Relicensing Study 3.3.5

EVALUATE DOWNSTREAM PASSAGE OF AMERICAN EEL

Updated Study Report Summary

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

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SEPTEMBER 2015

1.1 Study Summary

Downstream adult (silver phase) American eel studies are currently being conducted at the Northfield Mountain and Turners Falls Projects. The goals of these studies are to better understand emigration timing of adult American eel as it relates to environmental factors and operations at the Projects as well as determine the impact of the Projects on the emigration of silver eel in the Connecticut River. Specific objectives of the study are as follows:

- Characterize the general migratory timing and presence of adult, silver-phase American eel migrating past the Turners Falls and Northfield Mountain Projects relative to environmental factors and operations.

- Quantify movement rates and proportion of eel passing downstream via various passage routes at the Turners Falls and Northfield Mountain Projects as well as evaluate the proportion of eel entrained.

- Evaluate survival of adult silver eel passed at the available routes of passage at the Turners Falls complex.

The overarching resource management goal is to minimize project-related sources of downstream passage injury, stress, and mortality in order to maximize the number of silver eel migrating to the spawning grounds.

The study period includes the months of August, September and October 2015. Several methodologies/technologies are being used to achieve the study objectives. Migratory run time and magnitude are being evaluated through the use of hydroacoustics. Downstream eel passage route selection is being evaluated using radiotelemetry methods and downstream passage survival will be evaluated using a combination of HI-Z Turb'N tags and radio tags with mortality sensors.

Consultation: On February 21, 2014, the Federal Energy Regulatory Commission (FERC) issued its second Study Plan Determination Letter (SPDL), which approved the Revised Study Plan 3.3.5 with modification. On November 4, 2014 FirstLight submitted an updated Revised Study Plan for the Acoustic Evaluation of Adult American Eel Passage and Entrainment to stakeholders and a meeting was held at the Northfield Visitors Center on November 17, 2014 to discuss the plan. Meeting minutes[1] were filed with FERC on December 22, 2014. On January 22, 2015, FERC issued its Determination on Requests for Study Modifications and New Studies, approving Study No. 3.3.5 without modification.

1.2 Study Progress Summary

Task 1: Evaluate Timing of Downstream Migratory Movements

The adult eel emigration timing, duration and magnitude are being evaluated in the study area using a combination of hydroacoustic equipment, including split beam sonar and a dual frequency identification sonar (DIDSON). The split beam system will monitor entrainment and the DIDSON will help determine the timing, duration and magnitude of the run by providing a larger sampling area (beam angle ~29° x 15°) when compared to that of the split beam system (7°) alone and will increase the potential to document emigrating eel.

FirstLight began mobilization for the eel studies on July 9, 2015 with the installation of hydroacoustic monitoring equipment. The installation was a joint effort by FirstLight, Kleinschmidt Associates and

[1] Draft meeting minutes were circulated to the attendees on December 12, 2014, with comments due by December 17, 2014.

Aquacoustics, which provided hydroacoustic expertise. Data collection began on August 1, 2015 and will continue through the end of October, 2015 per the Revised Study Plan (RSP). The installation included four split beam sonar systems (four transducers each) and one DIDSON. Two split beam units were installed at the Cabot Station intake and one unit each was installed within the Turners Falls power canal in the vicinity of the 6th Street Bridge and at the Northfield Mountain Project intake. Each split beam unit operates four transducers. The DIDSON was installed in the power canal adjacent to the split beam system.

At Cabot, eight transducers were installed as illustrated in Figure 1.

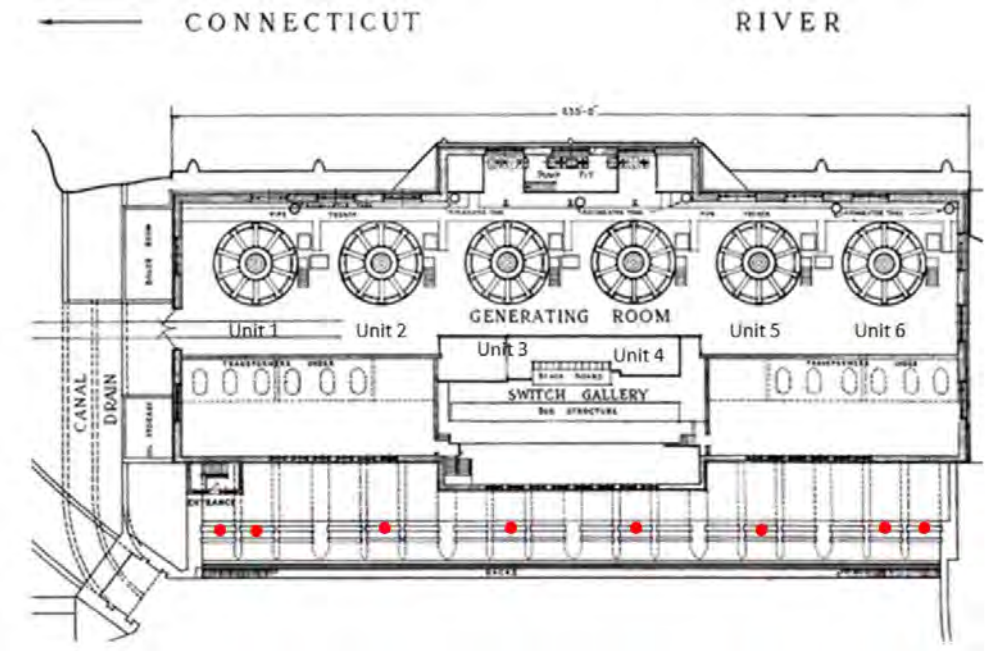

Figure 1. Plan view of Cabot Station, Turners Falls, MA. The red circles indicate the location of the split beam transducers used to monitor adult eel entrainment.

The transducers were mounted on a pole affixed to the head gates in a downward orientation approximately 7° from vertical as illustrated in Figure 2. This arrangement provides coverage of approximately 10% of the intake area.

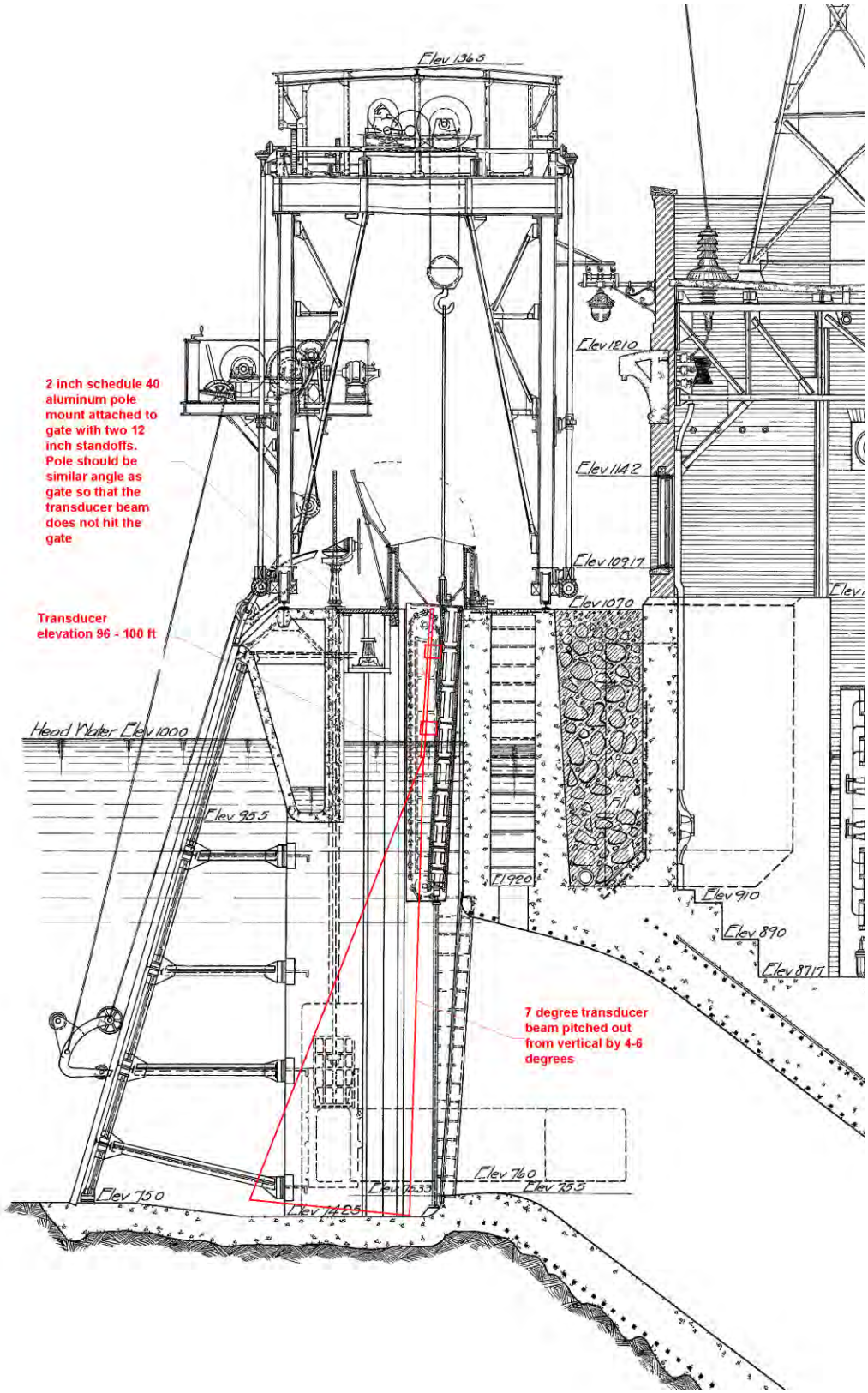

Figure 2. Cabot Station section view through the intake bays at Unit 3 showing the location of the transducer mount and an outline of the beam volume sampled.

A single split beam sonar unit with four transducers was installed in the Turners Falls power canal in the vicinity of the 6th Street Bridge. The transducers were deployed in an upward orientation and were affixed to the bedrock floor of the canal. The split beam transducers and DIDSON were located along a transect perpendicular to canal flow as illustrated in Figure 3. The DIDSON was deployed on the canal wall at a depth of 3 ft using unistrut to facilitate easy removal should cleaning or system maintenance be required (Figure 4). The DIDSON was oriented perpendicular to canal flow and aimed ~12° downward from horizontal. Figure 5 illustrates the sampling area provided by these hydroacoustic monitoring systems.

Figure 3. The location of the four split beam transducers (in red, not to scale) and a DIDSON (orange star, not to scale) used to monitor eel migration through the Turners Falls Project power canal, Turners Falls, MA.

Figure 4. The DIDSON camera prepared for installation along the canal wall at the Turners Falls Project, Turners Falls MA.

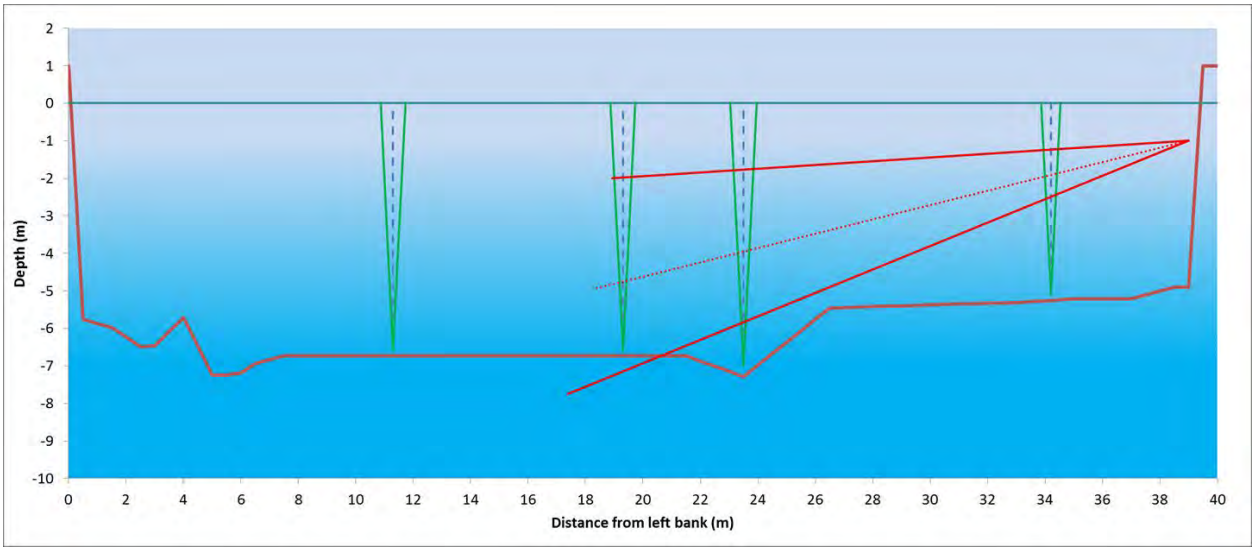

Figure 5. A section view of the power canal where the four split beam transducers and DIDSON are located, Turners Falls MA. The green cones represent the conical beam produced by the split beam transducers and the red line along the bottom represents the canal bathymetry. The red cone illustrates the beam angle of the DIDSON camera.

A single split beam sonar system with four transducers was installed at the Northfield Mountain Project intake. Each transducers was mounted to a pole, affixed to the top of the intake structure and oriented downward as illustrated in Figure 6 and 7.

Each transducer was tested and calibrated at all of the monitoring locations. Data are being recorded continuously at each split beam system, written to a 1TB hard drive on the control computer. The DIDSON data are being written directly to a 5 GB external hard drive. The data are backed up to an external hard drive once a week for archiving. Each of the four split beam systems and the DIDSON are networked and accessible via a *Go to My PC* account for real time remote status monitoring by the study team.

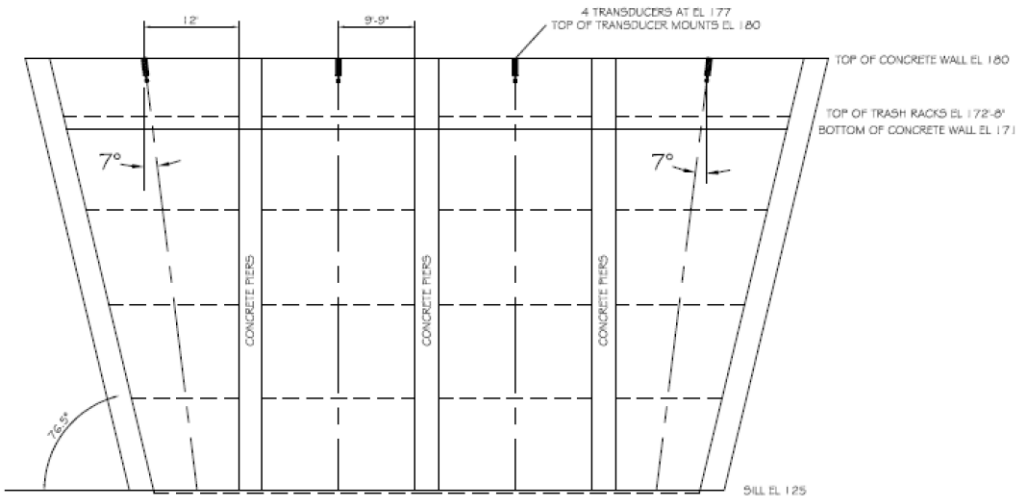

Figure 6. A section view of the Northfield Mountain Project intake structure depicting the location and orientation of the split beam sonar used to monitor entrainment of American eel, Northfield MA.

Figure 7. A photo of the split beam system at the NMPS Intake, Northfield MA. The concrete sill in the background is the top of the intake rack infrastructure where the transducers were mounted. The green cabling strung along the top of the sill are the spilt beam communication wires wrapped in protective shielding.

Task 2: Assessment of Downstream Passage of American Eel

FirstLight will assess downstream passage and entrainment survival of adult American eel through use of radiotelemetry techniques at the Turners Falls and Northfield Mountain Projects beginning in October 2015. The passage route and survival studies will require a large number of adult eel (n=432). There was concern that collecting this quantity of eel within the Connecticut River drainage might not be achievable. As such, FirstLight proposed to import adult eel from a commercially available source. The study team investigated this option and determined that the most reliable source of eels would be a commercial fishery in Newfoundland, Canada. This option was vetted with the United States Fish and Wildlife Service (USFWS) and Massachusetts Division of Fish and Wildlife (MDFW) and it was concluded that importation from Canada was a viable option. At the request of the resource agencies, Normandeau (TransCanada) and Kleinschmidt (FirstLight) developed an importation plan, which included a detailed procedure by which to collect, quarantine and test for pathogens prior to importation. For the FirstLight projects the plan was submitted to MDFW on May 8, 2015 and amended on July 15 based on a request for further information by MDFW issued on June 6, 2015. The importation plan was ultimately accepted. A permit will be issued for importation into the State of Massachusetts pending a quarantine inspection and pathogen testing (a three week process). An eel vendor, North Atlantic Aquaponics Ltd. and a pathogen testing facility, Atlantic Veterinary College - University of Prince Edward Island, are under contract to provide the eels and test for

pathogens, respectively. Eels selected for tagging will meet morphometric (e.g., eye diameter relative to body size, Pankhurst Index, of approximately 6.5 or greater) criteria to ensure they are migrant silver-phased eels. Eels are expected to be available for the study in October, 2015.

The assessment of downstream passage of American eel will be conducted in accordance with the RSP and FERC's SPDL. Tagged silver phase eels will be released at strategic points upstream of areas of interest to assess general routes of passage (i.e., via spill, fish passageways, or turbines). Radio tags will be surgically implanted in the peritoneal cavity. FirstLight and TransCanada consulted prior to purchasing tags to ensure all radio tags can be detected at all three Projects. The adult eel will be tagged with transmitters supplied by Sigma Eight Inc. that will operate on two frequencies; 149.740 and 149.760. The tags will be programmed with a two second burst. Tags are anticipated to operate for approximately 90 days. The tags will be programmed to include a mortality setting which will trigger after 6 hours of motionlessness. Once the mortality option is triggered the burst rate will slow to an 11 second burst. A total of 132 eel will be tagged; with 72 released approximately 5 km upstream of the Northfield Mountain tailrace; 30 released approximately 3 km upstream of the Turners Falls Dam; and 30 released within the canal just downstream of the gatehouse. Releases will occur in batches during a combination of existing and operational conditions. The telemetry receiver locations and equipment are listed on Table 1.

Table 1: Location and types of telemetry equipment used to evaluate silver eel emigration at the Turners Falls and Northfield Mountain Projects, Turners Falls and Northfield MA.

Location	RM	Receiver Station
Montague Wastewater	119.5	A Lotek SRX receiver with double yagi antennae will monitor the full width of the River
Cabot Station Tailrace	120	A Lotek SRX with yagi antenna will monitor the full river width. An Orion receiver and double yagi antennae will monitor the tailrace immediately downstream of the station.
Cabot Station Forebay	120	Two radio receivers will monitor the forebay area: 1) An Orion with double yagi and dropper antennae will monitor the full width of the forebay area 2) An Orion with dipole antenna will monitor the entrance to the Cabot downstream bypass
Station 1 Forebay	121	An Orion with yagi and dropper antenna will monitor the full width of the forebay area
Station 1 Tailrace	121	A Lotek SRX with yagi antenna will monitor the tailrace area. Detection zone will monitor the full width of the bypass reach. A detection power analysis will differentiate those test fish that are attracted to the tailwater from those that continue upstream
Below Turners Falls Dam	122	Two Lotek SRX receivers with double yagi antennae will monitor the area below the dam, one on either side of the river bank such that approach to the dam can be differentiated from either the right or left sides of the River
Upstream of Gatehouse	122	An Orion receiver with yagi and dropper antennas will be used to monitor the area immediately upstream of Gatehouse
Upstream End of the Canal	122	An Orion with a yagi antenna will monitor the full width of the canal at a location downstream of the Gatehouse in the upper canal to monitor fish entering the canal from upstream
Northfield Mountain Project Gill Bank	126.5	A Lotek with double yagi antennae will monitor the full width of the impoundment

Northfield Mountain Project Intake	127	An Orion with double yagi antenna will monitor the intake area
Northfield Mountain Project Upper Reservoir	127	An Orion receiver with yagi and dropper antennas will be used to monitor the upper reservoir
Shearer Farms	127.5	A Lotek with a yagi antenna will monitor the full width of the impoundment

Mobile tracking will be conducted in accordance with the RSP and FERC's SPDL. Tracking will concentrate in the reach between the upper release site (i.e., 5 km upstream of the Northfield Mountain Project intake) and 5 km downstream of Cabot Station. Tracking will be performed on a twice weekly basis during and after releases to confirm route selection and the fates of passed fish. Tracking will occur until the tagged eels leave the study area or water temperatures decline to 5°C. Movement rates (time between release and passage) of eels passing the projects by various routes will also be quantified.

Task 3: Data Management and Analysis

Data from hydroacoustic timing studies (Task 1) will be collected in the field and transferred to an electronic format. All data entry will be assured for quality. These data will be processed with Myriax Echoview®, ARIS Fish® or similar software. The split beam data will be reduced by applying an intensity threshold that is representative of the target size and analyzed with an α, β-tracking algorithm, which identifies the series of echoes that were returned by an individual fish over successive pings. The tracking results will be reviewed on the echogram and exported as a database containing time, target strength, and 3-D positional information for each fish detected. DIDSON data is similar to video data and standard video analysis techniques will be used in which the number, date and time of day of migrating eel will be determined. An expansion factor will be calculated as a function of their number within the monitoring area multiplied by the unsampled area as a proportion.

Data will be downloaded from the radio receivers (Task 2) weekly during the study period. Data will be archived and entered into an MS Access database or MS Excel spreadsheet for sorting and post-processing. All data entry will be reviewed for quality assurance. To the extent possible, routes of passage will be determined. Route determinations will be based on the sequence of individual eel detections at the monitoring locations. Additionally, route-specific survival will be determined by analysis of the sensor tag data, which will indicate whether an eel has resumed typical migratory behavior after passing downstream or has not survived passage.

Task 4: Turbine and Dam Passage Survival

The turbine and dam passage survival study will empirically determine rates of survival for eels entrained at Station No. 1 and Cabot Station and spill survival over the dam using HI-Z Turb'N tags. A total of 50 treatment fish will be released through each selected turbine and 125 fish through the bascule and taintor gates. All six turbines at the Cabot station are similar type and hydraulic capacity so testing will be conducted at one turbine as a representative unit and data will be extrapolated to calculate a total station survival rate. Station No. 1 has five Francis turbines; four of the five are similar in speed, hydraulic capacity (490-560 cubic feet per second, cfs) and one smaller turbine (140 cfs). Testing will be conducted at two turbines at Station No. 1 (one to represent the four larger units and at the smaller capacity unit). This data will also be extrapolated to calculate a total survival rate for all four units and combined with the data for the smaller unit for a total station survival rate. HI-Z tagged American eels will be injected into the selected turbines at Cabot Station and Station No. 1 at or near best efficiency hydraulic conditions for each test unit. An additional 125 fish will be released at the spillway to determine mortality due to passage at the bascule and tainter gates.

FirstLight is seeking a variance from the RSP. Although the RSP envisioned conducting the testing at two turbines at Station No. 1 (one to represent the four larger turbines and one at the smaller turbine, Unit 2), based on discussions with Normandeau Associates, the lead consultant on this aspect of the study, the velocity at the entrance of Station No. 1's small turbine (140 cfs) is too low to ensure the fish becomes entrained. In addition, typical operation is to run the smaller unit (Unit 2) in tandem with Unit 3 (the larger capacity unit). FirstLight proposes to conduct the first turbine survival test running both Units 2 and 3 together (50 adult eels) and then perform a second test at one of the larger units with an additional 50 adult eels. By setting up the tests in this manner, FirstLight can estimate survival at both the smaller and larger units.

The field work for this aspect of the study is slated to occur in October 2015.

Task 5: Reporting

Reporting will occur by March 1, 2017. Studies will conclude in November and time is needed for data analysis in 2016.

1.3 Variances from Study Plan and Schedule

FirstLight is seeking a variance from the study plan as noted above.

1.4 Remaining Activities

- Field Studies
- Data analysis, and
- Reporting