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Muddy Run Pumped Storage Project American Eel Collection Facility in Octoraro Creek, 2018

FERC Project No. 2355

Prepared for:

Exelon.

Submitted On:
January 2019

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Table of Contents

Page

EXECUTIVE SUMMARY V

LIST OF ABBREVIATIONS VII

1 INTRODUCTION 1

2 BACKGROUND 2

3 METHODS 3

3.1 DESIGN, CONSTRUCTION, AND INSTALLATION OF FACILITY 3
3.2 DATA COLLECTION 3
3.3 JUVENILE EEL TRANSPORT 3

4 RESULTS 4

4.1 JUVENILE EEL COLLECTION AND LENGTH DISTRIBUTION BY SUBSTRATE TYPE 4
4.2 JUVENILE EEL COLLECTION BY WEEK 4
4.3 PEAK PERIODS OF EEL COLLECTIONS 5
4.4 JUVENILE EEL CATCH IN RELATION TO ENVIRONMENTAL FACTORS 5
4.5 JUVENILE EEL TRANSPORT AND MORTALITY 6
4.6 QUALITY CONTROL ACTIVITIES 6
4.7 OTHER SPECIES CAUGHT 7

5 DISCUSSION 8

6 NEXT STEPS 10

7 REFERENCES 11

8 TABLES AND FIGURES 12

LIST OF APPENDICES:

Appendix A: Conceptual Design of Trapping Facility on South Shore of Octoraro Creek, 2015
Appendix B: Weekly Biological Data and Environmental Conditions for Octoraro Creek, 2018
Appendix C: Weekly Data for 2015-2018
Appendix D: Correspondence to Make Octoraro Creek Eel Facility Permanent
Appendix E: Agency Comments on Draft 2018 Octoraro Creek Eel Ramp Collection Report

List of Tables

Page

Table 4.0-1: Daily Number of Juvenile Eels Caught by Substrate 13
Table 4.1-1: Number of Juvenile Eel Captured and Length Measurements..... 16
Table 4.1-2: Juvenile Eel Length Frequency, 2018 17
Table 4.2-1: Weekly Juvenile Eel Collection by Week and Ranks 18
Table 4.4-1: USGS 01578475 - Octoraro Creek at Richardsmere, MD Gage Flows (cfs) 19
Table 4.4-2: Fraction of Moon Illumination, 2018 EST *(1.0 Equals Full Moon)* 20
Table 4.4-3: Water Temperature (Daily Average, °C) HOBO Water Temp Pro..... 21
Table 4.4-4: Dissolved Oxygen (mg/L) Reading Taken in Collection Tank 22
Table 4.4-5: Water Quality Parameters at Associated Locations at Octoraro Creek, 2018 23
Table 4.5-1: Eel Transport/Stocking Data, 2018..... 25
Table 4.6-1: Calibration of Flows (Gallons per Minute) in the Eel Collection Facility, 2018 26
Table 5.0-1: Comparison of Octoraro Creek Eel Ramps, 2015-2018 27

List of Figures

Page

Figure 2.0-1: Lower Octoraro Creek from Pine Grove Dam to the Mouth at the Susquehanna River, Octoraro Creek (Stone Masonry Dam also Known as Pine Grove Low-Head Dam) 28

Figure 2.0-2: Location of the Juvenile Eel Collection Facility on South Shore (Left Bank) Of Octoraro Creek Downstream of Art Building..... 29

Figure 2.0-3: Peak Timing of Historical Eel Passage at Conowingo, 2008-2016..... 30

Figure 3.2-1: Measuring Juvenile Eels to Nearest Millimeter While Sedated, Octoraro Creek..... 31

Figure 4.2-1: Percent Eel Catch per Week, Octoraro Creek, 2018..... 32

Figure 4.4-1: Weekly Eel Catch to Weekly Average Creek Flow, Octoraro Creek, 2018..... 33

Figure 4.4-2: Weekly Eel Catch to Weekly Average Lunar Fraction, Octoraro Creek, 2018 *(1.0 Equals Full Moon)* 34

Figure 4.4-3: Weekly Eel Catch to Weekly Average Water Temperature, Octoraro Creek, 2018 35

Figure 4.4-4: Comparison of Dissolved Oxygen Readings in Collection Tanks and Head Pond, Octoraro Creek, 2018..... 36

Figure 4.4-5: Weekly Eel Catch to Weekly Average Dissolved Oxygen, Octoraro Creek Eel Facility Collection Tanks, 2018..... 37

Figure 5.0-1: Weekly Catch and Average Creek Flow, Octoraro Creek, 2015-2018 38

Figure 5.0-2: Octoraro Creek Flow in 2018 and Historical Data, Octoraro Creek, 2018. 39

Executive Summary

Exelon Generation Company, LLC (Exelon) received a license from the Federal Energy Regulatory Commission (FERC) on December 22, 2015 for the Muddy Run Pumped Storage Project (Muddy Run Project). An American Eel, *Anguilla rostrata*, Passage Plan (Eel Plan) was developed by Exelon and included as a condition of the Pennsylvania 401 Water Quality Certification (WQC) (DEP File No. EA 36-033; dated December 10, 2014) for the Muddy Run Project, and is a condition of the FERC license for the Muddy Run Project.

Pursuant to the FERC License and the Pennsylvania Department of Environmental Protection (PADEP) 401 WQC, Exelon began operation of a temporary eel trapping facility at Octoraro Creek in 2015. The temporary eel trapping facility at Octoraro Creek operated for three seasons – 2015, 2016, and 2017. An annual report was developed and filed with FERC and resource agencies after each year of operation. On March 1, 2018, FERC issued a letter indicating that the reports met the requirements of the PADEP 401 WQC and U.S. Department of the Interior fishway prescription for the Project. Under this FERC review, and pursuant to the WQC, Exelon is currently consulting with the PADEP to determine a schedule to install and operate a permanent eel trapping facility at this location.

Eels collected in Octoraro Creek were transported to and held at the Conowingo Eel Collection Facility (CECF) at Conowingo Dam and subsequently transported and released at designated points in the Susquehanna River watershed.

The report provides details on the following objectives for the 2018 field investigation:

- Reinstall an eel collection facility on Octoraro Creek immediately downstream of Chester Water Authority's (CWA) Pine Grove Low-Head Dam;
- Operate, maintain, and monitor the eel collection facility (daily or as needed basis) from May 1 through September 15, 2018;
- Collect catch and length data (by substrate type), water quality, stream flow, and moon phase data during the entire sampling period;
- Stock at designated sites or deliver eels collected by the ramps to the CECF at Conowingo Dam;
- Conduct weekly quality control (QC) checks and cleaning of the eel collection facility to maintain proper attraction water flow;
- Document any modifications made to the facility during the course of the season to improve functionality and eel attraction capability.

The facility was installed and placed in service on May 1, 2018. The facility operated a total of 135 days from May 1 to September 15, with monitoring checks occurring on 86 days.

A total of 4,203 juvenile eels were collected; 2,087 from the Enkamat substrate and 2,116 from the Milieu substrate. The greatest number of juvenile eels were collected during a one-day sample on May 16 (1,136 eels and comprised 27.0% of the season total). A single peak occurred between May 14 and 16, accounting for 1,935 of the 4,203 (46.0%) juvenile eels collected at the facility. Four sporadic eel collections (June 2, July 25, August 5, and August 18) accounted for 5.3 to 7.4% of the

eels collected for the season. Over 70% of the juvenile eels collected at this facility occurred during these sporadic collections and the peak period, 7 days (2,969 of the 4,203 eels, 70.6%).

Creek flow and juvenile eel catch appeared to be directly related during the 2018 season. When flows increased, the number of juvenile eels collected also increased. The largest peak in capture occurred during periods of relatively low lunar fraction (new moons), which co-occurred with increases in creek flow.

A total of 4,203 juvenile eels collected at the facility were transported within 48 hours of capture to the CECF at Conowingo Dam where they were held before transport. No eels died at the facility or during transport during the 2018 season (100% survival).

Cleaning and calibration of the facility was performed weekly, except two weeks because of high creek flows. Scrubbing of the barrel that held the pump and the spray bars occurred prior to any calibration. The pump, manifold, and garden hoses were also cleaned or changed as needed during the season.

List of Abbreviations

Agencies/Groups

CWA	Chester Water Authority
CECF	Conowingo Eel Collection Facility
EPAG	Eel Passage Advisory Group
Exelon	Exelon Generation Company, LLC
FERC	Federal Energy Regulatory Commission
PADEP	Pennsylvania Department of Environmental Protection
plant	CWA water treatment plant
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Units of Measure

C	Celsius
cfs	cubic feet per second
DO	dissolved oxygen
gpm	Gallons per minute
km	kilometer
L	Liter
mg/L	milligrams per liter
mm	millimeter
QC	quality control

Miscellaneous

WQC	Water Quality Certification
YSI 550A	YSI Incorporated (water quality measuring device)

1 Introduction

Exelon Generation Company, LLC (Exelon) received a license from the Federal Energy Regulatory Commission (FERC) on December 22, 2015 for the Muddy Run Pumped Storage Project (Muddy Run Project). An American Eel, *Anguilla rostrata,* Passage Plan (Eel Plan) was developed by Exelon and included as a condition of the Pennsylvania 401 Water Quality Certification (DEP File No. EA 36-033; dated 10 December 2014) for the Muddy Run Project, and is a condition of the FERC license for the Muddy Run Project.

The Eel Plan required Exelon to investigate the feasibility of installing and operating a juvenile eel trapping facility on Octoraro Creek. The evaluation was conducted at a location identified on Octoraro Creek immediately downstream of the Chester Water Authority (CWA) Pine Grove Low-Head Dam. This site was approved by the Pennsylvania Department of Environmental Protection (PADEP) and other members of the Eel Passage Advisory Group (EPAG)[1].

Eels collected in Octoraro Creek were transported directly to and held at the Conowingo Eel Collection Facility (CECF) at Conowingo Dam and subsequently transported and released at designated points in the Susquehanna River watershed.

The report provides details relative to the following objectives for the 2018 field investigation:

- Reinstall an eel collection facility on Octoraro Creek immediately downstream of CWA's Pine Grove Low-Head Dam;
- Operate, maintain, and monitor the eel collection facility (daily or as needed basis) from May 1 through September 15, 2018;
- Collect catch and length data (by substrate type), water quality, stream flow, and moon phase data during the sampling period;
- Stock at designated sites or deliver eels collected by the ramps to the CECF at Conowingo Dam;
- Conduct weekly quality control (QC) checks and cleaning of the eel collection facility to maintain proper attraction water flow;
- Document any modifications made to the facility during the course of the season to improve functionality and eel attraction capability.

[1] EPAG members include the Pennsylvania Department of Environmental Protection, United States Fish and Wildlife Service, Pennsylvania Fish and Boat Commission, Maryland Department of Natural Resources, Susquehanna River Basin Commission, and Exelon.

2 Background

Areas of lower Octoraro Creek up to and including the area near CWA's Pine Grove Low-Head Dam were surveyed over a 13 week period from June 16 through September 10, 2014, using fyke nets, red-light headlamps, and fine mesh dip nets (Figure 2.0-1 and Normandeau Associates and Gomez and Sullivan 2014). Based on the information gathered during the 2014 survey, eels were consistently found in the north corner of the spillway adjacent to the Dam, whereas eels did not seem to be as abundant at the downstream sites during the same period. The report recommended that a site near the Dam be considered for future juvenile eel trapping (Normandeau Associates and Gomez and Sullivan 2014). Exelon and EPAG discussed the possibility of utilizing this north corner of the spillway site for the temporary eel collection facility in 2015. However, due to concerns by the CWA relating to existing structures at the site, an alternative site along the south shore of the Pine Grove Low-Head Dam was selected and approved by the CWA and EPAG. The alternative site is located immediately downstream of the Art Building (Figure 2.0-2).

Recent trapping efforts by the United State Fish and Wildlife Service (USFWS) (Minkkinen and Park 2014 and personal communication with USFWS, Christopher Reily, October 27, 2016) on the west shore of the Susquehanna River below Conowingo Dam have shown that the bulk of the juvenile eel migration occurs from May into September with most eels collected in June and July (Figure 2.0-3).

The temporary eel trapping facility adjacent to CWA's small hydroelectric site on Octoraro Creek was operated for three seasons – 2015, 2016, and 2017. An annual report was developed and filed with FERC and resource agencies after each year of operation. On March 1, 2018, FERC issued a letter indicating that the reports met the requirements of the PADEP 401 Water Quality Certification (WQC) and U.S. Department of the Interior fishway prescription for the Project. Under this FERC review, and pursuant to the WQC, Exelon is currently consulting with the PADEP to determine a schedule to install and operate a permanent eel trapping facility at this location.

3 Methods

3.1 Design, Construction, and Installation of Facility

The 2018 trapping facility design was identical to the 2015, 2016, and 2017 temporary trapping facility (Appendix A, Normandeau Associates and Gomez and Sullivan 2015, 2016, and 2018a). Complete designs descriptions can be found in Section 3: Methods in the Normandeau Associates and Gomez and Sullivan 2018a report.

3.2 Data Collection

All sample data, including eel counts and lengths were recorded, verified, tabulated, and entered into an electronic format for each ramp. Water quality and environmental conditions (including stream flow, moon phase, and weather condition) were also recorded, verified, tabulated, and entered into an electronic format during each sampling event.

Length measurements were taken, with a maximum of 25 individuals per substrate (when available) per sampling event. Eels were measured to the nearest millimeter (mm) after being anesthetized (Figure 3.2-1). Actual counts of eels from each substrate collection tank were performed during the 2018 season.

Water quality, temperature and dissolved oxygen (DO), was measured in each of the collection tanks, and also in the head pond near the pump during each sampling event, with a YSI© 550A water quality meter that was calibrated prior to each sampling event. A Hobo Water Temp Pro© monitor was also installed inside the water supply manifold that recorded hourly water temperature. The Hobo monitor was downloaded at season end.

3.3 Juvenile Eel Transport

All juvenile eels that were captured from the Octoraro Creek eel facility were transported to the CECF at Conowingo Dam where they were held before subsequent transport and release at designated locations in the Susquehanna River watershed.

When less than 50 eels were collected during a sampling event, the eels were transported in aerated 19-liter (L) buckets with lids that contained the maximum amount of water to prevent sloshing. When counts of juvenile eels were greater than 50 individuals, a small enclosed transport tank (250 L) that was filled completely to prevent sloshing and equipped with supplemental oxygen to maintain DO levels in the tank, was used.

4 Results

The Exelon juvenile eel trapping facility on Octoraro Creek was installed and put into service May 1 until September 15, 2018.The facility operated 135 days with monitoring checks occurring on 86 days. The period of time from August 13-16 electrical power was off due to a transformer replacement causing the facility to have no running water. Daily checks were initially scheduled, but due to low numbers of individuals (<100 juvenile eels per collection tank/per day) during portions of the sampling season, every other day checks were instituted with the concurrence of the EPAG. The every other day checks occurred from May 12-May 14, May 21-June 4, June 6–July 24, July 28-August 12, August 16-18, and August 19 through season end (September 15). The greatest number of juvenile eels was collected on May 16 (1,136 eels and comprised 27.0% of the season total). A total of 4,203 juvenile eels were collected during the 2018 season (Table 4.0-1).

4.1 Juvenile Eel Collection and Length Distribution by Substrate Type

Enkamat

Of the 4,203 juvenile eels collected, 49.7% (2,087 eels) were caught in the ramp containing Enkamat substrate (Table 4.1-1). The average length of 688 juvenile eels that were caught and measured from this substrate was 135 mm, with a median size of 134 mm. The length of juvenile eels ranged from 100-178 mm. No juvenile eels measured less than 100 mm and two eels measured greater than 175 mm (Table 4.1-2). The highest one-day total of 469 juvenile eels occurred on May 16 (Table 4.0-1). For the 2018 season, only seven (roughly 8%) of the monitoring checks for the Enkamat substrate recorded juvenile eel numbers greater than 100 individuals.

Milieu

A total of 2,116 (50.3% of 4,203) juvenile eels were collected in the ramp with the Milieu substrate (Table 4.0-1 and Table 4.1-1). The average length of 608 juvenile eels caught and measured by this substrate was 149 mm, with a median size of 146 mm. The smallest eel caught was 114 mm; the largest was 259 mm (Table 4.1-1). No juvenile eels using this substrate measured less than 100 mm, but 40 juvenile eels measured greater than 175 mm (Table 4.1-2). The highest one-day collection of juvenile eels occurred on May 16 with 667 individuals (Table 4.0-1). For the 2018 season, only five (roughly 6%) of the monitoring checks for the Milieu substrate recorded juvenile eel numbers greater than 100 individuals.

4.2 Juvenile Eel Collection by Week

The majority (49.3%, 2,072 individuals) of the juvenile eels were caught during Week 3 (May 13-19, Table 4.2-1 and Figure 4.2-1). A total of 854 juvenile eels were collected in the Enkamat substrate during this week, accounting for 40.9% of the season total for that substrate type. A total of 1,218 juvenile eels were collected from the Milieu substrate during the same week accounting for 57.6% of the total eels collected during the season for that substrate type.

Week 13 (July22-28), Week 6 (June 3-9), and Week 15 (August 5-11) of sampling collected the next greatest percentage of eels, 11.0% (464 individuals), 9.7% (407 individuals) and 9.4% (393 individuals), respectively (Table 4.2-1 and Figure 4.2-1).Weeks 16, 4, and 5 ranked fifth, sixth, and seventh, respectively, in numbers of eels caught and were the only three other weeks that collected

over 100 eels. Seven of the weeks (35%) collected less than 20 eels per week, which included the Weeks 1, 8-12, and 18. Weekly catch data are also provided in Appendix B.

4.3 Peak Periods of Eel Collections

During the season, there was one obvious peak period that occurred over a two or three day period. This peak period occurred between May 14 and 16, and accounted for 1,935 of the 4,203 (46.0%) juvenile eels collected at the facility (Table 4.0-1).

Other than the peak period, four sporadic eel collection samples accounted for 5.3 to 7.4% of the eels collected for the season. Three of these four samples (June 2nd, August 5th, and August 18th) were every other day checks, and the July 25th sample was a daily check. Over 70% of the juvenile eels collected at this facility occurred during the peak period and the four sporadic checks, 7 days (2,969 of the 4,203, 70.6%).

4.4 Juvenile Eel Catch in Relation to Environmental Factors

See Appendix B for weekly averages of juvenile eel capture, river flow, lunar fraction, water temperature, and DO.

Creek Flow

Creek flow and juvenile eel catch appeared to be directly related during the 2018 season. When flows increased, the number of juvenile eels collected also increased. The United States Geological Survey (USGS) 01578475 Octoraro Creek near Richardsmere, MD gage is located approximately 21 kilometers (km) downstream of CWA's Pine Grove Low-Head Dam. The highest daily average creek flow value per the USGS gage station occurred on August 13, 2018 (2,370 cubic feet per second, cfs, Table 4.4-1). During the 2018 season, the daily average Octoraro Creek flow value was above 1,000 cfs recorded on seven days, three days over 2,000 cfs. Week 3 had the second highest average weekly flows (822.6 cfs) and recorded 2,072 juvenile eels collected, the greatest number of eels captured in a single week (Figure 4.4-1). Two of the lowest daily average creek flow weeks (Weeks 10 and 11) correspond with the two lowest eel collection weeks, 0 and 1 eel captured, respectively. An increase of creek flow typically corresponds to increases in juvenile eel collection for this time period, but higher catch numbers during periods without an increase of flow may be a function of other variables (e.g., migration timing).

Lunar Cycle

The largest peak in eel abundance (Week 3) also occurred near the new moon (Table 4.4-2 and Figure 4.4-2, U.S Naval Observatory website 2018). During Weeks 7 and 11, ranked second and third darkest weeks, only 55 and 1 eel, respectively were captured. Increases in stream flow and the lower illuminance associated with a new moon have been reported to be associated with increases in eel catch at eel traps (Welsh *et al*. 2015 and Schmidt *et al*. 2009).

Water Temperature

Water temperature and eel catch did not appear to be related this season. Over the course of the study, the average weekly water temperature ranged from a high of 25.9°C during Week 15 to a low of 15.3°C during Week 1 (Table 4.4-3 and Figure 4.4-3). The Hobo Water Temp Pro monitor was used for the daily average temperature.

Dissolved Oxygen

Eel collection numbers and DO did not appear to be related this season. Dissolved oxygen is recorded as milligrams/Liter (mg/L). The data indicated that the water above the dam was not stratified and the readings were similar to those observed in the collection tanks prior to the installation of the aerator which occurred on June 20, except during the high eel collection day of May 16 (Figure 4.4-4). Detailed DO readings are presented in Table 4.4-4 and Table 4.4-5 and weekly averages are displayed in Figure 4.4-5. Measurements of DO were usually taken in the morning when the lowest DO would be more likely to be observed.

4.5 Juvenile Eel Transport and Mortality

See Table 4.5-1 for detailed information of transport, and mortality data.

Transport

Juvenile eels collected at the Octoraro Creek eel facility were transported within 48 hours of capture. Transport time from Octoraro Creek Eel Facility to the CECF at Conowingo Dam was about 30 minutes.

Mortality

Of the 4,203 juvenile eels that were captured at this facility, no eels were found dead in the collection tank (100% survival). All juvenile eels were observed to be free of fungus. Injuries were observed on two eels from the Milieu collection tank during the 2018 season, one eel had a bruise around mid-body (May 23) while another eel had a sore around the vent (August 18).

4.6 Quality Control Activities

Cleaning and calibration activities were conducted at least weekly during the season, except for two different weeks. Scrubbing of the barrel housing the pump, along with the spray bars, was performed prior to performing any calibrations. Garden hoses, pump, barrel, and the manifold were cleaned as needed during the season. Quality control was also performed on the volumetric eel estimates.

Calibration of the ramp flow was executed each week after cleaning, using a 4-gallon graduated bucket. Three different locations of each ramp were checked for calibration purposes - the spray bar, the collection tank drain, and the additional attraction flows at the entrance of each ramp. The attraction flow at the top of the ramp (top attraction flow) was calculated by subtracting the spray bar amount from the drain of the collection tank. Details and calibration records are listed in Table 4.6-1.

The amount of algae growth within the hoses and spray bar increased throughout the season. In an effort to increase the flow of attraction water to the ramps, the pump was exchanged six times during the 2018 season. The pump was exchanged with the same horsepower and model submersible pump on May 18, June 14, July 24, and August 16, 2018. The two other times it was exchanged with a larger, one horsepower submersible pump on September 2 and 11. Three of the above exchanges (May 18, September 2, and 11) occurred after high flow events that left the barrel and the pump out of water causing the pump to overheat. When a pump was exchanged, the inside

of the barrel was cleaned of caddisfly casings and biofilm. The attraction flow hoses were replaced or snaked clean on two days when the pump was replaced. On four other occurrences (May 23, June 6, July 6, and August 8), the hoses were cleaned without exchanging the pump.

Calibrations were not performed during two weeks of the season due to high creek flows. Between May 14-18 and August 20-24, the creek flow was too high to calibrate the eel facility. The additional attraction flows at the entrance of the ramp were underwater and it was unsafe to obtain flows during these weeks.

Volumetric eel estimates were not performed at the juvenile eel facility at Octoraro Creek in 2018 since daily eel collections were relatively light during the sample period.

4.7 Other Species Caught

Three additional aquatic species were caught in addition to American Eel. Four River Crayfish (Cambaridae family) were netted from the collection tank of the Enkamat substrate on four occasions during the season. Fourteen River Crayfish were netted from the collection tank of the Milieu substrate on ten occasions during the season. A Green Frog (*Lithobates clamitans*) was also removed from the Enkamat substrate collection tank on May 2, 2018. A Stinkpot Turtle (*Sternotherus odoratus*) was removed from the Milieu substrate collection tank on June 26, 2018.

5 Discussion

The CECF at Conowingo Dam has one Enkamat ramp compared to the Octoraro Creek eel facility which contains one Enkamat and one Milieu ramp. Both ramps operated simultaneously (May 1 – September 15), Conowingo's facility captured 67,949 eels compared to the Octoraro Creek eel facility that captured 4,203 juvenile eels during the 2018 season. With both ramps operating simultaneously, the Octoraro Creek facility captured roughly 6% of the number of eels collected by the CECF at Conowingo Dam. During this time, the size range of the juvenile eels caught at the CECF at Conowingo Dam facility was 84-173 mm with an average length of 121.6 mm (Normandeau Associates, Inc. 2018). The size of the juvenile eels caught in the ramp with the Enkamat substrate at the Octoraro Creek eel facility was similar with a size range of 100-178 mm and an average length of 135 mm. Juvenile eels that were captured using the Milieu substrate were larger (average size 149 mm), but this substrate did not capture any eels under 114 mm and captured eels as large as 259 mm. Overall, the ramps at the Octoraro Creek eel facility collected a wider size range of eels, but the CECF at Conowingo Dam collected much smaller eels. No eels died in the collection tank or during transport from the Octoraro Creek facility to the CECF.

The attraction flow to the ramps during the season was less than the design specifications for the system although the pump was sized to meet the specified parameters. The design specifications of the ramps were to have a total attraction flow of 210-230 L/min, (55-60 gpm) and the actual total attraction flows were between 17.4 and 25.0 gallons per minute (average 21.6 gpm). The distance that the pump must push the source water to the facility may be the reason for the lower attraction flow volume. The hardiness of this species and its ability to adjust to parameters outside of those developed was evidenced by the numbers captured here.

The scaffolding, collection tanks, and hoses are not shaded at this time. Collections tanks were cleaned, hoses inspected, and spray bars checked during each sample to ensure flow. Due to the algae build up inside the hoses, a routine (weekly) or as needed clean-out of the hoses and manifolds helped maintain a more consistent attraction flow.

Water temperature and DO readings were taken on sample days in the head pond at the pump level. The data indicated that the water above the dam was not stratified and these readings were similar to those observed in the collection tanks prior to the installation of the aerator which occurred on June 20, 2018 except during the high eel collection day of May 16, 2018 (Table 4.4-4 and Table 4.4-5).

The average creek flow value per the USGS gage station was considerably higher in 2018 than the prior three years. The average creek flow in 2018 was 411 cfs compared to the average creek flow value of 167, 121, and 138 cfs in 2015, 2016, and 2017, respectively (Table 4.4-1 and Normandeau Associates and Gomez and Sullivan 2015, 2016, and 2018a). From 2015-2017 the daily average creek flow only reached above 1,000 cfs once (in 2015) compared to nine times in 2018. In 2018, the daily average creek flow was below 100 cfs for only four days compared to 24, 65, and 46 days in 2015, 2016, and 2017, respectively. Similar to the 2015 and 2017 season, the small hydro was operated earlier in the year than later. CWA operated this facility on 23 of the 86 monitoring check days this year, but not after July 2 (Table 4.0-1). With the creek flow well above normal on some monitoring check days, water was flowing across the entire dam all season (Appendix A). With the higher

average creek flow in 2018 the ramp entrance was farther out into the flow and deeper in the water column compared to previous years.

Since 2015, when the flow in the creek has increased, the catch of juvenile eels has also increased within a few days of the flow increase. The average creek flow in 2018 was substantially greater than any other year and has a larger range of creek flow throughout the season (Table 5.0-1). Figure 5.0-1 shows comparison of 2015 through 2018 weekly catch and average creek flow data. In 2016, 2017, and 2018 the high flow events co-occurred with a new moon phase. See Appendix C for additional weekly data comparing 2015, 2016, and 2017. During the 2018 Octoraro Creek eel season, Octoraro Creek had a higher than normal creek flow (Figure 5.0-2). The creek flow during the season very rarely fell below the median creek flow. A pulse of eels was evident in the collection tanks at the eel facility shortly after an episode of increased flow in early May. The average size of eels has also increased over the four years by twelve mm (129.4 to 141.6 mm), and about six mm over the last year, Table 5.0-1). The Octoraro Creek eel ramp caught juvenile eels less than or equal to 100 mm every year. The size range of these eels has been roughly the same except some much larger eels were captured in 2017 and 2018 with the Milieu ramp.

During the 2018 season the Octoraro facility was interrupted with short term breaks in operation. A transformer was replaced from August 14-16 that powers the CWA water treatment plant (plant); the plant was under generator power during this time. When the plant is under generator power, the left bank of the Octoraro Creek (Chester County side) does not have power which powers the pump for the eel facility. Eels were removed on August 13 and the pump was unplugged and left this way until we were allowed to reenter the area on August 16. On August 27, the eel facility was out of power from 0900 to 1200 hours due to the plant operating on generators for a PADEP air quality inspection. From August 28 to 30, the plant was on generator power from 0600 to 1500 hours for a reactor removal project. The pump was not unplugged from August 27 to 30, so when power was restored to the left bank of Octoraro Creek the attraction flow was automatically restarted. One additional interruption in power to the left bank of the Octoraro Creek occurred on July 26 from 0755 to 1500 hours, when power was shut off to inspect the transformer. The facility was inspected at 1530 hours to insure water was supplying the eel facility. Three high flow events (May 18, September 1, and September 9) caused the screened barrel and pump to be dislodged from the forebay resulting in lost attraction flow to the eel facility when the water receded. When the eel facility was checked soon after these high flow events the pump was replaced when flows allowed for a safe exchange. No mortality was observed due to the above events in 2018.

6 Next Steps

The next steps for the Octoraro Creek Eel Facility is dependent on the agreement between Chester Water Authority and Exelon. See Appendix D for individual correspondence associated with the chronical timeline listed below.

- May 18th: Suggested Modifications to the Octoraro Eel Ramp for Conversion to a Permanent Facility;
- May 25th: Alex Haro's Octoraro Eel Pass Review;
- July 18th: Letter sent to Sharon Fillman (CWA) and passed onto CWA's legal team for review and comment;
- October 31st: Meeting between CWA, Exelon, and Exelon's legal team to discuss the upgrades;

The comments from the discussion on October 31, 2018 meeting will be reviewed by CWA's board of directors. The CWA has requested that Exelon provide more detailed drawings of the facility upgrades and a power point presentation during their monthly board meeting in December 2018.

7 References

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8 Tables and Figures

Table 4.0-1: Daily Number of Juvenile Eels Caught by Substrate

Date	Substrate Type		Total
	Enkamat	Milieu	
5/1/2018	-	-	-
5/2/2018	-	-	-
5/3/2018 *	-	-	-
5/4/2018 *	4	-	4
5/5/2018 *	1	-	1
5/6/2018 *	3	-	3
5/7/2018	5	1	6
5/8/2018 *	4	1	5
5/9/2018 *	1	-	1
5/10/2018 *	4	-	4
5/11/2018 *	5	3	8
5/12/2018 *	4	-	4
5/14/2018 *	**154**	**287**	**441**
5/15/2018	**169**	**189**	**358**
5/16/2018	**469**	**667**	**1136**
5/17/2018	7	28	35
5/18/2018	1	-	1
5/19/2018 *	54	47	101
5/20/2018 *	29	7	36
5/21/2018	14	3	17
5/23/2018	18	5	23
5/25/2018	13	12	25
5/27/2018	3	10	13
5/29/2018	40	15	55
5/31/2018	17	7	24
6/2/2018	13	10	23
6/4/2018	**162**	**105**	**267**
6/5/2018	18	19	37
6/6/2018	5	12	17
6/8/2018	45	41	86
6/10/2018 *	-	-	-
6/12/2018 *	12	26	38
6/14/2018 *	8	1	9
6/16/2018	-	8	8
6/18/2018 *	-	-	-
6/20/2018 *	-	-	-
6/22/2018 *	2	1	3
6/24/2018 *	-	-	-
6/26/2018 *	-	-	-
6/28/2018 *	-	-	-
6/30/2018 *	3	1	4

Table 4.0-1. (Continued)

Date	Substrate Type		Total
	Enkamat	Milieu	
7/2/2018 *	-	-	-
7/4/2018	-	-	-
7/6/2018	-	-	-
7/8/2018	-	1	1
7/10/2018	-	-	-
7/12/2018	-	-	-
7/14/2018	-	-	-
7/16/2018	-	-	-
7/18/2018	10	-	10
7/20/2018	1	-	1
7/22/2018	20	13	33
7/24/2018	7	1	8
7/25/2018	**127**	96	**223**
7/26/2018	90	75	165
7/27/2018	12	10	22
7/28/2018	7	6	13
7/30/2018	4	1	5
8/1/2018	2	1	3
8/3/2018	8	13	21
8/5/2018	**173**	**136**	**309**
8/6/2018	2	14	16
8/8/2018	-	2	2
8/10/2018	25	41	66
8/12/2018	33	8	41
8/13/2018	17	50	67
8/16/2018	-	-	-
8/18/2018	**179**	56	**235**
8/19/2018	10	2	12
8/21/2018	5	2	7
8/23/2018	12	39	51
8/25/2018	1	2	3
8/27/2018	2	-	2
8/28/2018	-	-	-
8/29/2018	-	-	-
8/30/2018	-	-	-
8/31/2018	-	-	-
9/1/2018	2	1	3
9/3/2018	15	11	26
9/4/2018	13	4	17
9/5/2018	3	3	6
9/7/2018	13	7	20

Table 4.0-1. (Continued)

Date	Substrate Type		Total
	Enkamat	Milieu	
9/9/2018	6	8	14
9/11/2018	-	2	2
9/13/2018	1	4	5
9/15/2018	-	1	1
	2087	**2116**	**4203**

* Indicates when hydro was operating
Bolded numbers are peak days
The peak periods are shown in boxes

Table 4.1-1: Number of Juvenile Eel Captured and Length Measurements

Substrate	Enkamat	Milieu	Total
Number eels collected	2,087	2,116	4,203
% per substrate	49.7%	50.3%	
Range on lengths (mm)	100 - 178	114 - 259	
Average length (mm)	135	149	
Number measured	688	608	1,296

Table 4.1-2: Juvenile Eel Length Frequency, 2018

TL (mm)	Enkamat	Milieu	Total
90-94	-	-	-
95-99	-	-	-
100-104	3	-	3
105-109	9	-	9
110-114	16	1	17
115-119	43	5	48
120-124	79	12	91
125-129	97	28	125
130-134	116	67	183
135-139	91	80	171
140-144	88	88	176
145-149	48	78	126
150-154	37	60	97
155-159	28	54	82
160-164	15	33	48
165-169	10	31	41
170-174	3	25	28
175-179	5	19	24
180-184	-	7	7
185-189	-	4	4
190-194	-	5	5
195-199	-	4	4
200-204	-	2	2
205-209	-	-	-
210-214	-	1	1
215-219	-	-	-
220-224	-	-	-
225-229	-	1	1
230-234	-	1	1
235-239	-	-	-
240-244	-	1	1
245-249	-	-	-
250-254	-	-	-
255-259	-	1	1
Total	**688**	**608**	**1,296**

Table 4.2-1: Weekly Juvenile Eel Collection by Week and Ranks

	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10
Enkamat	5	26	854	74	73	230	20	2	3	0
Milieu	0	5	1218	27	42	177	35	1	1	0
Total	5	31	2072	101	115	407	55	3	4	0
Rank	T-15	11	1	7	6	3	10	18	17	20
# Sampling Days	5	7	6	4	4	4	4	3	4	3

	Wk 11	Wk 12	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	Wk 18	Wk 19	Wk 20
Enkamat	0	11	263	14	200	229	28	4	44	7
Milieu	1	0	201	15	193	114	45	1	25	15
Total	1	11	464	29	393	343	73	5	69	22
Rank	19	14	2	12	4	5	8	T-15	9	13
# Sampling Days	4	3	6	3	4	4	4	6	4	4

Top 3 ranked weeks are shown in boxes.

Wk 1: May 1 - May 5
Wk 2: May 6 - May 12
Wk 3: May 13 - May 19
Wk 4: May 20 - May 26
Wk 5: May 27 - June 2
Wk 6: June 3 - June 9
Wk 7: June 10 - June 16
Wk 8: June 17 - June 23
Wk 9: June 24 - June 30
Wk 10: July 1 - July 7
Wk 11: July 8 - July 14
Wk 12: July 15 - July 21
Wk 13: July 22 - July 28
Wk 14: July 29 - August 4
Wk 15: August 5 - August 11
Wk 16: August 12 - August 18
Wk 17: August 19 - August 25
Wk 18: August 26 - September 1
Wk 19: September 2 - September 8
Wk 20: September 9 - September 15

Table 4.4-1: USGS 01578475 - Octoraro Creek at Richardsmere, MD Gage Flows (cfs)

Day	May	June	July	August	September
1	212	280	169	166	**1450**
2	203	538	160	197	441
3	201	**1180**	158	217	357
4	156	664	127	642	321
5	153	440	138	438	292
6	153	361	149	258	319
7	152	324	155	245	303
8	150	339	142	374	**1610**
9	149	325	136	455	**2170**
10	156	298	132	342	**1340**
11	153	501	126	98	724
12	88	460	118	282	731
13	262	333	112	**2370**	766
14	747	298	97	668	490
15	523	270	93	557	379
16	532	256	105	156	
17	**2310**	247	126	263	
18	611	239	286	337	
19	773	235	161	369	
20	766	221	124	776	
21	516	228	113	490	
22	471	222	349	**1920**	
23	546	227	**1430**	469	
24	409	229	737	308	
25	351	227	907	106	
26	330	203	583	191	
27	315	186	335	280	
28	304	160	248	280	
29	296	186	207	273	
30	284	179	181	264	
31	278		170	707	

Bolded values represent the average river flows over 1,000 cfs

*Daily average river flows are represented in cubic feet per second (cfs)

Table 4.4-2: Fraction of Moon Illumination, 2018 EST *(1.0 Equals Full Moon)*

Day	May	June	July	August	September
1	0.98	0.94	0.92	0.83	0.70
2	0.95	0.88	0.86	0.75	0.60
3	0.90	0.82	0.79	0.66	0.49
4	0.84	0.74	0.71	0.56	0.38
5	0.76	0.65	0.61	0.45	0.27
6	0.68	0.56	0.51	0.34	0.17
7	0.58	0.46	0.41	0.24	0.09
8	0.49	0.36	0.31	0.15	0.03
9	0.39	0.26	0.21	0.07	0.00
10	0.30	0.17	0.12	0.02	0.00
11	0.21	0.10	0.06	0.00	0.03
12	0.13	0.04	0.01	0.01	0.08
13	0.07	0.01	0.00	0.05	0.15
14	0.02	0.00	0.02	0.11	0.24
15	0.00	0.03	0.07	0.19	0.33
16	0.01	0.08	0.14	0.29	
17	0.04	0.16	0.23	0.39	
18	0.10	0.26	0.33	0.49	
19	0.19	0.36	0.44	0.59	
20	0.28	0.47	0.54	0.68	
21	0.39	0.58	0.64	0.77	
22	0.51	0.68	0.73	0.84	
23	0.62	0.78	0.82	0.91	
24	0.72	0.85	0.88	0.95	
25	0.81	0.92	0.94	0.98	
26	0.88	0.96	0.98	1.00	
27	0.94	0.99	1.00	0.99	
28	0.98	1.00	1.00	0.97	
29	1.00	0.99	0.98	0.93	
30	1.00	0.96	0.95	0.87	
31	0.97		0.90	0.79	

Table 4.4-3: Water Temperature (Daily Average, ˚C) HOBO Water Temp Pro

Day	May	June	July	August	September
1	14.0	21.9	25.2	24.9	23.2
2	14.6	21.9	25.1	24.5	24.1
3	15.8	20.3	25.7	25.3	24.4
4	16.0	20.6	25.4	25.3	25.1
5	16.2	20.3	27.7	26.4	25.6
6	14.5	20.3	26.1	27.3	25.3
7	15.3	19.9	24.2	26.4	24.9
8	16.2	20.2	24.8	25.7	22.7
9	16.3	21.5	25.8	25.1	14.8
10	15.7	21.1	27.2	24.8	16.3
11	16.4	19.4	26.3	25.4	18.4
12	16.8	19.7	24.5	25.2	19.0
13	19.1	20.9	25.0	24.1	19.3
14	18.0	22.2	24.6	*	19.4
15	18.6	20.3	23.4	*	20.1
16	19.6	22.0	26.2	25.6	
17	18.9	23.7	26.3	25.2	
18	17.7	24.2	26.0	25.3	
19	17.1	25.2	26.3	25.0	
20	18.4	22.0	25.9	23.8	
21	18.9	23.1	23.0	23.4	
22	18.2	20.6	23.8	23.0	
23	19.8	19.7	24.6	22.6	
24	20.0	23.8	24.6	22.4	
25	19.6	22.0	24.2	21.9	
26	20.8	20.4	25.2	22.7	
27	21.8	19.8	24.8	24.2	
28	20.9	22.6	25.2	28.0	
29	21.5	24.0	25.5	27.2	
30	21.0	24.7	24.4	27.2	
31	20.7		24.3	24.8	

*Ramp was out of service between 8/13 and 8/16, due to transformer replacement

Table 4.4-4: Dissolved Oxygen (mg/L) Reading Taken in Collection Tank

Day	May	June	July	August	September
1	8.7			6.9	6.7*
2	9.8	8.5	5.7		
3	8.6			5.9	4.1
4	9	8.3	7.1		6.8
5	8.1	9.1		6.2	6.4
6	8.5	7.7	7.1	5.4	
7	6.8				7.0
8	7.7	7.2	7.7	6.9	
9	7.8				*
10	7.6	6.1	7.8	6.4	
11	7.4				10.2
12	8.2	8.3	5.2	5.6	
13				7.8	10.0
14	8.7	7.8	5.3		
15	7.2				10.3
16	4.3	7.2	7.2	*	
17	8.8				
18	*	7.2	7.2	6.2	
19	8.5			7.0	
20	9.6	5.6	6.8		
21	9.5			6.3	
22		7.6	7.5		
23	9.6			4.7	
24		7.8	8.4		
25	9		7.2	5.0	
26		6.4	7.5		
27	8.8		7.3	6.3	
28		7.3	6.9	8.55*	
29	7.7			5.3*	
30		6.4	6.8	*	
31	6.7			5.0*	

* No water running when arrived or restarted pump
Underlined is when aeration was started

Table 4.4-5: Water Quality Parameters at Associated Locations at Octoraro Creek, 2018

Date	Time	Enkamat		Milieu		Head Pond	
		Temp	DO	Temp	DO	Temp	DO
5/1/2018	640	12.4	8.7	12.5	9.4	12.7	9.4
5/2/2018	745	12.8	9.8	12.7	6.9	12.7	7.5
5/3/2018	738	13.8	8.6	13.7	8.6	13.5	8.3
5/4/2018	731	15.1	9.0	15.0	9.0	15.0	8.8
5/5/2018	1115	15.3	8.1	15.2	8.3	15.2	8.9
5/6/2018	738	14.4	8.5	14.4	8.6	14.4	7.9
5/7/2018	816	14.0	6.8	13.9	7.6	14.0	6.7
5/8/2018	745	14.1	7.7	14.1	7.9	14.1	7.0
5/9/2018	845	14.5	7.8	14.4	7.9	14.4	7.3
5/10/2018	1018	15.1	7.6	15.2	7.7	15.0	7.3
5/11/2018	727	15.1	7.4	15.0	7.5	15.1	6.7
5/12/2018	732	16.1	8.2	15.9	7.6	16.0	7.2
5/14/2018	758	17.6	8.7	17.4	4.6	17.5	9.0
5/15/2018	645	18.6	7.2	18.5	6.7	18.6	8.6
5/16/2018	915	19.9	4.3	19.8	3.2	19.8	8.6
5/17/2018	900	17.8	8.8	18.0	8.8	17.8	8.7
5/19/2018	735	17.4	8.5	17.3	8.6	17.7	8.5
5/20/2018	745	17.1	9.6	17.2	9.2	16.8	9.4
5/21/2018	845	18.0	9.5	18.0	9.7	18.0	9.7
5/23/2018	855	18.5	9.6	18.6	9.5	18.5	9.6
5/25/2018	800	19.2	9.0	19.1	9.2	19.3	9.1
5/27/2018	845	21.8	8.8	21.8	8.2	21.6	8.2
5/29/2018	810	20.9	7.7	20.8	8.0	20.8	7.0
5/31/2018	800	20.9	6.7	20.8	6.9	20.9	6.5
6/2/2018	1045	22.0	8.5	22.4	8.4	21.4	8.8
6/4/2018	1050	20.5	8.3	20.4	8.2	20.4	8.8
6/5/2018	830	19.5	9.1	19.4	9.2	19.6	8.1
6/6/2018	1120	20.5	7.7	20.6	7.7	20.4	7.4
6/8/2018	800	20.0	7.2	20.0	7.2	20.1	7.3
6/10/2018	830	21.7	6.1	21.7	6.2	21.7	6.1
6/12/2018	950	20.1	8.3	20.2	8.1	19.9	7.7
6/14/2018	925	20.8	7.8	20.8	8.1	20.7	7.5
6/16/2018	900	20.2	7.2	20.2	7.4	20.3	6.8
6/18/2018	900	21.7	7.2	21.6	7.2	21.2	5.8
6/20/2018	743	21.4	5.6	21.3	6.1	21.2	3.8
6/22/2018	830	21.7	7.6	21.7	7.8	21.5	4.9
6/24/2018	1030	21.8	7.8	21.7	7.6	21.4	6.3
6/26/2018	915	20.7	6.4	20.7	6.5	20.6	5.1
6/28/2018	808	20.2	7.3	20.3	7.3	19.9	4.1
6/30/2018	730	22.5	6.4	22.6	6.3	22.7	4.6
7/2/2018	825	22.2	5.7	22.2	6.8	22.0	4.3

Table 4.4-5 (Continued)

Date	Time	Enkamat		Milieu		Head Pond	
		Temp	DO	Temp	DO	Temp	DO
7/4/2018	700	23.9	7.1	23.9	7.1	24.0	4.8
7/6/2018	905	26.1	7.1	26.2	7.2	26.0	6.3
7/8/2018	705	23.5	7.7	23.6	6.8	23.4	5.2
7/10/2018	1030	25.6	7.8	25.7	7.8	24.7	6.1
7/12/2018	900	24.7	5.2	24.4	6.7	24.8	4.0
7/14/2018	738	23.7	5.3	23.6	6.1	23.8	3.7
7/16/2018	855	24.5	7.2	24.5	7.2	24.5	5.2
7/18/2018	800	26.0	7.2	25.9	7.4	26.4	6.6
7/20/2018	745	24.9	6.8	25.1	6.4	25.2	4.2
7/22/2018	738	24.0	7.5	24.1	7.4	24.2	6.7
7/24/2018	1131	24.3	8.4	24.2	8.4	24.0	8.6
7/25/2018	1145	24.1	7.2	24.0	7.1	24.0	6.3
7/26/2018	945	23.9	7.5	23.8	7.4	23.8	5.4
7/27/2018	815	24.5	7.3	24.6	7.5	23.9	6.1
7/28/2018	745	24.5	6.9	24.5	7.0	24.6	6.6
7/30/2018	830	24.8	6.8	24.9	6.3	24.9	5.4
8/1/2018	900	24.9	6.9	25.0	6.8	24.5	6.6
8/3/2018	855	25.1	5.9	25.1	6.1	25.0	4.9
8/5/2018	730	25.2	6.2	25.1	6.2	25.2	5.4
8/6/2018	900	25.6	5.4	25.5	5.6	25.5	4.7
8/8/2018	810	24.3	6.9	24.3	6.7	24.2	6.8
8/10/2018	740	24.0	6.4	24.0	6.3	24.1	5.6
8/12/2018	740	26.4	5.6	26.3	5.8	26.6	4.7
8/13/2018	827	22.5	7.8	22.6	7.8	22.3	7.7
8/18/2018	800	25.0	6.2	25.0	6.4	25.0	5.4
8/19/2018	740	25.1	7.0	25.2	7.1	25.2	7.2
8/21/2018	920	23.5	6.3	23.5	6.5	23.4	4.4
8/23/2018	820	22.3	4.7	22.3	5.1	22.5	4.6
8/25/2018	730	21.2	5.0	21.3	5.1	21.5	4.4
8/27/2018	1130	22.2	6.3	22.3	6.4	22.2	6.0
8/28/2018	800	23.3	8.6	23.3	8.5	23.6	7.2
8/29/2018	1140	28.2	5.3	28.2	5.3	24.8	6.2
8/31/2018	800	25.1	5.0	25.1	5.2	25.1	5.2
9/1/2018	730	23.4	6.7	23.5	6.8	23.5	5.5
9/3/2018	930	23.7	4.1	23.6	4.2	23.5	9.5
9/4/2018	800	23.5	6.8	23.4	6.7	23.8	6.8
9/5/2018	1030	25.4	6.4	25.3	6.5	24.6	5.1
9/7/2018	835	24.6	7.0	24.6	6.9	24.6	7.1
9/11/2018	900	18.6	10.2	18.6	10.1	18.4	10.3
9/13/2018	830	19.8	10.0	19.0	9.2	18.7	10.7
9/15/2018	830	20.5	10.3	20.6	10.3	20.4	7.8

*6/20/18, started using the aerator and continued until the end of the season

Table 4.5-1: Eel Transport/Stocking Data, 2018

Location of Capture	Collected	Died in Collection	Died in Holding	Transported	Removed for Analysis	Removed for SRBC	Stocked
Octoraro Creek Collection tanks	4,203	0 (0.00%)					
Transported to Conowingo Eel Collection Facility	4,203			0 (0.00%)			4,203
Conowingo Collection tank	67,949	8 (0.01%)	**2,176 *(3.21%)***		93	60	65,612
Total Transported from Conowingo Eel Collection Facility	**69,815**			**12 (0.02%)**			**69,803**

Bolded value is assumed as worst case, could be eels from Octoraro or Conowingo

Table 4.6-1: Calibration of Flows (Gallons per Minute) in the Eel Collection Facility, 2018

	DATE									
	4/30	**5/4**	**5/11**	**5/23 ***	**5/29**	**6/6 ***	**6/14 ****	**6/20**	**6/28**	**7/6 ***
Enkamat Ramp										
Spray bar	4.3	4.3	4.5	5.2	5.8	4.1	4.7	4.0	3.2	4.8
Collection tank drain	1.6	1.0	0.8	1.3	0.4	0.4	0.8	0.6	0.4	0.5
Top Attraction flow	2.7	3.3	3.7	3.8	5.3	3.7	3.9	3.4	2.7	4.3
Bottom Attraction flow	7.4	5.9	6.9	6.6	6.2	6.7	6.7	5.5	7.1	5.4
Total Attraction flow	11.7	10.3	11.4	11.8	12.0	10.7	11.4	9.5	10.3	10.2
Milieu Ramp										
Spray bar	4.3	4.2	4.5	4.9	5.3	4.1	4.7	3.8	3.0	4.8
Collection tank drain	1.1	0.8	0.6	0.4	0.4	0.4	0.5	0.6	0.4	0.5
Top Attraction flow	3.2	3.4	3.9	4.5	4.8	3.6	4.2	3.2	2.6	4.3
Bottom Attraction flow	7.2	8.1	7.1	8.2	7.4	8.1	7.4	7.4	8.0	5.3
Total Attraction flow	11.5	12.3	11.6	13.0	12.7	12.2	12.1	11.2	11.0	10.1
Overall Attraction flows	**23.3**	**22.5**	**23.0**	**24.8**	**24.7**	**22.9**	**23.5**	**20.7**	**21.3**	**20.3**

Creek flows too high to calibrate (May 14-18), pump changed on 5/18
* Cleaned hoses to increase flow
** Pump was changed/cleaned to increase flow

	DATE								
	7/12	**7/18**	**7/24 ****	**8/1**	**8/8 ***	**8/16 ****	**8/31**	**9/5 ****	**9/11 ****
Enkamat Ramp									
Spray bar	3.1	4.2	4.6	4.6	4.2	5.4	5.3	5.5	4.9
Collection tank drain	1.1	1.0	0.5	0.4	1.1	0.8	1.1	0.7	0.6
Top Attraction flow	2.0	3.2	4.1	4.2	3.2	4.5	4.1	4.8	4.3
Bottom Attraction flow	5.7	6.1	4.0	4.6	5.6	5.2	5.2	5.5	5.5
Total Attraction flow	8.7	10.3	8.6	9.1	9.8	10.6	10.4	11.0	10.4
Milieu Ramp									
Spray bar	3.2	4.4	4.7	4.6	4.3	5.2	5.2	5.4	5.1
Collection tank drain	0.6	0.7	0.5	0.5	0.9	0.5	0.4	0.8	0.6
Top Attraction flow	2.6	3.7	4.1	4.1	3.4	4.8	4.8	4.6	4.5
Bottom Attraction low	7.8	5.4	4.1	3.7	5.7	5.4	5.3	5.6	9.5
Total Attraction flow	10.9	9.8	8.8	8.3	10.0	10.6	10.5	11.0	14.5
Overall Attraction flows	**19.7**	**20.1**	**17.4**	**17.5**	**19.8**	**21.2**	**20.9**	**22.0**	**25.0**

Creek flows too high to calibrate (August 20-24)
* Cleaned hoses to increase flow
** Pump was changed/cleaned to increase flow
Pumped changed on 9/2/2018 and 9/11/2018,

Table 5.0-1: Comparison of Octoraro Creek Eel Ramps, 2015-2018

Watershed area		**540 km²**			
Approximate Distance from Ocean to ramp		**341 km**			
	2015	**2016**	**2017**	**2018**	**Average**
Eels Collected	7,197	21,094	11,347	4,203	10,960
Average Size (mm)	129.4	130.9	135.4	141.6	134.3
Range of Sizes (mm)	95-232	99-202	99-245	100-259	
Days of Operation	89	138	138	135	125
Average eels per day	80.9	152.9	82.2	31.1	86.8
Average creek flow (cfs)	180.9	121.3	138.0	411.0	212.8
Range of flows (cfs)	60-1,490	43-512	51-557	88-2,370	

Figure 2.0-1: Lower Octoraro Creek from Pine Grove Dam to the Mouth at the Susquehanna River, Octoraro Creek (Stone Masonry Dam also Known as Pine Grove Low-Head Dam)

Figure 2.0-2: Location of the Juvenile Eel Collection Facility on South Shore (Left Bank) Of Octoraro Creek Downstream of Art Building

Figure 2.0-3: Peak Timing of Historical Eel Passage at Conowingo, 2008-2016

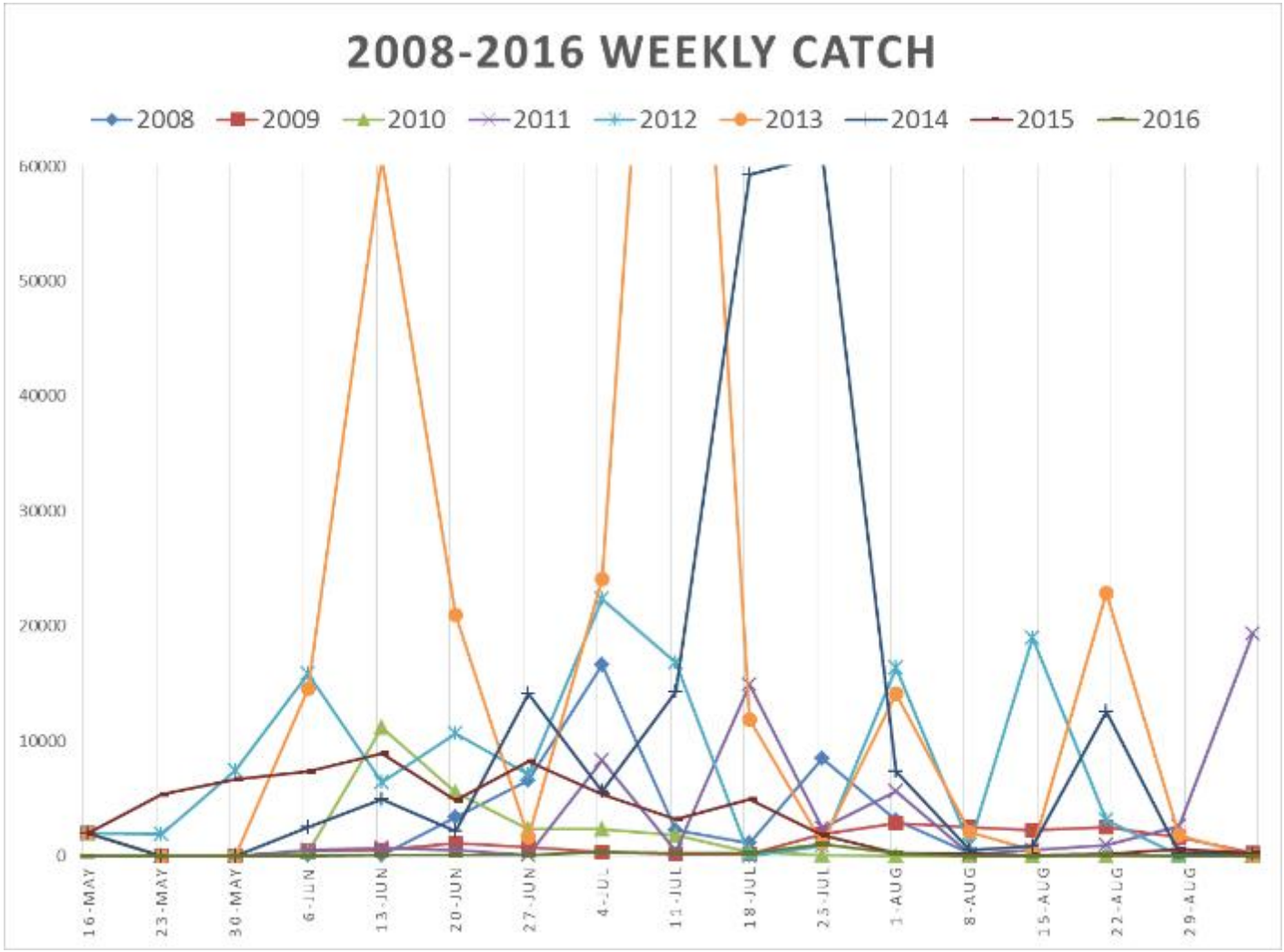


Figure 3.2-1: Measuring Juvenile Eels to Nearest Millimeter While Sedated, Octoraro Creek

Figure 4.2-1: Percent Eel Catch per Week, Octoraro Creek, 2018

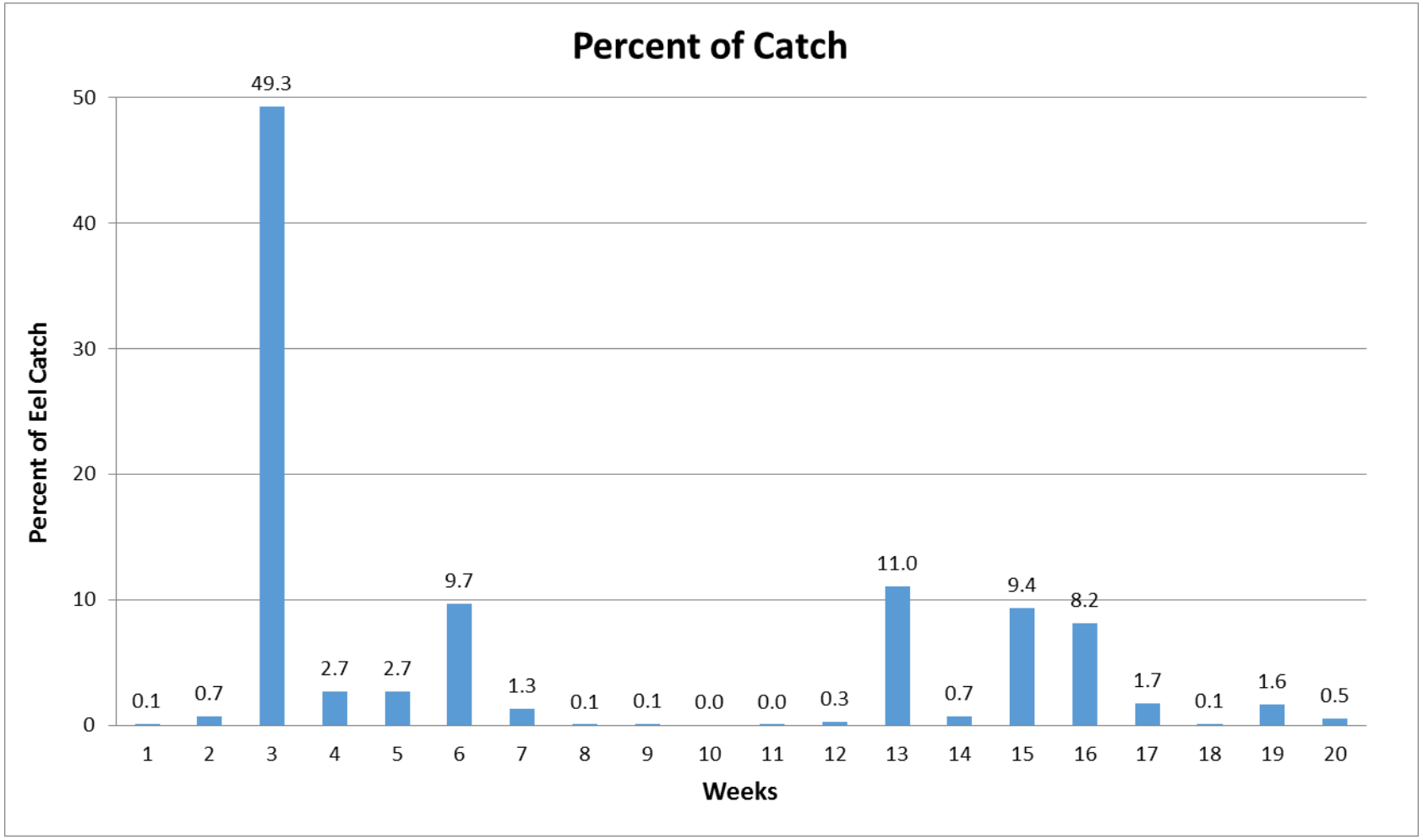


Figure 4.4-1: Weekly Eel Catch to Weekly Average Creek Flow, Octoraro Creek, 2018

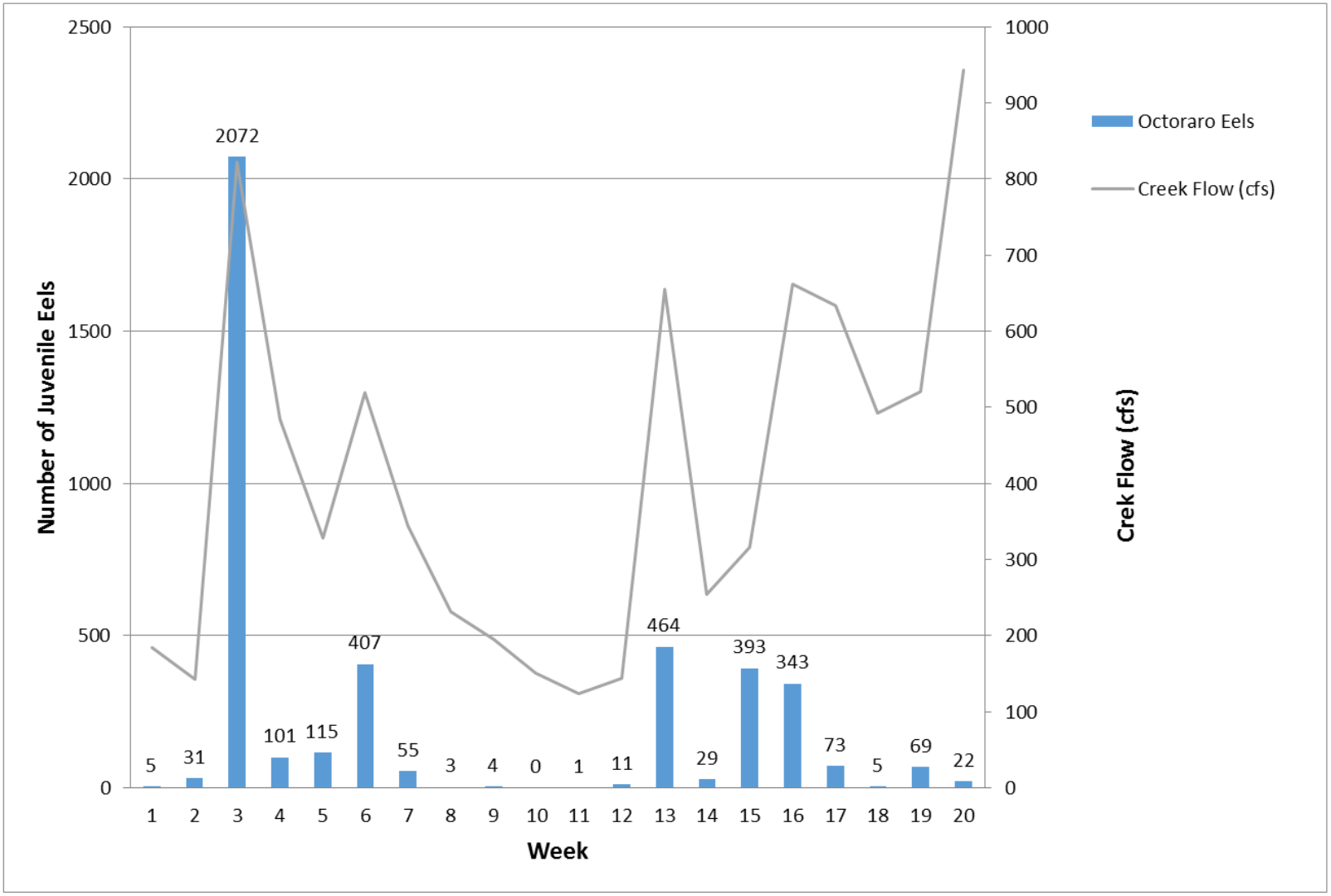


Figure 4.4-2: Weekly Eel Catch to Weekly Average Lunar Fraction, Octoraro Creek, 2018 *(1.0 Equals Full Moon)*

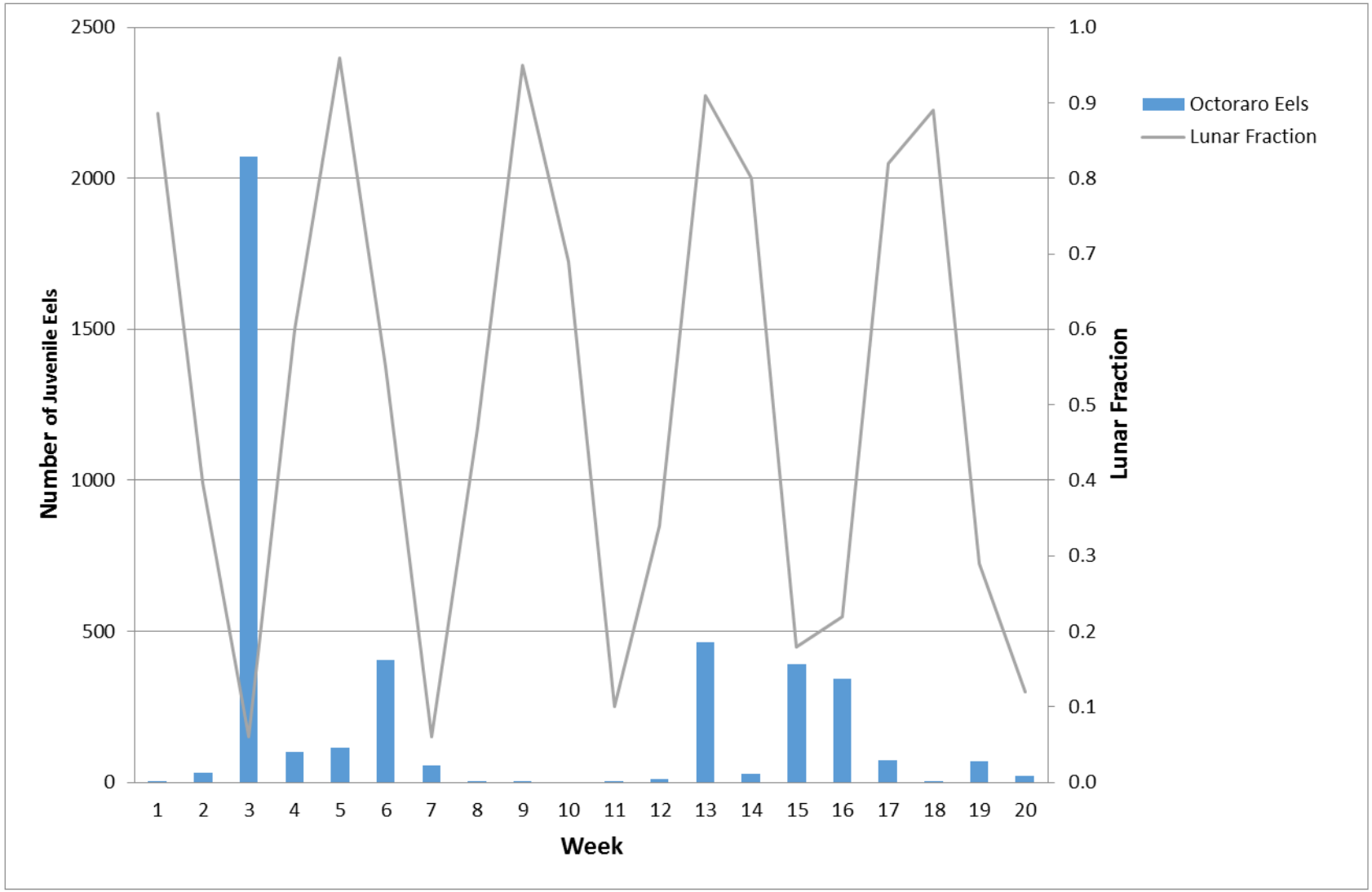


Figure 4.4-3: Weekly Eel Catch to Weekly Average Water Temperature, Octoraro Creek, 2018

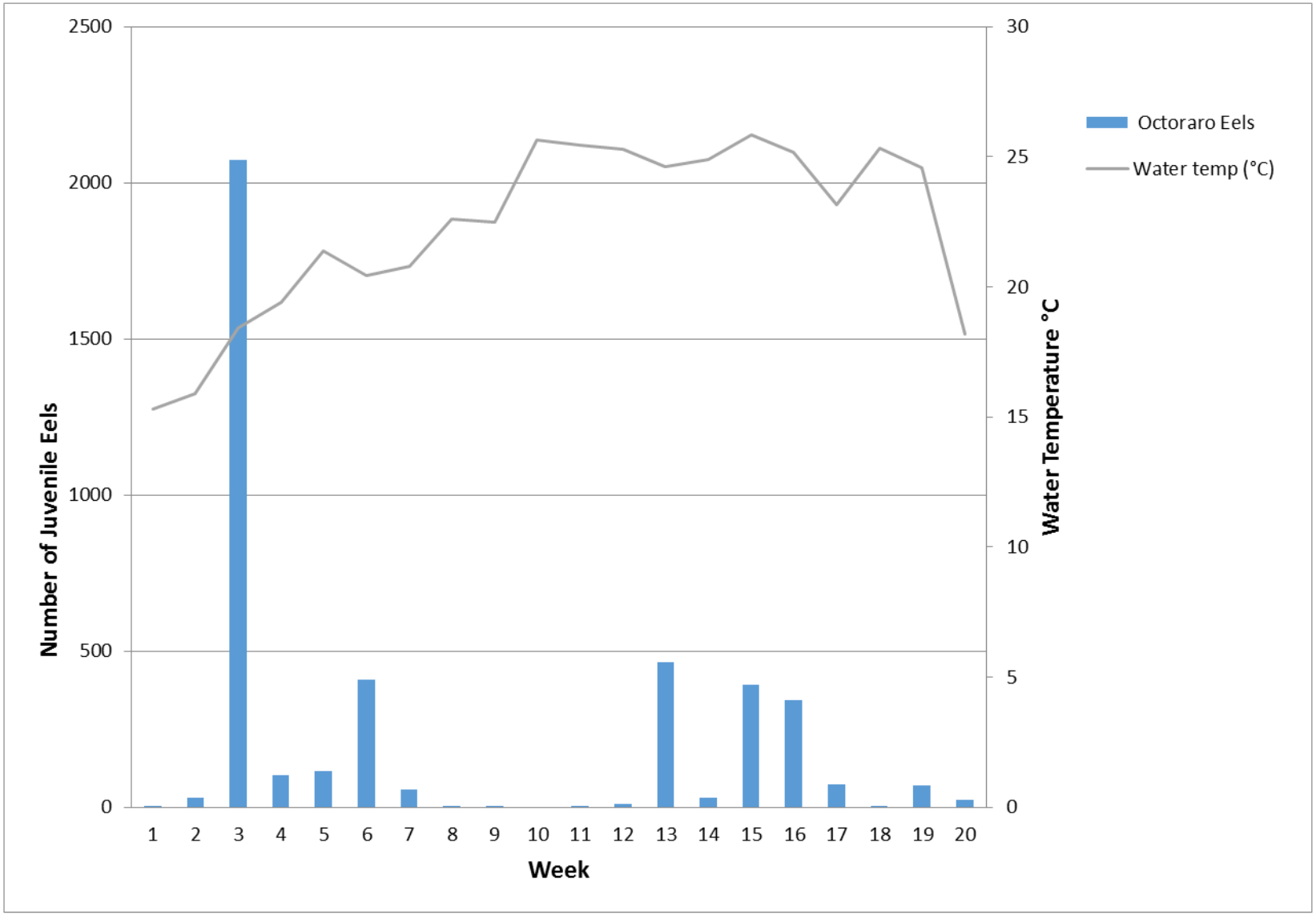


Figure 4.4-4: Comparison of Dissolved Oxygen Readings in Collection Tanks and Head Pond, Octoraro Creek, 2018

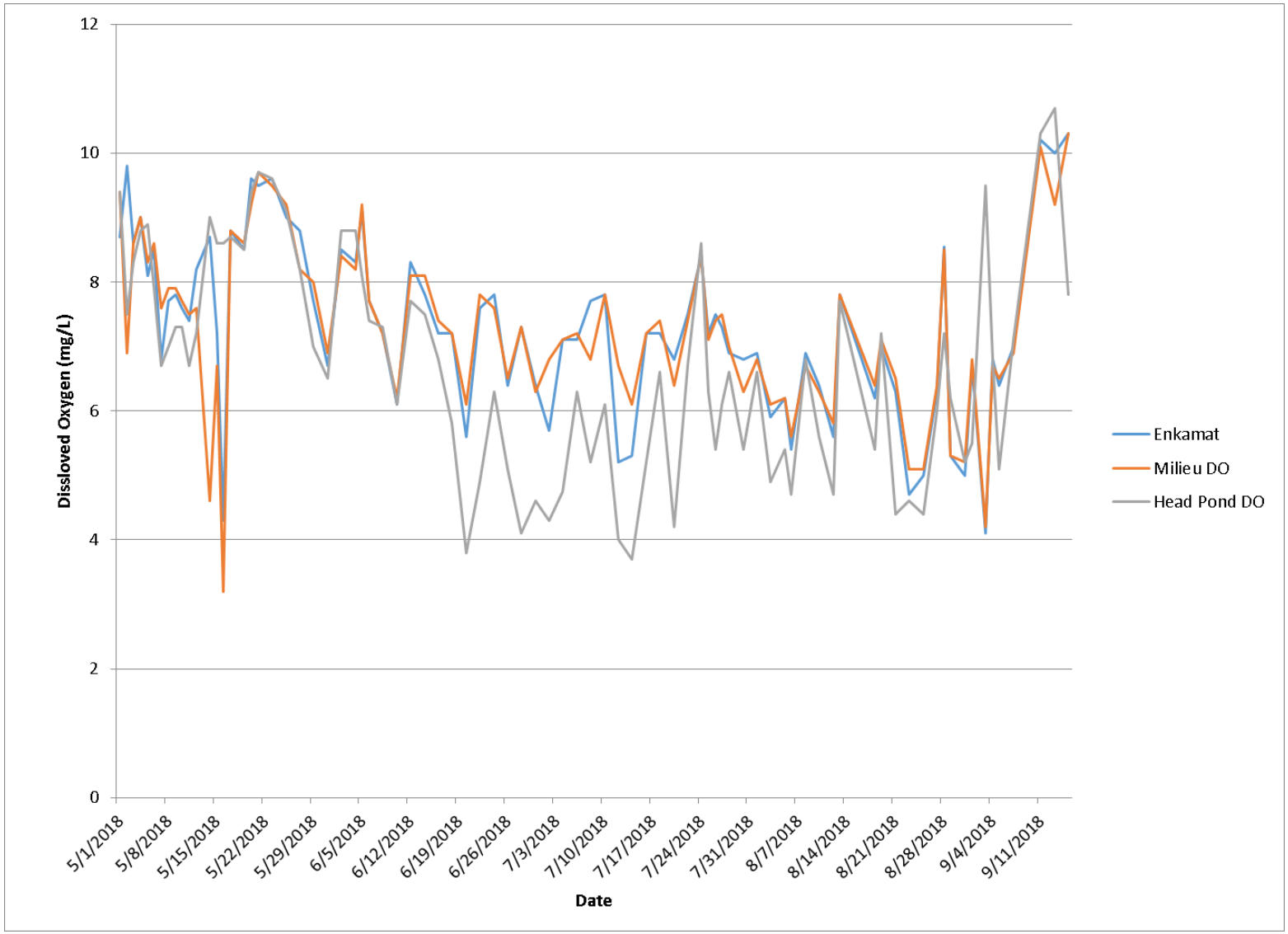


Figure 4.4-5: Weekly Eel Catch to Weekly Average Dissolved Oxygen, Octoraro Creek Eel Facility Collection Tanks, 2018

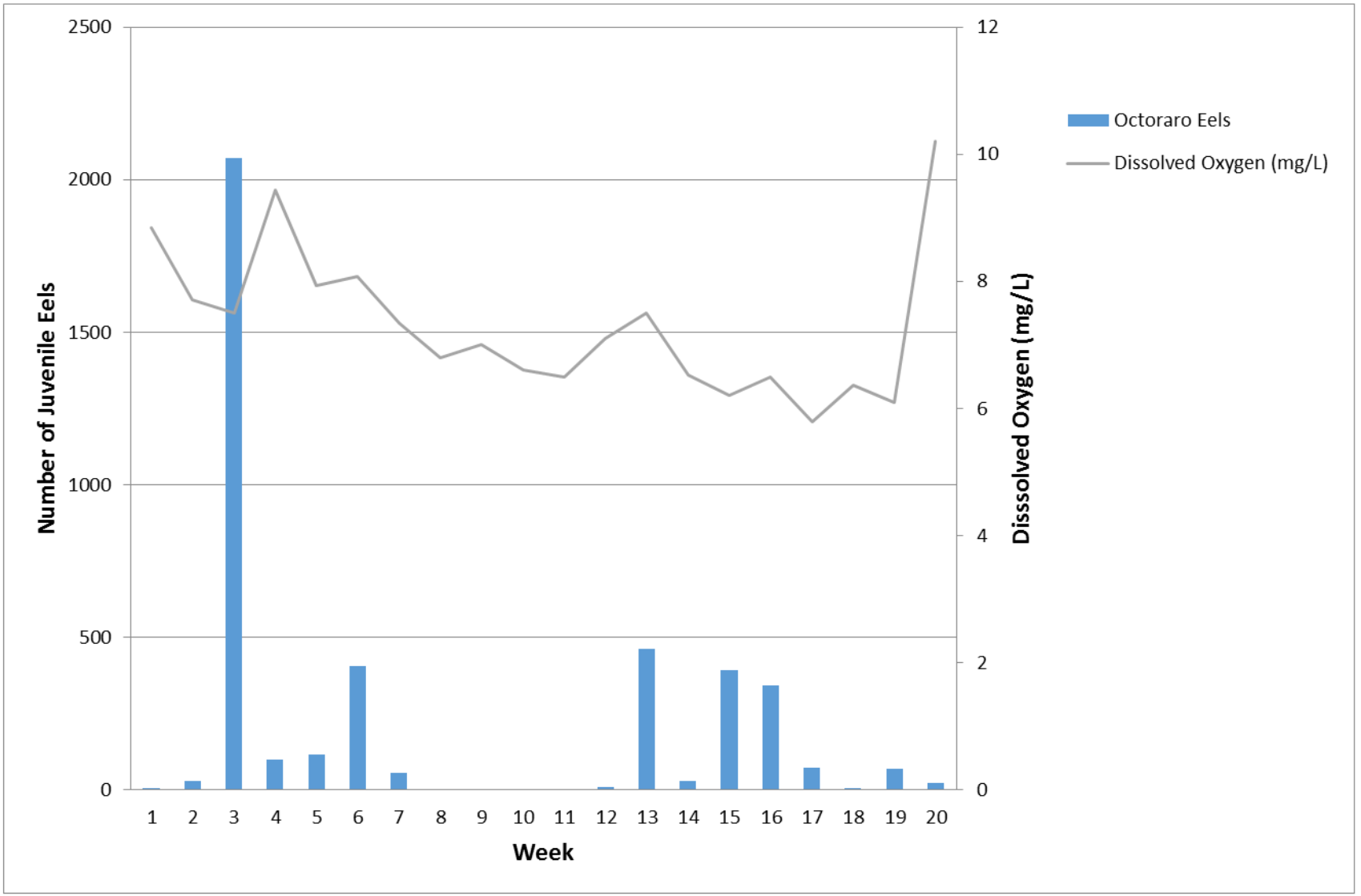


Figure 5.0-1: Weekly Catch and Average Creek Flow, Octoraro Creek, 2015-2018

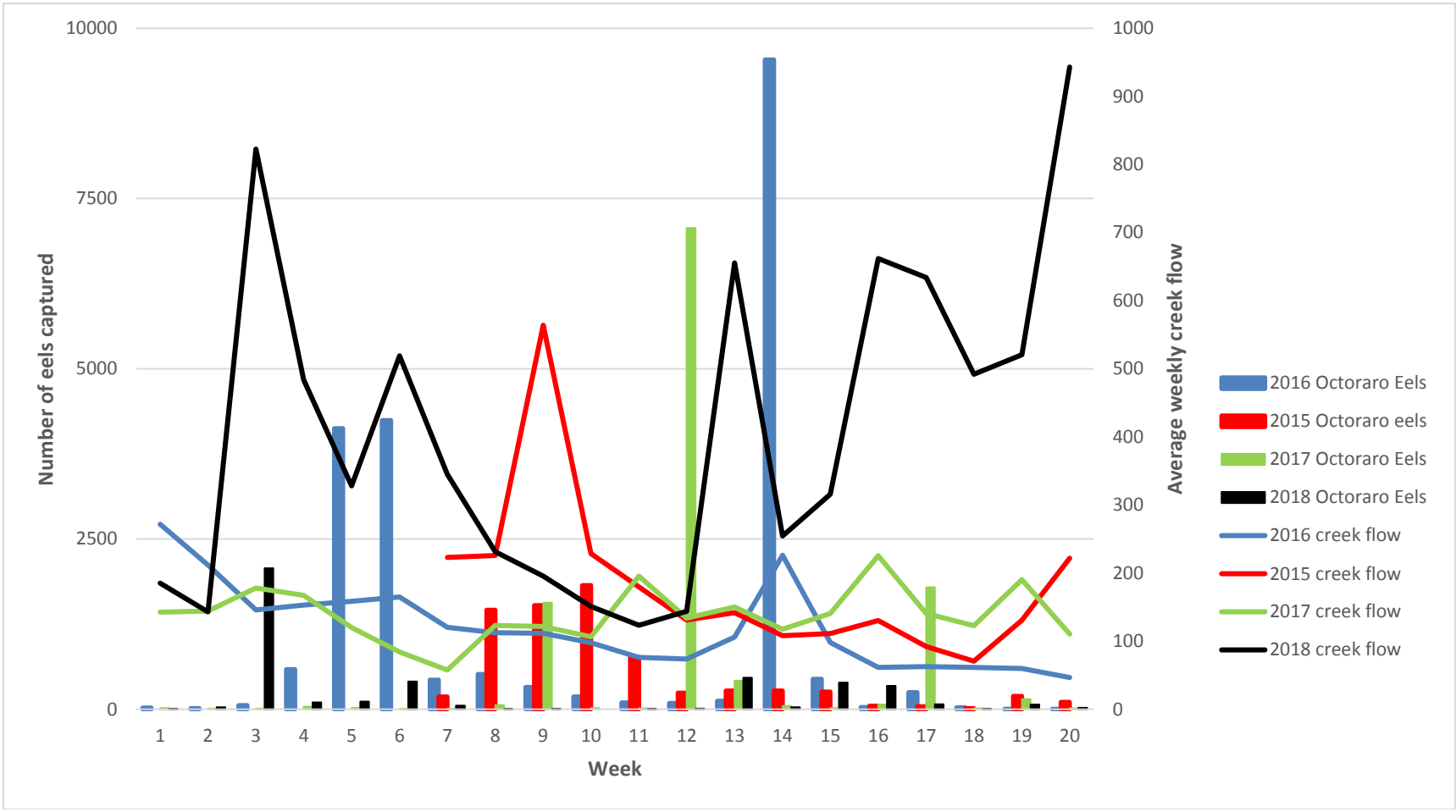
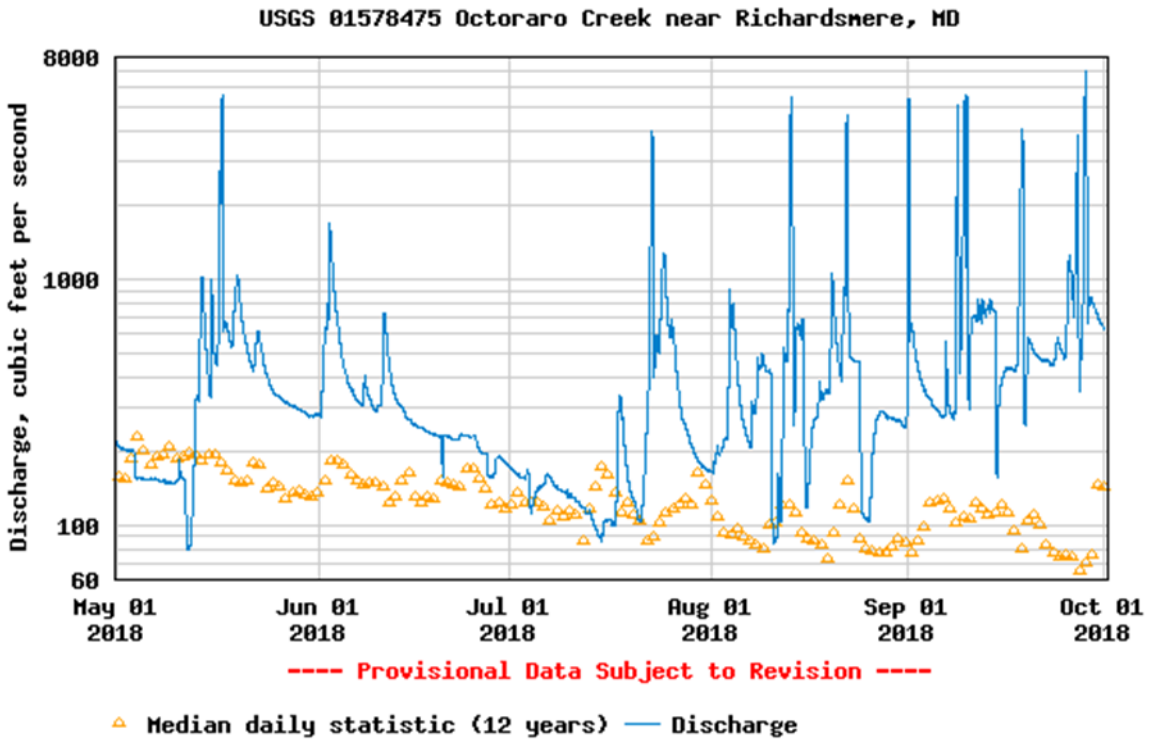
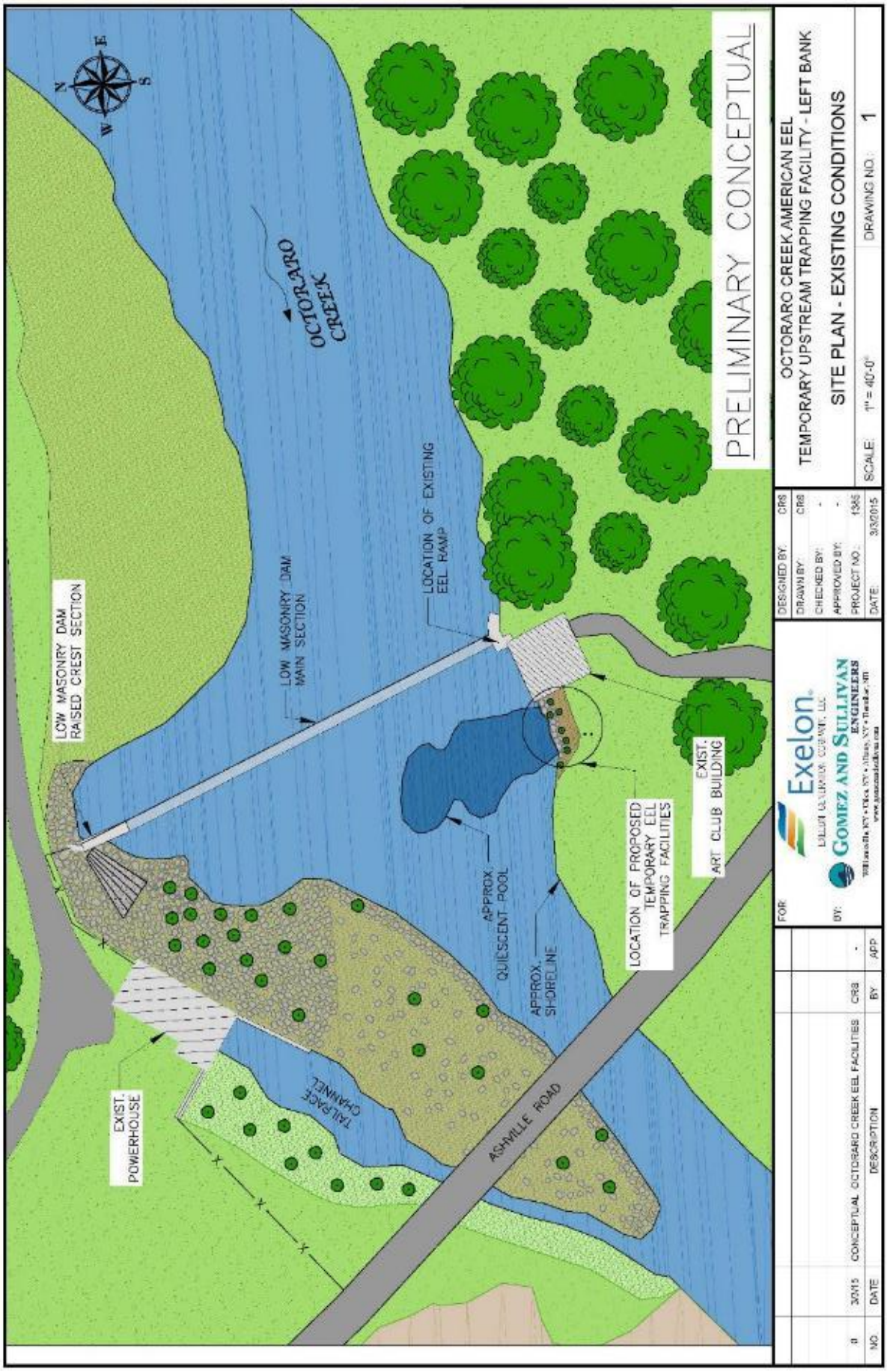
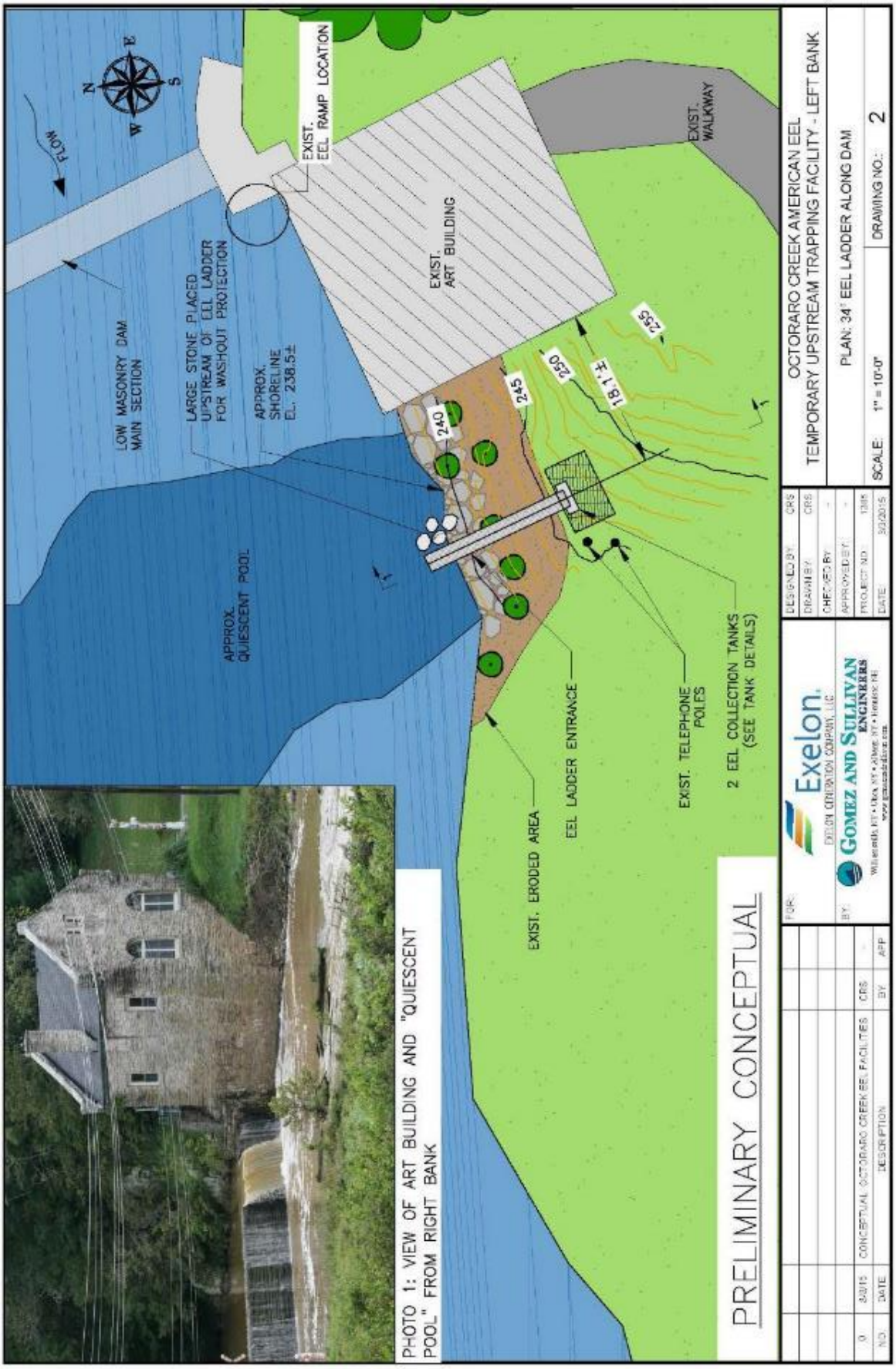


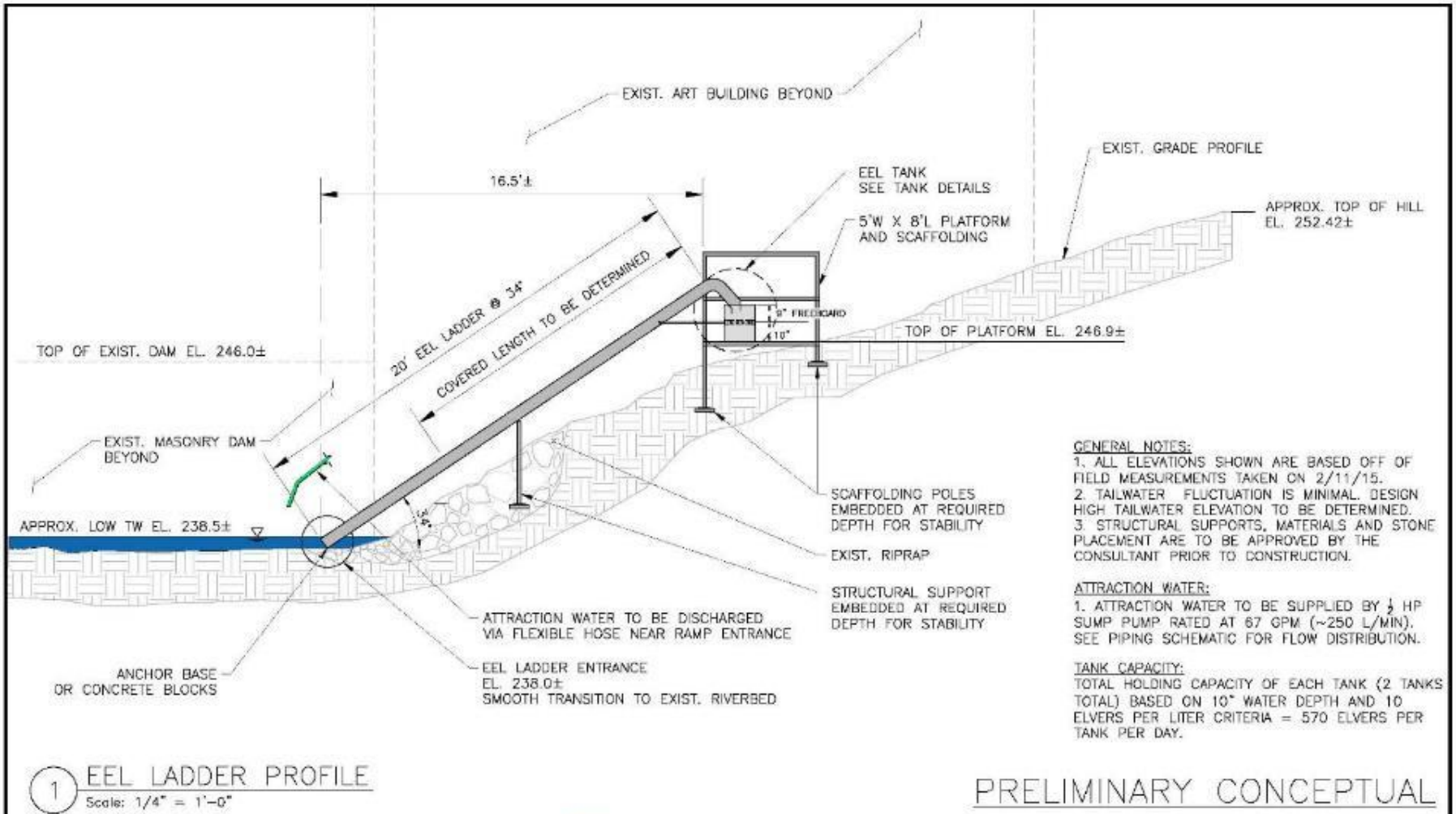
Figure 5.0-2: Octoraro Creek Flow in 2018 and Historical Data, Octoraro Creek, 2018.



Appendix A:
Conceptual Design of Trapping Facility on South Shore of Octoraro Creek, 2015


PRELIMINARY CONCEPTUAL
OCTORARO CREEK
LOW MASONRY DAM RAISED CREST SECTION
LOW MASONRY DAM MAIN SECTION
LOCATION OF EXISTING EEL RAMP
APPROX. QUIESCENT POOL
APPROX. SHORELINE
LOCATION OF PROPOSED TEMPORARY EEL TRAPPING FACILITIES
EXIST. ART CLUB BUILDING
EXIST. POWERHOUSE
TAILRACE CHANNEL
ASHVILLE ROAD
N
E
S
W
OCTORARO CREEK AMERICAN EEL
TEMPORARY UPSTREAM TRAPPING FACILITY - LEFT BANK
SITE PLAN - EXISTING CONDITIONS
SCALE: 1" = 40'-0"
DRAWING NO.: 1
DESIGNED BY: CRB
DRAWN BY: CRB
CHECKED BY: -
APPROVED BY: -
PROJECT NO.: 1385
DATE: 3/3/2015
FOR:
BY:
Exelon
GOMEZ AND SULLIVAN ENGINEERS
NO | DATE | DESCRIPTION | BY | APP
0 | 3/3/15 | CONCEPTUAL OCTORARO CREEK EEL FACILITIES | CRB | -


PRELIMINARY CONCEPTUAL
PHOTO 1: VIEW OF ART BUILDING AND "QUIESCENT POOL" FROM RIGHT BANK
FLOW
N
S
E
W
LOW MASONRY DAM MAIN SECTION
LARGE STONE PLACED UPSTREAM OF EEL LADDER FOR WASHOUT PROTECTION
APPROX. SHORELINE EL. 238.5±
APPROX. QUIESCENT POOL
EXIST. EEL RAMP LOCATION
EXIST. ART BUILDING
EXIST. WALKWAY
EXIST. ERODED AREA
EEL LADDER ENTRANCE
EXIST. TELEPHONE POLES
2 EEL COLLECTION TANKS (SEE TANK DETAILS)
240
245
250
255
± 18.1'
OCTORARO CREEK AMERICAN EEL TEMPORARY UPSTREAM TRAPPING FACILITY - LEFT BANK
PLAN: 34' EEL LADDER ALONG DAM
SCALE: 1" = 10'-0"
DRAWING NO.: 2
Exelon.
GOMEZ AND SULLIVAN ENGINEERS
DESIGNED BY: CRS
DRAWN BY: CRS
CHECKED BY: -
APPROVED BY: -
PROJECT NO: 1385
DATE: 3/2015
0 3/2015 CONCEPTUAL OCTORARO CREEK EEL FACILITIES CRS -
NO. DATE DESCRIPTION BY APP



1 EEL LADDER PROFILE
Scale: 1/4" = 1'-0"

GENERAL NOTES:
1. ALL ELEVATIONS SHOWN ARE BASED OFF OF FIELD MEASUREMENTS TAKEN ON 2/11/15.
2. TAILWATER FLUCTUATION IS MINIMAL. DESIGN HIGH TAILWATER ELEVATION TO BE DETERMINED.
3. STRUCTURAL SUPPORTS, MATERIALS AND STONE PLACEMENT ARE TO BE APPROVED BY THE CONSULTANT PRIOR TO CONSTRUCTION.

ATTRACTION WATER:
1. ATTRACTION WATER TO BE SUPPLIED BY ½ HP SUMP PUMP RATED AT 67 GPM (~250 L/MIN). SEE PIPING SCHEMATIC FOR FLOW DISTRIBUTION.

TANK CAPACITY:
TOTAL HOLDING CAPACITY OF EACH TANK (2 TANKS TOTAL) BASED ON 10" WATER DEPTH AND 10 ELVERS PER LITER CRITERIA = 570 ELVERS PER TANK PER DAY.

PRELIMINARY CONCEPTUAL

NO.	DATE	DESCRIPTION	BY	APP
0	3/3/15	CONCEPTUAL OCTORARO CREEK EEL FACILITIES	CRS	-

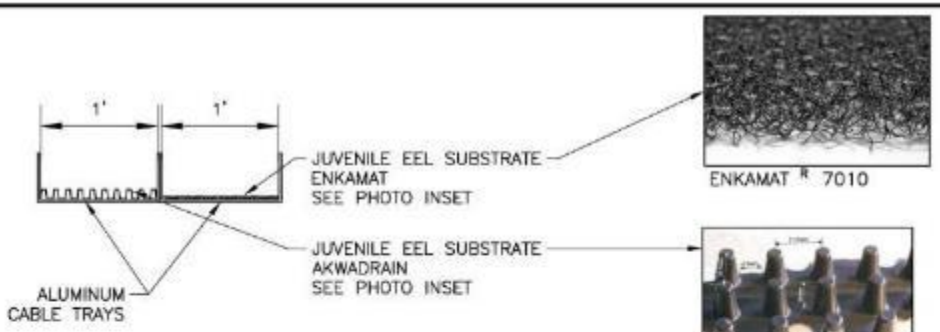
FOR: Exelon. EXELON GENERATION COMPANY, LLC
BY: GOMEZ AND SULLIVAN ENGINEERS

DESIGNED BY:	CRS
DRAWN BY:	CRS
CHECKED BY:	-
APPROVED BY:	-
PROJECT NO.:	1385
DATE:	3/3/2015

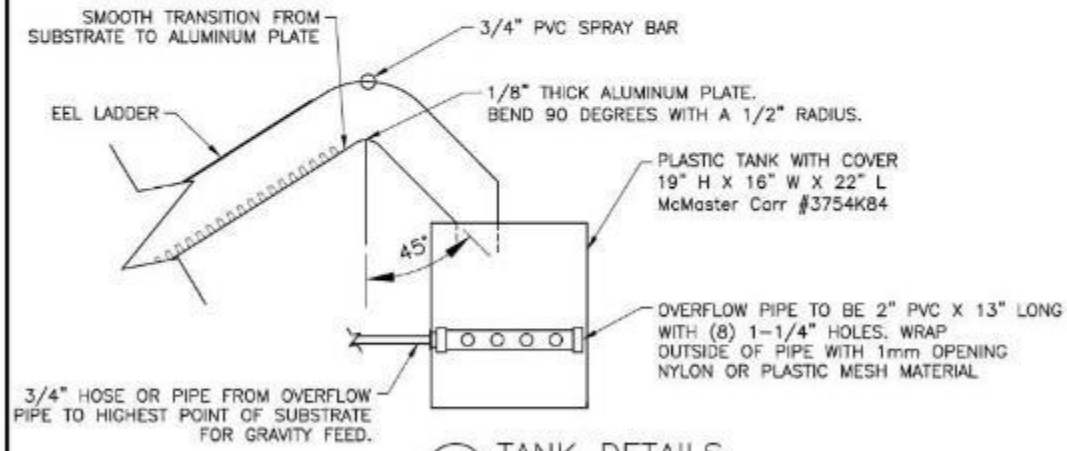
OCTORARO CREEK AMERICAN EEL
TEMPORARY UPSTREAM TRAPPING FACILITY - LEFT BANK

PROPOSED EEL LADDER PROFILE

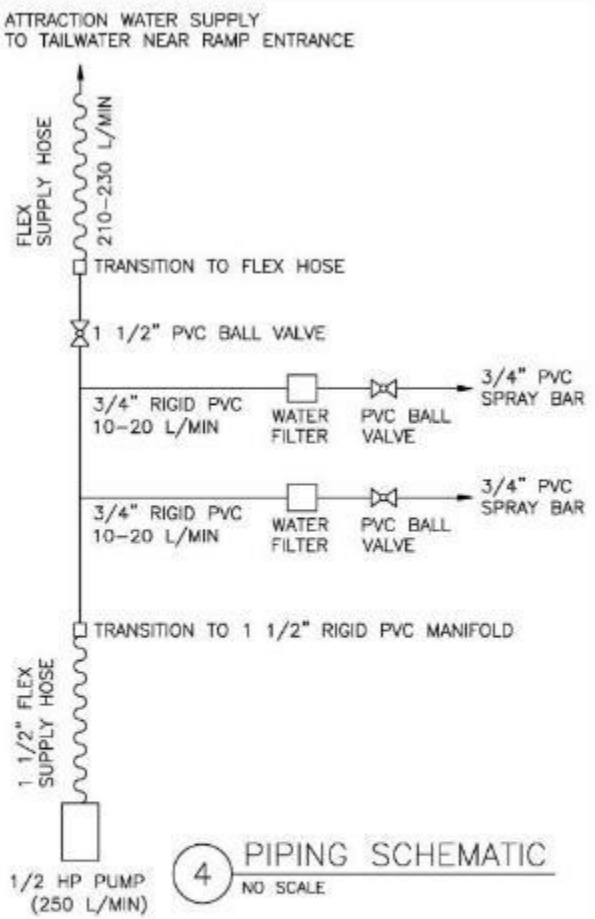
SCALE: 1/4" = 1'-0" | DRAWING NO.: 3



2 EEL LADDER SECTION (TYPICAL)
Scale: 1"=1'-0"



3 TANK DETAILS
Scale: 1"=1'-0"



4 PIPING SCHEMATIC
NO SCALE

PRELIMINARY CONCEPTUAL

NO.	DATE	DESCRIPTION	BY	APP
0	3/3/15	CONCEPTUAL OCTORARO CREEK EEL FACILITIES	CRS	-

FOR: Exelon. EXELON GENERATION COMPANY, LLC

BY: GOMEZ AND SULLIVAN ENGINEERS

DESIGNED BY:	CRS
DRAWN BY:	CRS
CHECKED BY:	-
APPROVED BY:	-
PROJECT NO.:	1385
DATE:	3/3/2015

OCTORARO CREEK AMERICAN EEL
TEMPORARY UPSTREAM TRAPPING FACILITY - LEFT BANK

TYPICAL EEL LADDER SECTION AND DETAILS

SCALE: 1" = 1'-0" | DRAWING NO.: 4

Appendix B:
Weekly Biological Data and Environmental Conditions for Octoraro Creek, 2018

Weekly Eel Catch Data, 2018

	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10
Octoraro Eels	5	31	2072	101	115	407	55	3	4	0
Creek flow (cfs)	185.0	143.0	822.6	484.1	327.9	519.0	345.1	231.3	195.7	150.9
Lunar Fraction	0.89	0.40	0.06	0.6	0.96	0.55	0.06	0.47	0.95	0.69
Water temp (°C)	15.3	15.9	18.4	19.4	21.4	20.5	20.8	22.6	22.5	25.6
Dissolved Oxygen (mg/L)	8.84	7.71	7.50	9.43	7.93	8.08	7.35	6.80	7.00	6.60
Percent of Catch	0.12	0.74	49.30	2.70	2.70	9.70	1.30	0.07	0.10	0.00
	Wk 11	**Wk 12**	**Wk 13**	**Wk 14**	**Wk 15**	**Wk 16**	**Wk 17**	**Wk 18**	**Wk 19**	**Wk 20**
Octoraro Eels	1	11	464	29	393	343	73	5	69	22
Creek flow (cfs)	123.3	143.89	655.6	254.3	315.7	661.9	634.0	492.1	520.4	943.0
Lunar Fraction	0.10	0.34	0.91	0.80	0.18	0.22	0.82	0.89	0.29	0.12
Water temp (°C)	25.5	25.3	24.6	24.9	25.9	25.2	23.2	25.3	24.6	18.2
Dissolved Oxygen (mg/L)	6.50	7.10	7.50	6.53	6.20	6.50	5.80	6.37	6.10	10.20
Percent of Catch	0.02	0.26	11.04	0.69	9.35	8.16	1.74	0.12	1.64	0.52

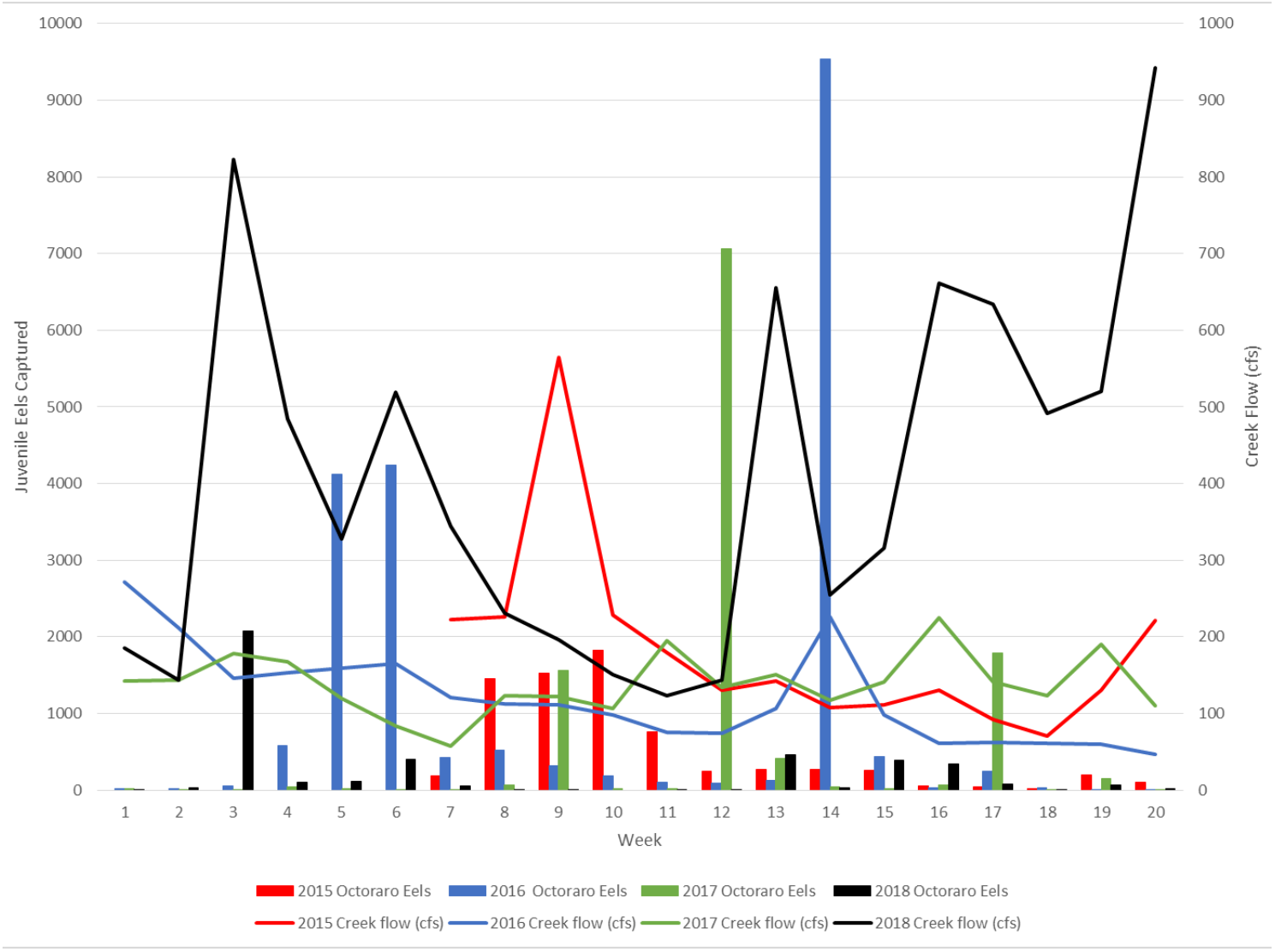
Wk 1: May 1 - May 5
Wk 2: May 6 - May 112
Wk 3: May 13 - May 19
Wk 4: May 20 - May 26
Wk 5: May 27 - June 2
Wk 6: June 3 - June 9
Wk 7: June 10 - June 16
Wk 8: June 17 - June 23
Wk 9: June 24 – June 30
Wk 10: July 1 - July 7
Wk 11: July 8 - July 14
Wk 12: July 15 - July 21
Wk 13: July 22 - July 28
Wk 14: July 29 - August 4
Wk 15: August 5 - August 11
Wk 16: August 12 - August 18
Wk 17: August 19 - August 25
Wk 18: August 26 - September 1
Wk 19: September 2 - September 8
Wk 20: September 9 - September 15

Appendix C:
Weekly Data for 2015-2018

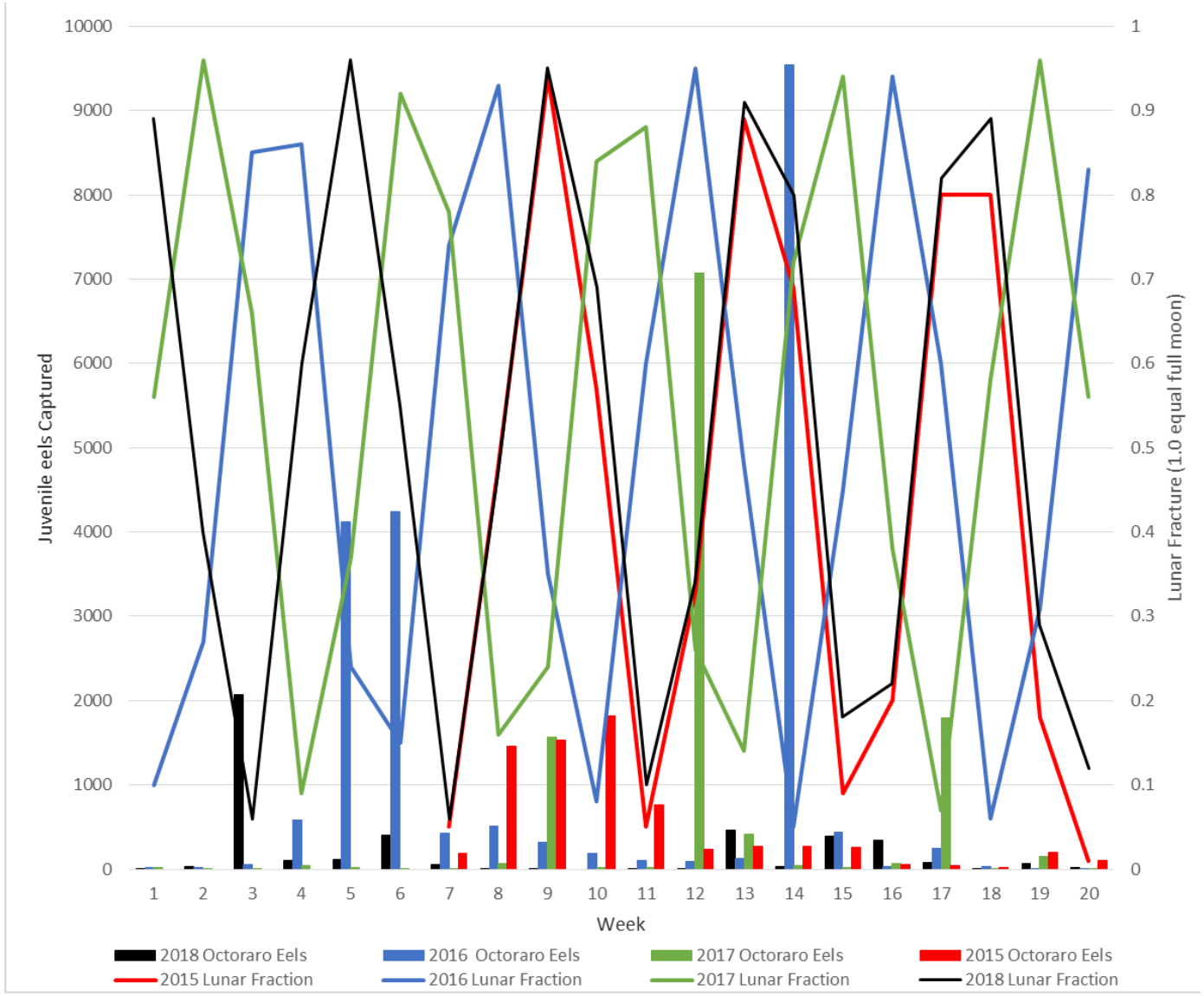
Weekly Eel Catch Data (2015-2018)

2015 Week							**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
2015 Octoraro Eels							183	1458	1524	1819	765	240	273	271	258	50	42	13	194	107
2015 Creek flow (cfs)							222.8	225.9	564	228.6	179.7	131	141.9	108.1	111.1	130.4	91.9	70.6	130.6	221.7
2015 Lunar Fraction							0.05	0.48	0.94	0.57	0.05	0.33	0.89	0.69	0.09	0.2	0.8	0.8	0.18	0.01
2015 Water temp (°C)							25.1	23.3	22.7	24.4	24.5	25.3	25.7	25	24.3	24.3	22.8	24.9	23.3	19
Dissolved Oxygen (mg/L)							6.7	7	8.8	7.3	5.1	4.5	4.1	3.3	3.1	5.1	4.3	3.5	5.4	6.8
Percent of Catch							2.5	20.3	21.2	25.3	10.6	3.3	3.8	3.8	3.6	0.7	0.6	0.2	2.7	1.5
Conowingo Eels							2439	8200	5400	3166	4930	1794	284	190	128	327	469	267	59	
2016 Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
2016 Octoraro Eels	23	13	58	585	4124	4243	431	516	323	183	97	90	121	9540	443	28	247	25	2	2
2016 Creek flow (cfs)	271.7	211.9	145.9	153	158.7	164.7	120.4	112.3	111.4	97.6	76	73.7	106.1	226.3	98.1	61.6	62.7	61.4	59.7	46.6
2016 Lunar Fraction	0.1	0.27	0.85	0.86	0.24	0.15	0.74	0.93	0.35	0.08	0.6	0.95	0.48	0.05	0.45	0.94	0.6	0.06	0.31	0.83
2016 Water temp (°C)	14.5	14.9	15.8	19.3	23.9	22.7	22.8	24.3	24.5	25.7	26.2	27.2	27.7	25.4	26.7	26.7	24.3	24.8	24.8	23.4
Dissolved Oxygen (mg/L)	9.8	10	9.1	7.8	5.3	5.4	6.9	6.3	5.6	5.9	5.6	5	4.7	3	3.9	3.7	3.8	4.4	4	3.8
Percent of Catch	0.1	0.1	0.3	2.8	19.6	20.1	2.0	2.4	1.5	0.9	0.5	0.4	0.6	45.2	2.1	0.1	1.2	0.1	0.0	0.0
Conowingo Eels				5	95	100	113	353	252	247	1061	280	26	25	53	14	31	20	6	3
2017 Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
2017 Octoraro Eels	17	9	9	39	21	7	2	61	1565	19	13	7067	419	48	16	68	1793	12	149	12
2017 Creek flow (cfs)	142.8	144	178.1	167.4	119.9	84.3	57.6	123.3	121.6	106.3	195.4	133.7	150.3	117.7	140.7	225.4	140.7	122.9	190.3	110.2
2017 Lunar Fraction	0.56	0.96	0.66	0.09	0.37	0.92	0.78	0.16	0.24	0.84	0.88	0.26	0.14	0.72	0.94	0.38	0.07	0.58	0.96	0.56
2017 Water temp (°C)	17.4	14.2	18.8	18.2	18.9	20.2	21.6	24.4	24.9	25.7	25.6	26.9	26.2	25.2	24.1	24	23.3	20.2	20.5	20.4
Dissolved Oxygen (mg/L)	9.5	8.3	7.5	7.5	6.4	5.7	4.4	4.9	5.1	4.5	2.3	5.1	5	4	4.5	5	3	4	6.3	5.5
Percent of Catch	0.2	0.1	0.1	0.3	0.2	0.1	0.0	0.5	13.8	0.2	0.1	62.3	3.7	0.4	0.1	0.6	15.8	0.1	1.3	0.1
Conowingo Eels	4387	151	1224	5384	2196	1761	5199	23318	8090	799	1503	1432	15435	32524	13130	2654	2931	88	51	43
2018 Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
2018 Octoraro Eels	5	31	2072	101	115	407	55	3	4	0	1	11	464	29	393	343	73	5	69	22
2018 Creek flow (cfs)	185	143	822.6	484.1	327.9	519	345.1	231.3	195.7	150.9	123.3	143.9	655.6	254.3	315.7	661.9	634	492.1	520.4	943
2018 Lunar Fraction	0.89	0.4	0.06	0.6	0.96	0.55	0.06	0.47	0.95	0.69	0.1	0.34	0.91	0.8	0.18	0.22	0.82	0.89	0.29	0.12
2018 Water temp (°C)	15.3	15.9	18.4	19.4	21.4	20.5	20.8	22.6	22.5	25.6	25.5	25.3	24.6	24.9	25.9	25.2	23.2	25.3	24.6	18.2
Dissolved Oxygen (mg/L)	8.8	7.7	7.5	9.4	7.9	8.1	7.4	6.8	7	6.6	6.5	7.1	7.5	6.5	6.2	6.5	5.8	6.4	6.1	10.2
Percent of Catch	0.1	0.7	49.3	2.7	2.7	9.7	1.3	0.7	0.1	0.0	0.0	0.3	11.0	0.7	9.4	8.2	1.7	0.1	1.6	0.5
Conowingo Eels	7	6443	6879	197	398	1316	462	657	1077	6020	3175	1029	7986	20965	5262	3948	1870	165	73	20

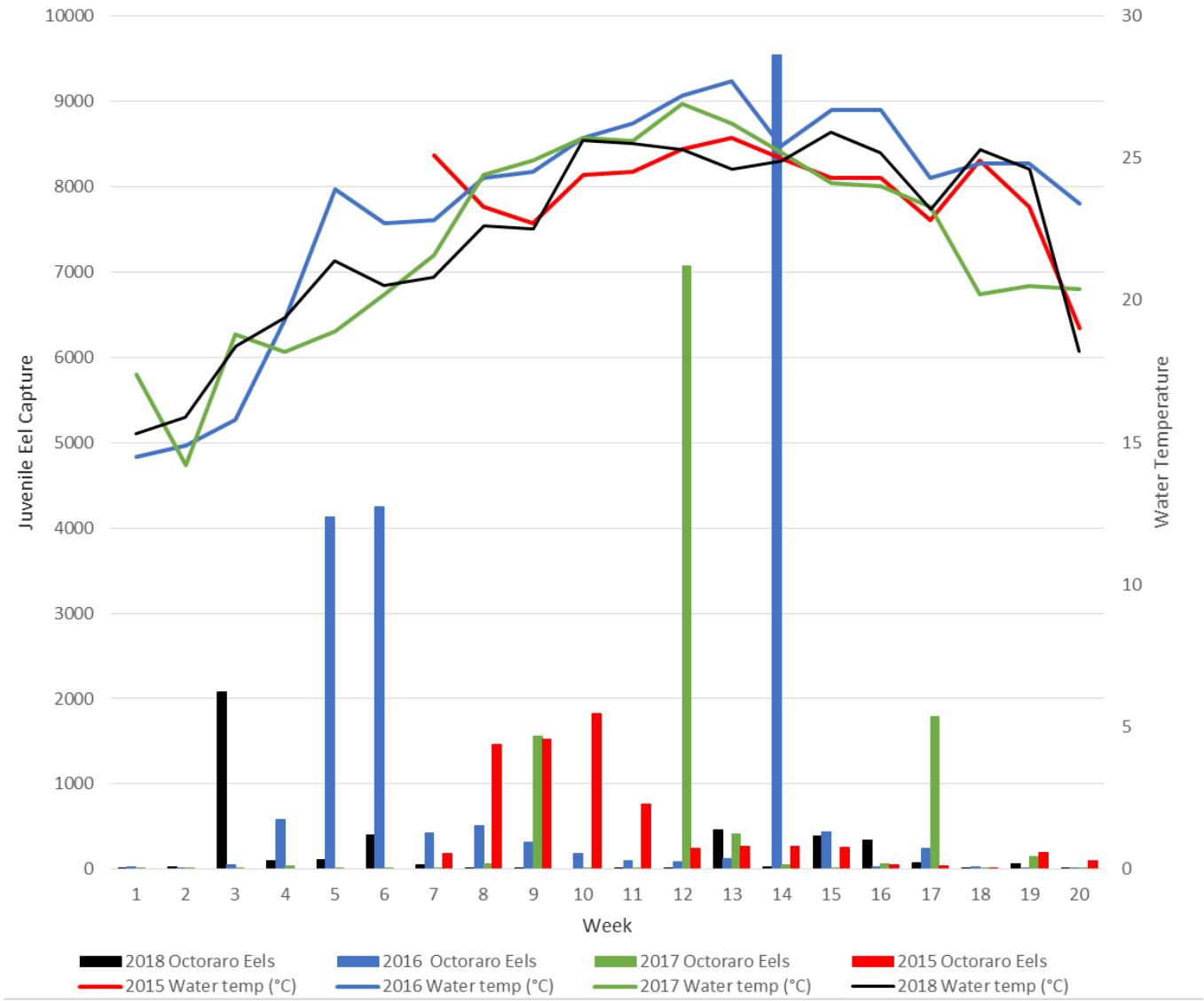
Eel Catch (Collection) to Creek Flow (2015-2018)



Eel Catch (Collection) to Lunar Fraction (2015-2018)



Eel Catch (Collection) to Water Temperature (2015-2018)



Appendix D:
Correspondence to Make Octoraro Creek Eel Facility Permanent

FEDERAL ENERGY REGULATORY COMMISSION
Washington, D. C. 20426

OFFICE OF ENERGY PROJECTS

Project No. 2355-026–Pennsylvania
Muddy Run Pumped Storage Project
Exelon Generation Company, LLC

March 1, 2018

Christopher Wilson, Director
Exelon Generation Company, LLC
101 Constitution Avenue NW
Suite 400 East
Washington, DC 20001

Subject: 2017 Eel Trapping Reports

Dear Mr. Wilson:

This letter acknowledges your 2017 American Eel Collection Facility in Octoraro Creek Report and 2017 Conowingo Eel Collection Facility Report, both filed with the Federal Energy Regulatory Commission (Commission) on January 9, 2018 for the Muddy Run Pumped Storage Project No. 2355.[1] Section III of the project's Water Quality Certification (WQC)[2] and section VIII of the U.S. Department of the Interior's fishway prescription[3] require various American eel protection measures, including the construction and operation of eel trapping facilities at the Conowingo Hydroelectric Project No. 405 tailrace and near Octoraro Creek for the purpose of stocking eels upstream. The Octoraro Creek facility, a temporary facility, is to be assessed after three years to determine whether it is effective for collecting juvenile eels, to supplement eels collected at the Conowingo facility. If you determine the site to be successful, in consultation with the Pennsylvania Department of Environmental Protection (Pennsylvania DEP), you would install a permanent eel trapping facility at Octoraro Creek. Your January 9, 2018 report covers the third year of operating the Octoraro

[1] Order Issuing New License (153 FERC ¶ 62,232), issued December 22, 2015.

[2] See Appendix A of the Order Issuing New License.

[3] See Appendix B of the Order Issuing New License.

facility. The Conowingo facility design was approved on May 9, 2017;[4] however, we do not require you to report its results to the Commission under the Muddy Run license.

You report that the Octoraro facility was installed and put into service by May 1, 2017, and operated for a total of 138 days, from May 1 and September 15. You collected a total of 11,347 juvenile eels, with approximately 61.6 percent of the captures occurring during a mid-July peak. You also noted peaks near the end of June and in late August. Your report details your transport and maintenance measures, as well as survival calculations and a summary of your 2015 and 2016 results. Based on the high number of eels collected and the high survivorship of those eels, you conclude that the Octoraro facility location is suitable for a permanent eel collection facility.

The Conowingo facility report provides a detailed account of the construction and design specifications which appear to be consistent with the approved plan. You were able to begin operating the facility in May as intended, and your report further details your eel capture and data collection methods. You collected a total of 122,300 juvenile eels during the 138 days of operation. You did not observe a distinct peak in eel migration as at the Octoraro facility, but your highest rate of capture occurred on July 30, when 6 percent of all juvenile eels were collected at the Conowingo facility. Your report also presents biological data collected from subsamples of the juvenile eels and reports a total mortality of 0.06 percent of captured eels.

On December 21, 2017, the U.S. Fish and Wildlife Service (FWS) indicated it had no comment on the Octararo report and requested a map and photos pertaining to the Conowingo report, which you provided. Also on December 21, the Pennsylvania DEP concurred with the FWS' comments; however, it did not explicitly state whether it concurred with your conclusion that the Octoraro collection site was sufficiently successful to be made a permanent facility.

Review of your filing indicates that it fulfils the pertinent WQC and fishway prescription requirements. Pursuant to the Pennsylvania DEP's WQC, because you have determined the Octoraro facility to be successful, you must now consult with the Pennsylvania DEP to determine a schedule to install and operate a permanent eel trapping facility at this location. The WQC does not specify a deadline for determining a schedule. In order to keep the Commission apprised of your actions, please file your schedule with us by April 1, 2018. If you have not determined a schedule by April 1, 2018, your filing should indicate the status of consultation with Pennsylvania DEP and an estimate of when you anticipate being able to file a final schedule with the Commission. Your filing should also describe your intended eel trapping measures for the Octoraro location in 2018.

---

[4] Order Approving Eel Trapping Facility Design (159 FERC ¶ 62,146).

Thank you for your cooperation. We look forward to your supplemental fling, **due April 1, 2018**. If you have any questions regarding this matter, please contact me at (202) 503-8038 or Alicia.Burtner@ferc.gov.

Sincerely,

Alicia Burtner
Aquatic Resources Branch
Division of Hydropower Administration
and Compliance

Exelon Generation

March 29, 2018

Kimberly Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Via Electronic Filing

RE: Muddy Run Pumped Storage Facility (FERC No. 2355-026)
2017 American Eel Collection Facility Supplemental Filing

Dear Secretary Bose,

On January 9, 2018, Exelon Generation Company, LLC (Exelon), licensee for the Muddy Run Pumped Storage Project (Project), submitted the 2017 American Eel Collection Facility in Octoraro Creek Report and 2017 Conowingo Eel Collection Facility Report to the Federal Energy Regulatory Commision (FERC or Commission). On March 1, 2018, FERC issued a letter (March 1 Letter) indicating that the reports met the requirements of the Pennsylvania Department of Enviromental Protection (PADEP) 401 Water Quality Certification (WQC) and U.S. Department of the Interior fishway prescription for the Project. However, the March 1 Letter also stated that the PADEP 401 WQC requires Exelon to consult with PADEP to determine a schedule to install and operate a permanent eel trapping facility at Octoraro Creek. The March 1 Letter requested that, by April 1, 2018, Exelon either: (1) submit its schedule to install and operate the permanent eel trapping facility; or (2) indicate the status of consultation with PADEP and when Exelon anticipates being able to file a final schedule with the Commission. The March 1 Letter also requested that Exelon describe its intended eel trapping measures for the Octoraro Creek location in 2018.

Exelon submits this letter to provide an update regarding its consultation with PADEP and the expected timeline for developing and submitting a final schedule for the permanent eel trapping facility at Octoraro Creek. Exelon discussed this issue with PADEP during the monthly EPAG teleconference on March 15, 2018 and had additional discussions with PADEP on March 27, 2018 and March 29, 2018. PADEP and Exelon have agreed to develop a schedule, in consultation with the other Resource Agencies, to make this site permanent and submit the schedule to FERC by May 15, 2018. Exelon and PADEP anticipate having several meetings between now and May 15, 2018 to discuss what upgrades may be needed to make the site permanent. With PADEP's agreement, Exelon will set up the Octoraro Creek facility in the same configuration as the last three years, and begin operation on May 1, 2018 and run through September 15, 2018.

PADEP has provided an email of their concurrence with the above plan to develop a schedule and provide it to FERC by May 15, 2018. A copy of the email is attached.

Please contact me at 267.533.1125 or Andrea.Danucalov@exeloncorp.com.

Sincerely Yours,

Andrea Danucalov
FERC License Compliance Manager
Exelon Power
300 Exelon Way
Kennett Square, PA 19348

FEDERAL ENERGY REGULATORY COMMISSION
Washington, D. C. 20426

OFFICE OF ENERGY PROJECTS

Project No. 2355-026–Pennsylvania
Muddy Run Pumped Storage Project
Exelon Generation Company, LLC

December 12, 2018

Christopher Wilson, Director
Exelon Generation Company, LLC
101 Constitution Avenue NW
Suite 400 East
Washington, DC 20001

Subject: 2017 Eel Trapping Supplemental Filing

Dear Mr. Wilson:

This letter is in reference to your supplement to the 2017 American Eel Collection Facility in Octoraro Creek Report and 2017 Conowingo Eel Collection Facility Report, filed with the Federal Energy Regulatory Commission (Commission) on June 29, 2018 for the Muddy Run Pumped Storage Project No. 2355.[1] Section III of the project's Water Quality Certification (WQC)[2] and section VIII of the U.S. Department of the Interior's fishway prescription[3] require various American eel protection measures, including the construction and operation of eel trapping facilities at the Conowingo Hydroelectric Project No. 405 tailrace and near Octoraro Creek for the purpose of stocking eels upstream. The Octoraro Creek facility, a temporary facility, was assessed after three years to determine its effectiveness for collecting juvenile eels to supplement eels collected at the Conowingo facility. Your 2017 American Eel Collection Facility in Octoraro Creek Report and 2017 Conowingo Eel Collection Facility Report were filed with the Commission on January 9, 2018, and based on the high number of eels collected and the high survivorship of those eels, you concluded that the Octoraro facility location is suitable for a permanent eel collection facility. As such, you began consultation with the Pennsylvania Department of Environmental Protection (Pennsylvania DEP) regarding a schedule for the installation of a permanent eel trapping facility at Octoraro Creek.

[1] Order Issuing New License (153 FERC ¶ 62,232), issued December 22, 2015.

[2] See Appendix A of the Order Issuing New License.

[3] See Appendix B of the Order Issuing New License.

On March 1, 2018, we requested that you provide a plan and schedule as the project WQC did not specify a deadline. Your filing indicates that you have consulted with the Pennsylvania DEP and determined a schedule to update the existing facilities, in order to make them permanent, prior to the 2019 eel passage season which begins May 1, 2019. The filing includes design drawings and interim deadlines for milestones such as obtaining permits and ordering equipment. Your plan and schedule appears reasonable and has been approved by the Pennsylvania DEP.

Thank you for your cooperation. Review of your filing indicates that it fulfils our March 1, 2018 request. If you have any questions regarding this matter, please contact me at (202) 503-8038 or Alicia.Burtner@ferc.gov.

Sincerely,

Alicia Burtner
Aquatic Resources Branch
Division of Hydropower Administration
and Compliance

NORMANDEAU
environmental consultants

Suggested Modifications to the Octoraro Eel Ramp for Conversion to a Permanent Facility

1. Install larger collection tank with removable center divider screen (to differentiate eels using Enkamat or Milieu substrate; divider screen may not be necessary if no longer required by Agencies). * Normandeau currently investigating proper tank dimensions to accommodate space constraints on platform. May need to custom fabricate a tank from the manufacturer that designed and built the tanks for the Conowingo West Eel Facility. Initial idea is for tank to have 100 to 120 gallon capacity (400 to 480 liters) which would accommodate approximately 4,000 juvenile eels. Approximate tank dimensions: 60"x22"x19".

   a. Two (2) screened 3" overflow discharge lines that exit collection tank from the front (creek-side of tank) to avoid any bends or kinks in the lines as eel scent water is returned back to ramps.

   b. Customized tank lid to prevent eel escapement.

   c. Flush drain with "ball valve" on new collection tank to expedite eel removal.

2. Replace 1.5" water supply line with a 2" line to match pump capacity.

   a. Requires current buried line to be excavated and replaced.

3. Install an electric line in its own conduit beside the new 2" water supply hose for powering the aeration system instead of relying on battery or solar power. Back-up aeration system will also be considered (battery and solar panel or Oxygen bottle—dependent upon space constraints on the platform due to installation of larger collection tank).

4. Install stairs to the eel ramp platform for safer work site access.

5. With CWA approval, provide some type of shade canopy over the eel collection facility that does not impede installation or removal of the eel ramp as it is carried up and down the proposed stairway.

U.S. Geological Survey - Ecosystems

Leetown Science Center
S. O. Conte Anadromous Fish Research Laboratory
1 Migratory Way/P.O. Box 796
Turners Falls, MA 01376 USA

24 May 2018

Jeremy Miller
Department of Environmental Protection | Clean Water Program
Southcentral Regional Office
909 Elmerton Ave, Harrisburg PA 17110

Jeremy,

Per your request on May 21, 2018, I am providing these comments based on my review of: 1) the report, *Muddy Run Pumped Storage Project - Evaluation of Temporary American Eel Collection Facility in Octoraro Creek, (Year 3); FERC Project No. 2355* (prepared by Normandeau Associates, Inc. for Exelon; and 2) design plans titled *Octoraro Creek American Eel Upstream Trapping Facility*; drafted 3/3/15 to 5/15/15 by Gomez and Sullivan Engineers for Exelon, both supplied to me by you on May 21, 2018. I am assuming that in addition to the design plans, the general design of the ramp pass is intended to emulate features of the ramp pass used in the 2017 studies, as described in the Exelon report.

1) **Siting:** the ramp entrance is located along the left bank, a considerable distance downstream of the dam. Ideally the entrance should be located at the base of the dam (e.g., at the location marked as "Existing eel ramp location" in Drawing 1 of the Gomez and Sullivan plans) to maximize attractiveness to dam spill flow and minimize entry delays. From the Exelon Report, it appears that the proposed location can in fact result in collection of considerable numbers of eels (>~10,000 per year), but the location of the pass is still technically suboptimal. I understand there may be physical reasons why the ramp pass cannot be sited at the base of the dam (i.e., exposure to spill flows, aesthetics, etc.), but if there is no significant reason that the entrance cannot be sited at the base of the dam, an effort should be made to do so.

2) **Entrance conditions:** The ramp entrances are located along the bank but extend out from the existing bank a considerable distance. "Large stone" is proposed to be placed upstream on the ramps to effectively extend the bank to the junction of the ramp entrance and the nominal water level. This "bank extension" should help increase attractiveness, but may need to be more extensive (e.g., as a "wing wall") to better integrate the ramp into the "bank" and direct eels ascending along the bank towards the ramp entrance. Again, inclusion of an artificial extended bank may not be as effective as locating the entrance at

the base of the dam.

3) **Ramp:** The proposed ramp is a 20 ft. long, single-flight double ramp with two different climbing substrates, with each ramp 24" wide and at a slope of 34 degrees. I assume the 20 ft length of the ramp is required to accommodate fluctuations in tailwater level, otherwise the ramp could potentially be made shorter. Attraction flow is proposed at 67 gpm, supposedly split between both ramps. In general, the ramp architecture should be adequate for a ramp of this size and capacity, for a site of this scale. However, given that the width of the ramps will be increased from 12" (2017 study) to 24", I would recommend that attraction flow to each ramp be doubled (67 gpm **for each ramp**). Adequate attraction flow for eel ramps may be as critical as siting, especially for ramps sited at suboptimal locations. An increase in ramp attraction flow (to 148-673 gpm) at the comparably-sized Holyoke Dam South Hadley eel ramp in 2007 resulted in substantial increases in catch (HG&E 2008). No specific details are given as to how attraction flow will be introduced and regulated into the entrance of the ramp. The ramp cover should extend down the entire ramp to within 1 ft of the tailrace high water level; the ramp cover should never be submerged at any flow condition.

4) **Substrates:** Akwadrain strip drain and Enkamat 7010 substrates are proposed for each ramp. For the 2017 study, Milieu 1" vertical tube substrate was used instead of Akwadrain. Although the Milieu substrate showed some selectivity against smaller eel sizes (and may have prompted the choice of the Akwadrain alternative), Akwadrain is not an optimal long-term substrate, and has not been evaluated for selectivity. I would recommend using the Milieu substrate instead of Akwadrain, given its past track record and durability. Design engineers and operators should consider the possibility of replacing one or both substrates in the future as better climbing substrates are developed.

5) **Ramp exit:** The apex of the ramp exit is shown as a ½" radius. I would recommend a 1" radius, which may reduce hesitation of eels to pass over the apex. Also, a spray bar ramp flow introduction system is proposed; I would recommend instead using a manifold multiple flexible Loc-Line nozzles (each with a flow control valve) with an overshot apex design (*see attachment*) instead of a spray bar (easier to regulate apex/ramp flow, less hesitation of eels to pass over the apex). Climbing substrate should extend as close to the ramp apex as possible, with a smooth transition to the apex, and the substrate sealed to the ramp floor to prevent eels from moving back down the ramp underneath the substrate. The "fall off" ramp extending into the trap box could be at a steeper angle than 45 degrees (e.g. 30 degrees relative to vertical) and should be designed to accommodate an overshot-type flow introduction system. The fall-off ramp should extend to below the top of the tank, and water level inside the tank should be at least 6 inches below the end of the fall-off ramp and at least 12 inches below the top of the tank, to prevent eels from escaping the trap box. The ramp cover should extend over the apex of the ramp and partially down the fall-off ramp.

6) **Trap box:** Trap boxes (I am assuming two trap boxes, one for each ramp, or a single

tank box of double volume with an internal divider if separated catch from each ramp is desired) are 19" H x 16" W x 48" L. Tank water depth is not specified. These boxes are probably undersized for daily catches of >1000 eels averaging 130-140 mm TL (maximum daily numbers from the 2017 study), and catches may increase in future years. I would recommend the wetted volume of each of the two boxes be increased by 3 or 4 times. Overflow from the trap box should be routed back into the ramp, to increase attractiveness (odor of trapped conspecifics). The trap box should have an internal lip or other structure to prevent eels that attempt to climb the wetted or damp box walls from escaping. The trap box should be protected against vandals and predators; shading of the box (e.g., an opaque roof structure) to prevent water overheating in direct sunlight is recommended, as well as supplemental emergency aeration.

7) **Operation:** Operation dates for the eel pass are not given; this is an agency decision but based on the 2008-2016 weekly catch data in the report (Fig. 2.0-3), the eel pass should be operated daily from *at least* mid-May to early September; possibly longer. Given the potential for large numbers of eels to be trapped throughout the season, the trap boxes should be checked and emptied daily. Other maintenance (cleaning of box screening, checks of ramp flows, regular cleaning of any debris accumulating in water supply lines) should be done on a regular (daily to weekly) basis.

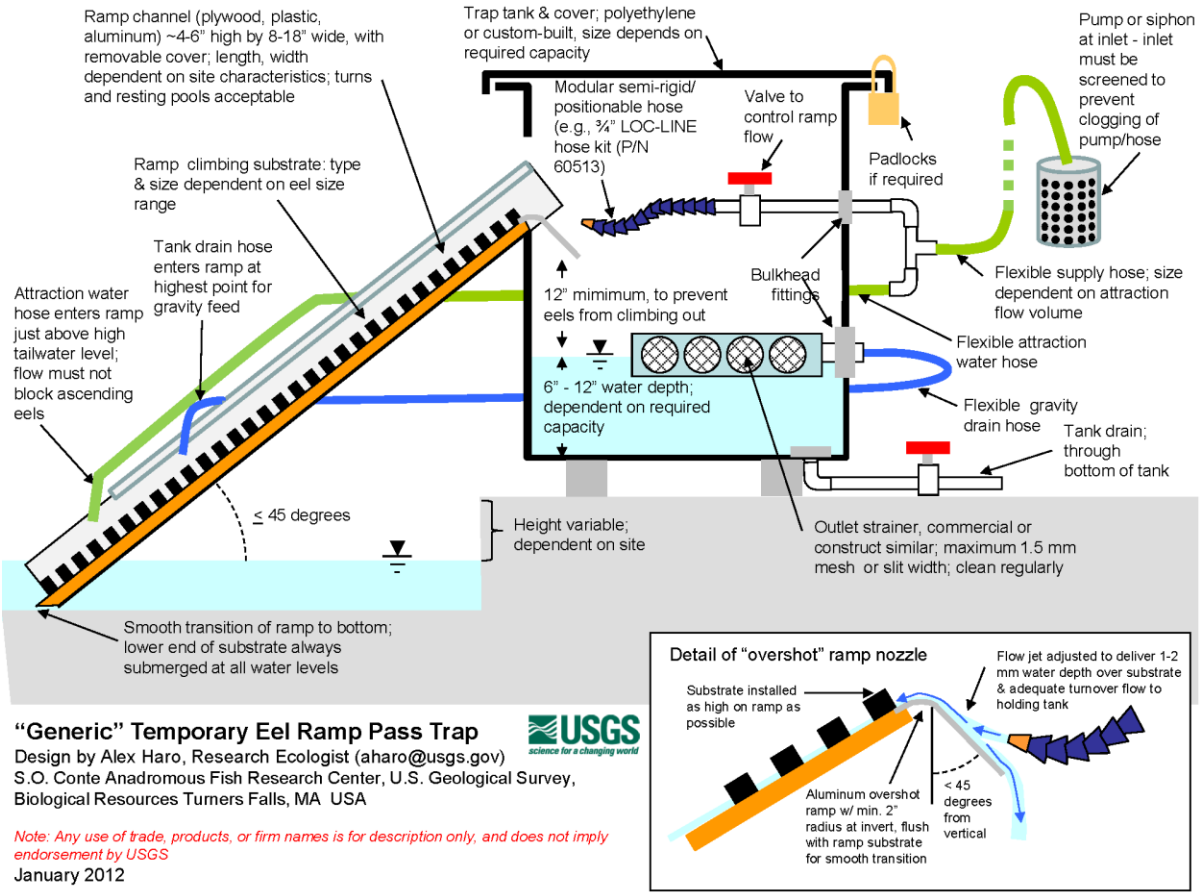
I would be happy to answer questions or conduct further reviews of revised or more detailed design plans if requested.

Sincerely,

Alex Haro, Ph.D.
Research Ecologist
(413) 863-3806
fax (413) 863-9810
email aharo@usgs.gov

Reference:

HG&E (Holyoke Gas and Electric Dept.) 2008. Survey for Upstream American Eel Passage at Holyoke Dam, Connecticut River, Massachusetts, 2007. Prepared by Normandeau Associates, Westmoreland, NH. Normandeau Project Number 20997.000



"Generic" Temporary Eel Ramp Pass Trap

Design by Alex Haro, Research Ecologist (aharo@usgs.gov)
S.O. Conte Anadromous Fish Research Center, U.S. Geological Survey,
Biological Resources Turners Falls, MA USA

Note: Any use of trade, products, or firm names is for description only, and does not imply endorsement by USGS

January 2012

Exelon Generation

July 18, 2018

Sharon L. Fillmann
Chief of Treatment and Pumping
Chester Water Authority
100 Ashville Road
Nottingham, PA 19362

RE: License Agreement to Use and Access Lands for Placement of an Eel Ladder Proposed Modifications to Eel Ladder and Collection Facilities

Dear Ms. Fillmann:

As discussed previously, Exelon Generation Company, LLC ("Exelon") would like to make certain modifications to the temporary eel ladder and collection facilities located at the low-head Pine Grove Dam to convert the current temporary facilities to permanent facilities, as required by the new Federal Energy Regulatory Commission ("FERC") license for the Muddy Run Pumped Storage Project. Section 15 of the License Agreement to Use and Access Lands for Placement of an Eel Ladder ("License Agreement") between Exelon and the Chester Water Authority ("Authority"), dated as of May 21, 2015, provides that Exelon may not "materially modify or alter" the eel ladder and collection facilities without the prior written approval of the Authority, which approval shall not be unreasonably withheld or delayed. Accordingly, Exelon seeks the Authority's approval to:

- Install a larger collection tank, likely with a removable center divider screen. The larger collection tank is expected to have approximate dimensions of: 60"x22"x19". The larger collection tank also would have:
    - Two screened 3" overflow discharge lines exiting the collection tank from the front (creek-side of tank).
    - A customized tank lid to prevent eel escape.
    - A flush drain with "ball valve" to expedite eel removal.
- Replace the current 1.5" water supply line with a 2" line to match pump capacity. This would require the current buried line to be excavated and replaced.
- Install an electric line in its own conduit beside the new 2" water supply hose for powering the aeration system instead of relying on battery or solar power and, if needed, a back-up

Active 36370688.2

aeration system (battery and solar panel or Oxygen bottle—dependent upon space constraints on the platform due to installation of the larger collection tank).

- Install stairs to the eel ramp platform for safer work site access.
- Replace the platform and scaffolding with a deck, railing, and a shade canopy or roof over the eel collection facility.
- Add large rocks in the water to the end of the eel ramp.

Drawings depicting the proposed modifications are attached.

If the above modifications are acceptable to the Authority, Exelon also would like to discuss amending the License Agreement to reflect the conversion of the eel ladder and collection facilities from temporary to permanent facilities. Specifically, Section 1 of the License Agreement states that the eel ladder and collection facilities are depicted in Attachment 2 of the License Agreement and "shall be temporary structures." Exelon proposes to strike the phrase "shall be temporary structures" from Section 1. Exelon also proposes to extend the term of the License Agreement until November 30, 2055 so that the License Agreement will remain valid during the entire term of the new FERC license.

Please do not hesitate to contact me with any questions regarding this letter or the proposed modifications to the eel ladder and collection facilities.

Sincerely,

Andrea Danucalov
FERC License Compliance Manager
Exelon Generation
300 Exelon Way
Kennett Square, PA 19348
Office: 267.533.1125
Cell: 610.301.1664
Email: andrea.danucalov@exeloncorp.com

cc: Colleen Hicks, Exelon

NORMANDEAU
environmental consultants

Suggested Modifications to the Octoraro Eel Ramp for Conversion to a Permanent Facility

1. Install larger collection tank with removable center divider screen (to differentiate eels using Enkamat or Milieu substrate; divider screen may not be necessary if no longer required by Agencies). * Normandeau currently investigating proper tank dimensions to accommodate space constraints on platform. May need to custom fabricate a tank from the manufacturer that designed and built the tanks for the Conowingo West Eel Facility. Initial idea is for tank to have 100 to 120 gallon capacity (400 to 480 liters) which would accommodate approximately 4,000 juvenile eels. Approximate tank dimensions: 60"x22"x19".

   a. Two (2) screened 3" overflow discharge lines that exit collection tank from the front (creek-side of tank) to avoid any bends or kinks in the lines as eel scent water is returned back to ramps.

   b. Customized tank lid to prevent eel escapement.

   c. Flush drain with "ball valve" on new collection tank to expedite eel removal.

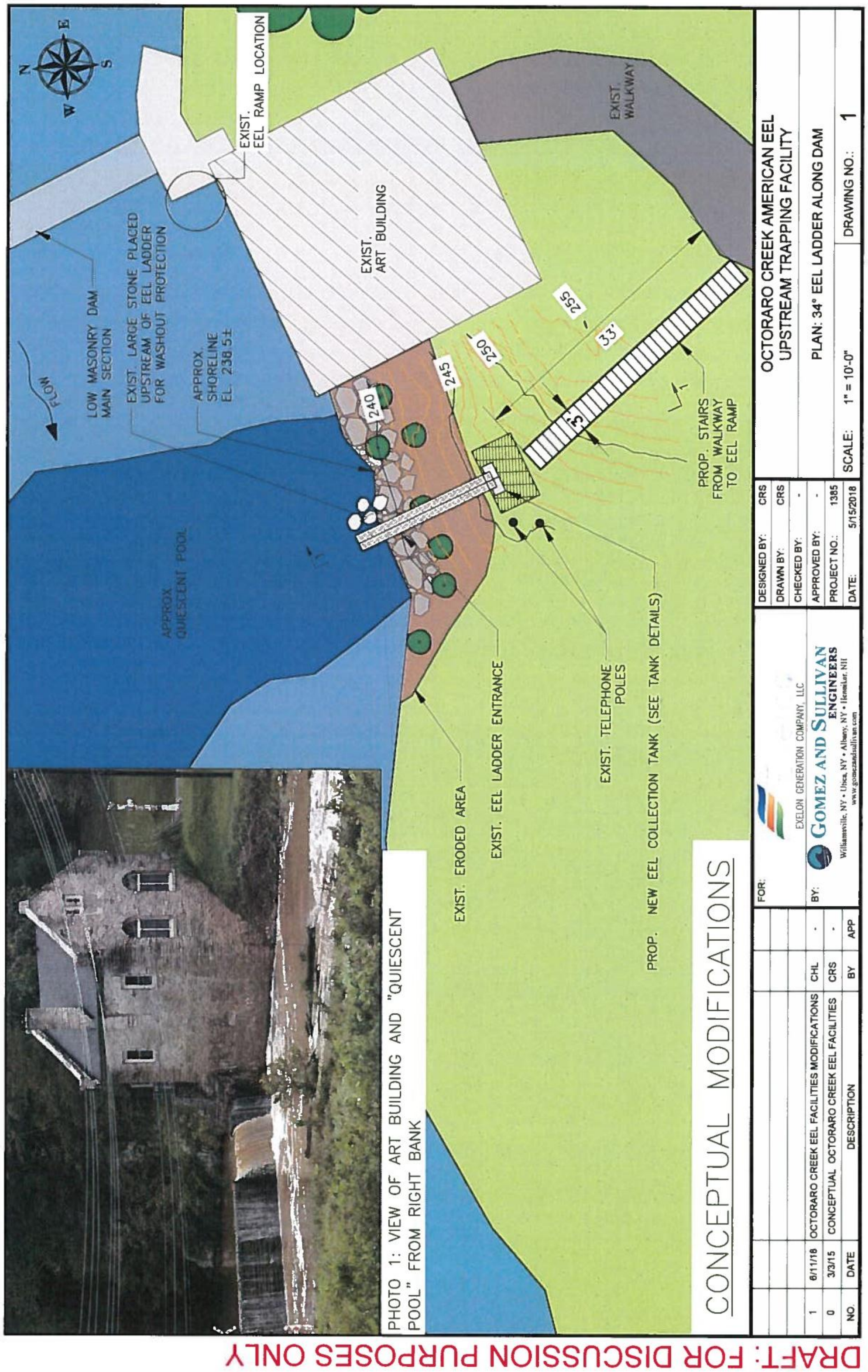
2. Replace 1.5" water supply line with a 2" line to match pump capacity.

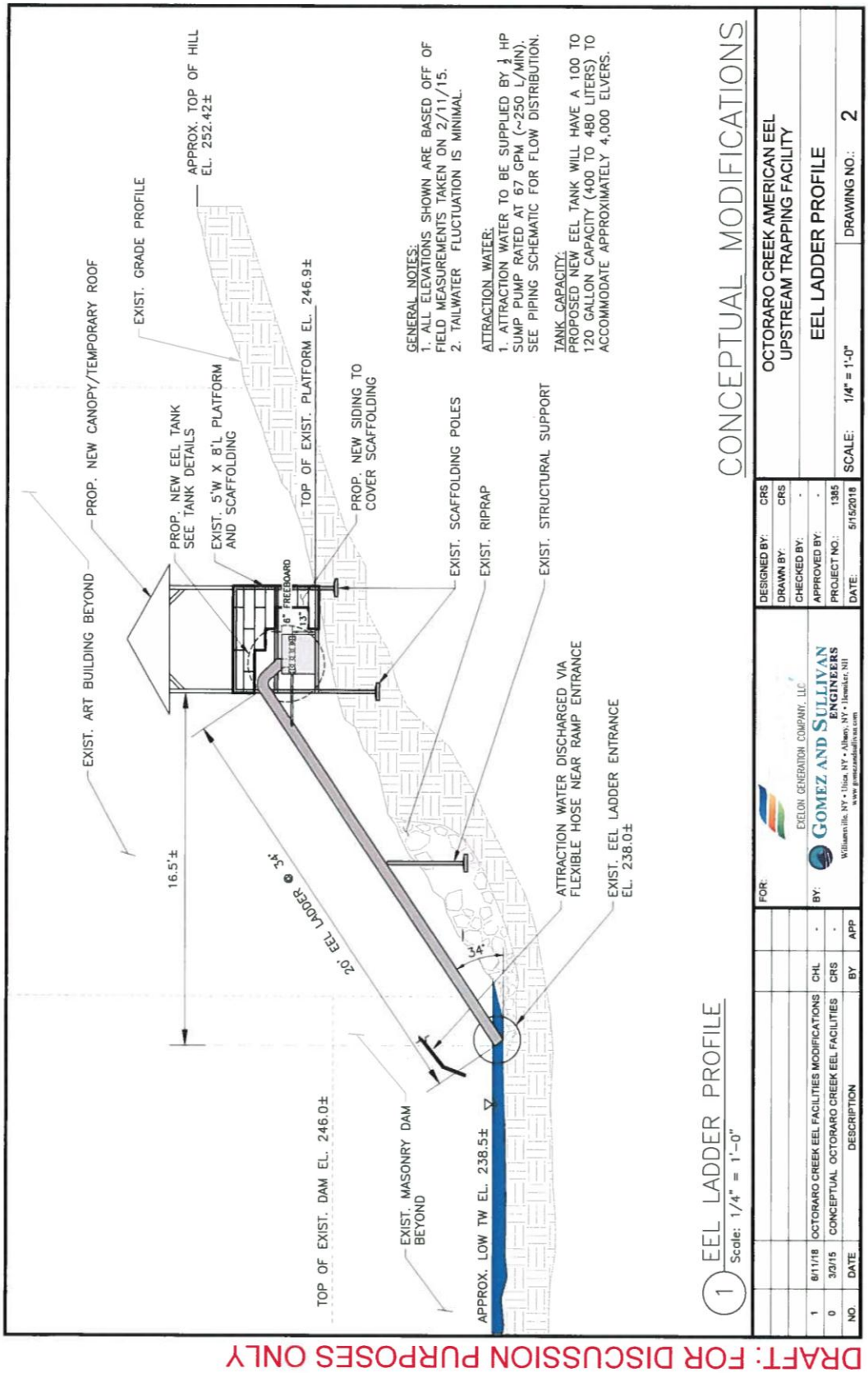
   a. Requires current buried line to be excavated and replaced.

3. Install an electric line in its own conduit beside the new 2" water supply hose for powering the aeration system instead of relying on battery or solar power. Back-up aeration system will also be considered (battery and solar panel or Oxygen bottle—dependent upon space constraints on the platform due to installation of larger collection tank).

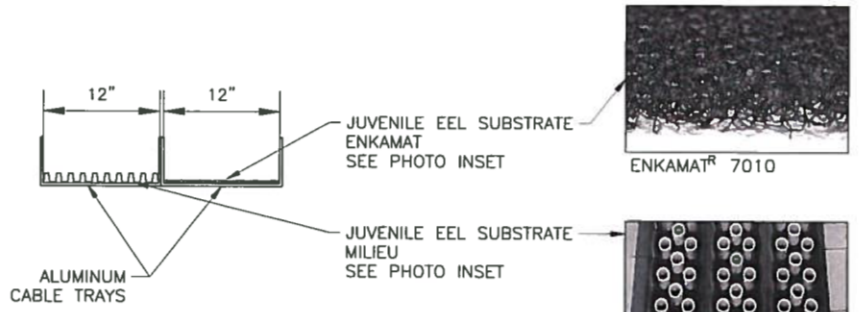
4. Install stairs to the eel ramp platform for safer work site access.

5. With CWA approval, provide some type of shade canopy over the eel collection facility that does not impede installation or removal of the eel ramp as it is carried up and down the proposed stairway.

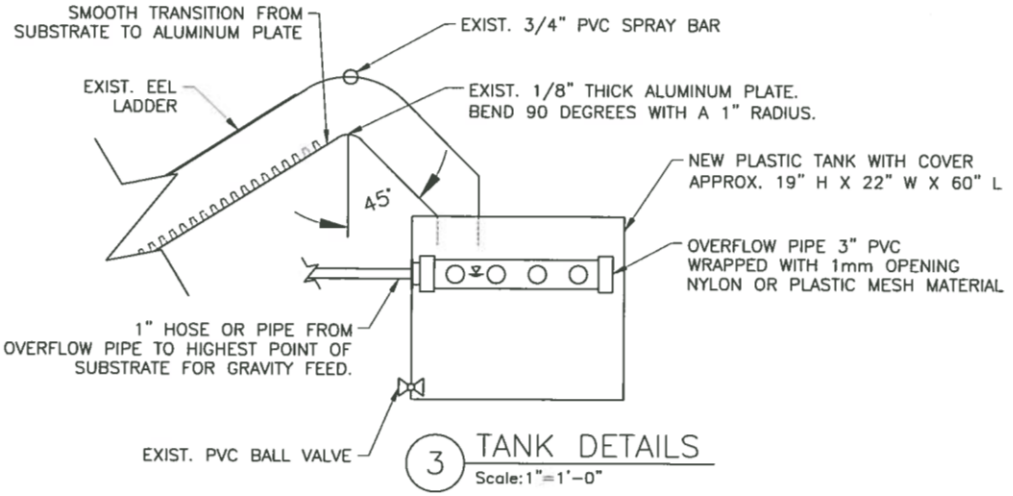

OCTORARO CREEK AMERICAN EEL
UPSTREAM TRAPPING FACILITY
PLAN: 34° EEL LADDER ALONG DAM
SCALE: 1" = 10'-0"
DRAWING NO.: 1
DESIGNED BY: CRS
DRAWN BY: CRS
CHECKED BY: -
APPROVED BY: -
PROJECT NO.: 1385
DATE: 5/15/2018
FOR:
EXELON GENERATION COMPANY, LLC
BY:
GOMEZ AND SULLIVAN ENGINEERS
1 6/11/18 OCTORARO CREEK EEL FACILITIES MODIFICATIONS CHL -
0 3/3/15 CONCEPTUAL OCTORARO CREEK EEL FACILITIES CRS -
NO. DATE DESCRIPTION BY APP
CONCEPTUAL MODIFICATIONS
PHOTO 1: VIEW OF ART BUILDING AND "QUIESCENT POOL" FROM RIGHT BANK
EXIST. ERODED AREA
EXIST. EEL LADDER ENTRANCE
EXIST. TELEPHONE POLES
PROP. NEW EEL COLLECTION TANK (SEE TANK DETAILS)
PROP. STAIRS FROM WALKWAY TO EEL RAMP
APPROX. QUIESCENT POOL
FLOW
LOW MASONRY DAM MAIN SECTION
EXIST. LARGE STONE PLACED UPSTREAM OF EEL LADDER FOR WASHOUT PROTECTION
APPROX. SHORELINE EL. 238.5±
EXIST. ART BUILDING
EXIST. EEL RAMP LOCATION
EXIST. WALKWAY
240
245
250
255
33'
3'
DRAFT: FOR DISCUSSION PURPOSES ONLY



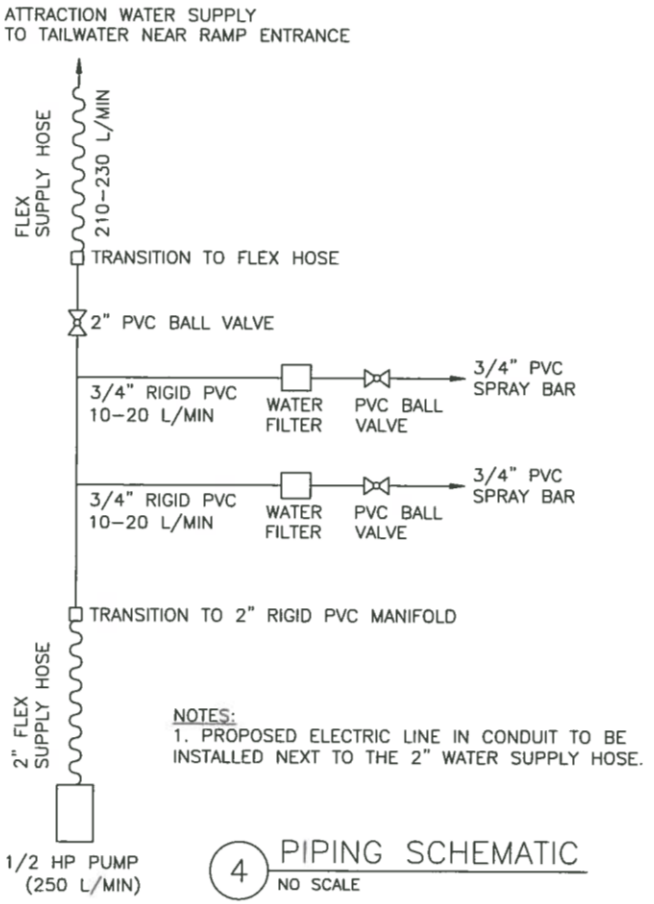
DRAFT: FOR DISCUSSION PURPOSES ONLY



2 EEL LADDER SECTION (TYPICAL)
Scale: 1"=1'-0"



3 TANK DETAILS
Scale: 1"=1'-0"



NOTES:
1. PROPOSED ELECTRIC LINE IN CONDUIT TO BE INSTALLED NEXT TO THE 2" WATER SUPPLY HOSE.

4 PIPING SCHEMATIC
NO SCALE

CONCEPTUAL MODIFICATIONS

NO.	DATE	DESCRIPTION	BY	APP
1	6/11/18	OCTORARO CREEK EEL FACILITIES MODIFICATIONS	CHL	-
0	3/3/15	CONCEPTUAL OCTORARO CREEK EEL FACILITIES	CRS	-

FOR: EXELON GENERATION COMPANY, LLC

BY: GOMEZ AND SULLIVAN ENGINEERS
Williamsville, NY • Utica, NY • Albany, NY • Henniker, NH
www.gomezandsullivan.com

DESIGNED BY:	CRS
DRAWN BY:	CRS
CHECKED BY:	-
APPROVED BY:	-
PROJECT NO.:	1385
DATE:	3/3/2015

OCTORARO CREEK AMERICAN EEL
UPSTREAM TRAPPING FACILITY

TYPICAL EEL LADDER SECTION AND DETAILS

SCALE: 1" = 1'-0"

DRAWING NO.: 3

Appendix E:
Agency Comments on Draft 2018 Octoraro Creek Eel Ramp Collection Report

Mike Martinek

Subject: FW: 2018 Exelon Conowingo Eel Ramp Collection Report and Appendices
Attachments: SRBC comments on Muddy Run Pumped Storage Project Periodic Evaluation of Upstream Stream Segments 2018.docx; SRBC comments on Muddy Run Pumped Storage Project American Eel Collection Facility in Octoraro Creek.docx; SRBC comments on Muddy Run Pumped Storage project Conowingo Eel Collection Facility 2018.docx

From: Henning, Aaron [mailto:ahenning@srbc.net]
Sent: Thursday, December 13, 2018 3:13 PM
To: Danucalov, Andrea H:(GenCo-Pwr) <Andrea.Danucalov@exeloncorp.com>
Cc: Bjorn Lake - NOAA Federal <bjorn.lake@noaa.gov>; Bob A. Sadzinski <bob.sadzinski@maryland.gov>; David Lemon <david.lemon@dec.ny.gov>; Don Pugh <don.pugh@outlook.com>; Jesus Morales <Jesus_Morales@fws.gov>; Mccollum, Allyson <amccollum@pa.gov>; Mike.Cox@ERM.com; Miller, Jeremy <jeremmille@pa.gov>; Richard McCorkle <richard_mccorkle@fws.gov>; Rob Bourdon <robert.bourdon@maryland.gov>; Shawn Seaman -DNR- <shawn.seaman@maryland.gov>; Steve Schreiner <sschreiner@versar.com>; Tryninewski, Joshua <jtryninews@pa.gov>; Williamson, Scott <scwilliams@pa.gov>; Shank, Matthew <mshank@srbc.net>; Sheila Eyler (sheila_eyler@fws.gov) <sheila_eyler@fws.gov>
Subject: RE: 2018 Exelon Conowingo Eel Ramp Collection Report and Appendices

Andrea,

Thank you for the opportunity to comment on these reports. The Susquehanna River Basin Commission's comments on these two reports as well as the Periodic Evaluation of Upstream Stream Segments are attached. If you have any questions or feedback on these comments feel free to contact me directly.

Aaron

Aaron Henning
Aquatic Biologist
Susquehanna River Basin Commission
4423 North Front St.
Harrisburg, PA 17110
Office: (717) 238-0423 ext.1184
Mobile: (717) 884-5937
ahenning@srbc.net

From: Danucalov, Andrea H:(GenCo-Pwr) [mailto:Andrea.Danucalov@exeloncorp.com]
Sent: Thursday, November 15, 2018 1:04 PM
To: Erin Redding; 'Avalos, Chris'; Elisabeth Bleistine; Bleistine, Ray; Mike.Cox@ERM.com; David Frazier; 'Eyler, Sheila'; Henning, Aaron; Hicks, Colleen E:(GenCo-Pwr); Ian Kiraly; jesus_morales@fws.gov; Martinek, Michael; 'McCollum, Allyson'; 'McCorkle, Richard'; 'Miller, Jeremy'; 'Minkkinen, Steve'; Peifer, Cheri A:(GenCo-Pwr); Royer, Doug; 'Sadzinski, Robert'; 'Seaman, Shawn'; Shank, Matthew; 'Slowik, Adam'; Smith, Fred P:(GenCo-Pwr); Kirk Smith; 'Tryninewski, Joshua'; White, Eric; 'Williamson, Scott'
Subject: 2018 Exelon Conowingo Eel Ramp Collection Report and Appendices

All,

Please see attached 2018 Conowingo Eel Ramp Collection Report and appendices. We are still waiting for the age analysis and will update as soon as we have that information.

1

Please provide comments by Friday, December 14, 2018 so that we can finalize the report for submittal to FERC.

Please let me know if you have any questions.

Thanks

Andrea

Andrea Danucalov
FERC License Compliance Manager

Exelon.

Exelon Generation
300 Exelon Way
Kennett Square, PA 19348
New Phone Number - Skype: 267.533.1125
Fax: 610.765.5805
Cell: 610.301.1664
andrea.danucalov@exeloncorp.com

SRBC comments on Muddy Run Pumped Storage Project American Eel Collection Facility in Octoraro Creek, 2018

- When making the modifications to operate the Octoraro Collection Facility as a 'permanent' facility please allow for flexibility in design providing as much additional attraction flow as practical given site conditions. As noted on page 5 of the report the relationship between stream flow and eel catch is quite clear. However maintaining a consistent and low level of attraction flow at the ramp relative to current stream flow conditions results in a greatly diminished overall attraction flow detectability.

- Related to the previous comment, please examine the relationship between attraction flow as a % of stream flow and eel catch.

- Please report attraction flow volumes in gallons per minute rather than liters per minute to maintain consistency with the data reported from the Conowingo collection facility

- In future reports when performing the daily ramp checks please note if generation is occurring at the CWA's hydroelectric turbine at the site

- If possible please collect a daily turbidity observation, reported in NTUs, from Octoraro Creek when performing ramp checks

Mike Martinek

Subject: FW: [EXTERNAL] FWS Comments on Exelon Reports

From: Eyler, Sheila [mailto:sheila_eyler@fws.gov]
Sent: Friday, December 14, 2018 1:46 PM
To: Danucalov, Andrea H:(GenCo-Pwr) <Andrea.Danucalov@exeloncorp.com>
Subject: [EXTERNAL] FWS Comments on Exelon Reports

Good afternoon Andrea,

Thank you for the opportunity to review several study reports related to the license requirements for Muddy Run Pumped Storage Facility and Conowingo Dam. The U.S. Fish and Wildlife Service offers the following specific comments and edits to the reports:

2018 Octoraro Creek Eel Ramp Collection Report
Attraction flow should be reported in gallons per minute in the report. Also, per discussion at the meeting held on December 11, 2018 between Exelon and the Resource Agencies, Exelon will need to increase attraction flow that will be provided to the permanent eel passage facility on the Octoraro. Current attraction flow at the temporary facility averages 81.8 L/min, where the design specifications for attraction flow at the project is 210-230 L/min (see report Pg 8, Section 5, Paragraph 2). The upper end of the target attraction flow range, 230 L/min, converts to <61 gal/min and would be more acceptable than what is currently being implemented at Octoraro. We recommend that Exelon/Normandeau address this issue to at least achieve the target attraction flow of 210-230 L/min. The plan to replace the 1.5" water supply line with a 2" line to match pump capacity, as a part of conversion to a permanent facility, may help to address this issue, but additional modifications (i.e. larger pump, increased supply line size, etc.) may be required to achieve the design specifications.

2018 Conowingo Eel Ramp Collection Report
No specific changes are recommended for the report, however, we support the plan to increase transport frequency to at least twice per week between June 15 and September 1. We also support daily transports when air temperatures are forecasted to be above 32 degrees C for three straight days and/or when water temperature is above 29 degrees C. With respect to the thresholds for daily transports, we recommend future consideration for lower thresholds if mortality events continue to occur during high air and water temperature periods.

2018 Periodic Evaluation of Upstream Stream Segments
FWS recommends that more information be included in Section 3.3 (Sampling Data and Collection) of the report. If the information is available from field collections, include more details on electrofishing methods, including the size of the sites that were blocked off and a spatial estimate of coverage for the site (length and average width of the site). Also include a spatial estimate of coverage (i.e. the percentage of blocked off area was covered during sampling). It appears that no portions of the site were subject to electrofishing more than once during the 30 minute time period (i.e. only 1 upstream pass was conducted), so the methods should be more explicit to indicate that effort. The methods for determining Habitat Suitability Scores should also be described in this section or reference a document where those methods can be accessed.

Muddy Run FPOP Annual Report – 2018
Please modify Pg 1-1, paragraph 4, line 2 to "United States Fish and Wildlife Service." Please submit the operational data (Appendix A) to the FWS in an Excel spreadsheet format as the link to the data in the report was inaccessible. FWS would also like to discuss the feasibility of adding peak hourly discharge and withdrawal along with the currently reported hourly averaged discharge and withdrawals in cfs in the spreadsheet.

1

Upstream and Downstream Adult Shad Telemetry
Comments on those reports will be submitted to Exelon no later than January 25, 2019.

Please let me know if you have any questions or require further clarification on the items described above.

Sheila Eyler
U.S. Fish & Wildlife Service
Mid-Atlantic Fish and Wildlife Conservation Office
177 Admiral Cochrane Dr., Annapolis, MD 21401
410-573-4554 (O)
717-387-2117 (C)
Sheila_Eyler@fws.gov

Mike Martinek

Subject: FW: Exelon - Muddy Run - EPAG and American Shad Studies Report Due Dates

From: Miller, Jeremy [mailto:jeremmille@pa.gov]
Sent: Friday, December 14, 2018 12:23 PM
To: Danucalov, Andrea H:(GenCo-Pwr) <Andrea.Danucalov@exeloncorp.com>; Ray Bleistine <rbleistine@normandeau.com>; Kirk Smith <ksmith@gomezandsullivan.com>
Cc: Williamson, Scott <scwilliams@pa.gov>; Mccollum, Allyson <amccollum@pa.gov>; Sheila Eyler <Sheila_Eyler@fws.gov>; Tryninewski, Joshua <jtryninews@pa.gov>; Shawn Seaman -DNR- <shawn.seaman@maryland.gov>; Aaron Henning <ahenning@srbc.net>; Richard McCorkle <richard_mccorkle@fws.gov>
Subject: RE: Exelon - Muddy Run - EPAG and American Shad Studies Report Due Dates

Andrea,

DEP offers the following comments for your review in regards to the Muddy Run Pumped Storage Project (FERC Project 2355 & PADEP 401 WQC EA 36-033) 2018 reports:

2018 Octoraro Creek Eel Ramp Collection Report-

1. Please convert liters per minute (L/min) to gallons per minute (gpm) in Table 4.6-1: Calibration of Flows and second paragraph under Discussion. This change will allow both the Conowingo and Octoraro reports to be consistent.
2. In Figure 4.4-4 Dissolved Oxygen was lower then head pond during 5/8-5/15 and again 9/4. Please explain why this occurred.

2018 Conowingo Eel Ramp Collection Report- No Comments

2018 Periodic Evaluation of Upstream Stream Segments Report-

1. The report did not mention what fish sampling protocol was used in the study. In an email dated November 20, 2017 from DEP to Exelon sampling guidance from either PADEP's semi-quantitative wadeable fish sampling protocol or SRBC's single-unit multiple-pass width based protocol was to be used with only one protocol being implemented across all sample sites. Please revise 2018 report to reflect chosen protocol and include any completed field data sheets.

2018 FPOP Annual Report- No comments

Comments in regards to the Muddy Run American Shad Radio Telemetry Study will submitted at a later date.

Thanks,
Jeremy

Jeremy Miller | Aquatic Biologist II
Department of Environmental Protection | Clean Water Program
Southcentral Regional Office
909 Elmerton Ave. | Hbg PA 17110

1

Phone: 717.705.4777 | Fax: 717.705.4760
www.dep.pa.gov

From: Danucalov, Andrea H:(GenCo-Pwr) <Andrea.Danucalov@exeloncorp.com>
Sent: Friday, November 16, 2018 4:27 PM
To: Erin Redding <eredding@gomezandsullivan.com>; 'Avalos, Chris' <cavalos@normandeau.com>; Elisabeth Bleistine <ebleistine@gomezandsullivan.com>; Bleistine, Ray <rbleistine@normandeau.com>; Mike.Cox@ERM.com; David Frazier <dfrazier@gomezandsullivan.com>; Sheila Eyler <Sheila_Eyler@fws.gov>; Aaron Henning <ahenning@srbc.net>; Hicks, Colleen E:(GenCo-Pwr) <Colleen.Hicks@exeloncorp.com>; Ian Kiraly <ikiraly@gomezandsullivan.com>; jesus_morales@fws.gov; Martinek, Michael <mmartinek@normandeau.com>; Mccollum, Allyson <amccollum@pa.gov>; 'McCorkle, Richard' <richard_mccorkle@fws.gov>; Miller, Jeremy <jeremmille@pa.gov>; 'Minkkinen, Steve' <steve_minkkinen@fws.gov>; Peifer, Cheri A:(GenCo-Pwr) <Cheri.Peifer@exeloncorp.com>; Royer, Doug <droyer@normandeau.com>; 'Sadzinski, Robert' <bob.sadzinski@maryland.gov>; 'Seaman, Shawn' <shawn.seaman@maryland.gov>; 'Shank, Matt' <mshank@srbc.net>; 'Slowik, Adam' <aslowik@normandeau.com>; Smith, Fred P:(GenCo-Pwr) <fredp.smith@exeloncorp.com>; Kirk Smith <ksmith@gomezandsullivan.com>; Tryninewski, Joshua <jtryninews@pa.gov>; White, Eric <ewhite@normandeau.com>; Williamson, Scott <scwilliams@pa.gov>
Subject: Exelon - Muddy Run - EPAG and American Shad Studies Report Due Dates

All,

As we discussed on the EPAG call yesterday, please find attached a table with the reports that have been emailed and corresponding Resource Agency and FERC filing dates.

Report/Study Plan Title	Date Exelon Emailed	Comments from Resource Agencies/Submit to Exelon	Resource Agency Filing Date	FERC Filing Date
2018 Periodic Evaluation of Upstream Stream Segments	11/14/2018	12/14/2018	1/15/2019	1/15/2019
2018 Octoraro Creek Eel Ramp Collection Report	11/14/2018	12/14/2018	1/15/2019	1/15/2019
2018 Conowingo Eel Ramp Collection Report	11/15/2018	12/14/2018	1/15/2019	1/15/2019
2018 Upstream Migrating Adult American Shad within the Muddy Run Pumped Storage Project	11/16/2018	12/14/2018	12/31/2018	3/1/2019*
2018 Emigrating Adult American Shad in the Vicinity of the Muddy Run Pumped Storage Project	11/16/2018	12/14/2018	12/31/2018	7/3/2019* (Exelon plans to file with upstream adult American Shad report on 3/1/2019)
FPOP Annual Report - 2018	11/16/2018	12/14/2018	12/31/2018	12/31/2018

2

2018 Emigration and Behavior of Telemetered Juvenile American Shad in the Vicinity of the Muddy Run Pumped Storage Project	4/5/2019 (est)	4/26/2019	5/3/2019	7/3/2019*

*Per the FERC Order issued April 5, 2018.

Please let me know if you have any questions.

Thanks

Andrea

Andrea Danucalov
FERC License Compliance Manager

Exelon.

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300 Exelon Way
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Cell: 610.301.1664
andrea.danucalov@exeloncorp.com

Mike Martinek

Subject: FW: [EXTERNAL] PFBC Comments: Exelon - Muddy Run - 2018 EPAG and American Shad Study Reports

From: Tryninewski, Joshua [mailto:jtryninews@pa.gov]
Sent: Friday, December 14, 2018 3:51 PM
To: Danucalov, Andrea H:(GenCo-Pwr) <Andrea.Danucalov@exeloncorp.com>
Subject: [EXTERNAL] PFBC Comments: Exelon - Muddy Run - 2018 EPAG and American Shad Study Reports

Andrea,

Thank you for the opportunity to review and provide comments on the following reports. Below you will find PFBCs comments on each report.

- Muddy Run Pumped Storage Project, Periodic Evaluation of Upstream Stream Segments, 2018:
  - The Sample and Data Collection sections should include more detail on methods employed and include references / citations. Specifically, the electrofishing technique, PIT tag insertion method, and water quality measurement protocol(s) and specifics on relevant equipment used should be identified (make, model, settings). Please include more detail on how mussel presence / absence was determined and include relevant methods reference. Similarly, please expand on the habitat assessment technique used, including methods reference. Collectively, this information will be important to maintain continuity in subsequent years of surveys.

- Muddy Run Pumped Storage Project, American Eel Collection Facility in Octoraro Creek, 2018:
  - Please report attraction flows in gallons per minute, similar to the Conowingo Eel Collection Facility Report.
  - Per our conversations on 12/11/18 at the Annual Fish Passage Technical Advisory Committee and Eel Passage Advisory Committee meetings regarding attraction flows at the Octoraro Creek eel collection facility, the PFBC recommends Exelon take the appropriate measures to increase attractions flow to the original design specifications of 210-230 L/min (over the current 65.7 to 94.6 L/min).

- Muddy Run Pumped Storage Project, Conowingo Eel Collection Facility, 2018:
  - Minor edit: Table 5.0-1: Specified operating range of Conowingo Eel Collection Facility, 2018 – Row heading "Flow (GMP)" should be "Flow (GPM)"

- Muddy Run Pump Storage Project, Fish Passage Operating Report, 2018:
  - No comments on the report.

- Assessment of Passage Success of Upstream Migrating Adult American Shad & Assessment of Passage Success of Emigrating Adult American Shad, at Muddy Run Pumped Storage Project Spring 2018
  - Comments to be submitted to Exelon by January 25, 2019.

Regards,
-Josh

Joshua D. Tryninewski
Anadromous Fish Restoration Unit

1

Pennsylvania Fish & Boat Commission
1735 Shiloh Rd.
State College, PA 16801
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Responses to Resource Agency Comments for the Muddy Run Pumped Storage Project
American Eel Collection Facility in Octoraro Creek, 2018

SRBC

- When making the modifications to operate the Octoraro Collection Facility as a 'permanent' facility please allow for flexibility in design providing as much additional attraction flow as practical given site conditions. As noted on page 5 of the report the relationship between stream flow and eel catch is quite clear. However maintaining a consistent and low level of attraction flow at the ramp relative to current stream flow conditions results in a greatly diminished overall attraction flow detectability.
  Exelon Response: See attached write-up regarding attraction flows

- Related to the previous comment, please examine the relationship between attraction flow as a % of stream flow and eel catch.
  Exelon Response: It is difficult to accurately compare having only one data point each week for attraction flow. The closest USGS gage measuring daily average creek flow is located 10 miles downstream of the eel ramp, and during most weeks this season, 3 or 4 eel checks were conducted weekly. Exelon has committed to conducting daily checks of the facility when it is assigned the "permanent" designation.
  Generally, when creek flows are decreasing after a high flow event, the number of eels captured at the facility increases. The lowest weekly average creek flows typically produce the lowest weekly eel catch.

- Please report attraction flow volumes in gallons per minute rather than liters per minute to maintain consistency with the data reported from the Conowingo collection facility.
  Exelon Response: Changed liters per minute to gallons per minute (gpm) in Table 4.6-1, and also in section 5.0 of the annual report.

- In future reports when performing the daily ramp checks please note if generation is occurring at the CWA's hydroelectric turbine at the site.
  Exelon Response: This information is documented on Table 4.0-1, * on the date indicates Hydro at CWA was operating.

- If possible please collect a daily turbidity observation, reported in NTUs, from Octoraro Creek when performing ramp checks.
  Exelon Response: Turbidity was not a monitoring parameter included in the Eel Plan section of the PADEP 401 WQC. We do not intend to monitor turbidity in 2019 as it is difficult to make a direct comparison between turbidity and stream flow at this site since the flow gage is 21 kilometers (10 miles) downriver and turbidity measurements would be taken at the facility. The turbidity values may not be the same at both location due to the distance, pooling of the creek in some locations, and the number of other tributaries that enter the Octoraro Creek between the eel facility and the gage. Rainfall/thunderstorms could influence the gage at times when rainfall does not occur at the facility. We will

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continue to discuss the issue in future meetings with the Resource Agencies, but we do not believe this variable is key to successfully collecting eels at the Octoraro eel facility. Please review the meeting minutes from December 2017 for additional information, as Aaron Henning (SRBC) attempted to collect this data in 2018, but to our knowledge the data has not been presented formally to the EPAG.

USFWS

- Attraction flow should be reported in gallons per minute in the report.
  Exelon Response: Changed liters per minute to gallons per minute (gpm) in Table 4.6-1, and also in section 5.0 of the annual report.

- Also, per discussion at the meeting held on December 11, 2018 between Exelon and the Resource Agencies, Exelon will need to increase attraction flow that will be provided to the permanent eel passage facility on the Octoraro. Current attraction flow at the temporary facility averages 81.8 L/min, where the design specifications for attraction flow at the project is 210-230 L/min (see report Pg. 8, Section 5, Paragraph 2). The upper end of the target attraction flow range, 230 L/min, converts to <61 gal/min and would be more acceptable than what is currently being implemented at Octoraro. We recommend that Exelon/Normandeau address this issue to at least achieve the target attraction flow of 210-230 L/min. The plan to replace the 1.5" water supply line with a 2" line to match pump capacity, as a part of conversion to a permanent facility, may help to address this issue, but additional modifications (i.e. larger pump, increased supply line size, etc.) may be required to achieve the design specifications.
  Exelon Response: See attached write-up regarding attraction flows.

PFBC

- Please report attraction flows in gallons per minute, similar to the Conowingo Eel Collection Facility Report.
  Exelon Response: Changed liters per minute with gallons per minute (gpm) in Table 4.6-1, and also in section 5.0 of the annual report.

- Per our conversations on 12/11/18 at the Annual Fish Passage Technical Advisory Committee and Eel Passage Advisory Committee meetings regarding attraction flows at the Octoraro Creek eel collection facility, the PFBC recommends Exelon take the appropriate measures to increase attractions flow to the original design specifications of 210-230 L/min (over the current 65.7 to 94.6 L/min).
  Exelon Response: See attached write-up on attraction flows.

PADEP

- Please convert liters per minute (L/min) to gallons per minute (gpm) in Table 4.6-1: Calibration of Flows and second paragraph under Discussion. This change will allow both the Conowingo and Octoraro reports to be consistent.

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Exelon Response: Changed liters per minute with gallons per minute (gpm) in Table 4.6-1, and also in section 5.0 of the annual report.

- In Figure 4.4-4 Dissolved Oxygen was lower then head pond during 5/8-5/15 and again 9/4. Please explain why this occurred.
  Exelon Response: Please see Table 4.4-5 for more detailed data in tabular form. Additional aeration supplied continuously to the collection tanks commenced on June 20, 2018 when the head pond DO fell below 5.0 mg/L. DO values below 5.0 mg/l in both tanks occurred on May 16 when the collection tanks contained a total of 1136 juvenile eels. The collection tanks also had lower DO values than the head pond on May 14 and 15 when a total of 441 and 358 eels respectively, were observed in the collection tanks. The DO value in the Milieu collection tank was also below 5.0 mg/L on May 14 when the majority of the eels collected that day were contained in the Milieu collection tank. The other days in early May, head pond DO values were higher than the collection tank DO values.
  We are unable to determine why the collection tank DO values on September 4, 2018 were lower than head pond DO values, but the head pond DO values for a few days prior to this date were mid to low 5.0 mg/L. This was also after a period of high flow (1,400+ cfs daily average) in early September.
  Exelon has committed to checking the Octoraro eel facility daily (same as the CECF), so dissolved oxygen checks will occur more often. We will also activate the aeration system earlier in the season if the ambient DO levels begin to approach 5.0 mg/L.

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Attraction Flow for the "Permanent" Octoraro Creek Eel Facility

The temporary Octoraro Creek Eel Facility was originally a feasibility study to install, operate, and evaluate the juvenile eel trapping facility for three years (2015-2017). This facility was supplied by a ½ horsepower submersible pump (Gorman Rupp Model 2XH5) rated at 67 GPM (~250 L/min). The pump had a 2" outlet that was necked down to 1½" to match the flex hose that was to supply water to the eel facility as shown in the conceptual design (Appendix A) of the Normandeau Associates, Inc. and Gomez and Sullivan 2015 report. This conceptual design was presented and agreed upon by Eel Passage Advisory Group (EPAG) in March 2015. The pump was powered by a 110-volt receptacle behind the art association building. This receptacle was fed from the Art Association Building with a dedicated line and breaker from the breaker box and was installed by Chester Water Authority (CWA) workers. The screened barrel and the pump are supported by the handrail of the old trash rack in the forebay, thus the weight of a ½ horsepower or even a 1 horsepower pump can be supported, but the weight of a larger pump may not be safely supported by the current handrail.

The head differential between the pump in the forebay and the hill behind the Art Association building along with the run was not taken into consideration for the attraction flow for the ramp and collection tanks at the eel platform. The calibration flows to this facility have varied from year to year with the following year averages: 2015- 16.3 gallons per minute (61.8 l/min), 2016- 21.5 gallons per minute (81.3 l/min), 2017-19.6 gallons per minutes (74.1 l/min), and 2018- 21.6 l/min). The proposed modification for the "permanent" Octoraro Creek eel facility is to increase the flex pipe from 1½" to a 2" flex hose, thus not restricting the ½ horsepower pump. This increase in flex pipe will increase attraction flows from 25.6 gallons per minute to a calculated valve of 60 gallons per minute. The manifold will also be increased from 1½" to 2" with each outlet for the different attraction point being increased from 5/8" to ¾" using ball valves and no longer spigots. The spray bar will be increased from ¾" to 1" PVC pipe for more attraction flow down the ramp.

The most recent Fish Passage Engineering Design Criteria was issued in February 2017 by the U.S Fish and Wildlife Service, Region 5 (USFWS 2017). In section 13.1.2 (Volitional Ramps), bullet number 12 states: "Attraction flows: required for *larger rivers or high flow tailraces*; minimum 50 gallons per minute (gpm) for 8 in. wide ramp: additional 5 gpm for each additional inch of ramp width; typically 80-300 gpm;" (USFWS 2017). The Octoraro Creek should not be considered a larger river or a high flow tailrace. The above bullets are from the Fish Passage Workshop: Training Manual slide presentation given by Alex Haro on August 8, 2014 (Towler ed., 2014).

In the Proceedings of a Workshop on American Eel Passage Technologies from July 2013, there are some examples of various eel trap/ladders from some Atlantic slope drainages (Haro 2013). Examples of these ramps that resemble the Octoraro Creek Eel Facility are the New Home Dam Ramp Trap (Millers River, Orange, Massachusetts) and the Amoskeag Dam Ramp Trap (Amoskeag Dam, Merrimack River, New Hampshire). The ramps have attractions flows of 26.4 gpm (100 l/min) for the Miller River ramp and 50 gpm (190 l/min) for the Amoskeag Dam ramp,

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but the annual statistics from the USGS water data website for these rivers are much higher than Octoraro Creek (Table 1).

	Miller River, MA	Amoskeag Dam, NH	Octoraro Creek, PA
Ramp Attraction Flow	26.4 (gpm)	50 (gpm)	25 (gpm)
USGS Annual Statistic	296-1,070 cfs	3,000 – 10,000 cfs	125 - 350
Years for Statistic	1915 - 2018	1937 - 2018	2006 - 2018

Table 1: Comparing eel passage ramps in Haro 2013 to the Octoraro Creek Eel Facility

The Miller River site is somewhat comparable to the Octoraro Creek facility because it is also a run-of-river mill dam converted to hydropower with continual spill and significant leakage from the dam. The Miller River facility has a ramp attraction flow of 26.4 gpm, similar to the current attraction flow of the Octoraro facility (25 gpm), although the range of stream flow (cfs) for the Miller River is much higher than the flow values observed in Octoraro Creek. Haro (2013) states: "Attraction flows directed to the vicinity of a pass entrance tend to attract more eels, although there are no set guidelines for either absolute attraction flows or flows relative to passage structure size or scale of the site. The general rule of "more is always better" seems to be effective, but care must be taken not to overwhelm entrances with too much flow, which can prevent eels from orienting to the entrance and entering the structure."

Generally speaking, when creek flows are decreasing after a high flow event the number of eels captured at the Octoraro facility tends to increase. The lowest weekly average creek flows typically produce the lowest weekly eel catches at the Octoraro Creek Eel Facility.

Exelon is currently investigating means to increase flow volumes in and around the eel ramp as well as negotiating with the Chester Water Authority to make modifications to upgrade the facility to a "permanent" status. Adding additional attraction flow may be dependent on site restraints. Exelon takes seriously its obligation to improve the Octoraro facility based on EPAG recommendations, however, if efforts to increase flow volumes fall short of EPAG expectations, we believe the eel ramp is effective based on what the facility has already achieved from 2015 through 2018 and due to the flow volume similarity with the Miller River, MA facility.

References

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