs retains 72,800 square feet of habitat per 1000 feet, reducing the loss to 22% (as opposed to 55%).

Although total habitat as measured in weighted useable area units (IFIM based) is substantially reduced by peaking, the population work done by the Department suggests that the actual impacts are not as severe. This is probably in large part due to the fact that locational shifting of habitat is limited; in the model, individual cell quality changes, but the cells remain useable, and the insects are not forced to move (if physically possible) to find suitable habitat. Aquatic organisms have some level of tolerance for changing flow conditions that the IFIM-based analysis does not reflect. However, it is likely that macroinvertebrate productivity would improve under a more controlled flow regime, and such controls are also necessary for fish protection. More effective habitat is provided with a minimum flow of 500 cfs and a fluctuation limit of 500 cfs, than is available at a minimum flow of 340 cfs, without peaking.

Comment: Habitat for black fry and young-of-the-year life stages of smallmouth bass are maximized at a flow of 150 cfs. In order to achieve 80 percent of the maximum of this habitat, flows would have to be less then 700 cfs. Irrespective of peaking operations, flows greater than 700 cfs are exceeded a high percentage of the time during the month of June when smallmouth black fry would be in the stream. The draft certification states that smallmouth bass are abundant in this section of this stream. One would therefore conclude that under existing flow conditions, the black fry are thriving. Perhaps a criteria not tied to the percentages of maximum habitat should be utilized for these lifestages. (GMP)

It needs to be decided if there are sufficient smallmouth bass nursery areas in other parts of the affected segment that were studied within the IFIM study to provide high quality aquatic habitat. Apparent habitat constraints

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for smallmouth bass black fry and young of the year need to be reconciled with Finding 80, which states that smallmouth bass are abundant. (GMP)

☛ Response: Relative to Finding 80 of the draft certification, the Department of Fish and Wildlife conducted electrofishing at the upstream end of the Gorge No. 18 impoundment for the purpose of removing the bass for stocking elsewhere. Bass were subjectively characterized as abundant in this area. Age and growth information was not obtained. No population data was collected upstream of the Gorge No. 18 impoundment where the greatest habitat impacts from peaking and minimum flows occur.

The IFIM study results show that the quantity of bass fry habitat is limited. GMP has offered two possible explanations to reconcile this fact with the field observation that adult bass are abundant. First, GMP suggests that suitable nursery habitat may exist in the river segment outside of the IFIM study reach. Neither of the IFIM study reaches was specifically selected to represent nursery habitat for bass. It is likely that the effects of peaking are less pronounced in the Gorge No. 18 impoundment and that this area provides better habitat for the immobile life stages of bass. Bass produced in this area may seasonally migrate upstream as far as the Essex No. 19 powerhouse.

Secondly, GMP states that flows during the June black fry period commonly exceed conditions which provide good nursery conditions. Although generally true, high flows become less frequent later in the month. Also, the June flow regime varies considerably from year to year, such that fry production could be high in some years but low in others. As the model results suggest, high flow events may be problematic for bass fry and young of the year. Years where natural flow conditions are conducive to high fry production are not by themselves sufficient to produce adult bass, since the young-of-year fish[3] must be protected from harmful flow fluctuations.

Orth and Maughan[4] found that the standing stock of juvenile and adult smallmouth bass was not correlated with weighted useable area in Glover Creek, Oklahoma. They felt that these fish were limited in abundance by factors other than useable habitat. Concerning juvenile fish, they agreed with the suggestion of other researchers that flooding during or after the spawning period may be the dominant factor influencing survival of eggs and fry for Glover Creek. Regarding the adult fish, they suggested several possibilities:

1. that this flooding limited the production such that the useable habitat for adults was not limiting;

2. that their definition of usable habitat is inaccurate (suitability criteria do not match actual habitat use); and

3. that sport harvest may have kept the adults below carrying capacity.

The authors also indicate that the validity of the IFIM model for the spawning and early life stages of bass has not been established, indicating that there are many factors of influence. Indeed, the smallmouth bass "bluebook"[5] contains numerous qualifiers on the use of its habitat suitability curves.

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[3]By definition, newly born fish are considered to be fry during the month of June and then are young of the year until their first birthday. The concern over peaking is with the fish while they are still small–throughout their first growing season.

[4]Orth, D.J. and O.E. Maughan. 1982. Evaluation of the incremental methodology for recommending instream flows for fishes. Transactions of the American Fisheries Society 111:413-445.

[5]Edwards, E.A., G. Gebhart, and O.E. Maughan. 1983. Habitat suitability information: smallmouth bass. U.S.D.I., Fish and Wildlife Service FWS/OBS-82/10.36. 47pp.

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The study by Orth and Maughan, that of Bain et al.[6], and the IFIM results for this project all suggest that the juvenile life stages of smallmouth bass are likely to be more susceptible to impacts of the project's operation than the adult life stage. Since fishing pressure in the reach is low, the population observed is relatively unexploited. The adults present likely represent a variety of age classes. The abundance of this population may not be able to stand up to increased angling pressure, given the fact that production of young fish is probably limiting. Abundance of adult fish is not necessarily indicative of good production of young fish, but may be indicative of an unexploited population of adult fish that has built up over time from even poor juvenile production. The amount of production needed to sustain a good population of adults is not known.

The concern over spring high water is largely a factor outside of the influence of project operation. We do not believe it precludes bass production. There is a need to protect the early life stages. The peaking at issue is for the non-spring period which does not begin until June 16; the peaking influence on the fry stage would therefore be for June 16-30, at which time the life stage changes to young of year by definition. Protection of bass throughout their first growing season is a concern; the juvenile fish are small, and their swimming ability is less than that of larger fish.

A study on the Huron River in Michigan showed that the population of adult bass was significantly related to the amount of habitat available for young-of-the-year bass (Bovee, personal communication with Roderick Wentworth). Bovee also found that bass become relatively dormant over the winter, and that it is more important to provide a minimum flow that maintains winter habitat (including undercut banks) than to limit high flows. Providing a more stable flow regime during the first summer of life is the primary concern.

Available scientific literature and the site-specific IFIM results indicate that the peaking operation exerts a negative influence on young bass. While the exact magnitude of this influence is uncertain, the IFIM results for bass suggest that the impact on fry is severe. The results of the dual flow analysis are tabulated below.

Percent Habitat Loss for Black Fry due to Peaking

Natural Flow (cfs)	Habitat Quantity (sf/1000 ft)	Peaking Condition (cfs)	Habitat Loss (%)	Peaking Condition (cfs)	Habitat Loss (%)
500	24,900	340 to 1000	63	Not allowed	0
		340 to 1500	84	Not allowed	0
		340 to 2000	92	Not allowed	0
800	21,300	340 to 1000	56	500 to 1000	40
		340 to 1500	81	500 to 1500	70
		340 to 2000	91	500 to 2000	83
1200	14,570	340 to 1500	72	500 to 1500	56
		340 to 2000	87	500 to 2000	75
1500	9,950	340 to 2000	81	500 to 2000	63

[6]Bain, M.B., J.T. Finn and H.E. Booke. 1988. Streamflow regulation and fish community structure. Ecology 69:382-392.

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As with macroinvertebrates, raising the minimum flow and limiting the total fluctuation significantly reduces the impact. For example, under a natural flow regime of 800 cfs, 21,300 square feet of habitat per 1000 feet of stream length is available. Cycling as proposed by GMP would result in an effective habitat quantity of 1860 square feet per 1000 feet, or a habitat loss of 91%. Raising the minimum flow to 500 cfs and limiting the fluctuation to 500 cfs retains 12,670 square feet of habitat per 1000 feet, reducing the loss to 40%.

Comment: Since the purpose in setting a continuous minimum flow is to set some flow at which the plant will generate during non-peak demand periods and since under most flow and demand conditions, hydroelectric plants experience these demands for at least one hour each day, Condition D essentially renders the Essex No. 19 plant useless as a peaking facility and relegates it to a run-of-the-river operation. Condition D coupled with Condition A would be near impossible for a plant operator to implement. Condition D makes operation of Gorge No. 18 and the Winooski One developments run-of-the river. (GMP) This will resnlt in the loss of 18.5 megawatts of peak hydroelectric capacity that would be replaced with fossil fuel generation. (Winooski One Partnership)

☛ Response: Use of a less-than-or-equal-to symbol in the table contained in draft Condition D (ref. the fourth and sixth line under the heading, second column) resulted in an assumption on GMP's part that the station would have to be operated run-of-the-river. If the station were operated at 500 cfs on any given day, it would not be permitted to peak. Of course, if GMP chose to release 501 cfs during the off-peak period, it would be able to operate out of storage in a peaking mode. The symbol has been corrected (changed to a less than symbol) to reflect the actual intent of the Department to allow peaking with a minimum release of 500 cfs for the season and periods shown. GMP has purposely chosen to read something into this that was clearly never intended.

c. Run-of-river operations

Comment: Run-of-river operations should be considered to realize benefits to the aquatic community and habitat. (Trout Unlimited)

☛ Response: The Department has concluded that operation in a peaking mode, with certain constraints, meets standards; however, this is not meant to infer that further improvement of water quality and river uses and values cannot be realized were a true run-of-the-river mode of operation instituted.

d. Ramping

Comment: The applicant requests that it be given one year to develop a ramping schedule to allow for any delays caused by weather.

☛ Response: In order to allow a summer season for completion of any necessary field work, the deadline is being extended to October 1, 1994, or about 10 months from certification issuance.

e. Boating and fishing

Comment: Flows of 500 to 1000 cfs are needed for the average canoeist in the downstream reach for reasonable navigability or boating. (Gonda)

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Comment: Flows from 350 cfs at the low end and from 1250 to 1750 at the high end would be the range for fishing from a canoe. (Gonda)

Comment: The useable range of flows for white water canoeing and kayaking is between 350 cfs and 1750 cfs with the optimal range from 1250 to 1500 cfs. (Gonda)

Comment: For canoeists who prefer "downriver running," flow in the range or 1500 to 1750 cfs would be needed. (Gonda)

☛ Response: These ranges of flows will be provided at different times under the requirements of the certification.

3. BYPASS FLOWS:

a. Aesthetics

Comment: Optimal flow over the dam for aesthetic purposes is in the range of 275 to 350 cfs. A bypass flow of 167 cfs should be considered a minimum value to mitigate the aesthetic impacts of the dam. (VNRC)

Comment: Water over the dam for aesthetics seems to create an artificial waterfall. In the operation of any dam anywhere in the country, in low flow periods, you normally are using the dams to impound water, not as an artificial waterfall. (Gerecke) The dam is not a scenic area. (Vile)

Comment: The dam is a rather ugly structure but it is quite interesting and attractive when water is flowing over it. At certain times of the year when there is real excessive water it draws crowds of people to watch it. (Krassner)

Comment: As for the aesthetic spillage, the applicant maintains that there is no viable method for accomplishing this goal while still maintaining a peaking facility. More over, the local interest, mainly the 21,000 people who live in Williston, Essex Junction, and Essex have voiced their opposition to an aesthetic flow through the representation of their elected officials. Not one individual or group participating in the Comprehensive Rivers Plan process cited this as a concern.

☛ Response: The bypass consists of two features for which appropriateness of minimum flows for aesthetics have been evaluated and considered--the dam and the natural gorge. The site is identified in the Village of Essex Junction Comprehensive Plan (March 1991) as one of three sites with outstanding view sheds. The dam is the major landscape feature that dominates the upstream view from Vermont 2A. The project as proposed will eliminate spillage caused by flashboard leakage; spillage will only occur when the station is off line during low flow periods and when inflow exceeds station capacity plus the 50 cfs gate discharge.

Williston Gorge will contain a continuous flow of 50 cfs or more when spillage occurs.

During the aesthetic flow evaluation (August 1992), observation flows less than 162 cfs (55 and 82 cfs) were generally rated as poor or fair.

Increased flows in the bypass for aesthetics has received very little public support and is no longer being required through this certification. It will be given further consideration in the FERC licensing process.

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b. Fisheries in the bypass

Comment: The Agency's draft certification does not provide adequate consideration of the existing use of fishing in the bypass and protection of that existing use. (VNRC)

☛ Response: Evidence regarding the current use of the bypass for fishing is very limited. Anecdotal reports suggest fishing is limited. This may be due to the lack of fish resident in the bypass, a condition that appears to be primarily due to conditions unrelated to project operation.

Comment: Trout Unlimited's recommendations to FERC are met by a flow of 50 cfs in the bypass.

Comment: The draft certification does not adequately quantify existing biota and aquatic habitat in the bypass. It fails to consider anything other than a life cycle of one game species of fish. The analysis is incomplete. The bypass flow requirements should be set at a value which will provide for habitat for rainbow trout adults, smallmouth bass and macroinvertebrates in addition to aesthetic and dissolved oxygen concerns. (VNRC)

Comment: VNRC maintains that additional questions need to be answered before minimum bypass flows can be set. At what flows will adult rainbow trout be able to enter the bypass from downstream? What flows are optimal for such passage? What flows would be optimal for rainbow trout in the bypass reach? How will various salmon and steelhead life stages be affected by the bypass flows? Without answering these questions, VNRC argues, the draft certification is arbitrary and contrary to the water Standards and Clean Water Act. Based on the information available at this time, VNRC recommends a bypass flow of at least 167 cfs around the clock and throughout the year.

☛ Response: The results of the demonstration flow assessment of habitat for adult smallmouth bass are shown below.

Grading of bypass habitat for smallmouth bass adults.

Flow (cfs)	Site 3	Site 11	Site 12	Composite	Score
350	E	G	F	G	3.0
275	E	F	G-F		2.8
216	E	P	G-F	G-F	2.5
162	E	P	G		2.7
82	G	P	E-G	G-F	2.5
55	G	P	G		2.3

The rating scale was Excellent, Good, Fair, and Poor. This scale was assumed to be an interval scale of measurement, meaning that the differences between each rating are quantitatively equal. As a result, it is possible to assign each rating a numerical value, so that the three sites can be averaged to produce a composite rating. Each site is weighted equally. The composite reflects the overall change in habitat conditions. The scores shown assume E=4, G=3, F=2, P=1 and that an intermediate rating has an intermediate score (G-F=2.5).

The composite habitat ratings vary from Good to slightly below Good-Fair. Overall, a bypass minimum flow of 50 cfs provides habitat conditions for adult smallmouth bass rated as slightly below "good-to-fair." Of the three

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sites assessed as part of the flow demonstration study, two were rated as "good" and one as "poor" at 55 cfs. Overall, the assessment indicates that the highest flows observed provided ouly slightly better habitat than that available at 55 cfs.

Fish are not expected to be abundant in the bypass. Ledge drops at the downstream end of the bypass are likely to prevent the upstream movement of fish into the bypass, except for those with strong leaping ability. Specifically, bass are not expected to be able to move up from downstream. Some bass may occur in the bypass as a result of downstream movement, but such movement is expected to be minimal. Rainbow trout stocked below the bypass can probably ascend the ledge falls under high to moderate flow conditions to access the bypass. During the spring, bypass spillage of high to moderate flows occurs.

Under the range of flows assessed, the bypass does not provide much suitable habitat for trout; it is better suited for bass due primarily to the low velocities. Providing high quality habitat conditions for rainbow trout in the bypass would require flows in excess of 350 cfs. Extension of rainbow trout management into the bypass reach cannot be justified based on the fishery potential and generation cost.

The value of the habitat for macroinvertebrates is expected to be low due to substrate type.

Comment: The Department should not require a contingency plan for prevention of walleye mortality in the bypass since there is no evidence that walleye are spawning in the bypass during the spring. The applicant is not aware of even one complaint or observation that the walleye mortality has resulted from the flows diverted from the bypass. (GMP)

☛ Response: Walleye may spawn in the left bypass channel unobserved. Subsequent dewatering of eggs would not be noticed without a purposeful investigation. The condition, however, has been modified to require Agency confirmation of spawning use before development of a contingency plan is necessary.

4. FISH PASSAGE:

Comment: Downstream fish passage facilities should be installed at Gorge No. 18 and Essex No. 19 by spring of 1995 to accommodate the anticipated smolt run of landlocked Atlantic salmon. (TU)

☛ Response: The first run of age 2 salmon smolts will occur in the spring of 1996. The Agency has requested that downstream fish passage be operational at that time.

Comment: Post-licensing studies on the success of downstream fish passage facilities should be required and operational and structural changes made if necessary. (TU)

☛ Response: The U.S. Fish and Wildlife Service has requested fish passage monitoring in its comments to FERC. In order to assure that any facilities installed are effective and efficient, the related certification condition has been modified to require such information and structural changes, if necessary.

Comment: Consider other approaches to fish passage in addition to trap and truck such as a fish ladder for long term effectiveness.(VNRC)

☛ Response: Due to the large number of dams on the Winooski River, providing upstream fish passage at each one (such as via a fish ladder) would be much more costly than the trap-and-truck alternative. A trap-and-truck facility has already been installed at the Chace Mill Project and will serve all basin dams. Ladders will only be considered if the trap-and-truck facility is found to be ineffective.

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5. IMPOUNDMENT FLUCTUATIONS

Comment: Elimination of pond level fluctuations would be beneficial to fisheries habitat, littoral zone spawners, and other aquatic organisms. (TU)

☛ Response: Minimizing the impoundment level fluctuation to three feet will reduce many of the detrimental affects of a wider fluctuation. The establishment of a littoral zone, which is very important to lakes and reservoirs, is less influential in the Essex No. 19 impoundment because it is more riverine in nature. The applicant's proposal for a three foot fluctuation is expected to allow for a partially functioning littoral zone with new establishment of aquatic plants and subsequent habitat improvement for fisheries, spawners and aquatic habitat. Curtailment of pond- level management would result the conversion of the project to run-of-the-river and the loss of enhanced peak-power production.

Comment: GMP comments that it will, whenever practical, provide prior notice to the Agency of scheduled drawdowns below elevation 272 feet. When this is not practical, GMP shall provide the Agency with notice as soon as practical but in no event later than two business days after such occurrence explaining the circumstances that caused such an occurrence. GMP states that exceptions must be written into the certification to allow for emergency maintenance and emergency system voltage support.

☛ Response: Intermittent drawdowns below elevation 272 feet would cause the types of environmental damage that the proposed project modifications are intended to prevent. Therefore, such drawdowns must be evaluated case specifically. GMP has not explained the types of emergencies that would necessitate intentional drawdowns greater than three feet and the associated magnitudes of the drawdowns.

6. RECREATION

Comment: A canoe portage should be provided on the North (Essex Junction) side of the river. This is the best, safest and shortest route and can provide for equipment security. (Gonda)

☛ Response: The applicant has proposed such a portage, and the portage is required under Condition M of the certification.

Comment: A double lock gate should be provided at the entrance to the power house to allow for unloading boats and equipment at the river's edge and parking behind the power house. (Gonda)

☛ Response: The Agency will be working further with the applicant on the details of the project recreation plan as part of the FERC process and general common interest in enhancing recreational use.

Comment: Investigate how a portage around the Gorge No. 18 facility can be provided. (Gonda)

☛ Response: The applicant is working with the Winooski Valley Park District to site and develop a portage route around Gorge No. 18 separate from this relicensing proceeding.

Comment: When releasing higher flows from Essex No. 19, keep the Gorge No. 18 pond lower to provide boater access to braided and meandering stretches of the river above the Gorge dam. (Gonda)

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☛ Response: The Department is not placing operational restrictions on Gorge No. 18 as part of the Essex No. 19 relicensing, as No. 18 is not part of the federal license under review. However, the Agency has been working cooperatively on modifications at No. 18 for improvements to flow management and recreation throughout the relicensing process.

Comment: There is no support or request by interest groups or others for a cartop boat put-in area in the impoundment. The Essex No. 19 project clearly has no impact on boat access in the impoundment. (GMP)

☛ Response: The project backwater is bounded by fourteen miles of shoreline. FERC AIR No. 17 involved the identification of access points to the impoundment. Only two informal access points within the project boundaries were identified. It is reasonable to expect GMP to provide formal access to the impoundment for car-top boats in order to support boating use.

Comment: In emergency situations, it may be appropriate to immediately limit public access in order to assure the public safety. At a minimum appropriate exceptions should be allowed to access provisions. (GMP)

☛ Response: In the event of a true emergency and clear and immediate danger, the Department would certainly not object to limiting access, but would expect the applicant to obtain concurrence from the Department after the fact.

Comment: A formal flow notification system is unwarranted and would merely impose unnecessary costs on the applicant. (GMP)

☛ Response: The project site is ideally located on the most urbanized part of Vermont and would be likely to receive more use by whitewater paddlers if a convenient method of finding out what the flows at the site were at any given time. This method has been used very successfully at other projects in Vermont and the Northeast.

Comment: Williston staff have come up with some proposed changes and modifications to the park on the south side of the river in Williston. (Gerecke)

☛ Response: The applicant is responsible for the development of a final recreation plan and the coordination of parties of interest, including the Agency. The Agency is interested in any ideas for changes to the recreation design for Overlook Park.

Comment: Higher flows during the day, during peaking, are good for the canoeists. (Marcotte of Essex)

☛ Response: A flow regime consistent with the certification conditions will offer many opportunities for canoeists, while limiting conflicts with fish and other resource values.

7. ECONOMICS

Comment: VNRC comments that the Department does not have the authority nor the expertise nor the information to consider economics (costs and benefits) in the issuance of the certification. VNRC further comments that the only possible consideration of economics under the Standards is in Section 1-03(C), Protection of High Quality Waters. This section provides that high quality waters may be reduced to a limited extent based upon a finding of substantial and widespread adverse economic or social consequences to the people of the state specifically resulting from the maintenance of the higher water quality.

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Comment: The applicant argues that if enhancements are contemplated that will impact or change existing use, the impact on hydropower must be considered. If the Standards allow high quality waters to be degraded for economic or social reasons then the Secretary could limit the enhancements to water quality proposed for a water quality limited section of the river for economic and social reasons. Economics is to be considered particularly if the use is an existing use. Economic and social impacts are the direct fallout of conditions that are to be placed in the certification.

☛ Response: The Department will manage the waters to allow beneficial and environmentally sound development (see Standards, Section 1-02), as long as no undue adverse effects to any beneficial value or use result. In certifying individual projects or activities, the Department considers both the relevant standards and the social and economic implications of its decision.

Comment: Economic impacts and the air emissions that will result from the burning of replacement fuels are of "Social Significance" in paragraph (d). (GMP)

Comment: The applicant believes that a better balancing can be done than appears in the draft certification. The applicant is of the opinion that if no balancing is allowed under the certification rules then no discharge, dam flow alteration or other actions requiring a permit for impacts to the river could be allowed since every change to the river will have some impact on the river. Balancing is the ouly way to protect all of the uses

Comment: The Agency has done an incomplete analysis of economic impacts. Consideration of the environmental cost of replacement power is inappropriate in the context of the certification process. There has been no analysis of the economic benefits of improvement of water quality to a level beyond which has been suggested by either by the applicant or the Agency. Those opportunity costs can be valued and have not been valued nor considered. (VNRC)

Comment: There were comments that flows should not be passed over the dam to improve aesthetic conditions because it would increase electric rates. On the other hand, there were also comments that the cost of passing flow over the dam for aesthetics and for other reasons (fisheries, dissolved oxygen, aquatic biota) is negligible, and persons so commenting were willing to bear the small rate increase. There also were comments that the rate increases would adversely affect business competitiveness, jobs, and commercial development in the area.

Comment: The applicant believes that the cost of flow related enhancements as proposed by the applicant is $552,000 per year. The cost of flow regime enhancements proposed by the Agency is $1,202,000 per year and result in air emissions that are more than double the applicant's proposal.

☛ Response: No analysis of the economic benefits of improving water quality to a level beyond that proposed by GMP or the Department has been attempted. No evidence has been introduced evaluating what those economic benefits or opportunity costs might be.

The Department had carefully estimated the costs associated with the changes proposed in the draft certification and had concluded that the small additional cost of power would not appreciably increase rates. No evidence was presented concerning how business competitiveness would be hurt or how jobs would be lost. There was no evidence presented that the conditions of the draft certification would result in substantial and widespread adverse economic or social impacts on the people of the state specifically resulting from maintaining the higher water quality in the area of this project.

Following is a more detailed response, which presents information, estimates and discusses the complexities of cost:

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Many comments received at the public hearing concerned the cost to the ratepayer to replace the power lost due to the release of minimum flows. Although there was a comment that there should be no flow restrictions at all, most of those who commented agreed that improved downstream minimum flows are necessary to maintain a healthy fishery and are acceptable. The concern was mainly the increased costs to the ratepayer from lost power generation due to the spillage requirement.

Both the Agency and GMP provided the interested public with estimates of the cost to the ratepayer due to minimum flow requirements proposed by GMP and those proposed in the draft certification by the Agency. The estimated rate increases, which include modifications at both Essex No. 19 and Gorge No. 18, are 0.4% (preliminary Agency analysis) and 1.1% (GMP analysis).

Both of these estimates are high for different reasons. The Agency estimate was high because the value of replacement power (to replace production lost due to minimum flow requirements) used to estimate the rate increase was high. The Agency used the value set forth by GMP which was based on older replacement power costs. Use of more recent replacement power costs would lower the estimates by at least 40% according to the Public Service Department. This results in an estimated cost or increase in rates of 0.24%.

The GMP estimate was found to be very high for two main reasons:

1. Use of an outdated estimate of replacement power cost as explained above; and

2. Use of a baseline condition of the project as licensed with no minimum flow constraints (the pre-1987 operating condition, prior to its current voluntary operating mode); the cost of the voluntary operation minimum flows is probably reflected in the present rate.

The Public Service Department indicates that the environmental costs of replacement power (air emissions) will, in the future, accrue to ratepayers as the Public Service Department and the Public Service Board, by policy and regulations, force utilities to consider the environmental costs of replacement power in the decision as to which replacement power source is acceptable. Replacement power sources with high environmental costs (although low in price) will not be acceptable and therefore the more expensive, less environmentally damaging power will be chosen. Thus, electric rates will increase somewhat to reflect this policy and decision.

On the other hand, Public Service Department and the Public Service Board will need to balance its policy on replacement power with a policy on the environmental costs, including decreases in aquatic habitat quality, stress on aquatic organisms, and reduced recreational opportunities. It is the Department's conclusion that the environmental costs of replacement power and the environmental costs of hydroelectric generation tend to balance out. It will be necessary to review each situation to see what the best balance is in order to minimize the total overall environmental costs.

GMP, in its presentation to the public, indicated that the increase in rate due to minimum flow requirements at Essex No. 19 was only the first of eight increases in rates, one each at all eight GMP hydroelectric facilities. GMP simply multiplied their estimate of the Essex No. 19 increase of 1.1% by eight to represent the total potential increase in rates attributable to environmental mitigation at the level desired by the Department. This is a substantial misrepresentation for the following reasons:

1. Included in the Essex No. 19 rate-increase estimates is a portion of the costs of implementing minimum flows at the Gorge No. 18 facility;

2. Several facilities are run-of-the-river or recently licensed with minimum flow requirements, and no substantial additional costs are expected (Middlesex, West Danville and Bolton Falls, or DeForge Station); and

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3. GMP did not prorate the cost of minimum flow requirement based on power output of any of the other facilities. Essex No. 19 and Gorge No. 18 account for about 39% of the power produced by GMP hydro facilities and expected losses at any of the other facilities would be much less.

If these factors are taken into account, the total potential increase in rates for the eight facilities would be 1.64 times instead of 8 times the rate increase associated with the changes at Essex No. 19 and Gorge No. 18. The estimated rate increase for mitigation at all projects would be 0.4%, based on the Department's analysis.

Based on the best information and estimates of replacement power (from Public Service Department) and using the GMP estimates power lost in meeting the minimum flow requirements proposed in the draft certification, the total increased cost to the average residential ratepayer would have been 23 cents per month. Of this cost, 7 cents per month is the cost of GMP-proposed mitigation, and 16 cents per month was the additional cost due to the draft-certification requirements. Most of this 16 cent increase was for mitigation of aquatic-biota impacts, and only a small portion, about one cent per month, was for the provision of an aesthetic spill over the dam crest.

In summary, the Agency has concluded that the additional cost from present operation of Essex No. 19 (and including Gorge No. 18) to comply with the draft certification conditions would have been the equivalent of a 0.24% rate increase for all residential, commercial, and industrial users. For the average residential ratepayer, this equals 23 cents per month.

8. OTHER

Comment: VNRC believes that significant benefits could be obtained from the long term protection of project lands associated with Essex No. 19 and other GMP lands which are located in the Winooski River Basin.

☛ Response: The disposition of lands outside the project boundaries is not within the purview of water quality certification review.

Comment: VNRC considers that Gorge No. 18 should be considered in concert with the certification of Essex No. 19 since the two dams are significantly inter-related.

☛ Response: The application before the Department is only for the Essex No. 19 Project. The Gorge No. 18 Project is an unlicensed facility presently not subject to Federal jurisdiction.

Comment: The applicant should not be responsible for debris which floats over the dam or for natural debris such as wood and leaves which exists naturally in the river and does not harm the biotic environment.

☛ Response: The applicant has a responsibility under the Standards, as well as state solid waste and anti-litter laws, to properly dispose of any material that it removes from the river.

Comment: Inspections by the Department of the facility will be subject to compliance with all GMP as well as State and Federal safety requirements while on the applicant's property. (GMP)

☛ Response: The Department expects that it will have free access to any of the project areas where general public access is not restricted. If there are special areas where there are access limitations or special safety protocols, then GMP should so inform the Department.

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Comment: The Agency should acknowledge that the applicant's application for a water quality certification has been supplemented with a copy of Green Mountain Power's Reply Comments to the Comments, Recommendations, Terms and Conditions, and Prescriptions (August 20, 1993). (GMP)

☛ Response: The document is part of record in this decision.

9. APPLICANT'S SPECIFIC COMMENTS ON FINDINGS

The applicant commented individually on many of the specific findings. Following are responses for those comments that have not already received an adequate response above. The comments are direct quotes.

Comment on Finding 6: In addition to GMP, many small power producers and municipal utilities own hydroelectric projects in the Winooski River Basin.

☛ Response: Washington Electric Co-operative and several small power producers own hydroelectric projects in the basin. No municipalities own projects to the Department's knowledge.

Comment on Finding 17: The 20% probability of flashboard failure with the rubber dam in place was associated with an earlier GMP proposal that would have retained the 84' curved tip section of flashboards. GMP's current proposal is to place a rubber dam along the entire spillway length.

☛ Response: The applicant has not indicated what the reduced frequency of failure is for a rubber dam that covers the entire crest. The finding has been changed to clarify this.

Comment on Finding 25: It should be clear that the on-peak periods referred to in FERC AIR No 18, page 23, refer to periods when the power is valued as on-peak power and not hours of typical generation.

☛ Response: The Department recognizes that the actual number of hours of on-peak generation vary within the hours stated in the finding. GPM provided very little information on operating characteristics.

Comment on Finding 26: The July 27 to August 27, 1975 hydrograph is a snapshot in time. The VANR is cautioned against characterizing this as typical operation. Generating hours depend on a number of factors including streamflow, energy demand, and maintenance.

☛ Response: In the absence of the data for the hours and discharges for typical generation, the Agency used the available data to interpret typical generation patterns. The Agency has also examined data from 1992, which was found to be similar to the 1975 data, except for the higher minimum flow release.

Comment on Finding 28: Another important reason for drawdowns greater than 5 feet could potentially be the need for voltage support for the local distribution network in the event of a generation/transmission system emergency.

☛ Response: This finding only listed the reasons for past drawdowns in excess of five feet. No information has been filed relative to if and when the impoundment has been drawn for voltage support.

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Comment on Finding 31: In addition to GMP's Gorge No. 18, the Winooski One Project is also operated in tandem with Essex No. 19. Although Winooski One is a run-of-river plant, it receives the benefits of peak power production due to the operation of Essex 19.

☛ Response: The finding has been changed to reflect this.

Comment on Finding 33: It should be acknowledged that since 1987 it has been GMP's practice to monitor inflows during low flow periods and to maintain the impoundment near the top of the flashboards during such periods to minimize the chance of occurrence of such lag time events.

☛ Response: This is noted. It will be necessary to develop a specific proposal for maintenance of minimum flow standards at all times, and the proposal will have to compensate for lag time.

Comment on Finding 40: GMP's verbal proposal of April 9, 1993 was part of an overall attempt to settle the issues over which GMP and VANR disagree. It has meaning only in that context, was not an official proposal for the record, and should not be cited in the 401. While not terribly important when taken alone, due to the fact that GMP made an official proposal in August 1993 (as cited), VANR is reminded that GMP attempts at settlement are not official proposals unless some agreement can be reached between GMP and VANR on an overall enhancement proposal.

☛ Response: The reference to the April 9, 1993 offer has been deleted from the certification.

Comments on Findings 43-47, 48, 49: Perhaps the most important information realized and presented in the June 1993 report and ironically, not stated in the Department's findings, is the fact that after GMP's review of ALL the possible alternatives for providing a uniform spillway veil flow, NONE of them would work without compromising worker safety, system operation and maintenance, hydraulic or structural changes to the dam, or cost of installing, operating and maintaining the system. In addition, they would compromise the stability of the impoundment level and its value to the aquatic biota.

Difficulties resulting from any of the design considerations listed above will render a veil flow system useless. This is why no such system can be found at any peaking hydroelectric facility in this country or elsewhere for that matter. It is essential the record reflects these important facts and should be modified as such.

Additionally, a point discharge system would be easily accessible and consequently, easier to conform to all of OSHA's mandated safety procedures. Inlet screens or trashrack bars which are susceptible to clogging, would not be necessary with a point discharge system.

Attached are two memorandums relative to several discussions concerning the proposed rubber flashboard system that GMP believes should be included in the final 401 under this finding. (Attachments 2 and 3)

It is particularly interesting to note that in the VANR's previous findings of assessing the various veil flow alternatives analyzed by GMP, the VANR accepts each conclusion and subsequent rejection of each alternative as it related to system operational difficulties, excessive maintenance or construction feasibility problems but not as it related cost. Considering the strong public opposition to any type of aesthetic spillage requirement expressed at the public hearing by the Towns of Williston and Essex, the Village of Essex Junction and the Essex Conservation Commission, issuing a final 401 as currently written would not be in the best interests of the Public Trust.

☛ Response: The Department believes that the technology exists to provide the spillage over the rubber dam. This option has been further discussed with the manufacturer, Bridgestone. The draft certification did not require spillage under winter conditions, where the greatest uncertainty existed, as noted in the GMP

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memorandum cited. The Department understands the concern to be more with respect to the risk potential for untried technology. Unless spillage is required by FERC, the issue is now moot as the spillage requirement is no longer in the certification.

The Department understands the positions of the municipalities to be better expressed as not supporting a spillage requirement because of the effect that decision may have on rates. Without the rate implications, we have every reason to believe that the municipalities would support spillage.

Comment on Finding 61: Since the term "mixing zone" has been replaced by the term "waste management zone" and since the entire Lower Winooski River has been classified as a waste management zone does this criteria even apply?

☛ Response: Mixing zones still exist. Mixing zone allow for temporary relief from standards within the plume from a wastewater discharge. Waste management zones replace Class C waters. The finding is correct.

Comment on Finding 66: Which facilities provide advanced wastewater treatment and for what water quality parameters do they provide this treatment? (i.e., what are the NPDES permit requirements?)

☛ Response: All wastewater treatment facilities on the Lower Winooski River are advanced treatment facilities. They all remove phosphorus and have specific limits on BOD and TKN effluent concentrations.

Comment on Finding 71: Attachment 1 is an annotated version of Table 3 that GMP would like included in the final 401. These annotations list percent saturation and identify the VANR proposal as listed in the draft conditions.

☛ Response: Percent saturation values have been added.

Comment on Finding 73: This paragraph is difficult to follow and unclear. It is assumed that the numbers are taken from Table 3 under the total flow rate of 386 cfs. Terms such as "reduction in the dissolved oxygen deficit" are hard to understand. Perhaps the actual dissolved oxygen concentration and/or percent saturations should be used. It should also be pointed out that dissolved oxygen concentrations for all of the proposals listed in Table 3 are generally considered excellent water quality.

☛ Response: The finding is technically correct. The numbers are derived through interpolation in Table 3.

Comment on Finding 74: VANR's point that "Depending on the design the aeration may be even less efficient than has occurred under present conditions of flashboard leakage" is well taken but out of place. The single source outlet has not been designed yet. It is quite possible that it could be designed to provide aeration at the same level as the flashboard leakage.

☛ Response: This is possible; however, it is noted that the same device may be designed for fish passage, which may reduce its reaeration potential.

Comment on Finding 145: What is the basis for VANR's population assessment of the bypass?

☛ Response: Profession judgement of Agency biologists. GMP has not furnished population data.

Comment on Finding 205: It should be clarified that the reason there were no perspectives from the bypass area of spillage over the dam is that the vast majority of people who would view spillage would be on Route 2A.

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☛ Response: The applicant is proposing to improve access to the Gorge, which will increase the existing use of people walking down into the Gorge and below the level of Vermont 2A to view the bypass. Therefore, it is reasonable to mention that this perspective was not evaluated in the aesthetics study.

Comment on Finding 216: It should also be pointed out that citizens who participated in the Lower Winooski Comprehensive River Planning process expressed a desire to retain peak power production in the basin and endorsed the theme of use with stewardship of the basin's waters.

☛ Response: The majority of citizens who participated in the comprehensive planning process did not specifically express an opinion on river use by hydroelectric projects. There was general agreement that hydro projects should continue to operate, but only if water quality and fisheries were not adversely impacted.

From the Alternative Futures Project, a scenario of river use with stewardship was preferred by participants, but it was noted that "these uses [including power production] defer to the primary role of the watercourses, namely, the support of native plants and animals." (Lower Winooski River Basin Alternative Futures Project, Project Summary, March 1991, Vision Statement, Lower Winooski River Basin, 2010) Most participants favored maintenance of minimum flows for fisheries support (70%) and high levels of access with education to encourage responsible use (55%). No participants favored the element of Scenario #1 (Full Corridor Development) that prioritized flow management for peak power and snowmaking.

10. APPLICANT'S SPECIFIC COMMENTS ON CONDITIONS

The applicant commented individually on most of the individual conditions. Following are responses for those comments that have not already received an adequate response above. The comments that follow are not direct quotes.

Comment: The applicant states that none of the conditions included in the draft certification are appropriate under the Clean Water Act nor necessary to assure that there is no impact to the water quality.

☛ Response: This is a matter under litigation in Vermont and nationally, and beyond the scope of this responsiveness summary.

Comment on Conditions H: Plans for monitoring instantaneous flow releases at the project should be made less onerous. Rating curves should be used to demonstrate compliance with downstream flows. The applicant would like to provide a hydrologic calculation to serve as a means of assuring bypass minimum flows.

☛ Response: The condition does not preclude the use of the rating curves; however, use of the downstream U.S. Geological Survey gage will also be considered. The condition is not onerous.

Comment on Condition M: No condition for portage is needed as the applicant has already committed to building the portage on the Essex side of the river.

☛ Response: As it is already proposed, no hardship is created, and there should be no objection.

Comments on Conditions R and S: The Department cannot predetermine that any possible change in operation will constitute a material impact on water quality. Prior review and written approval should only be required for significant changes that will impact water quality and notice regarding changes resulting from emergency conditions should be made within two business days of such emergency.

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