

GLENDALÉ HYDROELECTRIC PROJECT

LIHI APPLICATION

ATTACHMENT B

WATER QUALITY



COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WESTERN REGIONAL OFFICE

436 Dwight Street • Springfield, Massachusetts 01103 • (413) 784-1100

DEVAL L. PATRICK
Governor

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Lieutenant Governor

IAN A. BOWLES
Secretary

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Commissioner

SENT ELECTRONICALLY

Mr. Kevin M. Webb
Environmental Affairs Coordinator
Littleville Power Company, Inc.
One Tech Drive, Suite 220
Andover, MA 01810

July 8, 2009

Subject: Water Quality Certification
Glendale Hydroelectric Project
FERC No 2801

Dear Mr. Webb:

As attached, please find a Section 401 Water Quality Certificate as issued by the Department for the above referenced project. Your attention is directed to each of the Certification Provisions contained in the Certificate. If you have any questions please contact Robert Kubit at 508-767-2854 at Robert.Kubit@ma.state.us or myself at 413-755-2138, Robert.J.McCollum@state.ma.us.

Sincerely,

A handwritten signature in black ink, appearing to read "R. J. McCollum".

Robert J. McCollum
Program Chief
Wetlands & Waterways
DEP Western Region

W://RM/Stockbridge 401 WQC -r1 Letter
Enclosure

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SENT ELECTRONICALLY
Water Quality Certification
Glendale Hydroelectric Project,
FERC License No. 2801-MA
BRPWW11

Applicant: Littleville Power Company, Inc.
Subsidiary of Enel North America, Inc.

INTRODUCTION

In October 2007, the Littleville Power Company, Inc., a subsidiary of Enel North America, Inc. (Project Owner), submitted to the Federal Energy Regulatory Commission (FERC) an Application for Subsequent License for the Glendale Hydroelectric Project, a Minor Project of less than 1.5 MW Capacity located at an existing dam on the Housatonic River in Stockbridge, MA (Project). The Project was self-certified as a Qualifying Facility pursuant to Section 210 of the Public Utilities Resource Protection Act (PURPA) on October 30, 2000, under FERC docket QF01-26. The Project was self-recertified as a Qualifying Facility on May 3, 2006. The Project Owner submitted an application for Water Quality Certification (Certification) to the Massachusetts Department of Environmental Protection (MassDEP) on November 15, 2007. On November 11, 2008, the Project Owner withdrew and resubmitted its Certification application.

PROJECT DESCRIPTION

The Glendale Hydroelectric Project is located within River Segment MA21-19 on the main stem Housatonic River in southwestern Massachusetts. 314 CMR 4.06 of the Massachusetts Surface Water Quality Standards (Standards) classifies this segment as a Class B, Warm Water Fishery. The Housatonic River at the Project has a drainage area of 272 square miles.

The topography of the basin is greatly varied. It is hilly and mountainous in the east, gives way to rolling upland toward the west, and the Massachusetts and New York border region contains a large valley running in a north-south direction. The river reach between the nearest upstream Willow Mill dam and the Glendale dam is predominantly flat water with some areas of quick water and riffles. It meanders through areas of marble-limestone bedrock, wide floodplains, wetlands, meadows, and a golf course. The banks along the Project impoundment, canal, and bypassed reach are relatively steep. The base

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of the adjacent Monument Mountain, located to the west of the tailrace, is a flatter area. Below the Project, the river is swift with lots of quick water and several mid-sized rapids. The proposed Project will provide additional recreational access through formal canoe portage facilities and parking.

There are several dams on the main stem of the Housatonic River used for hydropower generation, and others are used for flood storage or water withdrawal. The Willow Mill Project (FERC Project No. 2985), used for hydropower generation and water withdrawals for paper mill processing, is the next upstream dam located about 6 miles from the Project dam. The next downstream dam is at the Risingdale Impoundment, approximately 4 miles from the Project dam in Great Barrington, Massachusetts. On December 15, 2004 FERC granted a three year preliminary permit to the Fox River Paper Company to study the proposed 1,100-kilowatt Risingdale Project No. 12528.

As licensed by FERC, the existing Glendale Hydroelectric Facility consists of:

1. a 250 foot long, 30 foot high concrete gravity dam with a 182 foot long spillway;
2. a 23 acre reservoir;
3. two manually operated 10 foot by 10 foot intake gates;
4. a 1,500 foot long by 40 foot wide intake canal;
5. a fore bay structure and a 250 foot long, 12 foot diameter steel penstock;
6. a powerhouse containing four turbine generating units with a combined installed capacity of 1,140 kilowatts;
7. a 300 foot long tailrace channel;
8. a step-up transformer and an 83 foot long, 13.8 kilovolt transmission line; and
9. appurtenant facilities.

The Housatonic River reach that is bypassed by the Project (measured from the gatehouse to the tailrace channel) is about 2,500 feet long. The Project Owner's Application for Subsequent License proposes significant modifications to the existing hydroelectric facility. General and detailed Project location maps are attached to this Certification as "Attachment A". The proposed Project will include a new 165kW turbine unit in the waste gate slot located at the gatehouse adjacent to the dam. This unit would operate off of a proposed minimum bypassed reach flow of 90 cubic feet per second (cfs) or inflow. The Project will continue to be operated in a run-of-river mode using automatic pond level control. The Project boundary circumscribes the Project's impoundment at elevation 814.9 ft NGVD, or 4.0 ft above the normal pond elevation of 810.9 ft NGVD, corresponding to the extent of the Project Owner's flowage rights. The Project boundary in the vicinity of the Project works follows the Project Owner's existing property lines.

IMPACTED RESOURCES

The Housatonic River originates approximately thirty miles upstream of the Project at the confluence of the West and Southwest Branches of the Housatonic River in Pittsfield. The West Branch Housatonic River originates at the outlet of Pontoosuc Lake in Lanesborough and Pittsfield. The Southwest Branch originates from Richmond Pond in the town of Richmond. The East Branch Housatonic River, which originates from Muddy Pond in the town of Washington, soon joins the main stem Housatonic River. From Pittsfield, the river flows south for 150 miles (approximately 54 river miles in Massachusetts) until it empties into Long Island Sound near Bridgeport, CT.

The Housatonic River is undergoing a process of restoration. MassDEP and the United States Environmental Protection Agency are working with local communities to address ongoing water quality issues at wastewater treatment facilities. The General Electric Corporation has begun an active program to remediate longstanding polychlorinated biphenyl (PCB) contamination issues in the Pittsfield area. Recreational activities in and around the Housatonic River continue to grow in popularity. A new catch and release fishing area created by the Massachusetts Division of Fisheries & Wildlife (MADFW), with brown trout as the target species, includes the Project bypass reach. While the Housatonic River in this reach is classified by MassDEP as a Warm Water Fishery, MADFW has evidence that brown trout do persist through the summer months in these reaches. Additionally, at least fifteen species of fish have been collected from the project impoundment in the recent past, including smallmouth bass, white sucker, yellow perch, pumpkinseed, and shiners. Downstream from the project tailrace many of those same species have been collected, as well as dace and brown trout. At this time, there are no anadromous fish species present within the vicinity of the Project. However, there is an active migratory fish restoration program on the Housatonic River in Connecticut.

Fishery resource agencies are actively involved in diadromous restoration efforts within the watershed. These efforts are based on management goals contained in the following published fishery plans:

1. Interstate Fishery Management Plan for American Eel. April 2000. Atlantic States Marine Fisheries Commission.
2. Fishery Management Plan for the American Shad and River Herring. 1985 (amended in 1998). Atlantic States Marine Fisheries Commission.
3. Diadromous Fisheries Plan for the Upper Housatonic River Basin. 2000. Connecticut Department of Environmental Protection.

These plans call for improved fish passage and other measures to enhance populations of migratory fish. Accomplishing the stated fishery management goals requires providing fish passage using methods such as the installation of fishways along the Housatonic River.

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According to the Connecticut Department of Environmental Protection's (CT DEP) Diadromous Fisheries Plan for the Upper Housatonic River Basin (2000), the Housatonic River from Derby Dam in the towns of Derby and Shelton, CT, upstream to the base of Bulls Bridge Dam in the Town of Kent, CT, has been targeted for anadromous fish restoration. The catadromous American eel will be restored up to the base of the Falls Village Dam in the towns of Salisbury and Canaan, CT. The new license issued for the Housatonic River Project (FERC No. 2576) requires fish passage facilities at the Stevenson, Shepaug, and Bulls Bridge dams.

Presently there are no plans to restore anadromous fish to the Massachusetts portion of the Housatonic River. However, once the CT DEP's restoration plan is fully implemented, American eel would have access to the base of the Risingdale Dam (FERC No. 12528) in Great Barrington, Massachusetts. Although no upstream eel passage facilities are required at the Housatonic River Project's Falls Village facility, it is assumed eels will be able to ascend the Great Falls at the Falls Village Dam. Therefore, passage would only need to be provided at the downstream Risingdale dam before eel have access up to the Glendale Project. Therefore, there is a possibility that passage for American eel will be required at this Project before the term of the proposed new license expires.

Upstream passage for eels is fairly well understood, and is relatively inexpensive compared to other upstream fishways. Downstream passage needs for eels are less well understood. Research is ongoing to determine the types of bypass measures that are most effective for upstream eel passage. At some sites a traditional surface bypass may suffice, while at others, temporary station shut-downs may be the only means to ensure safe passage of out-migrating adult eels.

APPLICABLE LAW

The Massachusetts Clean Waters Act (State Act), G.L. c.21, §§ 26-53, delegates responsibility for enhancing the quality and value of water resources within the Commonwealth to MassDEP. The State Act directs MassDEP to take all action necessary or appropriate to secure to the Commonwealth the benefits of the Federal Clean Water Act, 33 U.S.C. §§1251-1387 (Federal Act). The main objectives of the Federal Act are to restore and maintain the chemical, physical and biological integrity of the nation's waters. To meet these objectives, MassDEP adopted the Massachusetts Surface Water Quality Standards, 314 CMR 4.00. The Standards classify each body of water within the Commonwealth; designate the most sensitive uses to be enhanced, maintained and protected for each class; prescribe minimum water quality criteria required to sustain the designated uses; and contain regulations necessary to achieve the designated uses and maintain existing water quality including, where appropriate, the prohibition of discharges into waters of the Commonwealth.

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314 CMR 4.06 (5), Figure 2 and Table 2 classify the Housatonic River as a Class B water for its entire length in Massachusetts. All Class B waters are designated as habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation (314 CMR 4.05(3)(b)). Class B waters shall also be suitable for irrigation and other agricultural uses, and for compatible industrial cooling and process uses. Class B waters must also consistently exhibit good aesthetic quality (314 CMR 4.05(3)(b)). The minimum criteria applicable to Class B waters are listed within 314 CMR 4.05(3)(b). Additional minimum criteria applicable to all surface waters are listed within 314 CMR 4.05(5). The Antidegradation provisions of 314 CMR 4.04 at minimum require protection of all existing and designated uses of water bodies, and maintenance of the level of water quality needed to protect those uses.

CERTIFICATION PROVISIONS

1. MassDEP APPROVES the application of Littleville Power Company, Inc. and CERTIFIES that there is reasonable assurance that Glendale Hydroelectric Project, as described above and subject to the conditions below, can be operated in compliance with the applicable provisions of §303 of the Federal Act, 33 U.S.C. § 1313.
2. This Water Quality Certification shall become a condition on the FERC License issued to the Project Owner.
3. This Certification shall become effective on the date that the license issued for the Project by FERC becomes effective.
4. The state and federal resource agencies referred to in this Certification include the MassDEP, the Massachusetts Department of Fisheries and Wildlife (MADFW), and the U.S. Department of the Interior, Fish and Wildlife Service (USFWS).
5. The Project shall be operated by the Project Owner in accordance with the conditions contained in this Certification and the information included in the FERC application dated October 2007. Any modifications made to the FERC application during the initial licensing process that would have a significant or material effect on the conclusions or conditions contained in this Certification, as determined by MassDEP, must be submitted to MassDEP for prior review and approval.
6. The Project shall be operated to maintain the existing and designated uses of the Housatonic River as outlined in the Standards at 314 CMR 4.00, and to maintain an integrated and diverse biological community within the Housatonic River.

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7. The Project Owner shall obtain and comply with all applicable federal, state and local licenses, permits, authorizations, conditions, agreements and orders required for the operation of the project in accordance with the terms of this Certification.

8. All activities shall be conducted in compliance with the Massachusetts Wetlands Protection Act, including the Rivers Protection Act, G.L. Chapter 131, Section 40, and the implementing regulations at 310 CMR 10.00. A Water Quality Certification shall be obtained from MassDEP prior to initiating any activity that will cause a discharge subject to §404 of the federal Act, 33 U.S.C., §1344. The Project Owner shall comply with all applicable provisions of the Public Waterfront Act, G.L. c. 91, and the implementing regulations at 310 CMR 9.00.

9. Prior to beginning any construction on the Project, the Project Owner shall submit a plan to monitor and control erosion during construction activities to keep impacted waters free from turbidity in concentrations that are aesthetically objectionable or would impair any designated use(s) of such waters. The Project Owner shall implement the plan as approved by MassDEP.

10. All construction, maintenance and repair activities, including disposal of debris and removal of sediments in impounded areas, shall be conducted in a manner so as not to impair water quality, and pursuant to and in compliance with any required approvals.

11. Any proposed change to the Project that MassDEP determines would have a significant or material effect on the findings, conclusions, or conditions of this Certification, including Project operation, shall be submitted to MassDEP for prior review and approval.

12. MassDEP may request, at any time during which this Certification is in effect, that FERC reopen the license to make modifications MassDEP deems necessary to maintain compliance with the Standards at 314 CMR 4.00, or other appropriate requirements of state law.

13. MassDEP reserves the right to add and alter the terms and conditions of this Certification when authorized by law, and as it deems appropriate to carry out its responsibilities during the life of the Project with respect to water quality and the protection of the existing and designated uses of the waters of the Commonwealth.

14. The Project Owner shall operate the project in a run-of-river mode such that inflow to the project equals outflow from the project on an instantaneous basis and fluctuations of the head pond water level are minimized. This operating regime may be temporarily modified by approved maintenance activities, agreement between the Project Owner and appropriate state and/or federal resource agencies, or by extreme hydrologic conditions or emergency electrical system conditions, as these terms are defined below.

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15. The Project Owner shall release to the project bypass reach a continuous minimum flow of 90 cfs, or inflow, if less, for the protection and enhancement of fish and aquatic life habitat. Minimum flows may be temporarily modified by approved maintenance activities, by agreement between the Project Owner and appropriate state and federal resource agencies, or by extreme hydrologic conditions or emergency electrical system conditions, as these terms are defined below.

16. "Extreme Hydrologic Conditions" signifies the occurrence of events beyond the Project Owner's control including without limitation, abnormal precipitation, extreme runoff, flood conditions, ice conditions or other hydrologic conditions which render the operational restrictions and requirements contained within this Certification impossible to achieve, or are inconsistent with the safe operation of the Project.

17. "Emergency Electrical System Conditions" signifies operating emergencies beyond the Project Owner's control which require changes in flow regimes to eliminate such emergencies including without limitation, equipment failure or other abnormal temporary operating condition, generating unit operation or third-party mandated interruptions under power supply emergencies, and orders from local, state or federal law enforcement or public safety authorities.

18. During refilling of the project reservoir after dam maintenance or emergency drawdown, the Project Owner shall operate the project such that 90% of inflow to the project is released below the project and the impoundment is refilled on the remaining 10% of inflow.

19. Within three months of completion of turbine installation at the dam, or upon such other schedule established by FERC, the Project Owner shall, submit a plan for monitoring run-of-river operation and flow releases from the Project to MassDEP for approval. The plan shall include: a description and design of the mechanisms and structures that will be used; a description of periodic maintenance and/or calibration that will be conducted to ensure these mechanisms and structures work properly; a description of the method used to record project operation data for verification of proper operations and minimum flow releases; and a description of the manner in which data will be maintained for inspection by MassDEP and the state and federal resource agencies. The Project Owner shall consult with the state and federal resource agencies in developing these plans, shall respond to all agency comments, and shall include agency comment letters when submitting the plans to MassDEP for approval. The Project Owner shall provide the state and federal resource agencies with at least thirty days to respond to a draft plan before it is submitted to MassDEP for approval. The Project Owner shall implement the plan as approved by MassDEP.

20. Within six months of the effective date of this Certification, or upon such other schedule established by FERC, the Project Owner shall submit to MassDEP for approval, an Invasive Species Control Plan (ISCP). The plan shall include a schedule for regularly monitoring invasive species within the project area, including without limitation zebra mussel and water chestnut. The plan shall also identify methods used to control selected

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species. The Project Owner shall consult with the state and federal resource agencies and in developing the ISCP, shall respond to all agency comments, and shall include agency comment letters when submitting the plan to MassDEP for approval. The Project Owner shall provide the resource agencies with at least thirty days to respond to a draft plan before submission to MassDEP for approval. The Project Owner shall implement the plan as approved by MassDEP.

21. Within one year of the effective date of this Certification, or upon such other schedule established by FERC, the Project Owner shall install full-depth, one inch clear trash racks with velocities less than or equal to two feet per second (≤ 2 fps) at the intakes to the main and minimum flow units to reduce impingement and entrainment of fish at the Project.

22. The Project Owner shall, in a manner approved by MassDEP after consultation with the state and federal resource agencies, design, construct, operate, and maintain upstream eel passage facilities within one year of the installation of upstream eel passage facilities at the Risingdale Dam downstream of the Project. Six months prior to initiating operation of these facilities, the Project Owner shall, after consultation with the state and federal resource agencies, submit to MassDEP for approval an American eel passage effectiveness monitoring plan. The Project Owner shall implement the plan as approved by MassDEP. The schedule and other requirements of this condition may be amended with the mutual written agreement of the Project Owner and MassDEP.

23. Within one year of the installation of upstream eel passage facilities, the Project Owner shall submit to MassDEP for approval, a plan for providing safe downstream passage for American eels. The Project Owner shall implement the plan as approved by MassDEP.

24. The Project Owner shall, in a manner approved by MassDEP after consultation with the state and federal resource agencies, design, construct, operate, and maintain upstream and downstream anadromous fish passage facilities within one year of the installation of upstream and downstream anadromous fish passage facilities at the Risingdale Dam. Six months prior to initiating operation of these facilities, the Project Owner shall, after consultation with the state and federal resource agencies, submit to MassDEP for approval an upstream and downstream anadromous fish passage effectiveness monitoring plan. The Project Owner shall implement the plan as approved by MassDEP. The schedule and other requirements of this condition may be amended with the mutual written agreement of the Project Owner and MassDEP.

25. The Project Owner shall allow any employee, agent, consultant, contractor or authorized representative of MassDEP or MADFW to enter the facilities in order to assess compliance with the terms and conditions of this Certification including, but not limited to, entry for the purposes of: (i) investigating, sampling, inspecting, or photocopying documents or other writings, conditions, equipment, practices or property; (ii) interviewing facility personnel and contractors; (iii) making records of field activities;

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and (iv) observing any activities undertaken at the facilities under any of the provisions of this Certification.

26. If any event occurs which delays or will delay the Project Owner's performance of work beyond a deadline established by or pursuant to this Certification, which event was beyond the reasonable control and without the fault of the Project Owner or any person or entity subject to the Project Owner's control, and which event could not have been prevented or avoided by the exercise of due care, foresight, or due diligence on the part of the Project Owner (a "force majeure event"), then the time for performance shall be extended for an appropriate period of time, as determined by MassDEP in its sole discretion. The Project Owner shall bear the burden of demonstrating that a force majeure event has occurred or will occur, and that the delay was beyond the reasonable control and without the fault of the Project Owner. Such an extension of time must be in writing to have effect.

27. Submissions under this Certification shall be sent to:

MassDEP: Massachusetts Department of Environmental Protection
Division of Watershed Management
Central Regional Office
627 Main Street
Worcester, MA 01608
(508) 767-2854; FAX (508) 791-4131

Massachusetts Department of Environmental Protection
Bureau of Resource Protection
Western Regional Office
436 Dwight Street
Springfield, MA 01103
(413) 755-2138; FAX (413) 784-1149

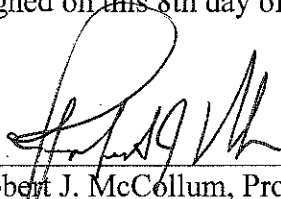
MADFW: Massachusetts Division of Fisheries and Wildlife
Field Headquarters
Assistant Director of Fisheries
1 Rabbit Hill Road
Westborough, MA 01581
(508) 389-6331; FAX (508) 389-7890

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USFWS: United States Fish and Wildlife Service
New England Field Office
Attention: Supervisor
70 Commercial Street, Suite 300
Concord, NH 03301-5087
(603) 223-2541; FAX (603) 223-0104

Signed on this 8th day of July, 2009.



7/8/09

Robert J. McCollum, Program Chief
Wetlands & Waterways
MassDEP Western Regional Office

137 FERC ¶ 62,196
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Littleville Power Company, Inc.

Project No. 2801-034

ORDER MODIFYING AND APPROVING INVASIVE SPECIES PLAN

(Issued December 1, 2011)

1. On August 16, 2011, the Littleville Power Company, Inc. (licensee) filed an updated Invasive Species Monitoring and Control Plan (plan) for the modified Glendale Hydroelectric Project (project). The Glendale Project is located on the Housatonic River in Berkshire County, Massachusetts.

BACKGROUND AND LICENSE REQUIREMENTS

2. License Article 401(a)¹ requires the licensee to file an invasive species monitoring and control plan with the Federal Energy Regulatory Commission (Commission), including documentation of consultation with the Massachusetts Department of Environmental Protection (MassDEP), copies of comments and recommendations made in connection with the plan, and a description of how the plan accommodates the comments and recommendations. Additionally, Condition No. 20 of the water quality certificate (WQC) issued by the MassDEP requires the licensee to submit the plan to the MassDEP for approval.

3. On April 15, 2011, the licensee filed an invasive species control plan with the MassDEP, Massachusetts Division of Fish and Wildlife (MDFW), and the U.S. Fish and Wildlife Service (FWS) (collectively, the resource agencies), concurrent with submitting the plan to the Commission. The resource agencies then filed comments on the plan, and as the plan filed with the Commission did not include the licensee's response to comments or the final approval of the MassDEP, the Commission stated that the filing did not meet its requirements for review pursuant to Article 401(a) and could not be processed.² The Commission stated that the licensee should file a new plan containing the approval of the MassDEP and responses to the comments provided by the agencies.

¹ Order Issuing Subsequent License. 28 FERC ¶ 62,123 (August 19, 2009).

² Letter dated July 18, 2011.

LICENSEE'S PLAN

4. The licensee states that nine invasive plant species have been observed within the project boundary, with varying abundance. Eurasian watermilfoil and curly leaf pondweed are present, but not abundant. Purple loosestrife and reed canary grass are commonly found throughout riparian areas of the impoundment. Common reed grows sparsely in the wetland areas adjacent to the impoundment. A single large monoculture of Japanese knotweed grows along the edge of the river on the west bank. Black locust trees, multiflora rose, and non-native honeysuckle also occur sparsely within the riparian zone. The licensee states that it recently learned of zebra mussel found on the abutments of the Glendale Road bridge (which crosses the project impoundment). Some invasive species known to occur in the Housatonic River Basin or within the watershed, but not reported at the project include water-chestnut, Didymo (a freshwater diatom), and mile-a-minute vine.

5. The licensee proposes to perform bi-annual monitoring of invasive plants growing within the project boundary. The licensee states that the monitoring will be performed in consultation with the resource agencies, including the specific details of the monitoring methods used. The licensee proposes to prepare a monitoring report for resource agency and Commission review at the end of each monitoring year.

6. The licensee states that its operations personnel is familiar with zebra mussels, and can identify any mussels that may be attached to the project's trash racks or other fixed structures. The licensee states that the project's power canal is typically drained for inspection and maintenance at least once annually, which provides an opportunity for operations personnel to inspect the canal structures for the presence of zebra mussels. The licensee states that the need for further monitoring will be discussed with the resource agencies, and the licensee also states that it has discussed the installation of a zebra mussel monitoring station with a consulting firm. Regarding the recent detection of zebra mussels on the abutments of the Glendale Road bridge, the licensee states that it will be notifying the resource agencies regarding any appropriate control or removal strategies, in accordance with this plan.

7. The licensee proposes to have qualified staff biologists monitor the bypass reach for Didymo on an annual basis. Alternately, such monitoring for Didymo may be coordinated with existing monitoring programs, such as those performed by the Housatonic Valley Association's Volunteer River Watch Program. The licensee states that if Didymo is confirmed to be present in the project area, the licensee will report its findings to the resource agencies, then consult with the resource agencies regarding any appropriate control or removal strategies.

8. The licensee states that project-specific control measures for invasive species would likely fall short, as they would be rendered ineffective by re-infestation from

outside of the project boundary. The licensee believes that invasive species control is a regional issue, and is willing to participate in an invasive species control program as a regional initiative within the Housatonic River Basin. The licensee states that it understands that public education can provide the first line of defense against the spread of invasive species, and proposes to install an informational kiosk in the new parking area. The licensee proposes to post educational information on invasive species at the kiosk, including how the species may be identified and who to contact should such species be found. The licensee states that it will also post specific warnings against the use of felt soled waders as they are a suspected route of Didymo transmission, and how wading shoes should be treated to kill Didymo cells.

AGENCY CONSULTATION

9. The licensee submitted its original draft plan to the resource agencies for review and comment by email on April 15, 2011. The FWS provided comments by letter dated May 17, 2011. The FWS stated that mile-a-minute vine has been documented in Massachusetts, and the licensee's final plan reflects this finding. The FWS requested that the licensee conduct invasive species monitoring surveys every year rather than the originally proposed schedule of every five years. The licensee's revised plan proposes to monitor invasive species every two years, as the licensee states that more frequent monitoring would be cost prohibitive. The FWS also requests that the licensee develop a control plan for the highly aggressive invasive aquatic and riparian species. The licensee states that efforts to control invasive species at the project-level would prove fruitless, but it is willing to participate in any such watershed-based control programs. The FWS notes that the references the licensee provides in the plan indicate that there are regional/watershed-wide efforts to control invasive species currently underway.

10. The MassDEP provided comments by email on August 2, 2011, requesting that the licensee include a map with bordering vegetated wetlands and banks within the project boundary, as well as the invasive species found there. The licensee provided a map indicating bordering vegetated wetlands and banks within the boundary in the final version of the plan, and states that the details of invasive species locations will be provided with the first monitoring report (tentatively scheduled for 2012).

11. The MDFW commented by email dated August 2, 2011, requesting that the licensee set up a zebra mussel monitoring site. As stated above, the licensee proposes to be in contact with the resource agencies regarding any appropriate control or removal strategies of the recently documented zebra mussels. The licensee additionally states that the need for further monitoring of zebra mussels will also be discussed with the resource agencies. The MDFW also requested that the licensee look into the eradication of common reed in the impoundment if it is still a small stand; the licensee states that it will consider eradicating common reed from the wetlands bordering the impoundment if it is found to be sparsely distributed.

DISCUSSION

12. The licensee's plan describes annual monitoring for zebra mussels and Didymo at specific project features (i.e., the trashracks, the power canal, the bypass reach) and bi-annual monitoring schedule for invasive plant species monitoring within the project area. The licensee increased the schedule for monitoring invasive plants from every five years to every two years, in response to the FWS's comment that the longer interval could allow the establishment of new colonies or significant expansion of existing ones. The licensee states that performing annual invasive plant surveys would be cost prohibitive.

13. Based on the results of the 2006 relicensing surveys and the projected current conditions of invasive species within the project boundaries, the licensee should have the opportunity to collect data on a bi-annual frequency to establish the current extent of invasive species in the project area and determine the amount of, and potential for, spread. The licensee's proposed plan, however, did not identify a schedule to implement its monitoring plan. The licensee should begin monitoring for invasive species, using the bi-annual schedule, in 2012. The Commission should reserve the right to increase the frequency of monitoring to ensure accurate monitoring and control of invasive species based on the results of bi-annual monitoring. In its first monitoring report, the licensee should compare its most recently collected invasive species data to the data collected during the 2006 relicensing surveys (a 6 year time interval); subsequent reports should include a comparison to previously collected data so that changes in the size or number of invasive plant stands over time may be assessed.

14. The licensee should prepare a report following each bi-annual year of invasive species monitoring. The report should contain, but not be limited to: descriptions and maps of existing and new stands of invasive species; control and removal efforts, if any, implemented during the previous monitoring period or proposed for the next monitoring period; and any participation in region-wide invasive species control efforts. The licensee's first bi-annual monitoring report should detail control plans for the most highly aggressive invasive aquatic and riparian species. Though the licensee proposes annual monitoring of zebra mussels and Didymo, and bi-annual monitoring of invasive plants, the licensee should file its monitoring results with the Commission bi-annually, and include in its reports the annually collected data. The licensee should file the report with the MassDEP, the MDFW, and the FWS for a minimum 30 day review and comment period. Monitoring reports filed with the Commission should include copies of the agencies' comments and the licensee's response to the comments. The licensee should file the bi-annual report with the Commission by January 15 following the year in which the monitoring occurred. The Commission should reserve its authority to require changes to the approved plan based on the results of the bi-annual reports.

15. The licensee assumes the position that invasive species control is a regional issue and that project-specific control would likely be unsuccessful. The presence of invasive species at the basin-wide or state-wide level does not excuse the licensee from taking measures that can potentially control or minimize the spread of invasive species at the project, ensuring the protection of wildlife habitat and native plant species. The licensee's plan includes the proposal to work with the resource agencies to implement the appropriate control or removal strategy, but provides no control plan for highly invasive species, as the FWS recommended in its comments.

16. Therefore, with the recent identification of zebra mussels at a location in the impoundment, the licensee should describe its control or removal strategies for zebra mussels (as developed in consultation with the resource agencies), and include control or removal measures, if any were taken, in its first bi-annual report. The licensee also stated that it will consider eradicating common reed bordering the impoundment, as suggested by the MDFW, if it is sparsely distributed as it was during pre-licensing surveys. The licensee's first bi-annual report should also include control or removal measures for common reed, if any were taken. Additionally, the licensee should continue to work with the agencies to develop methods of control for highly invasive species, and should describe larger regional or watershed-level control efforts in which it has participated or in which it plans to participate. Again, the control methods that are both proposed and implemented, as well as the larger control efforts the licensee has participated in, should be described in the licensee's first bi-annual report.

17. The licensee's plan to monitor for invasive species in the project area will help detect and identify invasive species and is critical to implementing successful control measures. The plan has been developed in consultation with the resource agencies and has been approved by the MassDEP. Accordingly, the licensee's proposed August 16, 2011 plan, as modified, should be approved.

The Director orders:

(A) The updated Invasive Species Monitoring and Control Plan filed on August 16, 2011, by the Littleville Power Company, Inc., licensee for the Glendale Hydroelectric Project, as modified by paragraph (B), is approved.

(B) The licensee shall prepare a report following each bi-annual year of invasive species monitoring. The report shall contain, but not be limited to: descriptions and maps of existing and new stands of invasive species; control and removal efforts, if any, implemented during the previous monitoring period or proposed for the next monitoring period; and any participation in region-wide invasive species control efforts. The licensee's first bi-annual report shall detail control plans for the most highly aggressive invasive aquatic and riparian species. Subsequent bi-annual reports shall contain data collected during both annual and bi-annual monitoring and control activities. The

licensee shall file the report with the Massachusetts Department of Environmental Protection, the Massachusetts Division of Fish and Wildlife, and the U.S. Fish and Wildlife Service for a minimum 30 day review and comment period. Monitoring reports shall include agency comments and the licensee's response to agency comments, and shall be filed with the Federal Energy Regulatory Commission (Commission) by January 15 following each year of monitoring. The first bi-annual monitoring report shall be filed by January 15, 2013. The Commission reserves the right to require changes to the plan based on the results of the bi-annual reports.

(C) This order constitutes final agency action. Any party may file a request for rehearing of this order within 30 days from the date of its issuance, as provided in section 313(a) of the Federal Power Act, 16 U.S.C. § 8251 (2006), and the Commission's regulations at 18 C.F.R. § 385.713 (2011). The filing of a request for rehearing does not operate as a stay of the effective date of this order, or of any other date specified in this order. The licensee's failure to file a request for rehearing shall constitute acceptance of this order.

Thomas J. LoVullo
Chief, Aquatic Resources Branch
Division of Hydropower Administration
and Compliance



Invasive Species Monitoring at the Glendale Hydroelectric Project

FERC Project #2801

prepared for
Enel Green Power North America, Inc.

prepared by
Biodiversity LLC and Gomez and Sullivan, PC

November 2012

Invasive Species Monitoring at the Glendale Hydroelectric Project

FERC Project #2801

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Invasive Species Monitoring at the Glendale Hydroelectric Project

FERC Project #2801

1. EXECUTIVE SUMMARY

In 2009, the Federal Energy Regulatory Commission (FERC) issued a Subsequent License to Littleville Power Company, Inc. (LPC), a subsidiary of Enel Green Power North America Inc. (EGP), for the Glendale Hydroelectric Project located on the Housatonic River in Stockbridge, Massachusetts. The FERC license incorporated conditions that required LPC to develop and implement an Invasive Species Monitoring and Control Plan. This plan, which was developed and approved in 2011, involves the monitoring of zebra mussels and invasive plant species within the 42.1-acre FERC project boundary (i.e., the impoundment, bypass, spillway, tailrace, and riparian zone), and consideration of control options. In August and October 2012, biologists surveyed for zebra mussels in the canal, upper bypass reach, tailrace, and impoundment and collected 430 individuals, with high densities observed in the tailrace and low densities observed in the impoundment and upper bypass reach. In September 2012, botanists conducted an invasive plant survey throughout the entire project boundary, plus a 10-foot buffer in certain riparian areas, resulting in a total survey area of 46.3 acres. The botanists documented 26 invasive plant species and mapped 23.2 acres of infestations (i.e., just over half of the survey area) with sub-meter accuracy. All but one of the species are on the Massachusetts Department of Agriculture (MDA) Prohibited Plant List. Nineteen of the species are listed by the Massachusetts Invasive Plant Advisory Group (MIPAG) as “invasive,” and six are listed as “likely invasive.” One species has no current MIPAG status but is banned in Connecticut. The target species of greatest concern—Japanese Stiltgrass, Mile-a-minute Vine, and Water Chestnut—were not observed. Both the zebra mussel survey and the invasive plant survey have provided the data required for intervention planning and have laid the groundwork for future monitoring.



The upper bypass reach, looking toward Glendale Dam.

2. BACKGROUND

In 2009, the Federal Energy Regulatory Commission (FERC) issued a Subsequent License to Littleville Power Company, Inc. (LPC), a subsidiary of Enel Green Power North America Inc. (EGP), for the Glendale Hydroelectric Project located on the Housatonic River in Stockbridge, Massachusetts. The FERC license incorporated conditions requested by the Massachusetts Department of Environmental Protection (MassDEP), which issued a Water Quality Certification (WQC) for the project. The WQC required LPC to develop an Invasive Species Monitoring and Control Plan that includes a regular schedule for monitoring invasive species within the project area, including zebra mussel and Water Chestnut, and that identifies specific methods that may be used to control selected species.

In April 2011, LPC filed an Invasive Species Monitoring and Control Plan for the Glendale Hydroelectric Project with resource agencies (MassDEP, MA Division of Fisheries and Wildlife, and the U.S. Fish and Wildlife Service), and the plan was approved in August 2011. LPC is now implementing the plan; the surveys in 2012 were intended to delineate and characterize invasive species populations. This report summarizes the 2012 study

designs, field methods, and results. Recommendations for future surveys and control work are outlined.

3. PROJECT AREA DESCRIPTION

The Glendale Hydroelectric Project is located off Glendale Road (Route 183) in Stockbridge, Massachusetts (Figure 1). It is 42.1 acres in size and includes approximately 1.5 miles of the Housatonic River. It extends from the eastern edge of the impoundment westward to the end of the training wall that divides the tailrace from the bypass reach downstream from the powerhouse. The project area includes all open water portions of the impoundment, coves, bypass reach, canal, spillway, and tailrace, as well as certain bordering wetland and riparian areas. On the north side of the river, from the dam to the tailrace, the project boundary extends well into the uplands and includes forest and shrub thickets, access road, lawns, powerhouse, and associated structures. On the south side of the river, along both the impoundment and the bypass reach, the project boundary follows the riverbank and does not extend into upland areas; vegetation cover along this shoreline consists primarily of shrub thickets. Additional vegetation cover types present include emer-

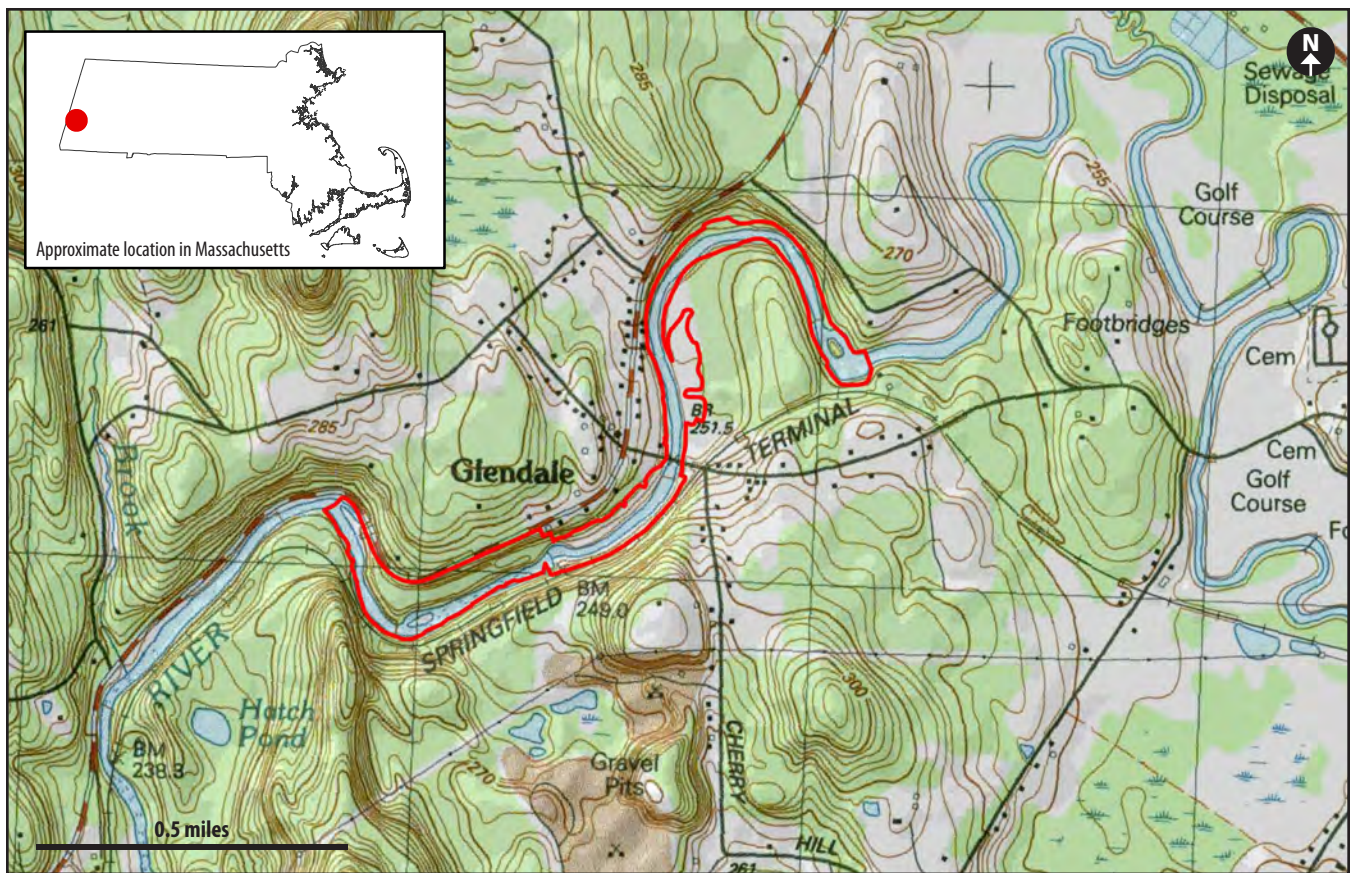


Figure 1. Location of the Glendale Hydroelectric Project.

gent plant beds patchily distributed along both shores, and aquatic beds comprising submersed vegetation that occur throughout the open water habitats.

4. ZEBRA MUSSEL SURVEY

4.1 Previous Zebra Mussel Surveys

Zebra mussels were discovered in Laurel Lake in Lee, Massachusetts, in July 2009; this was the first known infestation in Massachusetts and the third in the Housatonic River watershed (following East Twin Lake and West Twin Lake in Connecticut in the 1990s) (Biodrawversity 2009). In August and September of 2009, adult zebra mussels were also documented in the Housatonic River in Lee and Stockbridge but at extremely low densities (Biodrawversity 2009, 2010). In October 2010, adult zebra mussels were detected in the two largest impoundments of the Housatonic River in Connecticut—Lake Lillinonah and Lake Zoar—and population density and age structure suggested high likelihood of recruitment in Lake Zoar (Biodrawversity 2011a-b). Scientists speculated that Lake Lillinonah and Lake Zoar were colonized by zebra

mussel veligers (i.e., larval zebra mussels) originating in Laurel Lake in Massachusetts, suggesting that the entire length of the Housatonic River from Laurel Brook to the estuary was a dispersal corridor for zebra mussels and that suitable habitats along the entire length of river were at risk of being colonized by zebra mussels. Nevertheless, snorkel and SCUBA surveys at more than 125 locations in the free-flowing sections of the Housatonic River and small impoundments usually failed to detect zebra mussels (Biodrawversity 2010, 2011c, 2012a), raising questions about the overall suitability of the Housatonic River for zebra mussels. In 2011, extremely low numbers of adult zebra mussels were found in the Housatonic River in impoundments of the Willow Mill Dam, Glendale Dam, and Rising Paper Mill Dam in Massachusetts, and in the impoundment of the Derby Dam in Connecticut (Biodrawversity 2012a, unpublished data). Also in 2011, plankton samples collected in early summer from the three hydroelectric projects in Massachusetts, and at the confluence of Laurel Brook in Lee, contained very high densities of veligers. In summary, the Glendale Hydroelectric Project is close to the primary source of zebra mussels to the Housatonic River, high densities of veligers are known to pass through this area, and adult zebra mussels had been

documented in the impoundment in spring 2011. The Glendale Hydroelectric Project is one of several locations in the Housatonic River that is important for understanding the early colonization and spread of zebra mussels in the Housatonic River watershed.

4.2 Zebra Mussel Survey Methods

4.2.1 Field Data Collection

Both qualitative and quantitative data were collected on adult zebra mussels in the Glendale Dam project area. On August 22, 2012, two biologists surveyed the canal, upper bypass reach, and tailrace during the annual drawdown of the canal. In the canal, biologists collected quantitative data using 100 0.25m² quadrats randomly placed along the entire length of the canal (Figure 2). For each quadrat, biologists recorded location (using GPS), substrate type, and numbers of zebra mussels. During the canal survey, biologists also searched for zebra mussels qualitatively (i.e., outside of the quadrats), noted presence and species

of native mussels, and described habitat conditions. A total of eight person-hours were spent surveying the canal.

In the upper bypass reach, biologists conducted a snorkel survey in a 60-meter reach leading up to the base of the dam (Figure 2), especially on the right side (as facing downstream) of the river where the concrete walls and apron of the facility's structures provided good zebra mussel habitat. A total of two person-hours were spent snorkeling in this reach, in depths of 0.5–1.5 meters. A snorkel survey was also conducted in the lower tailrace, particularly along its right side and extending downstream to the stone riprap on the embankment of Route 183 (Figure 2). Three person-hours were spent looking for zebra mussels in this section. In the tailrace, it became apparent that zebra mussels were more common under rocks, and the snorkel survey morphed into a rock-flipping survey; a random subset of rocks that were small enough to move were lifted and flipped, and zebra mussels were scraped from rocks, collected, and preserved in alcohol. The survey duration in the tailrace was adequate for collecting



Three zebra mussel survey areas in the Glendale Hydroelectric Project, including the drained canal (top left), tailrace (bottom left), and Glendale Middle Road Bridge in the impoundment (top right). A 0.25m² quadrat used for sampling in the canal is shown (bottom right).

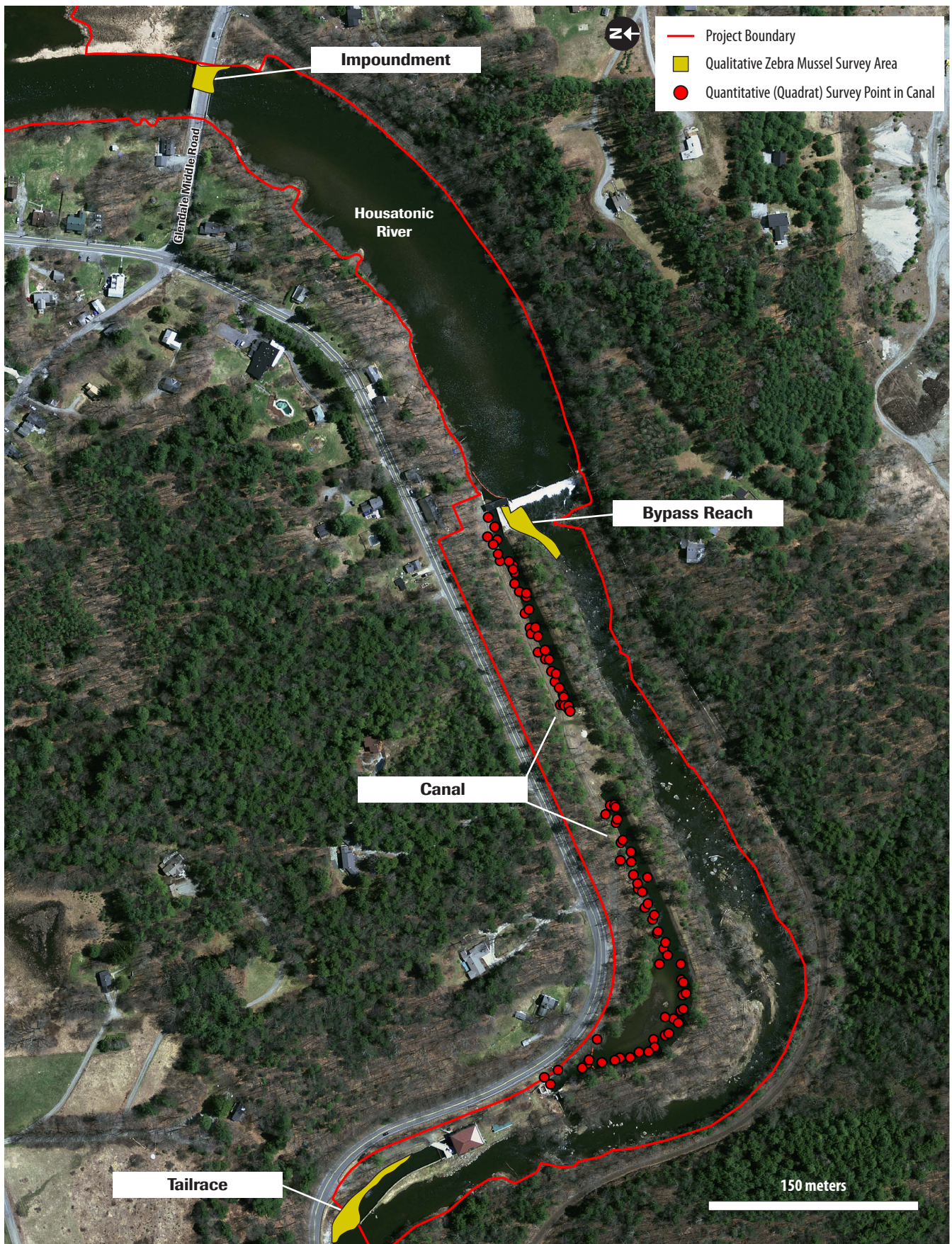


Figure 2. Areas of the Glendale Hydroelectric Project surveyed for zebra mussels in 2012. On this figure, some of the quadrat locations in the canal appear to be out of the water due to poor GPS satellite reception in steep-sided areas of the canal.

enough zebra mussels for a robust shell length-frequency analysis, but only a small portion of total available substrate was examined. On October 1, 2012, one SCUBA diver surveyed the entire left abutment and center pier of the Glendale Middle Road, as well as stone and submerged wood near these structures. The vertical concrete sides of the abutment and center pier provided ideal habitat for zebra mussels. During surveys of the bypass reach, tailrace, and impoundment, biologists also noted presence and species of native mussels and generally described and photographed habitat conditions.

4.2.2 Analysis

Spatial data were mapped in ArcGIS 9.2 software. Shell lengths of all collected zebra mussels were measured using a digital caliper. Length-frequency was analyzed and used as a surrogate for age structure, complimented with length-at-age data and growth rates. Quantitative data resulted in density estimates expressed as zebra mussels per square meter (mussels/m²), and the timed qualitative surveys resulted in catch-per-unit-effort (CPUE) statistics expressed as mussels per hour (mussels/hr). Biologists also noted the general dimensions (e.g., surface area) of rocks examined in the tailrace, and the number of zebra mussels on each, and crudely estimated density with these data.

4.3 Zebra Mussel Results

4.3.1 Canal

Zebra mussels were not detected in the canal between the intake and the powerhouse, despite a very large amount of suitable substrate (e.g., concrete and rock). Four native mussel species were detected: Eastern Elliptio (*Elliptio complanata*), Triangle Floater (*Alasmidonta undulata*), Creeper (*Strophitus undulatus*), and Eastern Floater (*Pyganodon cataraacta*). Appendix 1 provides raw data for each of the 100 quadrats surveyed in the canal.

4.3.2 Upper Bypass Reach

Three adult zebra mussels (23.0–29.0 millimeters in length) were detected on the concrete pad along the right side of the river within 30 meters of the dam. CPUE was only 1.5 mussels/hour. There was a large amount of natural (boulder and bedrock) and man-made (concrete) habitat present in this area, usually occurring at water depths of 0.5–1.5 meters, although water levels were higher than typical summertime flows because the canal was empty and all of the river's flow was passing over the dam. Flow velocity was moderate to strong in this reach, although there were eddies and other hydraulic refugia where veligers could settle. Eastern Elliptio was found in this section of the bypass reach.



Zebra mussels encrusted on a rock in the tailrace.

4.3.3 Tailrace

A total of 424 zebra mussels were collected in the tailrace. Most were found on the sides of, or underneath, non-embedded rocks within two meters of the right shoreline, in water depths of 0.25–1.0 meters. Flow velocity was light to moderate in these areas. CPUE was 141 mussels/hour overall, although CPUE was considerably higher once biologists zeroed in on areas where zebra mussels were more prevalent, and began flipping rocks to find them. The rocks that were flipped were typically flat, and smaller than 0.25m² (surface area) on a side. Zebra mussels were present on nearly every rock that was flipped, usually numbering 5–20 per rock, with a high of 66 on a rock with an underside surface area of approximately 0.25 meters (or a density of 264 mussels/m²). Mean shell length of these animals was 18.83 millimeters (range = 5.87–31.29, standard deviation = 3.34), and the frequency and percent composition of length classes is shown in Table 1. Eastern Elliptio, Triangle Floater, and Creeper were also found in the tailrace.

Table 1. Shell length statistics for zebra mussels collected in the Glendale Hydroelectric Project.

Length Class (mm)	Number of Mussels	Percent of Total
<5.0	0	0
5.0 - 9.99	12	2.81
10.0 - 14.99	39	9.13
15.0 - 19.99	217	50.82
20.0 - 24.99	149	34.89
25.0 - 29.99	8	1.87
>30	2	0.47

4.3.4 Impoundment

Three adult zebra mussels were found in the impoundment, including two on the vertical concrete wall of the left bridge abutment, and one on the vertical concrete wall of the center pier. These animals were in the 25.0–30.0 millimeter length range. Water depth exceeded five meters at the base of the center pier, flow velocity was light, and substrate was a mix of stone riprap, silt, sand, and large woody debris. Eastern Elliptio were found in this area.

4.4 Zebra Mussel Discussion

Results indicate that adult zebra mussels occupy the impoundment, bypass reach, and tailrace of the Glendale Dam project area, and that the canal also contains suitable habitat for zebra mussels but none were found in the canal. Highest densities were documented in the tailrace, where densities approaching 300 mussels/m² were observed underneath non-embedded rocks along the right side of the tailrace canal. The shell length statistics indicate that most of the animals observed may be at the end of their first full growing season, having settled in mid-2011 or early 2012, and older animals are uncommon. Although the growth rate of these animals is not known, water chemistry (particularly calcium concentrations and pH) in the Housatonic River are considered optimum for zebra mussels, food resources are abundant, and growth rates are expected to be high (Biodrawversity 2009). In Laurel Lake, first-year animals often exceeded 25.0 millimeter in length, and in Lake Zoar and Lake Lillinonah in Connecticut, first-year animals were often in the 15.0–25.0 millimeter length range (Biodrawversity, unpublished data). Overall, despite the high density of zebra mussels in the tailrace, we consider this population to be recently established.

The lack, or scarcity, of zebra mussels in the canal and impoundment was surprising because suitable habitat (e.g., deep water, ample substrate, and favorable hydraulic conditions) exists in these areas. It is possible that higher mussel densities occur in areas of the impoundment that were not surveyed, but we still feel that the abutments and center pier of the Glendale Middle Road bridge are good choices for long-term monitoring. The quantitative survey in the canal yielded no zebra mussels. It is possible that strong laminar flows, limited vertical mixing, and deep water in the canals might limit settlement of zebra mussels. The annual drawdown of the canals might prevent zebra mussels from becoming established in the canals, but it is important to note that the tailrace section of the canal, below the powerhouse, remains watered even when the canal is empty. Despite the lack of zebra mussels in the quantitative survey, this may prove to be an inter-

esting baseline dataset if zebra mussels become established in years ahead.

The scarcity of zebra mussels in the bypass reach was not surprising because of challenging environmental conditions—particularly moderate to strong flow velocities, shallow depth, high shear stress, potential for winter ice scour, and natural flow fluctuations that dewater shallow areas during low-flow periods.

For future monitoring, we recommend repeating the quantitative and qualitative data collection in the canal, adding more rigorous quantitative data collection for the tailrace (e.g., recording the precise number and physical dimensions of all flipped rocks and number of zebra mussels on each), repeating the timed qualitative survey in the upper bypass reach, and continuing to quantify adult zebra mussels on the abutments and center pier of the Glendale Middle Road bridge. Artificial substrate samplers (typically multiplate samplers suspended in the water column) have been used to study settlement and growth of zebra mussels in lakes and slow-flowing environments (Biodrawversity 2012b) and could be deployed within the impoundment.

5. INVASIVE PLANT SURVEY

5.1 Previous Invasive Plant Surveys

In 2006, biologists from Gomez and Sullivan conducted a two-day reconnaissance survey of the botanical resources upstream of the Glendale Dam. Areas downstream of the dam and upland riparian areas were not surveyed. During this rapid assessment, biologists recorded and mapped vegetation cover, wetland types, river bottom substrates, dominant native plant species, and all invasive plant species within the riparian zones, wetlands, and aquatic beds. The vegetation type associated with each invasive species was noted, but detailed location and density data were not collected. Emergent and submersed aquatic beds were documented throughout the impoundment, and silt was noted as the dominant substrate type in the impoundment. Nine invasive plant species were documented (Table 2), and most were found throughout the project area. Black Locust, Multiflora Rose, and shrubby honeysuckles were sparsely distributed along the riparian zone. Reed Canary Grass and Purple Loosestrife were present in moderate abundance throughout emergent wetlands, and a monoculture of Japanese Knotweed was present upstream of the Glendale Middle Road bridge. Two invasive aquatic species, Curly-leaf Pondweed and Eurasian Milfoil, were present but sparse within aquatic beds throughout the impoundment.

Table 2. Invasive species observed in the Glendale Hydroelectric Project in 2006 and 2012, with Massachusetts Invasive Plant Advisory Group (MIPAG) status and associated habitat type.

Common name	Species name	Years Documented	MIPAG status	Habitat type
Norway Maple	<i>Acer platanoides</i>	2012	Invasive	Upland/riparian
Garlic Mustard	<i>Alliaria petiolata</i>	2012	Invasive	Upland/riparian
Japanese Barberry	<i>Berberis thunbergii</i>	2012	Invasive	Upland/riparian
Common Barberry	<i>Berberis vulgaris</i>	2012	Likely invasive	Upland/riparian
Asiatic Bittersweet	<i>Celastrus orbiculatus</i>	2012	Invasive	Upland/riparian
Spotted Knapweed	<i>Centaurea stoebe</i>	2012	Likely invasive	Upland/riparian
Autumn Olive	<i>Eleagnus umbellata</i>	2012	Invasive	Upland/riparian
Burning Bush	<i>Euonymus alatus</i>	2012	Invasive	Upland/riparian
Japanese Knotweed	<i>Fallopia japonica</i>	2006, 2012	Invasive	Upland/riparian
Glossy Buckthorn	<i>Frangula alnus</i>	2012	Invasive	Upland/riparian
Ornamental Jewelweed	<i>Impatiens glandulifera</i>	2012	No status	Upland/riparian
Morrow's Honeysuckle	<i>Lonicera morrowii</i>	2012	Invasive	Upland/riparian
Tartarian Honeysuckle	<i>Lonicera tartarica</i>	2012	Likely invasive	Upland/riparian
Bell's Honeysuckle	<i>Lonicera x bella</i>	2006, 2012	Invasive	Upland/riparian
Creeping Jenny	<i>Lysimachia nummularia</i>	2012	Invasive	Upland/riparian
Purple Loosestrife	<i>Lythrum salicaria</i>	2006, 2012	Invasive	Upland/riparian
Forget-me-not	<i>Myosotis scorpioides</i>	2012	Likely invasive	Upland/riparian
Eurasian Milfoil	<i>Myriophyllum spicatum</i>	2006, 2012	Invasive	Aquatic beds
Brittle Water-nymph	<i>Najas minor</i>	2012	Likely invasive	Aquatic beds
Reed Canary grass	<i>Phalaris arundinacea</i>	2006, 2012	Invasive	Upland/riparian
Common Reed	<i>Phragmites australis</i> ssp. <i>australis</i>	2006, 2012	Invasive	Upland/riparian
Curly-leaf Pondweed	<i>Potamogeton crispus</i>	2006, 2012	Invasive	Aquatic beds
Common Buckthorn	<i>Rhamnus cathartica</i>	2012	Invasive	Upland/riparian
Black Locust	<i>Robinia pseudoacacia</i>	2006, 2012	Invasive	Upland/riparian
Multiflora Rose	<i>Rosa multiflora</i>	2006, 2012	Invasive	Upland/riparian
Coltsfoot	<i>Tussilago farfara</i>	2012	Likely invasive	Upland/riparian

5.2 Invasive Plant Survey Methods

5.2.1 Study Design

For the 2012 survey, botanists adapted methods described in the U.S. Forest Service document, *Field Guide: Invasive Plant Inventory, Monitoring, and Mapping Protocol* (2002). This document describes an approach to documenting, databasing, and mapping invasive plant infestations for long-term monitoring and restoration planning. It provides a simple, repeatable protocol for mapping and classifying invasive plant infestations in the field. It can accommodate infestations of varying size, density, and complexity, and can be used for fine- or coarse-scale data collection.

Two types of “Areas” inhabited by invasive plants were delineated: Gross Areas and Infested Areas. Gross Areas delineate infestations in which invasive plant species are broadly distributed with no discrete, easily identifiable boundary. In our survey, Gross Areas contained two or more invasive species, and had relatively consistent compositions and densities throughout. Gross Area boundaries were defined either by convenient landmarks (e.g., roads, lawn edges, the river bank, or the project boundary) or by changes in physiognomy or infestation density (e.g., from a shrub thicket to an emergent bed, or from a lightly infested area to a heavily infested area).

Infested Areas delineate the perimeter of single-species infestations. In our survey, Infested Areas were delineated for species that were present in discrete, typically dense patches with easily identifiable boundaries. These were typically dense stands of Common Reed, Japanese Knotweed, and Reed Canary Grass. In some cases there are other invasive species present, but in low densities.

Target invasive plant species included all species listed on the MDA Prohibited Plant List; many of these species have been identified by MIPAG as “invasive” or “likely invasive.” Special effort was given to searching for two MIPAG “early detection priority” species: Mile-a-minute Vine and Water Chestnut.

5.2.2 Field Data Collection

Botanists from Biodiversity and Gomez & Sullivan conducted the invasive plant survey from September 5 to 7, 2012. The actual survey area was about 4.2 acres larger than the defined project area; it was delineated by buffering the project boundary by 10 feet, and trimming the 10-foot buffer in places where the project boundary does not follow the shore. Data were collected within a 46.3-acre area.

The survey area was systematically traversed and all invasive plant species infestations were documented. Each infestation was designated as a Gross Area or Infested