



January 15, 2020

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

**RE: Muddy Run Pumped Storage Project, FERC Project No. 2355, License Article 401 – 2019 American Eel Collection Facility in Octoraro Creek Report**

Dear Secretary Bose,

Article 401(b) of the Muddy Run Pumped Storage Project (Project) license requires Exelon Generation Company, LLC (Exelon) to file various reports, required by the Pennsylvania Department of Environmental Protection's (PADEP) Water Quality Certification and the U.S. Department of the Interior's (DOI) fishway prescription, with the Federal Energy Regulatory Commission (Commission). In part, Article 401(b) requires Exelon to file an annual American Eel Collection Facility report, documenting the performance of an eel trapping facility on Octoraro Creek.

The enclosed documentation provides the American Eel Collection Facility in Octoraro Creek. The report was previously distributed to the PADEP and the Resource Agencies to review and to solicit comments. Comments were received in December 2019 from the Resource Agencies and are included in Appendix E of the attached report. Resource Agencies comments have been reviewed and addressed in the attached report.

If you have any questions regarding the plans, reports or information provided herein, please feel free to contact me at (267) 533-1125 or via email at [andrea.danucalov@exeloncorp.com](mailto:andrea.danucalov@exeloncorp.com).

Respectfully submitted,

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# Muddy Run Pumped Storage Project American Eel Collection Facility in Octoraro Creek, 2019

FERC Project No. 2355



Prepared for:



Submitted On:  
January 15, 2020

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*DISCLOSURE STATEMENT*

*The data contained in all pages of this document have been submitted in confidence and contain trade secrets and/or privileged or confidential information, and such data shall be used or disclosed only for evaluation purposes, provided that if a contract is awarded to this proposer as a result of or in connection with the submission of this proposal, the client shall have the right to use or disclose the data herein to the extent provided in the contract. This document includes data that shall not be disclosed outside of the purposes of this submittal and shall not be duplicated, used, or disclosed--in whole or in part--for any purpose other than for evaluation purposes.*

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## 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. The eel facility continued to operate as a temporary facility in 2018 and 2019, but the location is now considered permanent. Exelon completed upgrades (larger submersible pump and waterline, manifold, collection tank, and attraction flow lines) to the Octoraro Creek eel facility prior to May 1. Exelon received the new CWA signed agreement on December 2, 2019. The remaining work left to be completed was dependent upon receiving the signed agreement so that Exelon could apply for permits. The remaining work left to be completed addresses aesthetics and safety (stairs) and the erosion is an emerging issue due to storm events during the fall of 2018 and early 2019. During each monthly EPAG call the remaining work has been communicated. The permanent facility will be completed upon permit acquisition and construction completion without interruption to the 2020 season. The completed upgrades made in 2019 were related to eel passage, and the remaining upgrades involve addressing safety aspects and erosion issues.

Each year, 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 2019 field investigation:

- Install seasonal components of the eel collection facility on Octoraro Creek immediately downstream of Chester Water Authority's (CWA) Pine Grove Low-Head Dam;
- Document any modifications made to the facility during the course of the season to improve functionality and eel attraction capability.
- Operate, maintain, and monitor the eel collection facility (daily) from May 1 through September 15, 2019;
- Collect catch and length data, water quality, creek flow, and moon phase data during the entire sampling period;
- Transport eels collected by the facility 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;

Seasonal components of the Octoraro Creek Eel Facility included: new juvenile eel ramps, a larger submersible pump and waterline, manifold, collection tank, and attraction flow lines. The seasonal

components were installed and placed in service on May 1, 2019. Improvements to increase eel attraction and capacity were also completed by May 1, 2019. The facility operated a total of 138 days from May 1 to September 15, 2019.

A total of 14,170 juvenile eels were collected at the Octoraro Creek Eel Facility. The greatest number of juvenile eels was collected on July 14, 2019 with 2,842 eels or 20.1% of the total season catch. A single peak occurred between July 13-16, accounting for 8,897 of the 14,170 (62.8%) juvenile eels collected at the facility. Daily juvenile eel collections numbering less than 10 individuals were recorded on 102 days (73.9%) of the 138 collection days. Volumetric estimates were utilized on eight days this year.

Length, weight, and injuries (condition factor) were recorded from biweekly subsamples on 227 juvenile eels. Length of juvenile eels ranged from 93-252 mm with an average length of 129.9 mm. The average weight of juvenile eels was 2.7 grams (g) and ranged from 1.0-23.8 g. Only 2 of the 227 (0.9%) showed any form of external injury (condition factor) such as bruising, scrape, or hemorrhage.

A total of 14,170 juvenile eels collected at the facility were transported within 24 hours of capture to the CECF at Conowingo Dam where they were held before transport. No eels died at the facility or during transport to Conowingo during the 2019 season (100% survival).

Cleaning and calibration of the facility was performed weekly. Cleaning of the collection tank, screened drains, and spray bars occurred daily after all eels were removed for transport. 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 as needed during the season. Only one volumetric estimate was compared against an actual count this year, and due to the small difference in number between the estimate and actual count, the method provided an accurate estimate, so no changes to the method are warranted. CWA operated the small hydroelectric facility on 112 days (81.2%) of the 138 day sampling 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)<sup>1</sup>.

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 2019 field investigation:

- Installation of seasonal components to the eel collection facility on Octoraro Creek immediately downstream of Chester Water Authority's (CWA) Pine Grove Low-Head Dam;
- Document any modifications made to the facility during the course of the season to improve functionality and eel attraction capability.
- Operate, maintain, and monitor the eel collection facility (daily) from May 1 through September 15, 2019;
- Collect catch and length data, water quality, creek flow, and moon phase data during the entire sampling period;
- Transport eels collected by the facility 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;

Seasonal components of the Octoraro Creek Eel Facility included: new juvenile eel ramps, a larger submersible pump and waterline, manifold, collection tank, and attraction flow lines. The seasonal components were installed and placed in service on May 1, 2019.

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<sup>1</sup> 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, [Minkinen 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. The eel facility continued to operate as a temporary facility in 2018 and 2019, but the location is now considered permanent. Exelon completed upgrades (larger submersible pump and waterline, manifold, collection tank, and attraction flow lines) to the Octoraro Creek eel facility prior to May 1. Exelon received the new CWA signed agreement on December 2, 2019. The remaining work left to be completed was dependent upon receiving the signed agreement so that Exelon could apply for permits. The remaining work left to be completed addresses aesthetics and safety (stairs) and the erosion is an emerging issue due to storm events during the fall of 2018 and early 2019. The remaining upgrades to the Octoraro Creek eel facility will be completed upon permit acquisition and construction completion of the facility without interruption to the 2020 season. The completed upgrades made in 2019 were related to eel passage, and the remaining upgrades involve addressing safety aspects and erosion issues.

## 3 Methods

### 3.1 Design, Construction, and Installation of Facility

In 2019, modifications were made to the existing eel facility to improve eel attraction and to increase capacity. ([Appendix A, Normandeau Associates and Gomez and Sullivan 2015, 2016, 2018a, and 2019](#)). These upgrades included: new juvenile eel ramps, a submersible pump and larger waterline, manifold, collection tank, and attraction flow lines.

The new juvenile eel ramps were constructed and installed identical to the previous ramps. Each ramp consisted of approximately 7 meter (m) x 305 millimeter (mm) wide cable trays positioned at a 30° angle, plus a continuous length of tray that was bent and shaped at a 90° angle over a 25 mm radius at the top of the ramp to convey juvenile eels into the collection tanks. The entrance of each ramp was underwater during all flow conditions, which allowed for a smooth transition from the existing riverbed adjacent to a quiescent pool located in the creek. Ramps were held in place by three T-shaped solid metal braces, evenly spread across the length of the ramp, and driven into the ground beneath the ramps. On either side of these braces, a hole was drilled into the flat bar and a bungee cord was used to fasten the ramps to these braces. Ramps were covered from the top down to near the tail water median flow height to protect juvenile eels when ascending. A hinged covered was added to the new ramp over the spray bar to decrease light inside the ramp at the top of the ramp ([Figure 3.1-1](#)).

The 51 mm submersible pump increased from 0.5 horsepower (Gorman Rupp Model 2XH5, rated at approx. 65 gallons/minute) to 1.0 horsepower 51 mm submersible pump (Tsurumi Pump model 8-PN, rated at approx. 92 gallons/minute, [Figure 3.1-2](#)). The new pump was installed in the same screened barrel, at the same location and depth as the year previous ([Normandeau Associates and Gomez and Sullivan 2015, 2016, 2018a, and 2019](#)).

The waterline to the facility from the submersible pump was upgraded from a 38 mm water line to a 51 mm water line. This underground water line was encased in 152 mm PVC to protect the line from being crushed under the driveway ([Figure 3.1-3](#)). The 51 mm water line was attached to a 51 mm manifold with seven 25 mm ball valves that supplied water to the spray bars and additional attraction flow lines ([Figure 3.1-4](#)). The spray bars and the attraction flow lines were upgraded from 19 mm to 25 mm and each ramp had one spray bar and two attraction flow lines, identical to previous years.

The collection tank is 660 mm wide with a length of 1,575 mm. The depth of the water in the collection tank is about 299 mm, with a volume of approximately 310.4 Liters (L, [Figure 3.1-5](#)). The total volume of the previous collection tanks was approximately 80.1 L, combined ([Normandeau Associates and Gomez and Sullivan 2015, 2016, 2018a, and 2019](#)). Like prior years, the collection tank was filled by allowing some of the spray bar flow to enter the collection tank, thus providing a constant flow of freshwater. The upgraded collection tank contained two drains comprised of a 76 mm PVC pipe with holes drilled through it and wrapped in one mm mesh to prevent juvenile eel escapement. Each collection tank drain line was directed to the highest point possible (gravity feed) of the ramp, thus providing eel scent from the eels in the collection tank to the ramp. The collection tank was custom fitted with a lid that was held down by clamps. When the dissolved oxygen (DO) approached 5.0 milligram per Liter (mg/L) in the forebay, air stones from an aerator were added to

the collection tank to supply additional aeration. The aerator was connected to a deep cycle marine battery connected to a portable solar panel and a trickle charger ([Figure 3.1-6](#)).

Upgrades from the temporary facility (2015-2018) to the permanent facility (2019) are listed below.

	Temporary (2015-2018)	Permanent (2019)
Submersible Pump (hp)	0.5	1.0
Underground Water line (mm)	38	51
Manifold (mm)	38	51
Spray bar (mm)	19	25
Attraction flow lines (mm)	19	25
Collection Tank Capacity (L)	80.1	310.4

### 3.2 Data Collection

Sample data including date, time of sample, weather, eel counts, water temperature, and dissolved oxygen were recorded daily. The data was verified, tabulated, and entered into an electronic format each week as part of a quality control and quality assurance protocol. Environmental conditions such as creek flow and lunar fraction were also recorded, verified, and entered into an electronic format. Eel count data included actual counts or volumetric estimates (when performed).

Length and weight measurements, along with condition factor were recorded biweekly from a maximum of 25 individuals (when available). Eels were measured and weighed after being anesthetized ([Figures 3.2-1](#) and [3.2-2](#)).

Water temperature and DO were measured in the collection tank, 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.

### 3.3 Juvenile Eel Transport

All juvenile eels that were captured in 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 150 eels were collected during a sampling event, the eels were transported in aerated 19 L buckets with lids that contained the maximum amount of water to prevent sloshing, with  $\leq 50$  eels in each bucket. When counts of juvenile eels were greater than 150 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 ([Figure 3.3-1](#)).

## 4 Results

The Octoraro Creek Eel Facility commenced operation on May 1, with continued operation through September 15, 2019. The facility was checked daily during the 138 day season that the facility was operated. A total of 14,170 juvenile eels were collected during the 2019 season ([Table 4.0-1](#)). Daily checks were conducted as a condition of the facility's permanent status.

### 4.1 Juvenile Eel Collection

A total of 14,170 juvenile American Eels were captured at the Octoraro Creek Eel Facility during the 2019 season. Counts or volumetric estimates were recorded daily. Volumetric estimates were made on 8 of the 138 days of operation (5.8% of the season, [Table 4.0-1](#)).

The highest one-day total of 2,842 juvenile eels occurred on July 14, accounting for 20.1% of the season total ([Table 4.0-1](#) and [Figure 4.1-1](#)). For the 2019 season, 2.9% (4 days) of the monitoring checks recorded juvenile eel numbers > 1,000 individuals ([Table 4.0-1](#)).

### 4.2 Juvenile Eel Biological Data

Biological data (length, weight and condition factor) was recorded from biweekly subsamples. A total of 227 juvenile eels was collected from these biweekly subsamples (1.6% of total eels collected), during 24 of the 138 sample days ([Table 4.2-1](#)).

The average length of juvenile eels was 129.9 mm, with a median size of 128.0 mm ([Table 4.2-1](#)). The length of juvenile eels ranged from 93 - 252 mm. One juvenile eel measured less than 100 mm and two eels measured greater than 175 mm ([Table 4.2-2](#)). The average weight of juvenile eels was 2.7 grams (g), with a median weight of 2.3 g ([Table 4.2-1](#)). The weight of juvenile eels ranged from 1.0 – 23.8 g ([Table 4.2-3](#)). Over 90% of the 227 juvenile eels weighed between 1 – 5 g ([Table 4.2-3](#)).

Eels from each biweekly subsample were examined for external injuries. Individual condition factors, date, and detailed biological data for these are shown on [Table 4.2-4](#). External injuries were noted on 0.9% (2 of 227 individuals) of the examined eels. The two injuries were observed on August 1, 2019 and were coded as a scrape on the abdomen and a larger than normal abdomen.

### 4.3 Juvenile Eel Collection by Week

The majority of the juvenile eels were collected during Week 12 (July 14-20) when the facility collected 58.3% (8,266 individuals) of the season total. Weeks 13 and 11 collected the second and third greatest number of eels at 20.3% (2,874 eels) and 15.8% (2,244 eels) of the season total, respectively ([Table 4.3-1](#) and [Figure 4.3-1](#)). During Weeks 11-13, the Octoraro Creek Eel Facility collected 13,384 of the 14,170 juvenile eels or 94.5% of the season catch.

Weeks 14 and 7 collected 2.8% (391 eels) and 1.0% (144 eels) of the season total, respectively ([Table 4.3-1](#) and [Figure 4.3-1](#)). Weeks 1-6, 8-10, and 15-21 of sampling collected no greater than 1.0% of the season total, accounting for 251 individuals (1.7%) combined. Weekly catch data are also provided in [Appendix B](#).

#### 4.4 Peak Period of Eel Collections

During the season, there was one major peak period that produced high numbers of juvenile eels. This peak (July 13 -16, 4 days) yielded 8,897 of the 14,170 juvenile eels or 62.8% of the total season catch ([Table 4.0-1](#) and [Figure 4.1-1](#)).

#### 4.5 Juvenile Eel Catch in Relation to Environmental Factors

See [Appendix C](#) for weekly averages of juvenile eel capture, river flow, lunar fraction, water temperature, and DO.

##### *River Flow*

Creek flow and juvenile eel catch appeared to be slightly related during the 2019 season. Daily average creek flow was taken from the United States Geological Survey (USGS) 01578475 Octoraro Creek near Richardsmere, MD gage, located approximately 21 kilometers (km) downstream of CWA's Pine Grove Low-Head Dam ([Table 4.5-1](#)). The highest daily average creek flow value per the USGS gage station occurred on July 23, 2019 (1,610 cubic feet per second, cfs, [Table 4.5-1](#)). This single highest daily value occurred in the middle of Week 13 of eel facility operation, and occurred during a slight increase in eel catch ([Tables 4.0-1](#) and [4.5-1](#)). The second highest daily average creek flow value per the USGS gage station occurred on July 12, 2019 (1,330 cubic feet per second, cfs, [Table 4.5-1](#)). The second highest daily value occurred at the end of Week 11 of eel facility operation, and occurred the day before the peak of the eel catch at the Octoraro Creek Eel Facility in 2019 ([Tables 4.0-1](#) and [4.5-1](#)).

Week 3 had the second highest average weekly flows (530 cfs), but only five juvenile eels were collected ([Figure 4.5-1](#) and [Appendix C](#)). Two of the lowest daily average creek flow weeks (Weeks 21 and 20) 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 Fraction*

Juvenile eel catch did not appear to be correlated to lunar fraction (cycle) during the 2019 season. The largest peak in eel capture (8,897 eels collected from July 13-16) occurred during the brightest week of the season and during a full moon ([Table 4.5-2](#), [Figure 4.5-2](#) and [Appendix C, U.S Naval Observatory website 2019](#)). Full moon is equal to 1.0 lunar fraction.

During Weeks 10, 1, and 14, ranked first, second, and third darkest weeks, only 71, 1, and 391 eels, respectively were captured ([Appendix C](#)). Typically, the lower illuminance during lower lunar fraction periods, (new moon) has been 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 season, the water temperature ranged from a high of 26.1°C on July 23, 2019 (Week 13) to a low of 13.4°C on May 15 (Week 3, [Table 4.5-3](#) and [Figure 4.5-3](#)). Water temperatures did not reach 20.0° Celsius (C) until June 6, 2019.

### *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 26 ([Table 4.5-4](#) and [Figure 4.5-4](#)). Detailed DO readings are presented in [Tables 4.5-4](#) and [4.5-5](#) and displayed in [Figure 4.5-5](#). Measurements of DO were usually taken in the morning when the lowest DO would be more likely to be observed.

## 4.6 Juvenile Eel Holding and Mortality

See [Table 4.6-1](#) for detailed information of transport, and mortality data.

### *Transport*

Juvenile eels collected at the Octoraro Creek Eel Facility were transported within 24 hours of capture. Transport time from Octoraro Creek Eel Facility to the CECF at Conowingo Dam was about 30 minutes. No juvenile eel mortalities were observed when transferring eels from the transport vehicle into the Conowingo holding facility.

### *Mortality*

Of the 14,170 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.

## 4.7 Quality Control Activities

Cleaning and calibration activities were conducted at least weekly during the season. 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 check 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 4.7-1](#).

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, manifold, and all the attraction flow lines were scrubbed or snaked clean nine times during the 2019 season ([Table 4.7-1](#)). The same submersible pump was used all season.

Volumetric eel estimates were performed on eight days during the season. A quality control comparison on counts occurred once during the 2019 season on July 17. The volumetric estimate and the actual count differed by 10 eels. Due to the small difference in counts, no changes to the volumetric method were required.



#### 4.8 Other Species Caught

Two aquatic species were caught in addition to American Eel. Four River Crayfish (Cambaridae family) were netted from the collection tank on four occasions during the season. A Northern Water Snake (*Nerodia sipedon*) was also removed from the collection tank on May 19, 2019.

## 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 126,181 eels compared to the Octoraro Creek Eel Facility that captured 14,170 juvenile eels during the 2019 season. With both ramps operating simultaneously, the Octoraro Creek facility captured approximately 9% 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 64-165 mm with an average length of 114.4 mm ([Normandeau Associates, Inc. 2019](#)). The size of the juvenile eels caught in the ramp at the Octoraro Creek Eel Facility were slightly larger with a size range of 93-252 mm and an average length of 129.9 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 Eel Facility to the CECF.

The attraction flow to the ramps during the 2019 season was increased from prior years. The 2015 design specifications of the ramps were to have a total attraction flow of 210-230 L/min, (55-60 gpm) but the actual total attraction flows were between 17.4 and 25.0 gallons per minute (average 21.6 gpm). The increase in attraction flows to the permanent design specifications for the system was due to a larger submersible pump, 51 mm water line, 51 mm manifold, and 25 mm attraction flow lines that were installed prior to the start of the 2019 season. These upgrades increased the attraction flows to greater than 56.3 gpm and even as high as 74.5 gpm ([Table 4.7-1](#)). The collection tank was cleaned, hoses inspected, and spray bars checked and cleaned 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 used was performed to maintain a more consistent attraction flow. The range of attraction flows could be from the head difference when flows decrease or from the build-up of biological growth in the system. The hardiness of this species and its ability to adjust to parameters were evidenced by the numbers captured here.

The scaffolding, collection tanks, and hoses are not shaded at this time.

Water temperature and DO readings were taken daily 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 tank prior to the installation of the aerator which occurred on June 26, 2019 ([Tables 4.5-4](#) and [4.5-5](#)).

The average creek flow value per the USGS gage station during the 2019 season was similar to the previous years of operation (2015-present) during the operational period of May 1 to September 15. The average creek flow value during the operational period of May 1 through September 15, 2015-2019 was 218.2 cfs compared to the average creek flow value of 240 cfs in 2019 ([Table 5.0-1](#) and [Normandeau Associates and Gomez and Sullivan 2015, 2016, and 2018a](#) and [Normandeau Associates 2018a](#)). In 2019, daily average creek flow exceeded 1,000 cfs on two days, and the daily average creek flow was below 100 cfs for only 13 days compared to 24, 65, 46, and 4 days in 2015, 2016, 2017, and 2018, respectively. CWA operated its hydro facility on 112 of the 138 days (81.2%) this year, but we observed no relationship between eel catch and hydro operation ([Table 4.0-1](#)). With the 2018 creek flows well above normal, a cobble/gravel outcrop formed just downstream of the entrance to the eel ramps ([Figure 5.0-1](#)). The outcrop did not change the location of the ramp’s

entrance, which remained underwater throughout the entire 2019 season, just as in previous years ([Appendix A](#)).

Since 2015, when the creek flow has increased, the catch of juvenile eels has also increased within a few days of the flow increase. This was evident during the two higher creek flows in July 2019, but was not observed during the more sustained rise in creek flows during Week 3. [Figure 5.0-2](#) shows a comparison of 2015 through 2019 weekly catch and average creek flow data. In 2016, 2017, and 2018, the high flow events co-occurred with a new moon phase, unlike the 2019 season high flow events, which occurred during a full moon phase. See [Appendix C](#) for additional weekly data comparing 2015 through 2019.

The number of eels collected (14,170 individuals) in 2019 was the second highest total in the past five years ([Table 5.0-1](#)). The average size of eels has been increasing from 2015 to 2018, with the average size of eels collected in 2019 similar to those collected in 2015, (129.4 mm in 2015 to 129.9 mm in 2019, [Table 5.0-1](#)). From 2015 to 2018, juvenile eels were measured during every sample day (up to 25 eels if available), but biweekly subsamples of lengths were collected in 2019. The Octoraro Creek eel ramp has caught juvenile eels less than or equal to 100 mm every year, and the size range of eels collected and measured has been similar as well.

During the 2019 season, the Octoraro Creek Eel Facility was interrupted with short term breaks in operation. Operation changes or maintenance needs to the transformer occurred nine times during the 2019, causing the CWA water treatment plant to be under generator power during these times. 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. Eight events occurred during daytime hours (0600 to no later than 1400) on June 10, July 18, 24 and 25, and August 19-22. Eels were removed in the morning of these days, but the pump was not unplugged, so when power was restored to the left bank of Octoraro Creek the attraction flow was automatically restarted. Normandeau personnel inspected the site each day during these outages to verify that the pump did restart when power was restored. The other power event occurred on July 19, 2019. Normandeau arrived at the facility in the morning to find the GFCI had tripped and the pump did not automatically restart. No mortality was observed due to the above events in 2019.

See [Appendix D](#) for individual correspondence associated with making the Octoraro Creek Eel Facility a permanent facility after three years (if deemed successful by the Resource Agencies). The term permanent refers to the annual set-up and operation of the Octoraro Creek Eel Facility through the year 2030. Upgrades for the temporary facility were agreed upon by the members of EPAG after the March 1, 2018 FERC issued 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. Some upgrades that didn't require a permit were installed prior to the 2019 season which included: new juvenile eel ramps, a larger submersible pump and waterline, manifold, collection tank, and attraction flow lines.

FERC was sent a schedule for the upgrades on June 29, 2018 ([Appendix D](#)). Exelon received the new CWA signed agreement on December 2, 2019. The remaining work left to be completed was dependent upon receiving the signed agreement so that Exelon could apply for permits; the remaining work left to be completed addresses aesthetics and safety (stairs); and the erosion is an emerging issue due to storm events during the fall of 2018 and early 2019. During each monthly EPAG call the remaining work has been communicated. The next step for the Octoraro Creek Eel Facility is to complete the conversion to a permanent facility upon permit acquisition and

construction completion of the facility without interruption to the 2020 eel season. The remaining upgrades involve addressing safety aspects and erosion issues, in which will be completed outside of the 2020 season.

## 6 References

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## 7 Tables and Figures

Table 4.0-1: Number of Juvenile Eel Caught Daily, Octoraro Creek Eel Facility, 2019

Date	Number of Eels	Date	Number of Eels	Date	Number of Eels
5/1/2019*	0	6/16/2019*	4	8/1/2019*	65
5/2/2019*	0	6/17/2019	2	8/2/2019*	19
5/3/2019*	1	6/18/2019	0	8/3/2019*	10
5/4/2019*	0	6/19/2019	0	8/4/2019*	17
5/5/2019*	0	6/20/2019	0	8/5/2019*	5
5/6/2019*	3	6/21/2019	5	8/6/2019*	5
5/7/2019*	3	6/22/2019	1	8/7/2019*	8
5/8/2019*	0	6/23/2019	0	8/8/2019*	3
5/9/2019*	0	6/24/2019*	2	8/9/2019*	1
5/10/2019*	0	6/25/2019*	1	8/10/2019*	3
5/11/2019*	3	6/26/2019*	1	8/11/2019*	2
5/12/2019*	3	6/27/2019*	3	8/12/2019*	0
5/13/2019*	0	6/28/2019*	1	8/13/2019*	0
5/14/2019*	2	6/29/2019*	28	8/14/2019*	0
5/15/2019*	0	6/30/2019*	25	8/15/2019	2
5/16/2019*	0	7/1/2019*	12	8/16/2019*	1
5/17/2019*	0	7/2/2019*	5	8/17/2019*	0
5/18/2019*	0	7/3/2019*	5	8/18/2019*	2
5/19/2019*	0	7/4/2019*	3	8/19/2019	0
5/20/2019*	0	7/5/2019*	12	8/20/2019	3
5/21/2019*	0	7/6/2019*	11	8/21/2019	9
5/22/2019*	0	7/7/2019*	10	8/22/2019	2
5/23/2019*	1	7/8/2019	8	8/23/2019*	2
5/24/2019*	0	7/9/2019*	12	8/24/2019*	1
5/25/2019*	2	7/10/2019*	12	8/25/2019*	2
5/26/2019*	0	7/11/2019*	10	8/26/2019*	3
5/27/2019*	0	7/12/2019*	129	8/27/2019*	0
5/28/2019*	2	7/13/2019*	<b>2063</b>	8/28/2019	4
5/29/2019*	1	7/14/2019*	<b>2842</b>	8/29/2019	1
5/30/2019*	3	7/15/2019*	<b>1842</b>	8/30/2019	0
5/31/2019*	3	7/16/2019*	<b>2150</b>	8/31/2019*	2
6/1/2019*	0	7/17/2019*	<u>283</u>	9/1/2019*	2
6/2/2019*	3	7/18/2019	199	9/2/2019*	0
6/3/2019*	3	7/19/2019*	0	9/3/2019*	0
6/4/2019*	6	7/20/2019*	950	9/4/2019	1
6/5/2019*	5	7/21/2019*	435	9/5/2019	1
6/6/2019*	0	7/22/2019*	327	9/6/2019	0
6/7/2019*	3	7/23/2019*	518	9/7/2019*	0
6/8/2019*	0	7/24/2019*	582	9/8/2019*	0
6/9/2019	0	7/25/2019*	447	9/9/2019	0
6/10/2019	0	7/26/2019*	246	9/10/2019	0
6/11/2019*	13	7/27/2019*	319	9/11/2019	1
6/12/2019*	49	7/28/2019*	67	9/12/2019	0
6/13/2019*	11	7/29/2019*	123	9/13/2019*	0
6/14/2019*	66	7/30/2019*	62	9/14/2019*	0
6/15/2019*	5	7/31/2019*	45	9/15/2019*	0

\*Days the hydroelectric facility was operating (112 days)  
 Volumetric estimates are in italics (8)  
 Bolded numbers are peak days  
 The peak period is shown the box  
 \* QC check is underlined (1)

**Table 4.2-1: Number of Juvenile Eel Captured with Length and Weight Measurements, Octoraro Creek Eel Facility, 2019**

	<b>Total</b>
Number eels collected	14,170
Number measured	227
Data Collection Days	24
Range on lengths (mm)	93-252
Average length (mm)	129.9
Median length (mm)	128.0
Range on weights (g)	1.0-23.8
Average weight (g)	2.7
Median weight (g)	2.3



Table 4.2-2: Juvenile Eel Length Frequency, Octoraro Creek Eel Facility, 2019

TL (mm)	Number
90-94	1
95-99	-
100-104	7
105-109	10
110-114	18
115-119	16
120-124	38
125-129	36
130-134	33
135-139	18
140-144	11
145-149	13
150-154	12
155-159	3
160-164	4
165-169	2
170-174	3
175-179	1
250-254	1
<b>Total</b>	<b>227</b>

Table 4.2-3: Juvenile Eel Weight Frequency, Octoraro Creek Eel Facility, 2019

<b>Weight (g)</b>	<b>Number</b>
1.0-1.4	18
1.5-1.9	49
2.0-2.4	54
2.5-2.9	41
3.0-3.4	25
3.5-3.9	16
4.0-4.4	8
4.5-4.9	5
5.1-5.4	4
5.5-5.9	2
6.0-6.4	1
6.5-6.9	3
23.5-23.9	1
<b>Total</b>	<b>227</b>

Table 4.2-4: Observed Injuries of Juvenile American Eels, Octoraro Creek Eel Facility, 2019

Date	Length (mm)	Weight (grams)	Condition Factor
8/1/2019	136	3.0	Scrape on abdomen
	134	2.9	Larger than normal abdomen

2 of 227 eels (0.9%) that were processed had injury

Table 4.3-1: Juvenile Eel Collection by Week and Ranks, Octoraro Creek Eel Facility, 2019

	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	
Total	1	9	5	3	9	20	144	12	36	73	
Rank	T-19	T-13	T-15	18	T-13	9	5	T-11	8	6	
Percent Catch (%)	0.01	0.06	0.04	0.02	0.06	0.14	1.02	0.08	0.25	0.52	
	Wk 11	Wk 12	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	Wk 18	Wk 19	Wk 20	Wk 21
Total	2244	8266	2874	391	42	5	19	12	4	1	0
Rank	3	1	2	4	9	T-15	10	T-11	17	T-19	21
Percent Catch (%)	15.84	58.33	20.28	2.76	0.30	0.04	0.13	0.08	0.03	0.01	0.00
Top 3 ranked weeks are shown in boxes.											

Wk 1: May 1 - May 4

Wk 2: May 5 - May 11

Wk 3: May 12 - May 18

Wk 4: May 19 - May 25

Wk 5: May 26 - June 1

Wk 6: June 2 - June 8

Wk 7: June 9 - June 15

Wk 8: June 16 - June 22

Wk 9: June 23 - June 29

Wk 10: June 30 - July 6

Wk 11: July 7 - July 13

Wk 12: July 14 - July 20

Wk 13: July 21 - July 27

Wk 14: July 28 - August 3

Wk 15: August 4 - August 10

Wk 16: August 11 - August 17

Wk 17: August 18 - August 24

Wk 18: August 25 - August 31

Wk 19: September 1 - September 7

Wk 20: September 8 - September 14

Wk 21: September 15

Table 4.5-1: USGS 01578475 - Octoraro Creek at Richardsmere, MD Gage Flows Daily Average Creek Flows (cfs), 2019

Day	May	June	July	August	September
1	195	215	154	139	125
2	243	207	200	220	127
3	322	206	247	227	116
4	357	205	237	223	68
5	496	203	234	216	67
6	509	205	231	167	69
7	422	190	214	152	128
8	328	105	272	152	128
9	322	96	205	150	109
10	346	167	266	145	71
11	376	383	527	144	64
12	494	476	<b>1330</b>	138	63
13	963	467	295	137	82
14	834	360	203	151	125
15	388	282	177	154	88
16	349	219	138	137	
17	359	185	156	135	
18	324	144	232	134	
19	253	149	280	136	
20	291	208	190	74	
21	306	165	181	74	
22	302	147	214	106	
23	298	150	<b>1610</b>	168	
24	245	200	278	163	
25	241	273	267	164	
26	202	264	281	164	
27	184	205	213	159	
28	193	165	193	114	
29	316	166	203	74	
30	316	155	187	80	
31	252		130	127	

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

Table 4.5-2: Fraction of Moon Illumination, 2019 EST (1.0 Equals Full Moon)

Day	May	June	July	August	September
1	0.14	0.06	0.03	0.00	0.05
2	0.08	0.02	0.00	0.02	0.11
3	0.03	0.00	0.00	0.07	0.20
4	0.01	0.01	0.03	0.14	0.30
5	0.00	0.04	0.08	0.23	0.40
6	0.02	0.10	0.16	0.33	0.51
7	0.06	0.18	0.25	0.44	0.61
8	0.12	0.27	0.36	0.55	0.71
9	0.20	0.38	0.47	0.66	0.79
10	0.30	0.50	0.59	0.75	0.86
11	0.41	0.61	0.69	0.83	0.92
12	0.52	0.72	0.79	0.90	0.96
13	0.63	0.81	0.87	0.95	0.99
14	0.74	0.89	0.93	0.98	1.00
15	0.83	0.95	0.97	1.00	0.99
16	0.91	0.98	1.00	0.99	
17	0.96	1.00	1.00	0.97	
18	0.99	0.99	0.98	0.93	
19	1.00	0.97	0.95	0.88	
20	0.98	0.92	0.90	0.81	
21	0.94	0.86	0.84	0.73	
22	0.88	0.79	0.76	0.64	
23	0.81	0.70	0.68	0.54	
24	0.73	0.61	0.58	0.44	
25	0.64	0.52	0.49	0.34	
26	0.55	0.42	0.39	0.24	
27	0.45	0.33	0.29	0.15	
28	0.36	0.24	0.20	0.07	
29	0.27	0.16	0.12	0.02	
30	0.19	0.09	0.05	0.00	
31	0.12		0.01	0.01	

Table 4.5-3: Water Temperature (°C) from the Collection Tank, Octoraro Creek Eel Facility, 2019

Day	May	June	July	August	September
1	15.0	19.3	22.4	23.6	22.7
2	15.2	19.1	22.5	23.8	23.2
3	15.9	19.1	22.8	23.7	22.6
4	16.0	19.8	23.3	23.7	23.2
5	16.0	19.8	23.2	23.7	23.3
6	16.3	20.7	23.7	24.0	23.1
7	15.8	20.9	23.3	24.1	22.4
8	16.1	19.9	23.4	24.0	21.9
9	15.9	19.6	22.0	24.1	22.4
10	16.3	<b>19.2</b>	22.2	23.6	22.3
11	16.1	20.6	23.7	23.7	22.7
12	15.8	21.4	24.2	24.4	23.0
13	15.9	20.2	22.8	24.7	22.4
14	14.2	19.6	22.7	23.3	22.1
15	13.4	19.5	22.5	23.4	22.5
16	13.9	19.6	23.2	23.8	
17	14.4	20.5	23.8	24.1	
18	14.3	20.4	<b>23.8</b>	24.1	
19	14.4	20.9	N/A	<b>24.1</b>	
20	16.1	20.7	24.5	<b>24.1</b>	
21	15.0	20.9	24.7	<b>24.2</b>	
22	16.7	20.5	24.6	<b>24.2</b>	
23	15.7	20.6	26.1	23.7	
24	15.6	21.0	<b>22.4</b>	23.7	
25	16.5	21.5	<b>22.2</b>	23.5	
26	15.8	21.7	22.8	23.5	
27	15.9	21.0	23.2	23.2	
28	16.4	22.7	23.3	23.3	
29	18.8	22.6	23.7	22.9	
30	19.4	22.8	23.8	22.2	
31	19.6		23.8	22.8	

Bolded values represent power interruptions, no flow to the facility  
 N/A - July 19, 2019, no flow to the facility, reset GFIC which restarted pump

Table 4.5-4: Water Quality Parameters at Associated Locations at Octoraro Creek Eel Facility, 2019

Day	Time	Collection		Head Pond	
		Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)
5/1/2019	1040	15.0	9.70	14.9	8.90
5/2/2019	755	15.2	9.50	15.4	9.00
5/3/2019	1052	15.9	10.00	16.0	10.00
5/4/2019	730	16.0	9.70	15.8	9.80
5/5/2019	805	16.0	9.12	15.9	8.81
5/6/2019	900	16.3	9.70	16.1	9.50
5/7/2019	808	15.8	9.60	15.8	9.50
5/8/2019	855	16.1	9.33	16.1	9.00
5/9/2019	935	15.9	9.60	15.9	9.40
5/10/2019	930	16.3	8.98	16.0	8.90
5/11/2019	736	16.1	9.20	16.2	9.10
5/12/2019	716	15.8	9.30	16.1	9.30
5/13/2019	915	15.9	9.82	15.7	9.56
5/14/2019	748	14.2	11.00	14.5	11.20
5/15/2019	1000	13.4	10.04	13.1	9.70
5/16/2019	954	13.9	10.10	13.6	9.80
5/17/2019	930	14.4	10.80	14.0	10.14
5/18/2019	741	14.3	10.20	14.2	9.80
5/19/2019	820	14.4	10.20	14.3	10.10
5/20/2019	1012	16.1	10.30	15.3	10.20
5/21/2019	905	15.0	10.28	14.8	11.00
5/22/2019	1245	16.7	10.30	15.6	10.20
5/23/2019	950	15.7	10.00	15.3	9.70
5/24/2019	730	15.6	9.60	15.6	9.60
5/25/2019	745	16.5	9.66	16.4	9.56
5/26/2019	755	15.8	9.50	15.8	9.80
5/27/2019	815	15.9	9.30	15.8	9.20
5/28/2019	910	16.4	9.23	15.9	9.12
5/29/2019	925	18.8	9.90	18.5	9.83
5/30/2019	930	19.4	9.28	19.0	9.09
5/31/2019	1000	19.6	8.80	19.2	9.00
6/1/2019	750	19.3	8.80	19.2	8.56
6/2/2019	800	19.1	9.35	19.1	8.85
6/3/2019	822	19.1	8.90	19.2	8.53
6/4/2019	925	19.8	8.80	19.8	8.70
6/5/2019	855	19.8	8.30	19.8	7.80
6/6/2019	937	20.7	8.47	20.4	9.00
6/7/2019	930	20.9	8.30	20.6	9.60
6/8/2019	900	19.9	9.10	19.7	9.60
6/9/2019	730	19.6	8.60	19.5	8.70
6/10/2019	1040	19.2	8.23	20.2	8.04
6/11/2019	800	20.6	7.80	21.0	7.47
6/12/2019	955	21.4	8.46	21.3	9.10

(continued)



Table 4.5-4. (Continued)

Day	Time	Collection		Head Pond	
		Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)
6/13/2019	930	20.2	8.04	20.2	7.90
6/14/2019	930	19.6	7.60	19.7	7.40
6/15/2019	915	19.5	9.30	19.4	8.90
6/16/2019	710	19.6	9.40	19.6	9.10
6/17/2019	930	20.5	8.90	20.0	9.80
6/18/2019	910	20.4	8.70	20.1	8.40
6/19/2019	1055	20.9	8.63	20.6	8.22
6/20/2019	805	20.7	9.20	20.5	8.50
6/21/2019	830	20.9	6.89	20.8	7.30
6/22/2019	730	20.5	7.90	20.8	7.60
6/23/2019	845	20.6	6.00	20.9	6.50
6/24/2019	845	21.0	6.70	21.1	6.40
6/25/2019	740	21.5	6.40	21.4	5.90
6/26/2019	920	21.7	7.47	21.7	6.67
6/27/2019	732	21.0	8.00	21.1	7.10
6/28/2019	800	22.7	7.80	22.8	5.60
6/29/2019	730	22.6	7.60	22.9	5.70
6/30/2019	745	22.8	7.20	22.9	4.60
7/1/2019	830	22.4	7.20	22.6	4.20
7/2/2019	830	22.5	5.30	22.6	3.50
7/3/2019	730	22.8	5.57	22.9	3.90
7/4/2019	705	23.3	7.80	23.3	2.90
7/5/2019	710	23.2	5.90	23.2	2.86
7/6/2019	745	23.7	5.30	23.5	2.80
7/7/2019	745	23.3	5.70	23.2	2.90
7/8/2019	815	23.4	5.80	23.4	3.10
7/9/2019	745	22.0	7.20	22.3	6.10
7/10/2019	801	22.2	7.02	22.7	4.56
7/11/2019	810	23.7	5.80	23.6	3.50
7/12/2019	755	24.2	7.30	24.4	8.60
7/13/2019	730	22.8	4.10	23.1	6.30
7/14/2019	710	22.7	5.60	22.8	7.60
7/15/2019	830	22.5	5.89	22.7	8.38
7/16/2019	710	23.2	4.10	23.4	4.80
7/17/2019	740	23.8	5.14	23.8	3.13
7/18/2019	730	23.8	7.40	23.8	4.30
7/19/2019	730			23.3	7.10
7/20/2019	740	24.5	6.21	24.4	3.65
7/21/2019	750	24.7	6.80	24.6	4.00
7/22/2019	756	24.6	5.50	24.4	2.55
7/23/2019	735	26.1	6.30	26.4	7.60
7/24/2019	758	22.4	5.05	23.3	7.05
7/25/2019	800	22.2	6.65	23.2	7.21
7/26/2019	708	22.8	7.41	23.2	7.00

(continued)

Table 4.5-4. (Continued)

Day	Time	Collection		Head Pond	
		Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)
7/27/2019	710	23.2	5.50	23.3	3.40
7/28/2019	715	23.3	5.80	23.5	3.10
7/29/2019	825	23.7	6.02	23.7	3.06
7/30/2019	745	23.8	6.50	23.8	3.40
7/31/2019	738	23.8	7.80	23.8	4.20
8/1/2019	715	23.6	5.70	23.5	3.50
8/2/2019	739	23.8	6.40	23.9	3.57
8/3/2019	710	23.7	5.80	23.7	3.30
8/4/2019	725	23.7	5.84	23.7	2.91
8/5/2019	750	23.7	5.34	23.9	3.30
8/6/2019	733	24.0	5.40	24.1	3.40
8/7/2019	743	24.1	6.25	24.2	4.44
8/8/2019	850	24.0	6.30	24.1	4.40
8/9/2019	830	24.1	5.71	24.1	3.60
8/10/2019	705	23.6	6.40	24.0	4.40
8/11/2019	830	23.7	5.86	23.9	4.48
8/12/2019	1040	24.4	6.40	24.3	5.30
8/13/2019	752	24.7	6.10	24.1	4.90
8/14/2019	1115	23.3	4.70	23.3	3.30
8/15/2019	750	23.4	4.80	23.6	3.50
8/16/2019	730	23.8	5.00	23.7	2.70
8/17/2019	718	24.1	5.00	23.9	2.70
8/18/2019	732	24.1	4.90	24.0	2.20
8/19/2019	745	24.1	6.20	24.1	2.90
8/20/2019	735	24.1	6.50	24.5	3.50
8/21/2019	737	24.2	5.05	24.2	2.70
8/22/2019	733	24.2	6.60	24.4	3.00
8/23/2019	754	23.7	6.73	23.7	5.95
8/24/2019	730	23.7	5.09	23.4	2.94
8/25/2019	750	23.5	4.42	23.6	2.80
8/26/2019	730	23.5	4.83	23.5	3.45
8/27/2019	740	23.2	4.50	23.3	3.30
8/28/2019	735	23.3	4.70	23.3	3.50
8/29/2019	745	22.9	4.38	22.9	3.15
8/30/2019	730	22.2	4.71	22.6	2.92
8/31/2019	720	22.8	5.30	22.9	3.80
9/1/2019	730	22.7	5.10	22.9	3.20
9/2/2019	723	23.2	6.02	23.3	4.28
9/3/2019	855	22.6	5.20	22.8	2.63
9/4/2019	837	23.2	5.02	23.2	3.02
9/5/2019	740	23.3	4.85	23.4	3.30
9/6/2019	845	23.1	4.80	23.3	3.33
9/7/2019	730	22.4	4.90	22.6	3.80
9/8/2019	730	21.9	3.78	22.2	2.06

(continued)

Table 4.5-4. (Continued)

Day	Time	Collection		Head Pond	
		Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)
9/9/2019	846	22.4	4.23	22.5	2.30
9/10/2019	840	22.3	5.33	22.2	3.33
9/11/2019	840	22.7	5.53	22.7	3.91
9/12/2019	901	23.0	5.64	23.0	4.12
9/13/2019	805	22.4	5.13	22.6	3.14
9/14/2019	709	22.1	4.88	22.3	2.90
9/15/2019	800	22.5	4.63	22.4	3.07

Table 4.5-5: Dissolved Oxygen (mg/L) Reading Taken in Collection Tank, Octoraro Creek Eel Facility, 2019

Day	May	June	July	August	September
1	9.70	8.80	7.20	5.70	5.10
2	9.50	9.35	5.30	6.40	6.02
3	10.00	8.90	5.57	5.80	5.20
4	9.70	8.80	7.80	5.84	5.02
5	9.12	8.30	5.90	5.34	4.85
6	9.70	8.47	5.30	5.40	4.80
7	9.60	8.30	5.70	6.25	4.90
8	9.33	9.10	5.80	6.30	3.78
9	9.60	8.60	7.20	5.71	4.23
10	8.98	<b>8.23</b>	7.02	6.40	5.33
11	9.20	7.80	5.80	5.86	5.53
12	9.30	8.46	7.30	6.40	5.64
13	9.82	8.04	4.10	6.10	5.13
14	11.00	7.60	5.60	4.70	4.88
15	10.04	9.30	5.89	4.80	4.63
16	10.10	9.40	4.10	5.00	
17	10.80	8.90	5.14	5.00	
18	10.20	8.70	<b>7.40</b>	4.90	
19	10.20	8.63		<b>6.20</b>	
20	10.30	9.20	6.21	<b>6.50</b>	
21	10.28	6.89	6.80	<b>5.05</b>	
22	10.30	7.90	5.50	<b>6.60</b>	
23	10.00	6.00	6.30	6.73	
24	9.60	6.70	<b>5.05</b>	5.09	
25	9.66	6.40	<b>6.65</b>	4.42	
26	9.50	7.47	7.41	4.83	
27	9.30	8.00	5.50	4.50	
28	9.23	7.80	5.80	4.70	
29	9.90	7.60	6.02	4.38	
30	9.28	7.20	6.50	4.71	
31	8.80		7.80	5.30	

July 19, no water running when arrived, restarted pump  
 Power interruption (no flow) are shown in Bold (8 days)

Table 4.6-1: Eel Transport/Stocking Data, 2019

Location of stocking	Number of eels	Died (Mortality)			Removed for Analysis	Removed for SRBC	Removed by SUNY	Number Stocked
		Collection Tank	Holding Tank	Transported				
Octoraro Creek Collection tanks	14,170	0 (0.00%)						
Transported to Conowingo Eel Collection Facility	14,170			0 (0.00%)				14,170
Conowingo Collection tank	126,181	26 (0.02%)	<b>193 (0.15%)</b>		91	105	16,677	109,089
Total Transported from Conowingo Eel Collection Facility	123,259			61 (0.05%)				123,198

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

Table 4.7-1: Calibration of Flows (Gallons per Minute) in the Octoraro Creek Eel Facility, 2019

	DATE									
	5/1	5/8	5/15	5/22 *	5/29	6/5	6/12 *	6/19 *	6/26 *	7/3
<b>Enkamat Ramp</b>										
Spray bar	8.0	7.5	7.0	7.8	5.3	3.8	4.4	6.0	5.7	5.1
Collection tank drain	2.0	1.8	1.2	0.9	0.5	1.1	1.7	0.7	0.8	0.9
Top Attraction flow	6.0	5.8	5.8	6.9	4.8	2.7	2.8	5.4	5.0	4.3
Bottom Attraction flow	29.5	29.0	30.0	30.0	30.0	29.0	29.0	29.5	30.0	30.5
Total Attraction Flow	37.5	36.5	37.0	37.8	35.3	32.8	33.4	35.5	35.7	35.6
<b>Milieu Ramp</b>										
Spray bar	7.5	7.5	6.8	7.0	4.5	4.5	4.4	6.8	6.8	5.9
Collection tank drain	0.3	0.3	1.2	0.9	0.5	1.1	1.7	0.7	0.8	0.9
Top Attraction flow	7.3	7.3	5.6	6.1	4.0	3.5	2.8	6.1	6.0	5.0
Bottom Attraction flow	29.5	29.0	27.5	28.0	28.0	28.5	28.0	28.0	27.0	27.5
Total Attraction Flow	37.0	36.5	34.3	35.0	32.5	33.0	32.4	34.8	33.8	33.4
Overall Attraction Flows	74.5	73.0	71.3	72.8	67.8	65.8	65.8	70.3	69.5	69.0

\* Cleaned pump, manifold, and hoses to increase flow

	DATE									
	7/10	7/17 *	7/26	7/31 *	8/7	8/14	8/22 *	8/29	9/4 *	9/11 *
Spray bar	4.5	4.8	5.2	4.2	4.4	6.9	6.0	4.5	5.1	6.6
Collection tank drain	1.0	0.8	0.5	0.9	0.5	0.8	0.9	0.9	1.0	0.8
Top Attraction flow	3.5	4.1	4.7	3.3	3.9	6.1	5.1	3.6	4.1	5.9
Bottom Attraction flow	27.0	27.5	27.0	28.0	25.5	22.0	26.0	25.0	25.0	24.5
Total Attraction Flow	31.5	32.3	32.2	32.2	29.9	28.9	32.0	29.5	30.1	31.1
<b>Milieu Ramp</b>										
Spray bar	5.3	5.7	5.5	4.7	6.2	7.5	5.6	3.8	4.5	6.0
Collection tank drain	1.0	0.8	0.5	0.9	0.5	0.8	0.9	0.9	1.0	0.8
Top Attraction flow	4.3	5.0	5.0	3.8	5.7	6.7	4.7	2.9	3.5	5.3
Bottom Attraction flow	27.0	25.0	24.0	26.0	23.0	21.0	24.0	23.0	22.5	21.0
Total Attraction Flow	32.3	30.7	29.5	30.7	29.2	28.5	29.6	26.8	27.0	27.0
Overall Attraction Flows	63.8	63.0	61.7	62.9	59.1	57.4	61.6	56.3	57.1	58.1

\* Cleaned pump, manifold, and hoses to increase flow

**Table 5.0-1: Comparison of Octoraro Creek Eel Ramps, 2015-2019**

Watershed area 540 km<sup>2</sup>  
 Approximate Distance from Ocean to ramp 341 km

	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>Average</b>
Eels Collected	7,197	21,094	11,347	4,203	14,170	11,602
Average Size (mm)	129.4	130.9	135.4	141.6	129.9	133.4
Range of Sizes (mm)	95-232	99-202	99-245	100-259	93-252	
Days of Operation	89	138	138	135	138	127.6
Average eels per day	80.9	152.9	82.2	31.1	102.7	90
Average creek flow (cfs)	180.9	121.3	138.0	411.0	240.0	218.2
Range of flows (cfs)	60-1,490	43-512	51-557	88-2,370	63-1,610	

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)

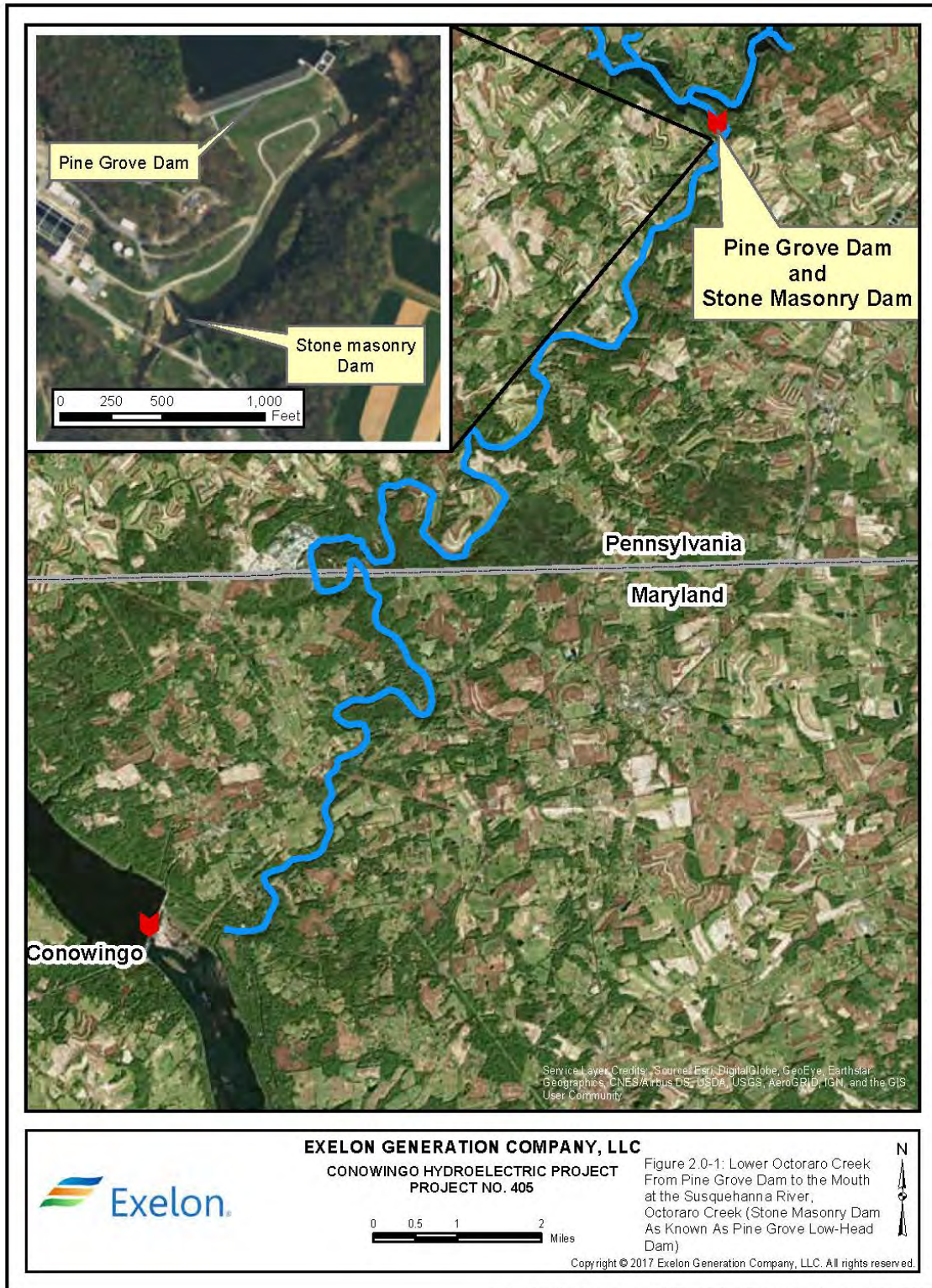
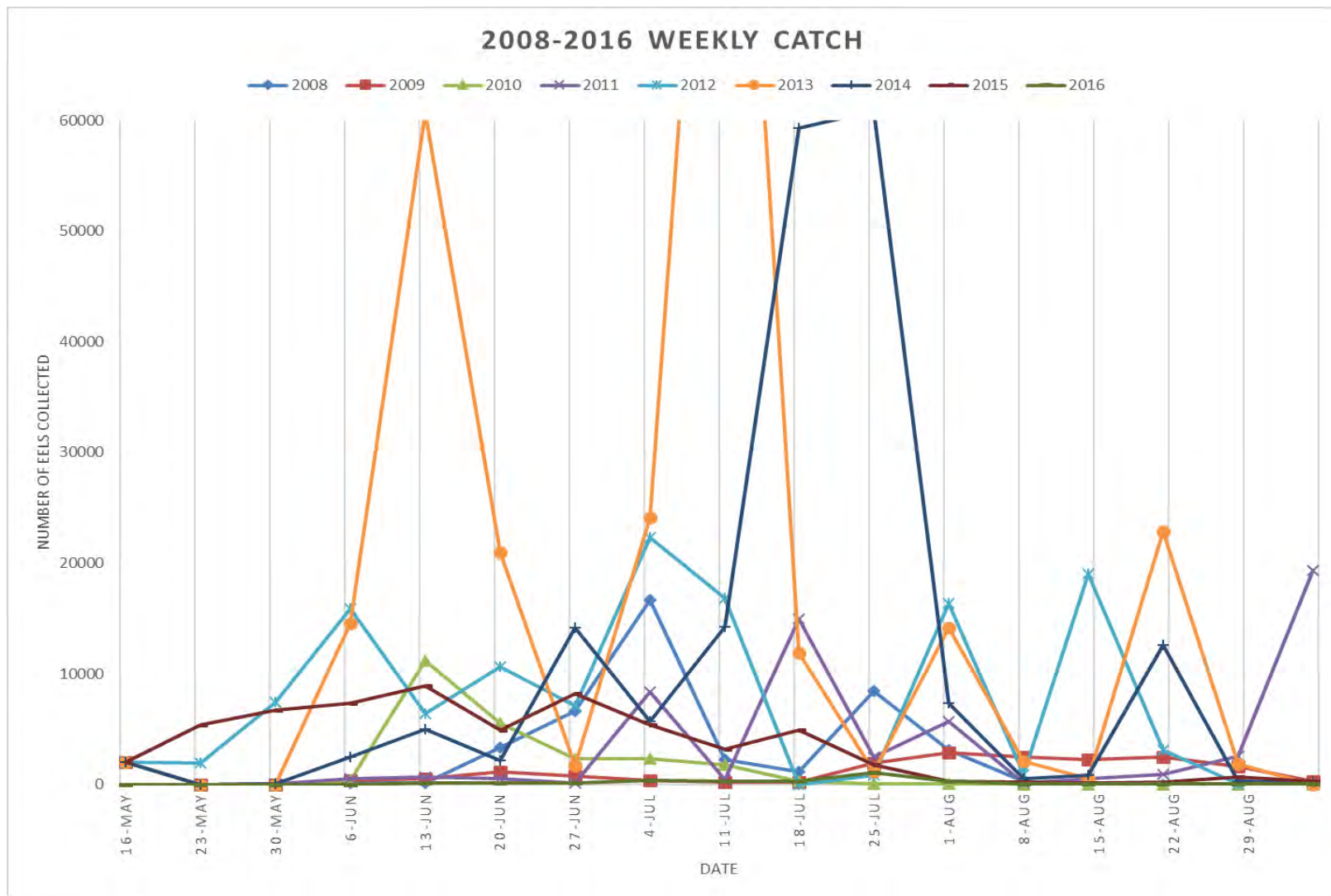




Figure 2.0-2: Location of the Juvenile Eel Collection Facility on South Shore (Left Bank) Of Octoraro Creek Downstream of Art Building



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



\*Data from the USFWS, [Minkinen and Park 2014](#) and personal communication with USFWS, Christopher Reily, October 27, 2016

**Figure 3.1-1: Hinged Cover over Spray Bar to Decrease Light inside the Eel Ramp, Octoraro Creek Eel Facility, 2019**



Figure 3.1-2: Submersible Pump for Attraction Flow, Octoraro Creek Eel Facility, 2019



**Figure 3.1-3: Larger Water Line Placed Underground, Octoraro Creek Eel Facility, 2019**



Figure 3.1-4: Upgraded Manifold and Attraction Line, Octoraro Creek Eel Facility, 2019



Figure 3.1-5: Larger Upgraded Collection Tank, Octoraro Creek Eel Facility, 2019



Figure 3.1-6: Aerator Powered by a Marine Battery and Charged by a solar Panel, Octoraro Creek Eel Facility, 2019





Figure 3.2-1: Measuring Juvenile Eels to Nearest Millimeter While Sedated, Octoraro Creek Eel Facility, 2019



Figure 3.2-2: Weighting Juvenile Eels in Grams While Sedated, Octoraro Creek Eel Facility, 2019



Figure 3.3-1: Small Eel Transport Tank, Octoraro Creek Eel Facility, 2019



Figure 4.1-1: Daily Eel Catch, Octoraro Creek Eel Facility, 2019

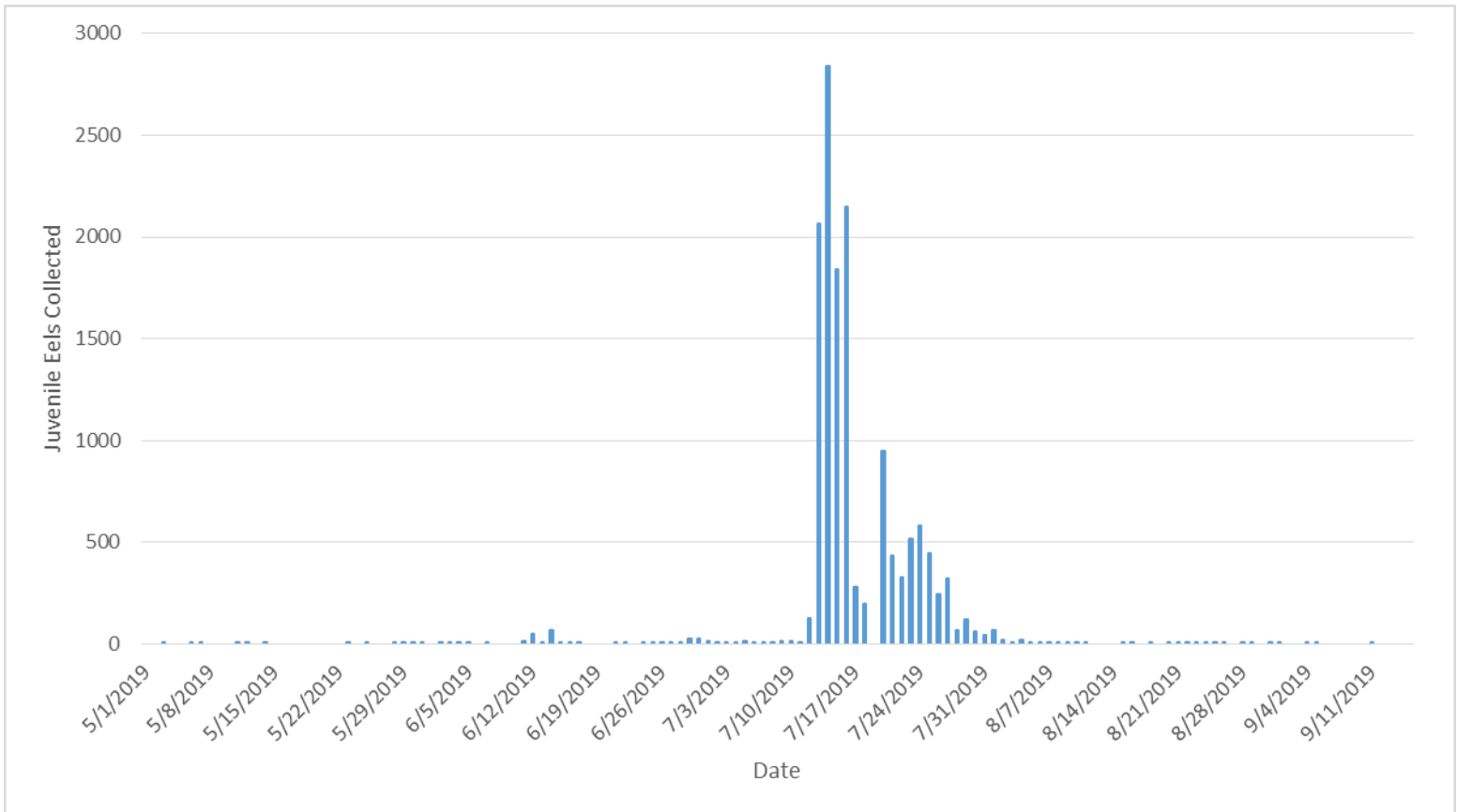


Figure 4.3-1: Percent Eel Catch per Week, Octoraro Creek Eel Facility, 2019

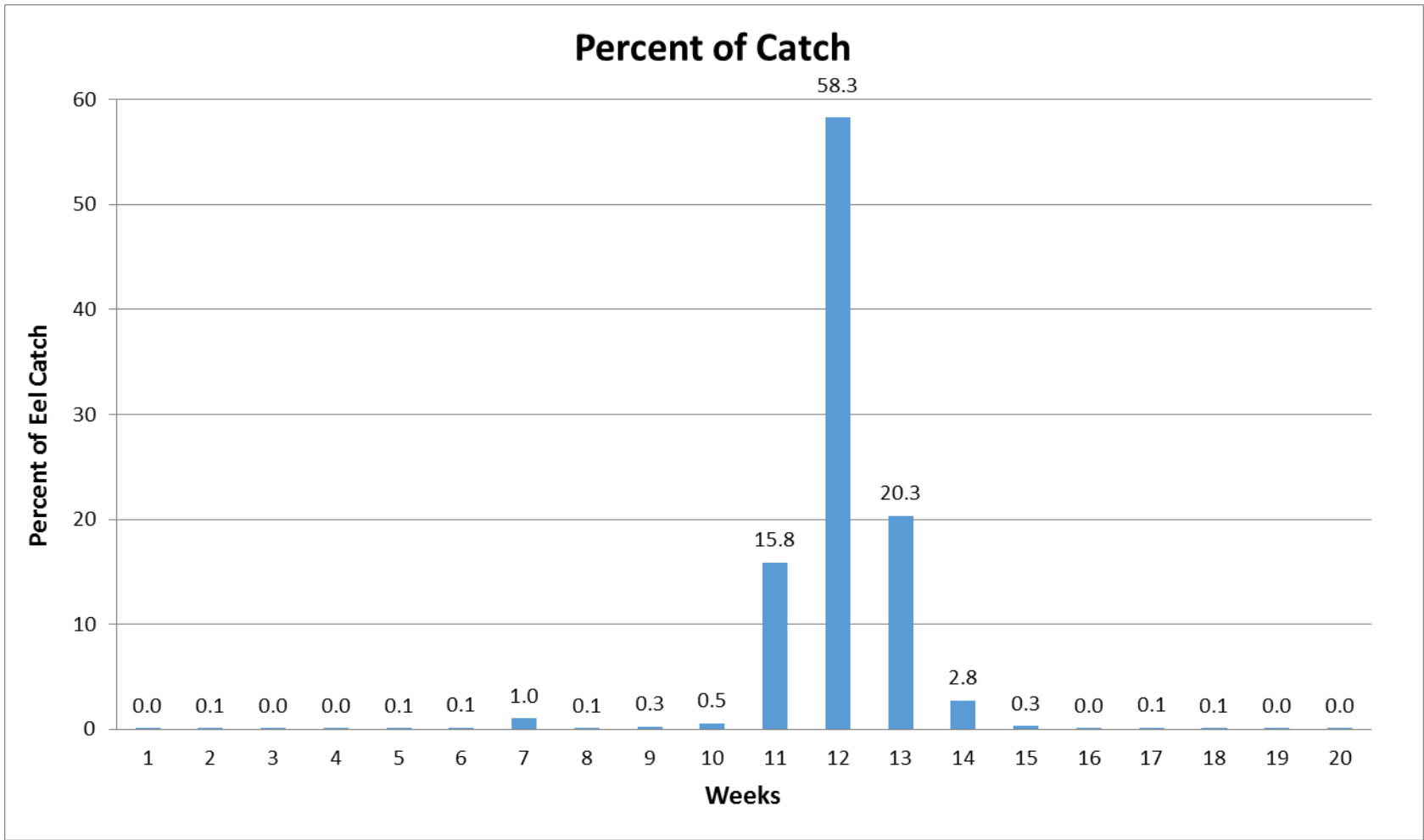


Figure 4.5-1: Daily Eel Catch and Daily Average Creek Flow (cfs, top graph) and Weekly Eel Catch and Weekly Average Creek Flow (cfs, bottom graph), Octoraro Creek Eel Facility, 2019

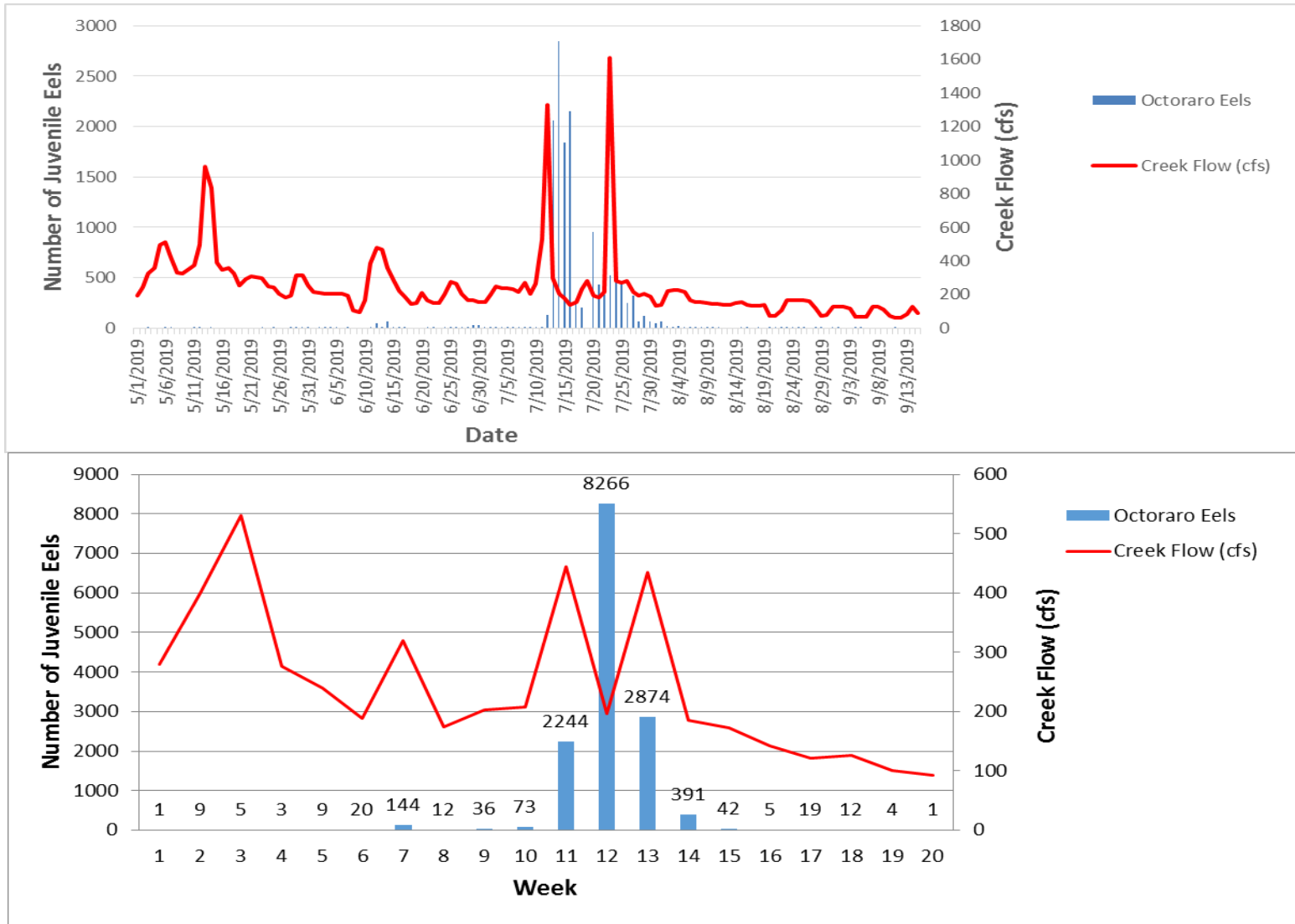


Figure 4.5-2: Eel Catch to Lunar Fraction (Daily above, Weekly Average below), Octoraro Creek Eel Facility, 2019 (1.0 Equals Full Moon)

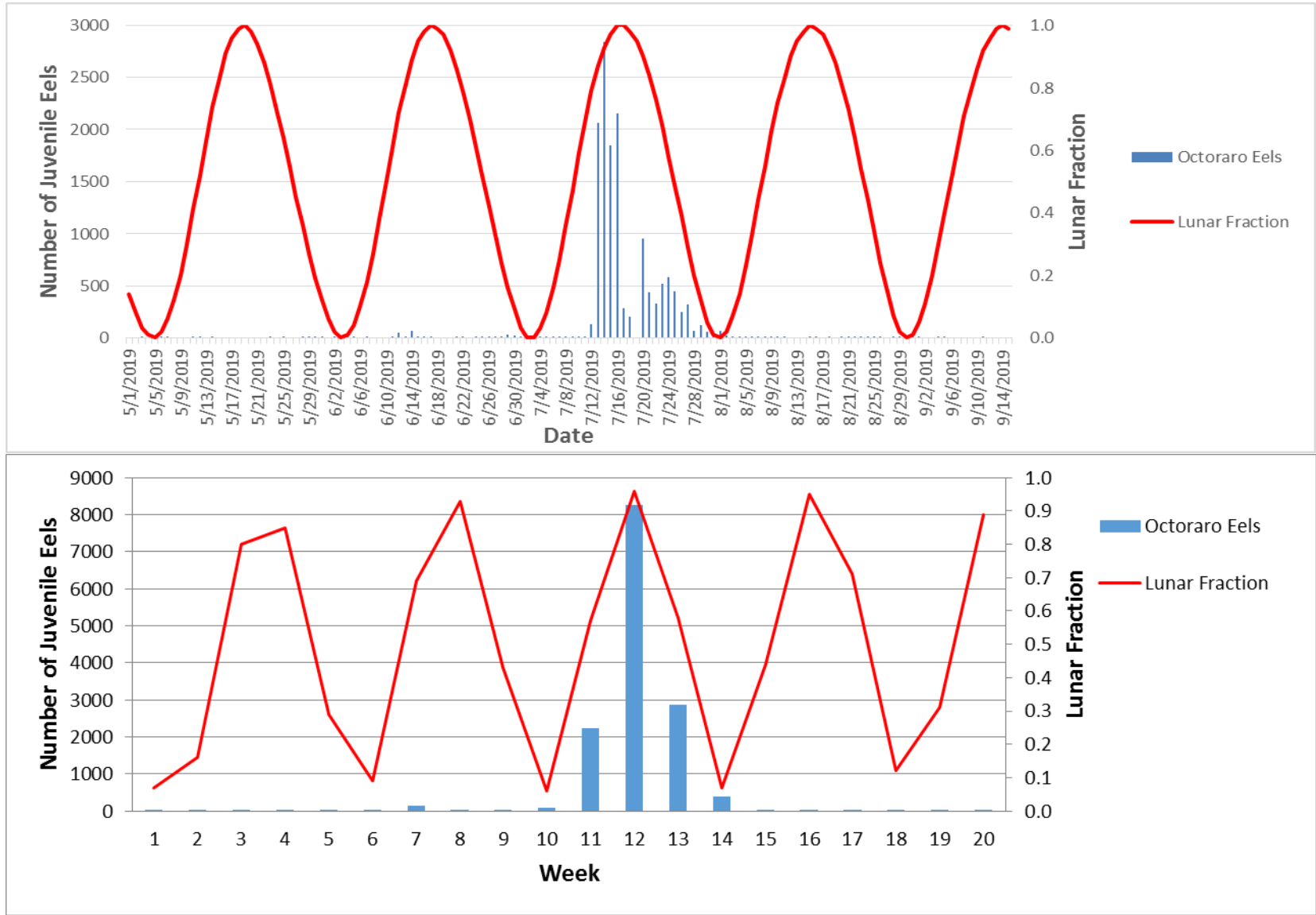


Figure 4.5-3: Eel Catch to Water Temperature (Daily above, Weekly Average below), Octoraro Creek Eel Facility, 2019

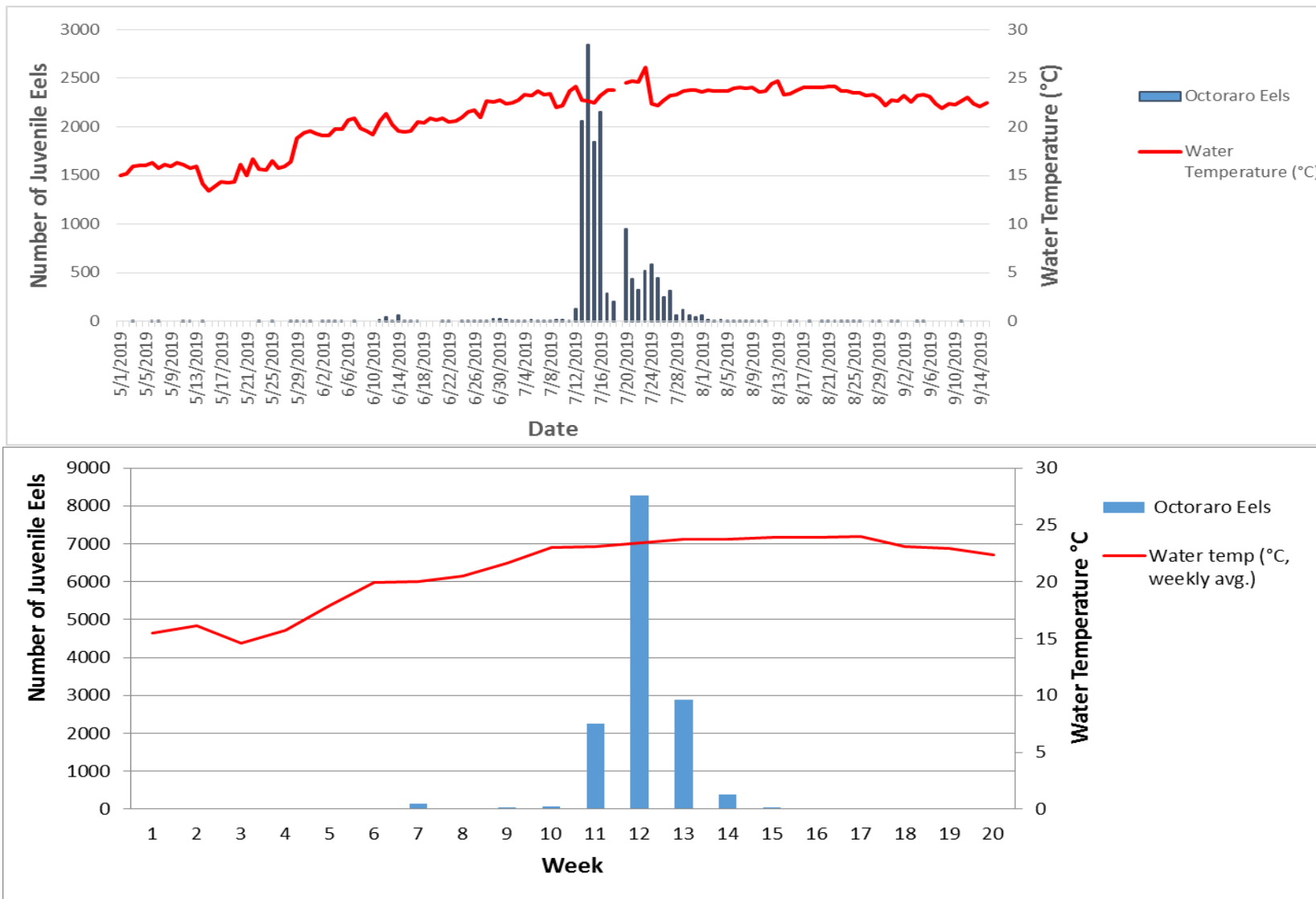




Figure 4.5-4: Comparison of Dissolved Oxygen Readings in Collection Tanks and Head Pond, Octoraro Creek Eel Facility, 2019

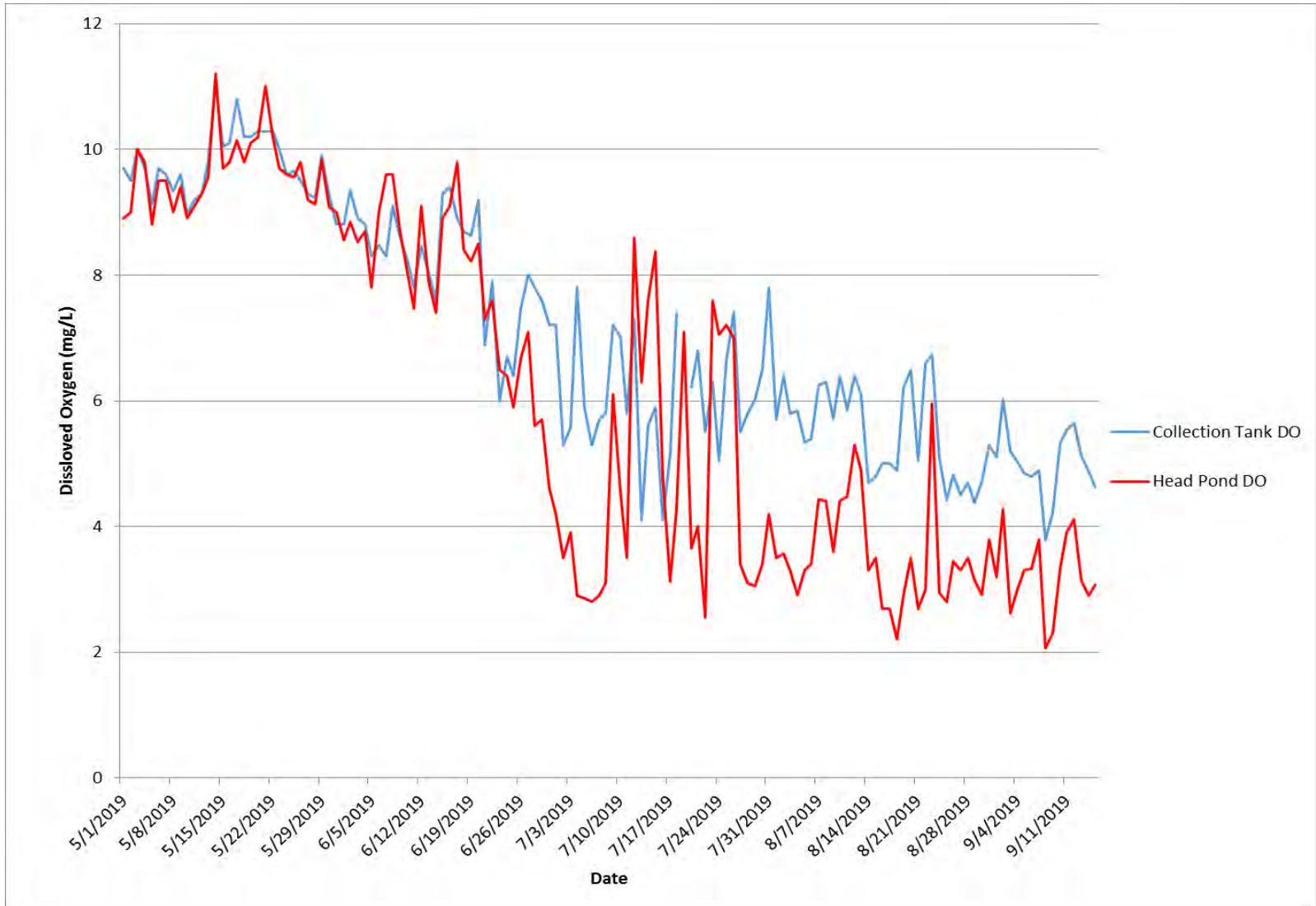


Figure 4.5-5: Eel Catch to Dissolved Oxygen (Daily above, Weekly Average below), Octoraro Creek Eel Facility, 2019

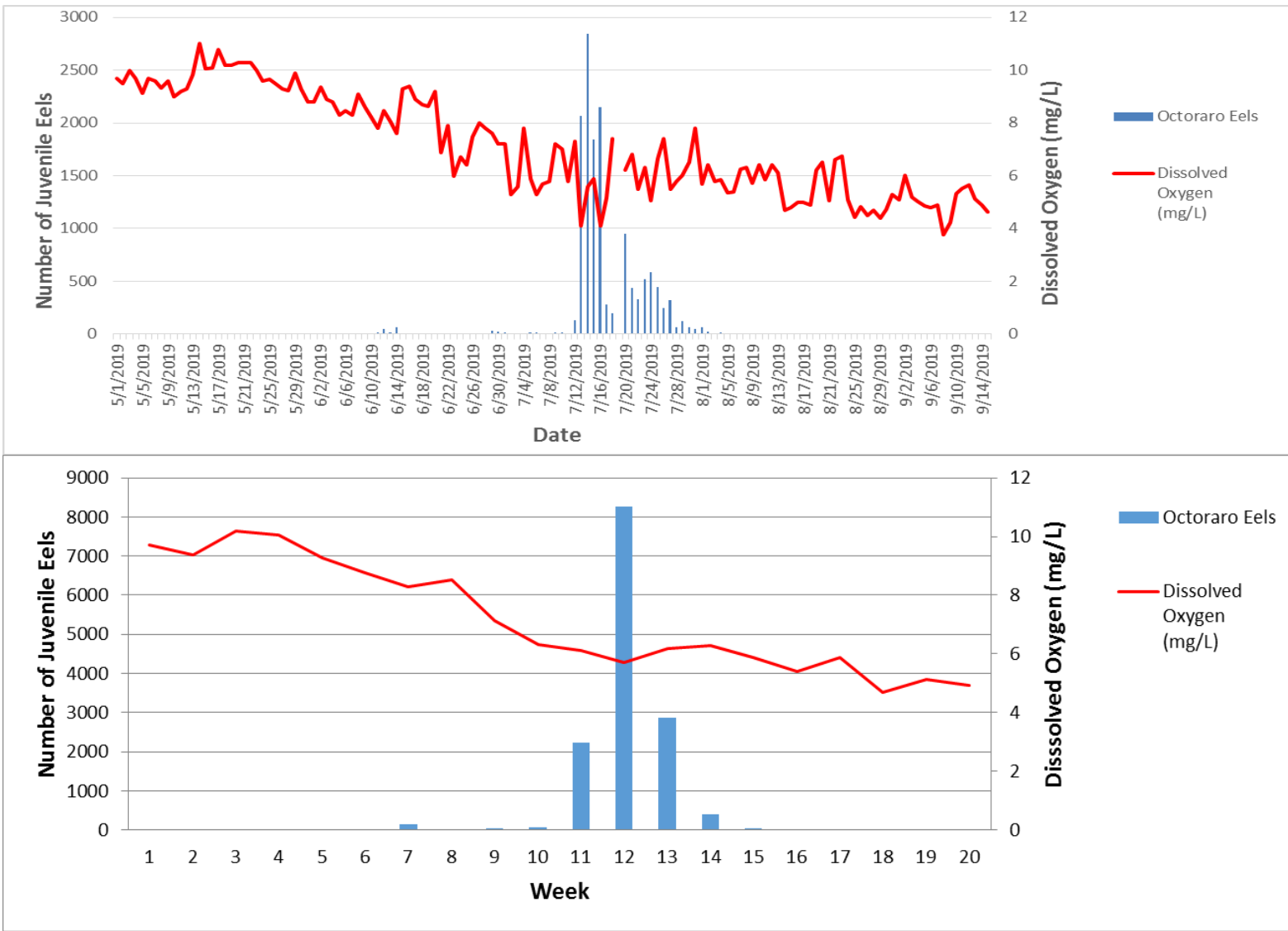
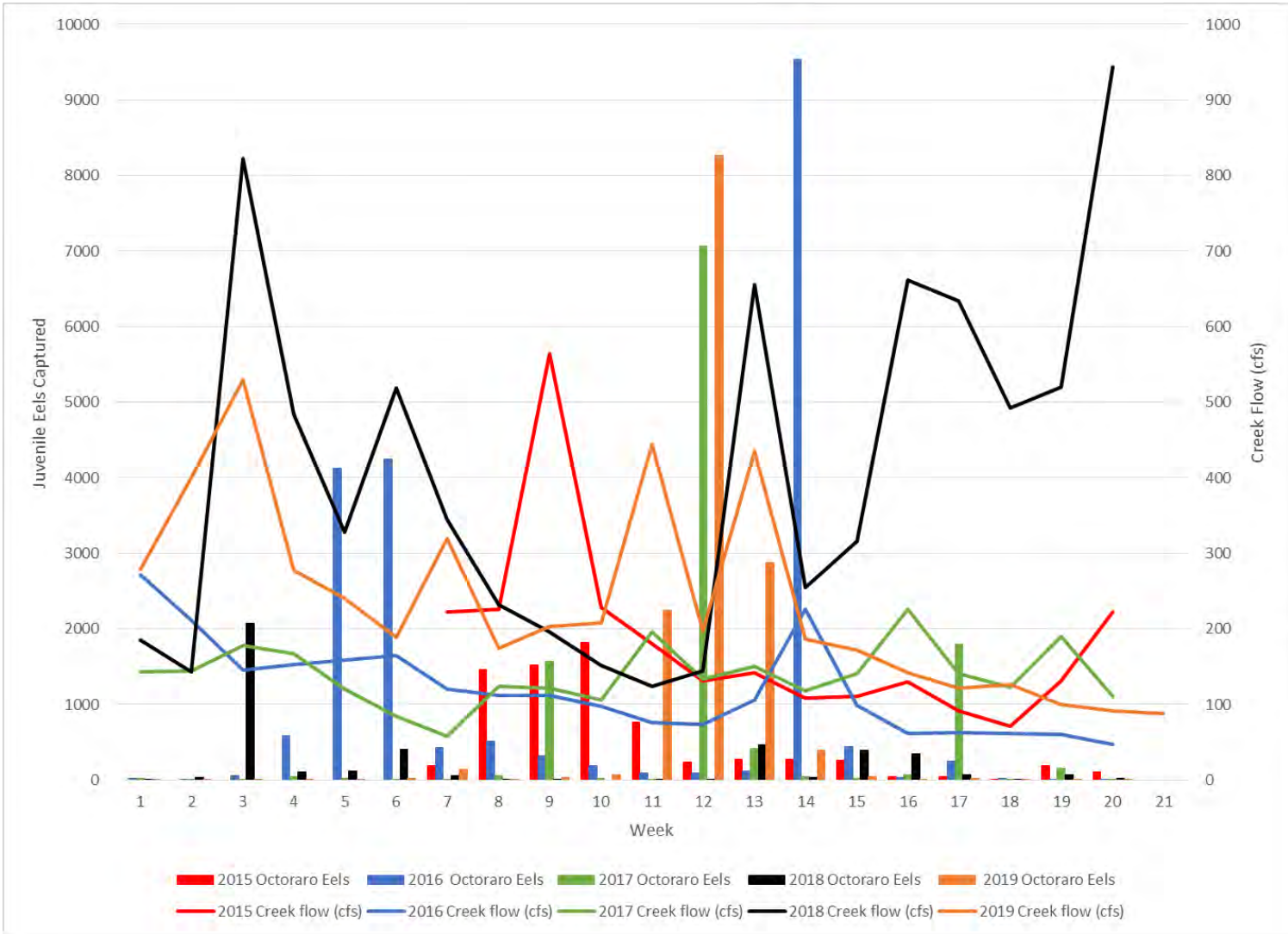


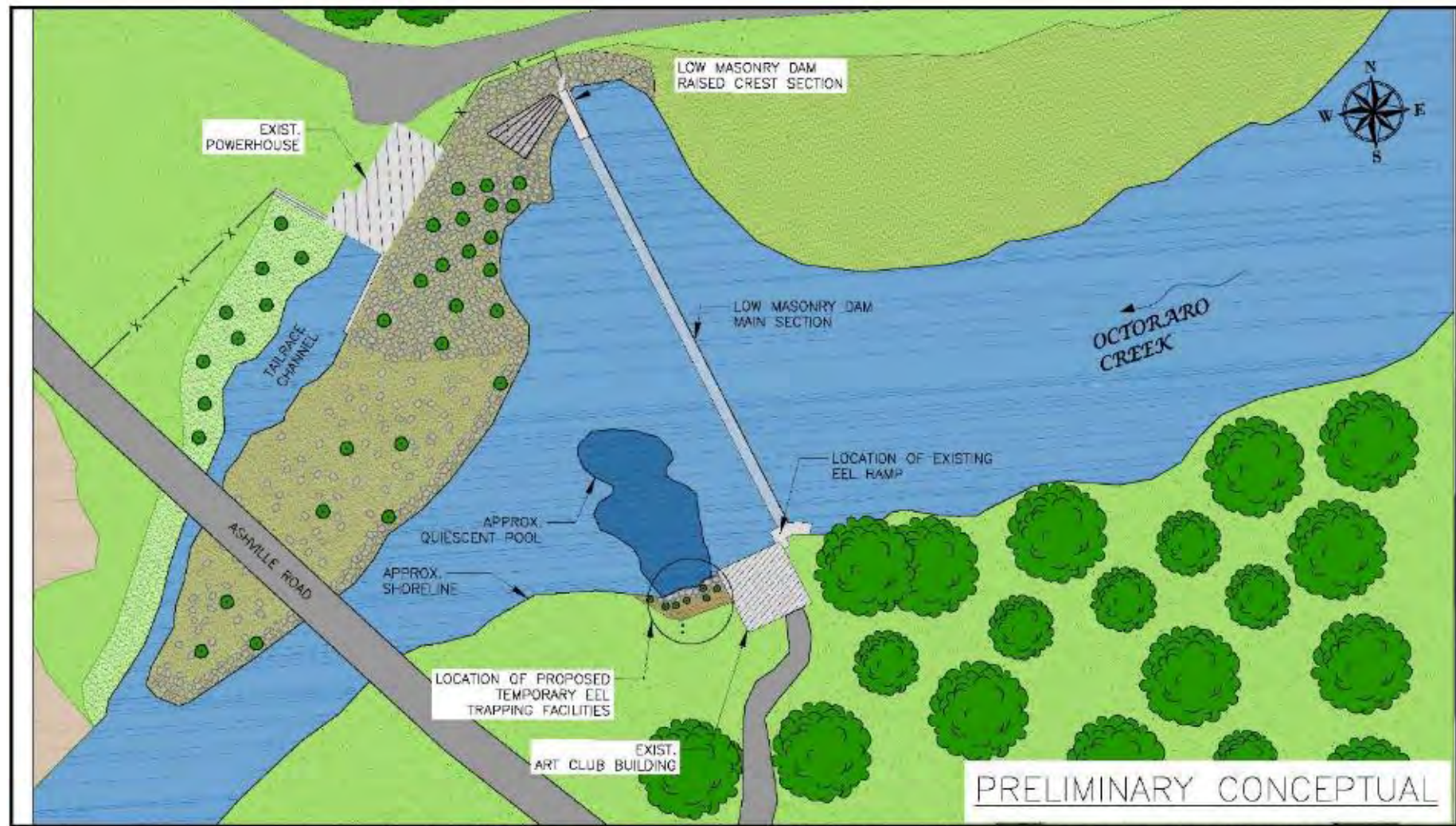
Figure 5.0-1: Cobble/gravel Outcrop Downstream of the Eel Ramp Entrance, Octoraro Creek Eel Facility, 2019



Figure 5.0-2: Weekly Catch and Average Creek Flow, Octoraro Creek Eel Facility, 2015-2019

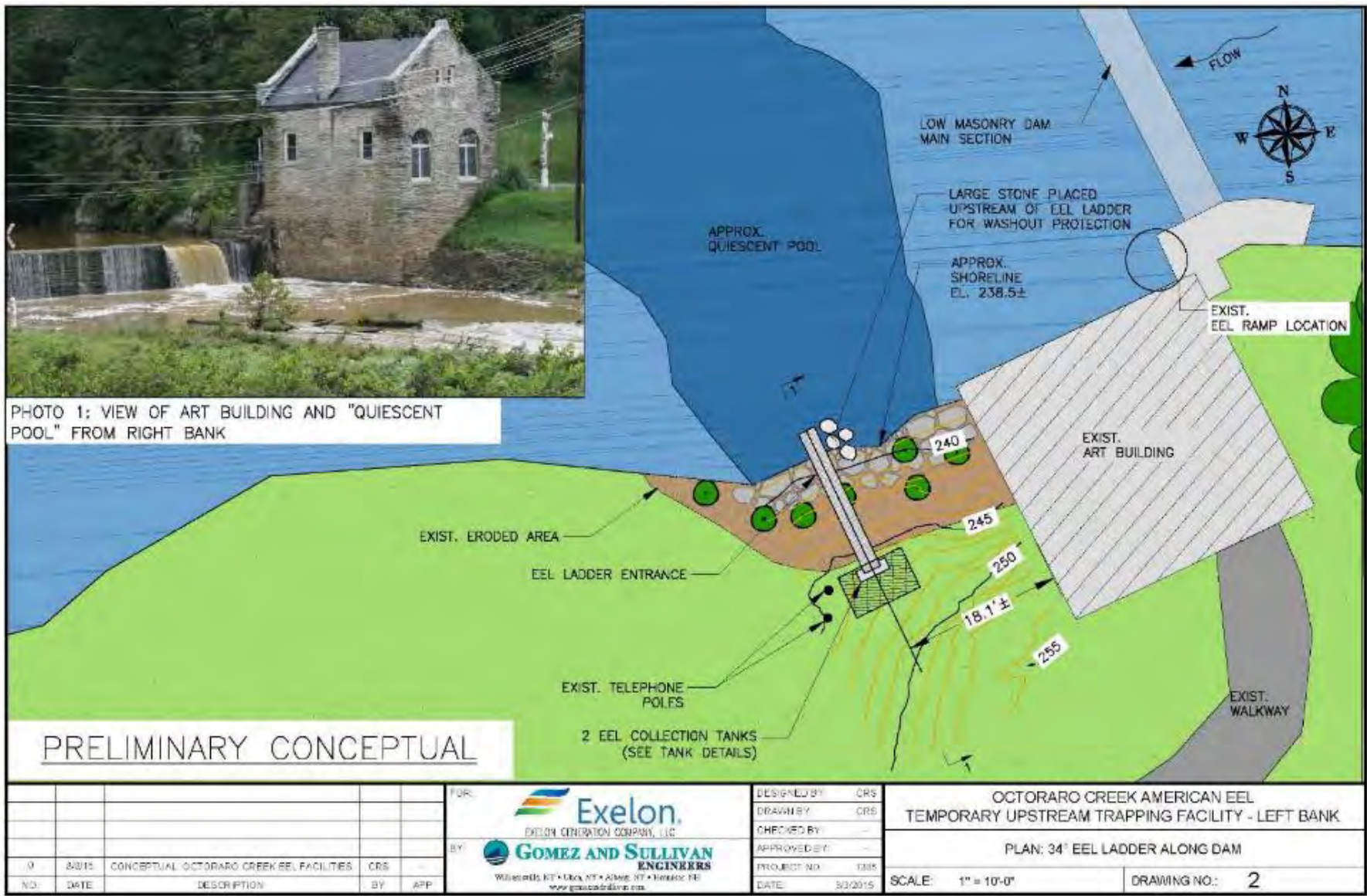


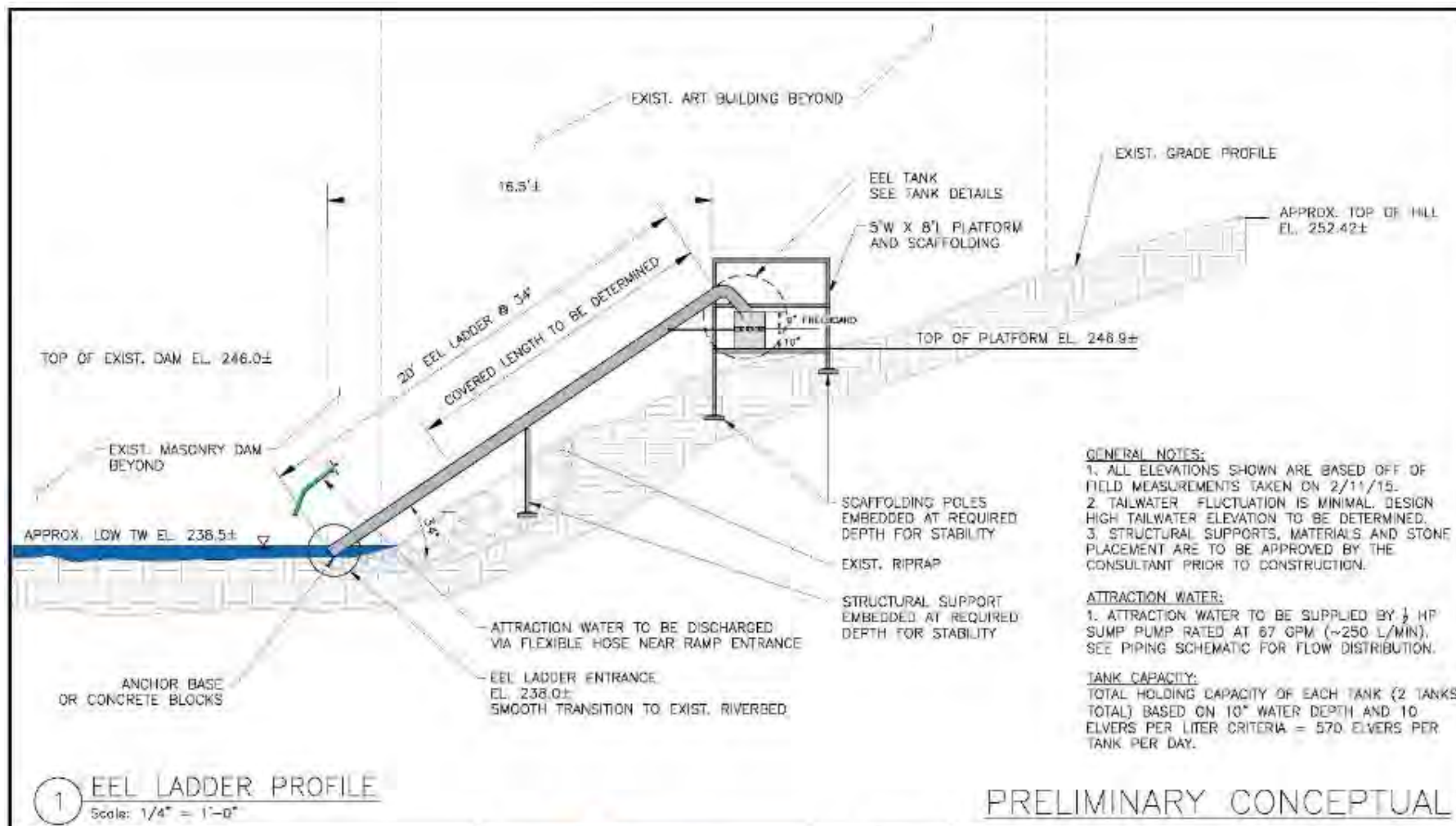
**Appendix A:  
Conceptual Design of Trapping Facility on South Shore  
of Octoraro Creek, 2015**



PRELIMINARY CONCEPTUAL

<table border="0"> <tr> <td>NO</td> <td>DATE</td> <td>DESCRIPTION</td> <td>BY</td> <td>APP</td> </tr> <tr> <td>1</td> <td>3/2/15</td> <td>CONCEPTUAL OCTORARO CREEK EEL FACILITIES</td> <td>CRS</td> <td>-</td> </tr> </table>					NO	DATE	DESCRIPTION	BY	APP	1	3/2/15	CONCEPTUAL OCTORARO CREEK EEL FACILITIES	CRS	-	<p>FOR:  <b>Exelon</b> LIBERTY UTILITIES COMPANY, LLC</p> <p>BY:  <b>GOMEZ AND SULLIVAN ENGINEERS</b> 2811 East 10th St • Okla. City • Okla., OK • Tulsa, OK • The Woodlands, TX www.gomezandsullivan.com</p>		<p>DESIGNED BY: CRS</p> <p>DRAWN BY: CRS</p> <p>CHECKED BY: -</p> <p>APPROVED BY: -</p> <p>PROJECT NO.: 1345</p> <p>DATE: 3/2/2015</p>		<p>OCTORARO CREEK AMERICAN EEL TEMPORARY UPSTREAM TRAPPING FACILITY - LEFT BANK</p> <p>SITE PLAN - EXISTING CONDITIONS</p> <p>SCALE: 1" = 40'-0"</p> <p>DRAWING NO.: 1</p>	
NO	DATE	DESCRIPTION	BY	APP																
1	3/2/15	CONCEPTUAL OCTORARO CREEK EEL FACILITIES	CRS	-																





**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 1/2 HP SUMP PUMP RATED AT 67 GPM (~250 L/MIN). SEE PIPING SCHEMATIC FOR FLOW DISTRIBUTION.

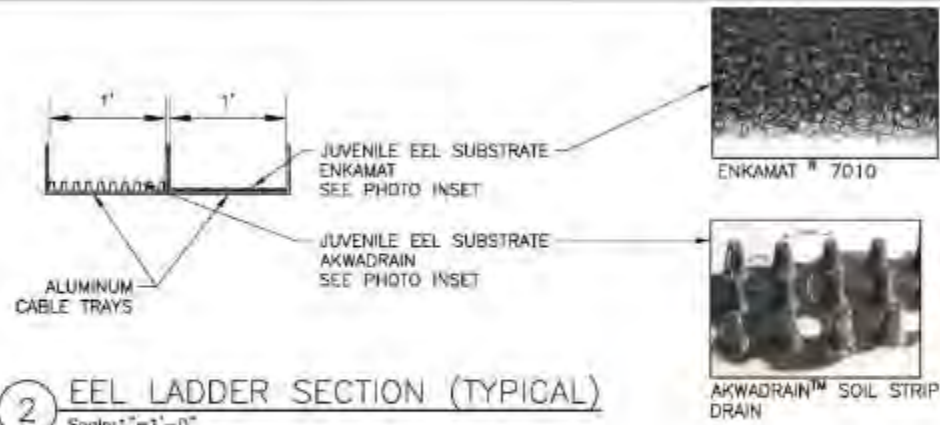
**TANK CAPACITY:**  
 TOTAL HOLDING CAPACITY OF EACH TANK (2 TANKS TOTAL) BASED ON 10" WATER DEPTH AND 10 ELVERS PER LITER CRITERIA = 570 ELVERS PER TANK PER DAY.

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

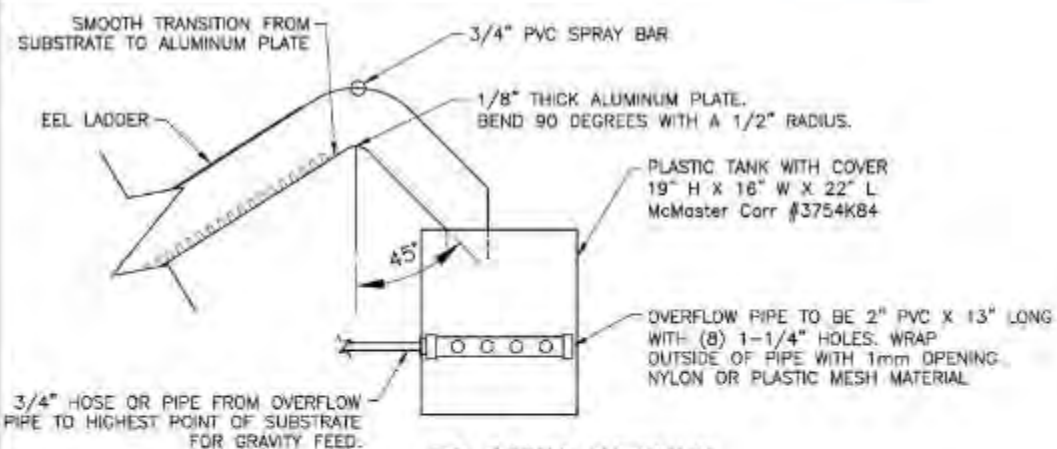
PRELIMINARY CONCEPTUAL

		FOR: 		DESIGNED BY: CRS	OCTORARO CREEK AMERICAN EEL	
		BY: 		DRAWN BY: CRS	TEMPORARY UPSTREAM TRAPPING FACILITY - LEFT BANK	
				CHECKED BY: -	PROPOSED EEL LADDER PROFILE	
				APPROVED BY: -		
0	3/5/15	CONCEPTUAL OCTORARO CREEK EEL FACILITIES	CRS	PROJECT NO. 1385	SCALE 1/4" = 1'-0"	DRAWING NO. 3
NO.	DATE	DESCRIPTION	BY	APP.		

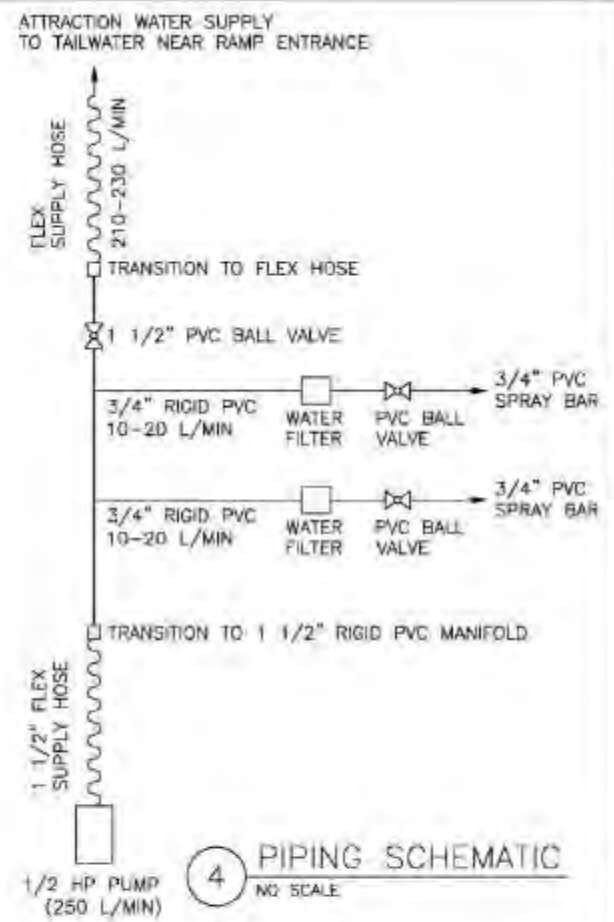




2 EEL LADDER SECTION (TYPICAL)  
 Scale: 1" = 1'-0"



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	DRS	

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

DESIGNED BY:	DRS
DRAWN BY:	DRS
CHECKED BY:	
APPROVED BY:	
PROJECT NO.:	1389
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, 2019**

### Weekly Eel Catch Data, 2019

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Octoraro Eels	1	9	5	3	9	20	144	12	36	73	2244	8266	2874	391	42	5	19	12	4	1	0
Creek flow (cfs, weekly avg.)	279	400	530	277	240	189	319	174	203	208	444	197	435	186	172	142	122	126	100	92	88
Lunar Fraction, (weekly avg.)	0.07	0.16	0.80	0.85	0.29	0.09	0.69	0.93	0.43	0.06	0.57	0.96	0.58	0.07	0.44	0.95	0.71	0.12	0.31	0.89	0.99
Water temp (°C, weekly avg.)	15.5	16.1	14.6	15.7	17.9	19.9	20.0	20.5	21.6	23.0	23.1	23.4	23.7	23.7	23.9	23.9	24.0	23.1	22.9	22.4	22.5
Dissolved Oxygen (mg/L, weekly avg.)	9.73	9.36	10.18	10.05	9.26	8.75	8.29	8.52	7.14	6.32	6.13	5.72	6.17	6.29	5.89	5.41	5.87	4.69	5.13	4.93	4.63
Percent of Catch	0.01	0.06	0.04	0.02	0.06	0.14	1.02	0.08	0.25	0.52	15.84	58.33	20.28	2.76	0.30	0.04	0.13	0.08	0.03	0.01	0.00
Conowingo Eels	6	4616	2237	1774	9359	2097	1706	2187	2056	39685	3076	3141	5210	3213	1158	38115	3160	3135	192	40	18

Wk 1: May 1 - May 4  
 Wk 2: May 5 - May 11  
 Wk 3: May 12 - May 18  
 Wk 4: May 19 - May 25  
 Wk 5: May 26 - June 1  
 Wk 6: June 2 - June 8  
 Wk 7: June 9 - June 15  
 Wk 8: June 16 - June 22  
 Wk 9: June 23 - June 29  
 Wk 10: June 30 - July 6

Wk 11: July 7 - July 13  
 Wk 12: July 14 - July 20  
 Wk 13: July 21 - July 27  
 Wk 14: July 28 - August 3  
 Wk 15: August 4 - August 10  
 Wk 16: August 11 - August 17  
 Wk 17: August 18 - August 24  
 Wk 18: August 25 - August 31  
 Wk 19: September 1 - September 7  
 Wk 20: September 8 - September 14  
 Wk 21: September 15

**Appendix C:**  
**Weekly Data for 2015-2019**

**Weekly Eel Catch Data (2015-2019)**

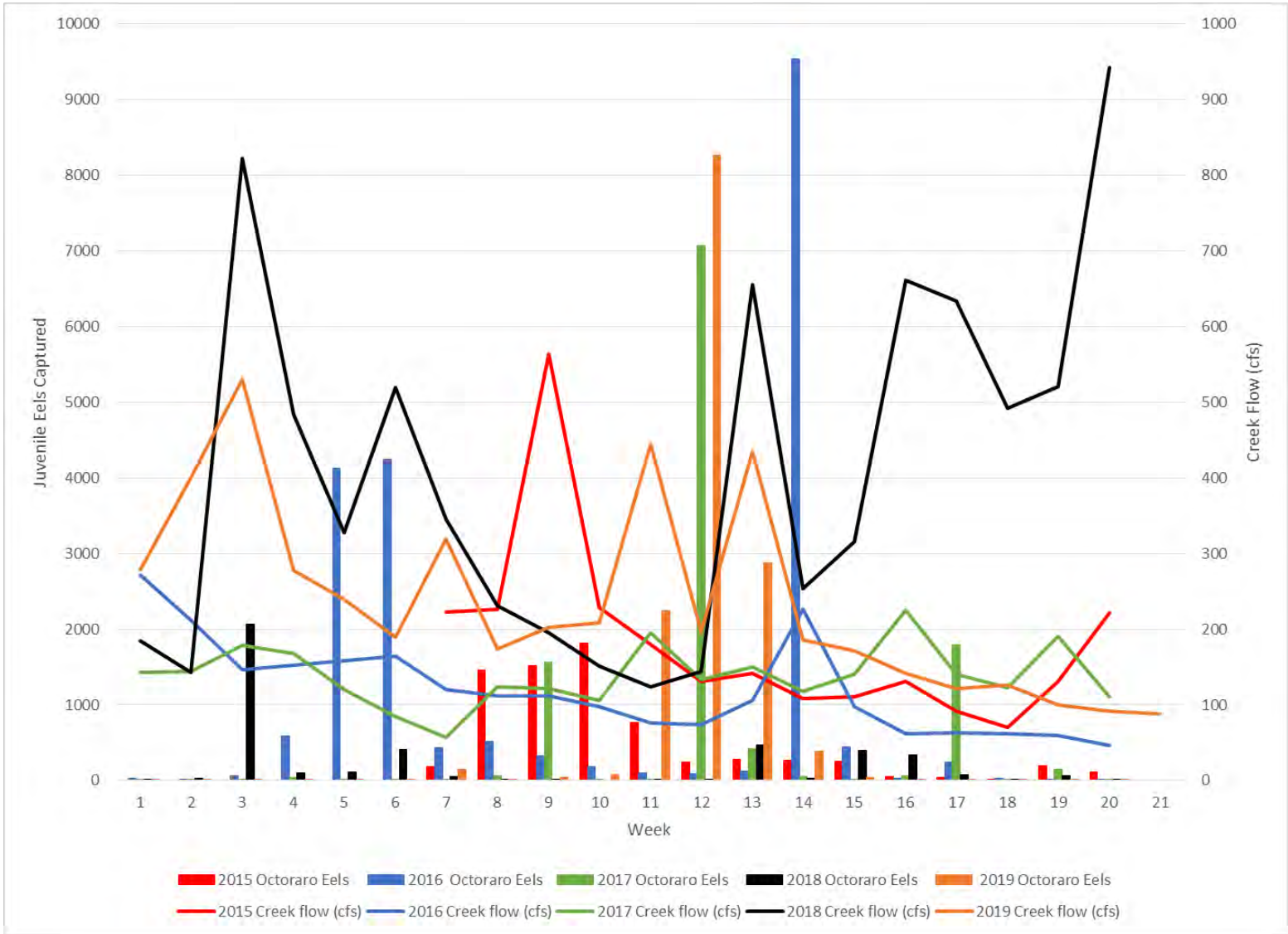
<b>2015 Week</b>							<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
2015 Octoraro Eels							183	1458	1524	1819	765	240	273	271	258	50	42	13	194	107
2015 Creek flow (cfs)							222.8	225.9	564	228.6	179.7	131	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	
<b>2016 Week</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
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
<b>2017 Week</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
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
<b>2018 Week</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
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

(continued)

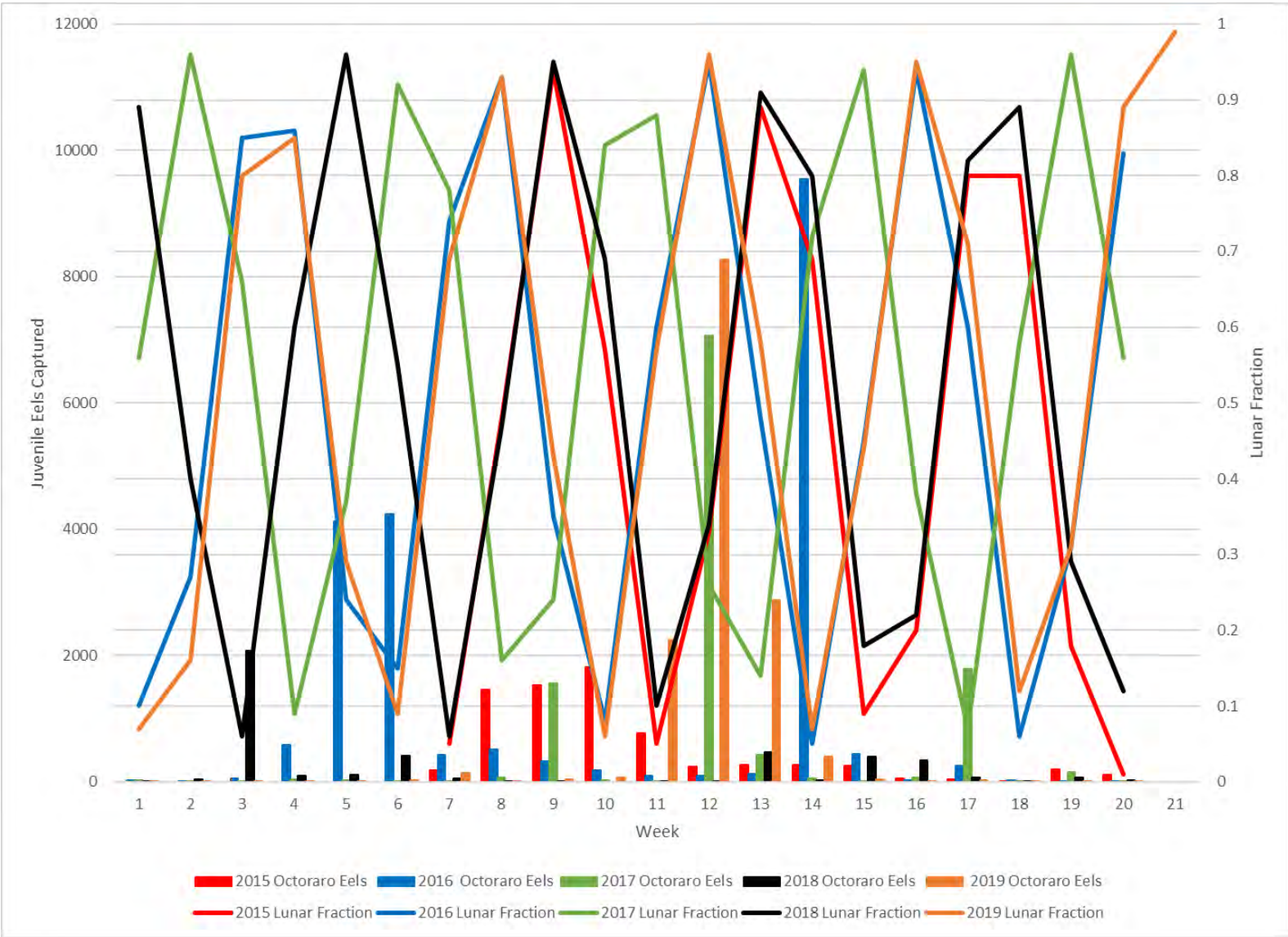
(Continued)

2019 Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
2019 Octoraro Eels	1	9	5	3	9	20	144	12	36	73	2244	8266	2874	391	42	5	19	12	4	1	0
2019 Creek flow (cfs)	279	400	530	277	240	189	319	174	203	208	444	197	435	186	172	142	122	126	100	92	88
2019 Lunar Fraction	0.07	0.16	0.80	0.85	0.29	0.09	0.69	0.93	0.43	0.06	0.57	0.96	0.58	0.07	0.44	0.95	0.71	0.12	0.31	0.89	0.99
2019 Water temp (°C)	15.50	16.10	14.60	15.70	17.90	19.90	20.00	20.50	21.60	23.00	23.10	23.40	23.70	23.70	23.90	23.90	24.00	23.10	22.90	22.40	22.50
Dissolved Oxygen (mg/L)	9.73	9.36	10.18	10.05	9.26	8.75	8.29	8.52	7.14	6.32	6.13	5.72	6.17	6.29	5.89	5.41	5.87	4.69	5.13	4.93	4.63
Percent of Catch	0.01	0.06	0.04	0.02	0.06	0.14	1.02	0.08	0.25	0.52	15.84	58.33	20.28	2.76	0.30	0.04	0.13	0.08	0.03	0.01	0.00
Conowingo Eels	6	4616	2237	1774	9359	2097	1706	2187	2056	39685	3076	3141	5210	3213	1158	38115	3160	3135	192	40	18

Eel Catch (Collection) to Creek Flow (2015-2019)

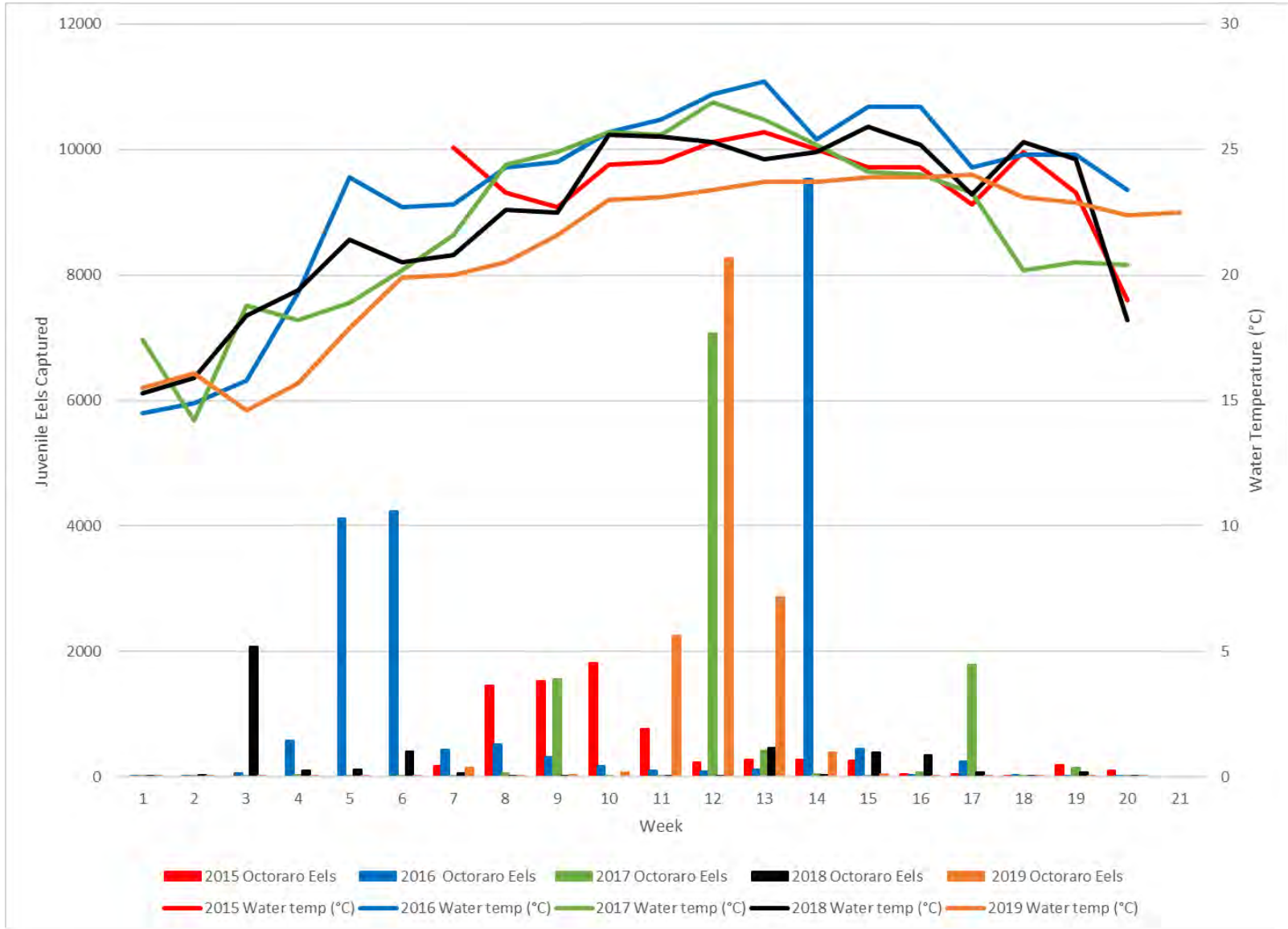


### Eel Catch (Collection) to Lunar Fraction (2015-2019)





### Eel Catch (Collection) to Water Temperature (2015-2019)



**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.<sup>1</sup> Section III of the project's Water Quality Certification (WQC)<sup>2</sup> and section VIII of the U.S. Department of the Interior's fishway prescription<sup>3</sup> 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

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<sup>1</sup> Order Issuing New License (153 FERC ¶ 62,232), issued December 22, 2015.

<sup>2</sup> See Appendix A of the Order Issuing New License.

<sup>3</sup> See Appendix B of the Order Issuing New License.

Project No. 2355-026

- 2 -

facility. The Conowingo facility design was approved on May 9, 2017;<sup>4</sup> 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 Octoraro 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 fulfills 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.

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<sup>4</sup> Order Approving Eel Trapping Facility Design (159 FERC ¶ 62,146).

Project No. 2355-026

- 3 -

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

Sincerely,



Alicia Burtner  
Aquatic Resources Branch  
Division of Hydropower Administration  
and Compliance



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 Commission (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 Environmental 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](mailto:Andrea.Danucalov@exeloncorp.com).

Sincerely Yours,

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

20181212-3020 FERC PDF (Unofficial) 12/12/2018

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.<sup>1</sup> Section III of the project's Water Quality Certification (WQC)<sup>2</sup> and section VIII of the U.S. Department of the Interior's fishway prescription<sup>3</sup> 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.

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<sup>1</sup> Order Issuing New License (153 FERC ¶ 62,232), issued December 22, 2015.

<sup>2</sup> See Appendix A of the Order Issuing New License.

<sup>3</sup> See Appendix B of the Order Issuing New License.

20181212-3020 FERC PDF (Unofficial) 12/12/2018

Project No. 2355-026

- 2 -

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 fulfills 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](mailto:Alicia.Burtner@ferc.gov).

Sincerely,



Alicia Burtner  
Aquatic Resources Branch  
Division of Hydropower Administration  
and Compliance





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,



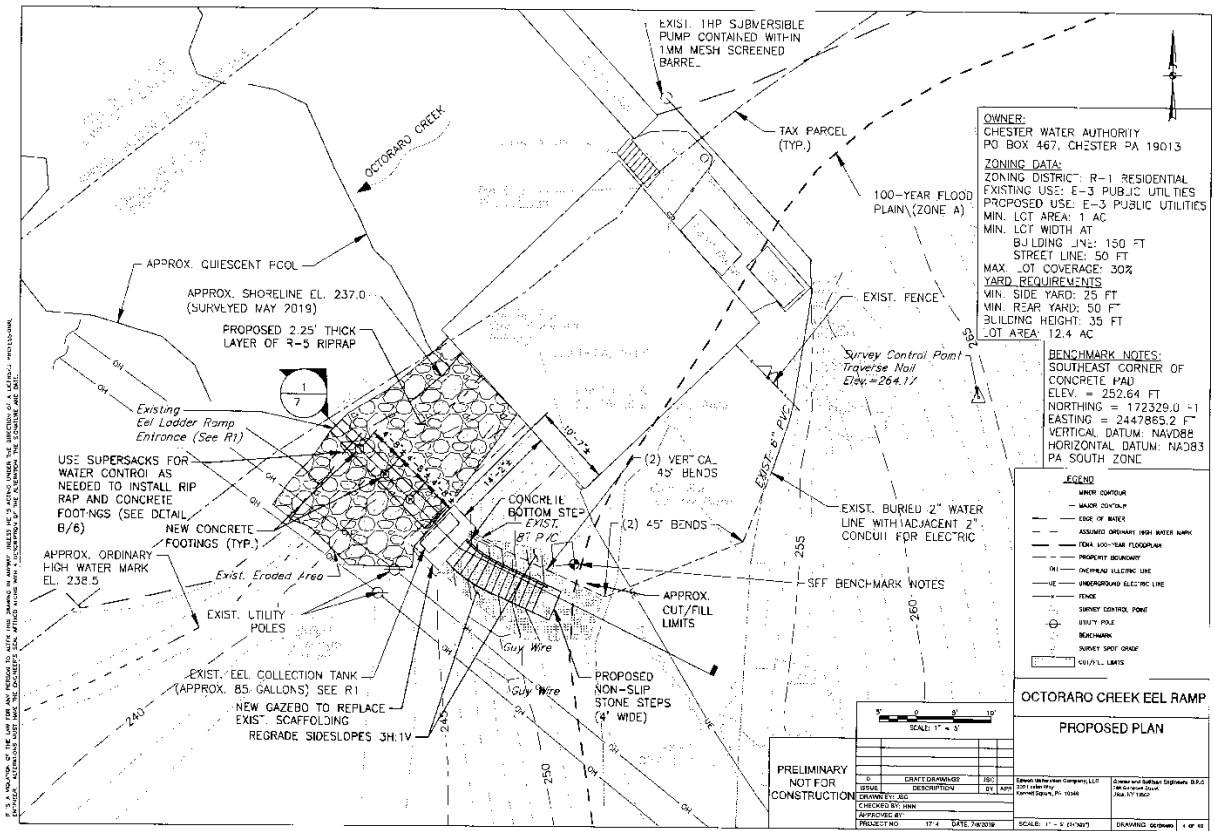
Andrea Danucalov  
FERC License Compliance Manager  
Exelon Generation  
300 Exelon Way  
Kennett Square, PA 19348  
Office: 267.533.1125  
Cell: 610.301.1664  
Email: [andrea.danucalov@exeloncorp.com](mailto:andrea.danucalov@exeloncorp.com)

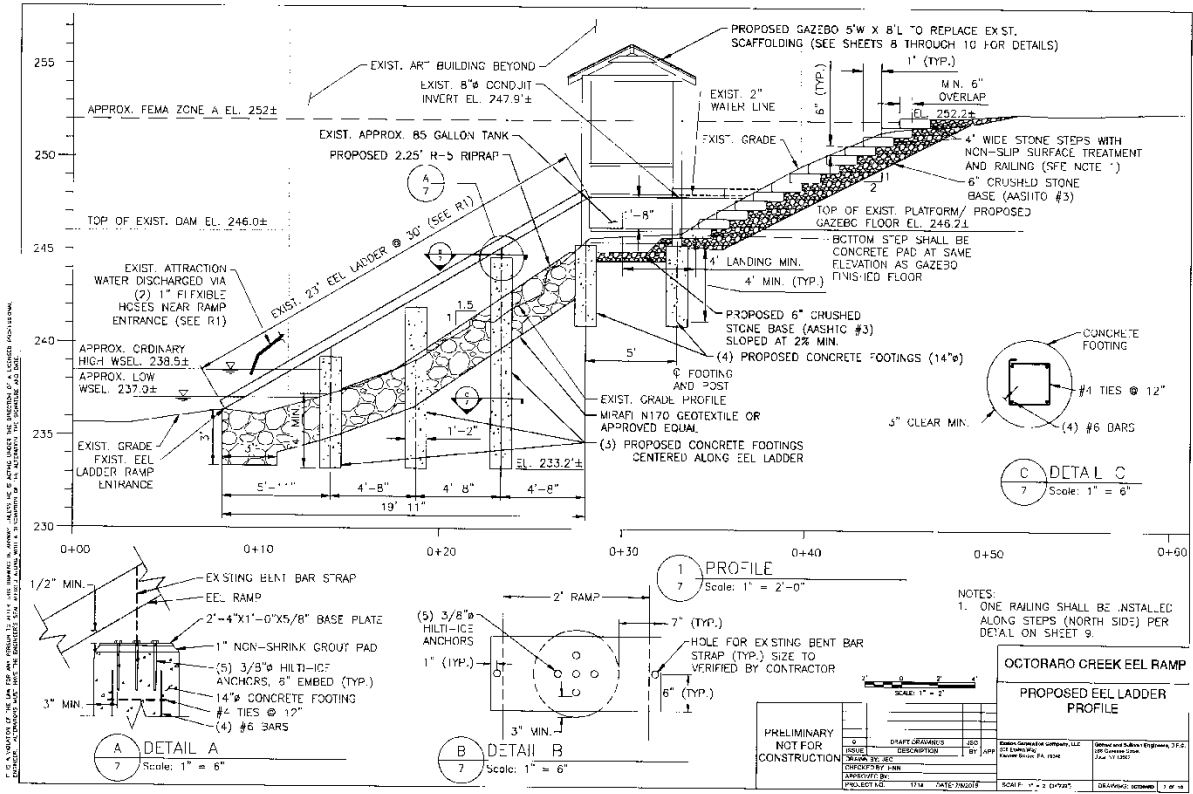
cc: Colleen Hicks, Exelon

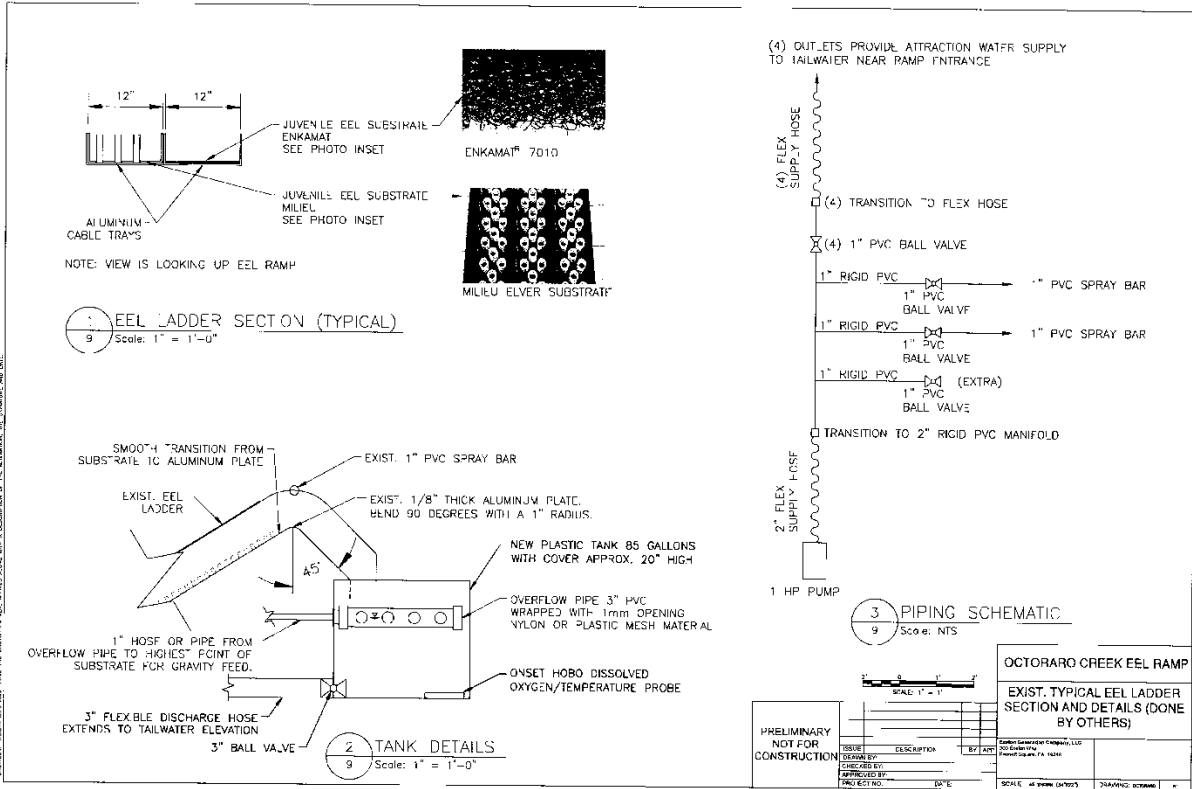


**Suggested Modifications to the Octoraro Eel Ramp for Conversion to a Permanent Facility**

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.









June 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 Commission (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 Environmental 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. On March 29, 2018, Exelon submitted a letter to FERC stating that a schedule would be filed no later than June 30, 2018.

Exelon has had several meetings with PADEP and the Eel Passage Advisory Group (EPAG) regarding upgrades to make the current facility at Octoraro Creek a permanent facility. Exelon, PADEP, and the EPAG jointly developed the following schedule to implement the necessary upgrades in advance of the 2019 eel passage season, which starts on May 1, 2019:

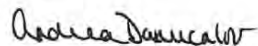
July 2018 – September 2018:	Submit List of Upgrades to Chester Water Authority
July 2018 – August 2018:	Develop Permit Applications
October 2018:	File Permit Applications and Order Equipment
October 2018 – February 2019:	Obtain Permits
April 2019:	Site Work
May 1, 2019:	Commence Operation of Permanent Eel Trapping Facility

Under Exelon's license agreement with the Chester Water Authority for the Octoraro eel trapping facility, Exelon must obtain approval from the Chester Water Authority to implement changes to the Octoraro eel trapping facility. Therefore, the schedule above is dependent on receiving timely approval from the Chester Water Authority, in addition to all necessary permits.

A copy of the planned upgrades ([Attachment 1](#)) and associated conceptual drawings ([Attachment 2](#)) are attached, as well as communications from PADEP and USFWS ([Attachment 3](#)). Final drawings will be filed with FERC in April 2019.

If you have any questions regarding this letter, please contact me at 267.533.1125 or [Andrea.Danucalov@exeloncorp.com](mailto:Andrea.Danucalov@exeloncorp.com).

Sincerely Yours,



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

Enclosures

cc: Colleen Hicks (Exelon)  
Scott Williamson (PADEP)  
Sheila Eyster (USFWS)



**Attachment 1- Planned Upgrades to the Octoraro Creek Eel Facility**



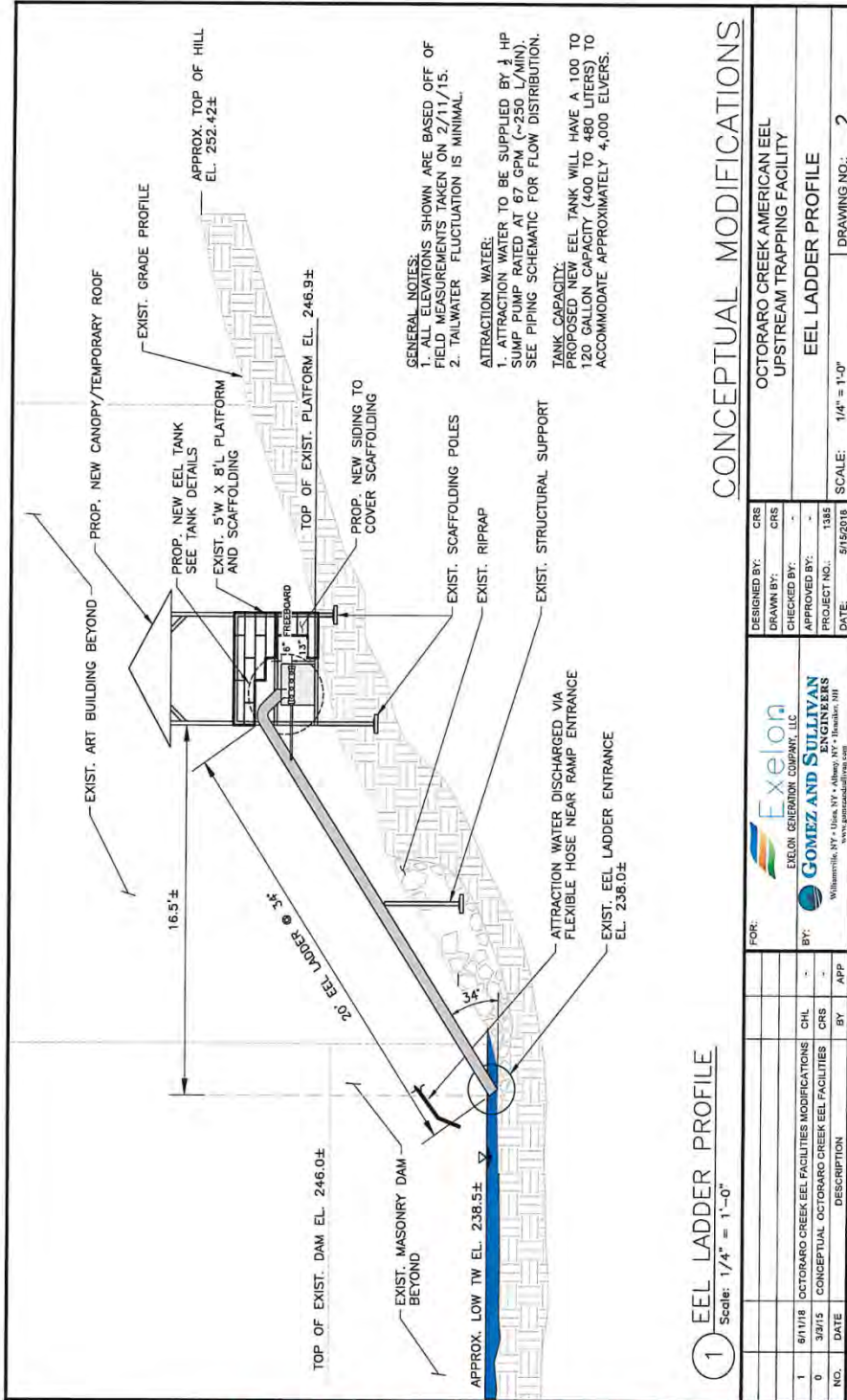
**Suggested Modifications to the Octoraro Eel Ramp for Conversion to a Permanent Facility**

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.

**Attachment 2: Conceptual Drawings of Proposed Permanent Octoraro Creek Eel Facility**



DRAFT: FOR DISCUSSION PURPOSES ONLY



DRAFT: FOR DISCUSSION PURPOSES ONLY

1 EEL LADDER PROFILE

Scale: 1/4" = 1'-0"

CONCEPTUAL MODIFICATIONS

DESIGNED BY:	CRS	FOR:	EXelon EXELON GENERATOR COMPANY, LLC GOMEZ AND SULLIVAN ENGINEERS Williamsville, NY • Union, NY • Albany, NY • Madison, WI www.gomesandullivan.com
DRAWN BY:	CRS	BY:	
CHECKED BY:	-	APP:	
APPROVED BY:	-	DATE:	5/15/2018
PROJECT NO.:	1385	SCALE:	1/4" = 1'-0"
DATE:	5/15/2018	DRAWING NO.:	2

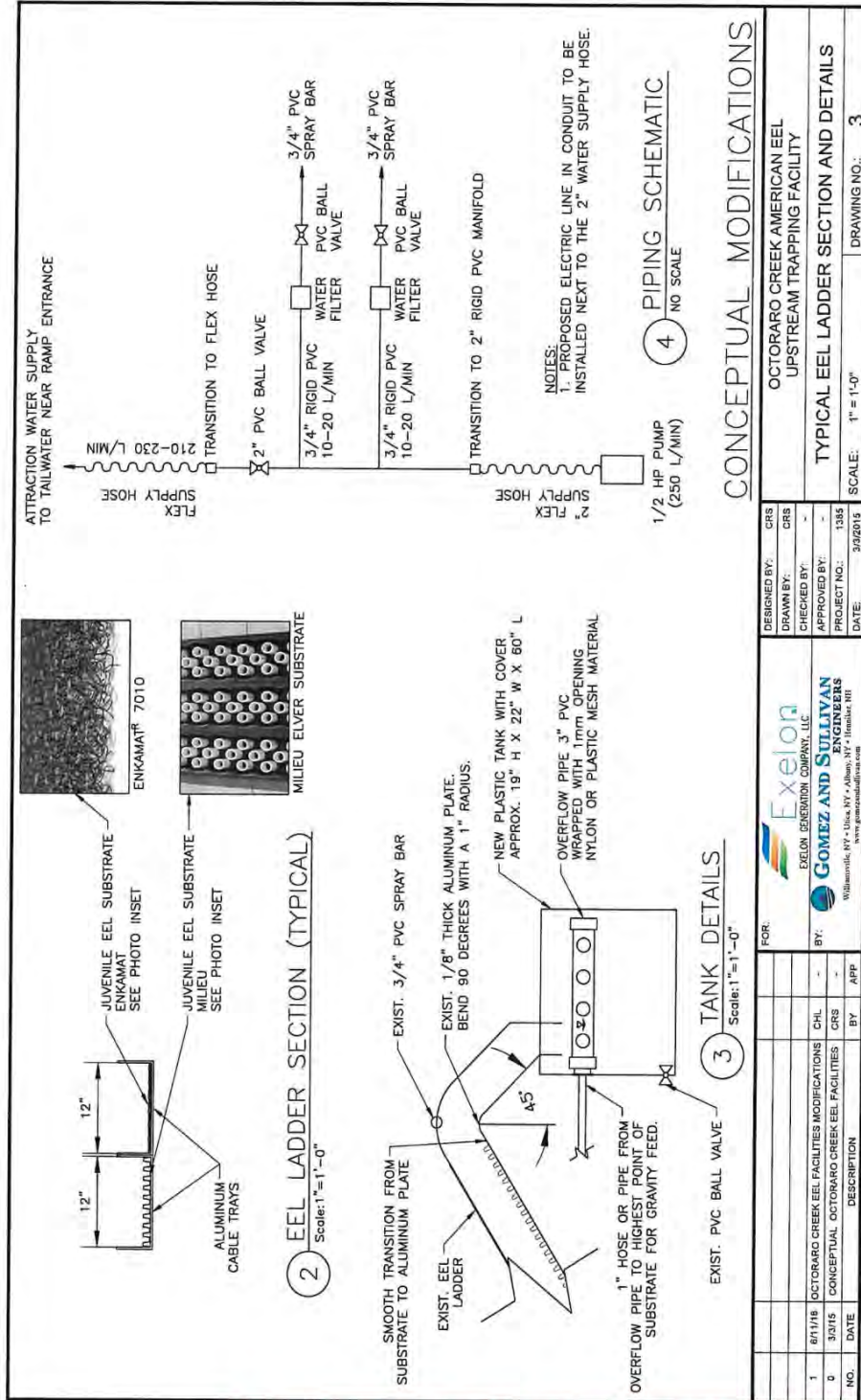
OCTORARO CREEK AMERICAN EEL  
UPSTREAM TRAPPING FACILITY

EEL LADDER PROFILE

GENERAL NOTES:  
1. ALL ELEVATIONS SHOWN ARE BASED OFF OF FIELD MEASUREMENTS TAKEN ON 2/11/15.  
2. TAILWATER FLUCTUATION IS MINIMAL.

ATTRACTION WATER:  
1. ATTRACTION WATER TO BE SUPPLIED BY 1/2 HP SUMP PUMP RATED AT 67 GPM (~250 L/MIN). SEE PIPING SCHEMATIC FOR FLOW DISTRIBUTION.

TANK CAPACITY:  
PROPOSED NEW EEL TANK WILL HAVE A 100 TO 120 GALLON CAPACITY (400 TO 480 LITERS) TO ACCOMMODATE APPROXIMATELY 4,000 EELERS.



DRAFT: FOR DISCUSSION PURPOSES ONLY

CONCEPTUAL MODIFICATIONS

DESIGNED BY:	CRS
DRAWN BY:	CRS
CHECKED BY:	-
APPROVED BY:	-
PROJECT NO.:	1385
DATE:	3/2/2015

FOR:	OCTORARO CREEK AMERICAN EEL UPSTREAM TRAPPING FACILITY
BY:	GOMEZ AND SUTLIJAN EXELON GENERATION COMPANY, LLC Williamsville, NY • Union, NY • Albany, NY • Hamlet, NH www.gomezandstulijan.com

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

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

**Attachment 3: Consultation Record**

**From:** Williamson, Scott  
**To:** [Danucalov, Andrea](#); [Hicks, Colleen](#)  
**Cc:** [Kirk Smith](#); [Elisabeth Bleistine](#); [Bleistine, Ray](#); [Sheila Eyles](#); [Aaron Henning](#); [Hicks, Colleen](#); [Martinek, Michael](#); [jesus\\_morales@fws.gov](#); [Mccollum, Allyson](#); [McCorkle, Richard](#); [Miller, Jeremy](#); [Minkinen, Steve](#); [Erin Redding](#); [Sadzinski, Robert](#); [Seaman, Shawn](#); [Shank, Matt](#); [Tryniewski, Joshua](#)  
**Subject:** Octorara Eel Facility Schedule  
**Date:** Thursday, June 28, 2018 9:02:41 AM

---

Andrea and Colleen,

With respect to designing and implementing a permanent American Eel collection facility at the Chester Water Authority, Octoraro Creek site, and as a result of the discussions and consultations that PADEP, Exelon and the other EPAG members have had, PADEP concurs with the following schedule:

July 2018 – September 2018: Submit List of Upgrades to Chester Water Authority  
July 2018 – August 2018: Develop Permit Applications  
October 2018: File Permit Applications and Order Equipment  
October 2018 – February 2019: Obtain Permits  
April 2019: Commence Site Work  
May 1, 2019: Commence Operation of Permanent Eel Trapping Facility

PADEP understands that under Exelon's license agreement with the Chester Water Authority for the Octoraro eel trapping facility, Exelon must obtain approval from the Chester Water Authority to implement changes to the Octoraro eel trapping facility. Therefore, the schedule above is dependent on receiving timely approval from the Chester Water Authority, in addition to all necessary permits. PADEP is confident that the above schedule will result in upgrades to the eel collection facility which can be placed in service by May 1, 2019.

Please contact me with any questions.

Sincerely,

**Scott R. Williamson** | Program Manager  
Department of Environmental Protection | Waterways and Wetlands Program  
South-central Regional Office  
909 Elmerton Ave. | Harrisburg, PA 17110  
Phone: 717-705-4799 | Fax: 717-705-4760  
[www.dep.pa.gov](http://www.dep.pa.gov)

**The 24-hour toll free Emergency Response number for the DEP SCRO is: 866-825-0208.**



**From:** Sheila Eyler  
**To:** [Kirk Smith](#)  
**Cc:** [Elisabeth Bleistine](#); [Avalos, Chris](#); [Bleistine, Ray](#); [Mike.Cox@FRM.com](#); [Danucalov, Andrea](#); [David Frazier](#); [Aaron Henning](#); [Hicks, Colleen](#); [Tan Kiraly](#); [Martinek, Michael](#); [Jesus Morales](#); [Mccollum, Allyson](#); [Richard McCorkle](#); [Miller, Jeremy](#); [Steve Minkinen](#); [Peifer, Cheri A. \(GenCo-Pwr\)](#); [Erin Redding](#); [Royer, Doug](#); [Bob A. Sadzinski - DNR](#); [Shawn Seaman -DNR](#); [Shank, Matt](#); [Adam Slowik](#); [Smith, Fred](#); [Tryniewski, Joshua](#); [White, Eric](#); [Williamson, Scott](#); [Kendra Gorski](#)  
**Subject:** Re: [EXTERNAL] RE: May 2018 EPAG Summary and June 2018 EPAG Agenda  
**Date:** Monday, June 25, 2018 1:49:21 PM

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Hi Kirk,

Thank you for distributing the documents. FWS has reviewed the documents and has no comments or concerns with the following:

- 1) a draft letter to FERC describing Exelon's schedule to install and operate the permanent eel trapping facility at Octoraro
- 2) design drawings for the facility
- 3) a list of modifications that will be made to the existing temporary facility in order to convert it to a permanent facility

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](mailto:Sheila_Eyler@fws.gov)

On Fri, Jun 22, 2018 at 12:57 PM Kirk Smith <[ksmith@gomezandsullivan.com](mailto:ksmith@gomezandsullivan.com)> wrote:

Hello,

Please find attached for your review and comment 1) a draft letter to FERC describing Exelon's schedule to install and operate the permanent eel trapping facility at Octoraro, 2) design drawings for the facility, as well as 3) a list of modifications that will be made to the existing temporary facility in order to convert it to a permanent facility.

Please provide any comments by COB, Monday June 25<sup>th</sup>. Thanks.

Kirk Smith  
Gomez and Sullivan Engineers, DPC  
41 Liberty Hill Road - Building 1  
P.O. Box 2179

**Appendix E:  
Agency Comments on Draft 2019 American Eel  
Collection Facility in Octoraro Creek**

**From:** Henning, Aaron <ahenning@srbc.net>  
**Sent:** Friday, December 13, 2019 11:30 AM  
**To:** Danucalov, Andrea <Andrea.Danucalov@exeloncorp.com>; Erin Redding <eredding@gomezandsullivan.com>  
**Cc:** Sheila Eyler (sheila\_eyler@fws.gov) <sheila\_eyler@fws.gov>; Richard McCorkle (richard\_mccorkle@fws.gov) <richard\_mccorkle@fws.gov>; Shawn Seaman -DNR- (shawn.seaman@maryland.gov) <shawn.seaman@maryland.gov>; Miller, Jeremy (jeremmille@pa.gov) <jeremmille@pa.gov>; 'Ron Eberts' (reberts@pa.gov) <reberts@pa.gov>; Tryninewski, Joshua (jtryninews@pa.gov) <jtryninews@pa.gov>; Jesus Morales <Jesus\_Morales@fws.gov>; Minkkinen, Steve (steve\_minkkinen@fws.gov) <steve\_minkkinen@fws.gov>; Rob Bourdon (robert.bourdon@maryland.gov) <robert.bourdon@maryland.gov>  
**Subject:** SRBC comments on Exelon studies

Andrea & Erin,

Attached are SRBC's comments on the flowing reports: Muddy Run Pumped Storage Project Conowingo Eel Collection Facility (2019), Muddy Run Pumped Storage Project American Eel Collection Facility in Octoraro Creek, 2019 and Muddy Run Pumped Storage Project – Periodic Evaluation of Upstream Segments 2018-2019.

Aaron

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

Muddy Run Pumped Storage Project Conowingo Collection Facility

- multiple references should be corrected to read 'eels in the classroom'
- pg 5, section 4.5, while the Conowingo gage is the closest geographically, please consider and compare using the Marietta gage which is more indicative of river conditions
- pg 6. Misleading/inappropriate to infer any relationship (or lack thereof) would exist between an oxygen infused collection tank and eels being captured from the river. Collection tank dissolved oxygen isn't an environmental variable. In-river readings are more appropriate.
- Appreciate the very low mortality of American eels at this facility
- in future reports please include photos of injuries noted on eels for reference

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

- Figure 2.0-3 needs axis labels
- Figure 5.0-2 too difficult to read with those many colors & lines
- Figure 4.5-4 shows dissolved oxygen levels in the head pond and collection tank dropped below PA water quality criteria of 5.0 mg/L for a significant portion of the season even after the installation of aerators. Table 4.5-4 and Figures 4.5-4 and 4.5-5 give two vastly different views of dissolved oxygen at this facility. Figures appear to be derived from the continuous DO sensor. Please plot continuous data at a finer scale (one month per figure max) to better show daily DO swings. Please report interval of continuous DO readings and any calibration procedures/records
- Please provide documentation of which days the CWA hydroelectric facility was in operation

Muddy Run Pumped Storage Project – Periodic Evaluations of Upstream stream segments

- Section 3.3.1 pulse width of 4-6 seconds is erroneous. Microseconds is more realistic
- eel densities per m<sup>2</sup> do not need to be reported if eel catch is zero

**From:** Eyler, Sheila <sheila\_eyler@fws.gov>  
**Sent:** Friday, December 6, 2019 11:02:29 AM  
**To:** Danucalov, Andrea H.(Exelon Power) <Andrea.Danucalov@exeloncorp.com>  
**Cc:** Ray Bleistine <rbleistine@normandea.com>; Richard McCorkle <richard\_mccorkle@fws.gov>; Jesus Morales <Jesus\_Morales@fws.gov>; Miller, Jeremy <jeremmille@pa.gov>; Ron Eberts <reberts@pa.gov>  
**Subject:** [EXTERNAL] Exelon's 2019 Muddy Run Eel Collection Facility in Octoraro Creek Draft Report FWS Comments

Andrea,

FWS has reviewed the 2019 Muddy Run Eel Collection Facility in Octoraro Creek Draft Report received on 11/8/19. We offer the following comments:

- Executive Summary, pg vii, 2nd paragraph - A subsample of 909 eels is listed here, but the report later states (in the Executive Summary and Section 4.2) that 227 eels were subsampled at Octoraro. The Executive Summary should describe subsamples from the Octoraro Collection only, as the 909 number also appears in the Conowingo Eel Collection Report as the number subsampled from that eel collection facility.
- Discussion, page 10, first full paragraph, line 5 - The reference to moon phase in 2019 should be "full" moon phase and not "new" moon phase.

Thank you for the opportunity to review.

Sheila

Sheila Eyler  
U.S. Fish & Wildlife Service

**Mike Martinek**

---

**From:** Miller, Jeremy <jeremmille@pa.gov>  
**Sent:** Thursday, December 5, 2019 11:03 AM  
**To:** Danucalov, Andrea H:(GenCo-Pwr); Ray Bleistine; Mike Martinek  
**Cc:** Williamson, Scott; Eberts, Ron; Sheila Eyler  
**Subject:** Exelon's 2019 Muddy Run Eel Collection Facility in Octoraro Creek Draft Report DEP Comments

Andrea,

DEP has reviewed the 2019 Muddy Run Eel Collection Facility in Octoraro Creek Draft Report received on 11/8/19 and offer the following comments for your review.

1. **Table 4.2-4 Observed Injuries of Juvenile American Eels, Octoraro Creek Eel Facility, 2019:** Please provide measurement units for Length and Weight.
2. **Table 4.5-4 Water Quality Parameters at Associated Locations at Octoraro Creek Eel Facility, 2019:** Please provide measurement units for Temp and DO under Collection and Head Pond columns.
3. **Appendix C, page C-5, Eel Catch (Collection) to Lunar Fraction (2015-2019):** In the Legend, we recommend shifting 2015 Octoraro Eels above 2015 Lunar Fraction and 2018 Octoraro Eels above 2018 Lunar Fraction.
4. **Appendix C, page C-6, Eel Catch (Collection) to Water Temperature (2015-2019):** In the Legend, we recommend shifting 2015 Octoraro Eels above 2015 Water Temperature and 2018 Octoraro Eels above 2018 Water Temperature.

Thank you for the opportunity to comment on the draft report. Feel free to contact me with any questions.

**Jeremy Miller** | Aquatic Biologist II  
Department of Environmental Protection | Clean Water Program  
Southcentral Regional Office  
909 Elmerton Ave. | Hbg PA 17110  
Phone: 717.705.4777 | Fax: 717.705.4760  
[www.dep.pa.gov](http://www.dep.pa.gov)

**24-hour toll free Emergency Response number for SCRO: 1-800-541-2050.**

**From:** Tryninewski, Joshua <jtryninews@pa.gov>  
**Sent:** Tuesday, December 17, 2019 5:18 PM  
**To:** Danucalov, Andrea H:(Exelon Power) <Andrea.Danucalov@exeloncorp.com>  
**Subject:** [EXTERNAL] Muddy Run Pumped Storage Project American Eel Collection Facility in Octoraro Creek, 2019 Draft Report - PFBC Comments

Andrea,

The PFBC has reviewed the *Muddy Run Pumped Storage Project American Eel Collection Facility in Octoraro Creek, 2019 Draft Report* and offers the following comments:

- Section 5, page 10, second to last sentence of first full paragraph: there appears to be confusion of moon phase in 2019. Should it read “full moon” not “new moon”?
- Table 4.5-1: Recommend including “daily mean flows” in the caption. The asterisked footnote does not refer to any asterisked data / item within the table or caption.
- Table 4.5-3: What does bolded data indicate?
- Table 4.5-4: Please include units of measure in each column heading for Temp & DO.
- Does Table 4.5-4 capture the same data which is presented in Tables 4.5-3 & 4.5-5? If so, it may be worth considering reducing redundant summaries of these data in future reporting.
- Figure 4.5-1: The caption should be clarified regarding flow. Presumably, the flow data for the top graph is daily mean river flow. Recommend rewriting caption – suggested rewrite: “Octoraro Creek Eel Collection Facility daily eel catch and daily mean river flow (cfs) (top graph) and weekly eel catch and weekly mean river flow (cfs) (bottom graph), 2019.”
- Figure 4.5-4 & Table 4.5-4: Dissolved oxygen values from the Head Pond between 7/12 – 7/16 are considerably greater than DO values from the Collection Tank for those same days, which is largely the inverse of observed DO trends preceding and subsequent to 7/12 – 7/16.
- Figure 5.0-2: This figure is too cluttered and difficult to discern catch trends. PFBC suggests separating by year and presenting as a “collage” figure.

Thank you for the opportunity to review and provide comments on the summary report.

Regards,  
-Josh

**Joshua D. Tryninewski**  
Anadromous Fish Restoration Unit  
Pennsylvania Fish & Boat Commission  
1735 Shiloh Rd.  
State College, PA 16801



2019 Octoraro Creek Eel Collection Report Comments Received by Resource Agency and Date	
Resource Agency	Date of Receipt by Exelon
Pennsylvania Department of Environmental Protection	Thursday, December 5, 2019
United States Fish and Wildlife Service	Friday, December 6, 2019
Susquehanna River Basic Commission	Friday, December 13, 2019
Pennsylvania Fish and Boat Commission	Tuesday, December 17, 2019

Responses to Resource Agency Comments for the Muddy Run Pumped Storage Project  
American Eel Collection Facility in Octoraro Creek, 2019

SRBC

- Figure 2.0-3 needs axis labels  
Exelon response: Added axis label to figure
- Figure 5.0-2 too difficult to read with those many colors & lines  
Exelon response: Exelon will revise the format of this figure in the 2020 report. Instead of one figure, there will be two different figures, one showing 2015-2018 (0.5 hp pump/temporary) and one showing 2019-Present (1.0 hp pump/permanent).
- Figure 4.5-4 shows dissolved oxygen levels in the head pond and collection tank dropped below PA water quality criteria of 5.0 mg/L for a significant portion of the season even after the installation of aerators. Table 4.5-4 and Figures 4.5-4 and 4.5-5 give two vastly different views of dissolved oxygen at this facility. Figures appear to be derived from the continuous DO sensor. Please plot continuous data at a finer scale (one month per figure max) to better show daily DO swings. Please report interval of continuous DO readings and any calibration procedures/records  
Exelon response: The Figures were derived using the daily single point measurements typically taken in the early morning when DO values are usually the lowest of the day. A constant HOBO monitor was deployed in addition to collecting the daily single point measurements, but a malfunction of the constant monitor occurred in August and the monitor was sent back to the manufacturer for repair. In future years, if the HOBO constant monitor data is reliable, we will evaluate how best to display the dissolved oxygen data. Prior to the HOBO monitor malfunction, DO readings were recorded every 30 minutes, and the monitor was calibrated and adjusted for drift on a weekly basis per manufacturers guidelines.
- Please provide documentation of which days the CWA hydroelectric facility was in operation  
Exelon response: These data are reported on Table 4.0-1 with an asterisk next to the date when the CWA hydroelectric facility was in operation. The CWA hydroelectric facility was in operation for 112 days in 2019.

USFWS

- Executive Summary, pg vii, 2<sup>nd</sup> paragraph – a subsample of 909 eels is listed here, but the report later states (in the Executive Summary and Section 4.2) that 227 eels were subsampled at Octoraro. The Executive Summary should describe subsamples from the Octoraro Collection only, as the 909 number also appears in the Conowingo Eels Collection Report as the number subsampled from the eel collection facility.  
Exelon response: The subsample of eels at Octoraro Creek eel facility was 227. The subsample of eels at the Conowingo eel collection facility was 909 eels. Correction was made to the Executive Summary to 227 eels.
- Discussion, page 10, first full paragraph, line 5 – The reference to moon phase in 2019 should be “full” moon phase and not “new” moon phase.  
Exelon Response: Correction was made from “new” moon phase to “full” moon phase.





PA DEP

- Table 4.2-4 Observed Injuries of Juvenile American Eels, Octoraro Creek Eel Facility, 2019: Please provide measurement units for Length and Weight.  
Exelon response: Measurement units were added to this table.
- Table 4.5-4 Water Quality Parameters at Associated Locations at Octoraro Creek Eel Facility, 2019: Please provide measurement units for Temp and DO under Collection and Head Pond columns  
Exelon response: Measurement units were added to this table.
- Appendix C, page C-5, Eel Catch (collection) to lunar fraction (2015-2019): In the legend, we recommend shifting 2015 Octoraro Eels above 2015 Lunar Fraction and 2018 Octoraro Eels above 2018 Lunar Fraction  
Exelon response: Appendix C, page 5, Legend has been adjusted to keep eels catches and lunar fraction from the same year in the same column.
- Appendix C, page C-6, Eel Catch (collection) to Water Temperature (2015-2019): In the legend, we recommend shifting 2015 Octoraro Eels above 2015 Water Temperature and 2018 Octoraro Eels above 2018 Water Temperature
- Exelon response: Appendix C, page 5, Legend has been adjusted to keep eels catches and water temperature from the same year in the same column.

PFBC

- Section 5, page 10, second to last sentence of first full paragraph: there appears to be confusion of moon phase in 2019. Should it read “full moon” not “new moon”.  
Exelon response: Correction was made from “new” moon phase to “full” moon phase.
- Table 4.5-1: Recommend including “daily mean flows” in the caption. The asterisked footnote does not refer to any asterisked data/item within the table or caption.  
Exelon Response: Daily Average Creek Flows was added to the caption and the asterisk footnote was removed from the page.
- Table 4.5-3: What does the bolded data indicate?  
Exelon Response: Bolded values represent power interruptions with no flow to the facility. This explanation was added as a footnote to the table.
- Table 4.5-4: Please include units of measure in each column heading for Temp & DO.  
Exelon response: Measurement units were added to this table.
- Does Table 4.5-4 capture the same data which is presented in Tables 4.5-3 & 4.5-5? If so, it may be worth considering reducing redundant summaries of these data in future reporting.  
Exelon response: Exelon will re-evaluate these tables in future reports to reduce redundant information.
- Figure 4.5-1: The caption should be clarified regarding flow. Presumably, the flow data for the top graph is daily mean river flow. Recommend rewriting caption – suggested rewrite: “Octoraro Creek Eel Collection Facility daily eel catch and daily mean river flow (cfs)(top graph) and weekly eel catch and weekly mean river flow (cfs)(bottom Graph), 2019  
Exelon response: Changed caption to read: Daily Eel Catch and Daily Average Creek Flow (cfs, top graph) and Weekly Eel Catch and Weekly Average Creek Flow (cfs, bottom graph), Octoraro Creek Eel Facility, 2019.
- Figure 4.5-4 7 Table 4.5-4: Dissolved oxygen values from the Head Pond between 7/12 – 7/16 are considerably greater than DO values from the Collection Tank for those same days, which is largely the inverse of observed DO trends preceding and subsequent to 7/12 – 7/16.  
Exelon Response: The higher DO values in the Head Pond than the Collection Tank between 7/13 – 7/16 correspond to high eel catch during this period. The number of eels collected between these dates ranged from 1842 – 2842 eels. No mortality was observed at the Octoraro Creek Eel Facility in 2019.
- Figure 5.0-2: The figure is too cluttered and difficult to discern catch trends. PFBC suggest separating by year and presenting as a “collage” figure.  
Exelon Response: Exelon will revise the format of this figure in the 2020 report. Instead of one figure, there will be two different figures, one showing 2015-2018 (0.5 hp pump/temporary) and one showing 2019-Present (1.0 hp pump/permanent). Figure 4.5-1 shows 2019 weekly eel catch and weekly average creek flow for the Octoraro Creek eel facility. Weekly eel catch and flows graphs are created in the previous year’s report to flow catch trends.