Upstream American Eel Passage Assessment

Lawrence Project (FERC No. 2800)

Prepared For
Essex Company, LLC
A subsidiary of Patriot Hydro, LLC

Prepared By
Normandeau Associates, Inc.
25 Nashua Road
Bedford, NH 03110
www.normandeau.com

April 2025

Table of Contents

List of Tables

List of Figures

1 Introduction

Essex Company, LLC (Essex), a subsidiary of Patriot Hydro, LLC, is the Licensee, owner, and operator of the Lawrence Hydroelectric Project (Project or Lawrence Project), which is Federal Energy Regulatory Commission (FERC or Commission) Project No. 2800. The Project was licensed by the Commission on December 4, 1978 (with an effective date of December 1, 1978), and the license expires on November 30, 2028. The Lawrence Project is located on the Merrimack River in the City of Lawrence in Essex County, Massachusetts.

In accordance with 18 C.F.R. § 5.15, Essex has initiated studies and information gathering activities as provided in the study plan and schedule approved by the Commission. Among the studies completed during 2024 was the Upstream American Eel Passage Assessment (Upstream Eel Passage Study), the methodologies of which were outlined in the Revised Study Plan (RSP) filed by Essex with the Commission on April 10, 2024, and approved by FERC in their May 10, 2024, Study Plan Determination (SPD). This report describes the Licensee's implementation of the study plan and schedule, the data collected, and any variances from the study plan and schedule.

2 Goals and Objectives

The goal of this study was to evaluate the effectiveness of the existing upstream American eel (*Anguilla rostrata*) passage facilities at the Project. Specifically, this study sought to:

- Assess attraction to the south side eel trap and north side eel lift.
- Determine the proportion of marked eels entering the south side eel trap or north side eel lift which then successfully ascend upstream (i.e., internal efficiency).
- Review the length frequency distribution of marked eels released downstream of the south side eel trap or north side eel lift with that of the subset which successfully pass upstream via each structure.
- Estimate the retention effectiveness of the collection trap associated with the existing eel passage facility at the south side eel trap.

3 Project Description and Study Area

3.1 Project Description

The Lawrence Project works consist of: (1) the 35-foot-high by 900-foot-long gravity Essex Dam of stone masonry construction (also known as the Great Stone Dam), with a five-foot-high pneumatic crest gate system mounted on the spillway crest; (2) a 9.8-mile-long impoundment having a surface area of 655 acres at a normal water elevation of 44.17 feet National Geodetic Vertical Datum of 1929 at the top of the crest gates, and gross storage capacity of approximately 19,900 acre-feet; (3) a powerhouse located at the end of a small forebay adjacent to the south abutment of the Essex Dam containing two 8.4 megawatt generating units and a tailrace channel

extending into the Merrimack River channel; (4) fish passage facilities integral with the powerhouse, including a fish lift, downstream fish bypass, an eel lift at the left abutment of the dam, and an eel ladder at the right abutment of the dam; (5) the North Canal, approximately 5,300 feet long by 95 feet wide by 15 feet deep, originating at the north abutment of the dam and paralleling the Merrimack River downstream of the Essex Dam; (6) the South Canal, approximately 2,750 feet long by 35 feet wide by 10 feet deep, originating at the south abutment of the Essex Dam and generally paralleling the Merrimack River downstream of the Essex Dam; (7) a single-circuit, underground/underwater 23.0-kilovolt transmission line to the Massachusetts Electric Company's Lawrence No. 1 substation; and (8) appurtenant facilities.

3.2 Existing Upstream Eel Passage Facilities

Essex operated two permanent upstream eel passage facilities during the 2024 evaluation: the south side eel trap and the north side eel lift.

The south side eel trap, located on the powerhouse side, consists of four switch-backed concrete ramp sections and three resting pools, totaling approximately 40 feet in length (Figure 3-1). Each of the unequal-length switchback sections has a slope of 40 degrees. The climbing substrate consists of 18-inch-wide Milieu elver climbing ramp (3 channels) fitted with 1-inch studs spaced at 0.5 inches. The sides are constructed of lumber and the ramps and pools are fitted with removable plywood cover sections. A 33-gallon collection tank serves as a temporary holding area and the entire system (collection tank water supply, ladder water supply, attraction water supply) is supplied by an 82 gallon per minute (gpm) submersible pump installed in the adjacent impoundment, with flow distributed through an adjustable manifold.

The north side eel lift is located on the river side opposite the powerhouse and consists of an aluminum hopper (70-gallon capacity) that is lifted on a track approximately 35 feet and emptied into a sorting tank at the top of the dam (Figure 3-2). The inside of the hopper consists of a section of cast aluminum climbing substrate manufactured by Lakeside Engineering, Inc., and is angled at an incline of approximately 40 degrees. A single 0.5-inch supply line feeds water to both the ramp and hopper. Two water lines, roughly 1.25 inches each, are located behind the hopper and provide additional attraction flow. Conveyance and attraction water is supplied from the impoundment by an 82-gpm submersible pump. Outside the hopper, affixed to the poured concrete pad to which the hopper sits, is a 30-inch long, 12-inch-wide section of studded substrate installed to help facilitate eel movement towards the hopper entrance. Once lifted and emptied into the sorting tank, eels are counted and then sluiced into the impoundment.

3.3 Upstream Eel Passage Study Area

The study area included the section of the Merrimack River located immediately downstream of Essex Dam, proximal to the existing upstream eel passage facilities.

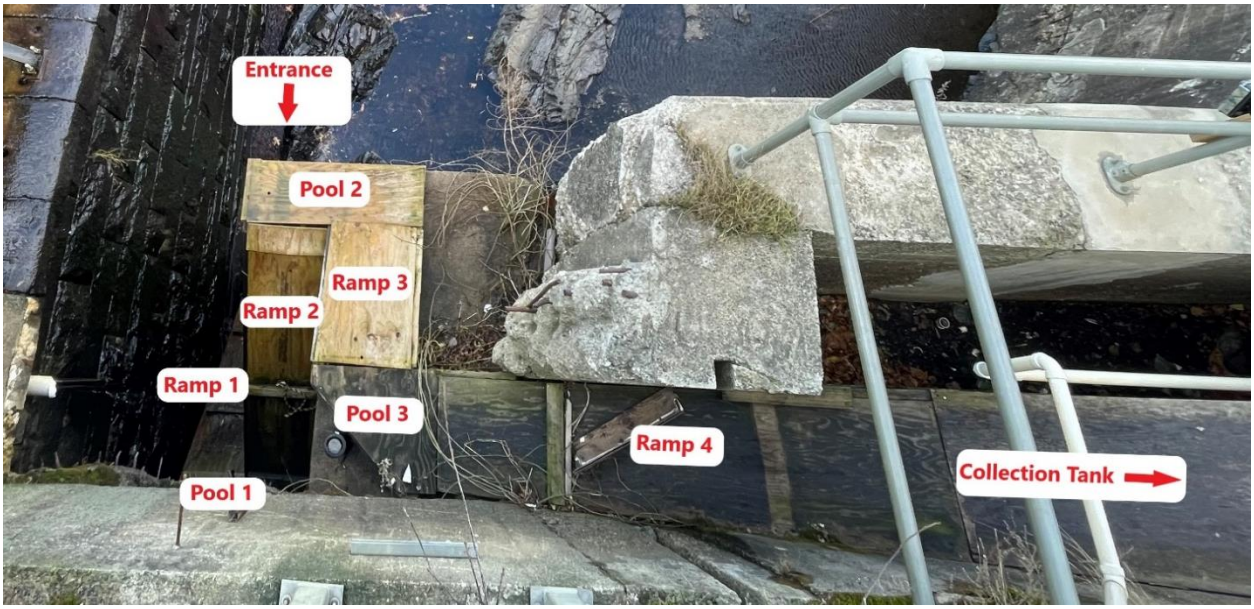

Figure 3-1. Overhead view of the Lawrence south side eel trap components.

Figure 3-2. North side eel lift approach substrate and collection hopper (left photo) and cast aluminum climbing substrate and water supply in the hopper (right photo).

4 Study Methods

4.1 Nighttime Observations – Assessment of Attraction Efficiency

Attraction to the existing upstream eel passage facilities was examined qualitatively during a series of nighttime observational surveys conducted at the Project once monthly during June, July, and August. Nighttime surveys for the south side eel trap followed the same methodology as was employed during the 2014 effectiveness evaluation (Normandeau 2015). Surveys consisted of an examination of both the internal trap components as well as nearfield approach areas (i.e., downstream ledges). Surveys were conducted no earlier than two hours after sunset. Internal eel pass counts during the visual survey events were conducted by removal of ramp and resting pool covers and enumeration of all visible eels. All observed eels were assigned to one of three length categories (0-6 inches, 6-12 inches, and 12+ inches). Nearfield observations consisted of using spotlights to conduct an examination of the surrounding rock formations from the tail water to the eel trap entrance and focused on areas of eel concentration, locations where juvenile eels were attempting to approach the eel trap entrance, and where eels were attempting to ascend the dam via routes other than the provided passage structure. Similar to internal eel counts, all eels observed during the nearfield surveys were assigned to one of the three length categories. Similar effort was expended to describe juvenile eel distribution within the entrance area of the north side eel lift. Additional information collected on each survey date included air and water temperature, moon phase, weather conditions, and Project operations.

4.2 Quantitative Evaluation of Internal Efficiency

4.2.1 South Side Eel Trap

To quantify the internal efficiency of the south side eel trap, Essex utilized a known number of marked eels placed at the downstream entrance of the structure. Essex obtained juvenile American eels using lined eel pots fished on the ledge areas immediately downstream of the dam. Each individual eel was marked using Visual Elastomer (VIE) tags (Figure 4-1). Eels were lightly anesthetized using diluted clove oil to allow for safe handling. Once immobilized, the total length was recorded. Once measured, a colored VIE mark was inserted at the base of the ventral fin margin. Essex conducted a total of two release events and during each event, study eels were placed at the downstream entrance to the south side eel trap. Unique VIE color marks were assigned to each group such that recaptured eels could be identified to release date.

Release events were conducted over consecutive 24-hour periods. The first set of marked eels were sealed in the entrance of the ramp and the south side eel trap was allowed to operate as designed. At the completion of the 24-hour period, all eels present in the upstream eel tank were removed and examined using a black light. Eels with VIE tags present fluoresced, and the total number of eels with a unique color mark was enumerated. Following removal of the 24-hour upstream trap catch, the second set of marked eels was placed in the downstream holding structure, and the process was repeated.

In addition to evaluating the internal passage efficiency of the south side eel trap, the retention efficiency of juvenile eels within the collection tank was examined. Collection efficiency consisted of placing a known number of marked eels (total n = 50) in the collection bucket during a regular trap check and then conducting a count of the number of marked eels remaining in the collection tank the following morning. This assessment was conducted on two separate occasions at the south side eel trap. Juvenile test eels used for both evaluation events were measured to the nearest millimeter and marked using VIE prior to placement within the collection tank. This allowed for the eel trap to operate normally during the overnight period and for differentiation of "test" eels from those which may have entered the eel passage facility volitionally during the retention assessment period.

4.2.2 North Side Eel Lift

To quantify the internal efficiency of the north side eel lift, Essex utilized a known number of marked eels placed in the lift hopper. Similar to efficiency testing at the south side eel trap, Essex obtained juvenile American eels to evaluate internal efficiency of the north side eel lift using lined eel pots fished on the ledge areas immediately downstream of the dam. Test eels were marked using VIE (following the same tagging methodology identified above and utilizing a unique color mark for each separate group). Essex conducted a total of five lift events by which to evaluate efficiency. Following placement of a group of marked eels in the lift hopper, the lift was allowed to operate normally so that the bucket rose to the upper deck and discharged into the collection tank. Once the lift had discharged, the number of marked eels deposited into the tank was enumerated.

4.3 Data Analysis

Internal efficiency was calculated as follows:

- South side eel trap: the percentage of VIE marked eels released at the base of the facility which are subsequently collected from the upstream collection tank at the 24-hour mark.
- North side eel lift: the percentage of VIE marked eels introduced into the hopper which were subsequently collected from the collection tank following a lift cycle.

Internal efficiency was calculated relative to the original number of marked eels (e.g., in the event any eels released at the base of the south side eel trap escaped from that structure during the test period, they were considered as part of the internal effectiveness calculation).

An estimate of the retention efficiency of the upstream holding tank at the south side eel trap was calculated as the percentage of marked eels placed directly in that structure at the initiation of the two 24-hour test periods. The retention efficiency estimate for the upstream holding tank was used to adjust the calculated internal efficiency rate to address the potential degree of variability due to volitional escapement from the upstream holding tank. As a result, internal efficiency rate for the south side eel trap is presented as a range in this report.

Figure 4-1. Visual Implant Elastomer (VIE) marking procedure (left photo) and juvenile American eel following marking with orange elastomer (right photo).

5 Results

5.1 Nighttime Observations – Assessment of Attraction Efficiency

Visual surveys of the south side eel trap and north side eel lift and the nearfield ledges approaching the upstream eel passage facilities were conducted on June 27, July 25 and August 22, 2024. The abundance of eels within the south side eel trap, including counts and location within the eel trap (i.e., the specific ramp section or resting pool – see Figure 3-1), as well as estimated numbers of juvenile eels present in the nearfield area are presented in Table 5-1. Juvenile eel counts within the north side eel lift as well as estimates of juvenile eel numbers present in the nearfield area below that passage facility are presented in Table 5-2. Conditions on each survey date are summarized in Table 5-3.

Table 5–1. Summary of juvenile American eel counts within the south side eel trap and associated nearfield areas during nighttime visual surveys conducted on June 27, July 25, and August 22, 2024.

	27-Jun-24			25-Jul-24			22-Aug-24		
Ladder Section	**< 6 in**	**6 - 12 in**	**12+ in**	**< 6 in**	**6 - 12 in**	**12+ in**	**< 6 in**	**6 - 12 in**	**12+ in**
Ramp Section 1 (bottom)	Not Accessible[1]			Not Accessible[1]			Not Accessible[1]		
Resting Pool 1	Not Accessible[1]			Not Accessible[1]			Not Accessible[1]		
Ramp Section 2	Not Accessible[1]			Not Accessible[1]			Not Accessible[1]		
Resting Pool 2	45	0	0	300	10	1	20	2	0
Ramp Section 3	0	0	0	0	0	0	0	0	0
Resting Pool 3	30	0	0	1000	0	0	100	0	0
Ramp Section 4 (top)[2]	55	0	0	200	30	0	5	0	0
Collection Tank	3	0	0	>100	0	0	0	0	0
Nearfield Observations[3]	**< 6 in**	**6 - 12 in**	**12+ in**	**< 6 in**	**6 - 12 in**	**12+ in**	**< 6 in**	**6 - 12 in**	**12+ in**
Approach Pools	7,950	815	0	26,300	3,500	0	259	68	0
Climbing Dam	475	0	0	3,000	0	0	80	20	0
Corner Behind Ramp	8,000	4,000	0	10,000	2,000	0	0	0	0
Climbing Eel Pass Leakage	863	2	0	2,050	15	0	23	0	0

[1] Ramp sections 'Not Accessible" denote sections surveyors were unable to visually access. Covers must be left on these lowermost sections to allow surveyors to safely access the nearfield habitat during each survey

[2] Ramp cover not completely removed. 25% covered 27 June and 66% covered on 25 July and 22 August

3 Numbers of eels in the nearfield reach were estimated based on what was directly visible and may underrepresent the actual number present

Table 5–2. Summary of juvenile American eel counts within the north side eel lift and associated nearfield areas during nighttime visual surveys conducted on June 27, July 25, and August 22, 2024.

	27-Jun-24			25-Jul-24			22-Aug-24		
Lift	**< 6 in**	**6 - 12 in**	**12+ in**	**< 6 in**	**6 - 12 in**	**12+ in**	**< 6 in**	**6 - 12 in**	**12+ in**
Collection Hopper + Internal Ramp	N/A			15	0	0	50	0	0
Nearfield Observations	**< 6 in**	**6 - 12 in**	**12+ in**	**< 6 in**	**6 - 12 in**	**12+ in**	**< 6 in**	**6 - 12 in**	**12+ in**
Approach Pools	1600	0	0	300	50	0	1000	250	0
Climbing Dam	150	0	0	38	0	0	450	0	0
Concrete Hopper Base	70	0	0	2	0	0	52	0	0
Eels Staging in River	N/A			500	0	0	500	50	1

Table 5–3. Site conditions for nighttime visual surveys to enumerate and observe juvenile American eels within the south side eel trap, north side eel lift, and associated nearfield areas on June 27, July 25, and August 22, 2024.

	June 27, 2024	July 25, 2025[1]	August 22, 2025
Survey Time (Start-End)	22:28-00:00	22:15-00:10	21:40-23:00
Mean River Flow (cfs)	3714	2771	4009
Mean Unit Flow (cfs)	3317	n/a	3867
Mean Spill Flow (cfs)	18	n/a	0
Mean Headpond Ele. (msl)	44.28	n/a	44.36
Mean Tailwater Ele. (msl)	15.35	n/a	15.92
Air Temperature (C)	21	22	18
Water Temperature (C)	25	26	n/a
Moon Percent illumination	64.2%	76.9%	88.0%
Weather Conditions	Clear	Partly Cloudy	Partly Cloudy

[1] Station in outage

5.1.1 South Side Eel Trap

June 27, 2024

The first south side upstream eel survey was conducted from 22:28 to 23:29 on June 27, 2024. The collection tank was observed to have adequate flow and was correctly directed at the crest of the fall-off portion of the ramp. The drain was found to be functioning properly with all excess water supplying the PVC spray bar located partway down the top section of ramp. Minimal leakage was observed on the outside of the collection tank with three eels observed inside tank at the time of survey. The uppermost section of the facility, Ramp 4, was found to have the highest observed number of eels (N=55) within the eel trap. The majority of the ramp cover (75%) was removed, for observation and access. A small section of the uppermost ramp cover remained secure to the structure. Surveyors observed black seine netting installed inside the peg channels of the Mileau elver substrate. Eels were also observed in a noticeable gap between the edge of the substrate and the wooden ramp wall. Halfway down the ramp, 45 eels were observed in Pool 2 and 30 eels in Pool 3, all of which were less than 6 inches in length.

Nearfield observations during the June 27 survey were confined to the area within 100 feet of the south side eel trap entrance. Four primary congregation points were identified during this survey and included (1) the face of the dam, (2) approach pools connecting the south side eel trap to the river, (3) leakage areas originating from the south side eel trap, and (4) the corner area located beneath Pool 1 and between Ramp 1 and the dam face. Over 8,000 eels were estimated to be

ascending the approach channel and in the water surrounding the eel pass entrance (Figure 5-1). Approximately 475 eels, all <6 inches, were observed climbing the rock wall face of the dam. Leakage from Pools and Ramps 1 through 3 created a wet surface on the surrounding concrete and contributed to attracting eels away from the eel pass entrance. An estimated 8,000 <6 inch and 4,000 6–12-inch eels were observed in the corner area below Pool 1. No eels in the 12+ size class were observed within the south side eel trap or the surrounding nearfield area during the June 27 survey.

Figure 5-1. View of the south side eel trap entrance and the approach pools conveying attraction water to the Lawrence tailrace.

July 25, 2024

The second south side juvenile eel survey was conducted from 22:15 to 23:45 on July 25, 2024. The collection tank supply water was noted to be significantly reduced from the flow observed during the June 27 survey. Two of the three spray nozzles were failing to adequately water the ramp and the PVC spray bar on Ramp 4 appeared to be plugged with debris (Figure 5-2). It was noted that a blockage to the tank water supply resulted in the majority of water from the impoundment pump being fully diverted to the attraction flow provided at the entrance of the south side eel trap.

Observations of the south side eel trap included individuals representing each of the three designated length categories (i.e., < 6 inches, 6-12 inches, and 12+ inches). Around 100 eels were estimated in the collection tank at the time of the survey. Around 1/3 of the cover was removed from Ramp 4 for this survey where 230 eels in the <6 inch and 6–12-inch size categories were observed. Leakage between the ramp base and collection tank was observed and 115 eels were counted on the outside of the tank. It appeared eels were ascending underneath and alongside the substrate of this ramp section and exiting outside the tank rather than inside it. An estimated 1,000 <6-inch eels were observed in Pool 3 and over 300, representing all size classes, in Pool 2. Surveys did observe eels belonging to the smallest size class exiting Ramp 1 through gaps in the plywood cover. Similar to the June 27 survey, leakage from the ramp and dam face was observed (Figure 5-3).

Substantially more eels were observed in the nearfield area on July 25 than were observed during the June 27 survey. An estimated 26,000 eels <6 inches and 3,500 eels sized 6-12 inches were observed in the approach channel and pools. Around 3,000 eels were observed climbing the face of the dam, aided by an increase in leakage from the block wall construction and the crest gates above. Twelve thousand eels were observed in the corner behind the ramp entrance with over 2,000 climbing the outside surfaces of the eel ladder wetted by leakage (Figure 5-4). Surveyors did note a large congregation of eels (in the thousands) attempting to ascend Ramp 1 but ultimately falling back out the entrance opening. The low volume of conveyance flow exiting Ramp 1, further reduced by leakage throughout the south side structure, appeared to be a factor. Note that the count for this set of eels was included in the "Approach Pools" category in Table 5-1.

A high number of eel mortalities were observed from two primary areas during the July 25 survey. Dead eels from all size classes were observed in a large leakage-filled concrete trough adjacent to the uppermost ramp section (Figure 5-5). Additional eel mortalities (all individuals greater than 6 inches) were observed in the nearfield area below the Ramp 4 section.

Figure 5-2. View of the south side eel trap collection tank (left photo) and ramp (right photo) water supply during the July 25, 2024 survey.

Figure 5-3. Areas wetted by leakage around the south side eel trap (left, photo taken daytime for better visibility), leakage areas around Ramp 1 and Pool 2 (right, photo taken during survey).

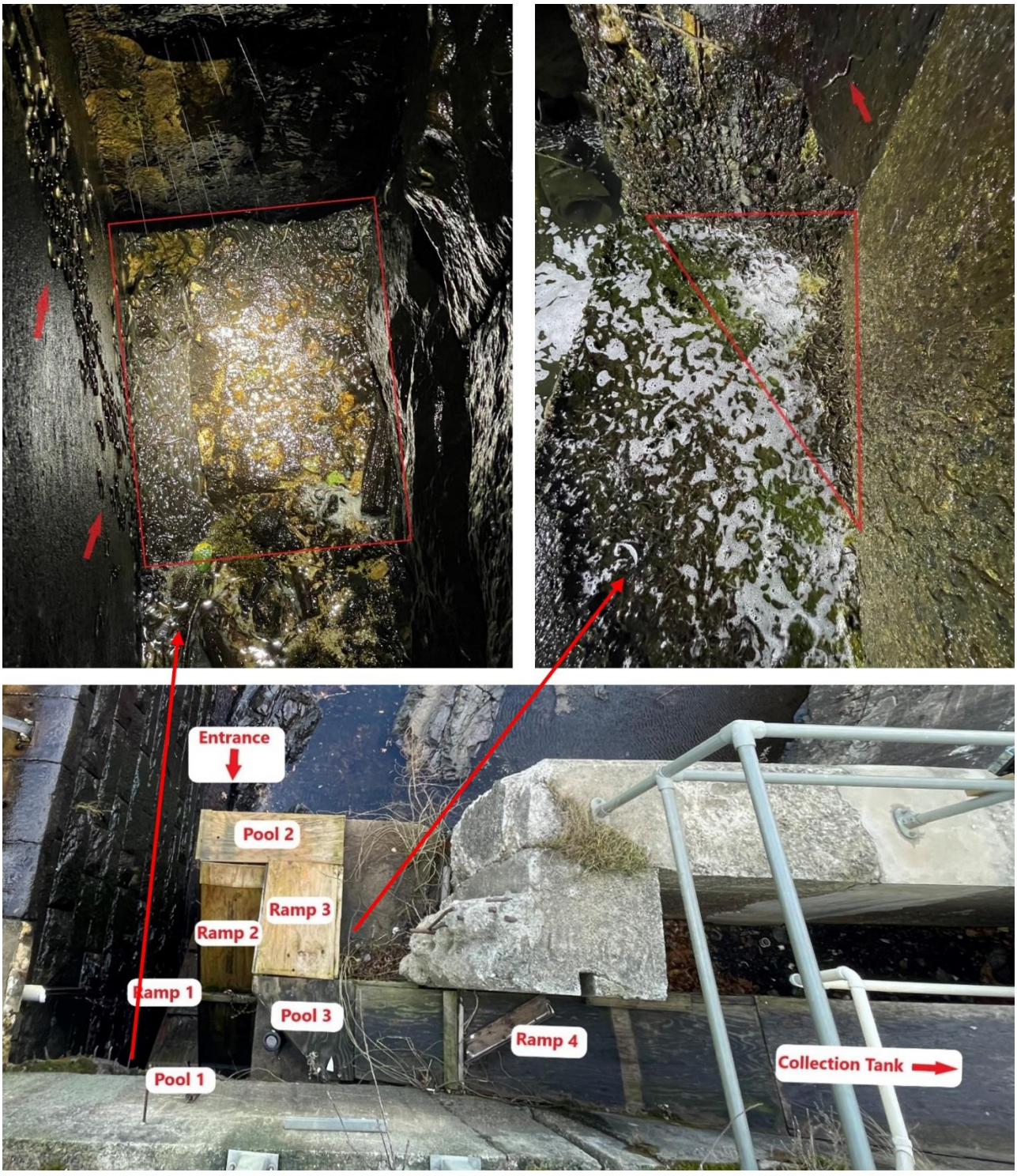

Figure 5-4. Juvenile eels congregating and ascending the wetted surface of Essex Dam below Pool 2 (left photo) and in the corner behind the south side eel trap entrance (right photo).

Figure 5-5. Juvenile eel mortality areas associated with the south side eel ramp observed during July at the base of trough leakage (left photo) and inside the trough adjacent ramp section 4 (right photo).

August 22, 2024

The third and final south side eel trap and nearfield visual survey was conducted between 21:40 and 22:30 on August 22, 2024. Observations during this survey were characterized by the lowest number of juvenile eels observed during the study period. As was noted during the July survey, the maintenance flow feeding the collection tank remained low. In contrast to observations during June and July, discharge from the hose supplying attraction flow at the south side eel ramp entrance was greatly reduced. Surveyors were unable to access the source water location in the impoundment to determine if debris was clogging the intake area of the pump.

There was minimal leakage from the collection tank during the August survey but evidence of the previously observed leakage conditions was apparent (Figure 5-6). No eels were counted inside the collection tank. The greatest number of eels counted in the south side facility were observed in Pool 3 where around 100 juvenile eels were observed.

Similar to the reduced numbers of juvenile eels observed within the south side eel trap, a large drop in the number of juvenile eels observed in the nearfield area was noted. The greatest number of eels, more than 300, were observed in the approach channel and pools. Around 100 eels were observed climbing the face of the dam and 23 eels were observed climbing the leakage originating from the south side eel trap. No eels were observed in the corner behind the south side eel trap entrance at the time of the survey.

Figure 5-6. Dried algal growth (left photo) and desiccated juvenile eels (right photo) left in areas of previously observed leakage flows associated with the south side eel trap collection tank.

5.1.2 North Side Eel Lift

June 27, 2024

The first survey event associated with the north side eel lift and adjacent nearfield areas was conducted at 23:45 on June 27, 2024. Upon approaching the north side eel lift, three raccoons were observed at the entrance and appeared to be predating on juvenile eels drawn toward the attraction flow. Conveyance flow from the hopper entrance and attraction flow from secondary hoses located behind the hopper were observed to be functioning properly. The inside of the hopper was not inspected during this survey but the outside tank and guidance rails looked to be in good working condition.

In the nearfield survey area, a total of 1,600 eels were observed ascending the approach channel to the concrete base of the north side eel lift (Figure 5-7). Approximately 70 eels were observed climbing on the poured concrete base of the lift and another 150 were observed climbing the face of Essex Dam. At the time of the survey, no eels were observed using the climbing substrate located on the poured concrete pad outside the hopper. All eels observed in the vicinity of the north side eel lift during the June 27 survey were in the smallest size class (i.e., less than 6 inches).

Figure 5-7. Juvenile American eels observed in the nearfield approach channel habitat associated with the north side eel lift during the June 27 survey.

July 25, 2024

The second survey event for the north side eel lift and associated nearfield area was conducted at 23:55 on July 25, 2024. Similar to observations upon arrival at the north side eel lift during the June survey, three raccoons were observed at the lift entrance and appeared to be predating on juvenile eels drawn toward the attraction flow. Conveyance flow from hopper entrance and supplemental attraction flow provided by the secondary hoses located behind the hopper were found to be functioning properly, and the single internal nozzle looked to be correctly positioned to provide overshot flow at the crest of the fall-off portion of the ramp. Fifteen eels were observed inside the collection hopper.

Within the nearfield survey area, 350 eels were observed ascending the approach channel to the lift with lesser numbers observed on the poured concrete base (n = 2) and climbing the face of Essex Dam (n = 38). Juvenile eels observed during the July 25 survey represented the <6 and 6-12-inch size classes. At least 500 juvenile eels were also observed in the deeper part of the river downstream of the attraction channel.

August 22, 2024

The third and final north side eel lift and nearfield visual survey was conducted at 22:40 on August 22, 2024. Similar to the previous survey events, conveyance flow from hopper entrance and supplemental attraction flow provided by the secondary hoses located behind the hopper were found to be functioning properly. The inside of the hopper was not inspected during this survey but the outside tank and guidance rails looked to be in good working condition.

Within the nearfield survey area, approximately 1,250 juvenile eels were observed ascending the approach channel to the lift entrance. Eels were observed ascending a natural bedrock channel from the river to the concrete base of the north lift. The eels then split into two primary travel routes, directed by the attraction flow hoses located behind the lift, around the lift base and towards the top of the concrete base and dam face (Figure 5-8). A total of 52 juvenile eels were observed climbing the poured concrete base to the lift and another 450 were observed climbing the face of Essex Dam. As with previous surveys, no eels were observed using the climbing substrate located on the poured concrete pad outside the hopper. Surveyors approximated 500 juvenile eels in main river habitat just downstream of the entrance to the attraction flow channel leading up to the north side eel lift. Juvenile eels representing all three size classes were present during the August 22 north side eel lift survey.

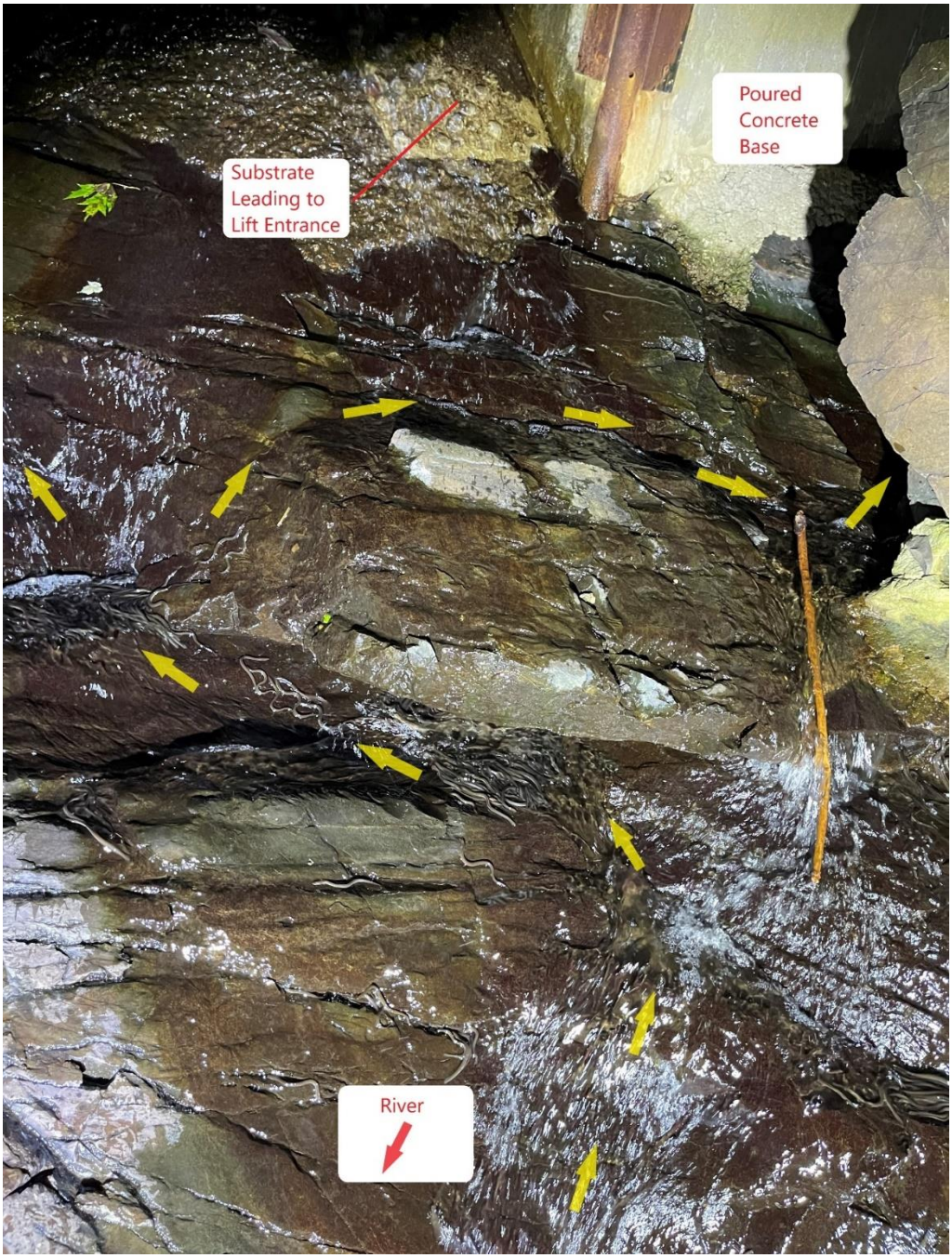

Figure 5-8. Observed movement pattern of Juvenile American eels observed in the nearfield approach channel habitat associated with the north side eel lift during the August 22 survey.

5.2 Quantitative Evaluation of Internal Efficiency

Internal effectiveness evaluations were conducted at the south side eel trap between July 18-20 and at the north side eel lift between August 1-3. Internal efficiency of the collection tank associated with the south side eel trap was assessed on August 7 and 8. A listing eels marked in each length class, and number of eels in each length class recaptured at the 24-hour and 48-hour tank checks is provided in Appendix A.

5.2.1 South Side Eel Trap

To evaluate the internal passage efficiency of the south side eel trap, the cover of the lowest ramp section was removed and a plywood panel fitted with mesh covered drain holes was installed at the ramp entrance (Figure 5-9). Once the lowermost ramp plywood panel was reinstalled, the end cap prevented test eels from exiting the ladder entrance during the test period[1].

Table 5-4 summarizes the findings for the two 24-hour internal efficiency evaluations conducted for the south side eel ramp. A total of 272 juvenile eels were released into the sealed base of the south side eel trap during the two events. Eels marked as part of the south side eel trap internal efficiency test ranged in length from 67-127 mm. Despite the introduction of 272 marked juvenile eels at the base of the south side eel trap during the internal efficiency evaluation, no marked individuals were recovered from the collection tank at the 24-hour check intervals following either the July 18 or July 19 release. A limited number of marked individuals (n = 6) were noted as still present at the base of the south side eel trap when project staff removed the plywood panel with mesh covered drain holes that had been installed to prevent escapement.

Results of the retention efficiency tests conducted for the collection tank of the south side eel trap are summarized in Table 5-5. Over the two test dates, a total of 50 marked eels (25 per date) were placed in the south side eel trap collection tank and assessed for presence 24 hours later. Eels marked as part of the south side eel trap collection tank efficiency test ranged in length from 68-115 mm. Counts conducted 24-hours post placement in the collection tank found 13 and 16 marked eels from the two assessments, respectively. Based on the retention efficiency testing, the effectiveness of the collection tank for the south side eel trap at retaining collected juvenile eels was estimated at 58%.

[1] Note – With the exception of preventing eels egress from the south side eel trap via the main entrance, Normandeau staff did not attempt to seal other areas of internal leakage flow and the resulting efficiency estimate represents the normal operating condition of the structure.

Table 5–4. Summary of the internal passage efficiency evaluation for the south side eel trap.

Group Color	Release Date	Tank Check	Number of Eels		Eel Size (mm)		
			Released	Recovered	Min	Mean	Max
Orange	18-Jul	19-Jul	144	0	65	87	113
Blue	19-Jul	20-Jul	128	0	70	94	154
Total			272	0	65	90	154

Table 5–5. Summary of the collection tank retention evaluation for the south side eel trap.

Group Color	Release Date	Tank Check	Number of Eels		Eel Size (mm)		
			Released	Recovered	Min	Mean	Max
Purple[1]	7-Aug	8-Aug	25	13	77	94	115
Green	8-Aug	9-Aug	25	16	68	86	112
Total			50	29	68	90	115

[1] one purple marked eel, 86mm, was recovered 48-hours post release and was not included as part of the 24-hour retrieval count

Figure 5-9. Cover used to seal the south side eel ramp during internal efficiency testing.

5.2.2 North Side Eel Lift

Results of the internal passage efficiency tests conducted for the north side eel lift are summarized in Table 5-6. A total of 260 juvenile eels were placed in the hopper of the north side eel lift during a total of five events (approximately 50 individuals per release group). Eels marked as part of the north side eel lift internal efficiency test ranged in length from 67-127 mm. Following placement in the hopper, tagged eels were lifted by Essex operations staff and the hopper was emptied into the upper catchment basin. Note that for these evaluations, it was necessary to insert a temporary screen cover on the drain in the catchment basin prior to testing so that eels would be retained for counting. Under normal operations, the screen cover is absent, and eels are released from the catchment basin into the impoundment upon exiting the hopper during a lift event.

Of the 260 marked juvenile eels, over 99% (259 out of 260) were accounted for upon being poured from the hopper into the catchment basin.

Table 5–6. Summary of the internal passage efficiency evaluation for the north side eel lift.

Group Color	Release Date	Tank Check	Number of Eels		Eel Size Distribution (mm)		
			Released	Recovered	Min	Mean	Max
Pink	1-Aug	1-Aug	55	55	67	92	108
Yellow	1-Aug	1-Aug	46	45	69	88	105
Red	2-Aug	2-Aug	58	58	72	91	106
Green	2-Aug	2-Aug	51	51	73	93	109
Red (2)	2-Aug	2-Aug	50	50	71	94	127
Total			260	259	67	92	127

6 Summary

The nearfield and internal effectiveness of the south side eel trap and north side eel lift at the Lawrence Project were evaluated during the 2024 upstream passage season. Assessment of nearfield effectiveness was conducted in a qualitative manner utilizing a series of nighttime visual surveys to examine habitat and structures in the vicinity of the entrances to the two currently operated upstream eel passage facilities at the Project. Internal efficiency of both structures was assessed quantitatively using a mark-recapture approach.

Visual observations made during all three survey events at the south side eel trap indicated adequate flow in the approach channel providing access for juvenile American eels to the ramp entrance. Approach pools in the nearfield area consistently had the highest number of eels during each of the three survey events with the peak in observed abundance within the approach pools occurring during the July survey. Conditions during the July survey coincided with the warmest recorded water temperature as well as a station wide outage which lead to a reduction in discharge downstream of the powerhouse and increased spill over the crest gates and into the attraction channel. This increase in flow through approach channel may have contributed to the increased juvenile eel abundance during the July survey. Leakage observed coming from the south side eel trap structure as well as the adjacent section of the dam was observed during all three survey events and likely resulted in sources of competitive flow for eels attempting to locate the entrance. A gradual decrease in the volume of discharge provided by the hose providing attraction water at the ramp entrance was observed over the three survey dates and may have been caused by debris fouling the supply pump.

Observations were made inside the south side eel trap structure during all three survey events. Juvenile eels were observed utilizing the ramp sections and resting pools, as well as ascending gaps between the milieu substrate and ramp wall. Leakage originating from the ramp was noted on many sections, most notably from the resting pools. This leakage provided wetted areas of false attraction outside the ramp for eels to ascend the dam structure and away from the ramp entrance. Due to the observed ramp leakage, the internal conveyance flow originating at the top of the ramp decreased with each descending section and resulted in markedly less internal flow at the entrance of the structure. Eels belonging to all three size classes were observed within the south side eel trap during the 2024 upstream evaluation. Among all three survey events at the south side eel trap, the majority, about 85%, belonged to the <6” class, around 15% belonged to the 6-12” class and one eel was observed belonging to the >12” size class.

Similar to the south side eel trap, juvenile eels were readily observed in the nearfield area of the north side eel lift during all three survey dates. At the north side eel lift, most juvenile eels were observed in the approach channel leading to the base of the eel lift. A large number were also observed congregating in the river, just below the attraction channel. After advancing to the base of the lift, eels appeared to be attracted over a large area that was wetted by the external attraction hoses. Eels of all size classes were observed during the 2024 night surveys, with the greatest

number of observations occurring during the August visit. The lowest observed abundances of juvenile eels in the nearfield region of the north side eel lift occurred during the July survey and coincided with the station outage which resulted in most of the river flow passing downstream via spill. Flow provided by the supplemental attraction hoses appeared to falsely attract a proportion of eels away from the north side eel lift entrance and towards leakage coming down the dam face. Among all three survey events at the south side eel trap, the majority, about 93.2%, belonged to the <6" class, around 6.7% belonged to the 6-12" class and one eel was observed belonging to the >12" size class.

A quantitative evaluation to assess the internal passage effectiveness of the south side eel trap was conducted over the course of two days in mid-July during which a total of 272 marked juvenile eels were placed at the sealed entrance of the ramp. Following the completion of a 24-hour period, the collection tank was checked, and no marked eels were found, suggesting high levels of escapement and poor internal effectiveness of conveying eels from the ramp entrance up to the collection tank. In addition to evaluating the effectiveness of the climbing structure, a retention test of the collection tank at the south side eel trap was also conducted. During two separate tests a total of 50 marked juvenile eels were placed in the tank and the 24-hour retention effectiveness was estimated at 58%, suggesting a measurable amount of escapement of collected eels from the collection tank is occurring.

Similar to the internal passage evaluation conducted at the south side eel trap, a quantitative evaluation was conducted at the north side eel lift in order to assess internal efficiency of that structure. Over the course of two days in the beginning of August, 260 marked juvenile eels were placed into the collection hopper of the north side eel lift. Of that total, 259 (over 99%) were successfully transported to the top of the dam, indicating high internal effectiveness for this facility.

7 Variances from the FERC Approved Study Plan

The Upstream American Eel Passage Assessment was conducted following the methodology described in the April 10, 2024, RSP and approved by FERC in their May 10, 2024, SPD with several exceptions:

- The use of red light during the visual surveys was identified in the RSP as a measure to minimize disturbance to eels. Surveys conducted during 2024 utilized standard white lights to ensure crew safety while transiting across wet ledge habitat and accessing the length of the south side eel trap.
- The RSP indicated that a collection tank efficiency test would be conducted for the north side eel lift. Upon review with Essex operations, it was determined that eels are not maintained in the upper catchment tank for any period of time following the dump of a

hopper lift (instead they are sluiced directly to the project impoundment). For the purposes of evaluating the internal effectiveness of the lift hopper, a temporary blocking screen was installed to allow project staff to recover eels following hopper dump for enumeration. Since normal operation of the north side eel lift facility does not include extended hold times for juvenile eels in the upstream catchment basin, that aspect of the study was not evaluated. Collection tank effectiveness was assessed for the south side eel trap where eels are held for a duration of time prior to being manually collected by project staff and transported to the impoundment.

8 References

Normandeau Associates, Inc. (Normandeau) (2015). Assessment of eel pass effectiveness at Lawrence Hydroelectric Project (FERC No. 2800), Merrimack, Lawrence, MA. Report Prepared for Enel Green Power North America, Inc.

.

Appendix A: Visual Implant Elastomer Tagging Record

South Side Eel Trap – Internal Effectiveness Testing

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Orange	87	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	101	7/18/2024	16:03	--	--
Orange	80	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	82	7/18/2024	16:03	--	--
Orange	91	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	102	7/18/2024	16:03	--	--
Orange	96	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	91	7/18/2024	16:03	--	--
Orange	86	7/18/2024	16:03	--	--
Orange	88	7/18/2024	16:03	--	--
Orange	105	7/18/2024	16:03	--	--
Orange	82	7/18/2024	16:03	--	--
Orange	96	7/18/2024	16:03	--	--
Orange	85	7/18/2024	16:03	--	--
Orange	89	7/18/2024	16:03	--	--
Orange	89	7/18/2024	16:03	--	--
Orange	96	7/18/2024	16:03	--	--
Orange	77	7/18/2024	16:03	--	--
Orange	82	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	65	7/18/2024	16:03	--	--
Orange	78	7/18/2024	16:03	--	--
Orange	80	7/18/2024	16:03	--	--
Orange	80	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	83	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	92	7/18/2024	16:03	--	--
Orange	69	7/18/2024	16:03	--	--

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Orange	85	7/18/2024	16:03	--	--
Orange	83	7/18/2024	16:03	--	--
Orange	94	7/18/2024	16:03	--	--
Orange	75	7/18/2024	16:03	--	--
Orange	87	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	82	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	88	7/18/2024	16:03	--	--
Orange	85	7/18/2024	16:03	--	--
Orange	83	7/18/2024	16:03	--	--
Orange	99	7/18/2024	16:03	--	--
Orange	75	7/18/2024	16:03	--	--
Orange	72	7/18/2024	16:03	--	--
Orange	72	7/18/2024	16:03	--	--
Orange	90	7/18/2024	16:03	--	--
Orange	71	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	74	7/18/2024	16:03	--	--
Orange	85	7/18/2024	16:03	--	--
Orange	109	7/18/2024	16:03	--	--
Orange	67	7/18/2024	16:03	--	--
Orange	80	7/18/2024	16:03	--	--
Orange	85	7/18/2024	16:03	--	--
Orange	75	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	70	7/18/2024	16:03	--	--
Orange	82	7/18/2024	16:03	--	--
Orange	81	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	86	7/18/2024	16:03	--	--
Orange	95	7/18/2024	16:03	--	--
Orange	110	7/18/2024	16:03	--	--
Orange	81	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	91	7/18/2024	16:03	--	--
Orange	100	7/18/2024	16:03	--	--

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Orange	90	7/18/2024	16:03	--	--
Orange	91	7/18/2024	16:03	--	--
Orange	87	7/18/2024	16:03	--	--
Orange	98	7/18/2024	16:03	--	--
Orange	94	7/18/2024	16:03	--	--
Orange	83	7/18/2024	16:03	--	--
Orange	72	7/18/2024	16:03	--	--
Orange	82	7/18/2024	16:03	--	--
Orange	98	7/18/2024	16:03	--	--
Orange	74	7/18/2024	16:03	--	--
Orange	88	7/18/2024	16:03	--	--
Orange	77	7/18/2024	16:03	--	--
Orange	70	7/18/2024	16:03	--	--
Orange	80	7/18/2024	16:03	--	--
Orange	95	7/18/2024	16:03	--	--
Orange	71	7/18/2024	16:03	--	--
Orange	95	7/18/2024	16:03	--	--
Orange	92	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	72	7/18/2024	16:03	--	--
Orange	92	7/18/2024	16:03	--	--
Orange	83	7/18/2024	16:03	--	--
Orange	113	7/18/2024	16:03	--	--
Orange	83	7/18/2024	16:03	--	--
Orange	85	7/18/2024	16:03	--	--
Orange	94	7/18/2024	16:03	--	--
Orange	90	7/18/2024	16:03	--	--
Orange	89	7/18/2024	16:03	--	--
Orange	71	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	73	7/18/2024	16:03	--	--
Orange	112	7/18/2024	16:03	--	--
Orange	89	7/18/2024	16:03	--	--
Orange	76	7/18/2024	16:03	--	--
Orange	95	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	92	7/18/2024	16:03	--	--

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Orange	91	7/18/2024	16:03	--	--
Orange	71	7/18/2024	16:03	--	--
Orange	73	7/18/2024	16:03	--	--
Orange	83	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	101	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	94	7/18/2024	16:03	--	--
Orange	99	7/18/2024	16:03	--	--
Orange	88	7/18/2024	16:03	--	--
Orange	65	7/18/2024	16:03	--	--
Orange	75	7/18/2024	16:03	--	--
Orange	101	7/18/2024	16:03	--	--
Orange	80	7/18/2024	16:03	--	--
Orange	91	7/18/2024	16:03	--	--
Orange	91	7/18/2024	16:03	--	--
Orange	94	7/18/2024	16:03	--	--
Orange	87	7/18/2024	16:03	--	--
Orange	71	7/18/2024	16:03	--	--
Orange	69	7/18/2024	16:03	--	--
Orange	93	7/18/2024	16:03	--	--
Orange	83	7/18/2024	16:03	--	--
Orange	80	7/18/2024	16:03	--	--
Orange	91	7/18/2024	16:03	--	--
Orange	99	7/18/2024	16:03	--	--
Orange	86	7/18/2024	16:03	--	--
Orange	108	7/18/2024	16:03	--	--
Orange	112	7/18/2024	16:03	--	--
Orange	76	7/18/2024	16:03	--	--
Orange	84	7/18/2024	16:03	--	--
Orange	96	7/18/2024	16:03	--	--
Orange	86	7/18/2024	16:03	--	--
Orange	98	7/18/2024	16:03	--	--
Orange	95	7/18/2024	16:03	--	--
Orange	87	7/18/2024	16:03	--	--
Orange	104	7/18/2024	16:03	--	--
Orange	105	7/18/2024	16:03	--	--

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Blue	94	7/19/2024	16:36	--	--
Blue	76	7/19/2024	16:36	--	--
Blue	88	7/19/2024	16:36	--	--
Blue	101	7/19/2024	16:36	--	--
Blue	95	7/19/2024	16:36	--	--
Blue	86	7/19/2024	16:36	--	--
Blue	82	7/19/2024	16:36	--	--
Blue	78	7/19/2024	16:36	--	--
Blue	96	7/19/2024	16:36	--	--
Blue	75	7/19/2024	16:36	--	--
Blue	107	7/19/2024	16:36	--	--
Blue	107	7/19/2024	16:36	--	--
Blue	92	7/19/2024	16:36	--	--
Blue	98	7/19/2024	16:36	--	--
Blue	110	7/19/2024	16:36	--	--
Blue	84	7/19/2024	16:36	--	--
Blue	90	7/19/2024	16:36	--	--
Blue	89	7/19/2024	16:36	--	--
Blue	87	7/19/2024	16:36	--	--
Blue	91	7/19/2024	16:36	--	--
Blue	95	7/19/2024	16:36	--	--
Blue	91	7/19/2024	16:36	--	--
Blue	80	7/19/2024	16:36	--	--
Blue	81	7/19/2024	16:36	--	--
Blue	94	7/19/2024	16:36	--	--
Blue	78	7/19/2024	16:36	--	--
Blue	91	7/19/2024	16:36	--	--
Blue	100	7/19/2024	16:36	--	--
Blue	98	7/19/2024	16:36	--	--
Blue	86	7/19/2024	16:36	--	--
Blue	100	7/19/2024	16:36	--	--
Blue	86	7/19/2024	16:36	--	--
Blue	105	7/19/2024	16:36	--	--
Blue	84	7/19/2024	16:36	--	--
Blue	94	7/19/2024	16:36	--	--
Blue	87	7/19/2024	16:36	--	--
Blue	95	7/19/2024	16:36	--	--

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Blue	149	7/19/2024	16:36	--	--
Blue	94	7/19/2024	16:36	--	--
Blue	88	7/19/2024	16:36	--	--
Blue	102	7/19/2024	16:36	--	--
Blue	105	7/19/2024	16:36	--	--
Blue	88	7/19/2024	16:36	--	--
Blue	83	7/19/2024	16:36	--	--
Blue	77	7/19/2024	16:36	--	--
Blue	92	7/19/2024	16:36	--	--
Blue	101	7/19/2024	16:36	--	--
Blue	96	7/19/2024	16:36	--	--
Blue	85	7/19/2024	16:36	--	--
Blue	89	7/19/2024	16:36	--	--
Blue	92	7/19/2024	16:36	--	--
Blue	80	7/19/2024	16:36	--	--
Blue	96	7/19/2024	16:36	--	--
Blue	79	7/19/2024	16:36	--	--
Blue	85	7/19/2024	16:36	--	--
Blue	88	7/19/2024	16:36	--	--
Blue	94	7/19/2024	16:36	--	--
Blue	97	7/19/2024	16:36	--	--
Blue	92	7/19/2024	16:36	--	--
Blue	84	7/19/2024	16:36	--	--
Blue	88	7/19/2024	16:36	--	--
Blue	91	7/19/2024	16:36	--	--
Blue	97	7/19/2024	16:36	--	--
Blue	85	7/19/2024	16:36	--	--
Blue	110	7/19/2024	16:36	--	--
Blue	88	7/19/2024	16:36	--	--
Blue	99	7/19/2024	16:36	--	--
Blue	92	7/19/2024	16:36	--	--
Blue	76	7/19/2024	16:36	--	--
Blue	99	7/19/2024	16:36	--	--
Blue	96	7/19/2024	16:36	--	--
Blue	102	7/19/2024	16:36	--	--
Blue	118	7/19/2024	16:36	--	--
Blue	84	7/19/2024	16:36	--	--

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Blue	127	7/19/2024	16:36	--	--
Blue	101	7/19/2024	16:36	--	--
Blue	98	7/19/2024	16:36	--	--
Blue	94	7/19/2024	16:36	--	--
Blue	89	7/19/2024	16:36	--	--
Blue	97	7/19/2024	16:36	--	--
Blue	99	7/19/2024	16:36	--	--
Blue	98	7/19/2024	16:36	--	--
Blue	97	7/19/2024	16:36	--	--
Blue	85	7/19/2024	16:36	--	--
Blue	119	7/19/2024	16:36	--	--
Blue	95	7/19/2024	16:36	--	--
Blue	84	7/19/2024	16:36	--	--
Blue	96	7/19/2024	16:36	--	--
Blue	102	7/19/2024	16:36	--	--
Blue	106	7/19/2024	16:36	--	--
Blue	96	7/19/2024	16:36	--	--
Blue	90	7/19/2024	16:36	--	--
Blue	100	7/19/2024	16:36	--	--
Blue	94	7/19/2024	16:36	--	--
Blue	103	7/19/2024	16:36	--	--
Blue	103	7/19/2024	16:36	--	--
Blue	94	7/19/2024	16:36	--	--
Blue	99	7/19/2024	16:36	--	--
Blue	92	7/19/2024	16:36	--	--
Blue	70	7/19/2024	16:36	--	--
Blue	95	7/19/2024	16:36	--	--
Blue	103	7/19/2024	16:36	--	--
Blue	87	7/19/2024	16:36	--	--
Blue	105	7/19/2024	16:36	--	--
Blue	154	7/19/2024	16:36	--	--
Blue	101	7/19/2024	16:36	--	--
Blue	90	7/19/2024	16:36	--	--
Blue	88	7/19/2024	16:36	--	--
Blue	87	7/19/2024	16:36	--	--
Blue	87	7/19/2024	16:36	--	--
Blue	80	7/19/2024	16:36	--	--

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Blue	85	7/19/2024	16:36	--	--
Blue	101	7/19/2024	16:36	--	--
Blue	113	7/19/2024	16:36	--	--
Blue	85	7/19/2024	16:36	--	--
Blue	100	7/19/2024	16:36	--	--
Blue	101	7/19/2024	16:36	--	--
Blue	95	7/19/2024	16:36	--	--
Blue	77	7/19/2024	16:36	--	--
Blue	100	7/19/2024	16:36	--	--
Blue	87	7/19/2024	16:36	--	--
Blue	105	7/19/2024	16:36	--	--
Blue	99	7/19/2024	16:36	--	--
Blue	87	7/19/2024	16:36	--	--
Blue	84	7/19/2024	16:36	--	--
Blue	82	7/19/2024	16:36	--	--
Blue	99	7/19/2024	16:36	--	--
Blue	92	7/19/2024	16:36	--	--

South Side Eel Trap – Collection Tank Retention Evaluation

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Purple	96	8/7/2024	11:18	8/8/2024	9:06
Purple	88	8/7/2024	11:18	--	--
Purple	77	8/7/2024	11:18	8/8/2024	9:06
Purple	88	8/7/2024	11:18	8/8/2024	9:06
Purple	99	8/7/2024	11:18	8/8/2024	9:06
Purple	95	8/7/2024	11:18	--	--
Purple	89	8/7/2024	11:18	--	--
Purple	115	8/7/2024	11:18	--	--
Purple	106	8/7/2024	11:18	--	--
Purple	94	8/7/2024	11:18	--	--
Purple	94	8/7/2024	11:18	8/8/2024	9:06
Purple	93	8/7/2024	11:18	8/8/2024	9:06
Purple	102	8/7/2024	11:18	8/8/2024	9:06
Purple	113	8/7/2024	11:18	8/8/2024	9:06
Purple	89	8/7/2024	11:18	8/8/2024	9:06
Purple	86	8/7/2024	11:18	8/9/2024	9:55
Purple	90	8/7/2024	11:18	8/8/2024	9:06
Purple	96	8/7/2024	11:18	8/8/2024	9:06
Purple	92	8/7/2024	11:18	8/8/2024	9:06
Purple	91	8/7/2024	11:18	--	--
Purple	91	8/7/2024	11:18	--	--
Purple	79	8/7/2024	11:18	--	--
Purple	95	8/7/2024	11:18	--	--
Purple	89	8/7/2024	11:18	--	--
Purple	99	8/7/2024	11:18	8/8/2024	9:06
Green	75	8/8/2024	11:10	--	--
Green	73	8/8/2024	11:10	--	--
Green	82	8/8/2024	11:10	8/9/2024	9:55
Green	87	8/8/2024	11:10	8/9/2024	9:55
Green	81	8/8/2024	11:10	--	--
Green	75	8/8/2024	11:10	--	--
Green	93	8/8/2024	11:10	8/9/2024	9:55
Green	83	8/8/2024	11:10	8/9/2024	9:55
Green	87	8/8/2024	11:10	8/9/2024	9:55

Tagging Group Color	Length (mm)	Release Date	Release Time	Recover Date	Recover Time
Green	112	8/8/2024	11:10	8/9/2024	9:55
Green	97	8/8/2024	11:10	8/9/2024	9:55
Green	81	8/8/2024	11:10	--	--
Green	105	8/8/2024	11:10	8/9/2024	9:55
Green	94	8/8/2024	11:10	8/9/2024	9:55
Green	82	8/8/2024	11:10	8/9/2024	9:55
Green	92	8/8/2024	11:10	8/9/2024	9:55
Green	98	8/8/2024	11:10	--	--
Green	92	8/8/2024	11:10	8/9/2024	9:55
Green	93	8/8/2024	11:10	8/9/2024	9:55
Green	76	8/8/2024	11:10	8/9/2024	9:55
Green	81	8/8/2024	11:10	--	--
Green	68	8/8/2024	11:10	--	--
Green	99	8/8/2024	11:10	8/9/2024	9:55
Green	76	8/8/2024	11:10	--	--
Green	72	8/8/2024	11:10	8/9/2024	9:55

North Side Eel Lift – Internal Effectiveness Testing

Tagging Group Color	Length (mm)	Release Date	Release Time	Recovered
Pink	92	8/1/2024	12:58	Yes
Pink	94	8/1/2024	12:58	Yes
Pink	102	8/1/2024	12:58	Yes
Pink	97	8/1/2024	12:58	Yes
Pink	92	8/1/2024	12:58	Yes
Pink	103	8/1/2024	12:58	Yes
Pink	93	8/1/2024	12:58	Yes
Pink	89	8/1/2024	12:58	Yes
Pink	92	8/1/2024	12:58	Yes
Pink	94	8/1/2024	12:58	Yes
Pink	82	8/1/2024	12:58	Yes
Pink	93	8/1/2024	12:58	Yes
Pink	85	8/1/2024	12:58	Yes
Pink	81	8/1/2024	12:58	Yes
Pink	87	8/1/2024	12:58	Yes
Pink	74	8/1/2024	12:58	Yes
Pink	91	8/1/2024	12:58	Yes
Pink	89	8/1/2024	12:58	Yes
Pink	93	8/1/2024	12:58	Yes
Pink	104	8/1/2024	12:58	Yes
Pink	90	8/1/2024	12:58	Yes
Pink	67	8/1/2024	12:58	Yes
Pink	92	8/1/2024	12:58	Yes
Pink	97	8/1/2024	12:58	Yes
Pink	104	8/1/2024	12:58	Yes
Pink	86	8/1/2024	12:58	Yes
Pink	91	8/1/2024	12:58	Yes
Pink	92	8/1/2024	12:58	Yes
Pink	89	8/1/2024	12:58	Yes
Pink	93	8/1/2024	12:58	Yes
Pink	76	8/1/2024	12:58	Yes
Pink	94	8/1/2024	12:58	Yes
Pink	95	8/1/2024	12:58	Yes
Pink	94	8/1/2024	12:58	Yes
Pink	101	8/1/2024	12:58	Yes
Pink	83	8/1/2024	12:58	Yes

Tagging Group Color	Length (mm)	Release Date	Release Time	Recovered
Pink	103	8/1/2024	12:58	Yes
Pink	71	8/1/2024	12:58	Yes
Pink	89	8/1/2024	12:58	Yes
Pink	108	8/1/2024	12:58	Yes
Pink	90	8/1/2024	12:58	Yes
Pink	77	8/1/2024	12:58	Yes
Pink	102	8/1/2024	12:58	Yes
Pink	100	8/1/2024	12:58	Yes
Pink	100	8/1/2024	12:58	Yes
Pink	103	8/1/2024	12:58	Yes
Pink	83	8/1/2024	12:58	Yes
Pink	97	8/1/2024	12:58	Yes
Pink	83	8/1/2024	12:58	Yes
Pink	82	8/1/2024	12:58	Yes
Pink	103	8/1/2024	12:58	Yes
Pink	105	8/1/2024	12:58	Yes
Pink	96	8/1/2024	12:58	Yes
Pink	89	8/1/2024	12:58	Yes
Pink	95	8/1/2024	12:58	Yes
Yellow	92	8/1/2024	16:00	**No**
Yellow	86	8/1/2024	16:00	Yes
Yellow	69	8/1/2024	16:00	Yes
Yellow	83	8/1/2024	16:00	Yes
Yellow	102	8/1/2024	16:00	Yes
Yellow	84	8/1/2024	16:00	Yes
Yellow	85	8/1/2024	16:00	Yes
Yellow	99	8/1/2024	16:00	Yes
Yellow	98	8/1/2024	16:00	Yes
Yellow	93	8/1/2024	16:00	Yes
Yellow	95	8/1/2024	16:00	Yes
Yellow	80	8/1/2024	16:00	Yes
Yellow	80	8/1/2024	16:00	Yes
Yellow	86	8/1/2024	16:00	Yes
Yellow	92	8/1/2024	16:00	Yes
Yellow	96	8/1/2024	16:00	Yes
Yellow	84	8/1/2024	16:00	Yes
Yellow	96	8/1/2024	16:00	Yes
Yellow	80	8/1/2024	16:00	Yes
Yellow	97	8/1/2024	16:00	Yes

Tagging Group Color	Length (mm)	Release Date	Release Time	Recovered
Yellow	91	8/1/2024	16:00	Yes
Yellow	105	8/1/2024	16:00	Yes
Yellow	89	8/1/2024	16:00	Yes
Yellow	84	8/1/2024	16:00	Yes
Yellow	76	8/1/2024	16:00	Yes
Yellow	88	8/1/2024	16:00	Yes
Yellow	74	8/1/2024	16:00	Yes
Yellow	95	8/1/2024	16:00	Yes
Yellow	70	8/1/2024	16:00	Yes
Yellow	82	8/1/2024	16:00	Yes
Yellow	86	8/1/2024	16:00	Yes
Yellow	99	8/1/2024	16:00	Yes
Yellow	90	8/1/2024	16:00	Yes
Yellow	75	8/1/2024	16:00	Yes
Yellow	95	8/1/2024	16:00	Yes
Yellow	100	8/1/2024	16:00	Yes
Yellow	98	8/1/2024	16:00	Yes
Yellow	95	8/1/2024	16:00	Yes
Yellow	70	8/1/2024	16:00	Yes
Yellow	69	8/1/2024	16:00	Yes
Yellow	81	8/1/2024	16:00	Yes
Yellow	97	8/1/2024	16:00	Yes
Yellow	95	8/1/2024	16:00	Yes
Yellow	71	8/1/2024	16:00	Yes
Yellow	96	8/1/2024	16:00	Yes
Yellow	100	8/1/2024	16:00	Yes
Red	92	8/2/2024	12:28	Yes
Red	88	8/2/2024	12:28	Yes
Red	83	8/2/2024	12:28	Yes
Red	101	8/2/2024	12:28	Yes
Red	84	8/2/2024	12:28	Yes
Red	92	8/2/2024	12:28	Yes
Red	80	8/2/2024	12:28	Yes
Red	102	8/2/2024	12:28	Yes
Red	90	8/2/2024	12:28	Yes
Red	96	8/2/2024	12:28	Yes
Red	89	8/2/2024	12:28	Yes
Red	81	8/2/2024	12:28	Yes
Red	82	8/2/2024	12:28	Yes

Tagging Group Color	Length (mm)	Release Date	Release Time	Recovered
Red	98	8/2/2024	12:28	Yes
Red	82	8/2/2024	12:28	Yes
Red	100	8/2/2024	12:28	Yes
Red	75	8/2/2024	12:28	Yes
Red	93	8/2/2024	12:28	Yes
Red	101	8/2/2024	12:28	Yes
Red	103	8/2/2024	12:28	Yes
Red	95	8/2/2024	12:28	Yes
Red	90	8/2/2024	12:28	Yes
Red	104	8/2/2024	12:28	Yes
Red	100	8/2/2024	12:28	Yes
Red	78	8/2/2024	12:28	Yes
Red	90	8/2/2024	12:28	Yes
Red	104	8/2/2024	12:28	Yes
Red	96	8/2/2024	12:28	Yes
Red	92	8/2/2024	12:28	Yes
Red	92	8/2/2024	12:28	Yes
Red	72	8/2/2024	12:28	Yes
Red	88	8/2/2024	12:28	Yes
Red	78	8/2/2024	12:28	Yes
Red	74	8/2/2024	12:28	Yes
Red	83	8/2/2024	12:28	Yes
Red	84	8/2/2024	12:28	Yes
Red	84	8/2/2024	12:28	Yes
Red	73	8/2/2024	12:28	Yes
Red	89	8/2/2024	12:28	Yes
Red	94	8/2/2024	12:28	Yes
Red	92	8/2/2024	12:28	Yes
Red	79	8/2/2024	12:28	Yes
Red	92	8/2/2024	12:28	Yes
Red	94	8/2/2024	12:28	Yes
Red	95	8/2/2024	12:28	Yes
Red	94	8/2/2024	12:28	Yes
Red	95	8/2/2024	12:28	Yes
Red	96	8/2/2024	12:28	Yes
Red	97	8/2/2024	12:28	Yes
Red	103	8/2/2024	12:28	Yes
Red	106	8/2/2024	12:28	Yes
Red	93	8/2/2024	12:28	Yes

Tagging Group Color	Length (mm)	Release Date	Release Time	Recovered
Red	95	8/2/2024	12:28	Yes
Red	93	8/2/2024	12:28	Yes
Red	93	8/2/2024	12:28	Yes
Red	90	8/2/2024	12:28	Yes
Red	94	8/2/2024	12:28	Yes
Red	94	8/2/2024	12:28	Yes
Green	104	8/2/2024	13:15	Yes
Green	89	8/2/2024	13:15	Yes
Green	95	8/2/2024	13:15	Yes
Green	109	8/2/2024	13:15	Yes
Green	85	8/2/2024	13:15	Yes
Green	92	8/2/2024	13:15	Yes
Green	93	8/2/2024	13:15	Yes
Green	98	8/2/2024	13:15	Yes
Green	95	8/2/2024	13:15	Yes
Green	107	8/2/2024	13:15	Yes
Green	95	8/2/2024	13:15	Yes
Green	100	8/2/2024	13:15	Yes
Green	100	8/2/2024	13:15	Yes
Green	95	8/2/2024	13:15	Yes
Green	94	8/2/2024	13:15	Yes
Green	102	8/2/2024	13:15	Yes
Green	103	8/2/2024	13:15	Yes
Green	100	8/2/2024	13:15	Yes
Green	83	8/2/2024	13:15	Yes
Green	96	8/2/2024	13:15	Yes
Green	94	8/2/2024	13:15	Yes
Green	87	8/2/2024	13:15	Yes
Green	84	8/2/2024	13:15	Yes
Green	86	8/2/2024	13:15	Yes
Green	99	8/2/2024	13:15	Yes
Green	105	8/2/2024	13:15	Yes
Green	94	8/2/2024	13:15	Yes
Green	73	8/2/2024	13:15	Yes
Green	79	8/2/2024	13:15	Yes
Green	87	8/2/2024	13:15	Yes
Green	85	8/2/2024	13:15	Yes
Green	92	8/2/2024	13:15	Yes
Green	95	8/2/2024	13:15	Yes

Tagging Group Color	Length (mm)	Release Date	Release Time	Recovered
Green	89	8/2/2024	13:15	Yes
Green	76	8/2/2024	13:15	Yes
Green	86	8/2/2024	13:15	Yes
Green	103	8/2/2024	13:15	Yes
Green	99	8/2/2024	13:15	Yes
Green	96	8/2/2024	13:15	Yes
Green	89	8/2/2024	13:15	Yes
Green	98	8/2/2024	13:15	Yes
Green	84	8/2/2024	13:15	Yes
Green	89	8/2/2024	13:15	Yes
Green	94	8/2/2024	13:15	Yes
Green	98	8/2/2024	13:15	Yes
Green	95	8/2/2024	13:15	Yes
Green	96	8/2/2024	13:15	Yes
Green	99	8/2/2024	13:15	Yes
Green	92	8/2/2024	13:15	Yes
Green	90	8/2/2024	13:15	Yes
Green	79	8/2/2024	13:15	Yes
Red (2)	91	8/2/2024	15:02	Yes
Red (2)	101	8/2/2024	15:02	Yes
Red (2)	100	8/2/2024	15:02	Yes
Red (2)	92	8/2/2024	15:02	Yes
Red (2)	101	8/2/2024	15:02	Yes
Red (2)	85	8/2/2024	15:02	Yes
Red (2)	91	8/2/2024	15:02	Yes
Red (2)	90	8/2/2024	15:02	Yes
Red (2)	71	8/2/2024	15:02	Yes
Red (2)	104	8/2/2024	15:02	Yes
Red (2)	86	8/2/2024	15:02	Yes
Red (2)	92	8/2/2024	15:02	Yes
Red (2)	80	8/2/2024	15:02	Yes
Red (2)	91	8/2/2024	15:02	Yes
Red (2)	88	8/2/2024	15:02	Yes
Red (2)	79	8/2/2024	15:02	Yes
Red (2)	94	8/2/2024	15:02	Yes
Red (2)	79	8/2/2024	15:02	Yes
Red (2)	89	8/2/2024	15:02	Yes
Red (2)	102	8/2/2024	15:02	Yes
Red (2)	99	8/2/2024	15:02	Yes

Tagging Group Color	Length (mm)	Release Date	Release Time	Recovered
Red (2)	75	8/2/2024	15:02	Yes
Red (2)	88	8/2/2024	15:02	Yes
Red (2)	76	8/2/2024	15:02	Yes
Red (2)	89	8/2/2024	15:02	Yes
Red (2)	99	8/2/2024	15:02	Yes
Red (2)	97	8/2/2024	15:02	Yes
Red (2)	93	8/2/2024	15:02	Yes
Red (2)	91	8/2/2024	15:02	Yes
Red (2)	105	8/2/2024	15:02	Yes
Red (2)	90	8/2/2024	15:02	Yes
Red (2)	111	8/2/2024	15:02	Yes
Red (2)	103	8/2/2024	15:02	Yes
Red (2)	102	8/2/2024	15:02	Yes
Red (2)	101	8/2/2024	15:02	Yes
Red (2)	101	8/2/2024	15:02	Yes
Red (2)	97	8/2/2024	15:02	Yes
Red (2)	96	8/2/2024	15:02	Yes
Red (2)	96	8/2/2024	15:02	Yes
Red (2)	81	8/2/2024	15:02	Yes
Red (2)	90	8/2/2024	15:02	Yes
Red (2)	127	8/2/2024	15:02	Yes
Red (2)	112	8/2/2024	15:02	Yes
Red (2)	87	8/2/2024	15:02	Yes
Red (2)	101	8/2/2024	15:02	Yes
Red (2)	96	8/2/2024	15:02	Yes
Red (2)	94	8/2/2024	15:02	Yes
Red (2)	97	8/2/2024	15:02	Yes
Red (2)	99	8/2/2024	15:02	Yes
Red (2)	98	8/2/2024	15:02	Yes