

Relicensing Study 3.3.7

**FISH ENTRAINMENT AND
TURBINE PASSAGE
MORTALITY STUDY**

Updated Study Report Summary

**Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

Prepared for:



Prepared by:



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1.1 Study Summary

This study involves both a qualitative and quantitative approach to characterizing and estimating fish entrainment for the Northfield Mountain Project and Turners Falls Project. Entrainment magnitude and turbine mortality will both be evaluated. A qualitative approach will utilize a desktop entrainment analysis of resident fish species entrainment, whereas a quantitative approach will be specific to adult and juvenile American shad and adult American eel.

The specific objectives of this study include:

- Estimate the potential risk of entrainment, impingement, and turbine mortality loss to resident fish species at the Northfield Mountain Project and Turners Falls Project by developing a qualitative scale of entrainment risk for resident and migratory fish species.
- Conduct a quantitative assessment of the potential impact of entrainment and turbine mortality of American shad and American eel.

Three other studies will inform this entrainment study as follows:

- Study No. 3.3.2 *Upstream and Downstream Passage of Adult American Shad*
- Study No. 3.3.3 *Downstream Passage of Juvenile Shad*
- Study No. 3.3.5 *Downstream Passage of American Eel*

Quantitative assessment of turbine mortality of downrunning American eel and juvenile American shad will be conducted by Normandeau Associates this fall (Study No. 3.3.3 and 3.3.5), and the results of those forthcoming analyses will be incorporated into this report.

1.2 Study Progress Summary

Task 1: Qualitative Assessment of Entrainment and Impingement

A preliminary assessment of entrainment risk was performed for resident species documented to be present in the Turners Falls Impoundment by the Massachusetts Department of Fish and Game between 1971 and 1975 (MDF&G 1978) and the Midwest Biodiversity Institute in 2008 (Yoder et al. 2010). A Traits Based Assessment was performed to qualitatively assess the potential risk of entrainment/impingement for species based on habitat preference, life history, behavior, morphology and demography. Based on these factors, species and life stages of resident fishes were indexed across a range from the most to least prone to entrainment. For the susceptible species, the assessment assumed that the degree to which individuals become entrained depends on their physical swimming abilities, such that if the darting speed is greater than the intake velocity, the fish would escape entrainment; and conversely, if the darting speed is less than the intake velocity, then the fish is at risk for being entrained. For impingement, body lengths and widths of species in the area of the intakes were assessed to determine which fish would likely be physically excluded by the bar rack spacing at each intake structure and if these species would be able to overcome the influence of the intake velocity.

Preliminary results indicate that most of the common resident fish are unlikely to inhabit the area of the intakes due to the habitat preferences of those species, and therefore, are unlikely to be entrained or impinged. Two species, walleye and fallfish, prefer habitat that is found in front of the Northfield Mountain Project intake/tailrace and may be more susceptible to entrainment or impingement depending on the size

of the individuals. Most of the common resident fish are likely to sustain their populations even if individuals of the population are entrained because, with the exception of largemouth bass, white suckers, walleye, white perch, and fallfish, these species can double their numbers every 1.4 to 4.4 years (species summaries accessed at www.fishbase.org, 2012). This analysis will be updated to include any additional species collected in Study No. 3.3.11 Fish Assemblage Assessment and Study No. 3.3.13 Impacts of the Turners Falls Project and Northfield Mountain Project on Littoral Zone Fish Habitat and Spawning Habitat.

Task 2: Quantification of Shad and Eel Entrainment

A preliminary desktop analysis of the potential for entrainment was performed for juvenile and adult American shad and adult American eel similar to the method described above for resident species. As American shad are anadromous, the potential for entrainment is restricted to the seasons when they may be present in the vicinity of the Northfield Mountain Project intake/tailrace. The quantification of entrainment rates will be refined once results from Study Nos. 3.3.2, 3.3.3, and 3.3.5 are available.

Entrainment of juvenile American shad at the Project will be estimated through a combination of approaches including hydroacoustics and radio telemetry. Hydroacoustics will be deployed at Cabot Station, Northfield Mountain Project and the Turners Falls power canal. An array of split beam transducers is currently deployed and collecting data. Data will be recorded and archived continuously; however, at the Northfield Mountain Project only data recorded during pumpback mode will be analyzed. Echo characteristics that separate juvenile shad and adult eels from other species will be ground-truthed by concurrent sampling to be conducted over several discreet events (12 to 18) at the Cabot fish bypass. Data is being recorded by onsite data loggers. Transducers are being inspected and serviced by a qualified technician on a weekly basis, and data is being remotely downloaded and reviewed at least once per week during sampling to qualitatively view trends, and to ensure the system is functioning properly. During analysis, echo data will be analyzed using standard analytical tools such as Echoview® software, and related to concurrent station operation, water temperature, other environmental conditions, and Connecticut River flow. Sampling began on August 15 and will run through October.

Additionally, both juvenile shad and emigrating adult American eel will be radio tagged and tracked to determine routes of passage. Stationary receivers will be placed at the Northfield intake and upper reservoir, Cabot intake and tailrace and Station No. 1 intake and tailrace. Data from those receivers will be used to quantify the number of tagged adult eels and juvenile shad entrained and their respective mortality rates. These studies are planned for late September or October 2015 depending on fish availability.

Task 3: Estimation of Turbine Mortality Rates

HI-Z Turb’N tags will be used to empirically determine rates of survival for fish entrained at Station No. 1, and Cabot Station, as set forth in the Updated Study Reports for Study No. 3.3.3 *Downstream Passage of Juvenile American Shad* and Study No. 3.3.5 *Downstream Passage of Adult American Eel*. These studies are planned for October 2015 depending on fish availability.

Task 4: Reporting

A report will be completed by October 1, 2016. Studies will not be completed until end of 2015 and the hydroacoustic and telemetry studies will produce extremely large volumes of data which will take some time to process.

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the study plan or schedule.

1.4 Remaining Activities

- Conduct the turbine mortality studies
- Conduct the radio telemetry study
- Complete report