# State of Vermont

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**Department of Environmental Conservation**
**WATER QUALITY DIVISION**
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**Waterbury, VT 05671-0408**

**802-241-3770**


January 30, 1995

Mark E. Slade
Senior Attorney
New England Power Service Company
25 Research Drive
Westborough, MA 01582-0099

RE: Deerfield River Hydroelectric Project
FERC Project No. 2323

Dear Mr. Slade:

Enclosed please find the water quality certification for the Deerfield River Hydroelectric Project, issued pursuant to Section 401 of the Federal Clean Water Act. The final certification includes the responsiveness summary for the formal comments filed when the certification was on public notice. 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.

We appreciate New England Power's cooperation in the processing of this certification.

Sincerely,

Jeffrey R. Cueto

Jeffrey R. Cueto
Principal Hydrologist

encl.
cc: distribution list

STATE OF VERMONT

WATER QUALITY CERTIFICATION

DEERFIELD RIVER HYDROELECTRIC PROJECT

John Ragonese
NEPCo

Vermont Agency of Natural Resources
Department of Environmental Conservation
Division of Water Quality
January 30, 1995

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

In the matter of: New England Power Company
25 Research Drive
Westborough, Massachusetts 01582

APPLICATION FOR DEERFIELD RIVER HYDROELECTRIC PROJECT

The Water Quality Division of the Vermont Department of Environmental Conservation (the Department) has reviewed a water quality certification application filed by New England Power Company (the applicant) for the Deerfield River Hydroelectric Project. The application was originally filed in December 1991; the application was subsequently withdrawn and refiled in October 1992, June 1993, and January 1994. The application was reviewed under the Vermont Water Quality Standards adopted by the Water Resources Board on April 17, 1991, in accordance with Section 1-01(A) *Applicability*, of the present Standards (July 1994). The application includes the applicant's Federal Energy Regulatory Commission (FERC) license application, filed with FERC under a cover letter dated December 27, 1991; an October 5, 1992 certification application; and subsequent submittals from the applicant, including October 1993 and January 1994 FERC Additional Information Request (AIR) responses.

The Department held a public hearing on October 17, 1994 under the rules governing certification and received testimony during the hearing and, as written filings, until November 4, 1994. Attached as Appendix B is a copy of the Department's responsiveness summary.

For the purposes of certification, the applicant proposed a project as modified by the provisions of a draft settlement agreement that had been developed with several conservation and sports groups, referred to as NGOs, or non-governmental organizations, and resource agencies, including the Massachusetts Department of Environmental Management, the Massachusetts Department of Environmental Protection, the Massachusetts Division of Fisheries and Wildlife, the U.S. Fish and Wildlife Service, and the U.S. National Park Service. The proposal was outlined in a document entitled Proposed Settlement Agreement

Overview - Deerfield River Hydroelectric Project, August 17, 1994, hereinafter referred to as the "draft settlement agreement".[1]

The Department, based on the application and record before it, makes the following findings and conclusions:

**I. Background/General Setting**

1. The applicant has applied to FERC for relicensure of the Deerfield River Hydroelectric Project (FERC No. 2323) located on the Deerfield River in south-central Vermont and northwestern Massachusetts. The applicant has owned and operated the project since 1912. The project was first licensed in 1963, and that license expired on December 31, 1993. FERC issued a Notice of Authorization for Continued Project Operation on January 21, 1994. The applicant is requesting a license term of 40 years.

2. The upper Deerfield River watershed in Vermont is a drainage system having an area of approximately 223 square miles and involving nine distinct towns within two counties. Large tributaries to the upper Deerfield River include the East, West and North branches. The Deerfield River watershed, with its abundance of surface water resources and forested terrain, is one of southern Vermont's greatest natural assets.

3. The Deerfield River originates in southern Vermont, with the headwaters located in the town of Stratton, flows southerly into the Commonwealth of Massachusetts, and empties into the Connecticut River in Greenfield, Massachusetts. With a total length of 72 miles and a watershed area of 655 square miles, the river is the second largest tributary of the Connecticut River. Including the headwaters of the North River and the Green River, almost half (307 square miles) of the watershed is in Vermont.

4. In Vermont, the Deerfield River and the East Branch are controlled by three project dams, which create three reservoirs totalling approximately 3,750 acres in surface area. A fourth dam, on the

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[1] The settlement agreement was finalized October 5, 1994, after the draft of this certification had been placed on public notice. Revisions were made to the draft settlement agreement to conform in most respects to the conditions of the draft certification. This certification is based on the Agency's review of the draft settlement agreement.

Deerfield River mainstem in Rowe and Monroe, Massachusetts, creates Sherman Reservoir. That dam is about 0.6 miles south of the state border. Approximately two thirds of the 218 acre reservoir is Vermont waters.

5. Below Sherman Dam, hydroelectric facilities included in the project are Deerfield No. 5 (dam at River Mile 41.2 (RM 41.2)), Deerfield No. 4 (dam at RM 20.0), Deerfield No. 3 (dam at RM 17.0), and Deerfield No. 2 (dam at RM 13.2). The Bear Swamp Project, under a separate license (FERC License No. 2669), is operated by the applicant and includes a mainstem dam at RM 36.8 (Fife Brook Dam) and a pumped storage facility know as Bear Swamp. Northeast Utilities operates a mainstem hydroelectric dam at Gardiner Falls, RM 15.7, under FERC License No. 2334.

6. The Deerfield River mainstem above the Searsburg impoundment is unregulated and undeveloped. The river is bordered predominantly by forest land owned either by the applicant or by the U.S. Forest Service. The Deerfield River below Searsburg Dam to its mouth can best be characterized as a working river, with about two-thirds of the river's fall harnessed for power production.

7. The West Branch of the Deerfield River, with its headwaters in the town of Woodford, Vermont, flows southeasterly and joins the Deerfield River in the village of Readsboro, Vermont. Streamflow on the West Branch is unregulated.

8. The North Branch of the Deerfield River, with its headwaters in the town of Dover, Vermont, flows in a southerly direction into the northeastern arm of Harriman Reservoir in the village of Wilmington, Vermont. The flow of the North Branch is partially regulated by winter water withdrawals used for snowmaking at the Haystack and Mt. Snow ski areas.

## II. Project and Civil Works

9. The project includes a total of eight separate facilities. Of the eight facilities, three facilities (Somerset Dam, Searsburg Dam and power appurtenances, and Harriman Dam and power appurtenances) are located wholly within Vermont and one facility, Sherman Dam, has a reservoir that straddles the state line.

**Somerset Dam - East Branch of the Deerfield River**

10. Somerset Dam, constructed in 1920, is located on the East Branch of the Deerfield River 5.6 miles above the confluence with the mainstem.

11. The dam is an earth-fill structure approximately 110 feet high by 2,101 feet long with a side-channel emergency spillway 800 feet long by 45 feet wide and 6 to 30 feet deep located at the west end of the dam. The crest elevation is 2133.58 feet msl. The reservoir is oriented north-south, with the dam at the southerly end. The crest can be fitted with three-foot-high flashboards.

12. A concrete outlet tunnel conduit 425 feet long and 12 feet in diameter houses two 48-inch steel pipes that convey water from the reservoir spillway tower to the East Branch. Water is admitted to the tower through the crest, which is at elevation 2100.58 feet msl or, for draining, through two four-foot square gates in the base of the structure. Hand-operated 48-inch gate valves control the pipe inlets (centerline at 2051.85 feet msl); motorized 42-inch gate valves control the outlets (centerline at 2050.18 feet msl). The gate house at the outlet also houses a 6-inch diameter gate valve (centerline at 2055.88 feet msl), which presumably controls the discharge from a pipe tapped into one of the 48-inch pipes ahead of the outlet valve.

13. When full (elevation 2134 feet msl), Somerset Reservoir has a surface area of 1,623 acres, making the reservoir the fifth largest body of water wholly within the state; at its maximum normal water level of 2131 feet msl, the surface area is 1,570 acres. It is 5.6 miles long and as much as 1.1 miles across, with a maximum depth of 90 feet. The maximum useable storage volume (spillway crest to the low-level outlet) is about 57,345 acre-feet; for the normal range of 2131 feet msl to 2116 feet msl, the storage is about 20,800 acre-feet. The reservoir morphological information is summarized in the following table.

**Table 1. Somerset Reservoir Morphological Information**

| Reservoir Elevation (feet msl) | Surface Area (acres) | Storage Volume (acre-feet) |
|---|---|---|
| 2133.6<br>full at conc. crest | 1,623 | 57,345 |
| 2131<br>normal high | 1,570 | 53,200 |
| 2116<br>normal low | 1,190 | 32,400 |
| 2110.6 | 1,070 | 25,780 |
| 2100.6<br>outlet tower crest | 840 | 17,500 |
| 2090.6 | 610 | 9,130 |
| 2070.6 | 192 | 2,540 |
| 2050.6<br>max. draw if gates operated | 0 | 0 |

14. Somerset Reservoir is used for flow regulation and enhancement of downstream power production. It does not incorporate generating facilities.

<u>Searsburg Station - Deerfield River</u>

15. Searsburg Dam is located on the mainstem of the Deerfield River 0.7 mile below the East Branch confluence. The dam, constructed in 1921, incorporates an earth-fill section approximately 50 feet high and 475 feet long and, to the south, a concrete gravity spillway 137 feet long with a crest elevation of 1749.66 feet msl. The spillway is normally fitted with 5-foot-high flashboards from May through October. The power intake is on river right (south end of spillway). Adjacent to the intake is a trash sluice with a 6 foot by 8 foot gate, invert elevation 1731.66 feet msl.

16. The penstock is of wood-stave construction, 8 feet in diameter and 18,412 feet long. Before the powerhouse, there is a steel surge tank, 50 feet in diameter and 34 feet high, and, from that point, the

penstock is steel, 6.5 feet in diameter and 495 feet long. The inlet invert elevation of the penstock is 1732.66 feet msl.

17. Bond Brook, which originally entered the Deerfield River 1.7 miles downstream (RM 58.6) of the dam site, is diverted into the penstock.

18. Searsburg impoundment has a surface area of 30 acres and is about 0.9 mile long and generally confined by the riverbanks. The impoundment has a maximum depth of 50 feet. A useable storage volume of 197 acre-feet is available in the operating range between the top of the flashboards and three feet below the spillway crest; the gross reservoir storage is 412 acre-feet (top of flashboards to intake invert, 23-foot range). When the flashboards are out, the useable storage is reduced to 67 acre-feet (three-foot drawdown from crest).

19. The facility's powerhouse contains a single vertical Francis turbine with a rated output of 6,950 HP at a head of 205 feet and a hydraulic capacity of 340 cfs. The turbine drives a generator with a nameplate capacity of 4,160 kw; the maximum plant capacity is 5,000 kw. The tailwater elevation of the plant typically varies from about 1523.2 feet msl to 1523.9 feet msl.

20. On an average annual basis, Searsburg Station generates approximately 24,800 mwh of electricity.

21. The discharge from Searsburg Station enters the Deerfield River about one mile upstream of the northwest arm of Harriman Reservoir.

22. Searsburg Station can be operated either on-site or remotely from Harriman Station.

<u>**Harriman Station - Deerfield River**</u>

23. Harriman Dam is located in the town of Whitingham on the mainstem of the Deerfield River, about three miles upstream of the West Branch and the village of Readsboro. The facility was constructed over several years in the early 1920s and first began operation in 1924. The dam, an earth-fill structure, is approximately 216 feet high and 1,250 feet long, with a circular morning-glory

spillway on river left, capable of being fitted with stanchion boards up to 6.0 feet in height. The fixed spillway crest elevation is 1491.66 feet msl. From the spillway, a 21.5-foot-high horseshoe-shaped tunnel carries water to the downstream river channel. A valved 4.0-foot-diameter pipe, centerline elevation of 1315.96 feet msl, exists that connects the outlet tunnel with the original construction diversion tunnel; this pipe was used to release flows into the Harriman bypass for relicensing studies.

24. The water conduit is a 14-foot-diameter concrete-lined horseshoe-shaped tunnel, 12,812 feet long. The intake tower contains two 8-foot valves, centerline elevations of 1389.66 feet msl, that control flows. Before the powerhouse, there is a steel surge tank, 34 feet in diameter and 184 feet high. From that point, three steel penstocks, 9 feet in diameter and 620 feet long, carry water to the powerhouse. The discharge from Harriman Station is directly into the head of Sherman Reservoir.

25. Harriman Reservoir has a surface area of 2,039 acres at the spillway crest elevation of 1491.66 feet msl and, when full, is the second largest body of water wholly within Vermont. The reservoir is about 9 miles long and as wide as 0.78 mile. The reservoir has a maximum depth of about 180 feet and a useable drawdown of 86 feet from the spillway crest (103,375 acre-feet of storage). The gross storage from the crest down to elevation 1325.66 feet msl is 117,300 acre-feet (166 foot drawdown). The storage corresponding to the normal operating range of 1494 feet msl to 1455 feet msl (39-foot range) is about 66,000 acre-feet. The reservoir morphological information is summarized in the following table.

**Table 2. Harriman Reservoir Morphological Information**

| Reservoir Elevation (feet msl) | Surface Area (acres) | Storage Volume (acre-feet) |
|---|---|---|
| 1491.66 crest w/o stoplogs | 2,039 | 117,300 |
| 1480 | 1,790 | 94,830 |
| 1470 | 1,580 | 78,000 |
| 1460 | 1,400 | 63,120 |
| 1450 | 1,200 | 50,090 |
| 1440 | 994 | 39,120 |
| 1430 | 838 | 30,010 |
| 1420 | 716 | 22,240 |
| 1405.7 maximum draw | 465 | 13,925 |
| 1314 low-level outlet | 0 | 0 |

26. The facility's powerhouse contains three vertical Francis turbines each with a rated output of 19,500 HP at a head of 345 feet and a discharge of 533 cfs. The generators are each rated at 11,200 kw of output; the combined maximum plant capacity is 45,000 kw. Although the rated total hydraulic capacity is 1,600 cfs, the station can operate up to 1,800 cfs under ideal head and tailwater conditions. Controlled by Sherman Reservoir, the tailwater elevation for the plant varies between is 1100.7 feet msl to 1107.7 feet msl.

27. On an average annual basis, Harriman Station generates approximately 100,200 mwh of electricity.

**<u>Sherman Reservoir - Deerfield River</u>**

28. Sherman Reservoir has a surface area of 218 acres and is about 2 miles long and as much as a quarter of mile wide. With four-foot flashboards in place, the maximum operating level is 1107.7 feet msl. A useable storage volume of 1,359 acre-feet is available in the operating range between the top of the flashboards and three feet

below the spillway crest; the gross reservoir storage is 3,593 acre-feet (top of flashboards to intake invert, 24-foot range).

29. The facility's powerhouse contains a single vertical Francis turbine with a rated output of 10,400 HP at a head of 86 feet and a hydraulic capacity of 1,200 cfs. The turbine drives a generator with a nameplate capacity of 7,200 kw; the maximum plant capacity is 6,500 kw.

30. On an average annual basis, Sherman Station generates approximately 28,700 mwh of electricity.

**III. River Hydrology and Streamflow Regulation**

31. The Deerfield River Project is operated as an integrated system primarily to provide peaking power and operational reserve capacity to the New England Power Pool. The New England Power Exchange dispatches the electricity produced by the Project through the regional grid. Typical peak demand occurs weekdays between 7:00 am and 11:00 pm and Saturday for a few hours. All stations from Searsburg down to the Fife Brook Development can be remotely operated from Harriman Station.

32. Somerset and Harriman are considered seasonal storage reservoirs and provide the predominant flow regulation for the watershed in order to enhance peaking operation and limit the loss of water during high flow periods such as spring runoff. These reservoirs also provide incidental flow management benefits, primarily in Massachusetts, including flood flow attenuation and summer flow augmentation that provides some enhancement of recreational boating and fisheries. Searsburg and Sherman stations are considered daily peaking plants.

33. Unregulated flow data for the upper Deerfield River is unavailable. Data from basin surface water gaging stations operated by the U.S. Geological Survey are available from several tributaries, including Beaver Brook at Wilmington, Vermont; the Green River near Colrain, MA; the North River at Shattuckville, MA; and the South River near Conway, MA and from mainstem gages near Rowe, MA (drainage area 254 sq. mi.), at Charlemont, MA (drainage area 361 sq. mi.), and near West Deerfield (drainage area 557 sq. mi.).

34. The mainstem gage near Rowe, MA provides information most applicable to the upper Deerfield River, but regulation of flow must be considered if the gage is used to estimate certain streamflow statistics. The station has been in operation since 1974 and is located just below Fife Brook, about five miles below Sherman Reservoir. The one major tributary between Harriman Reservoir and the gage station is the West Branch; a second, smaller tributary, the South Branch, also discharges into this reach.

    At the gage, the mean annual flow, which is a representation of total runoff and not subject to imprecision due to regulation, is 737 cfs, or 2.90 csm. The amount of runoff generated in the upper Deerfield basin is higher than that recorded for any other major basin in Vermont. Similarly, the average annual total precipitation is higher as well.

35. The present license includes no special provisions for minimum stream flows nor for restrictions in reservoir operating levels for the purposes of environmental protection.

<u>Somerset Reservoir</u>

36. The upper portion of the East Branch basin, an area of 30 square miles, contributes runoff to Somerset Reservoir. The drainage includes the west side of Stratton Mountain and a portion of the west side of Mt. Snow, in the Green Mountain Range.

37. For seasonal storage, Somerset Reservoir is normally drawn about 5 feet over the summer/fall period (from spring levels) and an additional 10 feet during the winter period, mid-December through mid-March, with reservoir levels restored by spring runoff. Management is highly variable from year to year. In anticipation of higher-than-normal spring runoff from snowmelt and/or precipitation, the reservoir is drawn to lower levels; the converse holds true for drier conditions. During the mid-July through October period, the reservoir is drawn about 4 feet on the average, but has been drawn as much as 19 feet, based on the 1973-1993 records.

    The summer drawdown is normally started after loon nesting has been completed.

The following table describes the typical behavior of Somerset Reservoir based on the operating data from 1973 to 1993. (Response to AIR No. 22, Somerset and Harriman Aesthetics Documentation, October 1993, Figure 22-3, *Somerset Reservoir Midnight 10-Day Elevations*)

**Table 3. Typical Reservoir Management at Somerset (1973-1993)**

| Period | Water Level (feet msl) | | Change in Stage (feet) |
|---|---|---|---|
| | Start | End | |
| May - July | 2131 | 2128 | -3 |
| August - October | 2128 | 2124 | -4 |
| November - December | 2124 | 2126 | +2 |
| January - early March | 2126 | 2116 | -10 |
| March - April | 2116 | 2131 | +15 |

38. Releases from Somerset Reservoir are controlled through the use of the two outlet pipes, which have a combined capacity of 850 cfs. The dam is normally visited twice weekly for adjustment of the gate valves. If conditions warrant, the dam is visited daily. Adjustments must be made on site; there is no remote monitoring or control. On the average, the number of gate adjustments during the summer, fall, winter, and spring periods numbers 17, 13, 20, and 12, respectively. (response to AIR No. 8, May 24, 1993) In the spring, the gate valves are normally shut to capture spring runoff and only operated when the reservoir approaches full pond; the reservoir is usually full by May 1 and stabilized by May 15.[2]

39. Occasionally, actual spring runoff is less than predicted by the existing watershed model, and the reservoir is underfilled. For

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[2]Article 28 of the present FERC license requires NEPCo to operate the gates at full capacity whenever the reservoir level is above the concrete crest of the spillway, elevation 2133.58 feet msl. As operating guidelines for highwater conditions, NEPCo initiates Condition II when the reservoir reaches elevation 2131.58 feet msl, two feet below the crest. Under Condition II, the gates are opened to release inflow up to full capacity in order to maintain the reservoir level and prevent the reservoir from rising above the crest. Under the highwater guidelines, the flashboards are installed if the reservoir is expected to exceed elevation 2128.58 feet msl, five feet below the crest; flashboards then typically remain in place until the fall. (Letter from NEPCo to Department, December 9, 1994)

example, in four years during the period 1961 to 1992 Somerset Reservoir was drawn down more than necessary to capture spring runoff and only reached a maximum elevation of approximately 2126 feet, or 5 feet less than full pond.

40. Releases from Somerset are normally controlled to raise the total inflow to the Searsburg impoundment to no more than 340 cfs when combined with the uncontrolled drainage. A flow of 340 cfs is Searsburg Station's maximum capacity.

41. Since May 23, 1963, the applicant has voluntarily released a continuous minimum flow via a half-gate opening of the 6-inch pipe, the discharge varying from 3.9 cfs to 4.7 cfs depending on reservoir elevation. The minimum flow was provided for the purpose of improving the fisheries potential of the East Branch.

42. During the winter drawdown period, the applicant normally releases about 120 cfs from Somerset Reservoir in order to maintain Searsburg Station on line, thereby preventing the penstock from freezing.

**Applicant proposal for relicensing:**

43. Under the draft settlement agreement, the reservoir would be operated, to the extent feasible, at a fixed elevation plus or minus one foot during the period May 15 through July 15. No other changes in reservoir regulation are proposed by the applicant.

44. Under the draft settlement agreement, a minimum flow of 24 cfs (0.80 csm) would be released from October 1 through May 31, and a minimum flow of 12 cfs (0.40 csm) from June 1 through September 30. The minimum flows are guaranteed, and storage would be depleted as necessary to meet these minimums.

**<u>Searsburg Station</u>**

45. The watershed area at Searsburg Station is 90 square miles, one third of which is controlled by Somerset Reservoir. The mainstem of the Deerfield River contributes runoff from 50 square miles of watershed, while the intervening watershed on the East Branch below Somerset Reservoir contributes runoff from 10 square miles.

46. The station is operated in a daily peaking mode utilizing, from May 1 through October 31, the eight feet of storage from the top of the 5-foot flashboards to 3 feet below the spillway crest and, from November 1 through April 30 with flashboards removed, the three feet of storage below the spillway crest.

47. The station is operated almost continuously during Somerset Reservoir's winter drawdown period. During the summer, the peak power production generally occurs over an eight-hour period on weekdays. During periods of high flow in excess of the plant maximum capacity of 340 cfs, the station is maintained on line. The single unit at the plant can operate down to 130 cfs.

**Applicant proposal for relicensing:**

48. Neither the license application nor the draft settlement agreement propose any changes in reservoir management.

49. Under the draft settlement agreement, a minimum flow of 28 cfs (0.31 csm), or inflow if less, would be released year round at the dam. No peaking constraints or additional minimum flows are proposed below the powerhouse.

__Harriman Station__

50. The watershed area at Harriman Reservoir is 184 square miles. Almost half of the inflows (90 square miles of watershed) to the reservoir are controlled by Searsburg Station; the North Branch, the largest intervening tributary, has a watershed area of 42 square miles. Downstream, the intervening watershed to the Harriman plant, including the West Branch, with its 33 square mile drainage area, increases the watershed area to 225 square miles.

51. For seasonal storage, Harriman Reservoir is normally drawn about 14 feet over the summer/fall period (from spring levels) and an additional 25 feet during the winter, with reservoir levels restored by spring runoff. Management is highly variable from year to year. In anticipation of higher-than-normal spring runoff from snowmelt and/or precipitation, the reservoir is drawn to lower levels; the converse holds true for drier conditions. During the mid-July through October period, the reservoir is drawn about 7 feet on the

average, but has been drawn as much as 23 feet, based on the 1973-1993 records.

52. The following table describes a typical behavior of Harriman Reservoir based on the operating data from 1973 to 1993. (Response to AIR No. 22, Somerset and Harriman Aesthetics Documentation, October 1993, Figure 22-4, *Harriman Reservoir Midnight 10-Day Elevations*)

**Table 4. Typical Reservoir Management at Harriman (1973-1993)**

| Period | Water Level (feet msl) | | Change in Stage (feet) |
|---|---|---|---|
| | Start | End | |
| late May - mid-July | 1494 | 1487 | -7 |
| mid-July - October | 1487 | 1480 | -7 |
| November - early December | 1480 | 1482 | +2 |
| December - early March | 1482 | 1455 | -27 |
| March - early May | 1455 | 1494 | +39 |

53. Almost all flows are controlled for generation. Seldom does spillage over the principal spillway at Harriman Dam occur. The reservoir is managed in the winter and spring period to attain maximum spring levels close to the spillway crest; watershed snowpack and precipitation are closely monitored to accomplish this. As the reservoir approaches the crest and if additional runoff is anticipated, three feet of stoplogs are installed to capture the additional runoff. Three more feet of stoplogs may be installed if the inflow is within the control of the station and considered manageable. (Letter from Cleveland Kapala, NEPCo to Thomas Willard, Department, December 9, 1994)

54. Occasionally, actual spring runoff is less than predicted by the existing watershed model, and the reservoir is underfilled. For example, in 1981 and 1991, the maximum reservoir elevation only reached 1482.3 feet msl and 1480.4 feet msl, respectively, or 9.4 feet and 11.2 feet below full reservoir.

55. The total station capacity of 1,600 cfs exceeds that of downstream facilities. The minimum station capacity for generation is 520 cfs.

Under ideal head and tailwater conditions, the station can operate at flows of up to 1,800 cfs.

**Applicant proposal for relicensing:**

56. Under the draft settlement agreement, the reservoir would be operated so as to prevent any drop in reservoir levels during the period May 1 through June 15. No other changes in reservoir regulation are proposed by the applicant.

57. Under the draft settlement agreement, a minimum flow of 74 cfs (0.40 csm), or inflow if less, would be released year round at the dam. No peaking constraints or additional minimum flows are proposed below the powerhouse.

<u>Sherman Reservoir</u>

58. The watershed area at Sherman Reservoir is 236 square miles. Most of the inflow is controlled by Harriman Station. Unregulated inflow includes the West and South branches. The latter branch, which flows entirely within Vermont, discharges directly into the reservoir; it has a watershed area of 7.0 square miles.

59. Sherman Reservoir is typically operated with a weekly drawdown behind its 4-foot flashboards; however, occasionally 7-foot drawdowns occur to meet peak power demand or to create storage in anticipation of high runoff.

60. Sherman Station pre-generates to create a storage deficit in order to prevent the loss of higher peak flow releases from Harriman Station.

**Applicant proposal for relicensing:**

61. Neither the license application nor the draft settlement agreement propose any changes in reservoir management.

## IV. Standards Designation

62. The Deerfield River in the project-affected reaches, including the East Branch and tributaries found below 2500 feet in elevation have been designated by the Vermont Water Resources Board as Class B waters. One small portion of Harriman Reservoir at the tributary

that drains Lake Sadawga and 1.0 mile of the Deerfield River from Readsboro village to the Harriman tailrace, formerly designated by the Board as Class C waters, are now managed by the State of Vermont as Class B waste management zones. These areas receive discharges of treated wastewater effluent from the Whitingham and Readsboro wastewater treatment facilities, respectively. The Water Resources Board has also designated the entire Deerfield River in Vermont and its reservoirs as cold water fish habitat.

The lengths and areas 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.

63. 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(A) *Class B Waters: Management Objectives*)

64. 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.

65. The dissolved oxygen standard for cold water fish habitat streams is 6 mg/l and 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 to 1.0 deg F from background. (Standards, Section 3-01(B)(2) *Temperature*) The turbidity standard is 10 ntu. (Standards, Section 3-03(B)(1) *Turbidity*)

66. 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 the species composition or propagation of fishes." (Standards, Section 3-01(B)(5) *Aquatic Habitat*)

67. Standards Section 2-02(B) *Hydrology: Artificial Flow Conditions* requires that "[t]he 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 dams are man-made structures that artificially regulate streamflow.

**Present status:**

68. According to the Department's Federal Clean Water Act Section 305(b) water quality assessment, of the 28 miles of stream from the headwaters of the East Branch to the head of Harriman Reservoir, 9.8 miles of stream does not support designated uses. This includes a 5.2-mile segment of the East Branch below Somerset Reservoir and a 4.6-mile segment below Searsburg Dam, primarily due to flow alteration.

    In the reach from the head of Harriman Reservoir to the state line, 3.5 miles of the Deerfield River does not support designated uses due to impairment by flow alteration and lack of buffering capacity against acid precipitation. The specific non-attainment segment is from the dam to the West Branch. The segment from the West Branch confluence to Sherman Reservoir is considered to only provide partial support of designated uses due to flow alteration. (*General Report on all Waterbody Data*, Department of Environmental Conservation, 1992)

## V. Water Chemistry

69. Because of the sparse settlement pattern and low population density in the upper Deerfield basin, the river is not heavily taxed for assimilation of sanitary or industrial wastes. The population centers of Wilmington, Whitingham, and Readsboro are each served by municipal wastewater treatment facilities. Wilmington discharges into the North Branch about one mile upstream of the Harriman Reservoir; Whitingham discharges into Harriman Reservoir via the stream draining Lake Sadawga; and Readsboro discharges into the mainstem below the West Branch.

70. Three main issues related to physical/chemical water quality have been the focus of the Department's review: a) the adequacy of the

river flow in the Harriman bypass to assimilate the wastewater discharge from Readsboro village; b) the influence of reservoir stratification on the dissolved oxygen and temperature regimes of the river below the reservoir releases; and c) the influence of artificial low flows on the river's temperature regime.

**Assimilation of Readsboro WWTF discharge:**

71. Typically, treatment facilities with dilution ratios of 28:1 or greater at 7Q10 flows are screened as not likely to cause a violation of dissolved oxygen standards with the treatment plant discharging at normal secondary limits. The present hydroelectric operating conditions were estimated to result in a dilution ratio of less than 9:1 at 7Q10 flows. This information was provided to the applicant by the Agency in a December 8, 1989 letter.

**Impact of reservoir stratification on downstream water quality:**

72. Thermal stratification of Somerset and Harriman reservoirs during the summer create oxygen-depleted conditions in the deeper zones of the reservoirs. The intake elevations are sufficiently low that there exists a potential for withdrawal of oxygen-deficient water from the reservoirs and discharge of that water downstream into the river proper.

73. The application presents dissolved oxygen and temperature data from reservoir water quality sampling done by the Department of Environmental Conservation in 1970 and 1982 (Somerset and Harriman); U.S EPA. in 1972 (Harriman); and the applicant in 1989 and 1991 (Somerset and Harriman) and 1993 (Harriman). In 1989, the applicant collected river water quality and flow data below Somerset Dam and at the Harriman tailrace. (License Application, Volume IV, Exhibit E(2), Water Use and Quality; Volume VII, Appendix E-2, Water Quality Report 1989/1990) In 1993, the applicant also collected data in the Harriman bypass during the aquatic habitat flow demonstration study. (Response to AIR No. 4, Harriman Qualitative Fisheries Assessment, January 1994)

*Somerset Reservoir*

oxygen concentrations at depths exceeding about thirty feet. The data set is insufficient on a temporal basis to indicate whether or not the profiles approached worse-case conditions for those summers and whether or not the profiles are typical for summer conditions. Further, the sampling stations were located mid-reservoir and not near the intake, and, therefore, would not be indicative of the water entrained in the intake and discharged downstream.

75. The applicant's July 1989 sampling near the intake showed a marked decline in dissolved oxygen levels between a depth of 4 m (6 mg/l, 20.8 deg C) and 9 m (4 mg/l, 13.3 deg C). A stable concentration of 4.5-4.7 mg/l was exhibited in the remainder of the lower water column. The reservoir elevation was 2129.5 feet msl at the time of the sampling.

76. During August 5-7, 1991 sampling, stratification was well defined at a station located 0.5 mile upstream of the outlet and not as well defined at the intake. In the epilimnion at the intake (surface to 8 m, elevation 2095.4 feet msl), the dissolved oxygen level was about 7.5 mg/l; below the epilimnion, the level rapidly decreased over the next few meters to about 4 mg/l (12 m, 12 deg C, elevation 2082.3 feet msl), then inexplicably increased to 4.7 to 6.3 mg/l from 16 to 25 m; at the bottom of the water column (26 m, elevation 2036.3 feet msl), the level decreased to about 2.6 mg/l. Several of the samples showed percent saturations of less than 40%. The reservoir water level was about 2121.6 feet msl during the 1991 sampling.[3]

77. Reservoir water is drawn into top of the outlet tower at an elevation of 2100.58 feet msl. (pers. comm. Jeffrey Cueto, Department with Cleveland Kapala, NEPCo, September 14, 1994)

78. In July, August, and September 1989, samples were taken at a point about 300 feet downstream of the Somerset Reservoir discharge. The three samples exhibited low temperatures (10 to 12 deg C) and

[3] Quality control on the sampling was not good. The dissolved-oxygen probe

high dissolved oxygen levels (about 10 mg/l and 90% saturation). The measured flows were 111 cfs, 167 cfs, and 78 cfs, respectively.

79. The reservoir outlet works, consisting of elevated pipe discharges, provides substantial reaeration. The July sampling showed an increase in dissolved oxygen from an intake condition of about 4 to 5 mg/l to a downstream condition of 10 mg/l. Other samples collected at the same downstream station during the period May through October 1989 also exhibited good dissolved oxygen levels, ranging from 9.1 to 13.0 mg/l.

*Harriman Reservoir*

80. Harriman Reservoir also displays stratified conditions. On July 28, 1970, the reservoir was stratified, but dissolved oxygen levels throughout the profile met standards. On August 4, 1982, the reservoir was not strongly stratified.

81. The U.S. EPA sampling was not done at the intake and only was done to a depth of 4 m. The sampling is not useful for determination of the characteristics of the intake-entrained water.

82. The July 1989 sampling near the Harriman intake displayed a rapid decrease in the dissolved oxygen level. In the first three meters, the percent saturation dropped from 102% to 38% (3.4 mg/l), and varied from 14 to 32% (generally about 2 mg/l) for the remainder of the water column. The reservoir elevation was 1488.0 feet msl at the time of the sampling.

83. On August 7, 1991, data was collected at the outlet of Harriman Reservoir. Dissolved oxygen levels in the epilimnion (0 to 7 m) varied from 6.3 to 6.8 mg/l. The level dropped to 4.9 mg/l at 10 m, and increased from that point to remain above 7 mg/l from 15 to 26 m. Readings were not recorded to the bottom, 31 m. The reservoir elevation was 1480.3 feet msl.

84. The dissolved oxygen and temperature profiles done in September 21, 1993 also exhibited stratification with a dissolved oxygen concentration of 3.6 mg/l measured at a depth of 31 m (5.5 deg C and 28% saturation). The reservoir elevation was 1482.7 feet msl on the date of the survey.

85. In July, August, and September 1989, tailrace samples were taken at a point about 25 feet downstream of the powerhouse draft tube exit. The lowest dissolved oxygen level was measured on September 28 under a powerhouse full-gate discharge of 1,600 cfs: 6.9 mg/l, or 66% saturation. The August sample was done under a no-discharge condition. The September sample is a technical violation of the saturation standard of 70% saturation. The applicant also did diurnal sampling at several stations, including the Harriman tailrace, in 1990. The September 18-19 sampling was done while the powerhouse was discharging, and the samples had dissolved oxygen levels of about 7.3 mg/l, or 70% saturation at 13 deg C.

86. Reservoir water is drawn through trashracks from the water surface down to elevation 1484 feet msl. The elevation of the intake pipe (centerline about 1389 feet msl) results in water being preferentially drawn through the lower portion of the trashracks, including the hypolimnion. (License Application, Volume XVI, Exhibit F(6), Sheet 4/6, *Harriman Development Intake Plan and Sections*)

87. The sampling at Harriman also exhibits substantial dissolved oxygen entrainment between the intake and the powerhouse discharge. The applicant attributes this to the integration of a special manifold in the design for the three turbines. The manifold introduces air just below the waterwheel. The applicant believes that the manifold was specifically designed for reaeration. For the July 1989 sampling date, the dissolved oxygen level increased from the reservoir concentration of about 2 mg/l[4] to the tailrace concentration of 9.2 mg/l (87% saturation); the powerhouse discharge was 490 cfs. With the exception of the September 28 sample discussed above, other samples collected at the tailrace station during the period June through October 1989 also exhibited good dissolved oxygen levels, ranging from 8.0 to 10.6 mg/l; flows were not recorded.

88. As part of the September 1993 data collection, samples were collected in the bypass directly below Harriman Dam during special flow demonstration studies. Flows during the studies were passed using a special low-level outlet that was used during dam construction; the centerline elevation of that outlet pipe is 1316.0 feet msl, or 167 feet below the water surface on the date of

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[4] The dissolved-oxygen probe reading at 18 m was 2.0 mg/l, but the value determined using a direct-reading titrator was 6.8 mg/l. The discrepancy is unexplained.

the survey. Given the stratified conditions of the reservoir, the water discharged from the outlet originated from the hypolimnion, where substantial dissolved oxygen deficits were recorded. (The sampling did not extend to this depth, but stopped at 33 m.) The sampling data indicated a substantial dissolved oxygen concentration increase at the discharge point. The water is apparently discharged from the outlet pipe in a free jet that impacts the side of the outlet tunnel, becoming highly reoxygenated.

**Impact of artificial low flows on river temperatures:**

89. In a letter dated August 28, 1989, the Department raised the impact of flow regulation on the river's temperature as an issue of concern. Spot water temperature readings taken at a limited number of stations are available for July, August, and September 1989, and continuous air and water temperature measurements were taken from May through October 1989 directly below Somerset Reservoir's outlet and directly below the Searsburg tailrace and reported as monthly means. Data was also collected below Harriman Dam in 1993.

90. *Somerset.* Spot temperature data was collected at the head of the Somerset-to-Searsburg reach of the East Branch, but the first downstream sampling station was below the confluence with the mainstem. Further, the flow releases from Somerset Reservoir were substantially higher (78 to 167 cfs) than those that exist under the present minimum flow (4 cfs). The continuous recorder only provides data on the East Branch at Somerset Dam. The present impact of flow regulation on the water temperature regime of the East Branch cannot be determined from the data available.

91. *Searsburg.* Midday sampling on July 20, 1989 showed an increase in temperature of 3.0 deg C through the 3.5 mile bypass reach at Searsburg Station. The temperature increased from 15.0 deg C to 18.0 deg C; as is typical, the bypass was receiving no releases from Searsburg Dam. The air temperatures measured at the dam and powerhouse were 18 deg C and 20 deg C (68 deg F), respectively. Similar conditions existed midday on August 28, 1989, with an increase in temperatures from 17.0 deg C at the dam to 20.0 deg C at the powerhouse and air temperatures of 20 deg C at the dam and 23 deg C at the powerhouse. No change in temperature was recorded on September 28, 1989 when the mid-afternoon water

temperature was 10.0 deg C; the recorded air temperatures were 15.5 deg C at the dam and 27.0 deg C. The latter air temperature is probably incorrectly recorded, given the other temperatures recorded on that date.

92. *Harriman.* In both 1989 and 1993, temperature data was collected at the head of the Harriman bypass, but the first downstream sampling station was below the influence of the West Branch. The present impact of flow regulation on the water temperature regime of the Deerfield River cannot be assessed using available data.

## VI. Aquatic Biota and Habitat

93. Class B waters are managed for high quality habitat for aquatic biota (Standards Section 3-03(A) *Class B Waters: Management Objectives*). Aquatic biota are defined in Standards Section 1-01(B) *Definitions* 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.

94. The Deerfield River and East Branch contain a diversity of recreationally important fishery resources that are found in impacted lake and riverine habitats. Protecting the spawning and nursery habitat potential for a variety of important lake and riverine species is a key to the future viability of the river's fishery and to the recreation-based economy of the region.

### History:

95. Prior to the mid to late 19th century, streams and ponds within the Deerfield River watershed of Vermont were populated by only fish species indigenous to the upper Connecticut River basin. Included among these were brook trout, Atlantic salmon, chain pickerel, golden and common shiners, blacknose and longnose dace, fallfish, creek chub, white and longnose suckers, brown bullhead, pumpkinseed, yellow perch, and slimy sculpin. Anadromous Atlantic salmon may also have accessed the upper Deerfield River although this has not been confirmed through documented records.

96. Salmon aside, the only salmonid native to the upper Deerfield River is the brook trout. Beginning as early as the late 1800s or early 1900s, brown trout may have been introduced to the basin. Since

the construction of the Deerfield River Hydroelectric Project, several other species have been introduced either deliberately or unintentionally over the years. Introduced fishes include brown trout, rainbow trout, kokanee, lake trout, rainbow smelt, mimic shiner, rock bass, smallmouth and largemouth bass, and walleye. With the exception of rainbow trout, kokanee, lake trout, and walleye, these introduced species occur as common, naturally reproducing populations.

97. Construction and operation of the Project has caused a marked changed in the river's physical habitat, resulting in changes to the fish communities.

**Behavior of reservoir fish species and effects of fluctuations:**

98. The several fish species that exist in the project reservoirs have a range of physical habitat requirements for their different life stages and are affected in different ways by reservoir fluctuations.

99. Reservoir drawdowns of the extent proposed limit the presence of aquatic vegetation. As a result, cover-dependent fishes that utilize shoreline areas do not have the habitat they require for normal survival, growth and propagation. In addition, fluctuations will affect the aquatic invertebrate community, which is the food base for a number of fishes. The magnitude of these effects in the project reservoirs is not known.

*Brook Trout*

100. Brook trout is a fairly adaptable species and a good choice for a put-and-take fisheries in small cold-water impoundments like the Searsburg impoundment. Habitat requirements for brook trout in an impoundment are primarily cold water and cover.

101. Brook trout spawn in the fall, primarily in streams, although spawning may occur over gravels in areas of groundwater upwelling in lakes and ponds. Migrational and seasonal movements are generally limited to short distances.

102. Brook trout are opportunistic feeders and eat drifting and benthic invertebrates and terrestrial insects.[5]

103. Impoundment drawdowns are unlikely to have significant effects on stocked brook trout that are captured during the same year as stocking. However, water level drawdowns which significantly change temperatures and available cover in the impoundment could be a limiting factor on brook trout numbers. The effects of drawdowns on stocked brook trout which remain over winter or on wild brook trout from the tributary streams that use the impoundment is not known.

104. Water level fluctuations can also strand invertebrates, creating a smaller forage base in the impoundment for brook trout.

*Landlocked Atlantic Salmon*

105. Salmon that live in lake systems migrate into tributary streams to spawn in the fall. Eggs incubate during the winter and hatch in the spring. Juvenile fish live in the stream, usually for one or two years, before migrating to the lake for their adult lives.

106. Planned landlocked salmon management in Harriman Reservoir includes use of the Searsburg reach as spawning, incubation, and nursery habitat. Only the adult stage is directly dependent on the reservoir environment.

107. Adult salmon are pelagic, that is, they live in mid-water areas as opposed to shoreline or littoral areas. In Harriman Reservoir, smelt would be the predominant forage species. Smelt in turn feed largely on zooplankton.

108. Reservoir drawdowns will have both direct and indirect affects on salmon. Some salmon will be entrained at the Harriman intake and subject to potential turbine mortality. Drawdowns also result in a nutrient export that may reduce the primary productivity of the reservoir. Reservoir water drawn off during the winter is largely replaced in the spring by nutrient-poor snowmelt. Salmon growth rates and reservoir carrying capacity may be reduced. Plankton and

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[5] Raleigh, R.F. 1982. Habitat suitability index models: brook trout. USDI, FWS. FWS/OBS-82/10.24 42 pp.

smelt will also be lost directly via penstock export. The magnitude of these effects is unknown.

109. A large winter drawdown will crowd fish, and foraging of predator fish is likely to increase. While this may benefit salmon in terms of the availability of forage, any growth effects are expected to be minimal. Since water temperatures are low during the winter, the metabolic rate of fishes and hence their growth rate is low.

110. Even with these impacts, it is likely that reasonably successful fisheries can be established for salmon as well as other salmonids.

*Lake Trout*

111. Lake trout are pelagic, although their distribution throughout a lake varies seasonally. They are generally restricted to waters less than 60 deg F. During the summer months, lake trout tend to be found in deep-water areas (hypolimnion). Lake trout spawn in the fall on rocky reefs, shoals or shoreline areas. Spawning may occur at depths ranging from 0.5 feet to over 100 feet.

112. The winter drawdown at Harriman Reservoir will preclude the establishment of a wild, self-sustaining lake trout population, since spawning areas are dewatered during the winter egg incubation period. However, management for lake trout is possible through stocking of yearlings in the reservoir. The drawdown effects on lake trout are expected to be similar to those discussed above for salmon.

*Rainbow Smelt*

113. The smelt is a very important forage fish for salmonids in Harriman Reservoir. Smelt are pelagic and live in mid-water areas of lakes. Smelt spawn in the spring in tributary streams and along the reservoir shoreline.

114. Even though there have been anecdotal reports (warden and technician observations) of smelt spawning activity in the Deerfield River in the vicinity of the Medburyville Bridge below Searsburg Station, inspections conducted each spring since 1991 have not detected spawning in this reach. This fact suggests that riverine spawning presently occurs very irregularly or at a low level. It is not

known what effects, if any, project regulation of river flows has had on the frequency or level of past smelt spawning activity.

115. Shoreline spawning is clearly the major source of smelt production in Harriman Reservoir. Observations of spawning activity in the reservoir indicate that spawning activity can be expected to occur during the period April 20 to May 15. To assure an adequate incubation period is provided for spawning that occurs during the later portion of the spawning period, reservoir levels must be held through June 15 to prevent dewatering.

116. Juvenile and adult smelt, while pelagic, may be affected by reservoir drawdowns (reference the discussion above under salmon). The magnitude of such an effect is not known.

*Chain Pickerel*

117. Chain pickerel spawn primarily in April and May over flooded and aquatic vegetation to which their sticky eggs adhere. Flooded vegetation or weedy areas provide good spawning habitat if high water levels are maintained through the fry stage.

118. Spawning can be interrupted by water level drawdowns, and extended interruption may result in egg resorption. Weak year classes can result from low water levels because even slight water level changes can strand incubating eggs and fry, which are usually found in water less than 0.5 m deep. Northern pike, which are closely related to chain pickerel, do "not do well in reservoirs with widely fluctuating water levels because nearshore vegetation does not develop."[6] Older fry, which are feeding, have greater mobility and can probably follow a slowly receding water level.

119. Stabilization of the water levels through mid-June, as proposed, will help protect spawning, incubation, and early fry development of chain pickerel. Invasive grasses and sedges which become established along the shoreline in the summer months can provide habitat for spawning in the spring and a source of nutrient release as this vegetation becomes flooded.

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[6] Inskip, P.D. 1982. Habitat suitability index models: northern pike. USDI, FWS. FWS/OBS-82/10.17. 40 pp.

120. Chain pickerel are predaceous carnivores even as juveniles. In lakes, pickerel prefer heavily vegetated areas, often within 10 feet of water depth, where they hide among the vegetation and ambush prey. They are active and feeding during the winter.[7] Chain pickerel require vegetation because of their predation and spawning method.

121. Pickerel may also be affected if the abundance of forage fish species is reduced by water level fluctuations, but the magnitude of such an effect is not known.

*Yellow Perch*

122. Spawning migrations of yellow perch occur from April through June into lake shallows. A gelatinous string of eggs is released near submerged or aquatic vegetation and in some cases over other substrate such as rocks or gravel at water depths of 1.0 to 3.7 m.

123. Rising water levels during spawning are beneficial to yellow perch incubation and hatching.[8] On the other hand, a reduction in water level during the spawning and incubation period may dewater and kill eggs. The proposed water level stabilization during the spring will help protect perch spawning and incubation.

124. All life stages of yellow perch are usually found near the shoreline in areas of low velocity and a moderate amount of vegetation, preferring lakes with vegetation covering 20 to 50% of the lake area. Drawdowns of reservoir levels may force juveniles and adults away from vegetation which provides cover. Juveniles may be more vulnerable to predators, and adults may be in greater competition for forage items of invertebrates and small fish.

*Smallmouth Bass*

125. Most bass spawning occurs from late May to early June. Nests are usually constructed in water at depths of 2 to 5 feet on gravel or

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[7]Scott, W.B., and E. J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada Bulletin 184. 966 pp.

[8]Krieger, D.A., J. W. Terrel, and P. C. Nelson. 1983. Habitat suitability information: yellow perch. USDI, FWS. FWS/OBS-83/10.55. 37 pp.

broken rock and often near boulders, logs or other cover.[9] Male bass guard their offspring from the egg stage until the young fry are ready to disperse, a period of a month or more. During this "black fry" stage, the fry are essentially helpless and remain over or near the nest site. Among common hazards to eggs and fry are temperature fluctuations, floods, and receding water levels.[10] Optimal spawning conditions are considered to be a relatively stable water level during spawning and for 45 days thereafter.[11] While a modest increase in water level generally does not cause problems for bass nesting, reservoir drawdowns may force guarding male fish from the nest site exposing the eggs and fry to predators or stranding. Since fry prefer shallow water associated with shoreline or marginal areas, they are especially vulnerable to stranding.

126. Reservoir water level fluctuations during the period from spawning through the early-fry stage can interfere with nest site selection and spawning; dewater nests, resulting in egg desiccation; cause the guardian male to abandon the nest or the black fry, resulting in high predation on the offspring; and force fry away from cover and subject them to predation. The proposed water level stabilization during the spring will help protect spawning, incubation, and the black fry of smallmouth bass.

127. All life stages of smallmouth bass demonstrate strong, cover-seeking behavior.[12] Drawdowns of reservoir levels may force juveniles and adults away from vegetation and other submerged cover. Juveniles may be more vulnerable to predators, and adults may be in greater competition for forage items of invertebrates and small fish.

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[9]Edwards, E.A., G. Gebhart, and O.E. Maughan. 1983. Habitat suitability information: smallmouth bass. USDI, FWS. FWS/OBS-82/10.36. 47 pp.

[10]Coble, D. W. 1975. Smallmouth bass. Pages 21-33 in R.H. Stroud and H. Clepper, editors. Black bass management. National Symposium on the Biology and Management of the Centrarchid Basses, Tulsa, Oklahoma.

[11]Edwards et al., Op. cit.

[12]Ibid.

*Rock Bass*

128. The rock bass, as its name suggests, inhabit rocky areas along the shallow shorelines of lakes and reservoirs. Rock bass spawn from late spring through June in nests made in gravelly shoreline areas. Similar in behavior to the smallmouth bass, guarding of the nest and the fry is done by the male.[13]

129. The effects of reservoir drawdowns on rock bass during the spawning period are similar to that of smallmouth bass. The proposed water level stabilization during the spring will help protect spawning, incubation, and the fry of rock bass.

130. Adult rock bass are found in groups often in association with other sunfishes and bass, and competition for similar resources can occur.[14] Reservoir drawdowns may result in juveniles becoming more vulnerable to predators and in greater competition among adults for forage items of invertebrates and small fish.

*Longnose Sucker*

131. Longnose suckers begin spawning migrations from mid-April to early July, with the peak being sometime in June. Eggs are broadcast over clean gravel and rocks at depths of 15 to 30 cm along lake and reservoir shallows and in tributary streams. Fry congregate in the top 150 mm of water and within 2 m of shore seeking shelter and plankton for food. Fry move to deeper water in July or August.

132. Reservoir drawdowns in June and July, when fry are still in shallow waters, can cause fry mortality.[15] Stabilization and limited drawdowns during this summer period will help to protect longnose sucker fry.

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[13]Scott and Crossman, Op. cit.

[14]Scarola, J.F. 1987. Freshwater Fishes of New Hampshire. The New Hampshire Fish and Game Department. 132 pp.

[15]Edwards, E. A. 1983. Habitat suitability index models: longnose sucker. USDI, FWS. FWS/OBS-82/10.35. 21 pp.

133. Longnose suckers are most abundant in cold-water lakes having limited littoral areas and rapidly increasing depths. Adults feed on plants and benthic invertebrates, but they feed on invertebrates in the water column as well. They are considered less successful than other species of suckers in reservoirs with fluctuating water levels[16]; however, the magnitude of the effect on suckers due to fluctuating water levels is not known.

*Minnows*

134. Minnow species, such as the golden shiner, are key forage fish for bass, pickerel, and other game-fish species. Most species have diets consisting of plant and animal matter. Spawning may occur from early spring through late summer for different species. Some species, such as the golden shiner, require vegetation for cover and spawning and utilize lake and pond habitat at all life stages.[17] For these cover-dependent species, reservoir drawdowns may disturb spawning behavior and/or force juveniles and adults out of cover, making them more vulnerable to predation.

135. The fallfish, which is a larger minnow species, and some other minnow species utilize both stream and shallow lake areas for spawning. Nests are constructed in gravel or sand and are often underneath overhanging cover.[18,19] The effect of reservoir drawdowns on less cover-dependent minnows is not known.

**Setting minimum flows in regulated river reaches:**

136. The present store-and-release mode of operation with no minimum flow regime significantly degrades conditions for fish and other aquatic biota below the dams and tailraces of the project.

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[16]Edwards, E. A. 1983. Habitat suitability index models: longnose sucker. USDI, FWS. FWS/OBS-82/10.35. 21 pp.

[17]Scott and Crossman, Op. cit.

[18]Trial, J. G. , C. S. Wade, J. G. Stanley. 1983. Habitat suitability information: fallfish. USDI, FWS. FWS/OBS-82/10.48. 14 pp.

[19]Trial, J. G., C. S. Wade, J. G. Stanley. 1983. Habitat suitability information: common shiner. USDI, FWS. FWS/OBS-82/10.40 22 pp.

137. In the licensing application, the applicant proposed flow regimes for the three flow regulated reaches in Vermont based on minimum flow prescriptions contained in the U.S. Fish and Wildlife Service Flow Recommendation Policy for the New England Area, February 13, 1981. The flow standards, or aquatic base flows, contained in the policy are the August median flow (regional average, 0.5 csm) for non-spawning periods; the February median flow (regional average, 1.0 csm) for the fall/winter spawning and incubation period; and the April/May median flow (regional average, 4.0 csm) for spring spawning and incubation. The applicant-proposed flow is the August median flow, 0.31 csm, estimated from an aquatic base flow study (License Application, Volume X, Appendix D, Aquatic Base Flow Study, May 1989).

    The August median flow value was derived from a parametric hydrologic analysis to determine Deerfield River monthly median flows and was estimated by averaging the median flow values at three unregulated gaging stations on Deerfield River tributaries in Massachusetts--the North, South, and Green rivers. The gage period of records used in the analysis were 1951-84, 1950-81, and 1951-83.

138. The Appalachian Mountain Club (AMC) had recommended using a higher estimate of the August median flow of 0.39 csm using gage periods of record that included data through 1991 (North River, 1967-91; South River, 1967-90; and Green River, 1968-91). (AMC, facsimile transmission of June 17, 1994, *Table of Recalculated August Median Streamflow Values*, July 26, 1993)

139. Annual precipitation in the Vermont portion of the watershed averages 52 inches compared to 46 inches in the lower portion of the watershed (License Application, Volume I, Exhibit B, Project Operation and Resource Utilization, pp. B-11 to B-12). Also, total annual runoff recorded for the Deerfield River at the gaging station near Rowe, MA is about one third higher than the total annual runoffs recorded at the three tributary gages. It is, therefore, reasonable to expect that the August median flow for the Deerfield in Vermont is somewhat higher than the estimates used by either the applicant or the AMC.

140. The Agency Interim Procedure for Determining Acceptable Minimum Stream Flows, July 1993 (Agency flow procedure)

endorses the standards used by the Fish and Wildlife Service; however, it does not accept estimation of monthly median flow values without site-specific flow data.

141. The following table compares the median monthly flow estimates for the months of August and January[20] for the Deerfield River.

**Table 5. Median flow estimates for the Deerfield River.**

| Method of analysis | Monthly Median Flow (csm) | |
|---|---|---|
| | August | January |
| | csm | csm |
| USF&WS New England average | 0.50 | 1.0 |
| NEPCo ABF study | 0.31 | 1.09 |
| AMC estimate | 0.39 | |

142. In the flow regulated reaches of the project, site-specific evaluations of the functional relationship between flow and fisheries habitat have been completed and considered in the determination of necessary minimum flows for the purposes of this certification. The studies are discussed below. One study methodology is the Instream Flow Incremental Methodology (IFIM), which quantifies physical habitat available, for certain fish species and life stages, at alternative flows based on habitat variables of depth, velocity, substrate, and cover. The IFIM modeling produces graphs of weighted usable area (WUA) as a function of flow. WUA is a composite measure of the quality and quantity of habitat available at alternative flows.

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[20]The U.S. Fish and Wildlife Service policy uses a fall/winter default minimum streamflow of 1.0 csm for protection of fall spawning; this value is based on a regional hydrologic analysis of the median flow characteristics for the low-flow month of the season. On a regional basis, the low-flow month was found to be February, but the applicant's analysis for the Deerfield River indicates that January has a lower median flow (1.09 csm) than February (1.26 csm).

## Somerset Facility

### *Reservoir*

143. The Department of Fish and Wildlife manages the fish populations in Somerset Reservoir primarily for brook trout and smallmouth bass, and secondarily for yellow perch, rock bass, chain pickerel, brown bullhead and pumpkinseed. These latter species contribute to the diversity of the system and support additional sport fishing opportunities.

144. Somerset Reservoir's brook trout population is derived from both stocking and natural reproduction. Brook trout spawning occurs during the period from mid-October through December in several streams flowing into the reservoir, including the East Branch, Black Brook, and Box Car Brook. Lake shore spawning may also occur but has not been substantiated.

145. The brook trout fishery is supported primarily through the annual stocking of yearling fish. In 1991, 17,500 yearling trout were released for harvest during the open-water trout season of that year. A creel survey was conducted by the Department of Fish and Wildlife over the length of the open-water fishing season. The estimated fishing pressure, measured in angler-hours, was 4,003. Despite this pressure and the high number of trout at large in the reservoir, no trout were caught. A similar fishery occurred the following year. The number of yearling trout stocked in the spring of 1992 was 17,000. Later in the fall, an additional 42,523 fall fingerling trout, also catchable size, were stocked. Fishing pressure estimated for the 1992 season was 4,897 angler-hours. Only 108 brook trout were caught and none were harvested over the season; the catch rate for brook trout was 0.02 fish per angler-hour, or 50 hours of effort expended for each trout caught.

146. All smallmouth bass in Somerset Reservoir are from natural reproduction. In recent years, the smallmouth bass fishery appears to be improving in the size and quality of the catch.

147. The 1991 and 1992 creel surveys also provide estimates of smallmouth bass catch and harvest. In 1991, 511 bass were caught at a rate of 0.13 fish per angler-hour. The catch nearly doubled in

1992 at 994 bass for a catch rate of 0.20 fish per angler-hour. The creel survey data is provided in the following table.

**Table 6. Creel survey data for Somerset Reservoir.**

| Species | 1991 | | 1992 | |
|---|---|---|---|---|
| | Catch | Catch Rate (fish/ angler hr.) | Catch | Catch Rate (fish/ angler hr.) |
| Brook trout | 0 | 0 | 108 | 0.02 |
| Smallmouth bass | 511 | 0.13 | 994 | 0.20 |

*River Reach from Reservoir to Searsburg Impoundment*

148. East Branch flows are regulated by releases made from Somerset Reservoir. This is a deep water release of cold water. The reach is predominantly riffle habitat, although small pools are frequent and several on-stream beaver impoundments exist. At about the midpoint in the reach is Flood Pond, a shallow impoundment formed by the remnants of an old log crib dam. The reach supports wild brook trout and hatchery brook trout stocked into Somerset Reservoir and Searsburg Reservoir. The adjacent upper section of the Deerfield River also contributes some fish to the reach.

149. This reach and the reach of the Deerfield River above Searsburg impoundment are being considered for landlocked salmon nursery habitat and smolt production.

150. Management objectives for the Somerset reach are: 1) continue managing the reach principally for wild brook trout, as a remote fishing experience, and improve the flow regime to enhance habitat for all brook trout life stages and 2) possibly introduce landlocked salmon smolt production for Harriman Reservoir.

151. *Analysis of IFIM results.* The steady state IFIM results show that habitat, measured as WUA, for brook trout and salmon early fry changes only slightly with changes in flow. Brook trout late fry habitat increases with flow from 4 to 19 cfs and then levels off. Habitat for brook trout and salmon juveniles and brook trout adults increases almost linearly with flow over the low-flow model range (4 to 48 cfs). The high flow model (35 to 250 cfs) shows juvenile

habitat continuing to increase up to 100 cfs and then declining. Adult habitat continues to increase up to the highest modeled flow, 250 cfs. The WUA curve for salmon late fry is flatter than those for older life stages. It increases fairly steadily from 4 to 25 cfs, with only a slight increase from 25 to 48 cfs. Based on the high flow model, habitat declines from 35 to 150 cfs and then increases as flows increase.

152. Although the WUA curves for brook trout spawning and incubation habitat are essentially flat at a near-zero habitat level, the curves are believed to be erroneous. This curve is characteristic of instances where study transects contain very little spawning substrate; however, spawning habitat often exists in small areas scattered through a reach and is not properly quantified in standard IFIM data collection. To properly characterize the habitat/flow relationship, a very large number of transects would have to be measured. The study results do not indicate that there is a shortage of spawning habitat, but rather that it was not included in the transects.

153. The Agency produced habitat curves for macroinvertebrates, based on the Agency's Fishery Flow Needs Assessment (FFNA) suitability criteria. Habitat increases fairly steadily from 4 to 48 cfs, with an inflection point near 30 cfs. The curve produced from the high flow model shows a rapid increase in macroinvertebrate habitat between 35 and 87 cfs, followed by a leveling off and decline at higher flows.

154. *Temperature and dissolved oxygen regime.* Monitoring of temperatures and dissolved oxygen concentrations directly below the dam outlet indicates suitable habitat conditions exist for those parameters to support salmonid, with normal growth potential (reference discussion below in Finding 196 related to growth rate issues related to water temperatures below deep reservoirs with low-level intakes). The mean monthly temperatures measured 100 feet below the outlet in 1989, a year where thermal stratification of the reservoir occurred, were 9.9 deg C in July, 11.1 deg C in August, 12.4 deg C in September, and 9.2 deg C in October (License Application, Volume IV, Exhibit E(2), Water Use and Quality).

## Searsburg Station

*Impoundment*

155. Searsburg impoundment has been managed primarily for brook trout. Stocking of yearling trout has occurred since 1965. Brown trout were stocked prior to 1973 but were replaced with brook trout in 1975. Yellow perch, which are also present in the impoundment, provide additional sport-fishing opportunities. Future management for the 30-acre impoundment would involve management for a brook trout fishery.

156. The littoral zone is regularly dewatered and consequently is not conducive to production of aquatic life.

157. In comparison with other project reservoirs, fish species diversity is lowest in Searsburg impoundment.

*Bypass and Tailrace Reaches*

158. These two river reaches are combined, as both share common management objectives. Currently, the 3.5-mile-long bypass reach does not have an established minimum flow. Generally, unless uncontrolled inflow to Searsburg exceeds the powerhouse capacity, the bypass is dewatered; the tailrace reach only is watered intermittently--when Searsburg Station is generating or when the station is off-line but runoff from snowmelt or rainfall is being discharged into the bypassed reach. Present habitat conditions in the bypass reach are not suitable for supporting fish.

159. The tailrace reach below Searsburg Station is 0.7 miles in length and discharges directly into Harriman Reservoir. It supports resident fish populations and is ascended during spawning seasons by brown trout and smelt. In recent years there have been unsubstantiated reports of adult landlocked salmon caught by anglers fishing this reach in the fall of year. It is reasonable to believe these reports; the salmon would have originated from salmon stocked into Harriman Reservoir in the 1980s.

160. Because these two segments are directly accessible to spawning fish migrating from Harriman Reservoir under favorable flow conditions, habitat in the reach could support spawning, juvenile rearing, and

adult fish, provided that adequate flows are established on a year-round basis. The reach would also serve as a migration corridor for smolts migrating from above Searsburg Dam, if the upper portion of the basin is used for salmon production in the future.

161. Management objectives for the Searsburg bypass and powerhouse tailrace reaches are: 1) establish minimum stream flows that will provide quality habitat for brown trout and landlocked salmon spawning and incubation, fry, juvenile, and adult life stages; 2) establish a flow regime in the powerhouse tailrace reach that protects smelt spawning; and 3) continue the annual stocking of yearling brook trout.

162. *Analysis of IFIM Results.* Much of the bypass is very wide and, as such, requires above average amounts of water to fill. Relatively large increases in flow are needed to achieve small increases in water depth. This fact is reflected in the IFIM results since they are depth sensitive.

163. The applicant has produced steady-state WUA curves for the Searsburg bypass and powerhouse reaches combined. The IFIM results for brook and brown trout are essentially the same. Late fry habitat increases significantly between 20 and 40 cfs, increasing only slightly between 40 and 120 cfs. The amount of juvenile and adult trout habitat increases nearly linearly with flow between 20 and 120 cfs. The habitat results for landlocked salmon late fry and juveniles are similar to those for trout. Adult habitat increases between flows of 20 cfs and 120 cfs, but the rate of increase is less than that for trout. Much less habitat exists at 20 cfs and 40 cfs, compared to higher flows.

164. Habitat results are presented for a high flow model range (60-360 cfs) in the powerhouse reach. For this range of flows, habitat for trout late fry increases to a maximum at 120 cfs and then decreases. The curve for salmon late fry is similar. These curves are, however, flatter than those for juvenile and adult trout. The adult trout and juvenile trout and salmon curves are slightly convex and show that habitat increases as flow increases. Adult salmon habitat is minimal at flows below 160 cfs, and then increases slowly as flows increase; however, adult salmon are expected to reside almost exclusively in the reservoir.

165. Spawning and incubation habitat was examined for brook and brown trout and for landlocked salmon. The habitat suitability curves for this life stage are very similar for the three species. The WUA curves exhibited the same effect discussed above for brook trout in the Somerset reach. Landlocked salmon management in Harriman Reservoir includes use of the Searsburg reach as spawning, incubation and nursery habitat. This reach is accessible to migrating adult salmon, so that natural reproduction is an important management objective. Since the habitat curves for spawning and incubation were not useful, the Agency conducted further analysis. Spawning substrate is scattered through the reach, and is thought to exist in sufficient quantity; however, no single transect would contain a large amount. If the depths and velocities throughout the reach are generally suitable under a certain minimum flow regime, then it is reasonable to assume that spawning use of the gravels will be supported. Therefore, the Agency modeled the habitat/flow relationship for the powerhouse reach based on depth and velocity alone. To further focus the analysis, the Agency selected only high quality habitat for inclusion as WUA by rejecting as unsuitable any cell that had a composite suitability value less than 0.5. The resulting habitat/flow relationship is used as a proxy for the "true" habitat/flow relationship for spawning habitat. These results indicate that habitat increases almost linearly with flow up to about 300 cfs.

166. To aid in the interpretation of the IFIM results, the Agency and the applicant conducted a flow demonstration on August 15, 1994. Flow and habitat conditions were observed at four sites. Flows of about 55 cfs and 75-80 cfs were observed. The difference between the two flows was not substantial. The change in depth was insignificant, although increases in velocities could be observed in portions of the pools. The observed flows wetted much of the channel, but riffle depths were commonly near one foot. Suitable spawning areas were limited to pools and deep runs. The IFIM results reflect the large increase in spawning habitat that would result if flows were increased to the point where riffle areas became deep enough to be suitable.

167. Adult salmon are likely to enter the tailrace reach during a generation release. When flows are reduced to the minimum level, these fish may migrate upstream into the bypass, hold in pools or return to Harriman Reservoir.

168. At the Agency's request, the applicant provided steady state habitat results using the Vermont Fishery Flow Needs Assessment criteria for macroinvertebrates (Letter from Mark J. Wamser, Gomez and Sullivan Engineers to Roderick Wentworth, Department of Fish and Wildlife, Macroinvertebrate IFIM Study below Searsburg Powerhouse, May 2, 1994). Since the applicant produced the habitat curve only for the high-flow model, the Agency generated the curve for the low-flow model. Macroinvertebrate habitat increases continually over the flow range of 19 to 420 cfs. Flows of 19 to 30 cfs were found to provide only low levels of macroinvertebrate habitat.

169. *Smelt spawning and incubation.* On September 14, 1990 the Agency viewed the powerhouse reach with applicant representatives. Two releases were observed: about 310 cfs (best gate) and about 145 cfs. The Department of Fish and Wildlife determined that there was little stranding potential or loss of wetted area as flows dropped from 310 to 145 cfs; however, based on the IFIM modeling, substantial dewatering occurs when flows are reduced to flows closer to the order of the applicant's proposed minimum flow of 28 cfs. Total wetted area from the IFIM results is shown below.

**Table 7. Change in wetted area with declining flows below Searsburg tailrace.**

| Flow (cfs) | Wetted Area (sq. ft.) | Reduction in Wetted Area from 360 cfs (%) |
|---|---|---|
| 360 | 430,000 | 0 |
| 300 | 425,000 | 1 |
| 240 | 410,000 | 5 |
| 175 | 395,000 | 8 |
| 120 | 370,000 | 14 |
| 55 | 323,000 | 25 |
| 28 | 261,000 | 39 |

***Downstream Passage/Intake Mortality***

170. Searsburg Reservoir is currently stocked with brook trout to provide a put-and-take fishery, and stocked and indigenous brook trout reside upstream. While these fish do not need to migrate

downstream to reaches below the dam as part of their life history, it is probable that some seasonal downstream movements occurs. Seasonal movements for brook trout have been reported up to one mile[21] to ten miles[22,23]. The drawdown of the reservoir may also induce fish movement.

171. Fish attempting to move downstream may be entrained at the intake and become injured or killed when passing through the turbine. The trashrack bar clear spacing at Searsburg Dam is 1 1/4 inch, which is slightly greater than the 1-inch spacing recommended by the U.S. Fish and Wildlife Service. The current placement of the trashrack is such that fish must travel some distance in an enclosed forebay. Fish behavior may deter fish from exiting this forebay and returning upstream; fish that enter the forebay may remain in this tunnel-like forebay and attempt to move with the flow. The extent of this fish movement and the potential for injury or mortality is not known. During times of high inflow to the reservoir, spillage over the dam will allow some fish to pass downstream.

172. The mainstem above Searsburg reservoir may be used as nursery habitat for landlocked salmon fry stocked as part of the planned initiative to establish a salmon fishery in Harriman Reservoir. Effective downstream fish passage must both prevent intake mortality and provide a means of safe conveyance past the dam.

173. The U.S. Fish and Wildlife Service has indicated that effective downstream passage at Searsburg would require the installation of an angled trashrack with a proper bar spacing, located upstream of the forebay. A conveyance pipe or other passage measure would also be required.

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[21] Trembley, G.L. 1945. Results form the plantings of tagged trout in spring Creek, Pennsylvania. Transactions of the American Fisheries Society 73:158-172.

[22] Shetter, D.S. and A.S. Hazzard. 1942. Planting "keeper" trout. Michigan Conservation, April 1942, Vol. XI, No. 4, 3-5.

[23] Shetter, D.S. 1947. Further results from spring and fall plantings of legal-sized, hatchery-reared trout in streams and lakes of Michigan. Transactions of the American Fisheries Society 74:35-58.

174. Modifications to Searsburg dam in order to accommodate salmon smolt movement can be designed to also protect brook trout from mortality and allow their downstream movement.

**Harriman Facility**

*Reservoir*

175. Harriman Reservoir is not only the largest body of water occurring in the Deerfield River Project, but also, when full, is the second largest water body contained in the state of Vermont. It supports the greatest diversity of sport fisheries within the Project and has the greatest potential for further fishery resource development. Harriman Reservoir attracts considerable angling pressure during both open water and ice fishing seasons. Brown and rainbow trout, smelt, smallmouth bass, and yellow perch are the mainstay fisheries. Natural reproduction occurs for all of these species except rainbow trout. There is also much public interest for the improvement in these fisheries and the development of landlocked salmon and lake trout fisheries.

176. Management objectives for Harriman Reservoir are: 1) continue stocking of brown and rainbow trout; 2) improve ice fishing opportunities by stocking large brook trout in the fall of the year; 3) establish and maintain landlocked salmon and lake trout fisheries; 4) sustain and enhance the rainbow smelt population; and 5) sustain and enhance the smallmouth bass population.

177. The Department of Fish and Wildlife conducted creel surveys during the open-water fishing season of 1991 and both the ice fishing and open-water seasons in 1992. Total fishing pressure on the reservoir during the 1991 open-water season was estimated at 15,026 angler-hours. Fishing efforts for the 1992 ice fishing and open-water seasons were estimated at 14,990 and 9,730 angler-hours, respectively. The following table gives total catch and catch rates estimated for the two years for trout (brown, rainbow, and brook trout combined), smallmouth bass, and yellow perch.

**Table 8. Creel survey data for Harriman Reservoir.**

| Species | 1991 | | 1992 ice fishing | | 1992 open water | |
|---|---|---|---|---|---|---|
| | Catch | Catch Rate (fish/ angler hr.) | Catch | Catch Rate (fish/ angler hr.) | Catch | Catch Rate (fish/ angler hr.) |
| All trout | 589 | 0.04 | 92 | 0.006 | 234 | 0.04 |
| Smallmouth bass | 2,800 | 0.19 | 12 | 0.001 | 934 | 0.10 |
| Yellow perch | 7,350 | 0.49 | 4,792 | 0.320 | 3,123 | 0.32 |
| Smelt | | | 12,397 | 0.827 | 0 | - |

Note: The trout catch number for the 1992 open-water season includes 10 landlocked salmon.

178. The following table provides comparison data from three of Vermont's largest salmonid lakes and Waterbury Reservoir, another reservoir that is subject to large water level fluctuations.

**Table 9. Catch rates (fish/angler-hour) from creel surveys for several comparison lakes.**

| Waterbody | Season | Species | | | |
|---|---|---|---|---|---|
| | | Trout | Bass | Perch | Smelt |
| Bomoseen | Ice | 0.006 | 0.064 | 0.328 | 0.121 |
| Seymour | Ice | 0.111 | | 0.001 | 0.264 |
| | Open | 0.184 | 0.017 | 0.011 | |
| Willoughby | Ice | 0.013 | | 0.094 | 0.041 |
| | Open | 0.069 | 0.004 | 0.053 | |
| Waterbury | Ice | 0.077 | | 0.116 | |

179. Catch rates are quite variable between waters. Any number of factors contribute to this variability, including sampling intensity, differences in species abundance and size, angling behavior and preferences, and physical and chemical differences in the water. These variables limit the extent to which comparisons can be made

between waterbodies. However, several general observations relative to Harriman Reservoir standout: 1) ice fishing catch rates for trout in Harriman Reservoir and Lake Bomoseen are very similar for the years surveyed and rank lowest among the waters considered; 2) conversely, ice fishing catch rates for perch are the highest for Harriman Reservoir and Lake Bomoseen; and 3) ice fishing catch rates for smelt are highest on Harriman Reservoir. For the limited open-water creel survey data available for three waterbodies, Harriman Reservoir exhibited the lowest trout catch rates but the greatest catch rates for bass and perch. To fully evaluate fishery quality, other fish population and growth statistics would also have to be considered. Detailed studies that assess the status of the fisheries populations within the project area have not been done.

180. *Landlocked salmon management.* The Department of Fish and Wildlife undertook a program, from 1975 through 1986, to introduce landlocked salmon to the reservoir. That effort produced a poor quality fishery, i.e. low catches and slow fish growth. Reasons for this result are not fully understood, but a residual salmon population persists in Harriman Reservoir, demonstrating the potential for yielding legal-sized fish (>15" total length) and natural reproduction. Yearling salmon were stocked directly into the reservoir in 1993 and 1994.

181. The Department of Fish and Wildlife plan for salmon management is to continue stocking juvenile fish directly into the reservoir, and initiate fry stocking in the Searsburg bypass once minimum flows are provided.

182. Establishment of a self-sustaining salmon fishery will require sufficient riverine spawning and nursery habitat.

183. Reservoir drawdowns, depending on magnitude, can dewater fish nursery areas, exposing eggs, fry and invertebrates to stranding, desiccation, ultraviolet light, and predation. The applicant's past reservoir management has often resulted in the reservoir being drawn several feet between the spring high level and the end the spawning period. This has been detrimental to spring spawning fish, including smelt. The dewatering of smelt eggs was documented in 1990, 1991 and 1992 resulting in high egg mortality. Because smelt are a primary forage fish for salmonids, it is critical that an

abundant and stable smelt population be available in Harriman Reservoir.

184. The landlocked salmon fishery planned for Harriman Reservoir is projected based on salmon management evaluations conducted in Maine and New Hampshire. Studies show that total annual salmon harvest rates range from 0.1 to 0.5 fish harvested per acre of lake surface area. The Department of Fish and Wildlife has targeted a mean annual harvest rate of 0.1 salmon/acre/year for Harriman Reservoir and has used that estimate in making preliminary estimates of the spawning and nursery habitat necessary to support the fishery. The assumed harvest rate is considered a reasonable yet conservative estimate for the reservoir.

185. Based on the target harvest rate and an assumed reservoir surface area of 1,716 acres (the area at an intermediate level corresponding to a reservoir elevation half way between the full elevation and the low winter elevation), the mean annual harvest would be 172 fish. New Hampshire studies indicate that successful salmon fisheries have harvest success rates of 15 to 25 angling-hours/salmon. Such a fishery in Harriman Reservoir would result in 2,580 to 4,300 hours of fishing.

186. The Searsburg bypass at a minimum flow of 35 cfs contains an estimated 1,047 units of nursery habitat, while the upper Deerfield River above Searsburg Dam is estimated to have at least 1,294 units. At a fry density of 30/unit and a fry-to-smolt survival rate of 2 smolts for each 30 fry stocked (6.6%), 2,073 and 2,562 smolts would be produced from the bypass and upper mainstem, respectively.

187. Maine salmon fisheries exhibit a smolt-to-creel return rate of about 5%. Based on this rate, 3,440 smolts would have to be produced to provide the 172 fish harvest. If the assumptions are correct, the bypass would produce 60% of the total smolt requirement. The upper mainstem would be capable of producing the additional smolts needed to achieve the harvest goals.

188. Use of the upper mainstem would require downstream passage at Searsburg Dam. The need for use of this habitat will be determined in part through annual population surveys of the bypass to determine its smolt production capability. Determination of the age

of smoltification will require at least two annual surveys. Smolt densities of less than 3.3 smolts per unit in the bypass may not meet the harvest goal. To determine the annual harvest, the sport fishery will be monitored directly through creel surveys conducted in years 5 to 7 following the first spring fry stocking.

189. Use of both reaches would necessitate the production of 1.5 smolts per unit to attain the harvest goal, assuming the 5% return rate. A lower return rate would result in an increased total smolt requirement.

*Bypass*

190. The Department of Fish and Wildlife's fisheries management goal for the bypass is to establish self-sustaining wild populations of brown and brook trout, and associated aquatic species, sufficient to support a high quality sport fishery. The reach should have a flow regime (both water quality and quantity) that provides for the establishment of a healthy ecosystem and the variety of aquatic life forms necessary to the system's functioning. While the planned fishery focuses on adult fish, habitat must also be provided for the other species and all life stages so that a self-sustaining population of fish can develop and so that they will have an abundant supply of food organisms.

191. The applicant's plans to release water to the bypass via an existing gate valve in the dam. Since this is a deep-water release from a large reservoir, it should provide stability in both temperature and flow regimes that is conducive to supporting a high quality tailwater fishery. The opportunities for such fisheries in Vermont are extremely limited. Tailwater fisheries currently exist in other states and provide many of the best fishing opportunities available in the country. Therefore, achieving this goal is of substantial importance. The bypass is 4.5 miles long and includes excellent physical habitat for trout and associated invertebrates.

192. *Flow Demonstration - Aquatic Life.* A flow demonstration assessment was conducted to determine the relationship between flow and habitat for target species and life stages, and to form the basis for flow regime recommendations. Assessments were conducted at seven locations representative of the fisheries habitat, four above

the West Branch confluence (referred to as the Upper Section) and three below (referred to as the Lower Section).

The following target flows were assessed: 2-3 cfs (leakage), 30 cfs, 57 cfs, 92 cfs, and 140 cfs. The species and life stages included macroinvertebrates and brown/brook trout spawning and incubation, fry, juveniles and adults.

193. The Upper Section composite habitat/flow curves indicate that habitat is maximized for trout fry and juveniles at 57 cfs, adults at 92 cfs and 140 cfs for macroinvertebrates. The percent change in the amount of habitat as flow increases from 57 to 92 cfs is shown below by life stage.

**Table 10. Harriman Bypass, Upper Section: Change in habitat quantity due to flow change from 57 cfs to 92 cfs.**

| Species | Life Stage | Change in Habitat (%) |
|---|---|---|
| Brook/Brown Trout | Fry | -12 |
| | Juveniles | -6 |
| | Adults | +7 |
| All macroinvertebrates | | +21 |

The highest flow observed (140 cfs) is not the most desirable since fry habitat declines notably and there is little improvement in habitat for the other species/life stages compared to 92 cfs. Overall, a flow of 30 cfs does not provide acceptable habitat conditions.

Additionally, more qualitative observations were also made during the flow demonstration, both with respect to habitat and wadeability for anglers. The 57 cfs release resulted in a reasonably full channel that was wadable and provided a good diversity of habitat for all target organisms. At 92 cfs, water movement increased along the stream margin; fast water was more common in thalweg areas (the deepest part of the channel), and deep-water habitat increased. Wading was found to have become more difficult but is still safe. At 140 cfs, the ability to wade was poor; suitable habitat had declined near the channel thalweg; and the interspersion of different habitat conditions (such as fast water next to an eddy) had decreased.

194. The Lower Section of the bypass is wide, often shallow, and more uniform in substrate, depth, and velocity than the Upper Section. This description is particularly true at station BW3, which is a wide reach with small cobble substrate and fairly uniform depths and velocities. The composite habitat/flow curves for lower section of the bypass show that habitat for juvenile trout and macroinvertebrates increases significantly up to 57 cfs and then changes little at the higher flows. Adult trout habitat increases steadily at each flow above 30 cfs. Fry habitat increases steeply to a maximum at the 57 cfs target release and then declines steeply as the flow increases. Selecting the flow that best accommodates all target organisms involves a trade-off between fry and macroinvertebrates, with the choice being between the target flows of 57 and 92 cfs. As with the Upper Section, a flow of 30 cfs does not provide acceptable habitat conditions.

195. Areas with spawning substrate matching the suitability criteria were identified before the flow assessment and then rated as either suitable or unsuitable at each demonstration flow. The number and percentage of suitable spawning areas or "pockets" are shown in the table below for the bypass sections both above and below the confluence of the West Branch, and for the total bypass.

**Table 11. Frequency of occurrence of useable trout spawning areas in the Harriman bypass.**

| Target Flow (cfs) | Frequency of Useable Spawning Areas | | | | | |
|---|---|---|---|---|---|---|
| | Above West Branch | | Below West Branch | | Composite | |
| | Number | % of Max. | Number | % of Max. | Number | % of Max. |
| leakage | 1 | 6 | 2 | 22 | 3 | 11 |
| 30 | 11 | 61 | 2 | 22 | 13 | 48 |
| 57 | 16 | 89 | 7 | 78 | 23 | 85 |
| 92 | 17 | 94 | 9 | 100 | 26 | 96 |
| 140 | 17 | 94 | 7 | 78 | 24 | 89 |

These results indicate that the target flow of 92 cfs provides the greatest number of suitable spawning areas, although in the Upper Section a flow of 57 cfs provides nearly the same number of spawning areas as 92 cfs. Habitat conditions are notably poorer at flows below 57 cfs. The study results indicate that the flow needs for spawning habitat are similar to those needed for the other target species and life stages.

196. *Temperature and dissolved oxygen regime.* Release of colder reservoir water has the potential to create a high quality tailwater fishery. The temperature regime provided by a cold-water release from a reservoir can often be ideal for the growth of salmonid species. Yet, deep water discharges can also limit fish growth and production as well, because the water from deep reservoir storage can have extremely low oxygen content, have higher heavy metal concentrations than surface waters, and have temperatures varying little above or below 4 deg C, none of which is conducive to good salmonid growth. Adequate growth rates would be provided by water temperatures that have seasonal variation and reach about 12 deg C in the summer.

197. Base flows also must be steady and maintained to provide the proper habitat for salmonids and their forage base. Fluctuating flows or large flow variations, even with appropriate temperature regimes, can result in reduced abundance, diversity, and productivity of many riverine species.[24]

198. Water temperatures in the deeper parts of Harriman reservoir stay very cold through most of the year. As discussed in the water chemistry section above, vertical profiles of temperature, dissolved oxygen and percent dissolved oxygen saturation, done in 1989, 1991, and 1993 at Harriman Reservoir indicate that the Harriman Reservoir is thermally stratified in the summer. Therefore, bottom level releases may not get warm enough in the summer to support good fish growth and production in the bypass. During the flow assessment conducted September 21-24, 1993, water was released at a temperature of 4.7 deg C and only increased in temperature about 2 to 3 deg C before reaching Harriman powerhouse.

199. When the stratification breaks up in the fall, mixing of water in the reservoir can result in fairly homogeneous temperatures in the water column (14.5 deg C was recorded on October 17, 1989 at the surface and down to a depth of 75 feet). But this brief period of water

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

temperatures of 10-14 deg C may not be of sufficient duration to result in adequate growth by salmonids in the bypass. Further, it is not known if temperatures at the depth of the low-level intake will mix to the same extent as those at a depth of 75 feet.

<u>Sherman Facility</u>

*Reservoir*

200. Sherman Reservoir supports populations of smallmouth bass, rock bass, chain pickerel, yellow perch, brown bullhead, sunfish species, and minnow species. Rainbow smelt have also been observed on occasion.

201. Cooperative fishery management of Sherman Reservoir by the fish and wildlife departments of both Massachusetts and Vermont began in 1988 with data collection and 1989 with the stocking of yearling brown trout.

202. Cooperative management objectives for Sherman Reservoir are: 1) the stocking of brown trout annually; 2) the protection of fish nursery areas; and 3) the cooperative development of more extensive management plans for Sherman Reservoir.

203. Water level drawdowns in the range of four to seven feet can have an effect on the littoral community and can disrupt fish nursery areas. Resident populations of fish may be affected during their spawning seasons and juvenile life stages as a result of drawdowns, causing the dewatering of eggs and loss of cover.

**Hydropeaking:**

204. The project storage reservoirs and powerhouses operate in a store-and-release or peaking mode. Frequent fluctuations between the peak flow release and the minimum flow is, therefore, an issue in riverine reaches downstream of powerhouse tailraces.

205. Typical peaking operations subject aquatic organisms to both high and low flows on a rapidly changing basis. The effects differ, depending on how mobile the organism in question is. Unless stranded, highly mobile organisms can move to find suitable habitat, which may change in location as flow changes. Whichever flow

(minimum or generation) provides the smaller amount of habitat tends to be more limiting. Naturally occurring low-flow events may also be limiting, although they differ with respect to timing, frequency, and duration.

206. 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.

207. Immobile species and life stages cannot relocate or move to suitable habitat if the location of the suitable habitat shifts between the minimum flow and generation flows. Since given depth and velocity conditions tend to move away from the thalweg and toward the shore as flows increase, suitable habitat often shifts spatially between the two flows. Macroinvertebrates 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 the organism is controlled by whichever flow (minimum or generation) provides poorer habitat conditions at its location. As with mobile organisms, naturally occurring low-flow events may also be limiting, although they differ with respect to timing, frequency, and duration.

*Somerset Reach*

208. IFIM habitat mapping was provided by the applicant, and allows an examination of the effects of a store-and-release operating regime on habitat. Comparison of the habitat maps for the minimum and generation flows revealed two effects that are not apparent from the review of steady state WUA curves: 1) changes in the locations of suitable cells and 2) changes in the quality of suitable cells. Habitat for brook trout late fry changes in both location and quality between low and high releases. A transition between these releases would require some relocation of fish, although in most cases the distance of movement involved is small. Fluctuations between 200 cfs and the higher flows reviewed showed little change in habitat location or quality.

209. Project operation rarely results in flows higher than 300 cfs. Higher flows are only released when inflows to Somerset Reservoir are high and the level is approaching the spillway.

210. The Agency examined hourly changes in habitat that resulted from project operation modeling (HEC-5). These results indicate that declines in the quantity of habitat are associated much more with low rather than high flow events.

*Searsburg Tailrace Reach*

211. In addition to the steady state IFIM work, the applicant provided habitat mapping for brook trout early and late fry in the powerhouse reach. Also, the Agency conducted a dual-flow analysis to examine the influence of peaking on macroinvertebrates.

212. *Habitat mapping.* The habitat maps suggest that, while there is a loss of wetted area between the generation and low flows, most of the effect of peaking is a change in the quality of suitable cells rather than locational shifts in suitable habitat. Mobile organisms do not need to move much to adjust to the change between the two flows. They can stay in one location and accept the change in habitat quality, or they can relocate to avoid a decline in quality. The habitat maps indicate that high quality habitat for late fry exists at both high and low flows, and that only a modest migration distance separates their locations. Since the peaking effects involve habitat quality changes more than locational changes, whichever flow (minimum or generation) provides the lesser total amount of habitat will be controlling (two-flow analysis).

213. *Two-flow analysis.* The two-flow analysis compares the total WUA available at the minimum flow with that at the generation flow and assumes that flow with the lesser WUA is more limiting in terms of habitat. Total WUA for brook trout fry in the powerhouse reach is summarized below for selected flows. Data are from the composite WUA curve prepared by the applicant (Letter from Mark J. Wamser, Gomez and Sullivan Engineers to Jeffrey Cueto, Department, Habitat Time Series Results for Baseline and NEP Proposal, August 13, 1993).

**Table 12. Habitat for brook trout late fry, Searsburg tailrace reach.**

| Flow (cfs) | Weighted Useable Area (sq. ft.x $10^3$) | Flow (cfs) | Weighted Useable Area (sq. ft.x $10^3$) |
|---|---|---|---|
| 30 | 137 | 240 | 150 |
| 40 | 147 | 270 | 145 |
| 60 | 162 | 340 | 131 |
| 70 | 165 | | |

This data shows that a similar amount of habitat is available at the generation flow level as at 30-40 cfs.

214. *Dual-flow analysis.* Immobile or poorly mobile organisms cannot relocate in response to hydropeaking. The dual-flow analysis assumes that an immobile organism is controlled by whichever flow (minimum or generation) provides poorer habitat conditions at its location. The dual-flow analysis uses this assumption to quantify the habitat that "remains available" under a peaking operation with a specified minimum flow and generation flow.

215. A dual-flow analysis was conducted by the Agency for macroinvertebrates, since they are essentially immobile. The percent habitat losses resulting from peaking is shown below for several combinations of minimum and generation flows. The loss is with reference to the habitat that exists under the base flow, or minimum flow.

**Table 13. Impact of generation flows on macroinvertebrates, Searsburg tailrace.**

| Flow (cfs) | | Habitat Loss (%) |
|---|---|---|
| Minimum | Peak Generation | |
| 60 | 120 | 0 |
| | 270 | 7 |
| | 360 | 12 |
| 90 | 120 | 0 |
| | 270 | 6 |
| | 360 | 9 |

216. These results indicate that the generation flow has little effect on habitat. There is very little benefit to be gained from a maximum flow limit. It is the minimum flow that significantly affects habitat.

## VII. Wildlife and Wetlands

217. Wetland areas exist that are associated with Somerset and Harriman reservoirs and the East Branch below Somerset Reservoir. (License Application, Volume XIII, Appendix E5, Wetland Inventory, January 1989) Several wetlands associated with the two reservoirs are categorized as Class II wetlands under Vermont Wetland Rules (adopted by the Water Resources Board pursuant to 10 V.S.A. § 905). Vegetative communities were field assessed in autumn of 1989 (License Application, Volume XIII, Appendix E6, Assessment of Wetlands at Harriman and Somerset Reservoirs, March 1991).

218. Wetland plant communities around the shorelines of the two reservoirs are limited in extent; this condition was attributed to non-nutritive, sandy and gravelly substrates; soft, clear waters; steeply sloping shorelines; wind and wave effects; and water level fluctuations. According to the survey, only two areas of muck soils support quality wetlands at Somerset Reservoir and only alluvial deposits at tributary mouths, including the mainstem of the Deerfield River, support wetlands of substantial extent at Harriman Reservoir. Other wetlands consist primarily of plant species that are tolerant of drawdowns.

219. The extensive drawdowns at Somerset and Harriman reservoirs are a major factor in preventing the establishment of beneficial wetland plant communities that would otherwise become established along the shoreline margins and in the shallow areas of the reservoirs. Perennial species that could become established if the reservoirs were stabilized include cattail, soft-stem bulrush, arrowhead, rattlesnake mannagrass, horsetail, and spike rush. Over time, the organic soils would accumulate in the wetland zones and cover the presently coarse substrates. The extent of possible wetland establishment through alternative water level management regimes has not been determined, as consideration is not being given to restrictions for the purpose of enhancement of wetlands.

## VIII. Rare and Endangered Plants and Animals; Outstanding Natural Communities

The Vermont Endangered Species Law (10 V.S.A. § 5401 to 5403) governs activities related to the protection of endangered and threatened species.

**Common Loon** (Gavia immer)

220. Somerset Reservoir has been Vermont's only nesting site for loons in the southern portion of the state and provides important regional habitat for the common loon, which was legally designated a state endangered species in 1987. Loons have been observed on the reservoir since 1977. Statewide, Vermont has supported 13 to 16 pairs of nesting loons since 1989.

221. A rise or fall of the reservoir's water level can severely impact the reproductive and nesting success of this endangered bird species. Nest flooding and predation are the two most common causes of nest failure in Vermont; over the period 1978-93, they each accounted for 26% of the failures. Nest stranding is also a cause for failure and accounted for 6% of the failures during that period. (Renfrew and Rimmer, The 1993 Breeding Status of Common Loons in Vermont, Vermont Institute of Natural Science, n.d.)

222. During the sixteen-year period 1978-93, loons nested on Somerset Reservoir in 11 years and were successful (young survived through August) in 7 years, producing 10 chicks total, or 6% of the known state production. The mean annual number of surviving chicks per nesting pair is 0.91 for Somerset Reservoir, slightly less than the state average of 1.00 chick/nesting pair (the survival rate for individual ponds varies from 0.40 to 1.53). *Id.* A chick fledged in 1994 as well.

223. The applicant has worked with the Vermont Institute of Natural Science and the Agency in past management of Somerset Reservoir to protect loon nesting.

224. Loon nest site selection and building typically begins in early May. Egg laying and the start of the 28-day incubation period may begin about mid-May. Chicks leave the nest within hours of hatching. It is common for loons to renest if the first attempt fails; however, if

renesting is later than July 15, the chick(s) would be unlikely to mature sufficiently to migrate in the fall.

225. The amount of water level fluctuation that is tolerable varies with physical characteristics of the nesting site. Drawdowns in excess of 3 inches can be excessive, especially where the shoreline gradient is shallow. Flooding is a more common and acute problem as it kills the eggs. A drop in elevation can make the nest inaccessible to the adult or expose the nest to predation. At Somerset during 1994, a reservoir drop of 6 or 7 inches below the nest forced the adult to drag itself 12 feet between the nest and the water (Memorandum from Steven Parren, Department of Fish and Wildlife, to Department, September 14, 1994).

226. The water elevation determined to be appropriate for protection of the 1994 nest site was 2128.58 feet msl. Nesting may occur on the same island at other elevations or at other reservoir locations in a given year. An elevation of 2128.58 feet msl is considered a reasonable target elevation to achieve by May 1 in order to support loon nesting. In certain years, the elevation may not be attained by May 1, and loons would either nest at a lower elevation or, depending on ice conditions, hold until ice out and nest later. Water elevations higher than 2128.58 feet msl may not be conducive to nesting. (Memorandum from Steven Parren, Department of Fish and Wildlife, to Department, September 14, 1994)

**Applicant proposal for relicensing:**

227. Under the draft settlement agreement, the proposal is to maintain a stable reservoir during the period May 15 through July 15 for the protection of loon nesting. Stable is defined as a normal fluctuation of plus/minus 1 foot.

**Tubercled Orchid** (<u>Platanthera</u> <u>flava</u>)

228. The bypasses at Harriman Station and Searsburg Station contain populations of the state threatened tubercled orchid. The Harriman bypass population, which contains over 130 stems at 35 locations, is the largest known population in the state. Three other populations are known outside of the Deerfield basin; these other populations contain only a few plants. The tubercled orchid is known also from nineteen historical locations where it was identified prior to 1970).

229. Two rare plants also occur in the Harriman bypass: musk flower (Mimulus moschatus) at three locations and a single site for dwarf bilberry (Vaccinium cespitosum). One rare plant species, Canada burnet (Sanguisorba canadensis), occurs at seven locations along the Searsburg bypass.

230. The tubercled orchid occurs mainly along riverbanks where it is subject to periodic scouring by high water and ice. This action apparently serves to reduce competition with other plants and allows the orchid to receive nearly full sunlight. The flooding may also serve to spread the species by disseminating seeds.

231. Although the orchid can tolerate periodic flooding, especially in the dormant season between mid-September and early May, it cannot survive permanent inundation nor is it tolerant of inundation during the growing season, which can result in damage due to scouring, siltation, and root rot.

232. In the Harriman bypass, the river channel is artificially reduced in width due to the absence of flow. Areas that were formerly part of the channel or banks are now densely populated by alders and willows. Most of the orchids found in the bypass occur on tussocks situated in the present channel; a few individuals occur on the bank where there is an absence of alders.

233. Projections were made of orchid mortality based on observations made during the test flows released in September 1993. Since it is solely based on the number of individuals actually inundated at each test flow, mortality is probably underestimated. It is reasonable to assume that additional plants located slightly above the water level would also eventually be harmed by the higher water levels.

**Table 14. Tubercled orchid mortality at Harriman bypass.**

| Flow (cfs) | Mortality |
|---|---|
| 30 | 40% |
| 57 | 60% |
| 72 | 75% |
| 92 | 90% |

Because the musk flower occurs on sandy riverbanks at the water's edge, mortality at the three locations is estimated to be 100% at the lowest test flow of 30 cfs. The single site for the dwarf bilberry is on a rock presumably beyond any influence of increased flows.

234. The population of tubercled orchids in the Searsburg bypass consists of at least 90 stems at two or more locations. All of the plants observed occur along the edge of the riverbank; a group of 82 stems occurs in the bypass, and a group of 8 stems is in the tailrace reach. The plants were located by a consultant working for the Vermont Agency of Transportation in conjunction with the proposed widening of Vermont Route 9. Although the entire bypass reach was inventoried for the orchid, only the portion along Route 9 was inventoried when the plants were in flower and most easily identifiable. Other plants may exist in the bypass section above Route 9. Canada burnet occurs along the edge of the riverbank at eight locations along Route 9.

235. No assessment has been made of the mortality that may result either to the tubercled orchid or to the Canada burnet due to the provision of a minimum flow in the Searsburg bypass.

**IX. Shoreline Erosion and Desilting**

236. The applicant surveyed Somerset, Searsburg, and Harriman reservoirs for shoreline erosion problems. Field observations were done October 22-23, 1990. (License Application, Volume VII, Appendix E3, Reservoir Bank Erosion Investigation, Somerset, Searsburg, and Harriman Reservoirs, April 3, 1991)

237. The three reservoir shorelines are generally stable. The shorelines at Somerset and Harriman are mostly rocky and well armored, a condition that resulted from the initial erosion of the fine soils that were exposed to flooding, wave action, and the loss of vegetation when the projects began operation in 1912 and 1924, respectively. The riverbank along the Searsburg impoundment is well vegetated, and the soils exposed during drawdowns are not subjected to substantial wave action.

238. Some minor erosion has been identified at recreational areas at Somerset and Harriman reservoirs. Erosion is occurring at the applicant's picnic areas along the west shore at the north end of the

reservoir and along the east shore at Wards Cove and at the boat launch near Whitingham.

239. Desilting does not occur at any of the Vermont facilities. (License Application, Volume XVIII, NEP Responses to Agency Correspondence, Table NEP-2.1, *Studies Requested by VANR During Consultations*)

## X. Recreational Use

240. The Deerfield River, the East Branch, and Somerset, Harriman, Searsburg, and Sherman reservoirs are popular for several water and land recreational uses such as angling, swimming, sunbathing, sail and power boating, trail uses, picnicking, photography, and viewing. Between 10 and 12 million people live within a 100-mile radius of the Deerfield basin, and the region offers these mostly urban populations a variety of four-season recreational opportunities. The Deerfield River region is popular to both local residents and as a destination for out-of-state recreation users. The river and associated reservoirs and impoundment have high recreational value, and there is a demand for additional recreational facilities such as canoe portages and improved public access (Comprehensive River Plan for the Deerfield River Watershed, VT Department of Environmental Conservation, November 1992).

241. The project lands, reservoirs, and river reaches receive substantial recreational use throughout the year. In 1991, the extent of recreational use of project lands was estimated at 7,263 user-days in the winter (approximately November 1 - March 31), 448,082 user-days in the spring and summer period (April 1 - August 31), 47,454 user-days in early fall (September 1 - Columbus Day), and 36,439 in late fall (Columbus Day - December 31). The late fall use was confined to hunting and land-based casual recreational use. (License Application, Volume XIX, Exhibit E(5), Supplemental Report on Recreational Resources, July 21, 1992)

242. The Deerfield River and the East Branch, Searsburg impoundment and the three reservoirs are navigable and boatable waters of the State.

243. The project has outstanding visual qualities. The river setting, other than electrical transmission appurtenances and the village areas of

Wilmington and Readsboro, is essentially undeveloped. Remote qualities associated with waterbodies are becoming less frequent in the region and state.

244. FERC regulations related to providing recreation benefits at licensed projects encourage project owners to give adequate consideration to the recreational demands of the public. 18 CFR, Section 2.7 requires licensees to define project boundaries ". . . to assure optimum development of the recreational resources afforded by the project."

245. The applicant has developed a system-wide, comprehensive recreation plan for the Deerfield River basin. The applicant has a longstanding commitment to providing public access to its lands, as illustrated by portions of its Recreation Mission Statement: "NEP is committed to providing a diversity of opportunity for quality recreation while protecting natural resource values and without impairing the operation of these properties for their primary purpose of producing power. The Company stresses the need to provide quality recreational experiences while avoiding over-crowding . . ." To fulfill its mission, the applicant's Outdoor Recreation Management Policy includes: "Maintaining resource quality and the special character of those areas . . . [m]aintaining the quality of the existing recreational experiences available . . . [p]roviding access to the water, and to all areas within the ownership, where it is safe to do so . . . [p]roviding a diversity of recreational opportunity . . . [p]roviding high quality, well maintained recreational facilities that are appropriate for the area, maintaining quality and appropriateness through facility design and capacity considerations . . . [p]roviding unique backcountry and undeveloped recreational opportunities that are appropriate and minimally impact these areas . . . [c]ontinuing to emphasize its long-standing 'day use only' policy as the primary policy . . ." (Response to AIR No. 24, Recreational Enhancements Supplemental Information, October 1993)

246. The applicant proposes to continue to provide access to the public at the three reservoirs and one impoundment using existing access sites and facilities. In the **Somerset Zone** (includes Searsburg impoundment and the East Branch), the applicant proposes to "[r]etain this area as a low use, remote location with hiking trails, possible primitive camping, and a low level of boating use [and]

[e]mphasize recreation values which are compatible with the remote wilderness character of the area, and maintain protection of existing critical habitat for Common Loon and Bald Eagle." The applicant proposes to possibly develop five primitive campsites; upgrade, but not enlarge, the picnic area and boat launch; build two portage trails and create a Searsburg carry-in access; improve three existing trails; and construct three new trails. *Id.* In addition, the applicant has proposed boating restrictions on Somerset Reservoir, which will be posted at the boat launch and enforced through access control. The restrictions include no motorized craft, except for official business, permitted north of the narrows in the center of the reservoir; no motorized craft with an engine over 35 horsepower, except for official business, permitted to access the reservoir or operate on the lower (southern) half of the reservoir, below the narrows; and no jet skis permitted access to the reservoir. *Id.*

247. In **Zone 2: Harriman**, the applicant proposes to maintain the existing picnicking and boating facilities and create facilities at the northern and southern end of Harriman Reservoir. The additions are to consider the limited carrying capacity of the reservoir for boating and sailing, and developed facilities. The applicant proposes, at the northern end of Harriman, to make improvements to, but not enlarge, five picnic areas (Mountain Mills East and West, Molly Stark, Castle Hill and Jacksonville); upgrade the boat launches at Mountain Mills East and Castle Hill; build trailhead parking at Mountain Mills West; maintain the Harriman West Side Trail; and develop a new picnic and boat launch facility (the North Branch facility). Toward the south end of Harriman, the applicant proposes to construct a new single ramp boat launch with parking along Vermont Route 100; upgrade the boat ramp at Sawyer; and construct a new picnic and swimming facility (the Whitingham Picnic Area) on the Harriman Dam access road. *Id.* The applicant does not propose a portage trail around the dam at Harriman Reservoir, because no special flow releases for boating are proposed for this reach of the Deerfield River.

248. The applicant has permitted sheltered mooring for up to 50 sailboats in Wards Cove south of the Jacksonville Picnic Area through a formal agreement dated July 13, 1992 between the applicant and the Windham Sailing Club .

249. In **Zone 3: Readsboro/Sherman/Zoar**, the applicant proposes to improve existing facilities for boaters. For Sherman Reservoir, this includes improving the picnic area and boat launch. In addition, the applicant proposes to add two new trails of over 13 miles from Readsboro to Zoar; upgrade 2.6 miles of existing trail; expand scheduled whitewater releases for boating; expand Dunbar Brook Picnic Area; build two new whitewater launch sites and spectator trails; and provide better angler access to the river at Fife Brook. No whitewater boating releases are planned in Vermont.

250. The applicant also proposes a comprehensive, coordinated signage program so that all facilities have standard signs and a consistent image. There are four types of signs proposed: Part 8 signs; disabled facility signs; trailhead signs; and facility signs.

251. The Deerfield River Guidebook, Lessels and Sims, 1993 provides information on whitewater boating opportunities in the three flow-regulated reaches in Vermont.

**Somerset.** This remote six-mile reach is canoeable at flows as low as 150 cfs. After a half-mile Class III+ gorge reach, the water is mostly Class I or II with several beaver flowages. Releases from Somerset to operate Searsburg provide sufficient flow to run this reach, and the flow is available during periods when natural flows in other rivers are inadequate to support whitewater boating.

**Searsburg.** Spillage of 800 cfs and higher at Searsburg Dam supports use of this excellent Class II or III run; above 1,400 cfs, the middle section is Class III+ or IV. When the powerhouse is operating at capacity with no flow in the bypass, the half mile to Harriman Reservoir is runnable, but "scratchy".

**Harriman.** Occasional high spillage flows at Harriman Dam provide a rare opportunity to boat the remote and challenging reach downstream. The first three miles, above Readsboro, is mostly fast-flowing Class III.

## XI. Aesthetics

252. In Vermont, much of the Deerfield River watershed is under the ownership of the applicant or the Green Mountain National Forest. Somerset Reservoir is surrounded by over 6,000 acres of land owned

by the applicant and substantial additional acreage that is part of the National Forest. The applicant has land holdings of almost 7,000 acres near Harriman Reservoir. The two reservoirs together comprise about 3,500 acres of water. Vermont routes 9 and 100 and the nearby town road networks host much of the watershed's development, but the watershed is mostly remote, rural, and somewhat isolated. The East Branch river corridor, the shoreline of Somerset Reservoir, the Deerfield River corridor above Searsburg impoundment, and the corridor of the Deerfield River between Harriman Dam and Readsboro Village all retain a remote, somewhat pristine quality.

253. The Department's comprehensive river planning initiative identified a local interest in maintaining the wild and pristine attributes of the East Branch watershed; avoiding large-scale development in the Deerfield basin overall; and promoting the region's recreation-based economy. (Preliminary Comprehensive Rivers Plan for the Deerfield River: An Inventory of Uses, Values, and Goals, VT Department of Environmental Conservation and the Windham Regional Commission, July 1991) Protection of the area's aesthetics is important to the identified goals.

254. The draft settlement agreement provides for conservation easements over Project lands[25] and certain other lands under the applicant's ownership, for the term of the license. The applicant will also be making a substantial investment in its recreational facilities and, under the terms of the draft settlement agreement, provide for a recreation enhancement trust fund for watershed conservation and planning and development of low-impact recreational and educational projects and facilities. Timber management, under the agreement, will also be carefully controlled.

255. Watershed protection and development and maintenance of recreational facilities as proposed will foster the protection of watershed aesthetics.

256. Aesthetics issues are raised by flow and reservoir regulation as well. Reservoir drawdowns expose extensive areas of the shoreline, and

[25]Project lands in Vermont total about 15,700 acres, excluding the reservoir acreages. Most, if not all, land holdings in Vermont are within the project boundary.

lack of minimum flows has resulted in virtually dry rivers in Vermont.

257. FERC issued AIR No. 22 to obtain information on the effects of drawdowns in Somerset and Harriman reservoirs on aesthetics and recreational use. Extensive documentation of reservoir conditions was obtained through videotaping and still photography, covering the range of normal water levels. The work was done in October 1992, mid-February 1993, mid-March 1993, and early May 1993. Observations were made from the recreation areas on the reservoirs.

258. The February and March views are under snow-cover conditions, and the May views are under full-reservoir conditions. The October views were made under the most critical condition of a typical fall drawdown with extensive exposed areas and no ameliorating effects of a snow cover. The applicant's response to AIR No. 22 does not attempt a qualitative evaluation of the visual impact of reservoir drawdowns, but simply provides the photographic documentation described above. The response does include a discussion of the non-aesthetic impairment of recreational use, in terms of the physical conditions for snowmobiling on ice or use of beaches or boat launches.

259. FERC issued AIR No. 23 to obtain videotape information on the aesthetic values of flows that were considered in biological instream flow studies and an assessment of flow needs for aesthetics. The applicant's assessment considered the visual and audible qualities of the flows, the degree of public exposure, the setting, and the cost of providing the flows. In all cases, a flow of 0.31 csm was recommended. Observations were made from two locations below each of the dams. (Response to AIR No. 23, Aesthetic Analysis of Flows, January 1994)

260. At Somerset, observations were made directly below the gatehouse and at the East Branch trail footbridge, about five miles downstream. Target flows of 0.31 csm (9 cfs), 0.5 csm (15 cfs), and 0.7 csm (21 cfs) were to be analyzed; however, a comparative analysis was not possible at the footbridge due to excessive runoff. The flows at the footbridge were 22 cfs, 35 cfs, and 203 cfs.

261. At Searsburg, flows were observed from the Vermont Route 9 bridge and from a highway pull-off. The target flows were 28 cfs, 45 cfs, and 63 cfs; flows observed were generally somewhat higher.

262. Below Harriman, observations were done at Readsboro Bridge and downstream along River Road, in conjunction with the habitat flow study. The observation flows at the bridge were leakage (0.02 csm), 0.16 csm, 0.31 csm, 0.50 csm, and 0.76 csm. Flows at River Road were augmented by the West Branch and were, therefore, somewhat higher.

**Table 15. Aesthetics Study Observation Flows (cfs).**

| Somerset | | | Searsburg | | | Harriman | | |
|---|---|---|---|---|---|---|---|---|
| Target | Dam | Footbr | Target | Bridge | Pull-off | Target | Bridge | River Road |
| 9 | 4 | 22 | 28 | 25 | 45 | Lkage | 3 | 25 |
| 15 | 14 | 35 | 45 | 50 | 53 | 30 | 30 | 61 |
| 21 | 23 | 203 | 63 | 71 | 90 | 57 | 57 | 81 |
| | | | | | | 92 | 92 | 94 |
| | | | | | | 140 | 140 | 190 |

## XII. Other Uses

263. The Department has not identified any non-designated existing uses that are not Class B designated uses and would be affected by the project.

## XIII. State Comprehensive River Plans

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

<u>Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities</u> (May 1988)

264. The Department publication <u>Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities</u> 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 to establish minimum flow requirements for the project in order to improve the river fisheries, water quality, recreation and aesthetics and to stabilize impoundment water levels to protect reservoir fisheries resources.

<u>1988 Vermont Recreation Plan</u>

265. The <u>1988 Vermont Recreation Plan</u> (Department of Forests, Parks and Recreation), 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 critical 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.

266. 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.

267. Enhancement of access, provision of portages, and improved flow management would be compatible with this policy and balance competing uses of the river for recreation and hydropower.

Nonassurance of access or failure to provide convenient portage trails would exacerbate a critical state recreational problem.

268. Another priority issue identified in the Recreation Plan is the loss or mismanagement of scenic resources. The plan notes "[f]ew 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."

269. 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.

Vermont Comprehensive Energy Plan (January 1991)

270. Pursuant to Executive Order No. 79 (1989), the Department of Public Service produced the Vermont Comprehensive Energy Plan. 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.

271. Vermont is not within the applicant's retail service area. The electricity produced by the Deerfield River Project is primarily used by consumers in southern New England.

Comprehensive River Plan for the Deerfield River (August 1992)

272. The Department recently completed a comprehensive river planning process for the Vermont portion of the Deerfield River watershed. The management goals and recommended actions contained in the Comprehensive River Plan for the Deerfield River Watershed (August 1992) have been derived from state law and written state policies along with an expression of public interest as determined through a three-year public participation process. Individuals who participated in the planning process expressed, as major issues of

concern, the protection of water quality, enhancement of Deerfield River fisheries, and maintenance and enhancement of recreational opportunities. Attached as Appendix A to this document is a copy of the hydroproject related goals identified in the plan.

## XIV. Analysis

### Bodies of Water

#### Somerset Reservoir

273. The applicant's proposal is for continuing the status quo in reservoir operation, but formalizing the management necessary for loon nesting protection.

274. The proposed water level management range for the loon nesting period (maintenance of water levels within a 2-foot range from May 15 through July 15) is inadequate for protection of nesting success. All reasonable measures should be instituted to reach a target elevation of 2128.58 feet msl by May 1 and to maintain the level within + / - 3 inches through July 31, unless the Department of Fish and Wildlife determines earlier than July 31 that there is no nesting. Continued close cooperation between the applicant and the Department of Fish and Wildlife will be necessary to assure loon protection and to adjust management in specific years as necessary to account for loons nesting at a lower elevation or for high inflow that results in the target elevation being exceeded on May 1. A reservoir stage recorder and real-time data transmitter is needed to enhance the capability of monitoring of reservoir elevations and reacting to changes in stage. Gate automation may be warranted if nesting failure is frequent due to flooding or stranding.[26]

275. Holding the reservoir stable during the period of May 1 through July 15 will help promote successful smallmouth bass spawning and fry development and provide an opportunity for temporary colonization of the littoral zone by aquatic macroinvertebrates until the late summer drawdown. This stabilization period may also allow for some colonization by aquatic macrophytes. Other warm water

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[26] By facsimile memorandum of August 26, 1994, the applicant proposed to convert the manual gate mechanisms to a remotely controlled operation, with a goal of completing the conversion by the end of 1998.

fish resident in Somerset Reservoir will spawn in the spring under a rising or stable reservoir, a condition which will be compatible with their spawning, egg incubation, and early fry development needs.

276. The present catch rates for smallmouth bass compare favorably to the catch rates estimated for Willoughby Lake and Seymour Lake and can be expected to improve with stabilization of spring reservoir levels.

277. *Drawdowns.* In order to protect summer/fall recreational use, a limit on drawdowns is necessary. Present operation is to typically draw the reservoir from elevation 2131 feet msl to 2124 feet msl over the period from the spring high level to the fall low. A maximum drawdown level of 2120 feet msl is required as a condition of this certification to protect open-water recreational use, which declines after Columbus Day.

278. The reservoir is typically drawn to an elevation of about 2116 feet msl, or 16 feet above the outlet, during the winter. This results in an overall reduction in the reservoir volume of 39% relative to the normal spring high elevation. In order to prevent the excessive release of reservoir biomass and to limit predation during the winter, a maximum annual drawdown limit of 2107 feet msl is required as a condition of this certification. Relative to the typical spring high elevation, drawdown to an elevation of 2107 feet msl would result in a reduction in reservoir volume of 57%.

279. Current impoundment operations are based on a watershed model that uses measurements of snowpack water equivalent to estimate spring snowmelt runoff and adds anticipated spring precipitation to determine the maximum winter drawdown. A more refined model of basin hydrology and project operations could be developed and used in order to create more accurate predictions of inflows on a seasonal, weekly, and daily basis and thereby reduce the occurrences of drawdowns that exceed the level necessary to capture spring runoff. A regression analysis using historic data could be used to generate a model that more closely correlates forecasted inflow volumes with actual inflows from snowpack meltwater. The model could include real-time data for precipitation, snowpack water

equivalent, temperature, reservoir levels, and discharge constraints[27], as well as routing equations to continuously predict inflow rates and necessary gate adjustments. Such modeling improvements are warranted as it is the policy of the State to, over the long term, upgrade the quality of waters and to reduce existing risks to water quality (10 V.S.A. § 1250, *Water Quality Policy*); improved modeling is being made a condition of this certification for both Somerset and Harriman reservoirs.

**Searsburg Impoundment**

280. Operation of this impoundment will continue to impact the aquatic community. In order to make any measurable improvements in the fisheries of this impoundment, water level fluctuations would have to be greatly reduced in both magnitude and frequency.

**Harriman Reservoir**

281. The winter drawdown and water level management at other times of the year will prevent the establishment of a functional littoral community. Reservoir productivity will continue to be affected.

282. Rising or stable water levels during the period of April 1 through June 15 will help promote successful smelt spawning and fry development. Conditions for spawning and incubation of smallmouth bass and other resident warm water species will also improve. During June 16 through July 15, the maximum drawdown rate should not exceed 1.0 foot/day in order to allow smallmouth bass fry the opportunity to move and avoid stranding.

283. The present catch rates for smelt, smallmouth bass, and yellow perch compare favorably to the catch rates estimated for Willoughby Lake and Seymour Lake, and Harriman Reservoir's catch rates can be expected to improve with stabilization of spring reservoir levels. Trout catch rates are low compared to Willoughby Lake and

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[27]One significant change that will affect the rate of rise of the reservoirs in the spring is the new requirement of minimum flow releases. These releases will necessitate that the reservoirs be drawn several feet less in the winter to attain the same target elevations in the spring. For example, a minimum flow of 70 cfs in the Harriman bypass, released over a three month rising-reservoir period, would necessitate starting at a low reservoir level of about 1452 feet msl instead of 1440 feet msl. The minimum flow is an important factor in eliminating the need for winter drawdowns in excess of elevation 1440 feet msl.

Seymour Lake, which are quality trout waters, but the total catch of salmonid species, trout and salmon, can be expected to improve markedly with improved management through lower stocking densities and the reintroduction of landlocked salmon using the Searsburg bypass for production of wild fish, and possibly the upper mainstem as a supplement for non-natal production through fry stocking.

284. *Landlocked salmon management.* Successful salmon management may require use of nursery habitat above Searsburg Dam. However, it is appropriate to first evaluate the viability and potential for success of salmon management in Harriman Reservoir and its tributaries. The water chemistry of the reservoir and its tributaries, water level management, and tributary flow regimes may all influence program success. The Department of Fish and Wildlife intends to initiate landlocked salmon management through the stocking of juvenile salmon in Harriman Reservoir and/or its tributaries, and will then assess the success of the fishery. Salmon management should be fully evaluated prior to making a request for downstream fish passage at Searsburg Dam. Such a request should be predicated upon a determination that 1) use of nursery habitat above the dam is necessary and 2) salmon management can be successful (based on evaluations made prior to the request).

285. The need for downstream passage will be determined over a seven-year period using stream and lake evaluation studies. This research would be conducted by the Department of Fish and Wildlife and would include assessment of survival and growth of juvenile salmon in tributaries and survival, growth, and harvest of adult salmon.

286. *Drawdowns.* In order to protect summer/fall recreational use, a limit on drawdowns is necessary. Present operation is to typically draw the reservoir from elevation 1494 feet msl to 1480 feet msl over the period. A maximum drawdown level of 1475 feet msl is required as a condition of this certification to protect open-water recreational use, which declines after Columbus Day.

287. The reservoir is typically drawn to elevation of about 1455 feet msl, during the winter, but has been drawn to much greater depths[28]. The typical drawdown results in an overall reduction in the reservoir volume of 54% relative to the normal spring high elevation. The intake trashrack at the outlet of Harriman Reservoir does not prevent the entrainment of fish; reservoir biomass is discharged to Sherman Reservoir during the winter drawdown. In order to prevent the excessive release of reservoir biomass and to limit predation during the winter, a maximum annual drawdown limit of 1440 feet msl is required as a condition of this certification. Relative to the typical spring high elevation, drawdown to an elevation of 1440 feet msl would result in a reduction in reservoir volume of 68%.

**Sherman Reservoir**

288. Water level management will continue to affect the littoral community. Fishes, such as bass, pickerel, and minnows, that utilize the shoreline areas will be affected.

**Water Chemistry**

289. Both Somerset and Harriman reservoirs are known to thermally stratify during the summer, producing low dissolved oxygen conditions at the water column depths where water is drawn into the intakes. At Somerset, the outlet configuration is such that the pipes discharge into the atmosphere in a free jet, experiencing rapid turbulent entrainment of oxygen. Further, the outlet tower draws water from a depth (summer conditions) of only about 30 to 35 feet. At Harriman, water is typically drawn from greater depths, including the hypolimnion, and there is a higher risk of a substandard release, both at the powerhouse and into the bypass. The aeration efficiency of the turbine air manifold is undefined. Assuming the dissolved oxygen levels recorded in the Harriman tailrace are accurate, large-volume discharges of water substandard in dissolved oxygen have occurred. The sampling base is very small, and additional sampling to fully define the magnitude and frequency of substandard conditions, if any, and effect solutions is needed. Similarly, the

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[28]For example, in February 1976 the level was drawn to elevation 1416 feet msl, or about 70 feet below the normal summer level. (Response to AIR No. 22, Somerset & Harriman Aesthetics Documentation, Fig. 22-4, *Harriman Reservoir Midnight Elevations*)

reaeration efficiency of the low-level outlet at the dam has not been defined; the design for the minimum flow device has not yet been developed and will be an important factor in the extent of reaeration.

290. The increase in the Harriman bypass minimum flow will provide sufficient dilution to remove the risk of a conflict with the assimilation of the Readsboro wastewater discharge. The summer guaranteed minimum flow required by this certification, 57 cfs, is on the order of four times the river's 7Q10 flow, which is the basis for wastewater treatment plant design.

291. Sufficient flows will be available in the flow-regulated reaches of the East Branch and the Deerfield River such that the impact of the project on concentrations or levels of the following parameters will not be significant:

Phosphorus
Nitrates
Oil, grease, and scum
Alkalinity
pH
Toxics
Escherichia coli
Color
Taste and odor

__Bypassed River Reaches__

292. 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 analyzed 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 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.

### Searsburg

293. The applicant has proposed a bypass minimum flow of 28 cfs (0.31 csm) or inflow. The August median flow was re-estimated as 35 cfs (0.39 csm) by AMC. The bypass above the Route 9 bridge is a wide riffle and requires a lot of water to provide high quality habitat. The natural hydrology does not provide sufficient water on a sustained basis to optimize habitat conditions for adult trout and macroinvertebrates. Even though flows above the August median flow provide more habitat for most target organisms, higher flows cannot be sustained from natural inflow. Flows naturally drop below this level. Provision of the August median flow during the summer season is consistent with the seasonal natural hydrology.

294. A higher flow is appropriate during the fall/winter period to protect salmon and trout spawning and incubation and overwintering fish and macroinvertebrates. Based on the flow demonstration work in 1994, a flow of 55 cfs was found to be acceptable for overwintering, although not optimal.[29] It is uncertain as to whether or not the areas offering suitable spawning habitat at this flow are sufficient to produce enough juvenile salmon to fully utilize the available rearing habitat. However, given the shape of the channel, abundant spawning habitat can only be achieved at relatively high flows.

295. Should the program to develop a landlocked salmon fishery fail or should adequate smolt production stem from the use of the watershed above Searsburg Dam, special fall/winter spawning and incubation flows would still be necessary to serve resident trout in the Searsburg bypass.

296. *Temperature.* The temperature criterion (Standards Section 3-01(B)(2)) limits increases in temperature to 1.0 deg F. Artificial flow regulation has produced a condition where the water temperatures in the bypass have exceeded this criterion. Samples

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[29] The fall/winter low month median flow under natural conditions probably exceeds 1.0 csm, or 90 cfs at the dam.

collected in 1989, for example, exhibited an increase in temperature of 5 deg F over the distance of the bypass, approaching the air temperature. Under natural flow conditions, it is unlikely that the increase in temperature would have been nearly as great. The minimum flow required by this certification will assure that temperature changes will meet the criterion.

297. *Aesthetics.* The summer flow proposed for the bypass, 35 cfs, is on the order of the low flow observed in the aesthetics study. It can be characterized as adequate for the support of aesthetics as a designated use (Standards Section 3-03(A) *Class B Waters: Management Objectives*). It is a substantial improvement over the present dry condition, but not of the visual quality of the higher flows observed.

**Harriman**

298. Based on the visual habitat assessment work, a flow above 57 cfs but less than 92 cfs would be optimal. A flow in the vicinity of the August median flow (estimated at 72 cfs) would provide high quality habitat conditions. The draft settlement agreement contains a flow of 74 cfs, or inflow if less.

299. Given the high value fishery that should develop in this bypass, it is desirable to guarantee minimum flows and not reduce them when inflow to Harriman Reservoir recedes. This is feasible due to the storage capacity of the reservoir. During the low-flow months of July through September, inflow to Harriman Reservoir may recede to the point where too high a guaranteed bypass minimum flow could result in an unacceptable decrease in the reservoir water level. A lesser, guaranteed minimum flow that still provides good habitat in the bypass would resolve this conflict. This certification is therefore conditioned on a minimum guaranteed flow of 70 cfs.

300. *Temperature/dissolved oxygen.* Available temperature data suggest that bypass releases through the existing release structure will not provide a favorable environment for fish growth. The impact of a low-level withdrawal on downstream levels of dissolved oxygen and temperature have not been well defined. Abiotic factors must be maintained within suitable ranges in order to manage for an outstanding cold-water fishery. The water quality study required as a condition of this certification will provide information on the

suitability of stream temperatures for adequate trout growth rates. If post-licensing operation demonstrates problems with low oxygen concentrations or the temperature regime, corrective measures will be necessary, and are provided for as a condition of this certification. The temperature criterion (Standards Section 3-01(B)(2)(a)) requires that changes in water temperature, either upward or downward, be controlled to prevent an undue adverse effect on aquatic biota and wildlife. Creation of a water temperature regime that impairs the normal development of fish would be considered an undue adverse effect.

301. *Aesthetics.* Although the aesthetics study did not include information on the remote reach of the bypass above Readsboro, it is reasonable to expect that a flow of 70 cfs would support the river's aesthetic values.

**Downstream River Reaches**

**Somerset**

302. Based on the IFIM modeling, a flow of 19 cfs provides suitable habitat for late fry. Higher flows, in the vicinity of 100 cfs, are preferable for juveniles and adults. Considering all target species and life stages, including macroinvertebrates, a flow near 60-75 cfs would provide the best habitat conditions. However, this quantity of flow cannot be sustained continuously from reservoir inflow.

303. Even though flows above the August median flow provide more habitat for most target organisms, a higher flow cannot be sustained from natural inflow. Flows naturally drop below this level. Provision of the August median flow during the summer season on a guaranteed basis is consistent with the seasonal natural hydrology. While releasing this flow as a guaranteed minimum will reduce the occurrence of higher flows, it will also reduce the occurrence of lower flows. The reduction of the incidence of natural flows below the August median flow represents an enhancement over natural hydrologic conditions for aquatic life during the stressful summer low-flow period.

304. Water level management to protect loons in Somerset Reservoir is a high Agency priority. Therefore, downstream releases during the period of loon protection will be determined as those necessary to

maintain a stable water level. In most cases, the resulting release will be close to the inflow to the reservoir and will exceed 12 cfs. However, it is not possible to hold the reservoir water level constant if inflow to the reservoir declines below 12 cfs when this flow is also being released downstream. To balance the competing resource interests, it is reasonable to allow the downstream release to decrease to no less than 9 cfs at times when reservoir inflow is less than 12 cfs. While 9 cfs does not provide desirable habitat conditions in the Somerset Reach, the frequency and duration of such flows is expected to be low.

305. A higher flow is appropriate during the late fall/winter period to protect trout spawning and incubation and overwintering fish and macroinvertebrates. A flow of 30 cfs approximates the median flow for the low-flow winter month of January and is therefore consistent with the seasonal natural flow regime. As discussed above, it provides improved habitat conditions compared to lesser flows.

306. Ice effects on fish are exacerbated by low flows and fluctuating flows. The period of the winter when very cold weather and icing is most likely to occur is December 16 to February 28. Since the applicant generally releases at least 120 cfs during this period, a sustained higher minimum flow would help to reduce the magnitude of flow fluctuation. Based on the IFIM results, 48 cfs provides very good habitat conditions for most target organisms. A minimum flow of 48 cfs during the above period would help to ameliorate ice impacts to fish and other aquatic life.

307. Provision of guaranteed minimum flows are possible due to the storage capacity of Somerset Reservoir and such flows will be beneficial from a habitat perspective. Lesser inflows that provide less habitat are avoided.

308. *Temperature/dissolved oxygen.* As discussed above, dissolved oxygen standards below Somerset Reservoir are expected to be met. Temperature conditions, based on the data provided, will not impair fish growth rates. The intake at Somerset Reservoir is at a shallower depth that the low-level outlet at Harriman Dam (at a depth of about 25-30 feet as opposed to 170-180 feet).

309. *Aesthetics.* The observed flow of 14 cfs provided a substantially improved visual effect over the 4 cfs low flow, based on the

videotape study. The 12 cfs flow will be a considerable enhancement over the present condition during the recreational use period.

**Searsburg**

310. Smelt spawning success is jeopardized by hydropeaking during the spring periods when flows are within control of Searsburg Station. With a 35 cfs minimum flow, flows would potentially cycle from 375 cfs on peak to 35 cfs off peak, resulting in the dewatering of over one third of the tailrace reach. Losses would be greater at the applicant's proposed flow of 28 cfs. Given the generally high flows naturally occurring during this period, a minimum flow of 175 cfs for the majority of the smelt spawning and incubation period is reasonable to prevent excessive dewatering. The 175 cfs flow is the minimum station capacity plus the bypass minimum flow, and would apply April 20 through May 15.

311. The Class B designated uses and values for the reach from Searsburg tailrace to Harriman Reservoir will be supported by the minimum flows prescribed for the Searsburg bypass, with the above limitation to protect smelt spawning.

**Harriman**

312. The reach below Harriman Station is influenced by backwater from Sherman Reservoir. The Class B designated uses and values for this reach will be supported by the minimum flows prescribed for the Harriman bypass.

**Ramping**

**Somerset**

313. Flow releases below Somerset can vary from 4 cfs to 850 cfs, assuming no spillway overflow. As the plant capacity at Searsburg is 340 cfs, flow releases from Somerset rarely exceed 300 cfs and only occur when necessary to prevent high reservoir stages. There is a need to control the rate of flow changes below Somerset in order to allow the stream biota time to reposition, if necessary, to prevent stranding or acclimate to changes in habitat characteristics.

314. Fish more than a year old should be able to cope with a ramped flow fluctuation, but the impact on fry is less clear. Stream channel areas that are dewatered on a frequent basis will not support relatively immobile aquatic life, such as macroinvertebrates. It is likely that macroinvertebrate habitat can be protected more through the minimum flow provision than a peaking constraint. The minimum flow dictates the amount of habitat that is nearly always wetted. Control of the peaking release deals more with "disturbance" and would have to be extreme to eliminate locational shifts. The most effective way to control peaking effects is to prescribe an adequate minimum flow in combination with a ramping requirement.

315. Flow fluctuations are not a serious concern as long as 1) rapid changes in flow do not occur and 2) a minimum flow is provided to prevent significant channel dewatering. Ramping provisions that limit the rate of change between releases allow fish time to adjust and avoid stranding. Because of stranding mortality, the rate of decrease in flow is a greater concern than the rate of increase. This certification is conditioned on an upramping rate of 100 cfs per day and a downramping rate of 50 cfs per day. These rates are based on the best judgement of Agency biologists from available data, which is limited. Special studies could be done to refine ramping rate needs and are provided for under the conditions of this certification.

316. A maximum flow release constraint of 312 cfs would help avoid excessive flow changes. Constraints on the water level management in Somerset Reservoir in combination with a minimum flow and ramping requirement should effectually stabilize the pattern of releases, further lessening the concern relative to peaking effects.

**Fish Passage - Searsburg**

317. If landlocked Atlantic salmon are to be successfully reintroduced to Harriman Reservoir, it may be necessary to use the upper watershed above Searsburg Dam for non-natal production. There may also be an interest, as management plans develop, to provide for upstream passage at the dam, although this is only considered a possible future need.

318. The Department of Fish and Wildlife will be undertaking a seven-year study to determine whether or not use of the upper watershed will be necessary in order to meet the goals of the salmon program and that there will be a reasonable assurance of success justifying the expenditure for passage facilities.

319. If the upstream basin is managed for salmon, passage facilities would be necessary to prevent an interference with the propagation of fish and to minimize fish mortality during downstream movement. Lack of facilities would result in an undue adverse effect on the species composition or propagation of fish and, therefore, constitute a violation of Standards, Section 3-01(B)(5) *Aquatic Habitat*.

**Intake Screening - Searsburg**

320. Modification of the intake trashrack or other measures may be necessary to minimize impingement and entrainment of resident fish at the Searsburg intake. It is reasonable to postpone such measures until a determination on downstream passage is made. Otherwise, the measures taken may be incompatible with the design for passage facilities, causing additional expense. A possible alternative to structural modifications is to first undertake a study of the risk of mortality prior to making a final decision on structural measures.

**Tubercled Orchid**

321. Restoration of flows to the Searsburg and Harriman bypasses will result in the loss of a significant amount of the habitat presently used by the tubercled orchid, a state threatened species, as well as habitat presently used by the musk flower and the Canada burnet. The habitat is in areas that are subject to inundation even under relatively low flows. This impact can be at least partially mitigated by creating new habitat along the original riverbank and both seeding this area and attempting to move plants into it.

322. A mitigation plan is needed and should emphasize the creation of new habitat as transplantation in the wild, especially of orchids, is very difficult. Transplantation should be considered experimental with follow-up monitoring to determine success, and should be limited to only those individuals that will be inundated or harmed by the increased flows. Habitat manipulation would entail elimination of alders to create open areas suitable for colonization by the

orchid. The musk flower and Canada burnet should be included in the plan; however, this is not being made a requirement of the certification as they are not state listed.

## Recreation

323. Vermont Water Quality Standards require the protection of existing water uses, including the use of water for recreation. Standards also requires the management of the waters of the State to improve and protect water quality in such a manner that the beneficial uses and values associated with a water's classification are attained. (Standards Section 1-03 *Anti-degradation Policy*)

324. Beneficial values and uses of Class B waters include water that exhibits good aesthetic value and swimming and recreation. (Standards Section 3-03(A) *Class B Waters: Management Objectives*) Standards Section 2-02(B) *Hydrology: Artificial Flow Conditions* prohibits regulation of river flows in a manner that would result in an undue adverse effect on any existing use, beneficial value or use.

325. Changes in reservoir management and provision of minimum flow releases will improve the likelihood of successful fisheries management and reduce or eliminate the present impairment of angling use. The restoration of flows to the Harriman bypass, in particular, is expected to produce an excellent stream fishery. Reintroduction of landlocked Atlantic salmon to Harriman Reservoir, if successful, will result in a good salmon fishery in the reservoir and in the Searsburg bypass.

326. Although flatwater boating opportunities are extensive, flow regulation will continue to reduce opportunities for whitewater boating in Vermont. Spring releases from Somerset and later releases to provide water for hydropeaking at Searsburg Station are sufficient to provide some periods of adequate flow for whitewater boating on the East Branch. High spring flows may also provide sufficient spillage at Searsburg Dam to run the four miles to Harriman Reservoir, and occasional spillage at Harriman Dam supports the rare experience of boating the challenging five-mile section downstream to Sherman Reservoir.

327. Because of the flow regulation and the resulting unpredictability of high river flows, a telephone notification system is necessary to allow boaters to call before traveling to the watershed.

328. A need for a formal portage at Searsburg Dam has been identified, as well as put-in capability below the dam and accessible from the road.

329. The applicant is will be maintaining existing recreation facilities and providing for future recreational use through its master recreation plan. The facilities, existing and planned, are extensive. Further, the applicant is providing for an enhancement fund that will support additional improvements to public recreational use. The designated uses of swimming and recreation will be supported.

**Erosion**

330. The applicant identified minor erosional areas associated with reservoir recreational use. Erosion, if severe, can impair recreational use and cause turbidity and the discharge of suspended solids, potentially violating the standards for those parameters (Turbidity: Standards Section 3-03(B)(1); Total Suspended Solids: Standards Section 3-01(B)(7)). This certification is being conditioned on remediation of any significant erosion problems when identified by the Department.

**Debris**

331. The applicant does not provide information on the handling and disposal of trashrack debris and other project related debris. The depositing or emission of debris and other solids to state waters violates the state solid waste laws and Standards, Section 3-01(B)(7) *Settleable solids, floating solids, oil, grease, scum, or total suspended solids*. A plan is being required as a condition of this certification.

**General Conclusions**

332. The non-attainment reaches identified in the Department's Section 305(b) assessment (ref. Finding 68) will meet the management objectives for Class B waters if the project is operated in conformance with the conditions of this certification, assuming that no other limiting sources of pollution exist.

333. The project, if operated consistent with the conditions of this certification, will support the designated uses for Class B waters (Standards Section 3-03(A) *Class B Waters: Management Objectives*); will not have a significant impact on aquatic biota, fish or wildlife such that the existing populations would have their viability impaired (Standards Section 1-03(B)(2)(a) *Anti-degradation Policy: Protection of Existing Uses*); and will not significantly degrade the use of the water body for recreation, fishing, water supply or commercial purposes (Standards Section 1-03(B)(2)(a) *Anti-degradation Policy: Protection of Existing Uses*).

334. As required under Standards Section 2-02 *Hydrology*, the applicant's artificial regulation of flows, if consistent with the conditions of this certification, will not result in an undue adverse effect on any existing or designated use, including high quality habitat for aquatic biota, fish and wildlife. In making this determination, the Water Quality Policy (10 V.S.A. § 1250) has been considered, including the need to allow beneficial and environmentally sound development.

335. All of the restrictions and conditions set forth herein, in conjunction with the applicant's proposal, are necessary to ensure compliance with all applicable provisions of the Vermont Water Quality Standards and other appropriate requirements of state law.

## KEY TO ACTIONS OF THE DEPARTMENT

## 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 Deerfield River 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 except where modified by these conditions.

B. **Reservoir and Flow Management.** The project shall be operated in accordance with the minimum flow and reservoir level management schedules tabulated below. Minimum flows shall be released on a continuous basis and not interrupted; minimum flows are the values listed below, or instantaneous inflow, if less, unless otherwise noted.

**Table A. Somerset Reservoir Operation**

| | Period | Minimum Flow Release (cfs) |
|---|---|---|
| 1 | May 1 - July 31 | 12/9 |
| 2 | August 1 - September 30 | 12 |
| 3 | October 1 - December 15 | 30 |
| 4 | December 16 - February 28 (29) | 48 |
| 5 | March 1 - April 30 | 30 |

Maximum annual drawdown elevation 2107 feet msl
Maximum summer/fall drawdown elev. 2120 feet msl
(through November 1)

Ramping requirements for periods 2-5:

Upramping at 100 cfs or less over 24 hours
Downramping at 50 cfs or less over 24 hours

Maximum gate release 312 cfs, or inst. inflow if higher

Loon protection:

Attain a target elevation of 2128.58 feet msl by May 1 and manage the level to stay within a range of +/- 3 inches of the target elevation through July 31. (see also Condition D)

Notes: 1. The minimum flow during Period 1 is 12 cfs, or instantaneous inflow if less than 12 cfs but greater than 9 cfs. If inflow is less than 9 cfs, 9 cfs shall be the guaranteed flow.

2. Minimum flows in periods 2 - 5 are guaranteed from storage.

3. *Loon Period.* If the target elevation cannot be reached by May 1 due to specific low inflow conditions unanticipated by the applicant, the applicant shall attempt to raise the reservoir to the target elevation as soon as possible after May 1, unless the loons nest at a lower elevation, in which case the reservoir shall be stabilized at that level. If the target elevation is not attained by June 1 due to low inflow, the reservoir shall be stabilized on June 1.

If high inflow causes the reservoir elevation to exceed the target elevation on May 1, the applicant shall release water as necessary to attain the target

**Table C. Harriman Station an**

Min 11-1 to 3/31 1440
S/R 4/1 to 6/15 2359 S/R
Min 6/16 to 10/31 1475
MAX

| | Period |
|---|---|
| 1 | October 1 - June 30 |
| 2 | July 1 - September 30 |

Maximum annual drawdown el
Maximum summer/fall drawdo
(through November 1)

Maximum drawdown rate, June

April 1 - June 15 water level mgmt. rising or stable

Note: Minimum flows in Table C are guaranteed from storage.

Within one year of the issuance of this certification or 30 days from the issuance of the federal license, whichever is sooner, the applicant shall file descriptions, hydraulic design calculations, an implementation schedule, and plans for the measures to be used to release the bypass flows with the Department for its review and approval. The filing shall address conditions with and without flashboards in place at Searsburg Dam, including conditions when the impoundment is drawn for flashboard replacement and subsequent refilling.

C. **Monitoring Plan for Reservoir and Flow Management.** The applicant shall file for review and approval, within one year of the issuance of this certification or 30 days from the issuance of the federal license, whichever is sooner, a plan for monitoring instantaneous flow releases at the project, both below dams and below tailraces, and reservoir levels and inflows. Following approval of the monitoring plan, the applicant shall then measure instantaneous flows and reservoir levels and provide records of such measurements on a regular basis as per specifications of the Department. Upon receiving a written request from the applicant, the Department may waive, this requirement, all or in part, for monitoring at this project provided the applicant satisfactorily demonstrates that the project will at all times be managed consistent with the requirements of conditions B and F.

elevation unless nesting occurs before that is possible, in which case the reservoir shall be stabilized at the higher elevation.

Period 1 may be extended as necessary for the protection of unusually late loon nesting, upon notification by the Department of Fish and Wildlife. The period may also be shortened in an individual year to end at an earlier date after June 15, if the Department of Fish and Wildlife determines that nesting is complete or that nesting will not occur.

The Department, upon a request of the Department of Fish and Wildlife, may adjust the target elevation if subsequently an alternate elevation is determined to better suit nesting.

4. *Ramping.* The applicant may elect to complete a study to define alternate ramping rates based on biological information or channel hydraulics. Any study plan shall be developed in consultation with the Agency, and a proposal for alternate ramping rates will require an amendment of this certification.

**Table B. Searsburg Station and Impoundment Operation**

| Period | | Bypass Minimum Flow Release (cfs) |
|---|---|---|
| 1 | June 1 - September 30 | 35 |
| 2 | October 1 - May 31 | 55 |

Impoundment fluctuation: No greater than proposed.

April 20 - May 15, a minimum flow of 175 cfs below the tailrace to protect smelt spawning

D. **Management Plan for Somerset Reservoir Gate Operation.** The applicant shall develop a management plan to govern operation of the gates at Somerset Reservoir to meet the goals of the water level management requirements set forth in Condition B for Period 1, and shall file that plan with the Department within 120 days of the issuance of this certification. Implementation shall begin no later than the first nesting season following license issuance. The gates shall be automated as soon as practicable, but no later than the end of 1998. The plan shall address manual operation during 1996, 1997, and 1998 in addition to the final automated operation. The management plan shall include performance expectations for the equipment to be used and operating method proposed, both for interim and final operation; the plan shall include a calculation brief to support the projected performance. At its discretion, the applicant may elect to file the long-term plan separate from the interim plan, in which case the long-term plan will be due on or before January 1, 1997.

The stage data recorder at Somerset Reservoir shall transmit real-time data to Harriman Station to enable the operators to monitor water levels and perform gate adjustments as necessary for the protection of loon nesting, consistent with the provisions of Condition B above. Within 10 days of each two-week period during the month of April and during Period 1, the applicant shall file reports of Somerset Reservoir hourly stages and outflows. Where the reservoir conditions are inconsistent with the goals of Condition B, the report shall indicate the reason.

Condition B allows the 100 cfs upramping requirements to be suspended as necessary to lower the reservoir to the loon nesting target elevation by May 1. As this is undesirable from a downstream resources perspective, the management plan shall be designed to minimize or eliminate the need to exceed the upramping requirement while achieving a high probability of attaining the target elevation.

E. **Refinement of Watershed Model for Reservoir Management.** The applicant shall develop a refined watershed model in cooperation with the Agency in order to better predict the timing and volume of inflow and minimize reservoir winter drawdowns to only those levels necessary to capture spring runoff. A plan for the model refinement effort shall be filed with the Agency within one year of the date of issuance of the certification. In no case shall reservoir drawdowns exceed the levels stipulated in Condition B above. The model shall be periodically updated over the license term.

F. **Flashboards Installation - Searsburg Dam.** At Searsburg Dam, following the reinstallation of flashboards or an approved special maintenance operation necessitating a drawdown and if impoundment inflows are sufficiently low that the impoundment cannot be filled while meeting the bypass minimum flow requirements, up to ten percent of instantaneous inflow may be placed in storage and the downstream minimum flow requirement adjusted accordingly.

G. **Monitoring of Dissolved Oxygen and Water Temperature at Harriman Dam.** Dissolved oxygen and temperature conditions shall be monitored from June through October at three locations: 1) the river channel directly below Harriman Dam; 2) the penstock at Harriman Station; and 3) the Harriman tailrace. Sampling shall be done at no less than weekly intervals. The two samples at Harriman Station shall be concurrent. Annual data reports shall be filed no later than the end of the sampling year. A quality assurance/quality control plan shall be filed with the Department within 60 days of issuance of the federal license. The sampling at the dam is deferred until the initiation of bypass minimum flows. The Department may suspend the data collection when there is an adequate data base to determine whether or not mitigatory action is necessary.

H. **Institution of Measures to Attain Dissolved Oxygen and Temperature Standards at Harriman Facility.** Upon request of the Department based on its review of the data collected pursuant to Condition G, the applicant shall design and implement measures as necessary to meet dissolved oxygen standards and/or raise the water temperature in the Harriman bypass sufficiently to support high quality habitat for aquatic biota and fish, including the provision of a temperature regime that does not impair the growth rates of fish.

I. **Tubercled Orchid.** The applicant shall file with the Department for prior review and approval within 90 days of issuance of this certification, a plan of mitigation (three copies) for the detrimental effect of increased flows in Harriman bypass on the state threatened tubercled orchid (Platanthera flava). The applicant shall consult with the Department of Fish and Wildlife during the development and implementation of this plan, which shall commence with the first summer following license issuance and shall include, but not be limited to the following steps:

FIRST SUMMER

1. Inventory the Searsburg bypass above Vermont Route 9 in early to mid-July when the tubercled orchid is in flower and hence most visible.

2. Locate the tubercled orchid plants throughout the Harriman and Searsburg bypass reaches in July when it is flowering and flag, if necessary, to facilitate re-identification in the fall.

FIRST AUTUMN

3. Conduct flow releases at the Harriman bypass (70 cfs) and the Searsburg bypass (35 cfs) after September 15 and locate and mark all inundated individuals of the tubercled orchid. At the same time potential new habitat would be identified and marked along the new edge of bank.

4. Create favorable habitat for the orchid in the areas previously identified along the new edge of bank by removing alders and any other means as required.

5. Collect seeds from the inundated orchids and sow along the new edge of bank using the best means available to insure germination.

6. Attempt to move all the orchids that will be inundated or harmed by whatever means available such as moving entire tussocks if all the plants it contains will be inundated. If individual plants are moved, as much soil as possible should be included, and the transplants should be covered with staked chicken wire to inhibit predation.

FIRST SPRING

10. Prior to mid-May and in coordination with the Agency, raise water levels up to the required minimum flows in the two bypasses.

11. Monitor the orchid populations on a yearly basis for the next five years and report results to the Agency of Natural Resources on a yearly basis.

J. **Turbine Rating Curves.** 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. **Downstream Fish Passage - Searsburg Dam.** The applicant shall submit a plan for downstream fish passage at Searsburg Dam, including estimated design flows necessary for proper operation, to the Department of Fish and Wildlife for review within four months of a request. Such a request shall be predicated on the Department of Fish and Wildlife finding that use of the riverine habitat upstream of the dam as non-natal rearing habitat is necessary to the successful establishment of a migratory salmonid fishery in Harriman Reservoir. The request shall indicate the annual period during which the facility must be operated, but the period will not exceed operation 24 hours per day from April 1 - May 31. The period may be shortened after implementation of the passage based on knowledge gained about migration periods for migratory salmonids. The facility shall be functional at all impoundment operating levels. Downstream fish passage facilities shall be installed so as to be operational within 18 months of a request by the Agency. This plan shall include provisions to:

1. minimize passage of fish into the generating unit(s) if injury or mortality 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.

The plan shall include an implementation/construction schedule. The U.S. Fish and Wildlife Service and the Department of Fish and Wildlife shall be consulted during plan development. The plan shall include an erosion control and water management plan designed to assure compliance with water quality standards during construction.

The Department of Fish and Wildlife may suspend the operation of downstream passage facilities at any time based on its fishery management needs.

A request for passage facilities will not be made any earlier than seven years from the issuance date of this certification.

L. **Intake Protection - Searsburg Dam.** If a request for downstream passage facilities is not made in accordance with Condition K above, the applicant shall, within seven years and four months of the issuance date of this certification, submit a plan to the Department of Fish and Wildlife for measures to prevent fish impingement and entrainment at the Searsburg Dam intake. The plan shall include an implementation/construction schedule. The U.S. Fish and Wildlife Service and the Department of Fish and Wildlife shall be consulted during plan development. The plan shall include an erosion control and water management plan designed to assure compliance with water quality standards during construction. The plan shall be implemented within one year from the date of approval by the Department of Fish and Wildlife.

The Department of Fish and Wildlife may waive or postpone implementation of this requirement based on an analysis of the risk of fish mortality or other relevant information. The applicant may elect to furnish the Department of Fish and Wildlife with data on entrainment and turbine mortality.

M. **Upstream Fish Passage - Searsburg Dam.** The applicant shall submit a plan for upstream fish passage at Searsburg Dam, including estimated design flows necessary for proper operation, to the Department of Fish and Wildlife for review within four months of a request. Upstream passage shall be provided March 15 - May 15 and October 1 - November 15, with the period subject to adjustment based on knowledge gained about migration periods for migratory salmonids. Upstream fish passage facilities shall be installed so as to be operational within 18 months of a request by the Agency; the request will not occur any earlier than 20 years from the issuance date of this certification.

The plan shall include an implementation/construction schedule. The U.S. Fish and Wildlife Service and the Department of Fish and Wildlife shall be consulted during plan development. The plan shall include an erosion control and water management plan designed to assure compliance with water quality standards during construction.

The Department of Fish and Wildlife may suspend the operation of upstream passage facilities at any time based on its fishery management needs.

N. **Debris Disposal Plan.** Within 90 days of the issuance of this certification, the applicant shall submit a plan for proper disposal of debris associated with project operation, including trashrack debris, for written approval by the Department. The plan shall include information on the design and materials used for flashboard construction at Searsburg and the potential for the discharge of flashboards downstream.

O. **Maintenance and Repair Work.** Any proposals for project maintenance or repair work involving the river, including desilting of impoundments, impoundment drawdowns to facilitate repair/maintenance work (except routine flashboard maintenance), and tailrace dredging, shall be filed with the Department for prior review and approval.

P. **Public Access.** 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; the applicant shall so notify the Department and shall file a request for approval, if the restriction is to be permanent or long term, within 14 days of the restriction of access.

Q. **Recreational Facilities.** Recreational facilities shall be constructed and maintained consistent with the proposed recreation plan (ref. response to AIR No. 24). Prior to construction at individual facilities, final design plans and details shall be filed with the Department and the Recreation Section of the Department of Forests and Parks for review and comment. The applicant is advised to consult with the Recreation Section in the development of plans. The filing shall include an erosion control plan that will be subject to Department approval prior to commencement of construction.

R. **Portage - Searsburg Dam.** The recreation plan shall be modified to include a portage at Searsburg Dam and a put-in on river right below the dam.

S. **Telephone Notification System for Flows.** The applicant shall install and have operational by May 1, 1996 a telephone flow notification system which informs callers as to approximate flow being released below Somerset Dam. By the date in which minimum flow releases are provided below Somerset and Harriman dams, the same type of telephone notification system shall be operational.

T. **Erosion Control.** Upon a written request by the Department, the applicant shall install erosion control measures as necessary to address erosion occurring as a result of use of project recreational facilities.

U. **Compliance Inspection by Department.** The applicant shall allow the Department to inspect the project area at any time to monitor compliance with certification conditions.

V. **Posting of Certification.** A copy of this certification shall be prominently posted within the project powerhouses and the Somerset gatehouse.

W. **Approval of Project Changes.** 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.

X. **Reopening of License.** 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.

Barbara Ripley
Barbara Ripley
Secretary
Agency of Natural Resources

Dated at Waterbury, Vermont
this 30 day of January, 1995.

Attachments: Appendix A. Comprehensive River Plan Goals
Appendix B. Responsiveness Summary

cc: Distribution List

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# APPENDIX A

# COMPREHENSIVE RIVER PLAN GOALS

November 1992

**II. HYDRO RELATED CONCERNS - Water Quality, Flow Regulation & Water Level Management.**

Watershed Opportunities

**Tourist & Service Economies** benefitted by hydropower production and modified water level management.
**Flood Protection Benefits** continued by modified reservoir water level management.
**Enhanced Aquatic Habitat** for fisheries and other aquatic biota in river segments below dams and in impoundments used for hydropower purposes.
**Assimilation of Treated Wastewater** enhanced by in-stream flow maintenance.

***** Current Issues, Goals & Recommended Actions *****

**Issue 1.** Significant impairment of riverine aquatic habitat and biota by hydroelectric facilities' development and operation.

**Goal 1.1.** Continued use of the river for the generation of electricity but in a manner that is compatible with and enhances other river uses and values.

**action:** NEPCo should consider modernization and/or improving generation efficiencies at Searsburg Station, Harriman Station and downstream facilities.

**Goal 1.2.** Establish conservation flows below each hydroelectric dam to improve aquatic habitat and biota and to achieve fishery management objectives.

**action:** NEPCo should release minimum conservation flows at Somerset Dam to provide suitable habitat for the restoration, enhancement and protection of aquatic biota and all life stages of brook trout and landlocked salmon.

**action:** NEPCo should release minimum conservation flows at Searsburg Dam to support a new 3.0 mile fishery (in bypass), improve habitat suitability for 0.7 miles below Searsburg Station (in tailrace) and provide habitat for the restoration, enhancement and protection of aquatic biota including all life stages of brown trout, rainbow smelt and landlocked salmon.

**action:** NEPCo should release minimum conservation flows at Harriman Dam to support a new 4.5 mile fishery and restore, enhance and protect habitat suitable for aquatic biota including all life stages of brown trout and brook trout in the bypass.

**action:** NEPCo should monitor compliance with conservation flows using stream gauges or other reliable means below Somerset, Searsburg and Harriman dams.

**action:** NEPCo should monitor compliance with conservation flows using stream gauges or other reliable means at Searsburg tailrace.

**Goal 1.3.** Reduce the impacts associated with present flow regimes at New England Power facilities.

**action:** The magnitude and frequency of flow fluctuation below Somerset Dam should be reduced to minimize the effect on aquatic biota.

**action:** The magnitude and frequency of flow fluctuation below Searsburg Station should be reduced to minimize the effect on aquatic biota.

**Goal 1.4.** Provision for fish passage and fish screening.

**action:** Downstream fish passage should be provided at Searsburg Dam.

**action:** Penstock intake screening should be installed to address fish entrainment at Somerset, Searsburg and Harriman reservoirs.

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**Issue 2.** Impacts to stream water quality, aesthetics and recreation from flow regulation and two water diversions.

**Goal 2.1.** Restoration and maintenance of in-stream flows to assimilate treated wastewater effluent.

**action:** Sufficient and continuous flows should be maintained below Harriman Dam to assimilate wastewater discharged by the Readsboro Wastewater Treatment Facility.

**Goal 2.2.** Establishment of a schedule for the release of whitewater boating flows below New England Power dams.

**action:** Sufficient water volume, in accordance with appropriate ramping rates, should be provided on certain occasions below Searsburg Dam.

**action:** Sufficient water volume, in accordance with appropriate ramping rates, should be provided on certain occasions below Harriman Dam.

**action:** A telephone flow notification system, from spring through fall, should be maintained to provide boaters and anglers information on the presence and amount of water being spilled or intentionally released at Somerset, Searsburg and Harriman dams.

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**Issue 3.** Impact on impoundment aquatic habitat and biota due to water level fluctuations at two reservoirs.

**Goal 3.1.** Continuation of flood protection benefits at Harriman Reservoir.

**action:** NEPCo should assure a reasonable level of downstream flood protection benefits by keeping Harriman

Reservoir more consistently below the spillway by the determined freeboard need for necessary floodwater storage.

**Goal 3.2.** Stabilization of water levels in Somerset and Harriman Reservoirs during critical biological periods.

**action:** Water levels should be held stable by NEPCo in Harriman Reservoir during smelt spawning and incubation (typically, mid-April through the middle of June).

**action:** Water levels should be held stable by NEPCo in Somerset and Harriman reservoirs during smallmouth bass spawning and incubation (typically, the first of May through June).

**action:** Water levels in Harriman Reservoir should be managed by NEPCo to assure successful reproduction and juvenile rearing of spring spawning fishes, including pickerel and yellow perch.

**Goal 3.3.** Establishment of a littoral zone in the reservoirs by reducing the magnitude of annual water level fluctuation.

**action:** Alternatives in water level management that would create productive and functional littoral zones in Harriman and Somerset reservoirs should be carefully evaluated against power production and flood control benefits.

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**Issue 4.** Impact to endangered bird species at Somerset Reservoir from unstable water levels.

**Goal 4.1.** Stabilization of water level elevation in Somerset Reservoir during critical loon reproduction periods.

**action:** Stable water levels should be maintained during the loon nesting and egg incubation period (typically, the first of May through July).

**Goal 4.2.** Documentation of loon nesting success.

**action:** Annual reservoir shoreline inspections should be conducted by the VT Natural Heritage Program, the VT Institute of Natural Science or the VT Audubon Society with assistance from NEPCo.

**action:** Greater effort should be spent in understanding and documenting reasons for loon nesting failures.

**Goal 4.3.** Establishment of a loon education program.

**action:** An information and education program concerning Somerset Reservoir loon protection should be created.

## III. HYDRO RELATED CONCERNS - Water Resource & Recreation.

Watershed Opportunities

**Improved Formal Public Access** at hydropower facilities.
**A Boatable River** with convenient dam portage facilities.
**Protected Open Space** enjoyed by watershed residents and visitors.
**Land Management Compatibility** between large land holders.

***** Current Issues, Goals & Recommended Actions *****

**Issue 1.** Deficient portage facilities for boaters.

**Goal 1.1.** Provide safe portage around each hydroelectric dam.
**action:** NEPCo should construct, maintain or improve trails for dam portage in consultation with the VT Agency of Natural Resources and boating interests.

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**Issue 2.** High user demand upon reservoir access facilities.

**Goal 2.1.** Implementation of an improved management and maintenance strategy for each reservoir access site.
**action:** Change house and restroom facilities at NEPCo's Wards Cove facility should be improved.
**action:** A parking area for vehicles and trailers should be delineated and maintained and the launching area for roof-top boats should be improved on Sherman Reservoir.
**action:** Site-specific educational signs should be installed to assist with the maintenance of reservoir access facilities.
**action:** NEPCo should avoid the placement of directional signs which would tend to promote reservoir usage.

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**Issue 3.** Selective utility enforcement of day-use only policy.

**Goal 3.1.** Establishment of limited reservoir shoreline camping.
**action:** NEPCo should locate, design and construct no more than five primitive shoreline camp sites on Somerset Reservoir. Each camp site should consist of a single tent platform and a "one-holer" pit privy.
**Goal 3.2.** Creation of a sailboat mooring program.
**action:** NEPCo should cooperatively manage with local interests (i.e. the Windham Sailing Club) a sailboat mooring program in Wards Cove on Harriman Reservoir.

**Issue 4.** Remote & pristine Somerset Reservoir watershed characteristics.

**Goal 4.1.** Restrict subdivision and development activities within the East Branch watershed.

- **action:** The acquisition of development rights for utility-owned land within the Somerset Reservoir sub-watershed should be a high priority of local, state and federal interests.

**Goal 4.2.** Limitations placed on Somerset Reservoir access.

- **action:** NEPCo should avoid undertaking improvements to Somerset Reservoir access and reservoir boat launching facilities which would increase use.
- **action:** NEPCo should maintain existing reservoir shoreline access site.
- **action:** A new year-round camping facility (to replace the decommissioned "Landing Strip" on Green Mountain National Forest land) should not be designed or located on or near the shoreline of Somerset Reservoir.
- **action:** A concrete boat launching ramp should not be constructed at Somerset Reservoir.

**Goal 4.3.** Establishment of controls affecting motorized vehicle usage within the Somerset Reservoir watershed.

- **action:** Controls to restrict entry of non-utility motorized vehicles into the watershed of Somerset Reservoir during the non-winter season should be implemented.
- **action:** The completion of a non-motorized trail from Somerset Reservoir to Dover should be completed as a priority. This trail should be designed to maintain the aesthetic integrity of the area's ridgeline.

**Goal 4.4.** Establishment of an education and protection program.

- **action:** A program to administer primitive camping, monitor and maintain access/use restrictions and educate reservoir and watershed users should be established by NEPCo from April through September.

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**Issue 5.** Differences between land management priorities.

**Goal 5.1.** Assure compatibility between land management goals, priorities and actions.

- **action:** NEPCo and the Green Mountain National Forest, in cooperation with the VT Agency of Natural Resources, should develop mutually compatible land management strategies for abutting lands (particularly in the watersheds of Somerset Reservoir, East Branch below Somerset dam, Deerfield River above Searsburg Reservoir and Harriman Reservoir's western drainage).

**action:** NEPCo and the Green Mountain National Forest should complete, in coordination with the VT Agency of Natural Resources and the Windham Regional Commission, the Memorandum of Understanding and carry out specified management objectives.

**action:** NEPCo should establish and implement a forestry management plan designed to protect and enhance critical habitat for game and non-game species as identified by VT Fish & Wildlife Department.

**Goal 5.2.** Restrict subdivision and development activities within the direct drainage to Harriman Reservoir.

**action:** The acquisition of development rights to utility-owned land found on the western drainage of Harriman Reservoir should be a high priority of local, state and federal interests.

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**Issue 6.** Previous cultural obligations unfulfilled.

**Goal 6.1.** Completion of a basin visitor information center.

**action:** NEPCo should locate and construct an information center within the Vermont portion of the Deerfield River watershed to house information on the area's cultural, economic, environmental and physical resources.

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**Issue 7.** Deficiencies in public access to the Deerfield River & reservoirs.

**Goal 7.1.** Establishment of a "Deerfield River Valley Heritage Trail."

**action:** The abandoned railroad right-of-way (VT/MA border to Somerset Dam) should be designated as the Heritage Trail corridor.

**action:** NEPCo should protect any cultural or historic remnants associated with the railroad right-of-way.

**action:** Vegetation should be removed from overgrown portions of the abandoned railroad bed.

**action:** Foot bridges should be built by NEPCo across Graves and Wilder Brooks (found along the west side of Harriman Reservoir) to eliminate present stream crossing difficulties.

**action:** Linkage of Catamount Trail segments should be given a high priority.

**action:** Arrangements between NEPCo and the Catamount Trail Association regarding trail maintenance responsibilities should be finalized.

**Goal 7.2.** Establishment of year-round access.
**action:** NEPCo should take steps to assure year-round access at present sites and provide new year-round access at Mt. Mills, Wards Cove and Whitingham sites on Harriman Reservoir.

**Goal 7.3.** Improved handicap accessibility to the reservoirs.
**action:** NEPCo should install facilities, at certain reservoir access sites, designed to improve handicap accessibility.

**Goal 7.4.** Preservation of existing Harriman Reservoir and Deerfield River access during Route 9 realignment.
**action:** Consideration should be given to replace existing access areas/sites serving Harriman Reservoir and the Deerfield River that may be damaged or eliminated during road construction activities.

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**Issue 8.** Architectural and aesthetic maintenance.

**Goal 8.1.** Preservation of facility integrity and condition.
**action:** NEPCo should maintain the historic architectural and scenic qualities of each power plant and associated appurtenances.

# APPENDIX B

# PUBLIC RESPONSIVENESS SUMMARY

## KEY TO PUBLIC RESPONSIVENESS SUMMARY

**Deerfield River Hydroelectric Project**
**Water Quality Certification**

**Public Responsiveness Summary**

The Department of Environmental Conservation conducted a public hearing on October 17, 1994 at Whitingham High School in Whitingham for the purpose of receiving oral testimony or written statements and data bearing on the issuance of a water quality certification to the New England Power Company (NEPCo or the applicant) for the continued operation of the Deerfield River Hydroelectric Project located in the Deerfield River basin in the towns of Stratton, Somerset, Searsburg, Wilmington, Whitingham, and Readsboro. In addition to the hearing, written comments were accepted through the end of the business day on November 4, 1994; the Vermont Natural Resources Council (VNRC) asked for and received a filing extension through November 8, 1994. Public meetings were also held on December 5, 1994 and January 4, 1995 to discuss technical and legal issues relevant to this decision.

A total of 17 persons, representing themselves or organizations, presented oral and/or written testimony at the hearing or subsequently filed letters with the Agency. Written testimony was received from the applicant, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Windham Regional Commission, VNRC, Conservation Law Foundation, Appalachian Mountain Club, New England FLOW, Connecticut River Watershed Council Inc., American Rivers, American Whitewater Affiliation, and seven individuals.

Following is a summary response to the substantive comments received. The full text of these comments is available for inspection or copying at the Department's office of the Water Quality Division. A tape of the hearing is also available at the same location.

Several commenters simply stated their support for the Settlement Agreement and asked that the Department revise the certification to strictly follow the terms of the agreement. Most of these commenters did not state specifically where the draft certification significantly deviated from the agreement nor did they present an argument as to why the additional limitations contained in the certification were not required to assure maintenance of Vermont Water Quality Standards.

## 1. WATER QUALITY STANDARDS

a. Consistency of reservoir drawdowns with Standards

Comment: U.S. EPA commented that the Department of Fish and Wildlife's evaluation of the impact of reservoir drawdowns on habitat did not seem to support positive findings with respect to Standards Section 3-01(B)(5) *General Criteria: Aquatic Habitat* and the designated Class B value of high quality habitat for aquatic biota, fish and wildlife. EPA recommends that the Agency either acknowledge that substandard conditions will continue to exist and complete a use attainability analysis to resolve this issue or provide substantiation that standards will be met.

☞ Response: Section 3-01(B)(5) requires that there be "[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 the species composition or propagation of fishes." Section 1-01(B) *Definitions* provides that, "[i]n determining undue adverse effect, the Secretary is authorized to make case specific judgements . . ." and shall consider "the water quality policy set forth in § 1-02, the classification of the waters and any other applicable provisions of these rules . . ." Section 1-02 *Water Quality Policy (10 V.S.A. § 1250)* sets forth a wide variety of potentially competing policies regarding the use of the State's waters, ranging from the policy of allowing "beneficial and environmentally sound development" to the policy of "upgrad[ing] the quality of waters." In view of the improvements and protections afforded to the aquatic biota in the reservoirs, including without limitation the creation of a quality salmon fishery, the Secretary has concluded that there is no undue adverse effect and that Section 3-01(B)(5) is satisfied. For substantially the same reasons, the Secretary has concluded that reservoir management will be compatible with the beneficial value of "high quality habitat for aquatic biota, fish and wildlife," which is set forth as a management objective in Section 3-03(A) *Class B Waters: Management Objectives*, particularly when read in light of Section 2-02(B) *Hydrology: Artificial Flow Conditions*, which requires that flows not be artificially controlled ". . . in a manner that would result in an undue adverse effect on any . . . beneficial value . . ."

Comment: VNRC comments that the Department has recognized reservoir fluctuations as impairing water quality (1994 Water Quality Assessment, 305(b) Report, Department of Environmental Conservation, July 1994, pp. 46-47) and that categorization as such requires the Department to condition the certification on stabilization of the reservoirs.

☞ Response: As discussed above, the Secretary has concluded that the Standards will be met in the reservoirs, as conditioned by the water quality certification. Therefore, stabilization beyond that required in the certification is not required.

Comment: VNRC comments that littoral zone impacts must be addressed in the certification of this activity.

☞ Response: The littoral zone benefits of reservoir stabilization is acknowledged. However, as discussed above, the Secretary has concluded that the Standards will be met.

Comment: Citing the water quality certification issued for the Lamoille River Hydroelectric Project (April 14, 1994), VNRC comments that consistency dictates that the Department limit drawdowns in order to provide for a functional littoral zone.

☞ Response: As noted in the discussion above, the determination of "undue adverse effect" under the Standards requires the making of "case specific judgements." The situation presented in the referenced project differed from the Deerfield River Project in several important respects, including existing recreational uses of the reservoirs, aesthetics considerations, wetland values, magnitude of the proposed drawdowns, and operating characteristics.

Comment: VNRC comments that reservoir fluctuations as sanctioned in the draft certification would result in non-attainment of designated uses for Class B waters, including high quality habitat for aquatic biota, fish and wildlife; recreational uses such as angling; and aesthetics.

☞ Response: As discussed above, the Secretary disagrees that the reservoir fluctuations allowed under the certification will result in non-attainment of designated uses for Class B waters.

Comment: VNRC comments that reservoir fluctuations as sanctioned in the draft certification would cause continued degradation of existing uses.

☞ Response: The Department disagrees. On the contrary, existing uses will be enhanced by the provisions of the certification.

Comment: VNRC comments that the aquatic habitat criterion (Section 3-01(B)(5)) of the Standards will be violated by proposed reservoir drawdowns. VNRC considers "background conditions" as used in this criterion to be the river under pre-dam conditions, but that the changes caused by conversion to a reservoir are not at issue.

☞ Response: The Department disagrees. As discussed above, in its view the reservoir drawdowns do not violate Section 3-01(B)(5).

Comment: VNRC comments that the artificial flow condition criterion (Section 2-02(B)) of the Standards will be violated by proposed reservoir drawdowns.

☞ Response: The Department disagrees. As discussed above, in its view the reservoir drawdowns do not violate Section 2-02(B).

Comment: VNRC comments that the draft certification allows the continued draining of wetlands in non-compliance with the Vermont Wetland Rules.

☞ Response: Several wetlands associated with Harriman and Somerset reservoirs would be considered protected Class II wetlands under the Vermont Wetland Rules. Technically, the rules only require a review when there is a proposal to change the hydrologic regime of a wetland associated with a fluctuating hydroelectric reservoir. Under Section 6.2(g), operation of existing hydroelectric projects is considered an allowed use not subject to review unless the flow of water into or out of the wetland is not altered or the wetland is to be drained, dredged, filled, or graded. When a change is proposed, a functional evaluation of the impact on wetland values would be completed before the change is authorized, whether that change is to stabilize a reservoir or increase the extent of drawdowns. The project as proposed complies with the Wetland Rules.

b. Interpretation of dissolved oxygen criteria

Comment: NEPCo notes that the Department interprets the standard for cold water fish habitat to be both a concentration level of 6 mg/l and a saturation value of 70 percent and states Standards are met if either condition exists.

☞ Response: Both factors are physiologically important for the support of fish. A high oxygen concentration assures that adequate oxygen is available for respiration by aquatic organisms, both plants and animals, and high saturation levels provide partial pressures across the fish gills necessary for transfer of the oxygen to the blood stream. The Department, therefore, has interpreted the standard to require that both conditions exist.

c. Hydroelectric projects as an existing use

Comment: VNRC comments that the hydroelectric project should not be considered an existing use for protection under the anti-degradation provisions of the Standards.

☞ Response: The Department agrees. The Department must consider whether or not the activity proposed for certification, which is the Deerfield River Project 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 Standards specifically require that determinations of what constitutes an existing use shall be made by the Secretary on a case-by-case basis. The Agency does not consider hydropower projects, which generally tend to degrade water quality, as meriting protection as existing uses.

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.

Even if hydroelectric facilities were 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))

d. Economics

Comment: VNRC comments that economics cannot be legally considered when making a determination under Section 401.

☞ Response: The Department agrees to the extent that economics cannot be considered such that it would result in the certification of an activity in order to assure its economic viability even though it fails to meet the criteria of the Standards. However, in this case, it is the Secretary's determination that Standards are met.

e. Application of Standards to Bypasses

Comment: VNRC takes issue with the application of the Agency flow procedure to hydroelectric project bypasses, arguing that the same standards apply to bypasses as downstream reaches and that use of the procedure constitutes a constructive amendment of the Standards.

☞ Response: Class B water quality standards apply to the bypasses associated with the Deerfield River Project. The Agency flow procedure is not designed to result in recommendations of minimum flows that violate the Standards or any other requirement of State law. As discussed above under the subject of economics, the determination of a minimum flow for a bypass can be made case specifically but must, at a minimum, meet applicable standards. Factors considered include the extent of habitat available in the bypass, recreational use of the bypass, aesthetics, and the contribution of oxygen-rich bypass flows to the downstream dissolved oxygen regime.

**2. PROCEDURAL ISSUE - REQUEST FOR A CONTESTED CASE PROCEEDING**

Comment: VNRC requested that this case be handled as a contested case proceeding under the Administrative Procedures Act (3 VSA, Section 809(a)).

☞ Response: The Department denies this request for the following reasons:

1) 3 V.S.A. §814(a) only applies when "the grant, denial, or renewal of a license is required to be preceded by notice and opportunity for hearing." The provisions for public hearings in the regulations applicable to 401 certificates give the Agency discretionary authority to hold hearings and thus does not come within the "required" language of §814.

2) The certification hearing held pursuant to Vermont Water Pollution Control Permit Regulations §13.3(i) is a public informational hearing where "any person shall be permitted to submit oral or written statements and data concerning the proposed permit." Its purpose is to give the public an opportunity to comment on the proposed permit. This is not a trial-like hearing conducted in a contested case proceeding where formal testimony is presented and cross-examination is allowed.

3) The Legislature clearly did not intend that the Agency conduct a contested case for the hundreds of permits it issues every year. It would be a practicable impossibility to do so with the resources allocated to the Agency.

4) Persons interested in 401 certificates issued by the Agency are not deprived of the due process provided by a contested case hearing. Appeals of 401 certificates are to the Water Resources Board which conducts a de novo hearing--a contested case with full due process rights.

## 3. FISHERIES MANAGEMENT

a. Resource conflict with management of Harriman Reservoir for lake trout

Comment: NEPCo comments that inclusion of lake trout in the Department of Fish and Wildlife's management plan for Harriman Reservoir may be unrealistic. The reasons put forward are 1) the stratification of the reservoir, with a relatively shallow epilimnion; 2) the limited forage base for support of large salmonids; and 3) the dewatering of spawning habitat during the winter drawdown. Regarding the loss of spawning habitat, NEPCo mentions that lake trout in Vermont lakes are generally managed as put-grow-and-take fisheries. NEPCo also states that management for lake trout is inconsistent with the Comprehensive River Plan for the Deerfield River Basin (Department of Environmental Conservation, November 1992) and the Settlement Agreement.

☞ Response: In the past, the reservoir has supported trout that hold over from year to year. Although the effects of stratification and the dissolved oxygen regime on lake trout may bear further investigation, it is premature at this time to abandon lake trout management.

While the forage base may be affected by reservoir drawdowns, the new water level management to protect smelt spawning and limit biomass export should enhance forage populations.

Improved support of lake trout should also occur as a result of the Department of Fish and Wildlife's reduced stocking rates for salmonids, which should lower inter- and intraspecies competition for food and space. The planned initial stocking density for brown trout, lake trout, and salmon totals 4 fish/acre, or 6,860 fish, half of which are expected to be salmon smolts produced in the Deerfield River. The remainder will be stocked brown trout and lake trout at a ratio of 2:1.

Since spawning habitat will likely be dewatered during the winter, lake trout management must be based on stocking of juveniles. *Vermont's Lake Trout Management Plan for Inland Waters* calls for encouraging natural reproduction where possible and for refining the stocking policy. Put-grow-and-take management for lake trout is commonly used in Vermont where natural reproduction is limited or lacking.

The water quality certification and put-grow-and-take management for lake trout is consistent with Goal 3.2 of the Comprehensive River Plan.

b. Design of formal assessment procedure to measure success of reintroduction of landlocked salmon to Harriman Reservoir

Comment: NEPCo requests joint development of the plan of study to assess the performance of the salmon program and the inclusion of the procedure in the certification.

☞ Response: While the assessment procedure can and has been outlined, it is not possible to detail in advance all the decision points for what constitutes success. Possible avenues for achieving success depend in part upon the results of the data to be collected. The broad salmon production targets have been discussed in the certification. The fishery assessment will include stream electrofishing surveys and lake creel surveys. These studies will allow the Agency to determine if the salmon harvest goal is being met, and if it is not, whether the obstacle is the stream smolt production or lake survival.

The Agency will encourage NEPCo's participation in the development of the study plan and involvement in the assessment of the data.

**4. FLOW MANAGEMENT**

a. Special flow requirements to support smelt spawning below Searsburg Station

Comment: NEPCo questions the need for providing a minimum flow of 175 cfs below Searsburg Station from April 20 through June 15 (ref. Condition B). NEPCo states that protection of river spawning would be adequately supported by providing the flows through May 15 because: 1) spawning activity normally ends by May 11; 2) other tributaries and Harriman Reservoir itself provide for spawning locations; and 3) the flow would not be hydrologically available that late in the spring. NEPCo also asks that the Department of Fish and Wildlife consult with NEPCo operations personnel each year regarding when the spawning and incubation period has ended; this would allow the special flows to be terminated earlier than May 15 in certain years.

☞ Response: A minimum flow of 175 cfs from April 20 through May 15 will provide a reasonable and acceptable level of protection for smelt spawning and incubation for the following reasons:

1) The Agency believes, based on past observations, that reservoir spawning is the primary contributor to the smelt population in Harriman Reservoir and that the Searsburg tailrace reach is much less important.

2) A significant portion of the river's spawning and incubation period is protected by providing the special flow of 175 cfs through May 15.

3) During the period from May 16 through June 15, a flow of 175 cfs is generally not sustained by natural flow conditions.

4) A flow of 55 cfs will protect most of the available habitat (about 80% of the area wetted under a flow of 175 cfs remains wet at 55 cfs)

The certification has been revised accordingly.

b. Ramping rates below Somerset Reservoir

Comment: For Somerset releases, the draft certification limits upramping to 100 cfs per day and downramping to 50 cfs per day. NEPCo indicates that the upramping limitation may cause a conflict with spillway operation under present license Article 28, which requires NEPCo to release full gate capacity of 850 cfs whenever the concrete crest is surcharged (elevation 2133.58 feet msl and higher). Regarding downramping, NEPCo is concerned that this limitation may result in increased failure rates for the Searsburg Dam flashboards.

☞ Response: *Upramping.* The upramping restriction of 100 cfs per day provides a reasonable rate of increase to respond to high runoff events. The Department has reviewed historic data from the U.S. Geological Survey Ayers Brook gage, which records flow from an unregulated watershed with approximately the same drainage area as Somerset Reservoir. The Somerset Reservoir gate capacity of 850 cfs is approximately equivalent to Ayers Brook's 1-day maximum high with a 25-year recurrence interval. Assuming a high inflow condition of 630 cfs (3-day high flow condition with a 200 year return interval), an initial reservoir release of 9 cfs, and an initial high reservoir elevation of 2131.6 feet msl (initiation of Condition II under reservoir highwater guidelines, see Footnote 1 of final certification), the reservoir would rise approximately 2.0 feet with the ramping rate set at 100 cfs. No surcharge would occur under that circumstance.

The three-foot flashboards provide a substantial storage buffer that further reduces the risk of spillage. Furthermore, the risk is even less during the late summer through winter, when the reservoir is maintained at lower elevations.

Although upramping does not seem to be an issue, NEPCo can change the highwater guidelines to provide for upramping to begin at a lower elevation than has historically been used.

For both upramping and downramping, the Department has added a notation in Condition B stating that the applicant may undertake studies to better define ramping needs.

☞ Response: *Downramping.* The flashboards at Searsburg are normally in place from May 1 to October 31 and, based on the information provided in NEPCo's December 9, 1994 comments, would potentially fail at flows around 1,800-2,000 cfs. The loon nesting requirement to stabilize Somerset through July 31 limits downramping during this period, as it would lead to a rising reservoir and potentially result in the flooding of the loon nests. Therefore, the period of concern for downramping rates is from August to October. Historic Somerset release records from 1980-1991, contained in NEPCo's response to AIR No. 8, show that the highest maximum daily discharge during the August-to-October period was 354 cfs. Without a downramping restriction, the maximum that NEPCo would have been able to reduce flows at Searsburg Dam would have been about 300 cfs, based on the historical data for this period. This reduction in flow would only represent 16% of the peak flow that causes failure of the flashboards. Control at Somerset would only potentially prevent failure if the gate is shut down at the correct time relative to the peak inflow hydrograph from the uncontrolled drainage; if the uncontrolled drainage does not produce 1800+ cfs alone; and if the initial release at Somerset is sufficiently high to allow the gate manipulation to make a difference at Searsburg. NEPCo has not provided any information showing the historic frequency of the use of the Somerset gates for this purpose nor has NEPCo supplied information on the present failure rate of the flashboards during the three months in question. Neither has NEPCo provided a technical analysis that demonstrates significant added risk of flashboard failure.

c. Flow proposal for Searsburg bypass

Comment: NEPCo comments that the Settlement Agreement provides for the maintenance of a minimum flow of 55 cfs in the Searsburg bypass through May 31 rather than through May 15 as provided for in Condition B (see Table B) of the certification.

☞ Response: The certification was drafted assuming that the draft Settlement Agreement was the proposal for licensing. The draft agreement did not provide for special fall/winter spawning and incubation flows. For consistency, the final certification has been revised to include the higher flow requirements for the second half of May.

Comment: VNRC recommends alternate minimum flow regimes and maximum flow releases below Somerset, Searsburg, and Harriman dams. (ref. pp. 33-34 of November 8, 1994 filing)

☞ Response: The minimum flows and other flow management controls contained in the certification were based on a thorough technical review and assure, in the Agency's opinion, that Standards will be met. VNRC does not put forward a scientific argument to justify the alternate flows recommended.

## 5. FISH PASSAGE AT SEARSBURG DAM

Comment: NEPCo notes its concern regarding the economic impact of both providing downstream passage at Searsburg Dam and releasing flows into the Searsburg bypass to support spawning and incubation during the fall/winter period. NEPCo notes that Finding 218 contemplates a 7-year evaluation period before a decision is made on the need for downstream passage and asks that Condition I (now K), which was drafted to allow a request for passage as early as five years.

☞ Response: A seven-year period is necessary to determine program success and the need for stocking upstream of Searsburg Dam. The condition has been revised to reflect this.

Comment: NEPCo indicates that the draft certification's requirement to provide measures to prevent impingement and entrainment of fish at the Searsburg forebay is unnecessary because of the limited risk presented by the present design of the intake. NEPCo also states that such a request, measures to prevent impingement and entrainment separate from passage facilities for anadromous fish, is unprecedented in Vermont's Section 401 program.

☞ Response: The need to minimize impingement or entrainment is a site-specific decision that is not solely based on a requirement for downstream passage nor on whether there is an established precedent for such protection without passage in place. Impingement and entrainment issues are valid for all fish species that may move downstream, whether in a full migration behavior or in seasonal movement behavior.

The extent of the risk of impingement and entrainment presented by the present design of the Searsburg intake is unknown, but risk does exist. Based on information available, a trashrack with bar clear spacing of 1 1/2 inch is much less effective at preventing impingement and entrainment of small salmonids than is a clear spacing of 1 inch. A clear spacing of 1 1/4 inch, as found at the Searsburg facility, may provide an improvement over a clear spacing of 1 1/2 inch, but the extent of improvement has not been quantified.

Given the cost of altering the intake now to prevent entrainment and impingement and the fact that it would have to be redesigned for downstream passage, it is reasonable to defer a request for impingement/entrainment measures until a determination of the need for downstream passage for salmon is made. If, upon completion of the salmon assessment, it is determined that management for migratory salmonids will occur upstream, then downstream fish passage facilities will be requested and these facilities will also be designed to protect against the entry of brook trout into the project works.

If it is decided that management for migratory salmonids will not occur upstream of the dam, then one of two options is recommended to prevent the brook trout from entering the project works. NEPCo could conduct a study to demonstrate if fish impingement and entrainment (with some corresponding mortality) is occurring and then install devices to minimize this effect if necessary. Alternatively, NEPCo could install devices to minimize entrainment. The flexibility on the type of devices is greater for the protection of brook trout than it would be for a strongly migratory fish like salmon.

**6. RESERVOIR WATER LEVEL MANAGEMENT**

a. Feasibility of controlling Somerset Reservoir to support loon nesting

Comment: NEPCo asks that the Agency reconsider the requirement that NEPCo maintain Somerset Reservoir within a +/- 3 inch operating band during the loon nesting period. NEPCo is unsure of its ability to manage the reservoir to that tolerance and requests that it manage within a +/- 12 inch band until as late as the year 2000 when it will have attained the capability to manage within a +/- 6 inch band. The gates would be automated by 1998 and tested over a two-year period. NEPCo also notes the potential significance of wave action in causing variation in water levels at the nesting sites beyond NEPCo's control.

☞ Response: The Department has added Condition D to require NEPCo to file a management plan for reservoir regulation the goal of which will be to maintain reservoir levels within the +/- 3 inch operating band and meet the other Somerset Reservoir management requirements of Condition B. As long as the reservoir is operated in accordance with the management plan, NEPCo will be considered to be managing water levels during Period 1 consistent with the requirements set forth in Condition B. If it is found that the operation in accordance with the plan does not attain the +/- 3 inch tolerance, the plan will be reevaluated to determine if changes can be made to maximize nesting success. The management plan shall reflect the schedule of gate automation; the testing procedures; analyses/studies related to water level variability during the nesting period; and the interim management strategy to be used until water levels will be managed using the automated gates.

Comment: NEPCo expresses concern over the certification's requirement to stabilize the reservoir by May 1 and the effect it may have on operational flexibility.

☞ Response: The certification condition only requires stabilization of the reservoir by May 1 if the target elevation for nesting is attainable or if loons nest at a higher elevation. If the reservoir is low on May 1 and the loons have not nested, the certification does not require the reservoir level to be stabilized until the target elevation is reached or loons nest at a lower elevation. This is consistent with prior discussions between the Department of Fish and Wildlife and NEPCo.

Comment: Citing dam safety, NEPCo also expressed a concern over the certification's requirement to stabilize the reservoir at a higher elevation than two feet above the loon target elevation of 2128.6 feet msl. (ref. meeting of December 5, 1994 and NEPCo letter of December 9, 1994)

☞ Response: NEPCo has not provided sufficient evidence to demonstrate that the reservoir cannot safely be held stable if loons nest at elevations higher than 2130.6 feet msl. We believe that, given NEPCo's lengthy operating experience and the substantial capacity of the outlet, NEPCo should generally be able to prevent the reservoir from rising more than two or three feet above the nesting target elevation. Reference the discussion above concerning upramping rates. Given that the ramping requirement is suspended when necessary to protect a loon nest from flooding, NEPCo should be able to prevent the reservoir level from rising above a nest above elevation 2130.6 feet msl; it does not seem necessary to strand that nest in order to prevent the reservoir levels from possibly reaching the crest.

Further, based on NEPCo's comment letter of December 9, 1994, this issue may be somewhat moot as historic nesting habitat is flooded above elevation 2130.6 feet msl, and useable habitat may be limited.

Operation that results in the stranding of a nest may be considered a taking under Vermont's endangered species law. Available evidence does not reveal a conflict between stabilization at a higher level and dam safety.

Comment: NEPCo states that the record of loon nesting reflects the success of its past protection efforts. NEPCo also states that it expects that the additional controls it proposes will improve success.

☞ Response: Loons were documented to have successfully nested (young survived through August) in 8 years during the 1978 through 1994 period (17 years). One chick fledged in 1994. The Agency agrees that the success rate can be expected to improve with more conducive water level management.

b. Restriction on maximum winter drawdown of Somerset Reservoir

General Comment: NEPCo requests that the maximum annual drawdown for Somerset Reservoir not be limited. NEPCo determines its maximum winter drawdown levels based on snowpack, anticipated spring runoff, and the precipitation expected during the runoff period, with goals of not spilling, complying with license Article 28 (see comments on ramping above), and minimizing the disruption to loons.

Comment: Design of the dam, with a spillway channel that can transfer water to toe of the dam, dictates that spillage risk be minimized.

☞ Response: Major drawdowns will continue to be allowed by this action, minimizing the risk of spring spillage. Spillage is more likely at other times of the year, when the storage deficit is not as great. NEPCo and Department calculations of reservoir elevation based on historic data from 1959-1992, taking into account the change in storage associated with the new minimum flow release, show that there were no occurrences in which the reservoir elevation exceeded the spillway crest with the allowance of a maximum drawdown to 2107 feet msl (NEPCo letter of December 9, 1994). In fact, the reservoir was at least three feet below the crest in each of the years from 1961 to 1973.

Improved watershed modeling and technological advancements like gate automation and telemetric rain gages can be employed to further improve reservoir management and reduce the risk of spillage.

Comment: NEPCo cites the water year 1984 as an example of the need for a greater winter drawdown, stating that it was necessary to perform emergency gate operations to meet the requirements of Article 28. Somerset was drawn to elevation 2105.6 feet msl that year and rose to 2131.5 feet msl in early June.

☞ Response: Information contained in the May 1993 response to Additional Information Request No. 8 does not support this argument. According to Table V, the reservoir releases were held at 4 cfs during most of April and May, and the highest spring gate release was 229 cfs, substantially less than the full capacity of 850 cfs. Elevation 2131.5 feet msl is fully two feet below the crest and just below the Condition II operating band of NEPCo's highwater guidelines. The situation seemed to have been well within control, and raising the maximum winter drawdown 1.4 feet to 2107 feet msl would not have caused the reservoir to reach the crest.

c. Restriction on maximum winter drawdown of Harriman Reservoir

General Comment: NEPCo requests that the maximum annual drawdown for Harriman Reservoir not be limited.[1] NEPCo determines its maximum winter drawdown levels based on snowpack, anticipated spring runoff, and the precipitation expected during the runoff period, with a goal of not spilling.

Comment: NEPCo states that additional upstream and downstream flooding may occur as a consequence of limiting the maximum drawdown.

☞ Response: The Department reviewed the effect of limiting the drawdown to elevation 1440 feet msl. As with Somerset Reservoir, the impact on spring high reservoir levels is somewhat offset by the fact that addition flows are released during the refill period because of the prescribed minimum flows. In the case of Harriman Reservoir, 70 cfs will be released into the bypass where no special releases have been provided previously. The 19-year record from 1974 to 1992 was analyzed. Under past management with no drawdown limit,

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[1]By letter dated December 9, 1994, NEPCo requested that the Department consider a maximum drawdown limitation of 1417.5 feet msl instead of the 1440 feet msl proposed in the draft certification.

the crest elevation was exceeded in 15 of the years, and elevation 1494.7 ft msl (3.0 feet of stoplogs) was exceeded in 5 years.[2] The Department's analysis indicates that the crest would have been surcharged in 6 of the years if a starting elevation of 1440 feet msl is used for each year, and in two of the years the level would have risen over three feet above the crest, assuming the stoplogs were in place.

NEPCo performed a similar analysis for the fourteen-year period 1960 to 1973 (NEPCo letter to the Agency, December 9, 1994). In 1969 and 1970 with a starting elevation of 1440 feet msl, the reservoir would have surcharged six-foot stoplogs. During those two years, the reservoir was actually was drawn to 1421.5 feet msl and 1423.5 feet msl, and the reservoir, although high, did not exceed a level higher that six feet over the concrete crest, or within the height of the stoplogs; in 1969, the water rose 4.0 feet above the concrete crest, and in 1970, 5.4 feet.

If NEPCo wishes to minimize the number of occurrences of levels greater than the crest elevation of 1491.7 feet msl, improved modeling of watershed processes and data gathering could be used to refine management and more accurately forecast the need for increased outflow earlier in the season. Those early releases can be timed to coincide with periods where flows in Massachusetts are sufficiently low that the added discharge from Harriman Reservoir would not pose a flood threat. Given the magnitude of the allowed winter drawdown, peak spring flows can be expected to continue to be attenuated significantly relative to natural conditions.

With respect to Wilmington, the Department reviewed the federal flood hazard boundary maps for Wilmington. The reservoir high stages under discussion would run up the North Branch to approximately the confluence of Binney Brook and do not appear to present a hazard to improved property.

Comment: NEPCo states that limiting the maximum drawdown will increase the incidence of potential ice entrainment in the morning-glory spillway, compromising dam safety.

☞ Response: The applicant has not demonstrated that ice entrainment is a significant problem associated with the reservoir drawdown limit at Harriman Reservoir. In its December 9, 1994 comments, NEPCo states that ice-out typically occurs between April 27 and May 1. Based on historic data, maximum reservoir elevations have occurred before May 1 only four times in the last 32 years. Therefore, ice-out typically occurs before the reservoir reaches its highest elevation.

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[2]The source of the data is NEPCo's response to AIR No. 22, Somerset and Harriman Aesthetics Documentation, October 1993, Figure 22-4, *Harriman Reservoir Midnight 10-Day Elevations*. Data was not presented in that reference to show in which of those years stoplogs were in place to prevent spillage. Also, higher levels may have actually occurred between the dates the 10-day readings were done, as was the case in 1976. NEPCo provided specific data for 1976 in a filing dated December 9, 1994; in 1976, the spring level reached 1496.9 feet msl.

NEPCo states in their comments of December 9, 1994 that Harriman is regulated to control the rate of rise, "with concern not to underfill the reservoir yet not have it rise to an elevation where ice could spill". If it appears that ice-out may be delayed and the forecasting model predicts high runoff rates, NEPCo has the option of increasing releases to control the rate of rise earlier in the spring period, thus avoiding ice spillage. This shifts the risk to one of underfilling, rather than one of ice spillage and dam safety.

In addition, the ability to control ice problems with structural solutions, such as an ice boom, have not been shown infeasible. NEPCo has cited incidences of having to handle ice at the outlet. If ice already poses a risk to the structure, NEPCo should be investigating solutions regardless of the issue of drawdown limitations. Another option may be to design the low-level outlet at the dam to pass discharges higher than the minimum flows when needed to control the rate of reservoir rise.

d. Source of maximum drawdown elevations used in the draft certification

Comment: NEPCo indicates that the Department selected maximum drawdown limitations based on water year 1980, which was used by NEPCo as an representative average year for the purposes of modeling project economics.

☞ Response: The low elevations in water year 1980 for Somerset Reservoir and Harriman Reservoir were 2108 feet msl and 1455 feet msl, respectively. The elevations used in the certification are 2107 feet msl and 1440 feet msl, respectively. These elevations differ, especially with respect to Harriman Reservoir. The elevations selected for the certification were based on a screening of historical data, with an objective of allowing management discretion to draw the reservoir to a greater extent than average conditions while retaining biomass in the reservoir. The winter 1980 low elevation for Somerset Reservoir is actually substantially lower than average conditions (2108 feet msl versus 2115 feet msl).

## 7. PROTECTION OF RARE AND ENDANGERED PLANTS

Comment: NEPCo questions the requirement of Condition G (now I) that NEPCo transplant the musk flower and Canada burnet, which are rare plants that are not protected under Vermont's endangered species law. NEPCo also states that it understands that a taking permit will be required for the endangered tubercled orchid. NEPCo states that it is of the opinion that Vermont is responsible for permitting and mitigation associated with the plants, given that the Agency is requiring the flows that are placing them at risk.

☞ Response: Although neither the musk flower nor the Canada burnet is legally protected under Vermont's endangered species statute, they are both rare in the state. The Agency did not request that NEPCo transplant the Canada burnet as it has a deep tap root and is not easily moved; however, this plant produces seeds that readily germinate. Mitigation would take the form of collecting the seeds and sowing them in favorable habitat along the new edge of bank rather than attempting to move mature individuals. As these two plants are not protected under the endangered species law and are not presently candidates for listing, the mitigation requirement has been removed from the certification; however, the Agency continues to encourage NEPCo to include these two plants in the mitigation plan along with the orchid.

Regarding the orchid, an endangered species permit is not required, and the issues that would be addressed in that process have been considered in this action.

## 8. APPLICANT'S SPECIFIC COMMENTS ON FINDINGS

The applicant commented individually on many of the specific findings. Following are responses for those substantive comments that have not already received an adequate response above. Where appropriate, findings have simply been changed to reflect the information provided by the applicant, and a response is not provided. The finding numbers referenced below are those used in the draft certification and may differ from those contained in the final draft.

Finding 34

Comment: It states that the mean annual runoff of the USGS gage near Rowe, MA is 737 cfs or 2.90 csm. It also states "The amount of runoff generated in the upper Deerfield basin is higher than that recorded for any other major basin in Vermont." The applicant recognizes that the average annual precipitation is higher in the Vermont section of the basin versus the Massachusetts section. However, natural runoff volumes should not be tied to flows at the Rowe, MA gage. This gage reflects regulated flow conditions. The flow per square mile of unregulated rivers in Vermont was calculated as part of the Vermont Flow Policy negotiations. Here, over 42 USGS gaging stations that experience minimal, if any, regulation were analyzed. The resulting mean annual flow per square mile for all 42 gages was 1.77 csm, which is well below 2.90 csm. Although it is typically felt that river regulation does not effect average annual flows this is a function of the magnitude of the regulation. Because the river is regulated at Rowe, MA the mean annual flow is higher than would normally occur in unregulated watersheds. Because Fife Brook, located immediately upstream of the Rowe, MA gage is a peaking facility, higher discharges occur that influence the mean annual csm factor.

☞ Response: It is a fundamental concept that flow regulation cannot affect the long-term mean annual flow unless there is a trans-basin water transfer, changes to hydrologic variables like evapotranspiration, or flow is being measured in a bypassed reach. NEPCo's regulation of flows has markedly changed the annual hydrograph but has not resulted in a significant change in the total volume of runoff. The upper Deerfield River basin is comparatively water rich.

Finding 68

Comment: It states: "The intake elevations are sufficiently low that there exists a potential for withdrawal of oxygen deficient water from the reservoirs and discharge of that water downstream into the river proper". The discharge of oxygen deficient water has not been shown in the data collected to date. At Somerset Reservoir, discharged water has remained well above Vermont dissolved oxygen standards. Likewise, based on the Class B water quality regulations, there have been no recorded violations of the dissolved oxygen standard below Harriman Station.

☞ Response: The finding is correct as written. Both reservoirs stratify, and the intake elevations are such that oxygen deficient water is entrained by the intakes. At Somerset Reservoir, samples collected 300 feet downstream of the outlet have demonstrated that reaeration at the free discharge point and in the outlet channel prevents a dissolved oxygen problem downstream. At Harriman, the condition that will exist at the bypass minimum flow discharge and at the tailrace have not been sufficiently defined, necessitating the certification condition related to further study at these two discharge points.

Finding 72

Comment: It is noted that during August 5, 1991, a D.O. and temperature profile of Somerset Reservoir was collected near the intake. It is also noted that the D.O. profile inexplicably increased from 4.7 mg/l to 6.3 mg/l from 16 to 25 m, respectively. In other reservoir sampling studies this same phenomenon was observed. During August 5, 1982, the Vermont Department of Environmental Conservation also collected a D.O. profile that showed a similar trend. The D.O. changed from roughly 3.7 mg/l to 5.3 mg/l in less than 6 feet. The August 5, 1982 sample was collected further upstream of the intake. Both surveys yielded the same observation in terms of the D.O. concentration decreasing and then suddenly increasing over a minimal change in depth. One theory regarding this phenomenon is algae settlement.

☞ Response: Although this atypical dissolved oxygen profile appears to have occurred twice during sampling on Somerset Reservoir, whether it was caused by sampling errors or a physical phenomenon cannot be determined from the existing data set. Further investigation and an attempt to define the cause is not warranted.

Finding 91

Comment: It states "The Appalachian Mountain Club (AMC) had recommended using a higher estimate of the August median flow of 0.39 csm". In determining the 0.39 csm value the AMC used the following periods of record: (North River, 1967-1991; South River, 1967-90; and Green River, 1968-91). The AMC excluded from the North River analysis the available data from the 1940-1966 period of record. By excluding the available data from a long(er) period, NEPCo believes that the full range of hydrologic events was not accurately portrayed. The August median flow for the period from 1940-1991 is substantially lower than the figure calculated from the 1967-1991 period. Calculations of median events should be based on the longest period of record available, not simply a recommended minimum of [25] years. It should also be noted that at the time the applicant completed its Aquatic Base Flow (ABF) analysis, the available hydrologic database ended in 1984. The AMC conducted their analysis a few years later with additional flow data available.

☞ Response: The Department has limited confidence in the parametric analysis used by both NEPCo and the AMC and, as stated in the certification, prefers basing estimates of a stream's hydrologic statistics on at least some gaging specific to the stream. No flow measurements specific to the upper Deerfield River basin were used in estimating the summer and winter flow statistics used by the applicant. Given that the minimum flows contained in the certification are based on special habitat studies rather than hydrologic standards, it is less important to develop refined estimates for the August and January median flows.

Finding 92

Comment: Three items need to be addressed here as follows: 1) it states that there is a difference in annual precipitation between the upper basin (within Vermont) and the lower basin (within Massachusetts) of 6 inches, 2) it states that the total annual runoff recorded at the Rowe, MA gaging station is about one third higher than the total annual runoffs recorded at the three tributary gages, and 3) it addresses the AMC's ABF analysis. Item 1) In the License Application (Volume XVII, NEPCo Responses to Agency Correspondence, NEPCo Responses, Page 64-65) NEPCo discusses the difference in precipitation between the upper and lower basins. In short, the average August precipitation for the upper and lower basin is 4.4 inches and 4.0 inches, respectively; a 10 percent difference. Assuming that all of this precipitation was converted to runoff, the applicant's 0.31 csm ABF ratio would increase by 10 percent to 0.34 csm. Item 2) see comments on Finding 34 regarding the difference between annual total runoffs at the Rowe, MA USGS gaging station and the three unregulated tributaries. In short, because the Rowe, MA gage reflects regulated flow conditions, csm ratios cannot and should not be compared to the three unregulated tributaries. Item 3) see comments on Finding 91.

☞ Response: Items 2 and 3 have already been discussed above. Regarding the first item, runoff for a given calendar month is not generated solely by precipitation in that month. Groundwater contributions can also be significant, and, given the overall higher annual precipitation in the upper portion of the basin, it is reasonable to assume that the river's unitized base flow is also somewhat higher in August as a result. The six-inch annual difference is a +13% difference relative to the lower basin and not much different than the +10% calculation NEPCo puts forward; however, the Department has not attempted to reestimate the August median flow based on a comparative analysis.

Finding 95

Comment: In addition to the IFIM studies that were conducted to establish minimum flow regimes, NEPCo also conducted other studies including demonstration flows and Aquatic Base Flow studies.

☞ Response: The finding mentions IFIM as one of the site-specific evaluations of the functional relationship between flow and fisheries habitat. It is correct that demonstration flow observations were also used, and those studies are discussed in the certification. The Aquatic Base Flow study was not accepted by the Agency, but is also discussed in the certification.

Finding 131

Comment: Under Table 7, it states: "Overall, a flow of 30 cfs does not provide acceptable habitat conditions". Other than this blanket statement, there is no rationale to explain why habitat conditions are not acceptable at 30 cfs.

☞ Response: A flow of 30 cfs in both the upper and lower sections of the Harriman bypass does not provide a reasonably full channel nor the diversity of habitat for all life stages of target organisms. Habitat is limited for adult trout species, and only a small amount of spawning habitat (approximately half of all suitable sites[3]) is available at 30 cfs. Observations made of the bypass at a flow of 30 cfs indicate that in general the velocity seemed low and side channels were dry or had water but no current. The water surface appeared very slack, lacking sufficient turbulence, thereby limiting the amount of instream overhead cover available.

Additionally, the upper bypass had study sites that appeared to be too shallow overall, thus there was little adult habitat. There is a significant increase in wetted width in the upper section of the bypass between 30 cfs and 57 cfs (9.5 feet) and 30 cfs and 90 cfs (20.5 feet)[4]. A flow of 30 cfs does not provide enough diversity or quantity of habitat for all life stages of the target organisms.

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[3] Memorandum from Roderick Wentworth, Department of Fish and Wildlife, to Jeffrey Cueto, Department of Environmental Conservation, June 27, 1994

[4] ibid.

Finding 132

Comment: It states: "As with the upper section, a flow of 30 cfs does not provide acceptable habitat conditions". Again, there is no rationale to explain why the habitat conditions at 30 cfs are not acceptable.

☞ Response: See the response to Finding 131 above.

Findings 144 and 146

Comment: It states, under both paragraphs, that an organism's habitat is controlled by whichever flow (minimum or generation) provides the smaller amount of habitat. It should be noted that natural flow conditions also control the amount of habitat.

☞ Response: The findings were written in the context of a highly regulated river. The findings have been revised for clarity on this issue.

Finding 157

Comment: In Finding 156 it states that the wetland plant communities around the Somerset and Harriman shorelines were found to be limited in extent due to non-nutritive soils, sand and gravelly substrates, steeply sloping shorelines, wind and water effects, and water level fluctuations. However, in Finding 157 it states that "The extensive drawdowns at Somerset and Harriman reservoirs prevent the establishment of beneficial wetland plant communities that would otherwise become established along the shoreline margins and in the shallow areas of the reservoirs". This statement is inconsistent with that stated in Finding 156. There are other reasons why wetland communities cannot be established along the Somerset and Harriman shorelines besides water level fluctuations. The non-nutritive soils, steeply sloping shorelines, and rocky substrate are the most important factors that inhibit significant wetland development along the shorelines of Somerset and Harriman reservoirs. The parent material of the soils that compose the substrate of Somerset and Harriman reservoirs is glacial till. Glacial till has little, if any, organic nutrients that could be used to support a prominent and diverse wetlands area. Presently, the only wetlands of any significance at Somerset and Harriman reservoirs, in terms of size, are located near the mouths of major tributaries. These wetlands communities have developed in the alluvial soils and rich organic muds that have been entrained and deposited by the tributaries. Also, the steep shorelines and rocky substrate do not provide a conducive environment for the development of emergent wetland vegetation. Without water level fluctuations, some wetland habitat could be expected to be developed. Although, the new wetland communities would not be substantial in terms of size and biodiversity. These wetland communities could be expected to inhabit only a very narrow strip along selected areas of the reservoir shorelines. Stabilizing the reservoir levels would not ensure that wetland communities could be developed any more significantly than in the present scenario. Even with reservoir drawdowns limited, the natural reservoir fluctuation could be expected to be as much as two to three feet. This would subject the existing wetland vegetation to drought conditions. In short, there is no guarantee that even with stable water levels, a wetland community could develop.

☞ Response: The extent of potential wetland establishment through reservoir stabilization has not been extensively investigated. Even narrow fringe wetlands are valuable for several functions, including shoreline stabilization, cover for wildlife, and food chain support. The natural variations in water levels that follow an annual cycle of two or three feet would not necessarily inhibit the establishment of wetlands. Many wetlands are subject to annual water level variations on that order.

Finding 159

Comment: It states that a rise or fall of the reservoir's water level can severely impact the reproductive and nesting success of the loon. It also states that the two most common causes of nest failure is nest flooding and predation. In a memo from Eric Chapman, VINS, to John Ragonese, NEPCo, it describes flooding as the more acute problem. Mr. Chapman describes a fluctuation range beyond 3 inches could cause nesting to fail. The memo states that a fluctuation of six or seven inches caused the nesting loons to have to drag themselves 12 feet. NEPCo understands the benefit to limiting the amount of fluctuation and the insurance it provides to the hatching success, yet in both 1993 and 1994, with fluctuations beyond 3 inches, loon eggs successfully hatched.

☞ Response: As stated in the finding, fluctuations in pond levels commonly cause nesting failure. Given that many of the ponds used in Vermont are hydroelectric reservoirs, this is not surprising. The 1994 Somerset loon nest referenced in the comment was compromised by a water level drop of 6 or 7 inches, as mentioned in draft Finding 163. The drop caused the adults to drag themselves 12 feet between the nest and the water. Lack of predation to exposed nest and determined loon adults caused the nest to succeed in spite of the risks presented by the lowered water level.

Finding 164

Comment: It states that an elevation of 2128.58 feet msl is considered a reasonable target elevation to achieve by May 1 in order to support loon nesting. In the memo dated September 14, 1994 from Steve Parren, VDFW, to Rod Wentworth, VDFW, reaching the 2128.58 msl target elevation is a goal and may be unattainable but water levels should be brought to the May 1 level as soon as possible. It is further stated in the memo that if this elevation is unattainable, the level should be stabilized at the June 1st elevation.

☞ Response: References made to the September 14, 1994 memo are incomplete and potentially misleading. The memo states the following.

"If by 1 June the 2138-foot [2128.58 feet msl datum] elevation is not reached, NEPCo shall stabilize water at the **highest elevation below 2138 feet that is attainable** within plus or minus 3 inches. If loons are known to be nesting at a different location, then NEPCo should stabilize water fluctuations within plus or minus 3 inches of the water level associated with the new nesting location."

The emphasis added above means that if loons are not yet nesting, water level should be stabilized below the target elevation that was not reached. The second line of the quote indicates that a loon nest location is associated with a water level elevation and this elevation should supersede the 2128.58 msl target whether it is above or below the target. The top of Page 68 of the September 16, 1994 certification draft gives an example of stabilization above the target elevation.

Finding 172 and 252

Comment: Review of the Rare, Threatened or Endangered Plant Species of the Deerfield River report (License Application, Volume XIII, Appendix E7, Page 2) indicates that there are observations of the tubercled orchid in the Searsburg bypass. NEPCo requests that the state provide whatever record they have of this plant in the Searsburg bypass.

☞ Response: A map developed by the Agency of Transportation consultant has been forwarded under separate cover.

Finding 201

Comment: NEPCo has reviewed the publication cited. Many of the values sought in the public warning draft reflect reservoir/lake ecosystem considerations or guaranteed minimum flow requirements which would not be possible without a hydropower (or other water management) system in place on the Deerfield River. NEPCo's view of the publication is that it is a non-technical public policy reflection seeking to "naturalize" regulated streams and ". . . to stabilize impoundment water levels to protect reservoir fisheries resources . . ." without bothering to address the fundamental irony that there would be no "reservoir" or "reservoir fishery resource" without the regulation of the hydropower facility.

☞ Response: The Department has recognized the value of the reservoirs for the special recreational and social values they offer, and the study report cited certainly made no recommendations to fully restore the lost riverine resources, but only suggested a course of mitigation which is now being followed in acting on this certification. For clarification, the Department does not view the flow regime, as proposed with guaranteed flows, as an enhancement over natural flow conditions.

Finding 235

Comment: It states that flows naturally drop below the August median flow. It should be noted that, by guaranteeing Somerset's minimum flow from storage, it represents an enhancement over natural hydrologic conditions.

☞ Response: The guaranteed minimum flows during summer low flow conditions are an enhancement for that period. The finding has been revised as recommended.

Finding 244

Comment: We are unsure if this paragraph is applicable to the Deerfield River Project.

☞ Response: The finding has been deleted.

Finding 253

Comment: The applicant has stated in its Additional Information Request No. 4 that minimum flows in the Harriman bypass should be increased slowly over time such that the tubercled orchid migrates naturally.

☞ Response: The suggestion for gradually increasing the minimum flows beginning in the spring (mid to late May) was intended to minimize the mortality to orchid individuals. Since the orchids produce new roots annually around late May to early June, the Agency expects that the greatest potential for success will occur if the transition to the new minimum flow regime is made before root growth begins. The schedule contained in the certification condition has been changed to reflect this.

## 9. APPLICANT'S SPECIFIC COMMENTS ON CONDITIONS

The applicant commented on several of the draft conditions. Following are responses where appropriate and not covered above. The letter references for specific conditions are those used in the draft certification and may differ from those contained in the final draft.

Condition A

Comment: NEPCo asks that the condition not be worded to specifically require operation and maintenance consistent with the findings of fact and conclusions in the certification.

☞ Response: This is a standard condition for Vermont certifications. NEPCo does not explain the basis for the requested change.

Condition B

Comment: NEPCo indicates that "or inflow, whichever is less" should be added after the two flows cited in Table B.

☞ Response: The introductory paragraph states that all flows requirements are the numeric value or "instantaneous inflow, if less."

Conditions B and C

Comment: NEPCo asks that the 90-day filing requirements be increased to one year.

☞ Response: The Department has revised the filing deadlines under several of the conditions to provide what it believes are reasonable timeframes for developing the filing information. The Department would like NEPCo to file information well in advance of these deadlines where practicable.

Condition E

Comment: NEPCo asks that the water quality reports be filed no later than February 1 following the sampling year instead of by the end of the year.

☞ Response: The sampling year ends with October. As the reports are only compilations of sampling data, NEPCo should be able to file by the end of December.

Comment: NEPCo asks that sampling at Harriman dam be deferred until "completion of the bypass works" instead of June 1996 as drafted.

☞ Response: The condition has been redrafted.

Condition Q

Comment: NEPCo asks that the telephone notification systems for Searsburg and Harriman dams be operational upon the commencement of passage of minimum flows rather than by May 1, 1996 as drafted.

☞ Response: The condition has been redrafted as recommended.

Requested additional condition

Comment: NEPCo has requested being given the discretion of operating the project differently than prescribed in the conditions of the certification if an emergency exists. NEPCo asked that the following condition be added:

> Emergency conditions beyond the control of NEPCo including, but not limited to, anticipation of or occurrence of high natural precipitation, or other natural conditions leading to extreme runoff events; flood storage requirements; ice conditions; equipment failure; or electrical emergencies in which the operational restrictions set out herein will or are reasonably likely to result in interruption of service to electrical customers; may occasionally require NEPCo to make variations from the operational restrictions set out herein when compliance would be impossible, or inconsistent with the prudent and safe operation of the Project. The applicant will provide notice of such variation to U.S. Fish and Wildlife Service, and the Vermont Agency of Natural Resources, within one business day of the applicant's knowledge of such an event.

☞ Response: The Department does not include broad-based waivers in certifications. NEPCo has not discussed specific power and non-power emergencies that may occur, including their frequency, and what extraordinary operating responses may be necessary. Without specific information, the Department cannot assess the impact of the deviations from the conditions of the certification as drafted and the implications for management of the resource under the Standards.