

**UPSTREAM FISH PASSAGE EFFECTIVENESS STUDY
RSP 3.5**

CONOWINGO HYDROELECTRIC PROJECT

FERC PROJECT NUMBER 405



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EXECUTIVE SUMMARY

Exelon Generation Company, LLC (Exelon) is in the process of relicensing the 573-megawatt Conowingo Hydroelectric Project (Conowingo Project) with the Federal Energy Regulatory Commission (FERC). The current license for the Conowingo Project was issued on 14 August 1980 and expires on 1 September 2014. FERC issued the final study plan determination for the Conowingo Project on 4 February 2010, approving the revised study plan with certain modifications. The final study plan determination required Exelon to conduct a Upstream Fish Passage Effectiveness Study, which is the subject of this report. The objectives of this study are: 1) to determine the fish passage efficiency of the Conowingo East Fish Lift (EFL) and 2) to identify factors, if any, that may influence efficiency on a daily or seasonal basis.

The initial phase of this study was conducted in spring 2010 with the second phase, or a repeat of the study, planned for spring 2011. However, high river flows in 2011 caused a postponement of the 2011 study. Therefore, the study was undertaken in 2012 and the findings of this study and comparisons to the 2010 study are the subject of this report.

In the previous 2010 study, a total of 151 radio-tagged shad were released for the study; 102 were released in the Conowingo Tailrace and 49 were transported five miles downstream to Lapidum, Maryland and released. Shad from both release locations were combined into two run segments used for analysis; the Early-Mid shad run segment included the first 75 shad tagged and released and the Mid-Late shad run segment included the last 76 shad tagged and released.

The following three metrics used in 2010 and again in 2012 were calculated: Fishway Attraction Effectiveness, Upstream Fish Passage Efficiency, and Upstream Fish Passage Effectiveness, and their definitions are given below.

Fishway Attraction Effectiveness: - The proportion of fish that enter a fishway from the number of fish available. For this study, “the number of fish available” is considered the number of radio-tagged American shad detected on the eight downstream facing antennas located at the Powerhouse and the antennas positioned on Rowland Island. The combined antenna array covered the width of the tailrace from the base of the dam to the downstream tip of Rowland Island.

Upstream Fish Passage Efficiency: - The proportion of fish that enter a fishway and pass upstream from those available. This is the definition used in the FERC (2004) review of fish passage mitigation.

Upstream Fish Passage Effectiveness : - The proportion of fish that enter a fishway, pass upstream, and remain upstream for a minimum of 48 hours from those available.

The findings of the previous 2010 study are summarized as follows:

Under existing Station and EFL operational conditions, 58.9% (89 of 151) of all radio-tagged shad were detected in the tailrace making them accessible to the EFL. The remaining 41.1% (62 of 151) of the tagged shad dropped back to areas of the lower Susquehanna River and did not enter the tailrace.

Fishway Attraction Effectiveness: Of the 89 radio-tagged shad detected in the tailrace, 73.0% (65 of 89) entered into the EFL.

Upstream Fish Passage Efficiency: Of the 89 radio-tagged shad detected in the tailrace, 44.9% (40 of 89) completed passage through the EFL. Of the 65 shad that entered the EFL, 61.5% (40 fish) successfully passed upstream.

Upstream Fish Passage Effectiveness: Of the 89 radio-tagged shad detected in the tailrace, 43.8% (39 of 89) completed passage through the EFL and remained upstream for 48 hours or more after passage.

Twenty-one of 40 (52.5%) radio-tagged shad with successful passage through the EFL were manually tracked upstream of the Conowingo Dam. Eighteen of 21 shad were detected in Conowingo Pond. Three of 21 shad were also detected upstream of Safe Harbor Dam; two of these shad successfully passed the York Haven Dam.

Twenty-three of 40 (57.5%) radio-tagged shad with successful upstream passage of Conowingo Dam eventually re-entered the tailrace via the turbines. Fifteen of those passing downstream via the turbines were believed alive at last detection. Signals from the other eight shad became stationary after passing downstream via the turbines and were considered dead.

The 2010 study, in conjunction with the report on Conowingo East Fish Lift Attraction Flows (RSP 3.6), did not identify any single operational parameter for the Project or the EFL that will suggest substantial improvements in fish passage effectiveness. However, the difference between the number of shad that enter the EFL (73% of available fish) and the number of shad that are successfully passed upstream (45%) suggested that improvements within the EFL may hold the most promise relative to improving the effectiveness of the EFL.

In 2012, a total of 155 radio-tagged shad were released for the study; The Early-Mid shad run segment included the first 75 shad tagged and released and the Mid-Late shad run segment included the last 80 shad tagged and released. Most shad were captured in the tailrace by angling and released in that location. Thirty five (35) of the Mid –Late shad run segment were collected from the WFL because angling did not collect sufficient specimens; these 35 fish were released downstream of the Dam at Shures Landing. Two angled shad regurgitated their transmitters immediately following tagging and were excluded from subsequent analysis.

Under existing Station and EFL operational conditions, 43.1% (66 of 153) of all radio-tagged shad were detected in the tailrace making them accessible to the EFL. The remaining 56.9% (87 of 153) of the tagged shad dropped back to areas of the lower Susquehanna River and did not enter the tailrace.

Fishway Attraction Effectiveness: Of the 66 radio-tagged shad detected in the tailrace, 43.9% (29 of 66) entered the EFL.

Upstream Fish Passage Efficiency: Of the 66 radio-tagged shad detected in the tailrace, 25.8% (17 of 66) completed passage through the EFL. Of the 29 shad that entered the EFL, 58.6% (17 fish) successfully passed upstream.

Upstream Fish Passage Effectiveness: Of the 66 radio-tagged shad detected in the tailrace, 25.8% (17 of 66) completed passage and remained upstream > 48 hours.

Four of 17 (23.5%) radio-tagged shad with successful upstream passage of Conowingo Dam eventually re-entered the tailrace via the turbines. All shad passed when the station was operating at full discharge. One shad each passed through Unit 1 and Unit 8. The routes utilized by the remaining two shad were unknown. Two of those passing downstream via the turbines were believed alive at last detection. Signals from the other two shad became stationary after passing downstream via the turbines and were considered dead.

There did not appear to be a single variable that consistently provided the best fish passage conditions or high rates of successful upstream passage. Radio-tagged shad passed upstream over the range of turbine-generation combinations that occurred most often, water temperatures, and EFL settings. The fishway attraction effectiveness value (44.0%) shows that American shad in 2012 were not as successful entering the EFL in 2012 as in 2010 (73.0%). Under existing Station and EFL operational conditions in 2010, 58.9% (89 of 151) of all radio-tagged shad were detected in the tailrace making them accessible to the EFL. In contrast, only 43.1% (66 of 153) were accessible in 2012.

There are several possible explanations for this observation either singularly or in combination. First, of the 35 shad captured and tagged at the WFL and transported downstream to Shures Landing and released in 2012, only two (5.7%) of these fish returned to the tailrace. It is possible that the tagging, transport, and/or potentially weakened condition of these fish played a role in such a low proportion returning.

There was also an observed difference in operating or flow conditions between 2010 and 2012. EFL operating conditions using the “A” gate (*i.e.* limited or no use of the Kaplan turbines) occurred 43.0% of the time in 2010 and use of the “C” gate (*i.e.* Kaplan turbines operated more frequently) occurred 57% of the time. In contrast, in 2012 the percentage of time these gates were operated was 36.5% and 63.5%, respectively. This greater use of the “C” gate indicated a higher daily flow condition during the migration season in 2012. In 2010, operation of the combination of Francis Units 1-7 and Kaplan Units 8-11 (all turbines operating) occurred only 4.7% of the time whereas this combination occurred 32.4% of the time in 2012. It is possible a higher flow discharge in 2012 affected the number of radio-tagged shad available in the tailrace.

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LIST OF ABBREVIATIONS

Agencies

| | |
|------|--|
| FERC | Federal Energy Regulatory Commission |
| MDNR | Maryland Department of Natural Resources |

Units of Measure

| | |
|-----|-----------------------|
| C | Celsius, Centigrade |
| cfs | cubic feet per second |
| d | day |
| F | Fahrenheit |
| fps | feet per second |
| hr | hour |
| m | meter |
| min | minute |
| MHz | megahertz |
| mm | millimeter |
| MW | megawatt |
| rm | river mile |
| sec | second |

Miscellaneous

| | |
|-----|------------------------------|
| EFL | East Fish Lift |
| F | female |
| M | male |
| ILP | Integrated Licensing Process |
| NOI | Notice of Intent |
| PAD | Pre-Application Document |
| PSP | Proposed Study Plan |
| RSP | Revised Study Plan |
| WFL | West Fish Lift |

DEFINITIONS FOR FISHWAY PASSAGE

Fishway Attraction Effectiveness: - The proportion of fish that enter a fishway from the number of fish available.

Upstream Fish Passage Efficiency: - The proportion of fish that enter a fishway and pass upstream from those available. This is the definition used in the FERC (2004) review of fish passage mitigation referenced in Introduction.

Upstream Fish Passage Effectiveness : - The proportion of fish that enter a fishway, pass upstream, and remain upstream for a minimum of 48 hours from those available.

Upstream Fish Passage Effectiveness is not often evaluated and perhaps difficult to define, as it builds on the Upstream Fish Passage Efficiency estimate. We define it as the effective number of fish that actually continue to migrate upstream, acknowledging that some fish that exit a fishway do not continue upstream migration.

1.0 INTRODUCTION

Exelon Generation Company, LLC (Exelon) is in the process of relicensing the 573-megawatt (MW) Conowingo Hydroelectric Project (Project) with the Federal Energy Regulatory Commission (FERC). Exelon is applying for a new license using the FERC's Integrated Licensing Process (ILP). The current license for the Conowingo Project was issued on 14 August 1980 and it will expire on 1 September 2014.

Exelon filed its Pre-Application Document (PAD) and Notice of Intent (NOI) with FERC on 12 March 2009. On 11 and 12 June 2009, a site visit and two scoping meetings were held at the Project for resource agencies and interested members of the public. Following these meetings, formal study requests were filed with FERC by several resource agencies. Many of these study requests were included in Exelon's Proposed Study Plan (PSP), which was filed on 24 August 2009. On 22 and 23 September 22 2009, Exelon held a meeting with resource agencies and interested members of the public to discuss the PSP.

Formal comments on the PSP were filed with FERC on 22 November 2009 by Commission staff and several resource agencies. Exelon filed a Revised Study Plan (RSP) for the Project on 22 December 2009. FERC issued the final study plan determination for the Project on 4 February 2010, approving the RSP with certain modifications. The final determination required Exelon to conduct an Upstream Fish Passage Effectiveness study on migratory adult American shad (*Alosa sapidissima*) and to monitor their behavior below Conowingo Dam in relationship to Project operations.

The objectives of this study are: 1) to determine the fish passage efficiency of the Conowingo East Fish Lift (EFL), 2) to identify factors, if any, that may influence efficiency on a daily or seasonal basis including potential barriers and impediments. The initial phase of this study was conducted in spring 2010 with the second phase, or a repeat of the study, planned for spring 2011. However, high river flows in 2011 caused a postponement of the 2011 study. Therefore, the study was undertaken in 2012 and the findings of this study and comparisons to the 2010 study are the subject of this report.

2.0 BACKGROUND

Fishways have been installed at numerous hydroelectric projects on American shad-bearing rivers on the Atlantic coast. Direct estimates of passage efficiency or effectiveness via a specially targeted passage effectiveness study are scarce. Methodologies for reported passage effectiveness or efficiency have also differed, as has the definition of what constitutes passage efficiency. FERC (2004) reported passage efficiency of the Conowingo East Fish Lift (EFL) as the number of American shad passed as a percentage of those estimated to be available. The numerator was the number passed and the denominator was the MDNR's population estimate below Conowingo Dam. This passage-count method is also used at other sites (e.g., dams on the Connecticut River; Merrimack River; and Lehigh River), but does not take into account: (a) the effects of station operations on passage of shad that can be variable between years and within season, and (b) the variable sexual maturity state of migrating shad. Another complicating factor at the Conowingo Dam is the mixed stock of American shad from various river origins; not all fish may be destined to migrate upstream. Additionally, similar efficiency estimate studies on various rivers have not taken into account the post-tagging dropback behavior of American shad (Frank *et al.*, 2009). As a result, there was some uncertainty associated with the denominator (the number available for passage). Shad spawning downstream of Conowingo Dam has also been documented which adds another variable to consider when calculating the number of shad available for upstream fish passage, ([RSP 3.21 Impacts of Plant Operations on Migratory Fish Reproduction; September 2012](#)).

The term dropback (or fallback) describes the downstream movement of an upstream migrating anadromous fish after tagging. In a literature review of anadromous shad and herring studies using radio or acoustic tags, post-tagging dropback ranged from 8.6 to 100% (Frank *et al.*, 2009). The spatial-temporal parameters (e.g., how long after release did it take the fish to start moving downstream, how fast did the fish move downstream, how far did the fish move downstream) used to define dropback varied among studies, yet the majority of researchers (63.6%) included fish with dropback in their analysis as long as the fish eventually returned upstream.

To clarify some of the confusion over vague terminology often used interchangeably, the fishway terms and their definitions as used in this report follows:

Fishway Attraction Effectiveness: - The proportion of fish that enter a fishway from the number of fish available. For this study, "the number of fish available" is considered the number of radio-tagged American shad detected on the eight downstream facing antennas located at the Powerhouse and those antennas positioned on Rowland Island. The combined antenna array covered the width of the tailrace from the base of the dam to the downstream tip of Rowland Island.

Upstream Fish Passage Efficiency: - The proportion of fish that enter a fishway and pass upstream from those available. This is the definition used in the FERC (2004) review of fish passage mitigation.

Upstream Fish Passage Effectiveness : The proportion of fish that enter a fishway, pass upstream, and remain upstream for a minimum of 48 hours from those available.

Upstream Fish Passage Effectiveness is not often evaluated and perhaps difficult to define, as it builds on the Upstream Fish Passage Efficiency estimate. We define it as the effective number of fish that actually continue to migrate upstream, acknowledging that some fish that exit a fishway do not continue the upstream migration.

2.1 Project and EFL Descriptions

The Conowingo Hydroelectric Project, built in 1928, is located at river mile (rm) 10 on the Susquehanna River ([Figure 2.1](#)). The powerhouse has a peaking generating capacity of 573 MW and a hydraulic capacity of approximately 86,000 cfs. Flows in excess of station capacity are spilled through two regulating and 50 crest gates. The powerhouse contains seven vertical Francis (numbered 1 through 7) and four mixed-flow Kaplan (numbered 8 through 11) turbines. The seven Francis units have been equipped with aeration systems that permit the unit to draw in air (vented mode) or operate conventionally (unvented mode). The four original Kaplan turbines installed in 1964 were replaced in the 1990's with more efficient mixed-flow Kaplan type turbines. Throughout this report, the small units will be collectively referred to as Francis units and the large units will be collectively referred to as Kaplan units. The Francis units have maximum hydraulic capacities ranging from 6,320 to 6,749 cfs and the Kaplan units have maximum hydraulic capacities ranging from 9,352 to 9,727 cfs.

The EFL, completed in 1991, is located immediately to the east of the Kaplan units and adjacent to the deflection wall, which separates the tailrace from the spillway ([Figure 2.2](#)). The EFL consists of two functioning Entrance Channels with independent weir gates at the downstream end of each channel to regulate flow. The Entrance Channels are 14 ft high x 10 ft wide and each can discharge 300 cfs of attraction flow, designed to provide velocities ranging from approximately three to six fps inside the entrance gate. The "A" and "C" Entrance Channels border the powerhouse and deflection wall, respectively. The specific entrance gate used to attract shad is dictated by which units are operating. When only Francis units are operating, the "A" Gate is fished; when a Kaplan unit is operating, the "C" Gate is fished.

The EFL Entrance Channels merge into a single Crowder Channel. Entering the Crowder Channel, the fish pass through the Crowder Gate ([Figure 2.2](#)). The gate is slightly opened in a v-shape, allowing fish

to enter, but making it difficult to leave. Once a number of fish have passed through the Crowder Gate, the gate is closed and the fish are trapped. The Crowder Screen upstream of the Crowder Gate is raised allowing the fish to move into the Hopper area at the upstream end of the Crowder Channel. With the Hopper sitting on the bottom of the Crowder Channel, the Crowder Gate is moved forward, concentrating the fish into the area immediately over the Hopper. The Crowder Screen is then lowered into position further corralling the fish, which are then lifted to the Exit Trough. As the 3,500 gallon Hopper is raised to the Exit Trough, the Crowder Gate is returned downstream into its open fishing position. When the Hopper reaches the Exit Trough, a door to the Hopper is opened and the fish and water within are released into the Exit Trough. The Exit Trough is 14 ft wide x 12 ft high x 190 ft long and maintains a water level equivalent to Conowingo Pond elevation. On their own volition, the fish swim by a viewing window situated in a constricted area of the Exit Trough before heading upstream into Conowingo Pond.

Fishing time and/or lift frequency is determined by fish abundance, but the Hopper is cycled at least hourly throughout the day. The method of lift operation is also influenced by fish abundance. When a great number of fish are in the Crowder Channel, the Crowder Screen is raised and lowered without moving the Crowder Gate to trap fish over the Hopper. This mode of operation, called “fast fish”, leaves the Crowder in the normal fishing position and raises the Hopper frequently to remove fish that accumulate in the channel. When fished normally, the entire mechanical process of a single lift cycle takes approximately 15 minutes to complete. When fast fished, the lift-cycle time is reduced by a few minutes.

Per the 2012 Study Plan for RSP 3.5 (Upstream Fish Passage Effectiveness Study), the operation of the Conowingo EFL during 2012 was modified compared to 2010 EFL operations. In 2012, the EFL was cycled a minimum of two lifts per hour as compared to a minimum cycling frequency of one lift per hour in 2010 to test the hypothesis that cycling the EFL more often will increase the passage of American shad at the EFL.

Additionally, from 24 April through 28 May, EFL operation start times were alternated between 0600 hrs and 0800 hrs to determine if starting attraction flows earlier in the day will increase the number of American shad entering the EFL.

3.0 METHODS

3.1 Study Objectives and Design

The objectives of this study are to determine Upstream Fish Passage Efficiency of migratory adult American shad at the Conowingo EFL and to identify factors that may influence efficiency on a daily or seasonal basis. To meet the objectives, radio tags were placed into numerous American shad caught and released downstream of Conowingo Dam, and their movements and behavior were monitored in relation to varying conditions.

3.2 Determination of Sample Size

Using a binomial model, we calculated sample sizes for various passage effectiveness levels ranging from 30% to 80%. For a passage effectiveness of 30%, a sample size of 81 fish would be required to obtain a precision of $\pm 10\%$ at a probability level of 0.95; for a 50% effectiveness a sample size of 96 fish is needed. At a passage effectiveness of 80%, a sample size of 62 fish is required to obtain the same level of precision. Consequently, a sample size of 150 fish was deemed necessary to estimate Upstream Fish Passage Effectiveness within $\pm 10.0\%$, 95% of the time assuming some level of drop back following tagging. The following table shows the required sample size to needed to achieve a precision of $\pm 10.0\%$, 90% and 95% of the time.

| Passage Effectiveness (%) | 1- α | |
|---------------------------|-------------|------|
| | 0.9 | 0.95 |
| 30 | 57 | 81 |
| 40 | 65 | 93 |
| 50 | 68 | 96 |
| 60 | 65 | 93 |
| 70 | 57 | 81 |
| 80 | 44 | 62 |

Therefore, a release sample size of 150 fish was proposed to encompass the two primary segments of the American shad run (early-mid and mid-late). The anticipated breakdown of these releases was 75 fish each in April and May, respectively. The use of 75 shad would allow an estimate of Upstream Fish Passage Effectiveness with 95% confidence intervals for each shad run segment and for the entire season.

3.3 Collection of Test Specimens

3.3.1 Tailrace Angling and Tagging

All radio-tagged shad angled for this study were caught, tagged, and released upstream of Rowland Island. Fishing locations by boat changed during tagging events as powerhouse unit combinations and

discharge changed. An individual shad caught by angling was brought to the boat, netted, and assessed for tagging suitability (e.g., general well-being—no wounds, abrasions, loss of equilibrium). Suitable shad were then transferred into a cooler outfitted with fine mesh to immobilize the specimen for tagging and to reduce stress; unsuitable fish were released. After gathering biological information such as sex and length, a radio tag was orally inserted into the shad's stomach by means of a cannula, guiding it gently through the esophagus. The tagged shad was then immediately placed back into the tailrace. This procedure took approximately one minute per fish.

3.3.2 WFL Trapping and Tagging

During the latter stages of the mid-late run, it became apparent angling shad had become unsuccessful. Individual shad collected at the WFL were netted out of the Sorting Tank and assessed for tagging suitability. The tagging process and biological data collected for each fish were similar to that done while angling in the tailrace. Once tagged, the shad was placed into a Transport Truck filled with river water and the process repeated until all the shad were tagged for that group. The group of 35 tagged shad was then driven down river to the Shores Landing Boat Launch, netted out of the truck, taken to the shoreline, and released. The release site was approximately 0.3 miles downstream of the Dam and located across from the lower tip of Rowland Island. The process from tagging to release took just over an hour.

3.4 Radio Telemetry Equipment

3.4.1 Radio Tags

Coded VHF radio transmitters (radio tags) supplied by Lotek Engineering Inc. (Lotek), Newmarket, Ontario, Canada were utilized for this study. The radio tags (model number MCFT-3EM) were digitally encoded and transmitted signals on two frequencies (channels), 150.210 and 151.540 MHz. Each radio tag contained a unique pulse train to allow for individual fish identification (codes). Each cylindrical radio tag measured 11 mm in diameter, 49 mm in length, weighed 4.3 g in water, and had a 455 mm long whip antenna. The radio tags propagated a signal every 2.5 seconds and had a minimum battery life of approximately 206 days.

3.4.2 Receivers

Lotek SRX_400 telemetry receivers installed with version W30 software were utilized to monitor American shad. Prior to release of fish, background noise levels were determined at Conowingo Dam during the calibration process. In terms of radio telemetry, background noise is any ambient electromagnetic noise detected by a receiver that is not produced by a radio tag. In general, hydroelectric facilities are noisy electromagnetic environments due to their production and distribution of electricity.

Receivers were configured to exclude background noise by utilizing specific features within the receiver's software. Receivers were set to scan each channel for specific time periods, depending on location. When a signal was received, the scan program temporarily suspended and the validity of the signal was verified and either logged or rejected. The receiver measured the duration of a preselected number of pulse intervals and if intervals differed significantly, the signal was rejected. All receivers were time synchronized. Additionally, Lotek SRX_600 telemetry receivers installed with W32 software were used at locations without easy access to facilitate remote downloads. The SRX_600's, similar in function as the SRX_400's, were coupled with a Laird ConnexLink 4490 Bluetooth antenna. The receiver was then downloaded from the opposing shore line using AeroComm software.

3.4.3 Antennas

Four types of antennas were used for the study: Laird P1504 four-element Yagi antenna (4-element antenna), Laird PLC1426 six-element Yagi antennas (6-element antenna), Laird PLC1429 nine-element Yagi antennas (9-element antenna), and custom-made underwater antennas (“dropper antenna”). All three types of Yagi antennas are aerial antennas that provide directionality and a large reception range (the more elements, the greater the range, i.e., 9-element antenna has greater range than 6-element antenna, which has greater range than a 4-element antenna). Dropper antennas, which are vertically deployed within the water column, are omni-directional and provide limited reception range. They are used to determine discrete movement within a specific location of interest. Constructed by stripping the shielded end of a 50-OHM RG58A/U coaxial cable, the length of the stripped portion of cable is a multiple of half the wavelength (λ) of 150 MHz.

3.5 Monitoring Locations and Antenna Arrangement

Monitoring stations were deployed in six general areas on the Susquehanna River below Conowingo Dam: Lower River, Rowland Island, Conowingo Tailrace, EFL, East Spillway Corner, and West Spillway Corner ([Figure 3.1](#)). Muddy Run Pumped Storage Project and Holtwood Dam were also monitored to examine movement of EFL passed fish. With most of the monitoring locations concentrated near Conowingo Dam, manual tracking was used to supplement data for the four-mile stretch of river between the Rowland Island monitors and the Lower River monitors.

3.5.1 Lower River Monitoring Stations

The Lower River monitoring stations included West shore opposite of Mud Island, Mud Island, West shore opposite Crab House, Crab House, West shore Opposite McGibney Island, McGibney Island, and the lower tip of Spencer Island ([Figure 3.2](#)). The stations in the Lower River were used to identify shad

fall back, aid observation of potential spawning habitat around Spencer Island, and assist in determining temporal aspects of upstream forays and any potential velocity barriers affecting their movement upstream (Conowingo Study 3.7, Fish Passage Impediments Study Below Conowingo Dam). All locations, with the exception of the Spencer Island station, used to monitor the lower river were added, following resource agency consultation, for the 2012 study to provide additional coverage between the tailrace and lower river.

West shore Opposite Mud Island monitoring station (0.50 miles across from Mud Island and 0.75 miles downstream of Rowland Island) consisted of a receiver and a 6-element antenna mounted on a tree oriented towards Mud Island. The antenna covered the Western half of the river downstream of the lower Rowland Island monitoring station.

Mud Island monitoring station (0.50 miles downstream of Conowingo Dam and 0.20 miles downstream of Octoraro Creek) consisted of a receiver and a 6-element antenna mounted on a tree oriented towards West shore opposite Mud Island monitoring station. The antenna covered the Eastern half of the river downstream of the lower Rowland Island monitoring station.

West shore opposite Crab House monitoring station (0.60 miles across from Crab House monitoring station and 0.75 miles downstream of West shore opposite Mud Island monitoring station) consisted of a receiver and a 6-element antenna mounted on a tree oriented towards Crab House monitoring station. The antenna covered the Western half of the river downstream of the West shore opposite Mud Island monitoring station.

Crab House monitoring station (0.60 miles across from West shore opposite Crab House monitoring station and 0.75 miles downstream of Mud Island) consisted of a receiver and a 6-element antenna mounted on a tree oriented towards West shore opposite Crab House monitoring station. The antenna covered the Eastern half of the river downstream of the Mud Island monitoring station.

West shore opposite McGibney Island monitoring station (0.55 miles across from McGibney Island monitoring station and 0.75 miles downstream of West shore opposite Crab House monitoring station) consisted of a receiver and a 6-element antenna mounted on a tree oriented towards McGibney Island monitoring station. The antenna covered the Western half of the river downstream of the West shore opposite Crab House monitoring station.

McGibney Island monitoring station (0.55 miles across from the West shore opposite McGibney Island and 0.75 miles downstream of Crab House monitoring station) consisted of a receiver and a 6-element

antenna mounted on a tree oriented towards West shore opposite McGibney Island monitoring station. The antenna covered the Eastern half of the river downstream of Crab House monitoring station.

Spencer Island monitoring station consisted of a receiver coupled via an ASP-8 switchbox to two 6-element antennas mounted on trees overlooking the lower tip of the island's shoreline. Antenna 1 monitored the Eastern channel of the river, while Antenna 2 monitored the Western channel of the river.

3.5.2 Rowland Island Monitoring Station

Rowland Island monitoring stations were located just downstream of the Conowingo Tailrace at the lower and upper tip of Rowland Island ([Figure 3.3](#)). These stations helped identify immediate fall back for shad released into the tailrace as well as assisted in detailing movements in and out of the tailrace. The lower Rowland Island monitoring station consisted of a remotely downloaded receiver (SRX_600) coupled via switchbox to two 6-element antennas mounted on a pole at the lower tip of the island. Antenna 1 monitored the eastern channel between Rowland Island and the cut in the spillway leading towards Octoraro Creek, while Antenna 2 monitored the west channel between Rowland Island and west shoreline near Shures Landing Boat Launch. The upper Rowland Island monitoring station consisted of a remotely downloaded receiver (SRX_600) coupled via switchbox to two 6-element antennas mounted on a pole at the upper tip of the island. Antenna 1 monitored the eastern channel between Rowland Island and the upper spillway leading towards the East shore, while Antenna 2 monitored the west channel between Rowland Island and west shoreline downstream of the Conowingo fishermen's wharf.

3.5.3 Conowingo Tailrace Monitoring Stations

The Conowingo Tailrace monitoring stations included the Francis Units station, the Kaplan Units station and the Rowland Island stations. Together, these stations monitored the area downstream of Unit 11 to the east, to Unit 1 and the Fisherman's Wharf to the west, all the way down river to the downstream tip of Rowland Island ([Figure 3.4](#)). The stations identified radio-tagged shad present in tailrace (i.e., "fish available" (the denominator) for estimating fishway attraction effectiveness, passage efficiency and passage effectiveness). In addition, the Conowingo Tailrace monitoring stations detected any fall back through the powerhouse after shad passed upstream through the EFL. The Francis-Units station consisted of a receiver coupled via switchbox to four 4-element antennas mounted on the tailrace catwalk railing and distributed equally over the Francis units. Antenna 1 was mounted at Unit 1, Antenna 2 was mounted at Unit 3, Antenna 3 was mounted at Unit 5, and Antenna 4 was mounted at Unit 7.

The Kaplan Units station consisted of a receiver coupled via switchbox to four 4-element antennas mounted on the upper tailrace catwalk railing and distributed equally over the Kaplan units. Antenna 1

was mounted at Unit 8, Antenna 2 was mounted at Unit 9, Antenna 3 was mounted at Unit 10, and Antenna 4 was mounted at Unit 11.

3.5.4 EFL Monitoring Stations

EFL monitoring stations included “A” Gate Aerial, “A” Gate Channel, “C” Gate Aerial, “C” Gate Channel, Crowder Channel, and the Exit Trough (Figure 3.5). The Aerial monitoring stations identified shad near the EFL. The Channel monitoring stations identified shad presence in the EFL (i.e., “proportion of fish” (the numerator) for estimating Fishway Attraction Effectiveness). The Exit Trough monitoring station identified shad passage through the EFL (i.e., “proportion of fish” (the numerator) for estimating Upstream Fish Passage Efficiency).

“A” Gate Aerial monitoring station consisted of a receiver and single 4-element antenna mounted onto “A” Gate Entrance perpendicular to the powerhouse discharge. The antenna was calibrated to have very limited range (< 75 ft.) so that it detected only fish in front of the “A” Gate Entrance.

“A” Gate Channel monitoring station consisted of a receiver coupled via switchbox to two dropper antennas. Antenna 1 monitored shad entering the “A” Gate Entrance. Antenna 2 monitored shad further upstream in the “A” Gate Entrance Channel closer to the Crowder Gate.

“C” Gate Aerial monitoring station consisted of a receiver and single 4-element antenna mounted onto “C” Gate Entrance parallel to the downstream deflection wall separating the tailrace from the spillway. The antenna was calibrated to have very limited range (<75 ft.) so that it detected only fish in front of the “C” Gate Entrance.

“C” Gate Channel monitoring station consisted of a receiver coupled via a switchbox to two dropper antennas. Antenna 1 monitored shad entering the “C” Gate Entrance. Antenna 2 monitored shad further upstream in the “C” Gate Entrance Channel closer to the Crowder Gate.

The Crowder Gate monitoring station consisted of two receivers each coupled to an ASP-8 switchbox. A upstream Crowder Channel dropper antenna mounted inside PVC pipe was fixed to angel iron outside of the Crowder Gate for each receiver and two dropper antennas in the lower Crowder Channel. Droppers were fixed on each side of the Crowder Channel Gate and lower Crowder Channel. These antennas were calibrated to detect only those shad upstream of the Crowder Gate entrance.

The Exit Trough monitoring stations consisted of a receiver with a single dropper antenna mounted upstream of the Exit Trough Viewing Window and a receiver with a single dropper antenna mounted

downstream of the Exit Trough Viewing Window. These antennas were calibrated to detect only those shad downstream and upstream of Exit Trough Viewing Window.

3.5.5 East and West Spillway Corner Monitoring Stations

The East Spillway Corner monitoring station was deployed at the far eastern corner of the spillway ([Figure 3.4](#)). This station helped identify fish moving into the spillway as well as movement along its periphery to and from the tailrace. The East Spillway Corner monitoring station consisted of a receiver and a single 4-element antenna mounted on a pole. The antenna was oriented across the spillway toward the middle of Rowland Island. The coverage of the far-field antenna array reached across the entire width of the spillway including a small portion of the tailrace downstream of the EFL. Due to limited boat access, the coverage of the near-field antenna array could not be calibrated, but was estimated at roughly half the far-field distance.

The West Spillway Corner monitoring station was deployed at the upstream end of the Exit Trough catwalk ([Figure 3.4](#)). This station also helped identify fish moving into the spillway. The West Spillway Corner monitoring station consisted of a receiver and a single 4-element antenna mounted on a pole. The antenna was oriented across the spillway toward the high tension power lines on the East shore in the spillway. The coverage of the far-field antenna array reached across the entire width of the spillway. Due to limited boat access, the coverage of the near-field antenna array could not be calibrated, but was estimated at roughly half the far-field distance.

3.6 Data Collection and Analysis

Data were stored in receivers as either a single event or a period of multiple events. If a shad was detected and remained in the reception area for a given period of time, it was recorded as a continuous event. Single events or events occurring greater than five minutes apart were recorded individually. Data stored for each event included start date, start time, channel, code, average pulse rate, average signal strength, end date, and end time.

Data were off-loaded from receivers three times a week throughout the study period with a laptop computer and stored on hard drive and flash drive. Backup copies of all telemetry data were made prior to receiver initialization. Data were consolidated into a PC database for review and verification.

3.7 Manual Tracking

Manual tracking by boat was done for all release groups to supplement the data collected from the fixed-monitoring locations. A crew surveyed the river weekly below Conowingo Dam from the tailrace to the I-

95 Bridge, approximately 1.5 miles downstream of the Lower River monitors. After all releases were made, manual tracking was expanded to incorporate a weekly survey of Conowingo Pond from the Baltimore Water Intake to the Norman Wood Bridge, approximately 0.2 to 13.4 miles upstream of the dam, respectively, to locate radio-tagged shad which passed upstream of Conowingo. When a tagged shad was located, GPS coordinates, date, and time were recorded to supplement the fixed-monitor data.

4.0 RESULTS

4.1 Tagging and Release Data

A total of 155 radio-tagged adult American shad were released in three groups. Two groups were collected by angling and the remaining group was collected at the WFL. At the time of release water temperature ranged from 12.7°C to 19.0°C (54.9 to 66.2°F). A water temperature less than 21.1°C (70.0°F) was desirable to avoid inclusion of partially spent and post-spawned fish. At the time of release plant discharge ranged from 10,210 to 78,780 cfs. Spill ranging from 16,000 to 32,000 cfs occurred for a two-day period on May 16 and 17, during the study. A listing of all radio-tagged adult American shad released downstream of the Conowingo Dam during the spring of 2012 is presented in [Appendix A](#).

One hundred twenty American shad (72 male and 48 female) were collected by angling in the Conowingo tailrace during 12 days between 12 and 19 April and 1 and 14 May ([Table 4.1](#)). Those collected in April (N=75) comprised the early-mid shad run segment and those collected in May (N=45) were part of the mid-late shad run segment. The remaining 35 American shad (10 male and 25 female) were collected by trapping in the WFL on May 19 ([Table 4.1](#)); these radio-tagged fish were transported downriver to the Shures Landing Boat Launch. These 35 shad were part of the 80 shad released for the mid-late shad run segment.

Following tagging and subsequent data review, it was determined two shad collected via angling regurgitated their transmitters shortly after release; they were excluded from subsequent data analysis. This provided a sample size of 153 American shad for analysis.

4.2 Fish Passage Statistics

Detection rates and known disposition of released shad were high. The data that address the principal objective of the study are as follows ([Table 4.2](#)):

Total Shad Released

| | | |
|---------|----------------------|---------------------|
| N = 153 | Early-Mid 75 (49.0%) | Mid-Late 78 (51.0%) |
|---------|----------------------|---------------------|

Non-tailrace (Shad not migrating after tagging)

| | | |
|--------|----------------------|---------------------|
| N = 87 | Early-Mid 29 (33.3%) | Mid-Late 58 (66.7%) |
|--------|----------------------|---------------------|

Shad Detected in Tailrace (post drop-back)

| | | |
|--------|----------------------|---------------------|
| N = 66 | Early-Mid 46 (69.7%) | Mid-Late 20 (30.3%) |
|--------|----------------------|---------------------|

Fishway Attraction Effectiveness

N = 29 Early-Mid 15 (51.7%) Mid-Late 14 (48.3%)

Upstream Fish Passage Efficiency

N = 17 Early-Mid 9 (52.9%) Mid-Late 8 (47.1%)

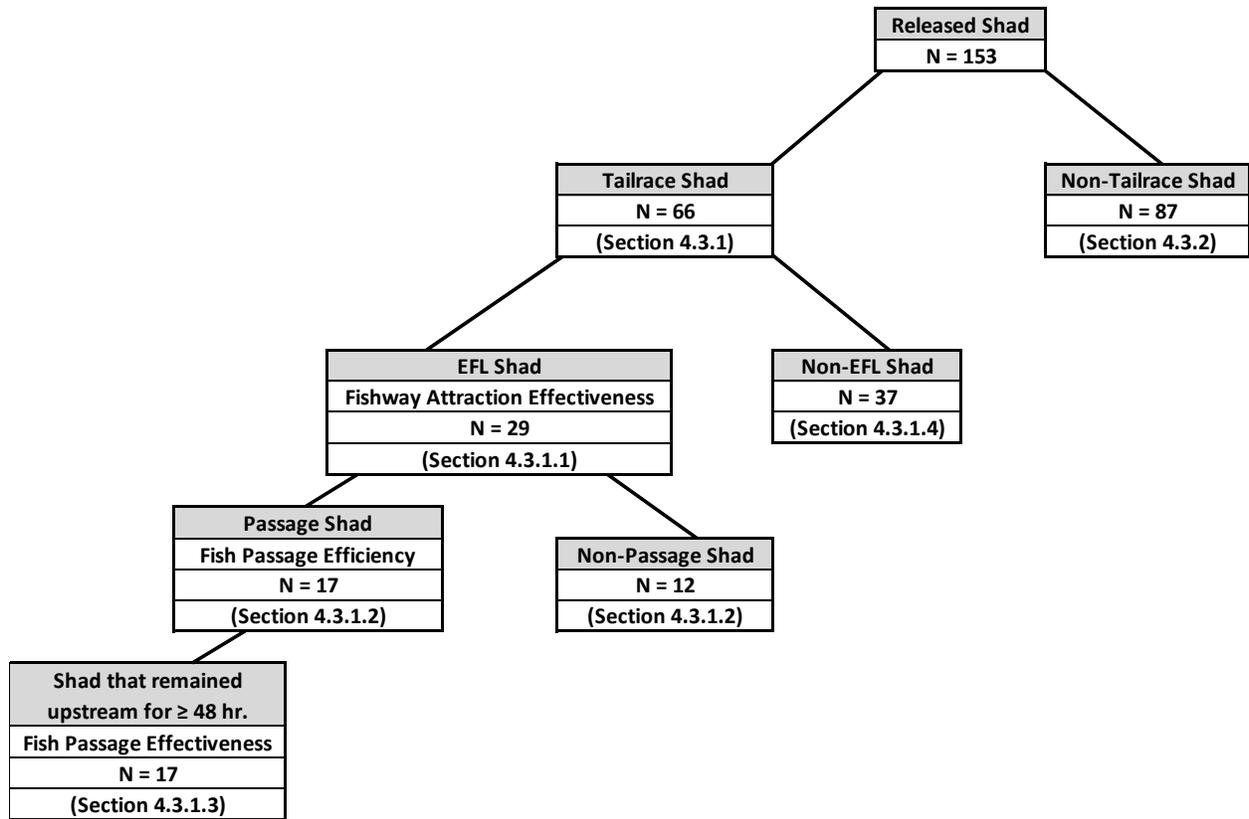
Upstream Fish Passage Effectiveness

N = 17 Early-Mid 9 (52.7%) Mid-Late 8 (47.1%)

4.3 Shad Behavior in the Study Area

As noted earlier, all of the tagged fish initially dropped back after release. To facilitate descriptions of the subsequent behavior of these fish, tagged shad were broken into two groups: Tailrace Shad (N = 66) and Non-Tailrace Shad (N = 87). Tailrace shad were tagged fish that returned to and were detected in the tailrace. Non-tailrace shad were tagged fish that did not move to the tailrace after tagging.

The Tailrace Shad group consisted of fish that entered the EFL (EFL Shad, N = 29) and fish that did not enter the EFL (Non-EFL Shad, N = 37). Within the EFL Shad group, there were fish that successfully passed upstream via the EFL (Passage Shad, N = 17) and fish that entered the EFL but did not pass upstream (Non-Passage Shad, N = 12). The following key illustrates the interconnected relationship between the various groups and sub-groups (movement classifications) as they are described within the following report sections.



The composition of each movement classification is presented in [Table 4.3](#).

4.3.1 Tailrace Shad

A total of 66 of the 153 radio-tagged American shad were detected in the Conowingo Tailrace. These 66 shad represented the fish available for passage (i.e., denominator for the Fishway Attraction Effectiveness, Upstream Fish Passage Efficiency, and Upstream Fish Passage Effectiveness calculations). Sixty two were tailrace-released fish and four were Shures Landing-released fish. Average travel time to the tailrace after initial drop back for tailrace-released fish was 6 days 2 hours 7 minutes ([Table 4.4](#)). In general, shad tagged earlier in the season took longer to move back into the tailrace than those shad tagged later in the season. Average travel time to initial tailrace detection for the early- mid group (6 days 6 hours 17 minutes) was greater than 14 hours longer than the mid - late group (5 days 16 hours 33 minutes). For a comparison of travel times to the tailrace between movement classifications by release location, refer to [Table 4.4](#) and [Appendix B](#).

In general, tailrace residency was greatest downstream of the Francis units. The greatest residency was on antennas located mid-dam, at Unit 5 and Unit 7, and to a lesser extent Unit 3. The greatest residency on the Kaplan units was on the antenna located at Unit 8, adjacent to the Francis units. Tagged fish actively

moved throughout the tailrace and were detected on all antennas, but tended to congregate near the Francis units that were running. Fish avoided the area immediately downstream of the Kaplan units when operating, preferring to stay to the periphery of flow. A series of accompanying animations were created to visually illustrate radio-tagged shad movement in relationship to generation (see accompanying DVR).

4.3.1.1 EFL Shad (Fishway Attraction Effectiveness)

Twenty nine (29) of 66 (44.0%) of the radio-tagged American shad detected in the tailrace were also detected in the EFL. These shad formed the numerator of the calculation of Fishway Attraction Effectiveness. Twenty eight were tailrace-released fish and the remaining fish was released at Shures Landing. Some 15 and 14 of the 29 American shad that entered the EFL were from the early- mid and mid- late groups, respectively. Average travel time from release to initial detection inside the EFL for the early-mid release group was 17 days 20 hours 42 minutes. Average travel time from release to initial detection inside the EFL for the mid-late release group was about 1.8 days less (16 days 7 minutes; [Table 4.4](#)).

A total of 49 forays were made into the EFL by the 29 radio-tagged shad ([Table 4.5](#)). Twenty six shad were detected at least one time on the upper crowder channel dropper antennas located upstream of the crowder gates. Time spent in the EFL for all 29 shad that entered averaged 54 minutes 56 seconds and ranged from 1 minute 30 seconds to 6 hours 25 minutes 24 seconds. The median duration prior to lifting was 24 minutes 1 second (data for these calculations are provided in [Appendices D, E, and F](#)).

4.3.1.2 Passage Shad (Upstream Fish Passage Efficiency)

A total of 17 (17 of 66, 25.7%) radio-tagged American shad was successfully passed upstream of Conowingo Dam through the EFL. These shad formed the numerator of the calculation of Upstream Fish Passage Efficiency. Nine were from the early-mid release group and 8 were from the mid-late group. No shad released at Shures Landing were passed upstream. These 17 shad were 58.6% of the 29 shad that entered the EFL. Average travel time from release to passage was 15 days 8 hours 5 minutes. The average travel times from release to passage for the early-mid and mid-late release groups were 13 days 16 hours 10 minutes and 17 days 4 hours 59 minutes. Two additional shad were recaptured at the WFL; both of these shad made previous forays into the EFL prior to WFL capture.

Eleven of 17 (64.7%) shad successfully passed through the EFL on their first foray into the EFL. The six (35.3%) shad that later passed the EFL had one or more unsuccessful forays into the EFL before passing upstream into the Pond. One of these six shad made six unsuccessful forays on three different days. The

other five shad make either one or two unsuccessful forays before successful passage. The 12 radio-tagged shad that were detected in the EFL but never passed made a total of 20 forays into the EFL.

Average foray duration within the EFL for successful passage fish was 43 minutes, compared to 1 hour 15 minutes, and 50 minutes for successful passage fish with multiple forays, and fish with unsuccessful passage, respectively. The median foray duration within the EFL for successful passage fish was 25 minutes, compared to 36, and 14 minutes for successful passage fish with multiple forays, and fish with unsuccessful passage, respectively ([Table 4.5](#)). All shad passing through the EFL remained upstream > 48 hours.

Overall, the average time it took a shad to make a repeat foray into the EFL was 3 days and 9 hours with a median time of 2 days and 12 hours. For the six shad that later passed, the average time it took a fish to make a repeat foray into the EFL was 3 days and 9 hours with a median time of 1 day and 9 hours. Only four of the 12 radio-tagged shad that never passed the EFL made repeat forays. The average time it took these fish to make a repeat foray into the EFL was 1 day and 5 hours with a median time of 23 hours (data for these calculations are provided in [Appendices D, E, and F](#)).

Collectively, 41.2 % (7 of 17) of the radio-tagged shad that successfully passed upstream entered the EFL through the “A” Gate Entrance, which was operated 36.5% of the time in 2012. The “A” Gate is only used when no mixed-flow Kaplan units are operating. Conversely, 58.8% (10 of 17) of the radio-tagged shad that successfully passed upstream entered the EFL through the “C” Gate Entrance, which was operated 63.5% of the time. Most (29) forays into the EFL occurred when the “C” Gate Entrance was open ([Table 4.6](#)). For a complete listing of generation (cfs) during each foray into the EFL, see [Appendix C](#).

Radio-tagged shad passage at the Conowingo EFL occurred at temperatures ranging from 13.0 to 26.0°C (57.0 to 69.6°F). Over 75% of the radio-tagged shad (11) passed at water temperatures of < 21°C (69.8°F), [Figure 4.1](#)). Radio-tagged shad made successful and unsuccessful forays into the EFL under various water temperatures. When all forays into the EFL are plotted against water temperatures, no relationship was apparent ([Figure 4.2](#)).

Shad passage at the Conowingo EFL occurred at plant discharges ranging from 9,200 to 77,520 cfs ([Figure 4.3](#)). Forty one percent (7) of the radio-tagged shad passed at two unit operation of 11,580 or less. An additional 41.2% passed at flow ranges of 68,400 to 77,520 cfs. Some 26.5% of forays were made at two unit operation of flows < 15,000 cfs. In contrast, 32.7% of all forays were made at flows ranging from 67,500 to 75,999 cfs ([Figure 4.4](#)).

Radio-tagged American shad with successful passage at the EFL did so under 5 of 19 various Conowingo turbine-generating combinations available during the study. Conowingo powerhouse and EFL operational conditions for individual fish entering the EFL are listed in the Appendices. Refer to [Appendix D](#) for successful forays, [Appendix E](#) for unsuccessful forays of fish that later passed upstream through the EFL, and [Appendix F](#) for unsuccessful forays of fish that never passed upstream through the EFL.

Radio-tagged shad passed the dam on 14 different days between 17 April and 29 May. The best day for passage of radio-tagged shad was 14 May when three shad passed the dam ([Figure 4.5](#)). On 14 May, the operation of all turbines (7 Francis and 4 Kaplan turbines) occurred from 0815 hrs until the end of EFL operations at 1900 hrs. Passage occurred between 0700 and 1800 hours with the most successful forays occurring between 0800-1000 hours and 1500-1700 hours ([Figure 4.6](#)).

4.3.1.3 Shad that remained upstream for \geq 48 hours (Upstream Fish Passage Effectiveness)

A total of 17 (17 of 66, 25.8%) radio-tagged American shad made passage through the EFL and remained upstream for greater than 48 hours. These shad formed the numerator of the calculation of Upstream Fish Passage Effectiveness.

4.3.1.4 Non-EFL Shad (In the Tailrace)

A total of 37 radio-tagged American shad were detected in the tailrace without making a foray into the EFL. The proximity to the EFL for these fish is as follows: 35.1% (13 of 37) were detected on EFL aerial antennas mounted on the Entrance Gate structures. Five were detected on both aerial antennas; five were detected on only the “C” Gate Aerial antenna and three were detected on only the “A” Gate Aerial antenna. The EFL aerial antennas were setup to have a limited detection range of less than 75 ft. Detailed movement of these fish as well as other movement classified fish into and out of the tailrace are discussed in Section 4.4 below

4.3.2 Non-Tailrace Shad

A total of 87 (41.1%) radio-tagged American shad were never detected in the Conowingo Tailrace after initial release. Literature review indicates that a certain proportion of radio-tagged shad dropback downstream shortly after tag and release with little or no subsequent upstream movement (e.g., [Leggett 1976](#); [RMC 1990](#); [Sprankle 2005](#); [Olney et al. 2006](#); [Normandeau 2011](#)). Depending upon site-specific characteristics and prevailing hydrological conditions, post-tagging stress has consistently been reported to affect migrational behavior of up to 40% of American shad. Released shad departed the tailrace within one hour, exhibiting drop-back behavior typically noted for tagged shad in other studies, notably work by [Leggett \(1976\)](#). Some shad from this group spent some time around Rowland Island before moving

downriver, but none returned to Rowland Island after detection on the Lower River monitors, so their detections at Rowland Island were not included. Movement data of all shad located at all non tailrace monitors is provided in [Table 4.7](#) and [Appendix G](#).

4.4 In-River Migration Evaluation

To evaluate in-river movements, the data set was analyzed to identify tagged shad that exhibited substantial upstream migrations from lower river areas after moving downstream from the tailrace after tagging and then migrated back up to the dam. Spatial and temporal data for these fish were correlated with Conowingo Station discharge in an attempt to characterize shad upstream movements over the spring migration period and to identify whether any delays could be due to velocity impediments or barriers. Conowingo Dam discharge data were derived from operations logs.

Of the 153 American shad radio-tagged and released, 66 returned to the tailrace with 57 (37.3%) providing sufficient data to evaluate upstream movement into the tailrace areas of Conowingo Dam. Of these 57, 53 (93 %) had been angled from, tagged and released back into the tailrace and four were taken from the WFL and released at Shures Landing. The other 87 shad that had been radio-tagged and released never exhibited appreciable upstream movement; most, after moving downriver, were never detected again and presumed to have left the river.

Thirty-eight of the 53 (72 %) tagged shad released in the tailrace moved downstream as far as the tidal portion of the river at least once before migrating back to the tailrace area. The other 15 shad migrated downstream varying distances multiple times before returning upstream, but none of these fish dropped back as far as the tidal portion. Only four of the 35 (14%) shad transported to and released at Shures Landing migrated back upstream to the tailrace from tidal areas of the river; the other 31 were not detected and apparently left the river. Overall, 42 (27% of all radio-tagged shad) individuals were monitored undertaking substantial upstream migrations from the lower tidal reaches (Spencer Island) of the Susquehanna River to the Conowingo tailwaters (Rowland Island and tailrace monitor stations). All discernible, volitional, timely upstream movements by tagged shad were included in the analyses.

The addition of more down-river monitoring stations between Rowland Island and the tidal zone in 2012 over those deployed for the 2010 study, allowed for a more precise determination of upstream movement events by radio-tagged shad. Every upstream movement detected among monitor stations, regardless of the distance, was utilized in the analyses. Thus, relatively short forays (e.g., 1.5 miles from Mudd Island monitor station to Crab House monitor station), were considered an upstream movement event and thus related to Conowingo discharge for determination of velocity impediments. In addition, movements from

Upper Rowland Island monitor station to near-field powerhouse stations were also included. These additional monitoring stations resulted in a substantial increase of observed upstream forays by tagged shad over those discerned during the 2010 study; they also allowed for a more precise time measure of the forays.

Many of the 57 radio-tagged American shad making upstream movements from various reaches of the river made more than one migration ([Table 4.8](#)). A third of the fish made just one to three separate forays and at least half made six or more separate trips; five shad made from 25 to 47 separate upstream movements ([Table 4.8](#)). Overall, there were 531 distinct upstream movement events completed by these 57 shad between April 13, 2012 and May 31, 2012. The mean and median average distance traveled by these tagged shad was 1.2 and 0.9 miles, respectively. The median time to complete the forays was 0.93 hr; the shortest time was just 0.07 hr and the longest time was just less than 8.28 hr ([Table 4.8](#)). Mean elapsed time for trips was 1.61 hr. Average speed during the trips for individuals was 1.65 feet/ second (fps). Speed per trip varied from 0.13 fps to more than 12 fps. Overall, station turbine discharge ranged from 9,200 cfs to 78,780 cfs during the time upstream forays were occurring; average discharge during the period was 40,719 cfs.

Each upstream migration event is listed by ascending trip duration in [Table 4.9](#). For each trip, Conowingo Station turbine discharge and average speed of each shad is presented. The shortest time duration trip was 0.07 hr (4.2 min) and extended just 0.1 mi (from just upstream of Rowland Island to near field powerhouse). Station discharge remained steady at 11,590 cfs during this short foray. The longest trip duration extended for more than 20 hrs and covered 4.3 miles from Spencer Island to near field Conowingo powerhouse. Turbine discharge ranged from 68,680 cfs at time of start to 49,530 cfs at time to finish the trip. The average turbine discharge was 24,499 cfs. The fastest, extended upstream movement (from Spencer Island to near field powerhouse) was shad 21-41 which was monitored traveling from tidal reach to tailrace, a distance of approximately 4.3 miles, in an elapsed time of 4.03 hr. This translates to an average speed of 1.5 fps. Station turbine discharge was steady at full operation, 78,780 cfs, during the migration. There were an additional 27 extended upstream forays completed in less than 6 hr elapsed time by 18 other radio-tagged shad. Generation during these trips varied between 10,170 and 78,780 cfs ([Table 4.9](#)); station generation generally remained steady during most of the trips. There were a total of 10 upstream movement events from Spencer Island to near field powerhouse by eight individual shad at sustained turbine generation of 70,000 cfs or greater. Overall, 477 (90%) of the 531 forays took less than four hrs. regardless of distance traveled. The vast majority (99%) of the upstream migrations were completed in less than 8 hrs. elapsed time.

Upstream movement by radio-tagged American shad were completed during an array of Conowingo Dam turbine discharges. Shad migrated up to the dam during flows as low as 9,930 cfs and as high as 78,780 cfs. Overall, 124 upstream trips were completed by 26 individual shad during generation flows of 70,000 to 78,780 cfs ([Table 4.10](#)). Between 60,000 and 70,000 cfs, 30 individuals completed 63 upstream migrations. As flows decreased, upstream forays generally increased in numbers as well as numbers of individual shad making the trips. At the lower flow ranges, 5,000 to 20,000 cfs, the number of forays was highest and numbers of individuals were also highest. Most upstream movement events (63%) occurred during average discharge flows of between 20,000 and 78,780 cfs.

The great number of discrete upstream movement events necessitated partitioning into movements greater than 0.5 mile and less than 0.5 mile in order to graphically depict those forays clearly. This partitioning generally enabled depiction of longer migrations apart from those shorter, (e.g., from Rowland Island to near field powerhouse). Charts illustrating the individual shad upstream movement events greater than 0.5 mile (solid lines) superimposed over hourly turbine discharge during those movement periods are presented in [Appendix H](#) with supporting data provided in [Appendix I](#). The initial upstream movement events by radio-tagged shad occurred during mid-April and continued through May. Turbine generation was variable from April 13 through April 27 and was primarily on the lower side. During that period, generation rarely was greater than 50,000 cfs; there were 70 distinct upstream movements by tagged shad. There was no clear relationship between flow and onset or completion of the migrations. This same general trend was evident throughout the migratory period. Some shad initiated upstream movement during high flows, while others began movement upstream during low flows. There were times when multiple upstream forays occurred during relatively low flows (May 6) and times when there were multiple forays during relatively high generation (May 7 through May 20). Many of the upstream movements were up into the tailrace, near field powerhouse, regardless of generation levels. Many forays were shorter, and ended in areas downstream of the tailrace. There was no discernible correlation between flow levels and movement initiations although it appeared that movement throughout the river including the tailrace was not noticeably limited by station generation.

The shorter upstream movement events (< 0.5 miles) exhibited by radio-tagged shad are illustrated in [Appendix J](#) with supporting data provided in [Appendix K](#). Most of these movements are into near field powerhouse areas of the site; only six (4.1%) of the 148 shorter forays ended near upper Rowland Island. There was no discernible correlation between generation and onset of upstream movement. These figures show that, movement into the immediate tailrace occurs regardless of generation. Tagged shad were observed moving from upper Rowland Island up to near field powerhouse at all generation discharges, and quite frequently at maximum turbine generation.

There was no indication that low flow (minimum flow – 9,200 cfs) or higher flows (up to 78,780 cfs) affect the timely upstream migration of radio-tagged American shad during 2012. The slopes of the solid lines in the figures presented in [Appendices H](#) and [J](#) provide a general indication of elapsed time for each upstream migratory event. A few trips are clearly longer than others, but most frequently the onset of these longer trips is within the same time frame and flow regime as much shorter trips.

Results observed during 2012 tend to corroborate those results found in the 2010 study. Although the addition of more monitoring stations during 2012 allowed for a much greater precision in movement observations than those during 2010, general comparisons can be made. Because there were only monitoring stations deployed on Spencer and Rowland Islands, as well as on the dam itself, only upstream movements of at least 4.9 miles (from Spencer Island to Rowland Island) could be observed during 2010. Consequently, all upstream migrations were based on initiation from Spencer Island with the ending at Rowland Island or near field tailrace. Data collected during this year's study indicated that shad frequently stopped upstream movement in differing areas of the river for varying time periods, thus, the relatively long elapsed time migrations of 2010 may have reflected several upstream movements that could not be detected. As a result, some 2010 trips were characterized as a single movement because shad holding in unmonitored area could not be detected. This year's study revealed that many shad moved down to the Mudd Island area overnight, then at the onset of generation, moved back up into the tailrace. Many other times, migrations began from the Spencer Island area and stopped in other monitored areas of the river for different time periods. Extended movements then began again, either up river or down river. [Table 4.11](#) lists continuous movements of four miles or greater by tagged shad in 2012. Direct comparisons cannot be made, however, since the extended movements in the present study were continuous and those migrations observed in 2010, were probably not continuous upstream movements for the most part. Nevertheless, both years of study indicated unimpeded movement about the entire river regardless of Conowingo Dam generation.

Overall, 531 separate upstream migrations (of less than 24 hr elapsed time) were completed by 57 individual radio-tagged American shad in the Susquehanna River during the spring 2012 study. These migrations were accomplished during Conowingo Dam discharges ranging between 9,200 and 78,780 cfs. There was no indication that migratory behavior or movement was adversely influenced by operations of Conowingo Dam in the river between Spencer Island and the dam tailrace. Variations in migration times could not be correlated to river flow. Based on the data of radio-tagged American shad gathered during the spring of 2012, and in corroboration with 2010 data, no velocity barriers were prevalent in the stretch of river between the tidal reach at Port Deposit and Conowingo Dam.

4.5 Animation

Animations were prepared to accompany this report to show visually the movement of 66 radio-tagged shad within the study area in relationship to Conowingo Station operations. These animations will be provided on DVR with the final report.

4.6 Manual Tracking of Tagged Shad Upstream and Downstream of Conowingo Dam

Manual tracking of radio-tagged American shad upstream of Conowingo Dam started on 7 May and continued on a weekly basis through 30 July. The upstream surveys covered an area of the river from the Baltimore Water Intakes to the Norman Wood Bridge, approximately 13 miles. Nine of 17 (53.0%) radio-tagged shad with successful passage through the EFL were manually tracked upstream of the Conowingo Dam. Four of nine (44.4%) Early-Mid run shad and five of eight (62.5%) Mid-Late run shad were detected upstream. All were detected downstream of the Muddy Run Project. Continual monitoring indicated 14 shad reached Holtwood tailrace and two passed upstream of Holtwood Dam.

Manual tracking of radio-tagged American shad downstream of Conowingo Dam started on 19 April and continued on a weekly basis through 30 July. The downstream surveys covered an area of the river from the Conowingo Dam to the I-95 Bridge, approximately 6.5 miles. Data collected on downstream surveys enhanced data collected from fixed-monitor detections, and are discussed as appropriate in earlier sections of this report.

4.7 Final Disposition of Tagged Shad

The fate of the 153 fish tagged and released was known with a high degree of certainty. Four of 17 (23.5%) radio-tagged shad with successful upstream passage of Conowingo Dam eventually re-entered the tailrace via the turbines ([Appendix L](#)). Residency upstream of the Conowingo Dam ranged from just over two days to > 30 days. Four of the 17 shad that passed upstream (23.5%) were last detected upstream of the dam alive and the remaining nine (53%) became stationary in Conowingo pond. The fate of the remaining shad is provided in [Appendix M](#).

All four shad passed when the station was operating at full discharge. One shad each passed through Unit 1 and Unit 8. The route utilized by the remaining two shad was unknown. Two of those passing downstream via the turbines were believed alive at last detection. Signals from the other two shad became stationary after passing downstream via the turbines and were considered dead.

4.8 2010 and 2012 Comparisons

Under existing Station and EFL operational conditions in 2010, 58.9% (89 of 151) of all radio-tagged shad were detected in the tailrace making them accessible to the EFL. In contrast, only 43.1% (66 of 153) were accessible in 2012. There are several possible explanations for this observation either singularly or in combination. First, the 35 shad tagged in 2012 were captured at the WFL and transported downstream to Shures Landing and released. Only two (5.7%) of these fish returned to the tailrace. It is possible that the tagging, transport, and/or potentially weakened condition of these fish played a role in such a low proportion returning. If these 35 shad, including the two fish detected in the tailrace, were excluded from the study, an effective sample would be 118 fish rather than 153, and the percentage of tagged fish accessible for the EFL would be 54.2% (64 of 118). There was also an observed difference in operating or flow conditions between 2010 and 2012. EFL operating conditions using the “A” gate (*i.e.* limited or no use of the Kaplan turbines) occurred 43.0% of the time in 2010 and use of the “C” gate (*i.e.*, Kaplans operated more frequently) occurred 57% of the time. In contrast, in 2012 the percentage of time these gates were operated was 36.5% and 63.5%, respectively. This greater use of the “C” gage indicated a higher daily flow condition over the migration season occurred in 2012. In 2010, operation of the combination of Francis Units 1-7 and Kaplan Units 8-11 occurred only 4.7% of the time whereas this combination occurred 32.4% of the time in 2012. It is possible a higher flow discharge in 2012 affected the number of accessible fish in the tailrace.

The higher flow scenario outlined above likely apply to the difference in proportions of shad entering the EFL in 2010 and 2012. In 2010, 73.0% (65 of 89) entered into the EFL. The proportion observed in 2012 was considerably less (44.0%).

The upstream passage efficiency of the EFL differed substantially between 2010 and 2012. The passage efficiency was 44.9% in 2010 and 25.8% in 2012. This observation cannot readily be explained. The EFL operated for a period of 47 days following tagging of the first release group in 2010 and operated 52 days following release of the first group in 2012. Additionally, the total hours operated in 2012 was 633 compared to 526 in 2010.

The proportion of fish that passed once the fish entered the EFL during their final foray was similar between years. In 2010, 40 of 65 shad that entered the EFL, (61.5%) successfully passed upstream. Some 58.6% (17 of 29 fish) successfully passed upstream in 2012.

Comparison of the 2010 and 2012 EFL passage results did not support the hypothesis that increasing the lift-cycle frequency will increase passage of American shad by the EFL. In 2010, the effort expended (59

days of operation, 526 hours of operation, and 685 lifts) resulted in the passage of 37,757 American shad as compared to the effort expended in 2012 (62 days of operation, 633 hours of operation, and 1,230 lifts) which resulted in the passage of 22,143 American shad.

A total of 18 days (starting 24 April and ending 28 May) were scheduled for the 0600 hr start time. However, due to EFL mechanical problems, operations were abbreviated (started later or ended early) or did not occur on 25, 26, 30 April and 2 May and were hampered on 17 May due to spillage (two spill gates open). These operational inconsistencies resulted in the loss of five “pair days”, providing 13 “pair days” available for comparative purposes of EFL operation with early (0600 hr) and late (0800 hr) start times.

Hourly American shad passage values for the 13 “pair days” is provided in [Table 4.12](#). A total of 4,954 American shad were passed on days starting at 0600 hrs as compared to 4,151 shad passed on days starting at 0800 hrs, a difference of 803 shad. We also compared the number of American shad passed during the first two hours of the day and the first four hours of the day. Shad passage during the first two hours of operation on early start dates totaled 525 shad as compared to 932 shad passed in the first two hours on days with later start times (difference of 407 shad). The number of shad passed within the first four hours per each start time was nearly identical (1,643 shad/0600 hr start; 1,638 shad/0800 hr start). Overall, in 2012 and in several previous years, the highest consistent passage of shad tends to occur in the afternoon and not in the early morning ([Table 4.13](#)).

5.0 CONCLUSIONS AND DISCUSSION

The objective of this study was to estimate the Upstream Fish Passage Effectiveness of migratory adult American shad at the Conowingo EFL, and this objective was achieved. A total of 153 adult American shad was successfully radio-tagged and released downstream of Conowingo Dam. Sixty-six shad (43.1%) entered the Conowingo Tailrace and were accessible to the EFL. A substantial portion (87 fish, 56.9%) dropped back; these fish did not return to the tailrace and were not available for the determination of the effectiveness of the EFL. Several factors potentially addressing the lower proportion of fish available in the tailrace for passage in 2012 are discussed in the previous section but most notable may be the difference in discharge scenarios between the two years of study. Over the course of the migration season in 2012, the combination of seven Francis Units and four Kaplan Units occurred 32.4% of the time and that same combination only occurred 4.7% of the time in 2010 indicating an overall higher level of discharge.

Twenty nine of 66 shad in the tailrace (43.9%) entered the EFL. Some 26 (89.7%) were detected on at least one occasion in the upper crowder channel upstream of the crowder doors. Data indicate the shad located upstream of the crowder doors are backing out prior to the crowder doors closing at the beginning of an EFL cycle.

Overall, 17 of 66 shad (25.8%) successfully passed the EFL into the Conowingo Pond. All shad that passed upstream remained upstream for at least 48 hours after leaving the Exit Trough. Four of 17 (23.5%) radio-tagged shad with successful upstream passage of Conowingo Dam eventually re-entered the tailrace via the turbines. Residency upstream of the Conowingo Dam ranged from just over two days to > 30 days.

There did not appear to be a single variable that consistently provided the best fish passage conditions or high rates of successful upstream passage. Radio-tagged shad passed upstream over the range of turbine-generation combinations that occurred most often, water temperatures, and EFL settings. The fishway attraction effectiveness value (44.0%) shows that American shad in 2012 were not as successful in entering the EFL as in 2010 (73.0%) with 97% of these fish moving to within a few feet of the Crowder Gate.

There is no evidence available to suggest that extreme water velocities present a barrier to upstream migration of American shad or River herrings. Radio telemetry data collected in 2010, and corroborated with much higher precision in 2012, illustrated the American shad's ability to traverse the length of the riverine portion of the Susquehanna River below Conowingo Dam with relative ease. Many radio-tagged

fish migrated upstream from lower portions of the river multiple times. In addition, the rates of migration, as indicated in 2012, did not appear to be related to Conowingo Dam discharge.

6.0 REFERENCES

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TABLE 4.1: SUMMARY OF TAGGED AND RELEASED ADULT AMERICAN SHAD DOWNSTREAM OF THE CONOWINGO DAM, SPRING 2012.

| Release Group | Shad Run Segment | Collection Method | Release Dates | Release Location | Number Released | Sex | | Water Temperature °C | Plant Discharge (cfs) |
|----------------------|-------------------------|--------------------------|----------------------|-------------------------|------------------------|------------|-----------|-----------------------------|------------------------------|
| 1 | Early-Mid | Angled | 12-19 April | Tailrace | 75 | M | 44 | 12.7-16.8 | 11,050 - 68,720 |
| | | | | | | F | 31 | | |
| 2 | Mid-Late | Angled | 1-14 May | Tailrace | 45 | M | 28 | 13.0-18.2 | 10,210 - 75,500 |
| | | | | | | F | 17 | | |
| 3 | Mid-Late | Trapped | 17-May | Shures Landing | 35 | M | 10 | 19.0 | 78,780 |
| | | | | | | F | 25 | | |
| | | | | | Total | | | Percentage | Range |
| | | | | | 155 | M | 82 | 52.9% | 10,210 to |
| | | | | | | F | 73 | 47.1% | 78,780 |

TABLE 4-2: MATRICES EXAMINED AT THE CONOWINGO EFL, SPRING 2012.

| 2012 Shad Run | Matrices | N | No. Affected | P | L95 | U95 |
|--------------------------|----------------------------------|-----------|---------------------|----------|------------|------------|
| Overall | In Tailrace | 66 | | | | |
| | Fishway Attraction Effectiveness | | 29 | 0.4394 | 0.3868 | 0.4920 |
| | Fish Passage Efficiency | | 17 | 0.2576 | 0.23040 | 0.28480 |
| | Fish Passage Effectiveness | | 17 | 0.2576 | 0.23040 | 0.28480 |
| Early-Mid Segment | In Tailrace | 46 | | | | |
| | Fishway Attraction Effectiveness | | 15 | 0.3261 | 0.28190 | 0.37030 |
| | Fish Passage Efficiency | | 9 | 0.1957 | 0.17700 | 0.21440 |
| | Fish Passage Effectiveness | | 9 | 0.1957 | 0.17700 | 0.21440 |
| Mid-Late Segment | In Tailrace | 20 | | | | |
| | Fishway Attraction Effectiveness | | 14 | 0.7000 | 0.55940 | 0.84060 |
| | Fish Passage Efficiency | | 8 | 0.4000 | 0.31410 | 0.48590 |
| | Fish Passage Effectiveness | | 8 | 0.4000 | 0.31410 | 0.48590 |

TABLE 4.3: COMPOSITION OF MOVEMENT CLASSIFICATIONS, SPRING 2012.

| | Passage Shad | | Non-Passage Shad (In EFL) | | Non-EFL Shad (In Tailrace) | | Non-Tailrace Shad | | Totals | |
|---------------------------------------|--------------|------------|------------------------------|------------|-------------------------------|------------|-------------------|------------|--------|------------|
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Overall Totals and Percentages | 17 | 11.1% | 12 | 7.8% | 37 | 24.2% | 87 | 56.9% | 153 | 100.0% |
| Sex | | | | | | | | | | |
| Male | 7 | 41.2% | 5 | 41.7% | 24 | 64.9% | 44 | 50.6% | 80 | 52.3% |
| Female | 10 | 58.8% | 7 | 58.3% | 13 | 35.1% | 43 | 49.4% | 73 | 47.7% |
| Size (mm) | | | | | | | | | | |
| Minimum | 422 | | 410 | | 390 | | 374 | | | |
| Maximum | 559 | | 552 | | 567 | | 589 | | | |
| Average | 509.1 | | 494.1 | | 456.7 | | 465.1 | | | |
| Median | 517 | | 498.5 | | 442 | | 461 | | | |
| Early-Mid Release | 9 | 12.0% | 6 | 8.0% | 31 | 41.3% | 29 | 38.7% | 75 | 49.0% |
| v | | | | | | | | | | |
| Mid-Late Release | 8 | 10.3% | 6 | 7.7% | 6 | 7.7% | 58 | 74.4% | 78 | 51.0% |

TABLE 4.4: TRAVEL TIMES TO BENCHMARK LOCATIONS BY RELEASE LOCATION AND MOVEMENT CLASSIFICATION, SPRING 2012.

| Travel time to Tailrace by movement classification (Days-hr:min:sec) | Travel time to EFL by movement classification (Days-hr:min:sec) | Travel time to Passage by movement classification (Days-hr:min:sec) |
|--|---|--|
| <u>Passage Shad averages</u> 17 Early - Mid 07-19:21:15 Mid - Late 02-22:03:07 All Fish Passage 06-04:05:07 | <u>Passage Shad averages</u> 17 Early - Mid 13-16:10:10 Mid - Late 17-04:59:55 All Fish Passage 15-08:05:21 | <u>Passage Shad averages</u> 17 Early - Mid 13-16:10:10 Mid - Late 17-04:59:55 All Fish Passage 15-08:05:21 |
| <u>Non-Passage Shad (In EFL)</u> 12 Early - Mid 01-15:18:38 Mid - Late 05-16:45:14 All Fish Forays without passage 03-16:01:56 | <u>Non-Passage Shad (In EFL)</u> 12 Early - Mid 24-03:29:37 Mid - Late 14-09:38:28 All Fish Forays without passage 19-06:34:03 | |
| <u>Non-EFL Shad (In Tailrace)</u> 37 Early - Mid 06-17:00:21 Mid - Late 07-11:54:14 All Tailrace Fish without foray 06-20:04:13 | | |

| Overall Travel time to Tailrace (Days-hr:min:sec) | Overall Travel time to EFL (Days-hr:min:sec) | Overall Travel time to Passage (Days-hr:min:sec) |
|---|--|--|
| 66 Overall average travel time to tailrace 06-02:07:40 | 29 Overall average travel time to EFL 16-23:11:01 | 17 Overall average travel time to passage 12-22:40:42 |
| 46 Early - Mid travel time to tailrace 06-06:17:16 | 15 Early - Mid travel time to EFL 17-20:41:57 | 9 Early - Mid travel time to passage 13-16:10:10 |
| 20 Mid - Late travel time to tailrace 05-16:33:37 | 14 Mid - Late travel time to EFL 16-00:07:52 | 8 Mid - Late travel time to passage 17-04:59:55 |

TABLE 4.5: FORAY DURATIONS FOR BOTH SUCCESSFUL AND UNSUCCESSFUL FORAYS, SPRING 2012.

| EFL Foray Resulting in Successful Passage | | |
|--|---------------------------|---------------------------|
| Number of Forays | Foray Durations | |
| 17 | (Hr:min:sec) | |
| Min | 00:11:31 | |
| Median | 00:24:38 | |
| Average | 00:43:10 | |
| Max | 05:39:29 | |
| | | |
| EFL Foray Resulting in Unsuccessful Passage (Shad Later Passed) | | |
| Number of Forays | Foray Durations | |
| 12 | (Hr:min:sec) | |
| Min | 00:02:16 | |
| Median | 00:35:51 | |
| Average | 01:15:33 | |
| Max | 05:37:42 | |
| | | |
| EFL Foray Resulting in Unsuccessful Passage (Shad Never Passed) | | |
| Number of Forays | Foray Durations | |
| 20 | (Hr:min:sec) | |
| Min | 00:01:30 | |
| Median | 00:13:36 | |
| Average | 00:49:57 | |
| Max | 06:25:24 | |
| | | |
| Total Forays | | |
| Total Number of Forays | Successful | Unsuccessful |
| 49 | 17 34.7% | 32 65.3% |
| | | |
| Total Number of Fish | | |
| Fish | Successful Foray | Unsuccessful Foray |
| 29 | 17 58.6% | 12 41.4% |

TABLE 4.6: TURBINE-OPERATING COMBINATIONS DURING EFL OPERATIONS, SPRING 2012.

| Turbine Operating Combinations | | Percentage of Time Turbine Operating Combination Occurred | | Number of Fish Passed | Percentage of Fish Passed (N=17) | Forays Made into EFL |
|--------------------------------|---------------------|---|--------------|-----------------------|----------------------------------|----------------------|
| Francis Units | Kaplan Units | Weir Gate A Operating | | | | |
| 1 | 0 | 1 | 0.2% | 0 | 0.0% | 0 |
| 2 | 0 | 161.5 | 25.5% | 7 | 41.2% | 13 |
| 2 | 1 | 10.5 | 1.7% | 0 | 0.0% | 0 |
| 3 | 0 | 36.5 | 5.8% | 0 | 0.0% | 0 |
| 4 | 0 | 13.5 | 2.1% | 0 | 0.0% | 0 |
| 4 | 1 | 8 | 1.3% | 0 | 0.0% | 0 |
| Subtotal | | 231 | 36.5% | | 41.2% | |
| Francis Units | Kaplan Units | Weir Gate C Operating | | | | |
| 4 | 1 | 22 | 3.5% | 0 | 0.0% | 0 |
| 4 | 2 | 39.5 | 6.2% | 2 | 11.8% | 4 |
| 4 | 3 | 34.5 | 5.4% | 1 | 5.9% | 5 |
| 4 | 4 | 12 | 1.9% | 0 | 0.0% | 1 |
| 5 | 2 | 1 | 0.2% | 0 | 0.0% | 0 |
| 5 | 4 | 5 | 0.8% | 0 | 0.0% | 0 |
| 6 | 1 | 1 | 0.2% | 0 | 0.0% | 0 |
| 6 | 2 | 1 | 0.2% | 0 | 0.0% | 0 |
| 6 | 3 | 21 | 3.3% | 0 | 0.0% | 3 |
| 6 | 4 | 40 | 6.3% | 1 | 5.9% | 4 |
| 7 | 1 | 8 | 1.3% | 0 | 0.0% | 0 |
| 7 | 3 | 12 | 1.9% | 0 | 0.0% | 0 |
| 7 | 4 | 205.5 | 32.4% | 6 | 35.3% | 19 |
| Subtotal | | 402.5 | 63.5% | | 58.8% | |

TABLE 4.7: SHAD COUNT AND PERCENTAGE ON NON-TAILRACE MONITORS BY MOVEMENT CLASSIFICATIONS, SPRING 2012.

| | | Lower River | | | | Rowland | East Spillway | |
|---|------------|-------------|------------|--------------|-------------|---------|---------------|-------|
| | | Mudd Is. | Crab House | McGibney Is. | Spencer Is. | Island | East | West |
| Passage Shad N = 17 | Count | 17 | 11 | 11 | 12 | 17 | 8 | 6 |
| | Percentage | 100.0% | 64.7% | 64.7% | 70.6% | 100.0% | 47.1% | 35.3% |
| Non-Passage Shad (In EFL) N = 12 | Count | 12 | 11 | 11 | 11 | 12 | 7 | 2 |
| | Percentage | 100.0% | 91.7% | 91.7% | 91.7% | 100.0% | 58.3% | 16.7% |
| Non-EFL Shad (In Tailrace) N = 37 | Count | 35 | 35 | 31 | 31 | 37 | 3 | 2 |
| | Percentage | 94.6% | 94.6% | 83.8% | 83.8% | 100.0% | 8.1% | 5.4% |
| Non-tailrace Shad N = 87 | Count | 70 | 66 | 47 | 60 | 0 | 4 | 0 |
| | Percentage | 80.5% | 75.9% | 54.0% | 69.0% | 0.0% | 4.6% | 0.0% |
| Combined Total N = 153 | Count | 134 | 123 | 100 | 114 | 66 | 22 | 10 |
| | Percentage | 87.6% | 80.4% | 65.4% | 74.5% | 43.1% | 14.4% | 6.5% |

TABLE 4.8: SUMMARY OF THE 57 RADIO-TAGGED AMERICAN SHAD WHICH EXHIBITED UPSTREAM MOVEMENTS DURING 2012.

| Fish | Trips | Between | | Average ¹ Trip | | Average ¹ Speed | |
|--------------|-------|---------|------|---------------------------|-----------|----------------------------|------|
| | | Date | Date | Distance (mi) | Time (hr) | mph | fps |
| 21-13 | 2 | 4/17 | 4/20 | 1.5 | 0.64 | 2.21 | 3.24 |
| 21-14 | 14 | 4/13 | 5/17 | 1.2 | 1.96 | 0.65 | 0.95 |
| 21-16 | 15 | 4/16 | 5/13 | 1.1 | 2.41 | 0.92 | 1.34 |
| 21-18 | 5 | 4/15 | 5/2 | 0.9 | 3.41 | 0.52 | 0.76 |
| 21-21 | 7 | 4/20 | 5/9 | 0.8 | 0.89 | 1.65 | 2.42 |
| 21-23 | 3 | 4/15 | 5/1 | 1.6 | 2.56 | 0.81 | 1.19 |
| 21-25 | 4 | 4/30 | 5/10 | 2.9 | 3.67 | 0.99 | 1.45 |
| 21-27 | 4 | 4/17 | 4/25 | 1.0 | 3.82 | 2.97 | 4.36 |
| 21-36 | 1 | 5/3 | | 0.9 | 6.73 | 0.13 | 0.19 |
| 21-37 | 25 | 5/5 | 5/17 | 1.1 | 1.93 | 0.76 | 1.11 |
| 21-39 | 6 | 5/2 | 5/12 | 0.6 | 1.38 | 1.13 | 1.66 |
| 21-41 | 14 | 5/5 | 5/23 | 1.9 | 2.35 | 0.87 | 1.27 |
| 21-43 | 12 | 5/7 | 5/28 | 1.1 | 1.38 | 1.06 | 1.56 |
| 21-46 | 3 | 5/17 | 5/20 | 3.0 | 3.43 | 1.11 | 1.62 |
| 21-52 | 3 | 5/23 | 5/25 | 2.2 | 2.79 | 0.78 | 1.15 |
| 21-64 | 3 | 5/12 | 5/15 | 2.2 | 3.72 | 0.63 | 0.92 |
| 21-66 | 6 | 5/2 | 5/17 | 1.7 | 2.28 | 0.85 | 1.24 |
| 21-68 | 4 | 5/7 | 5/9 | 1.4 | 2.09 | 1.05 | 1.54 |
| 21-72 | 11 | 5/10 | 5/14 | 1.2 | 1.43 | 1.61 | 2.36 |
| 21-73 | 1 | 4/18 | | 0.9 | 1.08 | 0.80 | 1.17 |
| 21-74 | 2 | 5/3 | 5/6 | 2.0 | 2.45 | 1.00 | 1.47 |
| 21-75 | 7 | 5/1 | 5/4 | 0.7 | 1.03 | 0.71 | 1.04 |
| 21-77 | 10 | 4/20 | 4/24 | 0.6 | 0.97 | 1.26 | 1.84 |
| 21-80 | 1 | 4/19 | | 1.7 | 6.87 | 0.24 | 0.36 |
| 21-81 | 3 | 5/2 | 5/5 | 1.4 | 1.30 | 1.31 | 1.92 |
| 21-85 | 3 | 4/20 | 4/22 | 1.6 | 4.06 | 0.46 | 0.67 |
| 21-87 | 18 | 4/22 | 5/17 | 0.8 | 1.67 | 0.76 | 1.11 |
| 21-89 | 4 | 5/26 | 5/27 | 1.2 | 0.68 | 2.81 | 4.12 |
| 54-12 | 5 | 4/24 | 4/27 | 1.8 | 2.00 | 0.63 | 0.93 |
| 54-13 | 13 | 4/15 | 5/18 | 1.1 | 1.76 | 1.31 | 1.92 |
| 54-14 | 2 | 4/25 | 4/26 | 2.0 | 2.97 | 2.00 | 2.93 |
| 54-15 | 25 | 4/18 | 5/16 | 0.9 | 0.95 | 1.26 | 1.85 |
| 54-17 | 3 | 4/27 | 5/5 | 2.4 | 2.51 | 0.99 | 1.45 |
| 54-18 | 17 | 4/21 | 5/16 | 1.3 | 2.57 | 1.20 | 1.75 |
| 54-20 | 1 | 4/26 | | 2.4 | 2.80 | 0.86 | 1.27 |
| 54-21 | 8 | 4/23 | 5/18 | 1.2 | 1.93 | 0.54 | 0.80 |

| Fish | Trips | Between | | Average ¹ Trip | | Average ¹ Speed | |
|---------------|--------------|----------------|---------------|---------------------------|----------------------|----------------------------|------------|
| | | Date | Date | Distance (mi) | Time (hr) | mph | fps |
| 54-24 | 47 | 4/15 | 5/18 | 0.9 | 1.12 | 1.14 | 1.68 |
| 54-27 | 1 | 4/18 | | 0.9 | 0.99 | 0.88 | 1.29 |
| 54-28 | 2 | 4/15 | 4/16 | 0.9 | 1.76 | 0.74 | 1.08 |
| 54-30 | 12 | 4/17 | 5/6 | 0.7 | 1.17 | 0.71 | 1.04 |
| 54-32 | 2 | 5/4 | 5/5 | 2.2 | 3.72 | 0.67 | 0.99 |
| 54-34 | 1 | 4/18 | | 0.9 | 1.96 | 0.44 | 0.65 |
| 54-36 | 16 | 4/24 | 5/9 | 0.6 | 0.90 | 0.55 | 0.81 |
| 54-39 | 26 | 4/26 | 5/27 | 1.1 | 1.22 | 1.03 | 1.52 |
| 54-42 | 10 | 5/3 | 5/9 | 1.0 | 0.93 | 1.48 | 2.16 |
| 54-43 | 1 | 5/2 | | 3.2 | 4.83 | 0.67 | 0.98 |
| 54-44 | 6 | 4/20 | 4/29 | 0.7 | 2.26 | 0.76 | 1.11 |
| 54-45 | 4 | 4/28 | 5/1 | 1.4 | 2.56 | 0.42 | 0.62 |
| 54-50 | 5 | 5/23 | 5/26 | 1.4 | 1.19 | 2.82 | 4.13 |
| 54-65 | 10 | 5/25 | 5/31 | 0.9 | 1.12 | 1.27 | 1.86 |
| 54-71 | 17 | 5/9 | 5/17 | 1.5 | 1.40 | 1.31 | 1.92 |
| 54-73 | 12 | 5/15 | 5/24 | 1.9 | 1.45 | 1.97 | 2.88 |
| 54-79 | 32 | 5/3 | 5/21 | 0.9 | 0.93 | 1.51 | 2.21 |
| 54-80 | 7 | 5/9 | 5/14 | 1.3 | 1.16 | 1.05 | 1.54 |
| 54-81 | 21 | 5/8 | 5/29 | 1.1 | 1.47 | 1.44 | 2.11 |
| 54-89 | 16 | 5/6 | 5/20 | 1.0 | 1.09 | 1.19 | 1.74 |
| 54-90 | 18 | 5/6 | 5/29 | 1.4 | 1.50 | 1.00 | 1.46 |
| | | | | | | | |
| Totals | | Between | | Trip² | | Speed² | |
| Fish | Trips | Date | Date | Distance (mi) | Time (hr) | mph | fps |
| 57 | 531 | 4/13 | 5/31 | | | | |
| | | | Min | 0.1 | 0.07 | 0.09 | 0.13 |
| | | | Mean | 1.2 | 1.61 | 1.13 | 1.65 |
| | | | Median | 0.9 | 0.93 | 0.84 | 1.24 |
| | | | Max | 4.9 | 20.78 | 8.28 | 12.15 |

1 - Average for fish with two or more trips.

2 - Actual values derived from all 531 upstream forays.

Bold, italics - Shure's Landing released fish.

TABLE 4.9: LISTING OF ALL UPSTREAM FORAYS BY RADIO-TAGGED AMERICAN SHAD WHICH EXHIBITED UPSTREAM MOVEMENTS DURING 2012, SORTED BY TIME.

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|-------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-18 | 4/15 | 15:23 | 0.1 | 0.07 | 1.35 | 1.98 | 11590 | 11590 | 11590 |
| 54-18 | 4/23 | 19:09 | 0.3 | 0.08 | 3.95 | 5.80 | 50470 | 50470 | 50470 |
| 54-71 | 5/12 | 7:36 | 0.2 | 0.10 | 2.47 | 3.63 | 75360 | 75360 | 75360 |
| 54-81 | 5/15 | 8:38 | 0.2 | 0.10 | 2.40 | 3.51 | 60430 | 60430 | 60430 |
| 21-77 | 4/22 | 13:23 | 0.2 | 0.10 | 2.37 | 3.47 | 11330 | 11330 | 11330 |
| 54-79 | 5/8 | 4:29 | 0.8 | 0.10 | 7.67 | 11.24 | 10580 | 10580 | 10580 |
| 54-81 | 5/16 | 6:34 | 0.8 | 0.12 | 6.62 | 9.71 | 77520 | 77520 | 77520 |
| 54-13 | 5/5 | 4:53 | 0.8 | 0.12 | 6.51 | 9.55 | 10450 | 10450 | 10450 |
| 54-15 | 5/7 | 6:36 | 0.2 | 0.12 | 1.99 | 2.92 | 58990 | 58990 | 58990 |
| 54-50 | 5/25 | 6:23 | 0.9 | 0.12 | 7.28 | 10.68 | 10610 | 10610 | 10610 |
| 54-81 | 5/13 | 6:38 | 0.2 | 0.12 | 1.92 | 2.82 | 10370 | 10370 | 10370 |
| 54-90 | 5/29 | 5:12 | 0.2 | 0.12 | 1.91 | 2.80 | 10500 | 10500 | 10500 |
| 54-81 | 5/25 | 6:01 | 0.2 | 0.13 | 1.86 | 2.73 | 10610 | 10610 | 10610 |
| 21-72 | 5/13 | 5:33 | 0.9 | 0.13 | 6.73 | 9.88 | 10370 | 10370 | 10370 |
| 54-79 | 5/21 | 8:38 | 0.2 | 0.13 | 1.80 | 2.64 | 31560 | 31560 | 31560 |
| 21-21 | 5/1 | 1:46 | 0.8 | 0.13 | 5.79 | 8.49 | 10520 | 10520 | 10520 |
| 21-27 | 4/25 | 4:27 | 1.1 | 0.13 | 8.28 | 12.15 | 11290 | 11290 | 11290 |
| 21-89 | 5/26 | 21:36 | 0.9 | 0.13 | 6.43 | 9.43 | 22560 | 22560 | 22560 |
| 54-79 | 5/6 | 4:02 | 0.8 | 0.14 | 5.52 | 8.10 | 10530 | 10530 | 10530 |
| 54-79 | 5/16 | 6:13 | 0.2 | 0.14 | 1.69 | 2.47 | 59510 | 71517 | 77520 |
| 54-73 | 5/24 | 5:02 | 0.9 | 0.15 | 5.87 | 8.61 | 10740 | 10740 | 10740 |
| 21-89 | 5/26 | 22:19 | 0.3 | 0.15 | 1.91 | 2.80 | 22560 | 22560 | 22560 |
| 21-46 | 5/17 | 18:28 | 0.2 | 0.15 | 1.55 | 2.27 | 78780 | 78780 | 78780 |
| 54-24 | 4/19 | 6:32 | 0.2 | 0.15 | 1.53 | 2.25 | 11240 | 11240 | 11260 |
| 54-24 | 5/11 | 7:32 | 0.2 | 0.17 | 1.40 | 2.06 | 74540 | 74540 | 74540 |
| 54-39 | 5/6 | 23:25 | 0.9 | 0.17 | 5.06 | 7.42 | 10530 | 10530 | 10530 |
| 21-77 | 4/20 | 4:10 | 0.9 | 0.18 | 4.89 | 7.17 | 11450 | 11450 | 11450 |
| 21-39 | 5/8 | 20:46 | 0.8 | 0.19 | 3.99 | 5.85 | 43420 | 43420 | 43420 |
| 21-21 | 4/25 | 17:08 | 0.2 | 0.20 | 0.95 | 1.40 | 11290 | 11290 | 11290 |
| 21-89 | 5/27 | 7:23 | 0.3 | 0.20 | 1.46 | 2.14 | 9200 | 9200 | 9200 |
| 21-14 | 4/21 | 19:46 | 0.2 | 0.20 | 1.19 | 1.75 | 18160 | 26757 | 32130 |
| 54-73 | 5/24 | 5:44 | 0.3 | 0.20 | 1.49 | 2.19 | 10740 | 10740 | 10740 |
| 21-72 | 5/14 | 6:56 | 0.3 | 0.20 | 1.39 | 2.04 | 39590 | 39590 | 39590 |
| 54-15 | 5/12 | 9:36 | 0.2 | 0.21 | 1.14 | 1.67 | 75360 | 75360 | 75360 |
| 54-65 | 5/28 | 5:43 | 0.9 | 0.21 | 4.18 | 6.14 | 10600 | 10600 | 10600 |
| 21-43 | 5/28 | 7:43 | 0.2 | 0.21 | 1.13 | 1.66 | 10600 | 10600 | 10600 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-65 | 5/27 | 12:10 | 0.2 | 0.21 | 1.13 | 1.65 | 9200 | 9200 | 9200 |
| 21-16 | 5/10 | 13:30 | 0.2 | 0.22 | 1.09 | 1.60 | 74890 | 74890 | 74890 |
| 54-13 | 5/5 | 6:34 | 0.5 | 0.22 | 2.10 | 3.08 | 10450 | 10450 | 10450 |
| 54-79 | 5/14 | 5:33 | 0.2 | 0.22 | 1.06 | 1.55 | 10980 | 10980 | 10980 |
| 54-24 | 4/21 | 7:06 | 0.9 | 0.23 | 3.85 | 5.65 | 11980 | 11980 | 11980 |
| 54-15 | 5/15 | 17:51 | 0.9 | 0.23 | 3.84 | 5.64 | 74440 | 74440 | 74440 |
| 54-24 | 5/11 | 6:14 | 0.9 | 0.23 | 3.77 | 5.53 | 74540 | 74540 | 74540 |
| 21-87 | 5/15 | 7:39 | 0.2 | 0.24 | 0.99 | 1.46 | 18780 | 18780 | 18780 |
| 21-87 | 5/12 | 6:05 | 0.2 | 0.24 | 0.98 | 1.44 | 40670 | 40670 | 40670 |
| 54-18 | 4/26 | 23:14 | 0.3 | 0.24 | 1.23 | 1.80 | 11300 | 11300 | 11300 |
| 54-65 | 5/29 | 16:06 | 0.2 | 0.24 | 0.96 | 1.41 | 33820 | 33820 | 33820 |
| 54-24 | 4/15 | 18:09 | 0.2 | 0.24 | 0.96 | 1.41 | 32070 | 32070 | 32070 |
| 54-79 | 5/15 | 5:36 | 0.2 | 0.25 | 0.95 | 1.39 | 9930 | 9930 | 9930 |
| 54-24 | 4/18 | 10:09 | 0.2 | 0.25 | 0.95 | 1.39 | 11240 | 11240 | 11240 |
| 54-14 | 4/26 | 2:48 | 0.9 | 0.25 | 3.42 | 5.02 | 11300 | 11300 | 11300 |
| 54-24 | 4/16 | 1:57 | 0.8 | 0.27 | 2.89 | 4.24 | 11450 | 11450 | 11450 |
| 54-15 | 5/4 | 6:26 | 0.2 | 0.27 | 0.88 | 1.30 | 10210 | 10210 | 10210 |
| 54-15 | 5/10 | 8:56 | 0.2 | 0.27 | 0.88 | 1.30 | 74890 | 74890 | 74890 |
| 54-18 | 5/6 | 15:34 | 0.2 | 0.27 | 0.86 | 1.26 | 74680 | 74680 | 74680 |
| 54-39 | 5/27 | 7:16 | 0.2 | 0.27 | 0.86 | 1.26 | 9200 | 9200 | 9200 |
| 21-16 | 4/17 | 20:42 | 0.9 | 0.28 | 3.14 | 4.60 | 68720 | 68720 | 68720 |
| 21-37 | 5/15 | 17:27 | 0.2 | 0.28 | 0.84 | 1.24 | 74440 | 74440 | 74440 |
| 54-79 | 5/3 | 8:55 | 0.9 | 0.28 | 3.06 | 4.49 | 31740 | 31740 | 31740 |
| 54-81 | 5/14 | 6:33 | 0.3 | 0.29 | 1.04 | 1.53 | 39590 | 39590 | 39590 |
| 54-79 | 5/17 | 11:36 | 0.2 | 0.29 | 0.81 | 1.18 | 78780 | 78780 | 78780 |
| 54-81 | 5/8 | 5:44 | 0.8 | 0.29 | 2.75 | 4.04 | 10580 | 14302 | 34150 |
| 54-90 | 5/19 | 5:32 | 0.9 | 0.29 | 2.96 | 4.34 | 69520 | 69520 | 69520 |
| 54-39 | 5/22 | 7:35 | 0.2 | 0.29 | 0.80 | 1.17 | 10030 | 10030 | 10030 |
| 54-24 | 4/20 | 15:56 | 0.2 | 0.30 | 0.80 | 1.17 | 11450 | 11450 | 11450 |
| 54-71 | 5/15 | 5:27 | 0.9 | 0.30 | 2.91 | 4.27 | 9930 | 9930 | 9930 |
| 54-39 | 5/14 | 6:28 | 0.2 | 0.30 | 0.79 | 1.16 | 39590 | 39590 | 39590 |
| 54-39 | 5/25 | 9:26 | 0.2 | 0.30 | 0.77 | 1.13 | 10610 | 10610 | 10610 |
| 54-24 | 5/12 | 5:43 | 0.2 | 0.31 | 0.76 | 1.12 | 40670 | 40670 | 40670 |
| 54-24 | 5/1 | 5:39 | 0.2 | 0.31 | 0.76 | 1.12 | 10520 | 10520 | 10520 |
| 54-15 | 5/9 | 15:00 | 0.3 | 0.31 | 0.96 | 1.40 | 69250 | 69250 | 69250 |
| 54-42 | 5/3 | 13:59 | 1.6 | 0.32 | 5.06 | 7.43 | 41020 | 41020 | 41020 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-50 | 5/26 | 6:12 | 0.9 | 0.32 | 2.72 | 4.00 | 10480 | 10480 | 10480 |
| 21-14 | 5/9 | 19:12 | 0.3 | 0.33 | 0.91 | 1.34 | 49660 | 49660 | 49660 |
| 54-89 | 5/19 | 9:48 | 0.9 | 0.33 | 2.63 | 3.86 | 69520 | 69520 | 69520 |
| 21-27 | 4/23 | 7:44 | 1.1 | 0.33 | 3.36 | 4.93 | 22760 | 22760 | 22760 |
| 54-24 | 4/18 | 13:50 | 0.2 | 0.34 | 0.70 | 1.02 | 11240 | 11240 | 11240 |
| 21-77 | 4/20 | 11:36 | 0.2 | 0.34 | 0.69 | 1.02 | 11450 | 11450 | 11450 |
| 54-24 | 5/10 | 5:35 | 0.9 | 0.34 | 2.56 | 3.75 | 30840 | 30840 | 30840 |
| 21-87 | 5/16 | 7:46 | 0.9 | 0.34 | 2.56 | 3.75 | 77520 | 77520 | 77520 |
| 54-18 | 4/25 | 18:45 | 0.2 | 0.34 | 0.69 | 1.01 | 23390 | 25824 | 41240 |
| 21-72 | 5/12 | 9:21 | 0.9 | 0.34 | 2.54 | 3.73 | 75360 | 75360 | 75360 |
| 54-79 | 5/18 | 6:06 | 0.3 | 0.34 | 0.86 | 1.27 | 69390 | 69390 | 69390 |
| 54-73 | 5/24 | 7:58 | 0.2 | 0.35 | 0.68 | 1.00 | 16800 | 16800 | 16800 |
| 54-44 | 4/20 | 1:53 | 0.8 | 0.35 | 2.19 | 3.21 | 11450 | 11450 | 11450 |
| 54-18 | 5/14 | 19:24 | 0.8 | 0.36 | 2.27 | 3.33 | 74830 | 74830 | 74830 |
| 54-36 | 5/9 | 18:21 | 0.3 | 0.36 | 0.84 | 1.22 | 49660 | 49660 | 49660 |
| 54-39 | 5/25 | 11:17 | 0.2 | 0.36 | 0.66 | 0.96 | 22730 | 22730 | 22730 |
| 54-24 | 5/4 | 5:50 | 0.2 | 0.37 | 0.64 | 0.94 | 10210 | 10210 | 10210 |
| 54-79 | 5/14 | 4:11 | 0.8 | 0.37 | 2.08 | 3.05 | 10980 | 10980 | 10980 |
| 54-36 | 5/6 | 18:27 | 0.2 | 0.38 | 0.62 | 0.91 | 74680 | 74680 | 74680 |
| 54-90 | 5/18 | 17:06 | 0.3 | 0.38 | 0.78 | 1.14 | 69390 | 69390 | 69390 |
| 54-79 | 5/16 | 5:38 | 0.9 | 0.38 | 2.26 | 3.31 | 50830 | 54447 | 59510 |
| 21-37 | 5/13 | 5:53 | 0.9 | 0.39 | 2.24 | 3.29 | 10370 | 10370 | 10370 |
| 21-87 | 5/15 | 5:34 | 0.9 | 0.39 | 2.24 | 3.29 | 9930 | 9930 | 9930 |
| 21-43 | 5/11 | 4:07 | 0.9 | 0.39 | 2.24 | 3.28 | 74540 | 74540 | 74540 |
| 21-41 | 5/20 | 9:15 | 0.2 | 0.39 | 0.60 | 0.88 | 40570 | 40570 | 40570 |
| 54-39 | 5/22 | 1:15 | 0.3 | 0.39 | 0.76 | 1.12 | 10030 | 10030 | 10030 |
| 54-15 | 5/2 | 21:53 | 0.9 | 0.39 | 2.21 | 3.23 | 16420 | 13026 | 10360 |
| 54-73 | 5/15 | 9:40 | 1.6 | 0.39 | 4.10 | 6.01 | 60430 | 60430 | 60430 |
| 54-24 | 4/18 | 4:58 | 1.0 | 0.40 | 2.50 | 3.67 | 12090 | 14372 | 23500 |
| 54-30 | 4/22 | 7:54 | 0.2 | 0.40 | 0.59 | 0.87 | 11330 | 11330 | 11330 |
| 54-24 | 5/11 | 23:09 | 0.9 | 0.40 | 2.17 | 3.18 | 39740 | 39740 | 39740 |
| 54-79 | 5/17 | 9:46 | 0.3 | 0.40 | 0.74 | 1.09 | 78780 | 78780 | 78780 |
| 54-65 | 5/30 | 8:12 | 0.2 | 0.40 | 0.59 | 0.86 | 16990 | 16990 | 16990 |
| 54-36 | 4/26 | 3:04 | 0.2 | 0.41 | 0.58 | 0.85 | 11300 | 11300 | 11300 |
| 21-14 | 4/23 | 14:55 | 0.2 | 0.41 | 0.58 | 0.85 | 23810 | 23810 | 23810 |
| 54-79 | 5/15 | 12:47 | 0.2 | 0.41 | 0.58 | 0.84 | 69110 | 69110 | 69110 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-24 | 4/20 | 14:20 | 0.9 | 0.41 | 2.10 | 3.08 | 11450 | 11450 | 11450 |
| 21-16 | 5/13 | 7:35 | 0.2 | 0.42 | 0.57 | 0.83 | 34240 | 34240 | 34240 |
| 21-16 | 5/9 | 5:54 | 0.8 | 0.42 | 1.85 | 2.71 | 22130 | 55065 | 57810 |
| 54-24 | 5/4 | 0:53 | 0.8 | 0.42 | 1.81 | 2.65 | 10210 | 10210 | 10210 |
| 54-79 | 5/16 | 16:34 | 0.2 | 0.43 | 0.55 | 0.81 | 77520 | 77520 | 77520 |
| 54-71 | 5/11 | 15:05 | 0.3 | 0.43 | 0.70 | 1.02 | 74540 | 74540 | 74540 |
| 54-42 | 5/3 | 18:14 | 0.9 | 0.43 | 2.03 | 2.98 | 58520 | 58520 | 58520 |
| 54-13 | 4/18 | 14:47 | 0.2 | 0.43 | 0.55 | 0.81 | 11240 | 11240 | 11240 |
| 54-18 | 5/14 | 10:47 | 0.8 | 0.43 | 1.88 | 2.75 | 74830 | 74830 | 74830 |
| 54-36 | 4/25 | 14:07 | 0.2 | 0.43 | 0.54 | 0.80 | 11290 | 11290 | 11290 |
| 54-39 | 5/21 | 13:52 | 0.3 | 0.43 | 0.69 | 1.01 | 65780 | 65780 | 65780 |
| 54-36 | 4/27 | 3:40 | 0.2 | 0.43 | 0.54 | 0.80 | 11530 | 11530 | 11530 |
| 54-73 | 5/22 | 17:54 | 1.1 | 0.43 | 2.55 | 3.74 | 55880 | 55880 | 55880 |
| 54-30 | 4/25 | 10:14 | 0.3 | 0.43 | 0.69 | 1.01 | 11290 | 11290 | 11290 |
| 54-89 | 5/10 | 15:11 | 0.8 | 0.43 | 1.77 | 2.60 | 74890 | 74890 | 74890 |
| 54-79 | 5/21 | 7:08 | 0.2 | 0.43 | 0.54 | 0.80 | 10670 | 10670 | 10670 |
| 54-36 | 4/24 | 16:15 | 0.2 | 0.44 | 0.54 | 0.79 | 11580 | 11580 | 11580 |
| 54-15 | 5/2 | 10:08 | 0.2 | 0.44 | 0.53 | 0.78 | 16420 | 16420 | 16420 |
| 21-72 | 5/13 | 8:28 | 0.2 | 0.44 | 0.53 | 0.78 | 75500 | 75500 | 75500 |
| 54-15 | 5/6 | 9:33 | 0.9 | 0.44 | 1.95 | 2.86 | 49210 | 49210 | 49210 |
| 54-15 | 5/13 | 7:31 | 0.2 | 0.45 | 0.53 | 0.78 | 34240 | 34240 | 34240 |
| 54-15 | 5/16 | 11:06 | 0.3 | 0.45 | 0.66 | 0.96 | 77520 | 77520 | 77520 |
| 54-71 | 5/12 | 10:03 | 0.3 | 0.46 | 0.65 | 0.95 | 75360 | 75360 | 75360 |
| 54-79 | 5/17 | 12:28 | 0.2 | 0.47 | 0.50 | 0.74 | 78780 | 78780 | 78780 |
| 54-24 | 4/16 | 14:42 | 0.3 | 0.47 | 0.63 | 0.93 | 32270 | 32270 | 32270 |
| 54-71 | 5/10 | 0:49 | 0.8 | 0.47 | 1.62 | 2.38 | 10860 | 10860 | 10860 |
| 54-21 | 4/28 | 17:53 | 0.2 | 0.47 | 0.50 | 0.73 | 31900 | 31900 | 31900 |
| 54-79 | 5/15 | 16:28 | 0.9 | 0.48 | 1.79 | 2.63 | 74440 | 74440 | 74440 |
| 54-18 | 5/13 | 19:03 | 0.8 | 0.49 | 1.66 | 2.44 | 75500 | 75500 | 75500 |
| 21-39 | 5/12 | 5:13 | 0.2 | 0.49 | 0.48 | 0.70 | 40670 | 40670 | 40670 |
| 54-79 | 5/16 | 8:47 | 0.2 | 0.50 | 0.47 | 0.70 | 77520 | 77520 | 77520 |
| 54-50 | 5/25 | 12:18 | 1.1 | 0.50 | 2.21 | 3.24 | 27610 | 27610 | 27610 |
| 54-79 | 5/12 | 5:46 | 1.6 | 0.50 | 3.21 | 4.71 | 40670 | 40670 | 40670 |
| 21-13 | 4/17 | 20:56 | 0.8 | 0.50 | 1.53 | 2.24 | 68720 | 56213 | 54360 |
| 54-44 | 4/25 | 23:49 | 0.3 | 0.50 | 0.59 | 0.87 | 11290 | 11297 | 11300 |
| 54-36 | 5/2 | 5:21 | 0.2 | 0.51 | 0.47 | 0.68 | 10360 | 10360 | 10360 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-43 | 5/13 | 7:06 | 0.9 | 0.51 | 1.70 | 2.49 | 10370 | 28273 | 34240 |
| 21-37 | 5/9 | 17:12 | 0.2 | 0.51 | 0.46 | 0.67 | 49660 | 49660 | 49660 |
| 54-90 | 5/13 | 4:36 | 1.0 | 0.52 | 1.91 | 2.80 | 10370 | 10370 | 10370 |
| 54-79 | 5/21 | 5:10 | 0.9 | 0.52 | 1.65 | 2.42 | 10670 | 10670 | 10670 |
| 54-30 | 4/23 | 2:16 | 0.8 | 0.53 | 1.45 | 2.13 | 11600 | 11600 | 11600 |
| 54-13 | 4/15 | 3:13 | 0.8 | 0.53 | 1.52 | 2.23 | 11410 | 11410 | 11410 |
| 54-13 | 5/5 | 5:14 | 0.5 | 0.53 | 0.88 | 1.29 | 10450 | 10450 | 10450 |
| 54-81 | 5/14 | 3:05 | 0.8 | 0.53 | 1.44 | 2.11 | 10980 | 10980 | 10980 |
| 54-18 | 4/23 | 15:42 | 0.9 | 0.54 | 1.61 | 2.36 | 41700 | 41700 | 41700 |
| 54-39 | 5/24 | 15:09 | 0.2 | 0.54 | 0.43 | 0.63 | 33100 | 33100 | 33100 |
| 54-15 | 5/16 | 5:16 | 0.9 | 0.55 | 1.59 | 2.34 | 50830 | 50830 | 50830 |
| 54-24 | 5/1 | 12:14 | 0.9 | 0.55 | 1.59 | 2.33 | 16610 | 16610 | 16610 |
| 54-39 | 5/14 | 2:47 | 0.8 | 0.56 | 1.38 | 2.03 | 10980 | 10980 | 10980 |
| 54-15 | 5/13 | 5:38 | 0.9 | 0.56 | 1.56 | 2.29 | 10370 | 10370 | 10370 |
| 54-24 | 4/22 | 0:35 | 1.6 | 0.56 | 2.87 | 4.20 | 11330 | 11330 | 11330 |
| 21-37 | 5/12 | 6:00 | 0.9 | 0.56 | 1.54 | 2.26 | 40670 | 40670 | 40670 |
| 54-24 | 5/2 | 6:45 | 0.2 | 0.56 | 0.42 | 0.61 | 31200 | 31200 | 31200 |
| 54-81 | 5/13 | 5:08 | 0.2 | 0.57 | 0.39 | 0.58 | 10370 | 10370 | 10370 |
| 54-89 | 5/8 | 6:32 | 0.8 | 0.57 | 1.35 | 1.98 | 34150 | 39554 | 61170 |
| 21-25 | 5/2 | 4:20 | 0.9 | 0.57 | 1.53 | 2.24 | 10360 | 10360 | 10360 |
| 54-79 | 5/3 | 16:18 | 0.3 | 0.57 | 0.52 | 0.76 | 58520 | 58520 | 58520 |
| 54-12 | 4/25 | 15:52 | 0.2 | 0.58 | 0.41 | 0.60 | 11290 | 11290 | 11290 |
| 54-36 | 5/9 | 14:44 | 0.2 | 0.58 | 0.41 | 0.60 | 69250 | 69250 | 69250 |
| 54-36 | 4/28 | 12:36 | 0.3 | 0.58 | 0.51 | 0.75 | 11500 | 11500 | 11500 |
| 54-39 | 4/28 | 13:51 | 0.3 | 0.58 | 0.51 | 0.75 | 11500 | 11500 | 11500 |
| 54-30 | 4/21 | 3:36 | 0.8 | 0.58 | 1.32 | 1.93 | 11980 | 11980 | 11980 |
| 21-14 | 5/10 | 6:54 | 0.2 | 0.59 | 0.40 | 0.59 | 74890 | 74890 | 74890 |
| 21-41 | 5/12 | 10:47 | 0.9 | 0.59 | 1.47 | 2.16 | 75360 | 75360 | 75360 |
| 54-42 | 5/7 | 8:41 | 0.2 | 0.59 | 0.40 | 0.58 | 58990 | 66827 | 75100 |
| 54-24 | 4/24 | 9:05 | 0.9 | 0.60 | 1.46 | 2.14 | 41430 | 41430 | 41430 |
| 54-71 | 5/14 | 5:55 | 0.9 | 0.60 | 1.45 | 2.12 | 10980 | 37270 | 39590 |
| 54-89 | 5/12 | 5:59 | 0.9 | 0.60 | 1.44 | 2.12 | 40670 | 40670 | 40670 |
| 54-80 | 5/10 | 9:51 | 0.2 | 0.60 | 0.39 | 0.57 | 74890 | 74890 | 74890 |
| 21-77 | 4/22 | 5:14 | 0.9 | 0.60 | 1.43 | 2.10 | 11330 | 11330 | 11330 |
| 21-75 | 5/3 | 8:57 | 0.2 | 0.61 | 0.39 | 0.57 | 31740 | 31740 | 31740 |
| 54-15 | 5/14 | 10:52 | 1.6 | 0.61 | 2.64 | 3.87 | 74830 | 74830 | 74830 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-39 | 5/2 | 0:37 | 1.0 | 0.61 | 1.62 | 2.37 | 10360 | 10360 | 10360 |
| 54-24 | 4/25 | 5:42 | 0.9 | 0.62 | 1.41 | 2.07 | 32190 | 32190 | 32190 |
| 54-71 | 5/10 | 15:36 | 0.9 | 0.62 | 1.41 | 2.07 | 74890 | 74890 | 74890 |
| 54-90 | 5/14 | 10:06 | 0.3 | 0.62 | 0.48 | 0.71 | 74830 | 74830 | 74830 |
| 54-81 | 5/15 | 5:20 | 1.2 | 0.62 | 1.99 | 2.92 | 9930 | 9930 | 9930 |
| 54-81 | 5/20 | 7:26 | 1.1 | 0.63 | 1.76 | 2.59 | 22610 | 22610 | 22610 |
| 54-71 | 5/11 | 23:18 | 1.6 | 0.63 | 2.56 | 3.76 | 39740 | 39740 | 39740 |
| 54-73 | 5/16 | 5:11 | 1.1 | 0.63 | 1.75 | 2.57 | 50830 | 50830 | 50830 |
| 21-21 | 5/2 | 22:45 | 0.8 | 0.63 | 1.21 | 1.78 | 10360 | 10360 | 10360 |
| 54-65 | 5/29 | 5:32 | 0.9 | 0.64 | 1.36 | 1.99 | 10500 | 10500 | 10500 |
| 21-23 | 4/15 | 5:28 | 0.8 | 0.64 | 1.26 | 1.85 | 11410 | 11410 | 11410 |
| 21-77 | 4/24 | 10:05 | 0.2 | 0.64 | 0.37 | 0.54 | 11580 | 11580 | 11580 |
| 54-39 | 5/24 | 4:32 | 1.6 | 0.64 | 2.50 | 3.67 | 10740 | 10740 | 10740 |
| 54-39 | 5/7 | 5:55 | 0.2 | 0.65 | 0.36 | 0.53 | 32830 | 55720 | 58990 |
| 54-79 | 5/14 | 10:15 | 1.1 | 0.65 | 1.70 | 2.49 | 74830 | 74830 | 74830 |
| 21-66 | 5/2 | 22:06 | 1.1 | 0.66 | 1.61 | 2.36 | 10360 | 10360 | 10360 |
| 54-36 | 4/28 | 7:11 | 0.2 | 0.66 | 0.36 | 0.52 | 63520 | 63520 | 63520 |
| 21-21 | 5/9 | 6:47 | 1.1 | 0.67 | 1.68 | 2.46 | 57810 | 60260 | 60600 |
| 54-45 | 4/29 | 18:49 | 0.2 | 0.67 | 0.35 | 0.52 | 32260 | 49827 | 75080 |
| 21-14 | 4/19 | 23:28 | 0.9 | 0.67 | 1.29 | 1.89 | 11260 | 11027 | 11450 |
| 54-36 | 5/6 | 4:59 | 0.2 | 0.67 | 0.35 | 0.51 | 10530 | 10530 | 10530 |
| 21-77 | 4/21 | 13:04 | 0.2 | 0.68 | 0.35 | 0.51 | 11980 | 11980 | 11980 |
| 54-42 | 5/7 | 5:14 | 0.9 | 0.69 | 1.26 | 1.84 | 32830 | 32830 | 32830 |
| 54-65 | 5/27 | 8:36 | 0.9 | 0.69 | 1.25 | 1.84 | 9200 | 9200 | 9200 |
| 54-24 | 4/30 | 14:04 | 0.2 | 0.70 | 0.34 | 0.50 | 23600 | 23600 | 23600 |
| 54-24 | 4/17 | 16:25 | 0.2 | 0.70 | 0.34 | 0.50 | 11330 | 11330 | 11330 |
| 21-43 | 5/14 | 5:54 | 1.1 | 0.70 | 1.58 | 2.31 | 10980 | 36929 | 39590 |
| 54-81 | 5/14 | 5:43 | 0.2 | 0.70 | 0.32 | 0.47 | 10980 | 29610 | 39590 |
| 54-24 | 4/19 | 14:14 | 0.2 | 0.70 | 0.34 | 0.49 | 11260 | 11260 | 11260 |
| 21-74 | 5/6 | 2:22 | 0.9 | 0.70 | 1.24 | 1.82 | 10530 | 10530 | 10530 |
| 21-37 | 5/17 | 5:32 | 0.9 | 0.71 | 1.23 | 1.80 | 78780 | 78780 | 78780 |
| 54-89 | 5/7 | 8:43 | 0.9 | 0.71 | 1.22 | 1.79 | 58990 | 68731 | 75100 |
| 21-16 | 4/16 | 4:34 | 1.2 | 0.71 | 1.75 | 2.56 | 11450 | 11450 | 11450 |
| 54-36 | 4/24 | 11:56 | 0.2 | 0.71 | 0.33 | 0.48 | 11580 | 11580 | 11580 |
| 54-30 | 4/17 | 13:27 | 0.2 | 0.71 | 0.33 | 0.48 | 11330 | 11330 | 11330 |
| 54-81 | 5/11 | 7:22 | 0.5 | 0.73 | 0.64 | 0.94 | 74540 | 74540 | 74540 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-13 | 4/17 | 8:08 | 0.2 | 0.73 | 0.32 | 0.47 | 17350 | 17350 | 17350 |
| 54-89 | 5/15 | 5:50 | 1.1 | 0.73 | 1.51 | 2.22 | 9930 | 9930 | 9930 |
| 21-14 | 4/15 | 18:49 | 0.3 | 0.73 | 0.41 | 0.60 | 32070 | 32070 | 32070 |
| 54-12 | 4/25 | 3:39 | 0.2 | 0.73 | 0.32 | 0.47 | 11290 | 11290 | 11290 |
| 21-37 | 5/12 | 9:12 | 0.9 | 0.74 | 1.18 | 1.73 | 75360 | 75360 | 75360 |
| 54-24 | 4/23 | 7:06 | 1.1 | 0.74 | 1.49 | 2.18 | 22760 | 22760 | 22760 |
| 54-28 | 4/15 | 11:37 | 0.9 | 0.74 | 1.17 | 1.71 | 11590 | 11590 | 11590 |
| 54-30 | 4/18 | 14:17 | 0.2 | 0.75 | 0.31 | 0.46 | 11240 | 11240 | 11240 |
| 54-24 | 5/4 | 3:57 | 0.5 | 0.75 | 0.62 | 0.91 | 10210 | 10210 | 10210 |
| 21-37 | 5/13 | 7:35 | 0.2 | 0.75 | 0.31 | 0.46 | 34240 | 45900 | 75500 |
| 21-81 | 5/2 | 19:24 | 1.6 | 0.75 | 2.15 | 3.15 | 68300 | 68300 | 68300 |
| 21-87 | 5/17 | 6:11 | 0.9 | 0.75 | 1.15 | 1.69 | 78780 | 78780 | 78780 |
| 54-89 | 5/11 | 7:05 | 0.9 | 0.76 | 1.15 | 1.68 | 74540 | 74540 | 74540 |
| 54-24 | 5/12 | 9:49 | 0.9 | 0.76 | 1.15 | 1.68 | 75360 | 75360 | 75360 |
| 54-81 | 5/24 | 6:00 | 1.1 | 0.76 | 1.45 | 2.12 | 10740 | 16668 | 16800 |
| 21-72 | 5/13 | 14:25 | 0.9 | 0.76 | 1.14 | 1.67 | 75500 | 75500 | 75500 |
| 54-79 | 5/10 | 17:18 | 0.9 | 0.77 | 1.13 | 1.65 | 74890 | 74890 | 74890 |
| 21-13 | 4/20 | 21:41 | 2.2 | 0.77 | 2.89 | 4.23 | 31460 | 23173 | 17550 |
| 54-24 | 4/19 | 7:59 | 0.3 | 0.78 | 0.38 | 0.56 | 11240 | 11260 | 11260 |
| 54-80 | 5/10 | 7:59 | 1.0 | 0.78 | 1.28 | 1.87 | 74890 | 74890 | 74890 |
| 54-36 | 5/7 | 5:08 | 0.2 | 0.78 | 0.30 | 0.44 | 32830 | 32830 | 32830 |
| 54-21 | 4/25 | 16:53 | 0.2 | 0.78 | 0.30 | 0.44 | 11290 | 11290 | 11290 |
| 54-42 | 5/6 | 5:43 | 0.9 | 0.78 | 1.11 | 1.62 | 10530 | 10530 | 10530 |
| 21-87 | 4/28 | 6:31 | 0.2 | 0.79 | 0.30 | 0.44 | 63520 | 63520 | 63520 |
| 54-18 | 5/16 | 3:51 | 1.1 | 0.79 | 1.39 | 2.04 | 41370 | 41370 | 41370 |
| 21-68 | 5/8 | 5:25 | 1.6 | 0.80 | 2.03 | 2.97 | 10580 | 17314 | 34150 |
| 54-13 | 5/12 | 12:57 | 0.2 | 0.80 | 0.29 | 0.43 | 75360 | 75360 | 75360 |
| 54-81 | 5/21 | 5:13 | 1.3 | 0.80 | 1.60 | 2.35 | 10670 | 10670 | 10670 |
| 21-75 | 5/1 | 0:03 | 0.9 | 0.80 | 1.08 | 1.58 | 34530 | 15322 | 10520 |
| 54-15 | 5/12 | 5:34 | 1.2 | 0.80 | 1.45 | 2.12 | 40670 | 40670 | 40670 |
| 21-68 | 5/9 | 5:42 | 1.0 | 0.81 | 1.25 | 1.83 | 22130 | 47616 | 57810 |
| 54-39 | 4/26 | 1:28 | 0.8 | 0.81 | 1.00 | 1.46 | 11300 | 11300 | 11300 |
| 21-87 | 5/12 | 13:57 | 0.2 | 0.83 | 0.28 | 0.42 | 75360 | 75360 | 75360 |
| 54-65 | 5/31 | 6:03 | 1.1 | 0.84 | 1.31 | 1.92 | 10180 | 10180 | 10180 |
| 21-75 | 5/2 | 18:19 | 0.9 | 0.85 | 1.03 | 1.50 | 68300 | 68300 | 68300 |
| 21-77 | 4/24 | 3:54 | 0.9 | 0.85 | 1.02 | 1.50 | 11580 | 11580 | 11580 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-15 | 5/9 | 7:09 | 1.1 | 0.85 | 1.30 | 1.91 | 60600 | 60600 | 60600 |
| 54-39 | 5/14 | 16:54 | 0.9 | 0.85 | 1.02 | 1.49 | 74830 | 74830 | 74830 |
| 54-80 | 5/14 | 5:38 | 1.1 | 0.86 | 1.29 | 1.89 | 10980 | 28794 | 39590 |
| 54-89 | 5/20 | 5:46 | 1.1 | 0.86 | 1.29 | 1.89 | 22610 | 22610 | 22610 |
| 21-72 | 5/12 | 6:04 | 1.6 | 0.87 | 1.85 | 2.71 | 40670 | 40670 | 40670 |
| 54-39 | 5/13 | 5:57 | 1.1 | 0.88 | 1.25 | 1.83 | 10370 | 10370 | 10370 |
| 21-39 | 5/2 | 17:16 | 0.2 | 0.88 | 0.27 | 0.39 | 68300 | 68300 | 68300 |
| 54-79 | 5/6 | 10:24 | 0.2 | 0.89 | 0.27 | 0.39 | 49210 | 49210 | 49210 |
| 54-73 | 5/23 | 5:52 | 1.1 | 0.89 | 1.24 | 1.82 | 10170 | 10170 | 10170 |
| 21-75 | 5/3 | 5:32 | 0.8 | 0.89 | 0.86 | 1.26 | 10640 | 13541 | 22690 |
| 54-42 | 5/3 | 16:10 | 1.6 | 0.91 | 1.78 | 2.60 | 58520 | 58520 | 58520 |
| 54-12 | 4/27 | 14:14 | 0.2 | 0.91 | 0.26 | 0.38 | 11530 | 11530 | 11530 |
| 54-39 | 4/30 | 12:09 | 0.2 | 0.91 | 0.26 | 0.38 | 23600 | 23600 | 23600 |
| 54-24 | 5/4 | 10:21 | 0.2 | 0.93 | 0.25 | 0.37 | 22390 | 23368 | 40640 |
| 54-13 | 5/18 | 15:05 | 1.6 | 0.93 | 1.73 | 2.54 | 69390 | 69390 | 69390 |
| 54-44 | 4/24 | 22:59 | 0.9 | 0.94 | 0.93 | 1.36 | 11580 | 11580 | 11580 |
| 21-37 | 5/11 | 6:20 | 0.9 | 0.95 | 0.92 | 1.35 | 74540 | 74540 | 74540 |
| 21-37 | 5/5 | 17:43 | 0.9 | 0.95 | 0.91 | 1.34 | 49530 | 49530 | 49530 |
| 54-89 | 5/6 | 10:01 | 1.1 | 0.95 | 1.16 | 1.70 | 49210 | 49210 | 49210 |
| 54-89 | 5/16 | 6:29 | 1.1 | 0.98 | 1.12 | 1.65 | 77520 | 77520 | 77520 |
| 54-13 | 4/15 | 0:31 | 0.8 | 0.98 | 0.82 | 1.20 | 11410 | 11410 | 11410 |
| 54-27 | 4/18 | 8:46 | 0.9 | 0.99 | 0.88 | 1.29 | 17390 | 17390 | 17390 |
| 54-15 | 5/15 | 5:12 | 1.1 | 1.01 | 1.10 | 1.61 | 9930 | 9930 | 9930 |
| 54-80 | 5/12 | 5:57 | 1.2 | 1.02 | 1.21 | 1.77 | 40670 | 40670 | 40670 |
| 21-41 | 5/9 | 7:08 | 1.0 | 1.02 | 0.98 | 1.44 | 60600 | 60600 | 60600 |
| 54-73 | 5/16 | 13:40 | 1.1 | 1.03 | 1.08 | 1.58 | 77520 | 77520 | 77520 |
| 21-43 | 5/27 | 16:21 | 1.1 | 1.03 | 1.07 | 1.57 | 31600 | 31600 | 31600 |
| 21-41 | 5/8 | 14:28 | 1.0 | 1.04 | 0.97 | 1.42 | 75100 | 75100 | 75100 |
| 54-90 | 5/14 | 5:40 | 1.1 | 1.04 | 1.06 | 1.56 | 10980 | 31543 | 39590 |
| 54-90 | 5/11 | 9:35 | 0.3 | 1.04 | 0.29 | 0.42 | 74540 | 74540 | 74540 |
| 54-50 | 5/24 | 7:07 | 1.1 | 1.04 | 1.06 | 1.55 | 16800 | 16800 | 16800 |
| 21-14 | 4/22 | 17:19 | 0.2 | 1.06 | 0.22 | 0.33 | 11330 | 11330 | 11330 |
| 54-39 | 5/6 | 4:10 | 1.6 | 1.06 | 1.51 | 2.22 | 10530 | 10530 | 10530 |
| 54-90 | 5/19 | 9:17 | 0.3 | 1.07 | 0.28 | 0.41 | 69520 | 69520 | 69520 |
| 21-52 | 5/24 | 1:11 | 1.0 | 1.07 | 0.92 | 1.36 | 10740 | 10740 | 10740 |
| 21-43 | 5/15 | 5:47 | 1.1 | 1.08 | 1.02 | 1.50 | 9930 | 9930 | 9930 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-75 | 5/1 | 4:49 | 0.2 | 1.08 | 0.22 | 0.32 | 10520 | 10520 | 10520 |
| 21-73 | 4/18 | 20:33 | 0.9 | 1.08 | 0.80 | 1.17 | 11240 | 11240 | 11240 |
| 54-39 | 5/1 | 13:39 | 0.9 | 1.09 | 0.80 | 1.17 | 16610 | 16610 | 16610 |
| 54-79 | 5/20 | 6:05 | 1.1 | 1.09 | 1.01 | 1.48 | 22610 | 22610 | 22610 |
| 21-75 | 5/1 | 20:52 | 0.9 | 1.10 | 0.79 | 1.16 | 62970 | 62970 | 62970 |
| 21-87 | 4/26 | 16:48 | 0.3 | 1.10 | 0.26 | 0.38 | 11300 | 11300 | 11300 |
| 54-90 | 5/18 | 13:59 | 1.0 | 1.11 | 0.89 | 1.31 | 69390 | 69390 | 69390 |
| 54-30 | 4/19 | 11:30 | 0.9 | 1.11 | 0.78 | 1.15 | 11260 | 11260 | 11260 |
| 54-80 | 5/13 | 6:50 | 1.1 | 1.11 | 0.99 | 1.45 | 10370 | 25815 | 34240 |
| 54-42 | 5/4 | 5:22 | 0.9 | 1.12 | 0.77 | 1.14 | 10210 | 10210 | 10210 |
| 54-71 | 5/11 | 6:41 | 1.1 | 1.13 | 0.98 | 1.44 | 74540 | 74540 | 74540 |
| 54-24 | 4/26 | 3:01 | 1.2 | 1.13 | 1.09 | 1.60 | 11300 | 11300 | 11300 |
| 21-37 | 5/12 | 16:36 | 1.0 | 1.14 | 0.88 | 1.29 | 75360 | 75360 | 75360 |
| 21-14 | 4/17 | 18:30 | 0.9 | 1.14 | 0.76 | 1.11 | 49490 | 20523 | 68720 |
| 54-90 | 5/13 | 8:47 | 1.0 | 1.15 | 0.86 | 1.26 | 75500 | 75500 | 75500 |
| 21-37 | 5/10 | 5:44 | 1.0 | 1.16 | 0.86 | 1.26 | 30840 | 64206 | 74890 |
| 54-21 | 4/28 | 7:26 | 0.2 | 1.16 | 0.20 | 0.30 | 63520 | 63520 | 63520 |
| 54-39 | 5/11 | 5:37 | 1.1 | 1.17 | 0.95 | 1.39 | 74540 | 74540 | 74540 |
| 54-30 | 5/6 | 5:27 | 1.0 | 1.17 | 0.86 | 1.26 | 10530 | 10530 | 10530 |
| 54-36 | 5/7 | 0:02 | 1.0 | 1.17 | 0.85 | 1.24 | 11570 | 11570 | 11570 |
| 21-41 | 5/20 | 11:16 | 1.1 | 1.17 | 0.94 | 1.38 | 66880 | 66880 | 66880 |
| 54-89 | 5/9 | 5:30 | 1.1 | 1.18 | 0.94 | 1.38 | 22130 | 44744 | 57810 |
| 54-71 | 5/14 | 18:08 | 1.6 | 1.19 | 1.35 | 1.98 | 74830 | 74830 | 74830 |
| 54-24 | 4/20 | 4:23 | 1.1 | 1.20 | 0.92 | 1.35 | 11450 | 11450 | 11450 |
| 54-89 | 5/14 | 5:56 | 1.1 | 1.21 | 0.91 | 1.34 | 10980 | 38817 | 39590 |
| 21-72 | 5/11 | 10:41 | 1.1 | 1.21 | 0.91 | 1.34 | 74540 | 74540 | 74540 |
| 21-81 | 5/3 | 1:13 | 1.6 | 1.21 | 1.33 | 1.95 | 10640 | 10640 | 10640 |
| 54-15 | 5/2 | 4:05 | 0.9 | 1.25 | 0.69 | 1.02 | 10360 | 10360 | 10360 |
| 54-89 | 5/7 | 11:08 | 1.1 | 1.25 | 0.88 | 1.29 | 75100 | 75100 | 75100 |
| 54-30 | 4/26 | 3:15 | 0.8 | 1.26 | 0.61 | 0.89 | 11300 | 11300 | 11300 |
| 54-18 | 5/6 | 2:53 | 0.9 | 1.26 | 0.69 | 1.01 | 10530 | 10530 | 10530 |
| 54-90 | 5/6 | 4:48 | 0.8 | 1.28 | 0.63 | 0.92 | 10530 | 10530 | 10530 |
| 21-72 | 5/11 | 6:12 | 1.1 | 1.31 | 0.84 | 1.24 | 74540 | 74540 | 74540 |
| 21-41 | 5/10 | 6:12 | 1.1 | 1.32 | 0.84 | 1.23 | 74890 | 74890 | 74890 |
| 54-90 | 5/11 | 5:59 | 1.0 | 1.33 | 0.75 | 1.10 | 74540 | 74540 | 74540 |
| 54-15 | 4/18 | 3:47 | 1.2 | 1.33 | 0.93 | 1.36 | 12090 | 12090 | 12090 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-16 | 4/24 | 5:14 | 1.2 | 1.34 | 0.93 | 1.36 | 26620 | 40333 | 41430 |
| 21-37 | 5/16 | 5:47 | 1.1 | 1.35 | 0.82 | 1.20 | 50830 | 70704 | 77520 |
| 54-36 | 5/5 | 17:44 | 1.1 | 1.36 | 0.81 | 1.19 | 49530 | 49530 | 49530 |
| 21-43 | 5/15 | 14:34 | 1.1 | 1.37 | 0.81 | 1.19 | 69110 | 71486 | 74440 |
| 54-90 | 5/28 | 22:37 | 0.8 | 1.37 | 0.56 | 0.82 | 22700 | 22700 | 22700 |
| 21-16 | 5/13 | 4:00 | 0.9 | 1.38 | 0.63 | 0.93 | 10370 | 10370 | 10370 |
| 21-21 | 4/20 | 21:19 | 1.0 | 1.38 | 0.72 | 1.06 | 31460 | 24339 | 17550 |
| 21-66 | 5/11 | 16:33 | 1.1 | 1.38 | 0.80 | 1.17 | 74540 | 74540 | 74540 |
| 21-87 | 5/14 | 5:20 | 1.1 | 1.39 | 0.79 | 1.16 | 10980 | 26800 | 39590 |
| 21-87 | 5/13 | 8:20 | 1.1 | 1.40 | 0.79 | 1.16 | 75500 | 75500 | 75500 |
| 54-42 | 5/8 | 7:29 | 1.1 | 1.43 | 0.77 | 1.13 | 61170 | 61170 | 61170 |
| 21-37 | 5/14 | 7:13 | 1.1 | 1.43 | 0.77 | 1.13 | 39590 | 49716 | 74830 |
| 21-87 | 4/23 | 5:57 | 0.9 | 1.44 | 0.60 | 0.89 | 11600 | 20194 | 22760 |
| 54-24 | 4/27 | 7:38 | 0.3 | 1.44 | 0.21 | 0.30 | 70100 | 70100 | 70100 |
| 54-18 | 4/25 | 5:11 | 0.9 | 1.46 | 0.60 | 0.87 | 11290 | 29607 | 32190 |
| 21-14 | 4/16 | 18:21 | 0.3 | 1.46 | 0.20 | 0.30 | 50110 | 50110 | 50110 |
| 54-24 | 5/8 | 5:05 | 1.1 | 1.47 | 0.75 | 1.10 | 10580 | 19584 | 34150 |
| 54-71 | 5/11 | 12:26 | 1.0 | 1.47 | 0.67 | 0.99 | 74540 | 74540 | 74540 |
| 21-23 | 4/21 | 7:21 | 0.9 | 1.47 | 0.59 | 0.86 | 11980 | 11980 | 11980 |
| 54-15 | 5/10 | 6:01 | 1.1 | 1.48 | 0.75 | 1.10 | 48000 | 74588 | 74890 |
| 54-42 | 5/9 | 14:30 | 1.3 | 1.48 | 0.87 | 1.28 | 69250 | 69250 | 69250 |
| 54-80 | 5/11 | 11:01 | 1.1 | 1.48 | 0.74 | 1.09 | 74540 | 74540 | 74540 |
| 54-39 | 5/18 | 10:21 | 0.9 | 1.50 | 0.58 | 0.85 | 69390 | 69390 | 69390 |
| 21-64 | 5/15 | 4:10 | 1.3 | 1.50 | 0.85 | 1.25 | 9930 | 9930 | 9930 |
| 54-90 | 5/10 | 6:36 | 0.9 | 1.51 | 0.57 | 0.84 | 74890 | 74890 | 74890 |
| 21-66 | 5/9 | 11:10 | 1.1 | 1.51 | 0.73 | 1.07 | 69250 | 69250 | 69250 |
| 54-24 | 4/17 | 6:20 | 0.9 | 1.52 | 0.57 | 0.84 | 11330 | 11330 | 11330 |
| 54-17 | 5/5 | 9:36 | 1.6 | 1.52 | 1.06 | 1.56 | 22570 | 22570 | 22570 |
| 54-18 | 5/6 | 6:23 | 1.1 | 1.53 | 0.72 | 1.06 | 10530 | 10530 | 10530 |
| 21-41 | 5/8 | 11:31 | 1.6 | 1.53 | 1.05 | 1.55 | 61170 | 61170 | 61170 |
| 54-79 | 5/13 | 5:26 | 2.4 | 1.54 | 1.57 | 2.30 | 10370 | 10370 | 10370 |
| 54-89 | 5/10 | 5:47 | 1.1 | 1.56 | 0.71 | 1.04 | 30840 | 68226 | 74890 |
| 54-30 | 4/25 | 5:04 | 0.9 | 1.57 | 0.55 | 0.81 | 11290 | 28230 | 32190 |
| 54-42 | 5/8 | 3:48 | 1.1 | 1.57 | 0.70 | 1.03 | 10580 | 10580 | 10580 |
| 54-65 | 5/25 | 12:26 | 1.3 | 1.57 | 0.82 | 1.20 | 27610 | 27610 | 27610 |
| 21-37 | 5/15 | 9:07 | 1.0 | 1.59 | 0.62 | 0.91 | 60430 | 60430 | 60430 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-16 | 5/12 | 6:50 | 0.2 | 1.59 | 0.11 | 0.16 | 40670 | 71746 | 75360 |
| 21-87 | 4/27 | 16:16 | 0.2 | 1.60 | 0.15 | 0.22 | 32420 | 32420 | 32420 |
| 21-77 | 4/22 | 7:56 | 0.9 | 1.60 | 0.54 | 0.80 | 11330 | 11330 | 11330 |
| 21-21 | 5/9 | 12:29 | 1.1 | 1.62 | 0.68 | 1.00 | 69250 | 69250 | 69250 |
| 54-13 | 5/12 | 5:15 | 1.1 | 1.63 | 0.68 | 1.00 | 40670 | 40670 | 40670 |
| 21-21 | 4/25 | 3:09 | 0.9 | 1.64 | 0.53 | 0.78 | 11290 | 11290 | 11290 |
| 54-15 | 5/11 | 15:55 | 1.3 | 1.66 | 0.78 | 1.14 | 74540 | 74540 | 74540 |
| 21-43 | 5/7 | 15:09 | 1.6 | 1.66 | 0.97 | 1.42 | 75100 | 75100 | 75100 |
| 54-15 | 5/11 | 5:17 | 1.1 | 1.66 | 0.66 | 0.97 | 74540 | 74540 | 74540 |
| 21-77 | 4/21 | 5:36 | 0.9 | 1.67 | 0.52 | 0.76 | 11980 | 11980 | 11980 |
| 54-13 | 4/17 | 18:21 | 0.9 | 1.70 | 0.51 | 0.75 | 49490 | 20523 | 68720 |
| 54-79 | 5/5 | 13:24 | 0.2 | 1.70 | 0.14 | 0.20 | 49530 | 49530 | 49530 |
| 21-37 | 5/15 | 15:42 | 1.7 | 1.72 | 0.97 | 1.43 | 74440 | 74440 | 74440 |
| 54-71 | 5/17 | 0:21 | 1.3 | 1.72 | 0.75 | 1.10 | 78780 | 78780 | 78780 |
| 54-45 | 4/30 | 17:39 | 0.2 | 1.73 | 0.14 | 0.20 | 75550 | 75550 | 75550 |
| 21-37 | 5/11 | 16:16 | 1.0 | 1.73 | 0.57 | 0.84 | 74540 | 74540 | 74540 |
| 21-87 | 4/22 | 13:24 | 0.9 | 1.74 | 0.50 | 0.73 | 11330 | 11330 | 11330 |
| 21-66 | 5/7 | 16:26 | 0.8 | 1.75 | 0.46 | 0.68 | 75100 | 75100 | 75100 |
| 54-21 | 4/26 | 5:46 | 1.1 | 1.75 | 0.63 | 0.93 | 50170 | 50170 | 50170 |
| 54-81 | 5/20 | 4:35 | 1.6 | 1.78 | 0.91 | 1.33 | 22610 | 22610 | 22610 |
| 21-43 | 5/10 | 6:54 | 1.1 | 1.79 | 0.62 | 0.90 | 74890 | 74890 | 74890 |
| 21-43 | 5/9 | 9:56 | 0.9 | 1.79 | 0.48 | 0.71 | 60600 | 67488 | 69250 |
| 21-87 | 5/11 | 6:47 | 0.8 | 1.85 | 0.42 | 0.61 | 74540 | 74540 | 74540 |
| 54-24 | 4/28 | 14:58 | 2.5 | 1.85 | 1.34 | 1.97 | 11500 | 11500 | 11500 |
| 21-75 | 5/4 | 5:38 | 1.1 | 1.88 | 0.59 | 0.86 | 10210 | 11706 | 22390 |
| 21-16 | 5/11 | 12:12 | 1.1 | 1.88 | 0.59 | 0.86 | 74540 | 74540 | 74540 |
| 54-89 | 5/17 | 6:14 | 1.1 | 1.88 | 0.59 | 0.86 | 78780 | 78780 | 78780 |
| 21-16 | 5/10 | 8:44 | 2.5 | 1.88 | 1.32 | 1.93 | 74890 | 74890 | 74890 |
| 54-79 | 5/11 | 6:12 | 1.1 | 1.89 | 0.58 | 0.86 | 74540 | 74540 | 74540 |
| 21-72 | 5/13 | 10:33 | 1.1 | 1.91 | 0.58 | 0.85 | 75500 | 75500 | 75500 |
| 54-21 | 4/25 | 5:50 | 1.1 | 1.91 | 0.58 | 0.85 | 32190 | 32190 | 32190 |
| 54-18 | 4/22 | 17:33 | 0.9 | 1.92 | 0.45 | 0.66 | 11330 | 11330 | 11330 |
| 54-71 | 5/10 | 20:21 | 0.8 | 1.94 | 0.40 | 0.58 | 74890 | 62096 | 22830 |
| 21-81 | 5/5 | 21:19 | 0.9 | 1.94 | 0.45 | 0.66 | 74250 | 54373 | 22570 |
| 54-24 | 5/13 | 8:05 | 1.1 | 1.96 | 0.56 | 0.83 | 34240 | 74451 | 75500 |
| 54-34 | 4/18 | 23:54 | 0.9 | 1.96 | 0.44 | 0.65 | 11240 | 11163 | 11260 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-79 | 5/12 | 7:45 | 2.7 | 1.98 | 1.37 | 2.01 | 75360 | 75360 | 75360 |
| 54-24 | 4/24 | 3:05 | 1.5 | 1.98 | 0.74 | 1.09 | 11580 | 11580 | 11580 |
| 21-39 | 5/9 | 15:15 | 0.5 | 2.00 | 0.23 | 0.34 | 69250 | 66660 | 49660 |
| 21-16 | 5/11 | 9:03 | 1.2 | 2.06 | 0.57 | 0.84 | 74540 | 74540 | 74540 |
| 21-14 | 4/14 | 20:53 | 1.2 | 2.08 | 0.60 | 0.88 | 23040 | 23040 | 23040 |
| 21-41 | 5/10 | 12:39 | 0.9 | 2.09 | 0.42 | 0.61 | 74890 | 74890 | 74890 |
| 54-79 | 5/17 | 5:10 | 1.9 | 2.10 | 0.91 | 1.33 | 78780 | 78780 | 78780 |
| 54-30 | 5/4 | 15:35 | 1.6 | 2.12 | 0.76 | 1.12 | 49340 | 66262 | 68680 |
| 54-44 | 4/29 | 10:09 | 0.8 | 2.13 | 0.38 | 0.56 | 58880 | 55166 | 32260 |
| 54-15 | 5/14 | 12:35 | 2.7 | 2.18 | 1.24 | 1.82 | 74830 | 74830 | 74830 |
| 54-81 | 5/17 | 5:31 | 1.4 | 2.20 | 0.62 | 0.91 | 78780 | 78780 | 78780 |
| 21-43 | 5/17 | 6:04 | 1.9 | 2.22 | 0.86 | 1.26 | 78780 | 78780 | 78780 |
| 54-39 | 4/26 | 5:37 | 1.0 | 2.23 | 0.44 | 0.65 | 50170 | 50170 | 50170 |
| 54-80 | 5/9 | 17:25 | 3.2 | 2.24 | 1.44 | 2.11 | 49660 | 49660 | 49660 |
| 21-89 | 5/26 | 18:05 | 3.2 | 2.24 | 1.44 | 2.11 | 22560 | 22560 | 22560 |
| 54-24 | 4/16 | 3:17 | 0.8 | 2.25 | 0.34 | 0.50 | 11450 | 11450 | 11450 |
| 54-24 | 5/2 | 11:48 | 0.9 | 2.27 | 0.38 | 0.56 | 16420 | 16420 | 16420 |
| 54-44 | 4/28 | 10:15 | 0.8 | 2.28 | 0.35 | 0.52 | 63520 | 38478 | 11500 |
| 54-71 | 5/12 | 1:30 | 2.5 | 2.28 | 1.09 | 1.59 | 40670 | 40670 | 40670 |
| 21-37 | 5/16 | 16:19 | 1.3 | 2.34 | 0.55 | 0.81 | 77520 | 77520 | 77520 |
| 21-37 | 5/12 | 10:03 | 0.2 | 2.35 | 0.10 | 0.15 | 75360 | 75360 | 75360 |
| 54-24 | 4/26 | 19:39 | 0.9 | 2.35 | 0.37 | 0.54 | 75060 | 75060 | 75060 |
| 54-18 | 5/13 | 14:34 | 1.6 | 2.37 | 0.68 | 1.00 | 75500 | 75500 | 75500 |
| 21-52 | 5/25 | 3:37 | 1.2 | 2.38 | 0.52 | 0.76 | 10610 | 10610 | 10610 |
| 21-18 | 4/22 | 5:04 | 1.1 | 2.38 | 0.47 | 0.69 | 11330 | 11330 | 11330 |
| 21-41 | 5/22 | 10:01 | 2.6 | 2.39 | 1.10 | 1.61 | 55880 | 55880 | 55880 |
| 21-87 | 5/9 | 9:13 | 1.1 | 2.40 | 0.46 | 0.68 | 60600 | 65345 | 69250 |
| 21-14 | 5/9 | 10:41 | 1.8 | 2.41 | 0.75 | 1.09 | 69250 | 69250 | 69250 |
| 54-24 | 5/9 | 3:15 | 1.1 | 2.42 | 0.46 | 0.67 | 10900 | 14054 | 22130 |
| 54-90 | 5/12 | 4:41 | 1.3 | 2.43 | 0.53 | 0.78 | 40670 | 42333 | 75360 |
| 21-37 | 5/11 | 11:13 | 1.0 | 2.47 | 0.40 | 0.59 | 74540 | 74540 | 74540 |
| 21-87 | 5/8 | 6:19 | 1.2 | 2.47 | 0.50 | 0.73 | 34150 | 53735 | 61170 |
| 54-24 | 4/22 | 5:41 | 2.7 | 2.53 | 1.07 | 1.57 | 11330 | 11330 | 11330 |
| 54-73 | 5/15 | 11:06 | 2.7 | 2.55 | 1.07 | 1.56 | 69110 | 69110 | 69110 |
| 21-85 | 4/22 | 21:11 | 1.6 | 2.58 | 0.63 | 0.92 | 11330 | 11330 | 11330 |
| 54-17 | 5/5 | 12:19 | 2.5 | 2.60 | 0.95 | 1.40 | 49530 | 49530 | 49530 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-87 | 5/16 | 10:45 | 1.0 | 2.67 | 0.37 | 0.54 | 77520 | 77520 | 77520 |
| 21-25 | 4/30 | 12:26 | 2.6 | 2.75 | 0.95 | 1.39 | 23600 | 23600 | 23600 |
| 54-28 | 4/16 | 12:26 | 0.9 | 2.79 | 0.31 | 0.46 | 23480 | 26081 | 32270 |
| 54-73 | 5/17 | 6:09 | 4.1 | 2.79 | 1.47 | 2.15 | 78780 | 78780 | 78780 |
| 54-20 | 4/26 | 21:22 | 2.4 | 2.80 | 0.86 | 1.27 | 75060 | 45635 | 11530 |
| 21-37 | 5/5 | 14:40 | 3.2 | 2.84 | 1.13 | 1.66 | 49530 | 49530 | 49530 |
| 54-65 | 5/25 | 8:10 | 2.4 | 2.85 | 0.85 | 1.25 | 10610 | 10751 | 22730 |
| 54-21 | 4/23 | 23:50 | 3.2 | 2.89 | 1.11 | 1.63 | 11560 | 11579 | 11580 |
| 54-32 | 5/4 | 15:28 | 3.2 | 2.92 | 1.10 | 1.62 | 49340 | 66167 | 68680 |
| 54-39 | 5/16 | 15:47 | 2.6 | 3.01 | 0.87 | 1.27 | 77520 | 77520 | 77520 |
| 21-16 | 5/7 | 22:00 | 1.6 | 3.02 | 0.53 | 0.78 | 31680 | 31680 | 10580 |
| 21-77 | 4/23 | 5:47 | 1.1 | 3.02 | 0.37 | 0.54 | 11600 | 20920 | 22760 |
| 54-15 | 5/1 | 19:34 | 3.2 | 3.04 | 1.06 | 1.55 | 68830 | 62658 | 49230 |
| 21-68 | 5/7 | 14:28 | 2.0 | 3.06 | 0.65 | 0.96 | 75100 | 75100 | 75100 |
| 54-81 | 5/29 | 14:30 | 2.7 | 3.07 | 0.89 | 1.30 | 33820 | 33820 | 33820 |
| 54-73 | 5/22 | 9:44 | 4.3 | 3.13 | 1.38 | 2.03 | 55880 | 55880 | 55880 |
| 21-37 | 5/8 | 15:03 | 1.3 | 3.14 | 0.41 | 0.61 | 75100 | 65371 | 61170 |
| 54-21 | 5/18 | 13:43 | 2.4 | 3.15 | 0.77 | 1.13 | 69390 | 69390 | 69390 |
| 21-72 | 5/12 | 12:52 | 1.2 | 3.15 | 0.39 | 0.57 | 75360 | 75360 | 75360 |
| 54-18 | 4/21 | 19:52 | 3.2 | 3.15 | 1.02 | 1.50 | 32130 | 31615 | 18160 |
| 54-71 | 5/13 | 11:13 | 4.1 | 3.20 | 1.28 | 1.88 | 75500 | 75500 | 75500 |
| 54-81 | 5/11 | 9:45 | 0.3 | 3.22 | 0.09 | 0.14 | 74540 | 74540 | 74540 |
| 21-18 | 4/16 | 4:16 | 0.9 | 3.24 | 0.27 | 0.39 | 11450 | 13861 | 17400 |
| 54-12 | 4/24 | 22:34 | 4.1 | 3.25 | 1.26 | 1.85 | 11580 | 11358 | 11290 |
| 54-15 | 5/3 | 21:31 | 0.9 | 3.26 | 0.27 | 0.39 | 58520 | 24401 | 10210 |
| 54-71 | 5/9 | 13:48 | 2.7 | 3.27 | 0.82 | 1.20 | 69250 | 68753 | 49660 |
| 21-85 | 4/21 | 19:35 | 1.6 | 3.33 | 0.48 | 0.71 | 18160 | 18160 | 18160 |
| 54-21 | 4/24 | 9:22 | 0.9 | 3.34 | 0.26 | 0.38 | 41430 | 17224 | 11580 |
| 21-18 | 5/2 | 16:37 | 1.2 | 3.35 | 0.36 | 0.53 | 68300 | 68300 | 68300 |
| 54-89 | 5/13 | 6:50 | 1.2 | 3.40 | 0.36 | 0.52 | 10370 | 57007 | 75500 |
| 54-90 | 5/28 | 12:15 | 4.5 | 3.40 | 1.31 | 1.92 | 16680 | 25414 | 27870 |
| 54-81 | 5/12 | 7:03 | 0.8 | 3.42 | 0.23 | 0.33 | 75360 | 75360 | 75360 |
| 54-17 | 4/27 | 9:38 | 3.2 | 3.42 | 0.94 | 1.38 | 70100 | 49629 | 11530 |
| 54-30 | 5/5 | 16:20 | 1.0 | 3.46 | 0.29 | 0.42 | 49530 | 53808 | 74250 |
| 54-45 | 5/1 | 9:43 | 0.9 | 3.49 | 0.25 | 0.37 | 49230 | 19717 | 16610 |
| 54-65 | 5/26 | 6:27 | 0.9 | 3.53 | 0.25 | 0.36 | 10480 | 10480 | 10480 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-39 | 5/24 | 6:18 | 2.7 | 3.56 | 0.76 | 1.12 | 16800 | 16800 | 16800 |
| 54-90 | 5/18 | 8:24 | 4.5 | 3.56 | 1.25 | 1.84 | 69390 | 69390 | 69390 |
| 21-41 | 5/19 | 8:41 | 4.1 | 3.64 | 1.12 | 1.65 | 69520 | 69520 | 69520 |
| 54-24 | 5/7 | 14:26 | 2.7 | 3.68 | 0.74 | 1.08 | 75100 | 75100 | 75100 |
| 21-68 | 5/8 | 8:42 | 1.0 | 3.70 | 0.27 | 0.40 | 61170 | 61170 | 61170 |
| 21-43 | 5/8 | 11:34 | 1.1 | 3.83 | 0.29 | 0.43 | 61170 | 69673 | 75100 |
| 21-41 | 5/11 | 9:48 | 1.6 | 3.95 | 0.40 | 0.58 | 74540 | 74540 | 74540 |
| 54-71 | 5/16 | 12:48 | 4.3 | 3.95 | 1.10 | 1.61 | 77520 | 77520 | 77520 |
| 54-50 | 5/23 | 14:34 | 3.2 | 3.97 | 0.81 | 1.19 | 41350 | 41350 | 41350 |
| 21-41 | 5/17 | 12:05 | 4.2 | 4.03 | 1.05 | 1.54 | 78780 | 78780 | 78780 |
| 21-39 | 5/11 | 19:19 | 0.8 | 4.09 | 0.19 | 0.28 | 74540 | 63647 | 39740 |
| 54-24 | 4/15 | 12:11 | 0.9 | 4.11 | 0.21 | 0.31 | 11590 | 11590 | 11590 |
| 21-14 | 4/13 | 23:53 | 0.9 | 4.13 | 0.23 | 0.33 | 11050 | 11181 | 11230 |
| 21-46 | 5/20 | 9:04 | 4.3 | 4.15 | 1.04 | 1.53 | 40570 | 54714 | 32790 |
| 21-66 | 5/17 | 7:13 | 4.2 | 4.17 | 1.01 | 1.49 | 78780 | 78780 | 78780 |
| 21-66 | 5/8 | 9:18 | 2.0 | 4.19 | 0.48 | 0.70 | 61170 | 62607 | 75100 |
| 21-74 | 5/3 | 19:54 | 3.2 | 4.20 | 0.77 | 1.13 | 58520 | 39843 | 10210 |
| 54-79 | 5/13 | 8:15 | 1.9 | 4.23 | 0.45 | 0.66 | 75500 | 75500 | 75500 |
| 21-64 | 5/13 | 22:44 | 1.0 | 4.32 | 0.22 | 0.32 | 40170 | 32442 | 10980 |
| 21-37 | 5/6 | 15:27 | 2.7 | 4.32 | 0.63 | 0.92 | 74680 | 74680 | 74680 |
| 54-45 | 4/28 | 23:56 | 4.1 | 4.36 | 0.94 | 1.38 | 11500 | 11500 | 11440 |
| 54-39 | 5/21 | 7:41 | 4.2 | 4.41 | 0.96 | 1.40 | 10670 | 53325 | 65780 |
| 21-41 | 5/5 | 14:51 | 1.6 | 4.50 | 0.36 | 0.52 | 49530 | 50442 | 74250 |
| 54-12 | 4/27 | 7:24 | 4.1 | 4.51 | 0.91 | 1.33 | 70100 | 69239 | 11530 |
| 54-32 | 5/5 | 12:11 | 1.1 | 4.51 | 0.24 | 0.36 | 49530 | 49530 | 49530 |
| 21-14 | 5/17 | 8:32 | 4.6 | 4.66 | 0.98 | 1.44 | 78780 | 78780 | 78780 |
| 21-37 | 5/14 | 23:50 | 0.9 | 4.73 | 0.18 | 0.27 | 39590 | 10465 | 9930 |
| 54-39 | 5/26 | 7:31 | 4.3 | 4.82 | 0.90 | 1.32 | 10480 | 11063 | 22560 |
| 54-90 | 5/25 | 11:17 | 4.5 | 4.82 | 0.92 | 1.35 | 22730 | 20917 | 27610 |
| 21-37 | 5/6 | 8:41 | 1.1 | 4.83 | 0.23 | 0.34 | 10530 | 46153 | 49210 |
| 54-43 | 5/2 | 16:09 | 3.2 | 4.83 | 0.67 | 0.98 | 68300 | 68300 | 68300 |
| 21-52 | 5/23 | 13:53 | 4.5 | 4.91 | 0.91 | 1.33 | 41350 | 41350 | 41350 |
| 54-73 | 5/18 | 7:29 | 4.5 | 4.93 | 0.90 | 1.33 | 69390 | 69390 | 69390 |
| 54-81 | 5/14 | 13:55 | 2.0 | 4.94 | 0.41 | 0.61 | 74830 | 74830 | 74830 |
| 54-13 | 5/3 | 18:10 | 4.1 | 4.94 | 0.83 | 1.21 | 58520 | 52195 | 10640 |
| 54-36 | 5/1 | 18:31 | 4.1 | 4.98 | 0.82 | 1.21 | 68830 | 56634 | 10520 |

| Fish | Upstream Movement | | | | Speed | | Conowingo Discharge | | |
|-------|-------------------|-------|------------------|-----------|-------|------|---------------------|---------|-------|
| | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-27 | 4/17 | 6:38 | 0.9 | 5.23 | 0.17 | 0.24 | 11330 | 11330 | 11330 |
| 21-41 | 5/23 | 6:42 | 4.3 | 5.26 | 0.82 | 1.21 | 10170 | 15736 | 41350 |
| 21-25 | 5/10 | 13:47 | 4.2 | 5.27 | 0.80 | 1.17 | 74890 | 74890 | 74890 |
| 21-16 | 5/8 | 2:20 | 1.2 | 5.33 | 0.23 | 0.34 | 10580 | 21447 | 61170 |
| 21-64 | 5/12 | 9:26 | 4.4 | 5.35 | 0.82 | 1.20 | 75360 | 75360 | 75360 |
| 21-37 | 5/9 | 5:35 | 0.9 | 5.37 | 0.16 | 0.24 | 22130 | 58686 | 69250 |
| 21-72 | 5/10 | 11:13 | 4.3 | 5.44 | 0.80 | 1.17 | 74890 | 74890 | 74890 |
| 54-79 | 5/19 | 7:24 | 4.3 | 5.49 | 0.79 | 1.16 | 69520 | 69520 | 69520 |
| 21-23 | 5/1 | 7:09 | 3.2 | 5.57 | 0.58 | 0.85 | 49230 | 33503 | 16610 |
| 54-14 | 4/25 | 19:30 | 3.2 | 5.68 | 0.57 | 0.83 | 41240 | 19141 | 11300 |
| 54-24 | 5/18 | 8:04 | 3.2 | 5.80 | 0.56 | 0.82 | 69390 | 69390 | 69390 |
| 21-16 | 4/25 | 0:29 | 0.9 | 5.82 | 0.15 | 0.22 | 11290 | 14694 | 32190 |
| 54-81 | 5/28 | 5:13 | 4.9 | 5.86 | 0.83 | 1.21 | 10600 | 11513 | 16680 |
| 21-46 | 5/17 | 9:05 | 4.3 | 5.98 | 0.72 | 1.06 | 78780 | 78780 | 78780 |
| 21-25 | 5/1 | 9:05 | 4.1 | 6.08 | 0.67 | 0.99 | 49230 | 21793 | 16610 |
| 21-85 | 4/20 | 20:28 | 1.6 | 6.27 | 0.26 | 0.38 | 31460 | 17700 | 11980 |
| 21-36 | 5/3 | 14:18 | 0.9 | 6.73 | 0.13 | 0.19 | 41020 | 56273 | 58520 |
| 21-80 | 4/19 | 22:17 | 1.7 | 6.87 | 0.24 | 0.36 | 45880 | 15365 | 11450 |
| 54-44 | 4/23 | 5:40 | 0.9 | 7.36 | 0.12 | 0.17 | 11600 | 18738 | 11630 |
| 21-14 | 5/15 | 9:36 | 4.1 | 7.61 | 0.54 | 0.79 | 60430 | 68845 | 74440 |
| 54-18 | 5/15 | 18:12 | 3.2 | 7.71 | 0.42 | 0.61 | 74440 | 67564 | 41370 |
| 21-18 | 4/15 | 4:02 | 1.2 | 8.00 | 0.15 | 0.23 | 11410 | 11230 | 11590 |
| 21-87 | 5/7 | 8:35 | 2.7 | 8.50 | 0.32 | 0.47 | 58990 | 73097 | 75100 |
| 54-13 | 5/18 | 17:51 | 2.4 | 9.34 | 0.25 | 0.37 | 69390 | 69435 | 69520 |
| 21-27 | 4/21 | 6:21 | 0.9 | 9.58 | 0.09 | 0.13 | 11980 | 11980 | 11980 |
| 21-16 | 5/6 | 23:30 | 2.9 | 9.87 | 0.29 | 0.42 | 10530 | 30453 | 75100 |
| 54-18 | 5/4 | 18:01 | 4.3 | 20.78 | 0.21 | 0.31 | 68680 | 24499 | 49530 |

TABLE 4.10: SUMMARY BY AVERAGE DISCHARGE FROM CONOWINGO DAM OF ALL RADIO-TAGGED AMERICAN SHAD WHICH MADE UPSTREAM MOVEMENTS DURING SPRING 2012.

| Average Conowingo Discharge (cfs) | No. Trips | No. Fish | Average | | Average Speed | |
|---|--------------|---------------|------------------|--------------|---------------|-------|
| | | | Distance (mi) | Time (hr) | mph | fps |
| 70,001 - 78,780 | 124 | 26 | 1.24 | 1.64 | 0.99 | 1.46 |
| 60,001 - 70,000 | 63 | 30 | 1.50 | 2.20 | 0.92 | 1.35 |
| 50,001 - 60,000 | 29 | 20 | 1.50 | 2.25 | 1.11 | 1.63 |
| 40,001 - 50,000 | 42 | 25 | 1.26 | 1.44 | 1.16 | 1.71 |
| 30,001 - 40,000 | 37 | 23 | 0.97 | 1.45 | 1.00 | 1.46 |
| 20,001 - 30,000 | 42 | 25 | 1.31 | 2.03 | 1.09 | 1.60 |
| 10,001 - 20,000 | 182 | 46 | 0.90 | 1.32 | 1.30 | 1.91 |
| 5,000 - 10,000 | 12 | 11 | 0.78 | 0.60 | 1.44 | 2.11 |
| Total Trips | 531 | Min. | 0.10 | 0.07 | 0.09 | 0.13 |
| | | Mean | 1.15 | 1.61 | 1.13 | 1.65 |
| | | S.D. | 1.03 | 1.85 | 1.09 | 1.60 |
| | | Median | 0.87 | 0.93 | 0.84 | 1.24 |
| | | Max. | 4.85 | 20.78 | 8.28 | 12.15 |

Data are derived by calculations of individual trips. Average distance, time and speed are determined from trips per average discharge thus for example at discharge 5,000 to 10,000 cfs, average distance of 12 trips was 0.78 miles. Average time to complete a trip within those 12 trips was 0.6 hr. These two values aren't necessarily derived from the same trip. Average speed is the average for the 12 trips and isn't necessarily the speed from the average distance or time value.

TABLE 4.11: SUMMARY OF RADIO-TAGGED AMERICAN SHAD WHICH EXHIBITED UPSTREAM MOVEMENTS OF AT LEAST 4.0 MILES DURING 2012.

| Fish | Trips | Between | | Average ¹ Trip | | Average ¹ Speed | |
|-------|-------|---------|-------|---------------------------|-----------|----------------------------|------|
| | | Date | Date | Distance (mi) | Time (hr) | mph | fps |
| 21-14 | 2 | 5/15 | 5/17 | 4.3 | 6.14 | 0.76 | 1.12 |
| 21-25 | 2 | 5/1 | 5/10 | 4.2 | 5.68 | 0.74 | 1.08 |
| 21-41 | 3 | 5/17 | 5/23 | 4.2 | 4.31 | 1.00 | 1.46 |
| 21-46 | 2 | 5/17 | 5/20 | 4.3 | 5.07 | 0.88 | 1.29 |
| 21-52 | 1 | 5/23 | | 4.6 | 4.91 | 0.91 | 1.33 |
| 21-64 | 1 | 5/12 | | 4.4 | 5.35 | 0.82 | 1.20 |
| 21-66 | 1 | 5/17 | | 4.2 | 4.17 | 1.01 | 1.49 |
| 21-72 | 1 | 5/10 | | 4.3 | 5.44 | 0.80 | 1.17 |
| 54-12 | 2 | 4/24 | 4/27 | 4.1 | 3.88 | 1.08 | 1.59 |
| 54-13 | 1 | 5/3 | 18:10 | 4.1 | 4.94 | 0.83 | 1.21 |
| 54-18 | 1 | 5/4 | | 4.3 | 20.78 | 0.21 | 0.31 |
| 54-36 | 1 | 5/1 | | 4.1 | 4.98 | 0.82 | 1.21 |
| 54-39 | 2 | 5/21 | 5/26 | 4.3 | 4.61 | 0.93 | 1.36 |
| 54-45 | 1 | 4/28 | | 4.1 | 4.36 | 0.94 | 1.38 |
| 54-71 | 2 | 5/13 | 5/16 | 4.2 | 3.57 | 1.19 | 1.74 |
| 54-73 | 3 | 5/17 | 5/22 | 4.3 | 3.61 | 1.25 | 1.84 |
| 54-79 | 1 | 5/19 | 7:24 | 4.3 | 5.49 | 0.79 | 1.16 |
| 54-81 | 1 | 5/28 | 5:13 | 4.9 | 5.86 | 0.83 | 1.21 |
| 54-90 | 3 | 5/18 | 12:15 | 4.5 | 3.93 | 1.16 | 1.70 |

| Totals | | Between | | Trip ² | | Speed ² | |
|--------|-------|---------|---------------|-------------------|-----------|--------------------|------|
| Fish | Trips | Date | Date | Distance (mi) | Time (hr) | mph | fps |
| 19 | 31 | 4/21 | 5/28 | | | | |
| | | | Min | 4.1 | 2.79 | 0.21 | 0.31 |
| | | | Mean | 4.3 | 5.15 | 0.95 | 1.39 |
| | | | Median | 4.3 | 4.82 | 0.91 | 1.33 |
| | | | Max | 4.9 | 20.78 | 1.47 | 2.15 |

1 - Average for fish with two or more trips.

2 - Actual values derived from all 31 upstream forays.

**TABLE 4.12: COMPARISON OF AMERICAN SHAD HOURLY PASSAGE ON DAYS
STARTING AT 0600 HRS VS. 0800 HRS IN 2012*.**

| Hour (Military Time) | Date | | | | | | | | | | | | | |
|-------------------------|------------|------------|------------|--------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|-------------|
| | 28-Apr | 29-Apr | 4-May | 5-May | 6-May | 7-May | 8-May | 9-May | 10-May | 11-May | 12-May | 13-May | 14-May | 15-May |
| 0600-0659 | 21 | | 1 | | 5 | | 2 | | 13 | | 0 | | 11 | |
| 0700-0759 | 13 | | 29 | | 61 | | 9 | | 16 | | 1 | | 13 | |
| 0800-0859 | 12 | 13 | 66 | 58 | 77 | 18 | 2 | 29 | 9 | 2 | 1 | 3 | 161 | 2 |
| 0900-0959 | 5 | 30 | 15 | 28 | 86 | 14 | 10 | 61 | 8 | 2 | 3 | 8 | 279 | 16 |
| 1000-1059 | 1 | 11 | 27 | 5 | 45 | 3 | 12 | 29 | 7 | 3 | 7 | 8 | 108 | 35 |
| 1100-1159 | 5 | 3 | 8 | 2 | 66 | 1 | 12 | 37 | 2 | 6 | 2 | 4 | 115 | 38 |
| 1200-1259 | 2 | 2 | 26 | 7 | 33 | 13 | 19 | 41 | 4 | 3 | 6 | 5 | 66 | 18 |
| 1300-1359 | 3 | 1 | 40 | 22 | 38 | 21 | 33 | 34 | 11 | 0 | 8 | 15 | 56 | 9 |
| 1400-1459 | 11 | 9 | 125 | 190 | 39 | 4 | 46 | 22 | 19 | 7 | 14 | 27 | 44 | 10 |
| 1500-1559 | 20 | 41 | 196 | 231 | 24 | 5 | 68 | 9 | 8 | 6 | 2 | 18 | 30 | 7 |
| 1600-1659 | 47 | 30 | 202 | 233 | 20 | 21 | 49 | 3 | 17 | 1 | 1 | 27 | 41 | 14 |
| 1700-1759 | 71 | 14 | 57 | 237 | 44 | 18 | 46 | 1 | 16 | 1 | 3 | 16 | 17 | 3 |
| 1800-1859 | 16 | | 25 | 217 | 15 | 13 | 29 | 23 | 14 | 0 | 22 | 8 | 28 | 8 |
| 1900-1959 | | | | 73 | | 5 | 21 | 6 | 2 | | 25 | 2 | 25 | 1 |
| Day Total | 227 | 154 | 817 | 1,303 | 553 | 136 | 358 | 295 | 146 | 31 | 95 | 141 | 994 | 161 |
| (Military Time) | 18-May | 19-May | 20-May | 21-May | 22-May | 23-May | 24-May | 25-May | 26-May | 27-May | 28-May | 29-May | Hourly Totals | |
| 0600-0659 | 0 | | 0 | | 68 | | 13 | | 8 | | 1 | | | 143 |
| 0700-0759 | 1 | | 7 | | 122 | | 13 | | 63 | | 18 | | | 366 |
| 0800-0859 | 1 | 0 | 2 | 23 | 99 | 93 | 38 | 41 | 73 | 24 | 30 | 2 | | 879 |
| 0900-0959 | 0 | 2 | 8 | 22 | 34 | 187 | 60 | 120 | 44 | 131 | 11 | 3 | | 1187 |
| 1000-1059 | 0 | 2 | 7 | 58 | 11 | 86 | 104 | 91 | 52 | 64 | 7 | 8 | | 791 |
| 1100-1159 | 1 | 0 | 5 | 52 | 26 | 84 | 75 | 41 | 40 | 27 | 9 | 8 | | 669 |
| 1200-1259 | 0 | 0 | 6 | 39 | 12 | 29 | 73 | 21 | 26 | 21 | 2 | 1 | | 475 |
| 1300-1359 | 2 | 0 | 13 | 21 | 22 | 32 | 37 | 26 | 14 | 25 | 4 | 3 | | 490 |
| 1400-1459 | 0 | 0 | 31 | 16 | 22 | 34 | 21 | 15 | 9 | 7 | 9 | 1 | | 732 |
| 1500-1559 | 1 | 1 | 45 | 31 | 16 | 32 | 20 | 4 | 12 | 5 | 5 | 0 | | 837 |
| 1600-1659 | 1 | 0 | 65 | 57 | 7 | 73 | 7 | 3 | 10 | 2 | 4 | 0 | | 935 |
| 1700-1759 | 2 | 0 | 75 | 31 | 6 | 49 | 14 | 5 | 9 | 11 | 0 | 0 | | 746 |
| 1800-1859 | 0 | 0 | 37 | 52 | 8 | 43 | 18 | 6 | 20 | 9 | | 4 | | 615 |
| 1900-1959 | 0 | 0 | 13 | 15 | 1 | 27 | 10 | 7 | 4 | 1 | | 2 | | 240 |
| Day Total | 9 | 5 | 314 | 417 | 454 | 769 | 503 | 380 | 384 | 327 | 100 | 32 | | 9105 |

* Data from 2012 Conowingo East Fish Lift Report (In Progress).

TABLE 4.13: ANNUAL CONOWINGO EFL AMERICAN SHAD HOURLY PASSAGE VALUES FOR YEARS 2004-2011*.

| Hour (Military Time) | Year | | | | | | | |
|-------------------------|----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| 0700-0759 | 681 | 97 | 32 | - | 101 | 179 | 0 | 161 |
| 0800-0859 | 2,424 | 1,866 | 1,945 | 810 | 1207 | 2,743 | 1,144 | 991 |
| 0900-0959 | 5,805 | 4,765 | 2,839 | 1,682 | 1,871 | 4,244 | 1,903 | 1,512 |
| 1000-1059 | 8,564 | 4,922 | 4,119 | 2,307 | 2,055 | 4,651 | 2,921 | 2,180 |
| 1100-1159 | 12,819 | 6,096 | 4,928 | 2,351 | 1,880 | 3,481 | 2,870 | 2,308 |
| 1200-1259 | 12,684 | 5,719 | 5,304 | 2,658 | 1,584 | 1,991 | 2,670 | 1,727 |
| 1300-1359 | 13,246 | 7,076 | 5,576 | 2,957 | 2,309 | 2,760 | 3,814 | 1,885 |
| 1400-1459 | 13,445 | 8,117 | 6,411 | 4,075 | 3,112 | 1,618 | 4,802 | 1,891 |
| 1500-1559 | 12,219 | 7,809 | 8,071 | 3,536 | 2,444 | 2,104 | 5,419 | 1,700 |
| 1600-1659 | 10,640 | 7,736 | 8,505 | 2,558 | 1,884 | 1,944 | 4,646 | 1,893 |
| 1700-1759 | 9,425 | 8,001 | 6,806 | 1,947 | 1,216 | 1,448 | 4,735 | 1,761 |
| 1800-1859 | 6,346 | 5,648 | 2,167 | 583 | 241 | 946 | 2,645 | 1,596 |
| 1900-1959 | 1,062 | 1,074 | 196 | - | 10 | 1,163 | 188 | 966 |
| Season Total | 109,360 | 68,926 | 56,899 | 25,464 | 19,914 | 29,272 | 37,757 | 20,571 |

* Data taken from annual SRAFRRC Reports, 2004-2011.

FIGURE 2.1: CONOWINGO DAM AND THE LOCATIONS OF HYDROELECTRIC STATIONS WITH FISHWAYS AND YEAR OF INSTALLATION ON THE LOWER SUSQUEHANNA RIVER.

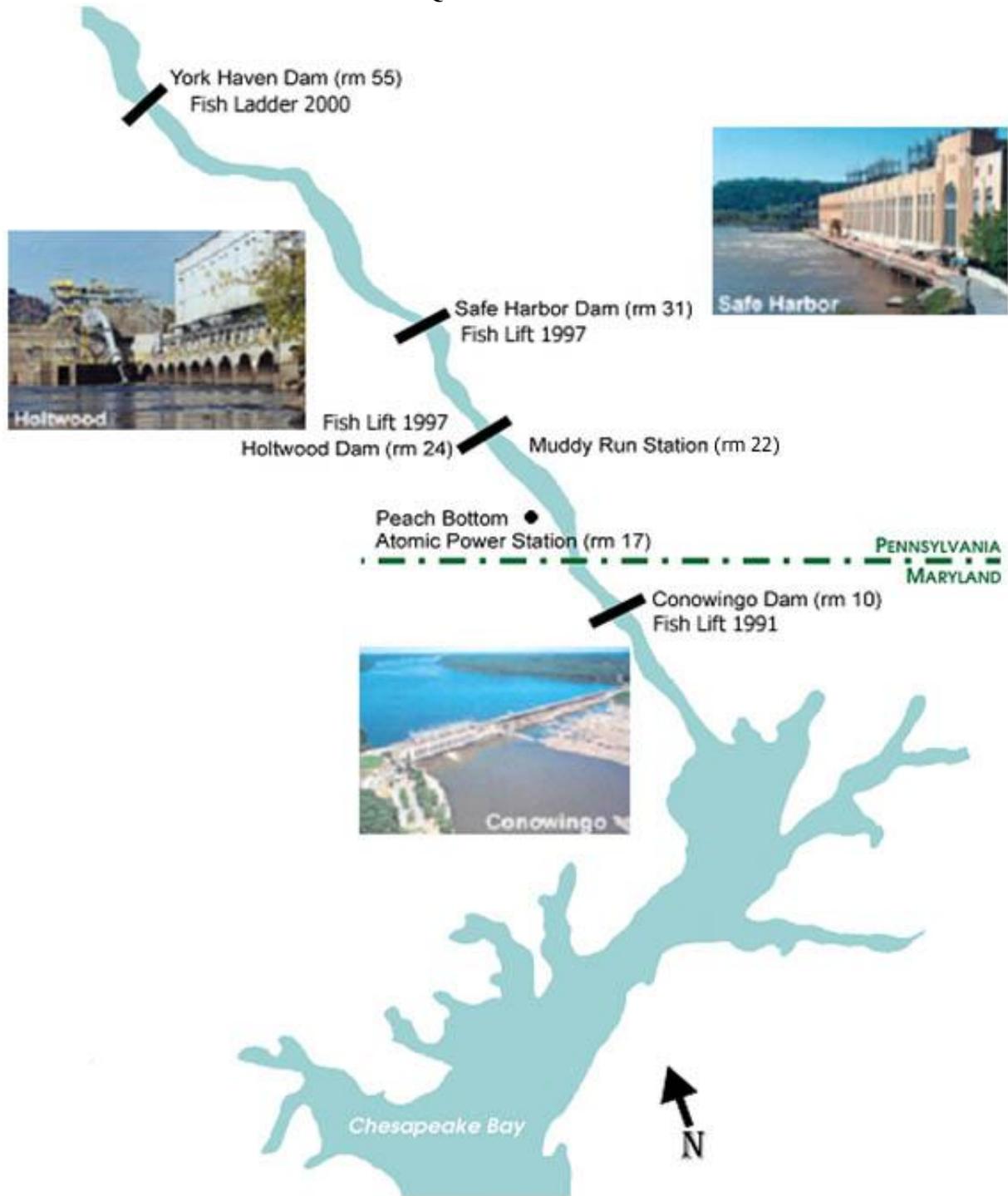
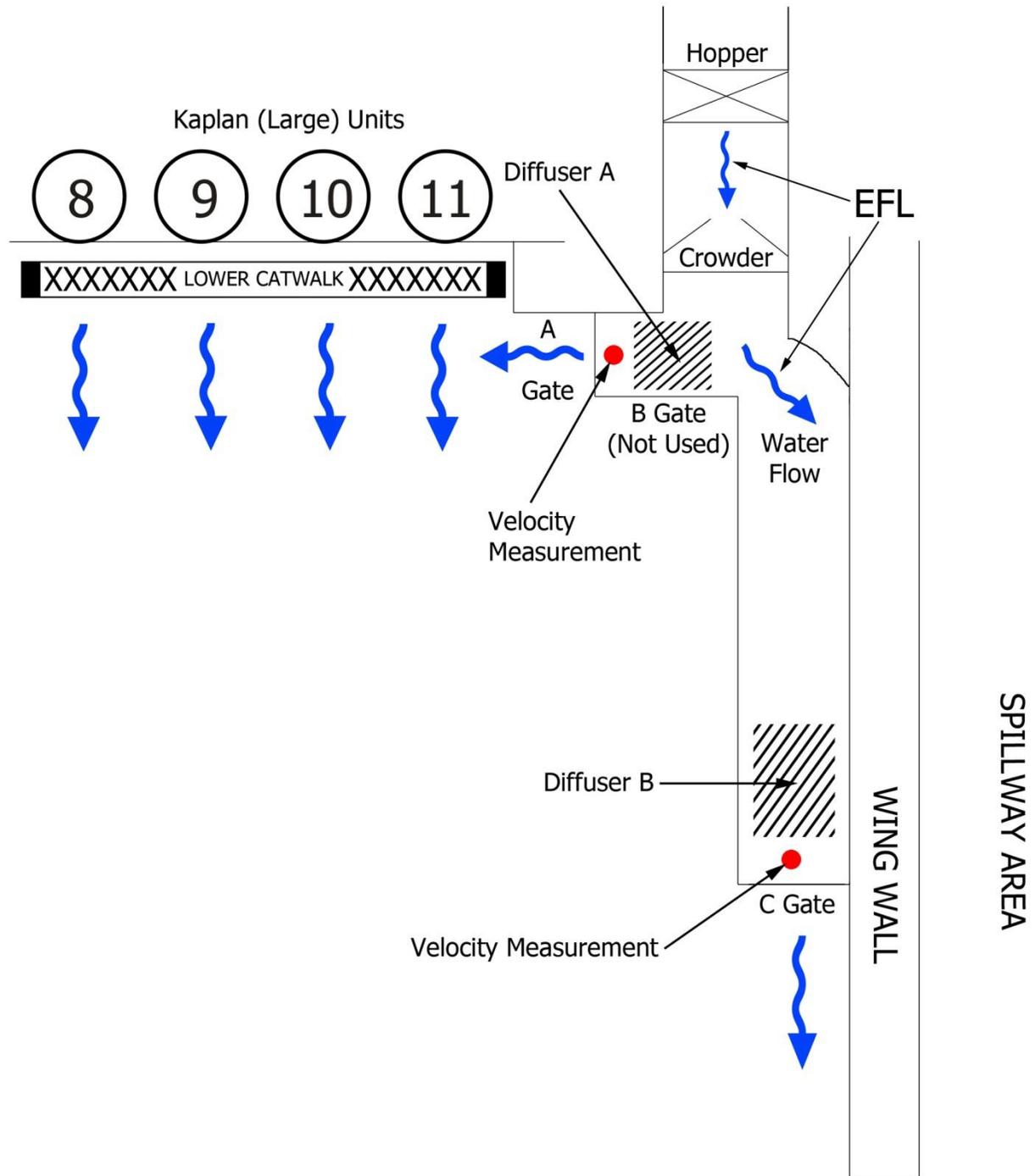
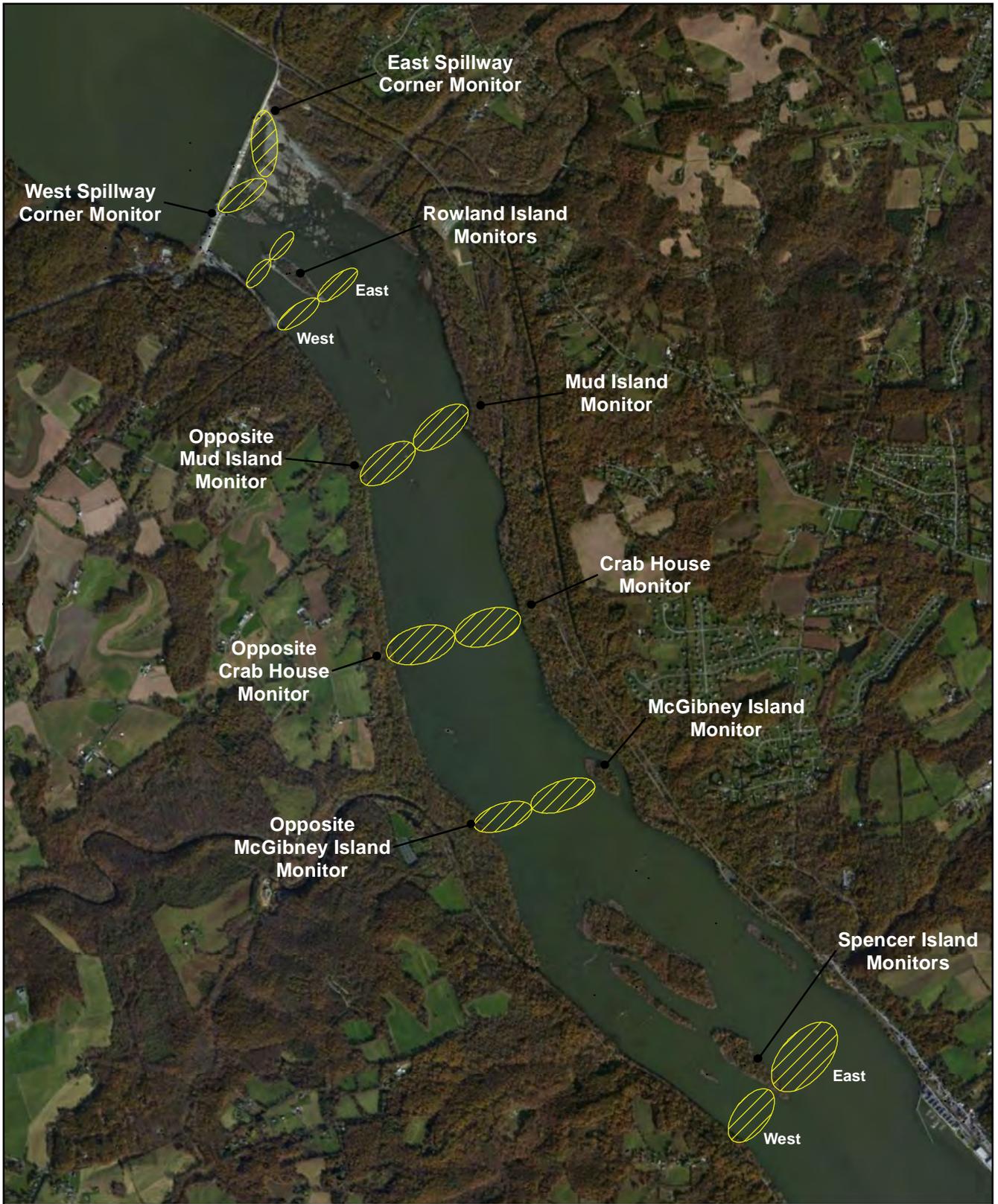


FIGURE 2.2: SCHEMATICS OF EFL (HOW IT FUNCTIONS).





EXELON GENERATION COMPANY, LLC

**RSP STUDY 3.5
CONOWINGO HYDROELECTRIC PROJECT
PROJECT NO. 405**

1 inch = 0.6 miles

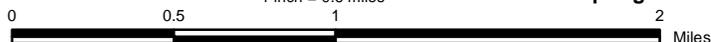


Figure 3.1

Figure Title: General map of study area showing monitoring locations, spring 2012.

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FIGURE 3.2: MAP OF LOWER RIVER MONITORS.

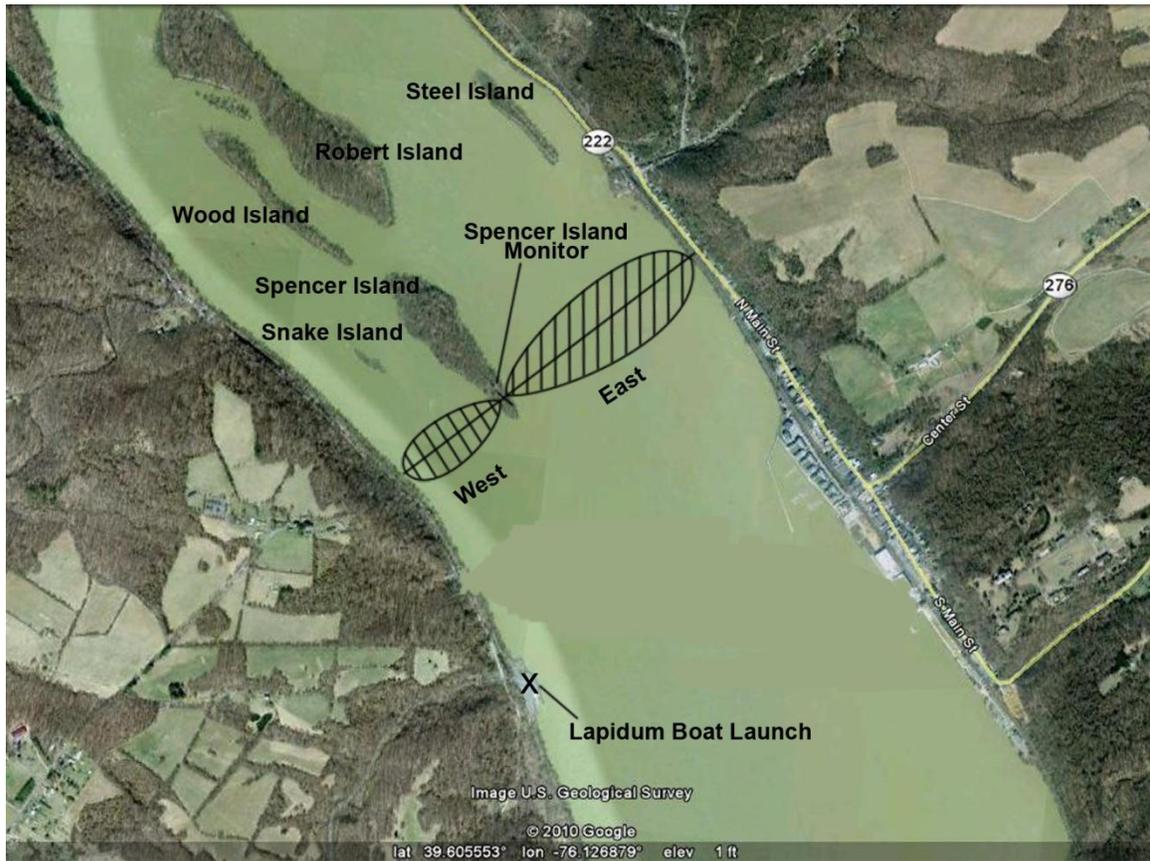


FIGURE 3.3: MAP OF ROWLAND ISLAND AND EAST SPILLWAY CORNER MONITORS.

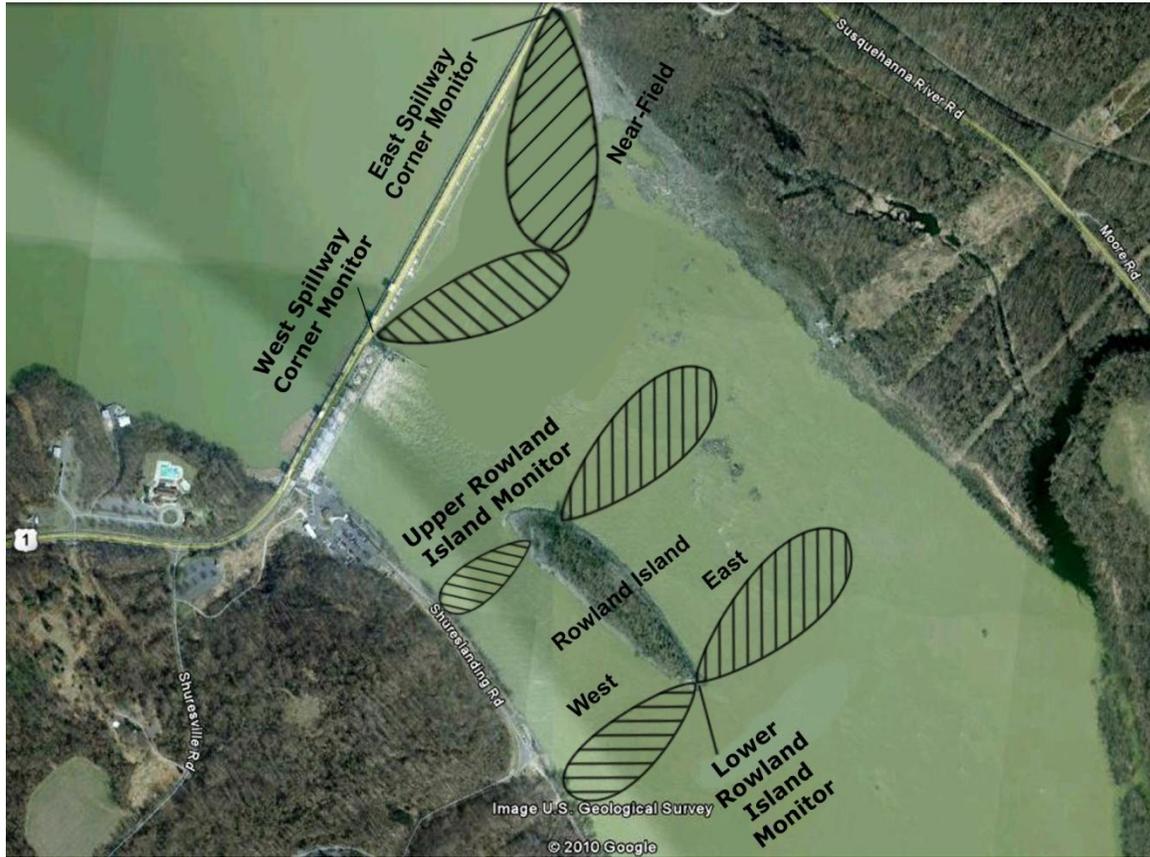


FIGURE 3.4: MAP OF TAILRACE MONITORS.



FIGURE 3.5: EFL MONITORS.

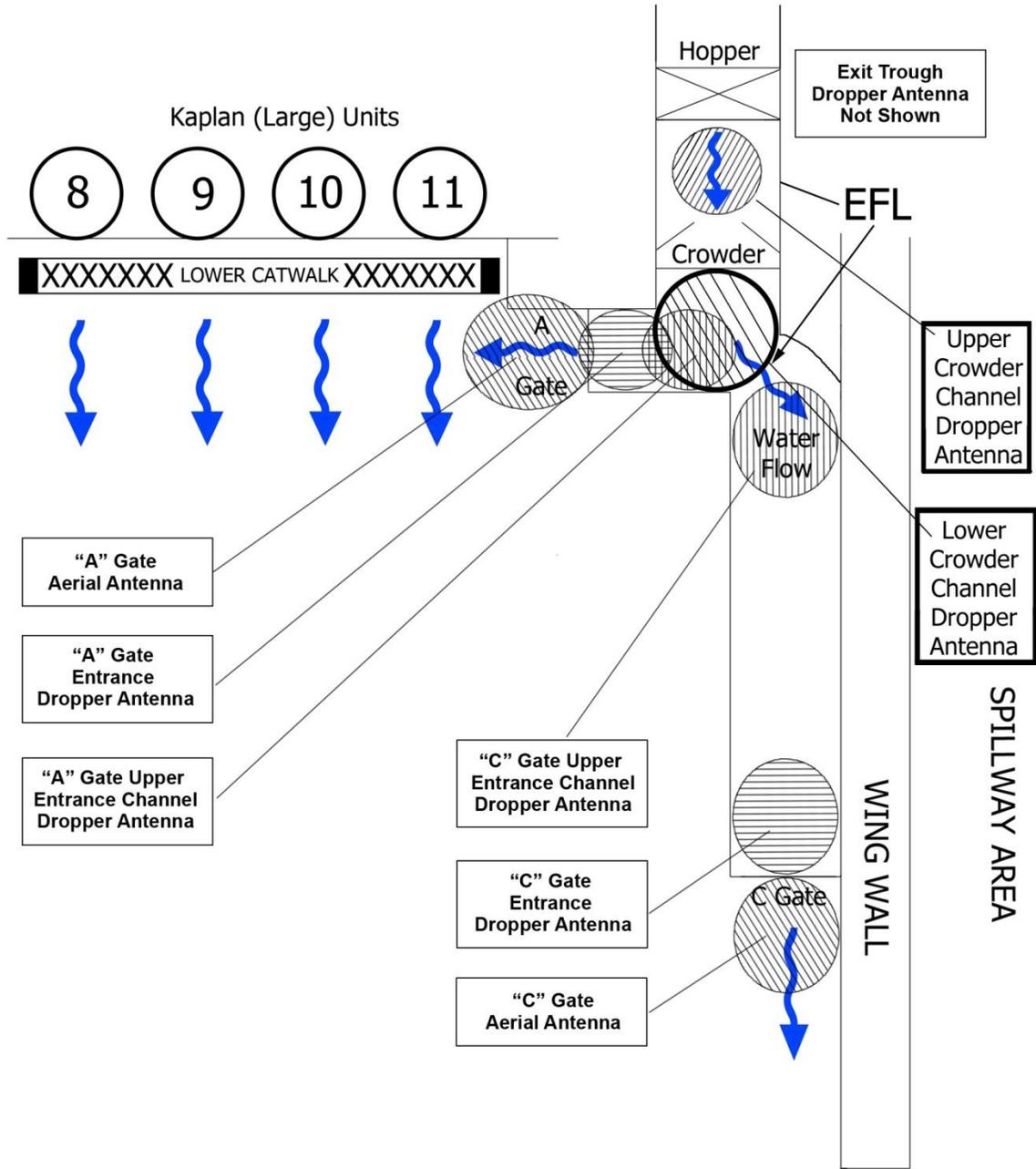


FIGURE 4.1: TEMPERATURE DURING TAGGED SHAD PASSAGE, SPRING 2012.

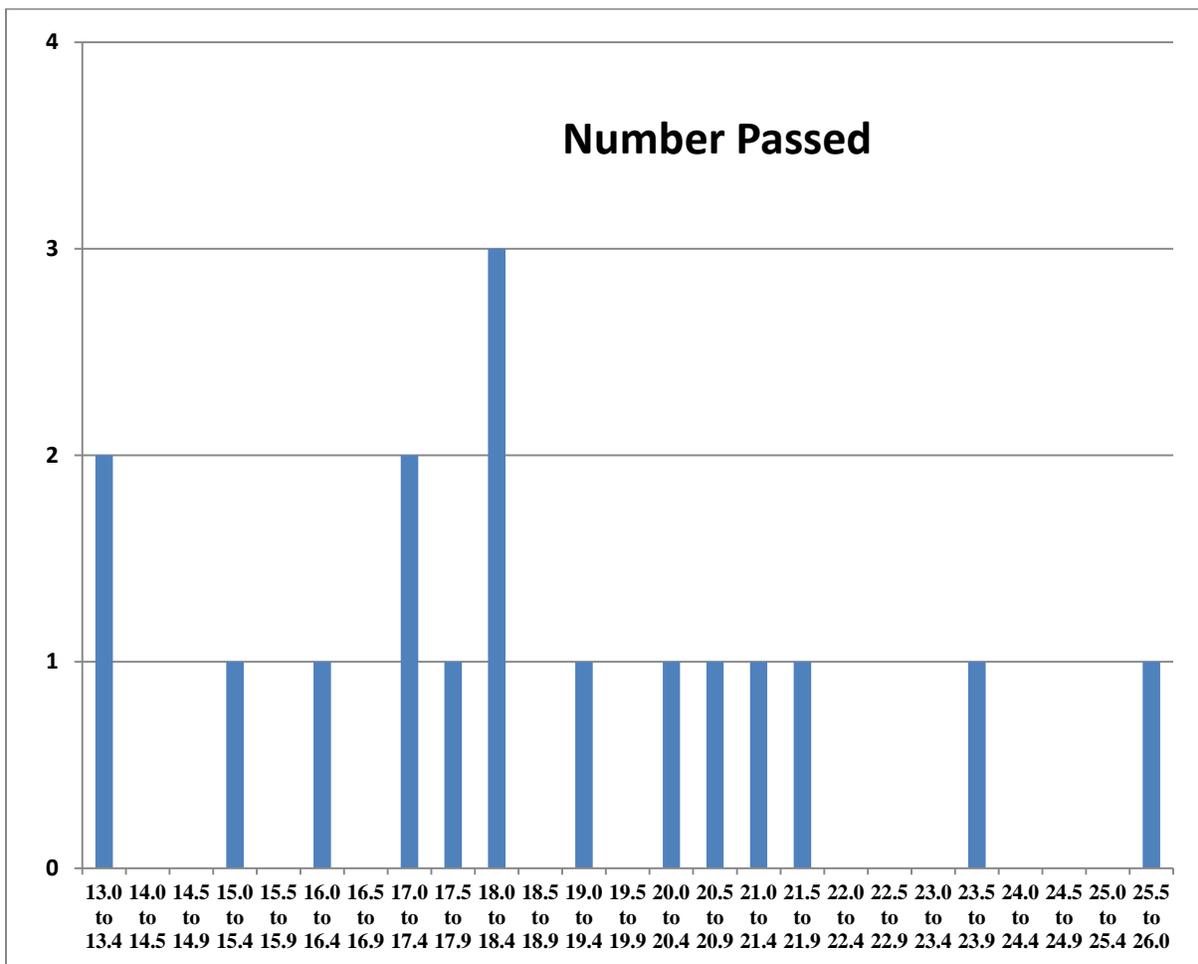


FIGURE 4.2: TEMPERATURE DURING FORAYS INTO EFL, SPRING 2012.

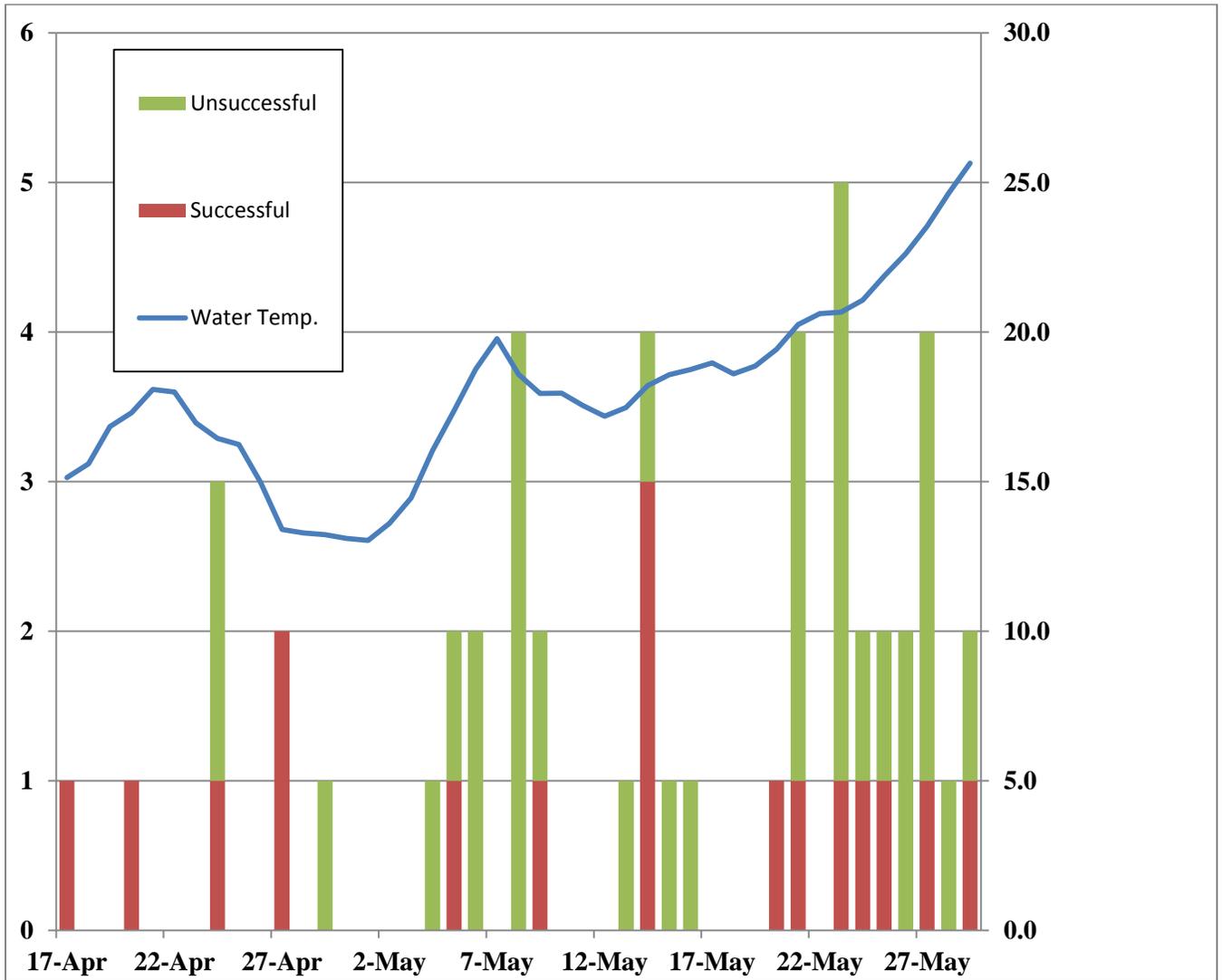


FIGURE 4.3: GENERATION DURING TAGGED SHAD PASSAGE, SPRING 2012.

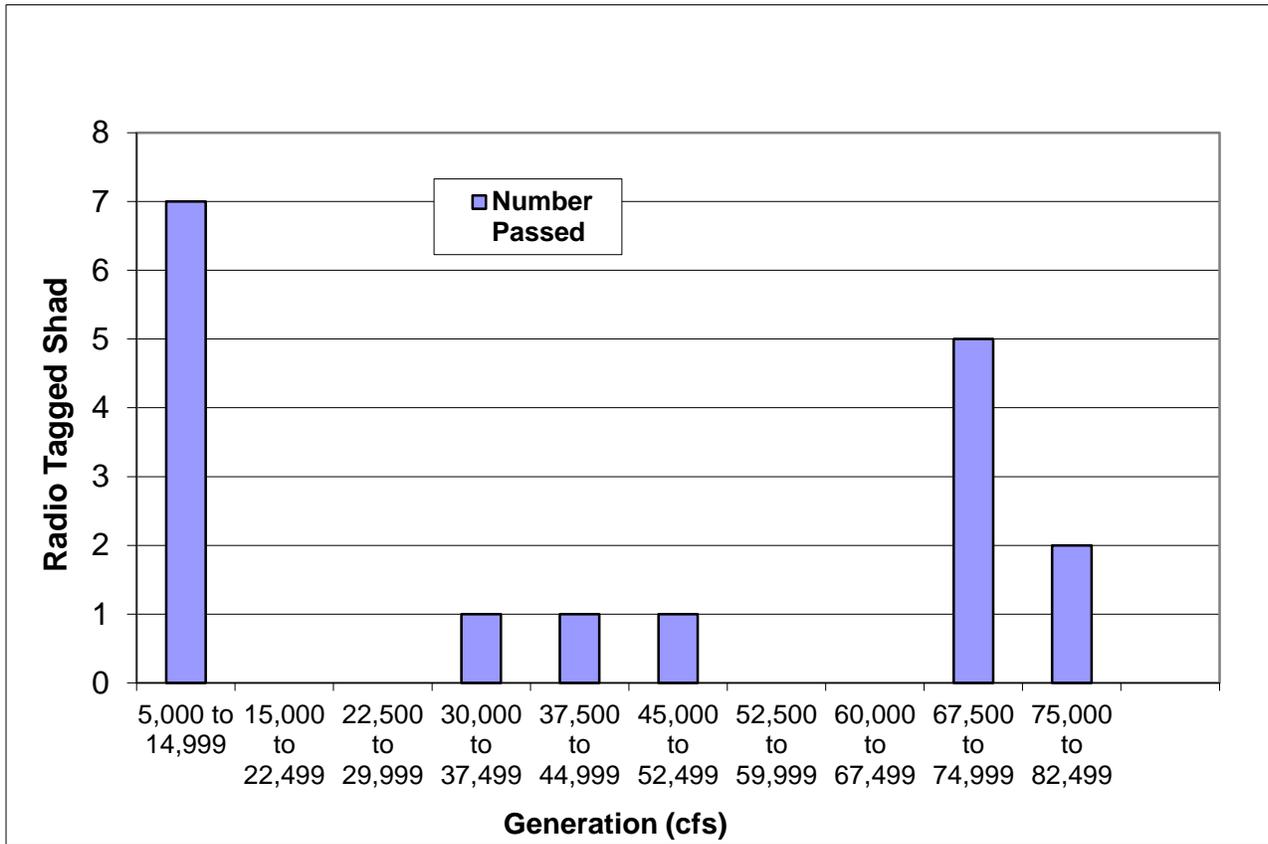


FIGURE 4.4: GENERATION DURING EFL FORAYS, SPRING 2012.

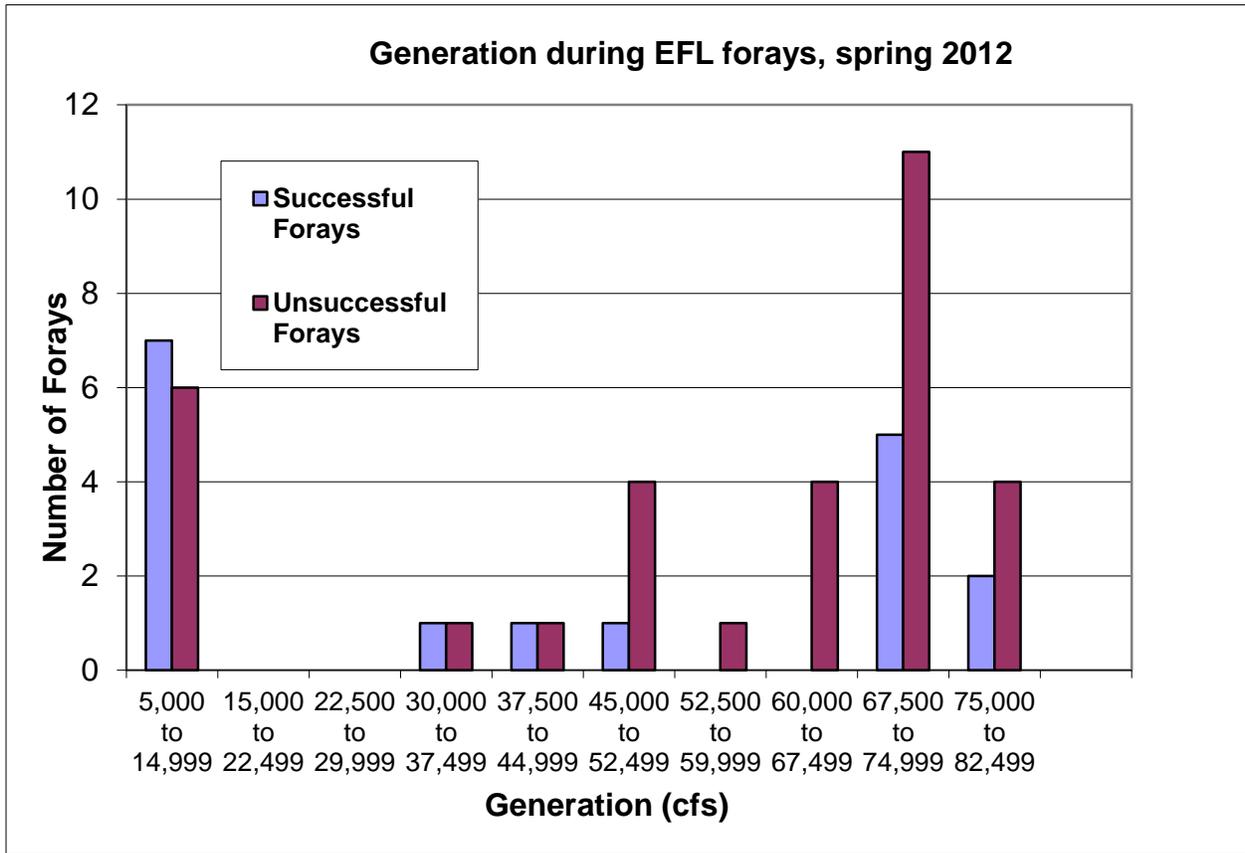


FIGURE 4.5: DATES OF EFL FORAYS, SPRING 2010.

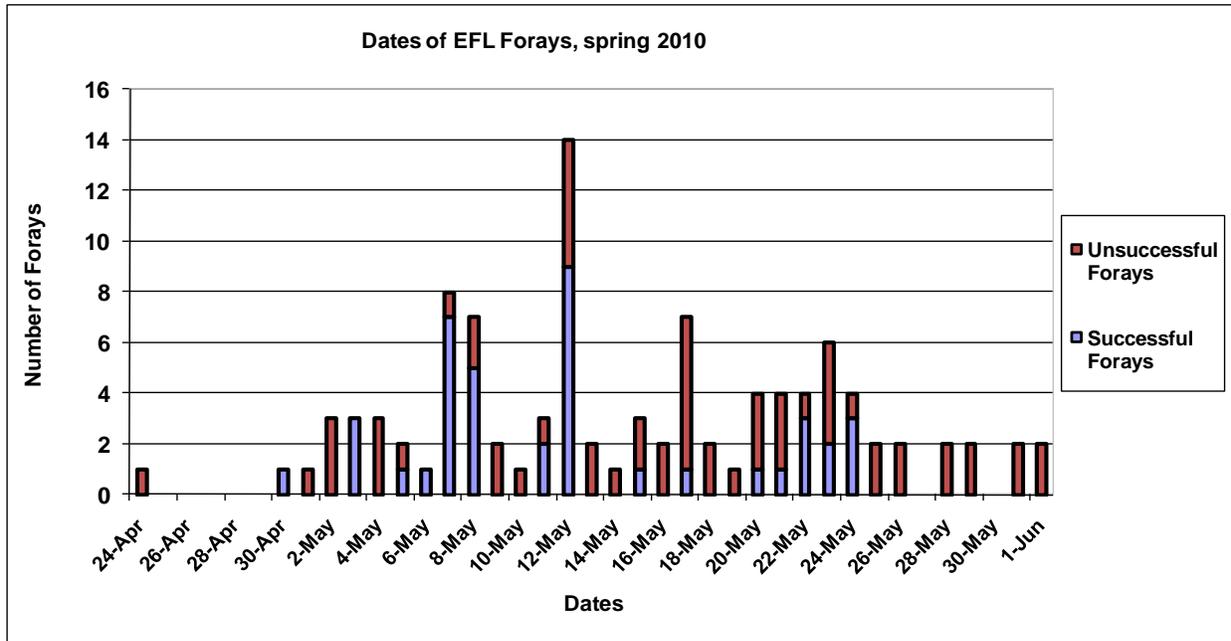
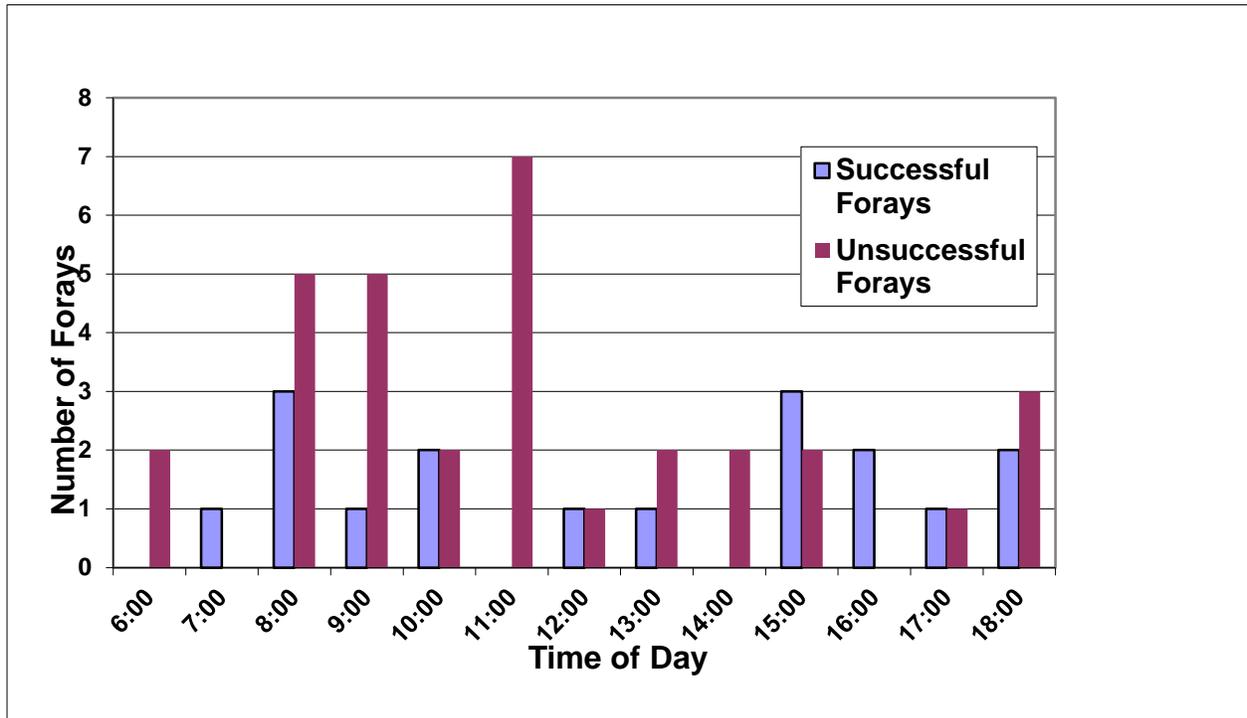


FIGURE 4.6: TIME OF DAY FOR EFL FORAYS, SPRING 2012.



**APPENDIX A: SUMMARY OF TAGGED AND RELEASED ADULT AMERICAN SHAD
DOWNSTREAM OF THE CONOWINGO DAM, SPRING 2012.**

Appendix A

Summary of tagged and released adult American shad downstream of the Conowingo dam, spring 2010.

| Fish | Sex | Length (mm) | Capture Method | Release | | | | River Flow (cfs) | Water Temperature (°C) |
|----------|-----|-------------|----------------|---------|-----------------------|----------|------------------------|------------------|------------------------|
| | | | | Group | Date and Time | Location | Location Description | | |
| 54-192 | F | 515 | Angled | R1 | 4/20/2010 7:53:00 AM | Tailrace | Downstream of "C" Gate | 34,000 | 14.7 |
| 54-190 | M | 463 | Angled | R1 | 4/20/2010 10:11:00 AM | Tailrace | Downstream of "C" Gate | 34,000 | 14.7 |
| 54-191 | M | 473 | Angled | R1 | 4/20/2010 10:24:00 AM | Tailrace | Downstream of "C" Gate | 34,000 | 14.7 |
| 54-193 | M | 465 | Angled | R1 | 4/20/2010 1:08:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-194 | M | 486 | Angled | R1 | 4/20/2010 1:09:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-195 | M | 468 | Angled | R1 | 4/20/2010 1:15:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-196-1 | M | 474 | Angled | R1 | 4/20/2010 1:24:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-197 | M | 475 | Angled | R1 | 4/20/2010 1:29:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-198 | M | 499 | Angled | R1 | 4/20/2010 1:36:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-199 | M | 432 | Angled | R1 | 4/20/2010 1:52:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-200-1 | M | 478 | Angled | R1 | 4/20/2010 1:54:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-201 | F | 468 | Angled | R1 | 4/20/2010 2:08:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-202 | M | 469 | Angled | R1 | 4/20/2010 2:12:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-203 | M | 463 | Angled | R1 | 4/20/2010 2:16:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-204 | F | 491 | Angled | R1 | 4/20/2010 2:20:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-205 | M | 423 | Angled | R1 | 4/20/2010 2:30:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-206 | M | 450 | Angled | R1 | 4/20/2010 2:35:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 54-207 | M | 463 | Angled | R1 | 4/20/2010 2:41:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.7 |
| 21-100 | M | 468 | Angled | R2 | 4/22/2010 10:36:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-101 | M | 478 | Angled | R2 | 4/22/2010 10:47:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-102 | F | 445 | Angled | R2 | 4/22/2010 10:55:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-103 | M | 415 | Angled | R2 | 4/22/2010 11:00:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-104 | M | 430 | Angled | R2 | 4/22/2010 11:06:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-136 | M | 506 | Angled | R2 | 4/22/2010 11:22:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-105 | M | 480 | Angled | R2 | 4/22/2010 11:26:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-106 | M | 451 | Angled | R2 | 4/22/2010 11:29:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-107 | F | 496 | Angled | R2 | 4/22/2010 11:34:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-109 | M | 459 | Angled | R2 | 4/22/2010 11:34:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-110 | F | 518 | Angled | R2 | 4/22/2010 11:35:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-111 | F | 460 | Angled | R2 | 4/22/2010 11:38:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-112 | M | 481 | Angled | R2 | 4/22/2010 11:44:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-113 | F | 510 | Angled | R2 | 4/22/2010 11:51:00 AM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-114 | M | 462 | Angled | R2 | 4/22/2010 12:03:00 PM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-115 | M | 480 | Angled | R2 | 4/22/2010 12:10:00 PM | Tailrace | Downstream of "C" Gate | 45,000 | 14.5 |
| 21-116 | M | 510 | Angled | R2 | 4/22/2010 12:34:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-117 | F | 484 | Angled | R2 | 4/22/2010 12:37:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-108 | F | 499 | Angled | R2 | 4/22/2010 12:45:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-135 | M | 452 | Angled | R2 | 4/22/2010 12:56:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-118 | F | 505 | Angled | R2 | 4/22/2010 1:00:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-119 | M | 491 | Angled | R2 | 4/22/2010 1:02:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-120 | F | 532 | Angled | R2 | 4/22/2010 1:10:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-121 | M | 427 | Angled | R2 | 4/22/2010 1:11:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-122 | M | 471 | Angled | R2 | 4/22/2010 1:20:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-123 | M | 468 | Angled | R2 | 4/22/2010 1:21:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-124 | F | 514 | Angled | R2 | 4/22/2010 1:26:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-125 | F | 493 | Angled | R2 | 4/22/2010 1:28:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-126 | M | 440 | Angled | R2 | 4/22/2010 1:31:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |

| | | | | | | | | | |
|--------|---|-----|----------------|----|-----------------------|---------------------|------------------------|--------|------|
| 21-127 | M | 462 | Angled | R2 | 4/22/2010 1:34:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-128 | M | 461 | Angled | R2 | 4/22/2010 1:35:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-129 | M | 472 | Angled | R2 | 4/22/2010 1:37:00 PM | Tailrace | Downstream Units 5 & 7 | 10,000 | 14.5 |
| 21-130 | F | 505 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 21-131 | F | 480 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 21-132 | F | 485 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 21-133 | F | 495 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 21-134 | F | 505 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-174 | F | 475 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-175 | M | 465 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-176 | M | 485 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-177 | M | 455 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-178 | M | 435 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-179 | M | 480 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-180 | F | 515 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-181 | F | 490 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-182 | M | 415 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-183 | M | 490 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-184 | M | 475 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-185 | F | 525 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-186 | M | 455 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-187 | F | 505 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-188 | M | 480 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-189 | M | 450 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-208 | F | 475 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-209 | M | 450 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-210 | F | 495 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-211 | M | 460 | West Fish Lift | R3 | 4/28/2010 11:35:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 45,000 | 14.8 |
| 54-172 | F | 510 | Angled | R4 | 5/7/2010 9:28:00 AM | Tailrace | Between Units 3 & 5 | 34,000 | 20.8 |
| 54-173 | F | 490 | Angled | R4 | 5/7/2010 9:34:00 AM | Tailrace | Between Units 3 & 5 | 34,000 | 20.8 |
| 54-171 | F | 500 | Angled | R4 | 5/7/2010 10:13:00 AM | Tailrace | Between Units 3 & 5 | 34,000 | 20.8 |
| 54-168 | M | 470 | Angled | R4 | 5/7/2010 10:15:00 AM | Tailrace | Between Units 3 & 5 | 34,000 | 20.8 |
| 54-169 | F | 490 | Angled | R4 | 5/7/2010 10:33:00 AM | Tailrace | Between Units 3 & 5 | 34,000 | 20.8 |
| 54-170 | M | 470 | Angled | R4 | 5/7/2010 10:55:00 AM | Tailrace | Between Units 3 & 5 | 34,000 | 20.8 |
| 54-137 | M | 440 | Angled | R4 | 5/7/2010 11:16:00 AM | Tailrace | Between Units 3 & 5 | 34,000 | 20.8 |
| 54-136 | M | 450 | Angled | R4 | 5/7/2010 11:28:00 AM | Tailrace | Between Units 3 & 5 | 34,000 | 20.8 |
| 54-135 | M | 440 | Angled | R4 | 5/7/2010 11:39:00 AM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-139 | F | 510 | Angled | R4 | 5/7/2010 11:44:00 AM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-138 | M | 440 | Angled | R4 | 5/7/2010 12:05:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-142 | M | 500 | Angled | R4 | 5/7/2010 12:09:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-141 | M | 445 | Angled | R4 | 5/7/2010 12:41:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-140 | M | 480 | Angled | R4 | 5/7/2010 12:55:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-144 | F | 500 | Angled | R4 | 5/7/2010 1:10:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-167 | F | 505 | Angled | R4 | 5/7/2010 1:26:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-164 | M | 440 | Angled | R4 | 5/7/2010 1:28:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-160 | M | 480 | Angled | R4 | 5/7/2010 1:33:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-158 | F | 510 | Angled | R4 | 5/7/2010 2:03:00 PM | Tailrace | Downstream of "C" Gate | 34,000 | 20.8 |
| 54-166 | M | 440 | Angled | R4 | 5/7/2010 3:03:00 PM | Tailrace | Downstream of "C" Gate | 68,000 | 20.8 |
| 54-149 | M | 470 | Angled | R4 | 5/7/2010 3:20:00 PM | Tailrace | Downstream of "C" Gate | 68,000 | 20.8 |
| 54-150 | F | 500 | Angled | R4 | 5/7/2010 3:20:00 PM | Tailrace | Downstream of "C" Gate | 68,000 | 20.8 |
| 54-148 | M | 475 | Angled | R4 | 5/7/2010 3:27:00 PM | Tailrace | Downstream of "C" Gate | 68,000 | 20.8 |
| 54-145 | M | 450 | Angled | R4 | 5/7/2010 3:45:00 PM | Tailrace | Downstream of "C" Gate | 68,000 | 20.8 |

| | | | | | | | | | |
|----------|---|-----|----------------|-----|-----------------------|-------------------------|----------------------------|--------|------|
| 54-151 | M | 525 | Angled | R4 | 5/7/2010 4:14:00 PM | Tailrace | Downstream of "C" Gate | 68,000 | 20.8 |
| 54-153 | F | 510 | Angled | R4 | 5/7/2010 5:13:00 PM | Tailrace | Downstream of "C" Gate | 68,000 | 20.8 |
| 54-152 | F | 515 | Angled | R4 | 5/7/2010 8:02:00 PM | Tailrace | Downstream of "C" Gate | 68,000 | 20.8 |
| 21-137 | F | 495 | Angled | R5 | 5/10/2010 10:29:00 AM | Tailrace | Between Units 7 & 8 | 22,500 | 18.1 |
| 21-138 | F | 460 | Angled | R5 | 5/10/2010 10:44:00 AM | Tailrace | Between Units 7 & 8 | 22,500 | 18.1 |
| 21-139 | M | 450 | Angled | R5 | 5/10/2010 10:52:00 AM | Tailrace | Between Units 7 & 8 | 22,500 | 18.1 |
| 21-140 | F | 468 | Angled | R5 | 5/10/2010 10:55:00 AM | Tailrace | Between Units 7 & 8 | 22,500 | 18.1 |
| 21-141 | F | 470 | Angled | R5 | 5/10/2010 11:02:00 AM | Tailrace | Between Units 7 & 8 | 22,500 | 18.1 |
| 21-174 | F | 482 | Angled | R5 | 5/10/2010 11:17:00 AM | Tailrace | Between Units 7 & 8 | 22,500 | 18.1 |
| 21-142 | F | 495 | Angled | R5 | 5/10/2010 11:45:00 AM | Tailrace | Off of "A" Gate discharge | 22,500 | 18.1 |
| 21-143 | F | 480 | Angled | R5 | 5/10/2010 12:00:00 PM | Tailrace | Off of "A" Gate discharge | 22,500 | 18.1 |
| 21-144 | M | 440 | Angled | R5 | 5/10/2010 12:08:00 PM | Tailrace | Off of "A" Gate discharge | 22,500 | 18.1 |
| 21-145 | F | 475 | Angled | R5 | 5/10/2010 12:12:00 PM | Tailrace | Off of "A" Gate discharge | 22,500 | 18.1 |
| 21-173 | F | 505 | Angled | R5 | 5/10/2010 12:33:00 PM | Tailrace | Off of "A" Gate discharge | 22,500 | 18.1 |
| 21-149 | F | 445 | Angled | R5 | 5/10/2010 12:34:00 PM | Tailrace | Off of "A" Gate discharge | 22,500 | 18.1 |
| 21-146 | F | 505 | Angled | R5 | 5/10/2010 12:36:00 PM | Tailrace | Off of "A" Gate discharge | 22,500 | 18.1 |
| 21-147 | F | 503 | Angled | R5 | 5/10/2010 12:54:00 PM | Tailrace | Off of "A" Gate discharge | 22,500 | 18.1 |
| 21-148 | F | 480 | Angled | R5 | 5/10/2010 2:22:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-150 | M | 475 | Angled | R5 | 5/10/2010 2:35:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-151 | F | 540 | Angled | R5 | 5/10/2010 2:54:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-170 | M | 445 | Angled | R5 | 5/10/2010 3:05:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-152 | M | 440 | Angled | R5 | 5/10/2010 4:14:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-153 | F | 445 | Angled | R5 | 5/10/2010 4:24:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-154 | M | 465 | Angled | R5 | 5/10/2010 5:14:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-155 | M | 480 | Angled | R5 | 5/10/2010 5:21:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-156 | F | 540 | Angled | R5 | 5/10/2010 5:30:00 PM | Tailrace | Between Units 3 & 5 | 7,500 | 18.1 |
| 21-157 | F | 520 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-158 | F | 480 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-159 | F | 505 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-160 | F | 485 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-161 | F | 495 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-162 | F | 515 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-163 | F | 505 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-164 | F | 490 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-165 | F | 455 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-166 | F | 500 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-168 | F | 490 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-169 | F | 475 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-171 | F | 485 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 21-172 | F | 475 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-147 | M | 465 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-154 | F | 480 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-155 | M | 430 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-156 | F | 490 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-157 | F | 510 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-159 | F | 475 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-161 | M | 435 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-162 | M | 460 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-163 | M | 460 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-165 | F | 465 | West Fish Lift | R6L | 5/12/2010 11:40:00 AM | Lapidum Boat Launch | Lapidum Boat Launch | 17,000 | 15.7 |
| 54-196-2 | F | 510 | West Fish Lift | R6T | 5/12/2010 11:00:00 AM | West Fish Lift Tailrace | West Fishlift Sorting Tank | 17,000 | 15.7 |
| 54-200-2 | F | 500 | West Fish Lift | R6T | 5/12/2010 11:00:00 AM | West Fish Lift Tailrace | West Fishlift Sorting Tank | 17,000 | 15.7 |

**APPENDIX B: INITIAL POST TAGGING RETURN DATES AND TIMES TO CONOWINGO
TAILRACE, SPRING 2012.**

Appendix B

Initial post tagging return dates and times to Conowingo Tailrace, spring 2012.

| Fish | Release | | Movement Classification | Release | | Initial Return to Tailrace days-hrs:min:sec |
|-------|---------|------------------------|----------------------------|-----------------|-------------------|--|
| | Group | Location | | Date & Time | Date & Time | |
| 21-13 | | Downstream of "C" Gate | Tailrace without EFL | 4/13/2012 10:23 | 04/17/12 23:34:12 | 04-13:11:12 |
| 21-14 | | Downstream of "C" Gate | EFL No passage | 4/13/2012 14:57 | 04/14/12 20:01:33 | 01-05:04:33 |
| 21-16 | | Downstream of "C" Gate | Tailrace without EFL | 4/13/2012 13:47 | 04/16/12 20:10:30 | 03-06:23:30 |
| 21-18 | | Downstream of "C" Gate | EFL No passage | 4/13/2012 11:13 | 04/15/12 11:58:04 | 02-00:45:04 |
| 21-21 | | Downstream of "C" Gate | Tailrace without EFL | 4/13/2012 10:21 | 04/20/12 22:42:24 | 07-12:21:24 |
| 21-23 | | Downstream of "C" Gate | Tailrace without EFL | 4/12/2012 14:28 | 04/21/12 08:49:28 | 08-18:21:28 |
| 21-24 | | Downstream of "C" Gate | Tailrace without EFL | 4/12/2012 14:38 | 04/12/12 17:08:31 | 00-02:30:31 |
| 21-25 | | Downstream of "C" Gate | Tailrace without EFL | 4/12/2012 14:44 | 04/14/12 04:56:02 | 01-14:12:02 |
| 21-27 | | Downstream of "C" Gate | Passage | 4/12/2012 12:17 | 04/17/12 11:52:43 | 04-23:35:43 |
| 21-28 | | Downstream of "C" Gate | Tailrace without EFL | 4/12/2012 12:16 | 04/13/12 05:13:18 | 00-16:57:18 |
| 21-29 | | Downstream of "C" Gate | Tailrace without EFL | 4/12/2012 12:48 | 04/20/12 08:20:07 | 07-19:32:07 |
| 21-30 | | Downstream of "C" Gate | Tailrace without EFL | 4/12/2012 14:13 | 05/17/12 08:34:10 | 03-18:21:10 |
| 21-36 | | Downstream of "C" Gate | Tailrace without EFL | 5/1/2012 12:22 | 05/05/12 07:29:18 | 03-19:07:18 |
| 21-37 | | Downstream of "C" Gate | EFL No passage | 5/1/2012 14:45 | 05/05/12 11:47:23 | 03-21:02:23 |
| 21-39 | | Downstream of "C" Gate | Passage | 5/1/2012 15:03 | 05/04/12 17:53:06 | 03-02:50:06 |
| 21-41 | | Downstream of "C" Gate | Passage | 5/2/2012 11:15 | 05/07/12 16:31:22 | 05-05:16:22 |
| 21-43 | | Downstream of "C" Gate | EFL No passage | 5/2/2012 12:19 | 05/08/12 23:15:40 | 06-10:56:40 |
| 21-46 | | Downstream of "C" Gate | Tailrace without EFL | 5/2/2012 13:51 | 05/16/12 13:57:34 | 14-00:06:34 |
| 21-52 | | Shures Landing | Tailrace without EFL | 5/17/2012 11:40 | 05/22/12 17:27:51 | 05-05:47:51 |
| 21-64 | | Downstream of "C" Gate | Tailrace without EFL | 5/2/2012 13:54 | 05/12/12 12:38:04 | 09-22:44:04 |
| 21-66 | | Downstream of "C" Gate | Passage | 5/2/2012 15:00 | 05/07/12 13:25:00 | 04-22:25:00 |
| 21-68 | | Downstream of "C" Gate | EFL No passage | 5/2/2012 13:55 | 05/07/12 17:32:05 | 05-03:37:05 |
| 21-69 | | Downstream of "C" Gate | Tailrace without EFL | 4/16/2012 13:20 | 04/16/12 20:04:03 | 00-06:44:03 |
| 21-71 | | Downstream of "C" Gate | Tailrace without EFL | 4/18/2012 11:23 | 04/18/12 13:02:37 | 00-01:39:37 |
| 21-72 | | Downstream of "C" Gate | Passage | 4/18/2012 11:34 | 05/09/12 14:58:24 | 21-03:24:24 |
| 21-73 | | Downstream of "C" Gate | Tailrace without EFL | 4/18/2012 13:59 | 04/19/12 02:24:22 | 00-12:25:22 |
| 21-74 | | Downstream of "C" Gate | Tailrace without EFL | 4/18/2012 12:46 | 05/05/12 18:18:56 | 17-05:32:56 |
| 21-75 | | Downstream of "C" Gate | Passage | 4/18/2012 14:05 | 04/19/12 23:17:24 | 01-09:12:24 |
| 21-77 | | Downstream of "C" Gate | Passage | 4/18/2012 14:29 | 04/20/12 01:31:37 | 01-11:02:37 |
| 21-80 | | Downstream of "C" Gate | Tailrace without EFL | 4/18/2012 15:58 | 04/18/12 21:31:22 | 00-05:33:22 |
| 21-81 | | Downstream of "C" Gate | Tailrace without EFL | 4/18/2012 16:34 | 05/03/12 06:23:42 | 14-13:49:42 |
| 21-82 | | Downstream of "C" Gate | Tailrace without EFL | 4/18/2012 16:36 | 04/24/12 11:21:45 | 05-18:45:45 |
| 21-87 | | Downstream of "C" Gate | EFL No passage | 4/19/2012 13:29 | 04/19/12 19:04:23 | 00-05:35:23 |
| 21-89 | | Shures Landing | EFL No passage | 5/17/2012 11:40 | 05/25/12 22:20:04 | 08-10:40:04 |
| 54-12 | | Downstream Units 5 & 7 | Passage | 4/12/2012 13:08 | 04/25/12 01:54:04 | 12-12:46:04 |
| 54-13 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/12/2012 13:00 | 04/16/12 04:07:18 | 03-15:07:18 |
| 54-14 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/12/2012 13:35 | 04/25/12 03:26:07 | 12-13:51:07 |
| 54-15 | | Downstream Units 5 & 7 | EFL No passage | 4/12/2012 13:17 | 04/14/12 14:43:33 | 02-01:26:33 |
| 54-17 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/12/2012 14:54 | 05/05/12 15:12:07 | 23-00:18:07 |
| 54-18 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/12/2012 13:47 | 04/22/12 18:32:20 | 10-04:45:20 |
| 54-19 | | Downstream Units 5 & 7 | Passage | 4/12/2012 16:11 | 04/16/12 18:42:00 | 04-02:31:00 |
| 54-21 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/13/2012 13:07 | 04/23/12 15:26:39 | 10-02:19:39 |
| 54-24 | | Downstream Units 5 & 7 | EFL No passage | 4/13/2012 13:11 | 04/14/12 18:21:09 | 01-05:10:09 |
| 54-27 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/16/2012 11:41 | 04/18/12 09:56:50 | 01-22:15:50 |
| 54-28 | | Downstream Units 5 & 7 | Passage | 4/13/2012 13:24 | 04/15/12 15:45:24 | 02-02:21:24 |
| 54-30 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/16/2012 12:02 | 04/16/12 15:10:51 | 00-03:08:51 |
| 54-32 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/16/2012 12:51 | 05/04/12 16:22:38 | 18-03:31:38 |
| 54-33 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/18/2012 12:58 | 04/20/12 00:48:02 | 01-11:50:02 |
| 54-34 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/18/2012 13:05 | 04/19/12 06:33:05 | 00-17:28:05 |
| 54-35 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/18/2012 13:30 | 04/24/12 02:30:38 | 05-13:00:38 |
| 54-36 | | Downstream Units 5 & 7 | EFL No passage | 4/18/2012 13:45 | 04/21/12 15:35:07 | 03-01:50:07 |
| 54-38 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/18/2012 14:41 | 04/18/12 19:25:08 | 00-04:44:08 |
| 54-39 | | Downstream Units 5 & 7 | Passage | 4/18/2012 14:48 | 04/25/12 10:00:42 | 06-19:12:42 |
| 54-40 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/18/2012 14:52 | 04/18/12 15:13:11 | 00-00:21:11 |
| 54-42 | | Downstream Units 5 & 7 | Passage | 4/18/2012 15:31 | 05/04/12 09:35:55 | 15-18:04:55 |
| 54-44 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/19/2012 15:05 | 04/23/12 13:08:47 | 03-22:03:47 |
| 54-45 | | Downstream Units 5 & 7 | Tailrace without EFL | 4/19/2012 14:25 | 04/28/12 04:28:46 | 08-14:03:46 |
| 54-50 | | Shures Landing | Tailrace without EFL | 5/17/2012 11:40 | 05/23/12 07:43:57 | 05-20:03:57 |
| 54-65 | | Shures Landing | EFL No passage | 5/17/2012 11:40 | 05/24/12 14:09:51 | 07-02:29:51 |
| 54-71 | | Downstream of "C" Gate | Tailrace without EFL | 5/2/2012 12:45 | 05/08/12 16:20:38 | 06-03:35:38 |
| 54-73 | | Downstream of "C" Gate | Passage | 5/2/2012 13:09 | 05/14/12 13:55:21 | 12-00:46:21 |
| 54-79 | | Downstream of "C" Gate | Passage | 5/2/2012 14:27 | 05/02/12 22:24:40 | 00-07:57:40 |
| 54-80 | | Downstream of "C" Gate | Passage | 5/2/2012 14:53 | 05/09/12 13:42:26 | 06-22:49:26 |
| 54-81 | | Downstream of "C" Gate | Passage | 5/4/2012 10:09 | 05/04/12 11:17:29 | 00-01:08:29 |
| 54-89 | | Downstream of "C" Gate | Passage | 5/4/2012 10:29 | 05/06/12 10:31:16 | 02-00:02:16 |
| 54-90 | | Downstream of "C" Gate | EFL No passage | 5/5/2012 10:23 | 05/08/12 14:08:18 | 03-03:45:18 |

**APPENDIX C: GENERATION (CFS) DURING FORAYS INTO EAST FISH LIFT, SPRING
2012.**

Appendix C

Generation (cfs) during forays into EFL, spring 2012.

| Fish | Initial Foray into EFL Date and Time | Generation Total Discharge (cfs) | Turbine Operating Combination Description | Units Operating | Foray Outcome |
|-------|---|-------------------------------------|--|-------------------------|------------------|
| 54-39 | 05/27/12 08:40:44 | 9200 | 2 & 0 | 5,7 | Successful |
| 21-89 | 5/27/2012 08:13:40 | 9200 | 2 & 0 | 5,7 | Unsuccessful |
| 54-65 | 5/27/2012 12:30:29 | 9200 | 2 & 0 | 5,7 | Unsuccessful |
| 54-90 | 5/26/2012 06:25:02 | 10480 | 2 & 0 | 5,7 | Unsuccessful |
| 54-36 | 5/6/2012 08:12:14 | 10530 | 2 & 0 | 5,7 | Unsuccessful |
| 21-66 | 05/25/12 09:55:30 | 10610 | 2 & 0 | 3,5 | Successful |
| 54-28 | 04/17/12 15:25:24 | 11330 | 2 & 0 | 5,7 | Successful |
| 54-19 | 04/20/12 18:05:32 | 11450 | 2 & 0 | 4,5 | Successful |
| 21-27 | 04/27/12 13:39:00 | 11530 | 2 & 0 | 5,7 | Successful |
| 54-12 | 04/27/12 15:37:32 | 11530 | 2 & 0 | 5,7 | Successful |
| 21-77 | 04/24/12 16:39:15 | 11580 | 2 & 0 | 5,7 | Successful |
| 21-27 | 4/24/2012 13:40:02 | 11580 | 2 & 0 | 5,7 | Unsuccessful |
| 21-27 | 4/24/2012 17:21:53 | 11580 | 2 & 0 | 5,7 | Unsuccessful |
| 54-73 | 05/24/12 10:57:03 | 32,490 | 4 & 2 | 4,5,6,7,9,10 | Successful |
| 21-66 | 5/24/2012 10:55:13 | 32490 | 4 & 2 | 4,5,6,7,9,10 | Unsuccessful |
| 54-80 | 05/14/12 07:58:28 | 39590 | 4 & 2 | 2,3,4,5,8,10 | Successful |
| 21-18 | 5/4/2012 14:39:21 | 40640 | 4 & 2 | 3,4,5,7,10,11 | Unsuccessful |
| 54-65 | 5/26/2012 14:09:20 | 49060 | 4 & 3 | 3,4,5,7,9,10,11 | Unsuccessful |
| 21-18 | 5/6/2012 12:28:35 | 49210 | 4 & 3 | 3,4,5,7,9,10,11 | Unsuccessful |
| 21-75 | 05/05/12 15:32:57 | 49530 | 4 & 3 | 3,4,5,7,9,10,11 | Successful |
| 21-18 | 5/5/2012 12:30:40 | 49530 | 4 & 3 | 3,4,5,7,9,10,11 | Unsuccessful |
| 21-68 | 5/9/2012 18:53:17 | 49660 | 4 & 3 | 3,4,5,7,9,10,11 | Unsuccessful |
| 21-75 | 4/29/2012 10:08:58 | 58880 | 4 & 4 | 3,4,5,7,8,9,10,11 | Unsuccessful |
| 54-39 | 5/8/2012 12:10:03 | 61170 | 6 & 3 | 2,3,4,5,6,7,8,10,11 | Unsuccessful |
| 21-18 | 5/8/2012 09:39:46 | 61170 | 6 & 3 | 2,3,4,5,6,7,8,10,11 | Unsuccessful |
| 54-24 | 5/8/2012 12:27:18 | 61170 | 6 & 3 | 2,3,4,5,6,7,8,10,11 | Unsuccessful |
| 21-43 | 5/27/2012 18:07:50 | 67160 | 6 & 4 | 1,2,3,4,5,7,8,9,10,11 | Unsuccessful |
| 54-65 | 5/25/2012 14:00:37 | 68840 | 6 & 4 | 2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 21-87 | 5/15/2012 15:09:35 | 69110 | 6 & 4 | 2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 54-42 | 05/09/12 16:16:30 | 69250 | 6 & 4 | 2,3,4,5,6,7,8,9,10,11 | Successful |
| 21-41 | 05/23/12 12:24:37 | 73830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Successful |
| 21-66 | 5/23/2012 11:24:12 | 73830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 21-66 | 5/23/2012 17:15:44 | 73830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 54-73 | 5/23/2012 12:52:40 | 73830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 54-81 | 5/23/2012 15:03:00 | 73830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 21-39 | 05/14/12 08:18:49 | 74830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Successful |
| 21-72 | 05/14/12 08:55:17 | 74830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Successful |
| 21-43 | 5/28/2012 17:32:41 | 74830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 21-87 | 5/14/2012 09:44:34 | 74830 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 54-79 | 05/21/12 10:06:22 | 74940 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Successful |
| 21-66 | 5/21/2012 11:22:15 | 74940 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 21-66 | 5/21/2012 15:27:52 | 74940 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 54-81 | 5/21/2012 15:52:58 | 74940 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 54-15 | 5/8/2012 15:56:24 | 75100 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 21-14 | 5/13/2012 15:49:49 | 75500 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 54-89 | 05/20/12 17:28:13 | 75860 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Successful |
| 54-81 | 05/29/12 18:43:52 | 76200 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Successful |
| 54-65 | 5/29/2012 18:53:21 | 76200 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |
| 21-37 | 5/16/2012 18:52:24 | 77520 | 7 & 4 | 1,2,3,4,5,6,7,8,9,10,11 | Unsuccessful |

**APPENDIX D: SUCCESSFUL PASSAGE FORAY AND CORRESPONDING OPERATIONAL
CONDITIONS, SPRING 2012.**

Appendix D

Successful passage foray and corresponding operational conditions.

| Fish | Successful foray that leads to passage | Passage Date and Time | Foray Duration hh:mm:ss | Day of Week | Water Temp. | Hourly Shad Count | Generational Conditions | | | | | | | | | | | Total Flow | Fishlift Operational Conditions | | | Diffuser Setting | | Spillway Attraction Flow Setting | Gate Settings | | Crowder Doors open | Crowder Doors close | Lift Time |
|-------------|--|-----------------------|-------------------------|-------------|-------------|-------------------|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|------------|---------------------------------|-------------|---------------------|------------------|----|----------------------------------|---------------|------|--------------------|---------------------|-----------|
| | | | | | | | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Unit 6 | Unit 7 | Unit 8 | Unit 9 | Unit 10 | Unit 11 | | Weir Gate | Weir % Open | Crowder Area Gate % | A | B | | A | C | | | |
| 21-27 1 | Initial Fishlift Detection | 04/27/12 13:39:00 | 00:19:49 | Friday | 55.81 | 250 | 0 | 0 | 0 | 0 | 5490 | 0 | 6040 | 0 | 0 | 0 | 0 | 11530 | A | 0.91 | 0.35 | 10 | 0 | 14 | 0.91 | 0 | 1358 | 1355 | 1355 |
| | Last Lower Fishlift Det. | 04/27/12 13:58:49 | | Friday | 55.81 | 250 | 0 | 0 | 0 | 0 | 5490 | 0 | 6040 | 0 | 0 | 0 | 0 | 11530 | A | 0.91 | 0.35 | 10 | 0 | 14 | 0.91 | 0 | 1358 | 1355 | 1355 |
| | Exit Trough | 04/27/12 15:24:08 | | Friday | 55.81 | 250 | 0 | 0 | 0 | 0 | 5490 | 0 | 6040 | 0 | 0 | 0 | 0 | 11530 | A | 0.95 | 0.35 | 10 | 0 | 14 | 0.95 | 0 | 1533 | 1530 | 1530 |
| 21-39 2 | Initial Fishlift Detection | 05/14/12 08:18:49 | 00:47:46 | Monday | 64.78 | 161 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 14 | 0 | 0 | 838 | 835 | 835 |
| | Last Lower Fishlift Det. | 05/14/12 09:06:35 | | Monday | 64.78 | 161 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 14 | 0 | 0 | 908 | 905 | 905 |
| | Exit Trough | 05/14/12 09:22:52 | | Monday | 64.78 | 161 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 14 | 0 | 0 | 938 | 935 | 935 |
| 21-41 3 | Initial Fishlift Detection | 05/23/12 12:24:37 | 05:39:29 | Wednesday | 69.2 | 12 and 8 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 0.1 | 0.5 | 10 | 50 | 15 | 0 | 0.1 | 1238 | 1230 | 1230 |
| | Last Lower Fishlift Det. | 05/23/12 18:04:06 | | Wednesday | 69.2 | 12 and 8 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 0.1 | 0.5 | 10 | 50 | 15 | 0 | 0.1 | 1804 | 1800 | 1800 |
| | Exit Trough | 05/23/12 18:17:48 | | Wednesday | 69.2 | 12 and 8 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 0.1 | 0.5 | 10 | 50 | 15 | 0 | 0.1 | 1839 | 1830 | 1830 |
| 21-66 4 | Initial Fishlift Detection | 05/25/12 09:55:30 | 00:34:19 | Friday | 71.36 | 91 | 0 | 0 | 6060 | 0 | 4550 | 0 | 0 | 0 | 0 | 0 | 10610 | A | 1.07 | 0.5 | 10 | 0 | 14 | 1.07 | 0 | 1003 | 1000 | 1000 | |
| | Last Lower Fishlift Det. | 05/25/12 10:29:49 | | Friday | 71.36 | 91 | 0 | 0 | 6060 | 0 | 4550 | 0 | 0 | 0 | 0 | 0 | 10610 | A | 1.07 | 0.5 | 10 | 0 | 14 | 1.07 | 0 | 1033 | 1030 | 1030 | |
| | Exit Trough | 05/25/12 10:39:11 | | Friday | 71.36 | 91 | 0 | 0 | 6060 | 0 | 4550 | 0 | 0 | 0 | 0 | 0 | 10610 | A | 1.07 | 0.35 | 10 | 50 | 14 | 1.07 | 0 | 1103 | 1100 | 1100 | |
| 21-72 5 | Initial Fishlift Detection | 05/14/12 08:55:17 | 00:11:31 | Monday | 64.78 | 279 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 14 | 0 | 0 | 908 | 905 | 905 |
| | Last Lower Fishlift Det. | 05/14/12 09:06:48 | | Monday | 64.78 | 279 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 14 | 0 | 0 | 908 | 905 | 905 |
| | Exit Trough | 05/14/12 09:26:38 | | Monday | 64.78 | 279 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 14 | 0 | 0 | 938 | 935 | 935 |
| 21-75 6 | Initial Fishlift Detection | 05/05/12 15:32:57 | 00:28:15 | Saturday | 63.27 | 231 | 0 | 0 | 6040 | 6080 | 4920 | 0 | 5530 | 0 | 8730 | 8940 | 9290 | 49530 | C | 0.45 | 0.5 | 10 | 52 | 16 | 0 | 0.45 | 1535 | 1530 | 1530 |
| | Last Lower Fishlift Det. | 05/05/12 16:01:12 | | Saturday | 63.27 | 231 | 0 | 0 | 6040 | 6080 | 4920 | 0 | 5530 | 0 | 8730 | 8940 | 9290 | 49530 | C | 0.45 | 0.5 | 10 | 52 | 16 | 0 | 0.45 | 1602 | 1600 | 1600 |
| | Exit Trough | 05/05/12 16:17:01 | | Saturday | 63.27 | 231 | 0 | 0 | 6040 | 6080 | 4920 | 0 | 5530 | 0 | 8730 | 8940 | 9290 | 49530 | C | 0.45 | 0.5 | 10 | 52 | 16 | 0 | 0.45 | 1633 | 1630 | 1630 |
| 21-77 7 | Initial Fishlift Detection | 04/24/12 16:39:15 | 00:25:16 | Tuesday | 61.6 | 417 | 0 | 0 | 0 | 0 | 5490 | 0 | 6090 | 0 | 0 | 0 | 0 | 11580 | A | 0.96 | 0.3 | 10 | 0 | 14 | 0.96 | 0 | 1635 | 1630 | 1630 |
| | Last Lower Fishlift Det. | 04/24/12 17:04:31 | | Tuesday | 61.6 | 417 | 0 | 0 | 0 | 0 | 5490 | 0 | 6090 | 0 | 0 | 0 | 0 | 11580 | A | 0.96 | 0.3 | 10 | 0 | 14 | 0.96 | 0 | 1703 | 1700 | 1700 |
| | Exit Trough | 04/24/12 17:16:49 | | Tuesday | 61.6 | 417 | 0 | 0 | 0 | 0 | 5490 | 0 | 6090 | 0 | 0 | 0 | 0 | 11580 | A | 0.96 | 0.3 | 10 | 0 | 14 | 0.96 | 0 | 1732 | 1730 | 1730 |
| 54-12 8 | Initial Fishlift Detection | 04/27/12 15:37:32 | 00:22:10 | Friday | 56.12 | 369 | 0 | 0 | 0 | 0 | 5490 | 0 | 6040 | 0 | 0 | 0 | 0 | 11530 | A | 0.95 | 0.35 | 10 | 0 | 14 | 0.95 | 0 | 1533 | 1530 | 1530 |
| | Last Lower Fishlift Det. | 04/27/12 15:59:42 | | Friday | 56.12 | 369 | 0 | 0 | 0 | 0 | 5490 | 0 | 6040 | 0 | 0 | 0 | 0 | 11530 | A | 0.72 | 0.35 | 10 | 0 | 14 | 0.95 | 0 | 1603 | 1600 | 1600 |
| | Exit Trough | 04/27/12 16:09:21 | | Friday | 56.12 | 369 | 0 | 0 | 5950 | 6030 | 5490 | 0 | 6040 | 0 | 0 | 8910 | 0 | 32420 | A | 0.72 | 0.35 | 10 | 0 | 14 | 0.72 | 0 | 1633 | 1630 | 1630 |
| 54-19 9 | Initial Fishlift Detection | 04/20/12 18:05:32 | 00:26:52 | Friday | 63.14 | 110 | 0 | 0 | 0 | 6240 | 5210 | 0 | 0 | 0 | 0 | 0 | 0 | 11450 | A | 0.95 | 0.36 | 10 | 0 | 14 | 0.95 | 0 | 1803 | 1800 | 1800 |
| | Last Lower Fishlift Det. | 04/20/12 18:32:24 | | Friday | 63.14 | 110 | 0 | 0 | 0 | 6240 | 5210 | 0 | 0 | 0 | 0 | 0 | 0 | 11450 | A | 0.95 | 0.36 | 10 | 0 | 14 | 0.95 | 0 | 1803 | 1800 | 1830 |
| | Exit Trough | 04/20/12 18:39:04 | | Friday | 63.14 | 110 | 0 | 0 | 0 | 6240 | 5210 | 0 | 0 | 0 | 0 | 0 | 0 | 11450 | A | 0.95 | 0.36 | 10 | 0 | 14 | 0.95 | 0 | 1803 | 1800 | 1800 |
| 54-28 10 | Initial Fishlift Detection | 04/17/12 15:25:24 | 00:24:05 | Tuesday | 59.25 | 280 | 0 | 0 | 0 | 0 | 5200 | 0 | 6130 | 0 | 0 | 0 | 0 | 11330 | A | 0.94 | 0.36 | 10 | 0 | 14 | 0.94 | 0 | 1523 | 1520 | 1520 |
| | Last Lower Fishlift Det. | 04/17/12 15:49:29 | | Tuesday | 59.25 | 280 | 0 | 0 | 0 | 0 | 5200 | 0 | 6130 | 0 | 0 | 0 | 0 | 11330 | A | 0.94 | 0.36 | 10 | 0 | 14 | 0.94 | 0 | 1553 | 1550 | 1550 |
| | Exit Trough | 04/18/12 14:11:43 | | Wednesday | 62.54 | 0 | 0 | 5020 | 6110 | 6140 | 5490 | 0 | 0 | 0 | 0 | 0 | 0 | 22760 | A | 0.94 | 0.36 | 10 | 0 | 14 | 0.94 | 0 | 1553 | 1550 | 1550 |
| 54-39 11 | Initial Fishlift Detection | 05/27/12 08:40:44 | 00:11:31 | Sunday | 74.36 | 24 | 0 | 0 | 0 | 0 | 4250 | 0 | 4950 | 0 | 0 | 0 | 0 | 9200 | A | 1.05 | 0.4 | 10 | 35 | 14 | 0 | 0.14 | 848 | 840 | 840 |
| | Last Lower Fishlift Det. | 05/27/12 08:52:15 | | Sunday | 74.36 | 24 | 0 | 0 | 0 | 0 | 4250 | 0 | 4950 | 0 | 0 | 0 | 0 | 9200 | A | 1.05 | 0.4 | 10 | 35 | 14 | 0 | 0.1 | 918 | 915 | 915 |
| | Exit Trough | 05/27/12 09:08:03 | | Sunday | 74.36 | 24 | 0 | 0 | 0 | 0 | 4250 | 0 | 4950 | 0 | 0 | 0 | 0 | 9200 | A | 1.05 | 0.4 | 10 | 35 | 14 | 0 | 0.1 | 949 | 946 | 946 |
| 54-42 12 | Initial Fishlift Detection | 05/09/12 16:16:30 | 00:13:36 | Wednesday | 64.3 | 29 | 0 | 5190 | 5900 | 6040 | 5130 | 5540 | 5770 | 8860 | 8650 | 8890 | 9280 | 69250 | C | 0.3 | 0.29 | 10 | 50 | 14 | 0 | 0.3 | 1603 | 1600 | 1600 |
| | Last Lower Fishlift Det. | 05/09/12 16:30:06 | | Wednesday | 64.3 | 29 | 0 | 5190 | 5900 | 6040 | 5130 | 5540 | 5770 | 8860 | 8650 | 8890 | 9280 | 69250 | C | 0.3 | 0.29 | 10 | 50 | 14 | 0 | 0.3 | 1633 | 1630 | 1630 |
| | Exit Trough | 05/09/12 16:38:49 | | Wednesday | 64.3 | 29 | 0 | 5190 | 5900 | 6040 | 5130 | 5540 | 5770 | 8860 | 8650 | 8890 | 9280 | 69250 | C | 0.3 | 0.29 | 10 | 50 | 14 | 0 | 0.21 | 1703 | 1700 | 1700 |
| 54-73 13 | Initial Fishlift Detection | 05/24/12 10:57:03 | 00:14:29 | Thursday | 69.93 | 75 | 0 | 0 | 0 | 6060 | 4970 | 5870 | 5770 | 0 | 8710 | 1110 | 0 | 32490 | C | 0.4 | 0.5 | 10 | 50 | 15 | 0 | 0.4 | 1033 | 1030 | 1030 |
| | Last Lower Fishlift Det. | 05/24/12 11:11:32 | | Thursday | 69.93 | 75 | 0 | 0 | 0 | 6060 | 4970 | 5870 | 5770 | 0 | 8710 | 1110 | 0 | 32490 | C | 0.4 | 0.5 | 10 | 50 | 15 | 0 | 0.4 | 1103 | 1059 | 1100 |
| | Exit Trough | 05/24/12 11:16:15 | | Thursday | 69.93 | 75 | 0 | 0 | 0 | 6060 | 4970 | 5870 | 5770 | 0 | 8710 | 1110 | 0 | 32490 | C | 0.4 | 0.5 | 10 | 50 | 15 | 0 | 0.4 | 1133 | 1130 | 1130 |
| 54-79 14 | Initial Fishlift Detection | 05/21/12 10:06:22 | 00:24:38 | Monday | 68.45 | 58 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 0.15 | 0.5 | 10 | 50 | 14 | 0 | 0.15 | 1003 | 1000 | 1000 |
| | Last Lower Fishlift Det. | 05/21/12 10:31:00 | | Monday | 68.45 | 58 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 0.15 | 0.5 | 10 | 50 | 14 | 0 | 0.15 | 1033 | 1030 | 1030 |
| | Exit Trough | 05/21/12 11:21:33 | | Monday | 68.45 | 58 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 0.15 | 0.5 | 10 | 50 | 14 | 0 | 0.15 | 1104 | 1100 | 1100 |
| 54-80 15 | Initial Fishlift Detection | 05/14/12 07:58:28 | 00:42:25 | Monday | 64.78 | 161 | 0 | 4880 | 5960 | 5950 | 5030 | 0 | 0 | 8870 | 0 | 8900 | 0 | 39590 | C | 0.46 | 0.35 | 10 | 50 | 14 | 0 | 0 | 808 | 805 | 805 |
| | Last Lower Fishlift Det. | 05/14/12 08:40:53 | | Monday | 64.78 | 161 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 14 | 0 | 0 | 838 | 835 | 835 |
| | Exit Trough | 05/14/12 08:50:09 | | Monday | 64.78 | 161 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | | | | | | | | | | | | |

**APPENDIX E: UNSUCCESSFUL PASSAGE FORAY FOR SHAD THAT LATER PASSED AND
CORRESPONDING OPERATIONAL CONDITIONS, SPRING 2012.**

Appendix E

Unsuccessful passage foray for shad that later passed and corresponding operational conditions.

| Fish | Number of Unsuccessful Forays | Unsuccessful Forays | Foray Date and Time | Foray Duration hh:mm:ss | Day of Week | Water Temp. | Hourly Shad Count | Generational Conditions | | | | | | | | | | | Total Flow | Fishlift Operational Conditions | | | Diffuser Setting | | Gate Setting | | Spillway Attraction Flow Setting | Crowder Doors | | | | |
|------------|-------------------------------|--------------------------------|---------------------|-------------------------|-------------|-------------|-------------------|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|------------|---------------------------------|-------------|---------------------|------------------|-----|--------------|-----|----------------------------------|---------------|--------|----|------|------|
| | | | | | | | | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Unit 6 | Unit 7 | Unit 8 | Unit 9 | Unit 10 | Unit 11 | | Weir Gate | Weir % Open | Crowder Area Gate % | A | B | A | C | | Open | Closed | | | |
| 21-27 1 | 2 | Foray 1 Initial Lift Detection | 4/24/2012 13:40:02 | | Tuesday | 61.6 | 57 | 0 | 0 | 0 | 0 | 5490 | 0 | 6090 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11580 | A | 96% | 30% | 10 | 0 | 96% | 0% | 14 | 1335 | 1330 |
| | | Foray 1 Last Lift Detection | 4/24/2012 13:42:18 | 00:02:16 | Tuesday | 61.6 | 57 | 0 | 0 | 0 | 0 | 5490 | 0 | 6090 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11580 | A | 96% | 30% | 10 | 0 | 96% | 0% | 14 | 1335 | 1330 |
| 21-27 2 | 2 | Foray 1 Initial Lift Detection | 4/24/2012 17:21:53 | | Tuesday | 61.6 | 208 | 0 | 0 | 0 | 0 | 5490 | 0 | 6090 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11580 | A | 96% | 30% | 10 | 0 | 96% | 0% | 14 | 1703 | 1700 |
| | | Foray 1 Last Lift Detection | 4/24/2012 17:32:10 | 00:10:17 | Tuesday | 61.6 | 208 | 0 | 0 | 0 | 0 | 5490 | 0 | 6090 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11580 | A | 96% | 30% | 10 | 0 | 96% | 0% | 14 | 1732 | 1730 |
| 21-66 2 | 5 | Foray 1 Initial Lift Detection | 5/21/2012 11:22:15 | | Monday | 68.45 | 52 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 15% | 50% | 10 | 50 | 0% | 15% | 14 | 1104 | 1100 | | | |
| | | Foray 1 Last Lift Detection | 5/21/2012 11:50:37 | 00:28:22 | Monday | 68.45 | 52 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 15% | 50% | 10 | 50 | 0% | 15% | 14 | 1134 | 1130 | | | |
| 21-66 3 | 5 | Foray 1 Initial Lift Detection | 5/21/2012 15:27:52 | | Monday | 68.45 | 31 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 15% | 50% | 10 | 50 | 0% | 15% | 14 | 1504 | 1500 | | | |
| | | Foray 1 Last Lift Detection | 5/21/2012 16:01:44 | 00:33:52 | Monday | 68.45 | 57 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 15% | 50% | 10 | 50 | 0% | 15% | 14 | 1604 | 1600 | | | |
| 21-66 4 | 5 | Foray 1 Initial Lift Detection | 5/23/2012 11:24:12 | | Wednesday | 69.2 | 84 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 10% | 50% | 10 | 50 | 0% | 10% | 15 | 1103 | 1100 | | | |
| | | Foray 1 Last Lift Detection | 5/23/2012 13:29:22 | 02:05:10 | Wednesday | 69.2 | 32 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 10% | 50% | 10 | 50 | 0% | 10% | 15 | 1303 | 1300 | | | |
| 21-66 5 | 5 | Foray 1 Initial Lift Detection | 5/23/2012 17:15:44 | | Wednesday | 69.2 | 49 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 10% | 50% | 10 | 50 | 0% | 10% | 15 | 1703 | 1700 | | | |
| | | Foray 1 Last Lift Detection | 5/23/2012 18:12:21 | 00:56:37 | Wednesday | 69.2 | 43 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 10% | 50% | 10 | 50 | 0% | 10% | 15 | 1804 | 1800 | | | |
| 21-66 6 | 5 | Foray 1 Initial Lift Detection | 5/24/2012 10:55:13 | | Thursday | 69.93 | 104 | 0 | 0 | 0 | 6060 | 4970 | 5870 | 5770 | 0 | 8710 | 1110 | 0 | 32490 | C | 40% | 50% | 10 | 50 | 0% | 40% | 15 | 1033 | 1030 | | | |
| | | Foray 1 Last Lift Detection | 5/24/2012 11:33:02 | 00:37:49 | Thursday | 69.93 | 75 | 0 | 0 | 0 | 6060 | 4970 | 5870 | 5770 | 0 | 8710 | 1110 | 0 | 32490 | C | 40% | 50% | 10 | 50 | 0% | 40% | 15 | 1133 | 1130 | | | |
| 21-75 3 | 1 | Foray 2 Initial Lift Detection | 4/29/2012 10:08:58 | | Sunday | 55.81 | 8 | 0 | 0 | 6000 | 6000 | 5600 | 0 | 5840 | 8830 | 8680 | 8820 | 9110 | 58880 | C | 55% | 35% | 10 | 55 | 0% | 55% | 14 | 1014 | 1010 | | | |
| | | Foray 2 Last Lift Detection | 4/29/2012 11:06:47 | 00:57:49 | Sunday | 55.81 | 8 | 0 | 0 | 6000 | 6000 | 5600 | 0 | 5840 | 8830 | 8680 | 8820 | 9110 | 58880 | C | 55% | 35% | 10 | 55 | 0% | 55% | 14 | 1114 | 1110 | | | |
| 54-39 4 | 1 | Foray 1 Initial Lift Detection | 5/8/2012 12:10:03 | | Tuesday | 65.45 | 19 | 0 | 5210 | 6040 | 6040 | 5370 | 5750 | 5740 | 8830 | 0 | 8920 | 9270 | 61170 | C | 16% | 35% | 10 | 50 | 0% | 16% | 14 | 1203 | 1200 | | | |
| | | Foray 1 Last Lift Detection | 5/8/2012 12:31:21 | 00:21:18 | Tuesday | 65.45 | 19 | 0 | 5210 | 6040 | 6040 | 5370 | 5750 | 5740 | 8830 | 0 | 8920 | 9270 | 61170 | C | 16% | 35% | 10 | 50 | 0% | 16% | 14 | 1233 | 1230 | | | |
| 54-73 5 | 1 | Foray 1 Initial Lift Detection | 5/23/2012 12:52:40 | | Wednesday | 69.2 | 29 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 20% | 50% | 10 | 50 | 0% | 20% | 15 | 1238 | 1230 | | | |
| | | Foray 1 Last Lift Detection | 5/23/2012 18:30:22 | 05:37:42 | Wednesday | 69.2 | 43 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 15% | 50% | 10 | 50 | 0% | 15% | 15 | 1839 | 1830 | | | |
| 54-81 6 | 2 | Foray 2 Initial Lift Detection | 5/21/2012 15:52:58 | | Monday | 68.45 | 31 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 15% | 50% | 10 | 50 | 0% | 15% | 14 | 1533 | 1530 | | | |
| | | Foray 2 Last Lift Detection | 5/21/2012 18:59:04 | 03:06:06 | Monday | 68.45 | 52 | 5440 | 5180 | 5970 | 6110 | 5010 | 5890 | 5660 | 8900 | 8730 | 8890 | 9160 | 74940 | C | 15% | 50% | 10 | 50 | 0% | 15% | 14 | 1833 | 1830 | | | |
| 54-81 7 | 2 | Foray 1 Initial Lift Detection | 5/23/2012 15:03:00 | | Wednesday | 69.2 | 32 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 10% | 50% | 10 | 50 | 0% | 10% | 15 | 1503 | 1500 | | | |
| | | Foray 1 Last Lift Detection | 5/23/2012 15:12:17 | 00:09:17 | Wednesday | 69.2 | 32 | 5470 | 4830 | 5980 | 6040 | 4580 | 5790 | 5590 | 8860 | 8740 | 8850 | 9100 | 73830 | C | 10% | 50% | 10 | 50 | 0% | 10% | 15 | 1503 | 1500 | | | |

**APPENDIX F: UNSUCCESSFUL PASSAGE FORAY FOR SHAD THAT NEVER PASSED AND
CORRESPONDING OPERATIONAL CONDITIONS, SPRING 2012.**

Appendix F

Unsuccessful passage foray for shad that never passed and corresponding operational conditions

| Fish | Number of Unsuccessful Forays | Unsuccessful Forays | Foray Date and Time | Foray Duration hh:mm:ss | Day of Week | Water Temp. | Hourly Shad Count | Generational Conditions | | | | | | | | | | | Total Flow | Fishlift Operational Conditions | | | Diffuser Setting | | Gate Settings | | Spillway Attraction | | Crowder Doors | |
|-------|-------------------------------|--------------------------------|---------------------|-------------------------|-------------|-------------|-------------------|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|------------|---------------------------------|-------------|---------------------|------------------|----|---------------|------|---------------------|------|---------------|------|
| | | | | | | | | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 | Unit 6 | Unit 7 | Unit 8 | Unit 9 | Unit 10 | Unit 11 | | Weir Gate | Weir % Open | Crowder Area Gate % | A | B | A | C | Flow Attraction | Open | Closed | |
| 21-14 | 1 | Foray 1 Initial Lift Detection | 5/13/2012 15:49:49 | | Sunday | 63.46 | 18 | 5420 | 4920 | 6000 | 6020 | 5450 | 5820 | 6030 | 8880 | 8690 | 8900 | 9370 | 75500 | C | 0 | 0 | 0.5 | 10 | 50 | 0 | 0 | 14 | 1533 | 1530 |
| | | Foray 1 Last Lift Detector | 5/13/2012 16:09:28 | 00:10:39 | Sunday | 63.46 | 27 | 5420 | 4920 | 6000 | 6020 | 5450 | 5820 | 6030 | 8880 | 8690 | 8900 | 9370 | 75500 | C | 0 | 0 | 0.5 | 10 | 50 | 0 | 0 | 14 | 1603 | 1600 |
| 21-37 | 1 | Foray 1 Initial Lift Detection | 5/16/2012 18:52:24 | | Wednesday | 65.74 | 13 | 5860 | 5030 | 6180 | 6180 | 5960 | 6190 | 6180 | 8860 | 8680 | 8940 | 9460 | 77520 | C | 0 | 0 | 0.6 | 10 | 60 | 0 | 0 | 14 | 1833 | 1830 |
| | | Foray 1 Last Lift Detector | 5/16/2012 19:04:29 | 00:12:05 | Wednesday | 65.74 | 2 | 5860 | 5030 | 6180 | 6180 | 5960 | 6190 | 6180 | 8860 | 8680 | 8940 | 9460 | 77520 | C | 0 | 0 | 0.6 | 10 | 60 | 0 | 0 | 14 | 1833 | 1830 |
| 21-43 | 2 | Foray 1 Initial Lift Detection | 5/27/2012 18:07:50 | | Sunday | 74.36 | 9 | 5500 | 4880 | 6000 | 6020 | 4250 | 0 | 4950 | 8850 | 8730 | 8860 | 9120 | 67160 | C | 0.2 | 0.45 | 10 | 5 | 0 | 0.2 | 14 | 1804 | 1800 | |
| | | Foray 1 Last Lift Detector | 5/27/2012 18:20:12 | 00:12:22 | Sunday | 74.36 | 9 | 5500 | 4880 | 6000 | 6020 | 4250 | 0 | 4950 | 8850 | 8730 | 8860 | 9120 | 67160 | C | 0.2 | 0.45 | 10 | 5 | 0 | 0.2 | 14 | 1804 | 1800 | |
| 21-43 | 2 | Foray 1 Initial Lift Detection | 5/28/2012 17:32:41 | | Monday | 76.36 | 0 | 5510 | 5170 | 6020 | 6080 | 5160 | 5910 | 5440 | 8860 | 8710 | 8840 | 9130 | 74830 | C | 0.25 | 0.25 | 10 | 35 | 0 | 0.25 | 14 | 1803 | 1730 | |
| | | Foray 1 Last Lift Detector | 5/28/2012 17:56:37 | 00:23:56 | Monday | 76.36 | 0 | 5510 | 5170 | 6020 | 6080 | 5160 | 5910 | 5440 | 8860 | 8710 | 8840 | 9130 | 74830 | C | 0.6 | 0.6 | 10 | 55 | 0 | 0.6 | 14 | 1803 | 1730 | |
| 54-15 | 1 | Foray 1 Initial Lift Detection | 5/8/2012 15:56:24 | | Tuesday | 65.45 | 68 | 5330 | 5210 | 6040 | 6040 | 5370 | 5750 | 5740 | 8830 | 8600 | 8920 | 9270 | 75100 | A | 0.95 | 0.3 | 10 | 0 | 0.95 | 0 | 14 | 1533 | 1530 | |
| | | Foray 1 Last Lift Detector | 5/8/2012 16:10:28 | 00:14:04 | Tuesday | 65.45 | 49 | 0 | 5210 | 6040 | 6040 | 5370 | 5750 | 5740 | 8830 | 0 | 8920 | 9270 | 61170 | A | 0.95 | 0.3 | 10 | 0 | 0.95 | 0 | 14 | 1603 | 1600 | |
| 54-24 | 1 | Foray 2 Initial Lift Detection | 5/8/2012 12:27:18 | | Tuesday | 65.45 | 19 | 0 | 5210 | 6040 | 6040 | 5370 | 5750 | 5740 | 8830 | 0 | 8920 | 9270 | 61170 | A | 0.95 | 0.3 | 10 | 0 | 0.95 | 0 | 14 | 1203 | 1200 | |
| | | Foray 2 Last Lift Detector | 5/8/2012 18:52:42 | 06:25:24 | Tuesday | 65.45 | 29 | 0 | 5210 | 6040 | 6040 | 5370 | 5750 | 5740 | 0 | 0 | 0 | 9270 | 42420 | A | 0.95 | 0.3 | 10 | 0 | 0.95 | 0 | 14 | 1833 | 1830 | |
| 54-65 | 4 | Foray 3 Initial Lift Detection | 5/25/2012 14:00:37 | | Friday | 71.36 | 15 | 0 | 4880 | 6060 | 6060 | 4550 | 5760 | 6060 | 8850 | 8730 | 8810 | 9080 | 68840 | C | 0 | 0.6 | 10 | 50 | 0 | 0 | 14 | 1404 | 1400 | |
| | | Foray 3 Last Lift Detector | 5/25/2012 15:35:23 | 01:34:46 | Friday | 71.36 | 4 | 0 | 4880 | 6060 | 6060 | 4550 | 5760 | 6060 | 8850 | 8730 | 8810 | 9080 | 68840 | C | 0.15 | 0.5 | 10 | 50 | 0 | 0.15 | 14 | 1534 | 1530 | |
| 54-65 | 4 | Foray 1 Initial Lift Detection | 5/26/2012 14:09:20 | | Saturday | 72.71 | 9 | 0 | 0 | 6040 | 6040 | 4830 | 0 | 5650 | 0 | 8810 | 8760 | 8930 | 49060 | C | 0.45 | 0.5 | 10 | 50 | 0 | 0.45 | 14 | 1404 | 1400 | |
| | | Foray 1 Last Lift Detector | 5/26/2012 15:34:31 | 01:25:11 | Saturday | 72.71 | 12 | 0 | 0 | 6040 | 6040 | 4830 | 0 | 5650 | 0 | 8810 | 8760 | 8930 | 49060 | C | 0.5 | 0.7 | 10 | 60 | 0 | 0.5 | 14 | 1534 | 1530 | |
| 54-65 | 4 | Foray 1 Initial Lift Detection | 5/27/2012 12:30:29 | | Sunday | 74.36 | 21 | 0 | 0 | 0 | 0 | 4250 | 0 | 4950 | 0 | 0 | 0 | 0 | 9200 | C | 0.99 | 0.45 | 10 | 5 | 0 | 0.99 | 14 | 1233 | 1230 | |
| | | Foray 1 Last Lift Detector | 5/27/2012 13:16:34 | 00:46:05 | Sunday | 74.36 | 25 | 0 | 0 | 6000 | 6020 | 4250 | 0 | 4950 | 0 | 0 | 0 | 0 | 21220 | C | 0.55 | 0.45 | 10 | 5 | 0 | 0.55 | 14 | 1305 | 1300 | |
| 54-65 | 4 | Foray 1 Initial Lift Detection | 5/29/2012 18:53:21 | | Tuesday | 78.16 | 4 | 5490 | 4890 | 6110 | 6830 | 4930 | 5820 | 5570 | 9050 | 9030 | 9050 | 9430 | 76200 | C | 0.35 | 0.4 | 10 | 36 | 0 | 0.35 | 14 | 1833 | 1830 | |
| | | Foray 1 Last Lift Detector | 5/29/2012 19:04:17 | 00:10:56 | Tuesday | 78.16 | 2 | 5490 | 4890 | 6110 | 6830 | 4930 | 5820 | 5570 | 9050 | 9030 | 9050 | 9430 | 76200 | C | 0.35 | 0.4 | 10 | 36 | 0 | 0.35 | 14 | 1833 | 1830 | |
| 21-68 | 7 | Foray 2 Initial Lift Detection | 5/9/2012 18:53:17 | | Wednesday | 64.3 | 23 | 0 | 0 | 5900 | 6040 | 5130 | 0 | 5770 | 0 | 8650 | 8890 | 9280 | 49660 | C | 0.21 | 0.41 | 10 | 50 | 0 | 0.21 | 14 | 1833 | 1830 | |
| | | Foray 2 Last Lift Detector | 5/9/2012 18:57:36 | 00:04:19 | Wednesday | 64.3 | 23 | 0 | 0 | 5900 | 6040 | 5130 | 0 | 5770 | 0 | 8650 | 8890 | 9280 | 49660 | C | 0.21 | 0.41 | 10 | 50 | 0 | 0.21 | 14 | 1833 | 1830 | |
| 21-87 | 2 | Foray 1 Initial Lift Detection | 5/14/2012 09:44:34 | | Monday | 64.78 | 279 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 0 | 0 | 14 | 938 | 935 | |
| | | Foray 1 Last Lift Detector | 5/14/2012 10:00:02 | 00:15:28 | Monday | 64.78 | 108 | 5410 | 4880 | 5960 | 5950 | 5030 | 5780 | 6030 | 8870 | 8660 | 8900 | 9360 | 74830 | C | 0 | 0.35 | 10 | 50 | 0 | 0 | 14 | 1008 | 1005 | |
| 21-87 | 2 | Foray 2 Initial Lift Detection | 5/15/2012 15:09:35 | | Tuesday | 65.44 | 16 | 0 | 4180 | 5750 | 6080 | 5460 | 5770 | 6080 | 8850 | 8680 | 8890 | 9370 | 69110 | C | 0 | 0.35 | 10 | 50 | 0 | 0 | 14 | 1503 | 1500 | |
| | | Foray 2 Last Lift Detector | 5/15/2012 15:17:07 | 00:07:32 | Tuesday | 65.44 | 35 | 0 | 4180 | 5750 | 6080 | 5460 | 5770 | 6080 | 8850 | 8680 | 8890 | 9370 | 69110 | C | 0 | 0.35 | 10 | 50 | 0 | 0 | 14 | 1503 | 1500 | |
| 21-89 | 9 | Foray 3 Initial Lift Detection | 5/27/2012 08:13:40 | | Sunday | 74.36 | 24 | 0 | 0 | 0 | 0 | 4250 | 0 | 4950 | 0 | 0 | 0 | 0 | 9200 | A | 1.05 | 0.4 | 10 | 0 | 1.05 | 0 | 14 | 800 | 800 | |
| | | Foray 3 Last Lift Detector | 5/27/2012 08:32:13 | 00:18:33 | Sunday | 74.36 | 24 | 0 | 0 | 0 | 0 | 4250 | 0 | 4950 | 0 | 0 | 0 | 0 | 9200 | A | 1.05 | 0.4 | 10 | 0 | 1.05 | 0 | 14 | 834 | 830 | |
| 54-36 | 1 | Foray 1 Initial Lift Detection | 5/6/2012 08:12:14 | | Sunday | 65.76 | 77 | 0 | 0 | 0 | 0 | 4820 | 0 | 5710 | 0 | 0 | 0 | 0 | 10530 | A | 0.95 | 0.3 | 10 | 0 | 0.95 | 0 | 14 | 803 | 800 | |
| | | Foray 1 Last Lift Detector | 5/6/2012 08:25:23 | 00:13:09 | Sunday | 65.76 | 77 | 0 | 0 | 0 | 0 | 4820 | 0 | 5710 | 0 | 0 | 0 | 0 | 10530 | A | 0.95 | 0.3 | 10 | 0 | 0.95 | 0 | 14 | 803 | 800 | |
| 21-18 | 11 | Foray 1 Initial Lift Detection | 5/4/2012 14:39:21 | | Friday | 60.85 | 125 | 0 | 0 | 6090 | 6090 | 4800 | 0 | 5410 | 0 | 0 | 8970 | 9280 | 40640 | C | 0.5 | 0.5 | 10 | 50 | 0 | 0.5 | 14 | 1437 | 1430 | |
| | | Foray 1 Last Lift Detector | 5/4/2012 14:51:38 | 00:12:17 | Friday | 60.85 | 125 | 0 | 0 | 6090 | 6090 | 4800 | 0 | 5410 | 0 | 0 | 8970 | 9280 | 40640 | C | 0.5 | 0.5 | 10 | 50 | 0 | 0.5 | 14 | 1437 | 1430 | |
| 21-18 | 3 | Foray 1 Initial Lift Detection | 5/5/2012 12:30:40 | | Saturday | 63.27 | 7 | 0 | 0 | 6040 | 6080 | 4920 | 0 | 5530 | 0 | 8730 | 8940 | 9290 | 49530 | C | 0.45 | 0.35 | 10 | 52 | 0 | 0.45 | 14 | 1237 | 1235 | |
| | | Foray 1 Last Lift Detector | 5/5/2012 14:20:10 | 01:49:30 | Saturday | 63.27 | 7 | 0 | 0 | 6040 | 6080 | 4920 | 0 | 5530 | 0 | 8730 | 8940 | 9290 | 49530 | C | 0.45 | 0.35 | 10 | 52 | 0 | 0.45 | 14 | 1405 | 1400 | |
| 21-18 | 3 | Foray 1 Initial Lift Detection | 5/6/2012 12:28:35 | | Sunday | 65.76 | 33 | 0 | 0 | 5950 | 6030 | 4820 | 0 | 5710 | 0 | 8700 | 8870 | 9130 | 49210 | C | 0.4 | 0.55 | 10 | 50 | 0 | 0.4 | 14 | 1208 | 1205 | |
| | | Foray 1 Last Lift Detector | 5/6/2012 14:21:06 | 01:52:31 | Sunday | 65.76 | 39 | 0 | 0 | 5950 | 6030 | 4820 | 0 | 5710 | 0 | 8700 | 8870 | 9130 | 49210 | C | 0.4 | 0.55 | 10 | 50 | 0 | 0.4 | 14 | 1403 | 1400 | |
| 21-18 | 3 | Foray 1 Initial Lift Detection | 5/8/2012 09:39:46 | | Tuesday | 65.45 | 10 | 0 | 5210 | 6040 | 6040 | 5370 | 5750 | 5740 | 8830 | 0 | 8920 | 9270 | 61170 | C | 0.16 | 0.35 | 10 | 50 | 0 | 0.16 | 14 | 933 | 930 | |
| | | Foray 1 Last Lift Detector | 5/8/2012 09:41:16 | 00:01:30 | Tuesday | 65.45 | 10 | 0 | 5210 | 6040 | 6040 | 5370 | 5750 | 5740 | 8830 | 0 | 8920 | 9270 | 61170 | C | 0.16 | 0.35 | 10 | 50 | 0 | 0.16 | 14 | 933 | 930 | |
| 54-90 | 1 | Foray 1 Initial Lift Detection | 5/26/2012 06:25:02 | | Saturday | 72.71 | 8 | 0 | 0 | 0 | 0 | 4830 | 0 | 5650 | 0 | 0 | 0 | 0 | 10480 | A | 1.07 | 0.5 | 10 | 0 | 1.07 | 0 | 14 | 600 | 600 | |
| | | Foray 1 Last Lift Detector | 5/26/2012 06:33:40 | 00:08:38 | Saturday | 72.71 | 8 | 0 | 0 | 0 | 0 | 4830 | 0 | 5650 | 0 | 0 | 0 | 0 | 10480 | A | 1.07 | 0.5 | 10 | 0 | 1.07 | 0 | 14 | 633 | 630 | |

**APPENDIX G: RADIO-TAGGED SHAD PRESENCE ON NON-TAILRACE MONITORS BY
MOVEMENT CLASSIFICATIONS, SPRING 2012.**

Appendix G

Radio tagged shad presence on non-tailrace monitors by movement classifications, spring 2012.

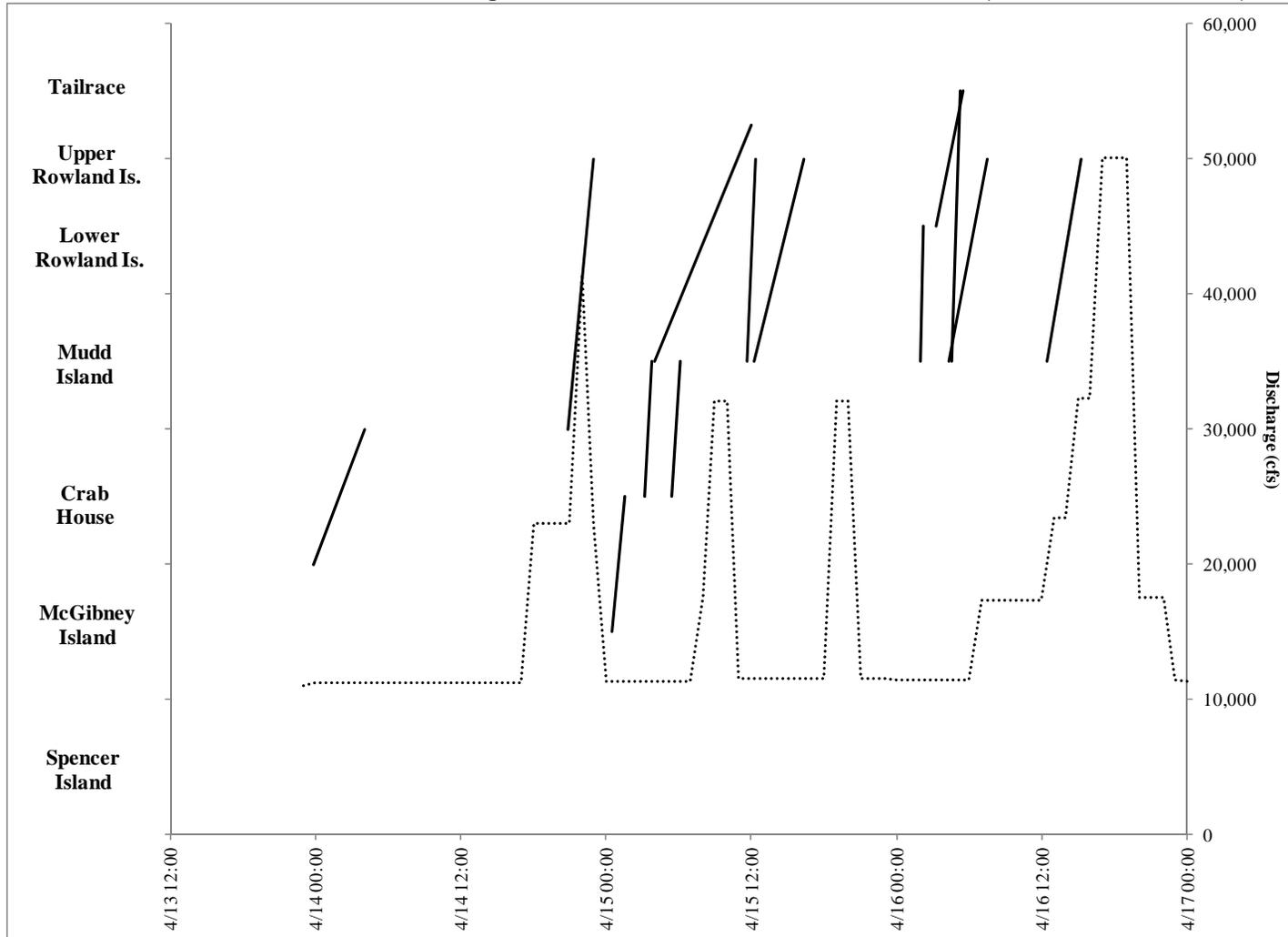
| Fish | Release | | Movement Classification | Lower River and mid-River | | | | Rowland | Spillway | |
|-------|-----------------|------------------------|----------------------------|---------------------------|--------------|------------|-------------|---------|----------|------|
| | Date | Location | | Spencer | McGibney Is. | Crab House | Mudd Island | Island | East | West |
| 21-13 | 4/13/2012 10:23 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-14 | 4/13/2012 14:57 | Downstream of "C" Gate | EFL No passage | yes | yes | yes | yes | yes | yes | no |
| 21-15 | 4/13/2012 15:28 | Downstream of "C" Gate | Non tailrace | no | yes | yes | yes | no | no | no |
| 21-16 | 4/13/2012 13:47 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-17 | 4/13/2012 13:33 | Downstream of "C" Gate | Non tailrace | no | yes | yes | yes | no | no | no |
| 21-18 | 4/13/2012 11:13 | Downstream of "C" Gate | EFL No passage | no | no | no | yes | yes | yes | no |
| 21-19 | 4/13/2012 10:54 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-20 | 4/12/2012 14:49 | Downstream of "C" Gate | Non tailrace | yes | yes | no | yes | no | no | no |
| 21-21 | 4/13/2012 10:21 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-23 | 4/12/2012 14:28 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-24 | 4/12/2012 14:38 | Downstream of "C" Gate | Tailrace without EFL | no | yes | yes | yes | yes | no | no |
| 21-25 | 4/12/2012 14:44 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-26 | 4/12/2012 12:35 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | no | no | no |
| 21-27 | 4/12/2012 12:17 | Downstream of "C" Gate | Passage | yes | yes | yes | yes | yes | no | no |
| 21-28 | 4/12/2012 12:16 | Downstream of "C" Gate | Tailrace without EFL | no | yes | yes | no | yes | no | no |
| 21-29 | 4/12/2012 12:48 | Downstream of "C" Gate | Tailrace without EFL | yes | no | yes | yes | yes | no | no |
| 21-30 | 4/12/2012 14:13 | Downstream of "C" Gate | Tailrace without EFL | no | yes | yes | yes | yes | no | no |
| 21-31 | 4/12/2012 12:03 | Downstream of "C" Gate | Non tailrace | no | yes | yes | yes | yes | no | no |
| 21-32 | 4/13/2012 16:15 | Downstream of "C" Gate | Non tailrace | no | no | yes | yes | yes | no | no |
| 21-34 | 5/4/2012 12:19 | Downstream of "C" Gate | Non tailrace | no | yes | no | yes | yes | no | no |
| 21-36 | 5/1/2012 12:22 | Downstream of "C" Gate | Tailrace without EFL | no | yes | no | yes | yes | no | no |
| 21-37 | 5/1/2012 14:45 | Downstream of "C" Gate | EFL No passage | yes | yes | yes | yes | yes | yes | no |
| 21-38 | 5/1/2012 14:48 | Downstream of "C" Gate | Non tailrace | yes | no | yes | yes | yes | yes | no |
| 21-39 | 5/1/2012 15:03 | Downstream of "C" Gate | Passage | no | no | no | yes | yes | no | no |
| 21-41 | 5/2/2012 11:15 | Downstream of "C" Gate | Passage | yes | yes | yes | yes | yes | no | yes |
| 21-42 | 5/2/2012 12:06 | Downstream of "C" Gate | Non tailrace | no | no | yes | yes | yes | no | no |
| 21-43 | 5/2/2012 12:19 | Downstream of "C" Gate | EFL No passage | yes | yes | yes | yes | yes | no | no |
| 21-44 | 5/2/2012 12:40 | Downstream of "C" Gate | Non tailrace | no | no | yes | yes | no | no | no |
| 21-45 | 5/2/2012 13:50 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-46 | 5/2/2012 13:51 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-47 | 5/2/2012 13:45 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-48 | 5/5/2012 10:55 | Downstream of "C" Gate | Non tailrace | no | no | yes | yes | no | no | no |
| 21-49 | 5/9/2012 11:38 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-50 | 5/14/2012 6:33 | Downstream of "C" Gate | Non tailrace | yes | no | yes | yes | yes | no | no |
| 21-51 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | yes | no | no | no |
| 21-52 | 5/17/2012 11:40 | Shures Landing | Tailrace without EFL | yes | no | yes | yes | yes | no | no |
| 21-53 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | yes | no | no | no |
| 21-54 | 5/17/2012 11:40 | Shures Landing | Non tailrace | no | no | no | yes | no | no | no |
| 21-56 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | yes | no | yes | no | no | no |
| 21-57 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | yes | no | yes | no | no | no |
| 21-58 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | yes | no | yes | no | no | no |
| 21-59 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | no | no | yes | no | no |
| 21-60 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | no | no | no | no |
| 21-61 | 5/17/2012 11:40 | Shures Landing | Non tailrace | no | no | no | yes | no | no | no |
| 21-62 | 5/3/2012 11:12 | Downstream of "C" Gate | Non tailrace | yes | no | yes | yes | yes | no | no |
| 21-63 | 5/4/2012 10:35 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-64 | 5/2/2012 13:54 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-65 | 5/2/2012 14:55 | Downstream of "C" Gate | Non tailrace | no | yes | no | yes | yes | no | no |
| 21-66 | 5/2/2012 15:00 | Downstream of "C" Gate | Passage | yes | yes | yes | yes | yes | yes | yes |
| 21-67 | 5/3/2012 11:22 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-68 | 5/2/2012 13:55 | Downstream of "C" Gate | EFL No passage | yes | yes | yes | yes | yes | no | no |

| Fish | Release | | Movement | Lower River and mid-River | | | | Rowland | Spillway | |
|-------|-----------------|------------------------|----------------------|---------------------------|--------------|------------|-------------|---------|----------|------|
| | Date | Location | Classification | Spencer | McGibney Is. | Crab House | Mudd Island | Island | East | West |
| 21-69 | 4/16/2012 13:20 | Downstream of "C" Gate | Tailrace without EFL | no | yes | yes | yes | yes | no | no |
| 21-70 | 4/18/2012 10:43 | Downstream of "C" Gate | Non tailrace | no | yes | yes | yes | yes | no | no |
| 21-71 | 4/18/2012 11:23 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-72 | 4/18/2012 11:34 | Downstream of "C" Gate | Passage | yes | yes | yes | yes | yes | no | yes |
| 21-73 | 4/18/2012 13:59 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | no | yes | yes | no | no |
| 21-74 | 4/18/2012 12:46 | Downstream of "C" Gate | Tailrace without EFL | yes | no | yes | yes | yes | yes | no |
| 21-75 | 4/18/2012 14:05 | Downstream of "C" Gate | Passage | no | no | no | yes | yes | yes | no |
| 21-76 | 4/18/2012 14:15 | Downstream of "C" Gate | Non tailrace | no | no | yes | yes | yes | no | no |
| 21-77 | 4/18/2012 14:29 | Downstream of "C" Gate | Passage | yes | no | no | yes | yes | no | no |
| 21-78 | 4/18/2012 14:37 | Downstream of "C" Gate | Non tailrace | no | yes | yes | yes | yes | no | no |
| 21-79 | 4/18/2012 15:53 | Downstream of "C" Gate | Non tailrace | no | yes | no | yes | yes | no | no |
| 21-80 | 4/18/2012 15:58 | Downstream of "C" Gate | Tailrace without EFL | yes | no | yes | yes | yes | no | no |
| 21-81 | 4/18/2012 16:34 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-82 | 4/18/2012 16:36 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 21-83 | 4/19/2012 15:12 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | yes | no |
| 21-84 | 4/19/2012 15:01 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-85 | 4/19/2012 13:56 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-86 | 4/18/2012 11:55 | Downstream of "C" Gate | Non tailrace | yes | yes | no | yes | yes | no | no |
| 21-87 | 4/19/2012 13:29 | Downstream of "C" Gate | EFL No passage | yes | yes | yes | yes | yes | yes | no |
| 21-88 | 4/19/2012 13:18 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 21-89 | 5/17/2012 11:40 | Shures Landing | EFL No passage | yes | yes | yes | yes | yes | no | no |
| 21-91 | 5/5/2012 10:42 | Downstream Units 5 & 7 | Non tailrace | no | no | yes | yes | yes | no | no |
| 21-92 | 5/5/2012 10:47 | Downstream Units 5 & 7 | Non tailrace | yes | no | yes | yes | yes | yes | no |
| 54-12 | 4/12/2012 13:08 | Downstream Units 5 & 7 | Passage | yes | yes | yes | yes | no | no | no |
| 54-13 | 4/12/2012 13:00 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-14 | 4/12/2012 13:35 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-15 | 4/12/2012 13:17 | Downstream Units 5 & 7 | EFL No passage | yes | yes | yes | yes | yes | yes | yes |
| 54-16 | 4/12/2012 14:55 | Downstream Units 5 & 7 | Non tailrace | no | yes | yes | yes | yes | no | no |
| 54-17 | 4/12/2012 14:54 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-18 | 4/12/2012 13:47 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-19 | 4/12/2012 16:11 | Downstream Units 5 & 7 | Passage | no | no | no | yes | yes | no | no |
| 54-20 | 4/12/2012 15:14 | Downstream Units 5 & 7 | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 54-21 | 4/13/2012 13:07 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | yes |
| 54-22 | 4/13/2012 12:49 | Downstream Units 5 & 7 | Non tailrace | no | yes | yes | yes | yes | no | no |
| 54-23 | 4/12/2012 16:16 | Downstream Units 5 & 7 | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 54-24 | 4/13/2012 13:11 | Downstream Units 5 & 7 | EFL No passage | yes | yes | yes | yes | yes | yes | no |
| 54-25 | 4/13/2012 13:15 | Downstream Units 5 & 7 | Non tailrace | no | yes | yes | yes | yes | no | no |
| 54-27 | 4/16/2012 11:41 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-28 | 4/13/2012 13:24 | Downstream Units 5 & 7 | Passage | no | no | no | yes | yes | yes | yes |
| 54-29 | 4/16/2012 11:51 | Downstream Units 5 & 7 | Non tailrace | no | no | yes | yes | yes | no | no |
| 54-30 | 4/16/2012 12:02 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-31 | 4/16/2012 12:11 | Downstream Units 5 & 7 | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 54-32 | 4/16/2012 12:51 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-33 | 4/18/2012 12:58 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-34 | 4/18/2012 13:05 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-35 | 4/18/2012 13:30 | Downstream Units 5 & 7 | Tailrace without EFL | yes | no | yes | yes | yes | no | no |
| 54-36 | 4/18/2012 13:45 | Downstream Units 5 & 7 | EFL No passage | yes | yes | yes | yes | yes | no | yes |
| 54-37 | 4/18/2012 13:48 | Downstream Units 5 & 7 | Non tailrace | yes | yes | no | yes | yes | no | no |
| 54-38 | 4/18/2012 14:41 | Downstream Units 5 & 7 | Tailrace without EFL | yes | no | yes | yes | yes | no | no |
| 54-39 | 4/18/2012 14:48 | Downstream Units 5 & 7 | Passage | yes | yes | yes | yes | yes | yes | no |
| 54-40 | 4/18/2012 14:52 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-41 | 4/18/2012 15:07 | Downstream Units 5 & 7 | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 54-42 | 4/18/2012 15:31 | Downstream Units 5 & 7 | Passage | yes | yes | yes | yes | yes | no | no |
| 54-43 | 4/19/2012 15:43 | Downstream Units 5 & 7 | Non tailrace | yes | no | yes | yes | no | no | no |

| Fish | Release | | Movement | Lower River and mid-River | | | | Rowland | Spillway | |
|-------|-----------------|------------------------|----------------------|---------------------------|--------------|------------|-------------|---------|----------|------|
| | Date | Location | Classification | Spencer | McGibney Is. | Crab House | Mudd Island | Island | East | West |
| 54-44 | 4/19/2012 15:05 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-45 | 4/19/2012 14:25 | Downstream Units 5 & 7 | Tailrace without EFL | yes | yes | yes | yes | yes | yes | yes |
| 54-46 | 4/19/2012 13:35 | Downstream Units 5 & 7 | Non tailrace | yes | yes | yes | yes | no | no | no |
| 54-48 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | yes | no | no | no | no | no |
| 54-49 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | no | no | no | no | no |
| 54-50 | 5/17/2012 11:40 | Shures Landing | Tailrace without EFL | yes | yes | yes | yes | yes | no | no |
| 54-51 | 5/17/2012 11:40 | Shures Landing | Non tailrace | no | no | yes | yes | no | no | no |
| 54-52 | 5/17/2012 11:40 | Shures Landing | Non tailrace | no | no | yes | no | no | no | no |
| 54-53 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | no | no | no | no |
| 54-54 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | yes | no | no | no | no | no |
| 54-55 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | no | no | no | no |
| 54-56 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | no | no | no | no | no |
| 54-57 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | no | no | no | no | no |
| 54-58 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | yes | no | no | no |
| 54-59 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | yes | no | yes | no | no | no |
| 54-60 | 5/17/2012 11:40 | Shures Landing | Non tailrace | no | no | yes | yes | no | no | no |
| 54-61 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | no | no | no | no | no |
| 54-62 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | no | no | no | no |
| 54-63 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | yes | yes | no | no | no | no |
| 54-64 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | yes | no | no | no |
| 54-65 | 5/17/2012 11:40 | Shures Landing | EFL No passage | yes | yes | yes | yes | yes | no | no |
| 54-66 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | yes | yes | no | no | no |
| 54-67 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | no | no | no | no | no | no |
| 54-68 | 5/17/2012 11:40 | Shures Landing | Non tailrace | yes | yes | no | no | no | no | no |
| 54-69 | 5/17/2012 11:40 | Shures Landing | Non tailrace | no | no | yes | no | no | no | no |
| 54-70 | 4/19/2012 13:20 | Downstream of "C" Gate | Non tailrace | yes | no | yes | yes | no | no | no |
| 54-71 | 5/2/2012 12:45 | Downstream of "C" Gate | Tailrace without EFL | yes | yes | yes | yes | yes | yes | no |
| 54-72 | 5/2/2012 13:05 | Downstream of "C" Gate | Non tailrace | no | no | yes | yes | no | no | no |
| 54-73 | 5/2/2012 13:09 | Downstream of "C" Gate | Passage | yes | yes | yes | yes | yes | yes | no |
| 54-74 | 5/2/2012 13:31 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | no | no | no |
| 54-75 | 5/2/2012 13:37 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | no | no | no |
| 54-76 | 5/2/2012 13:58 | Downstream of "C" Gate | Non tailrace | yes | no | yes | yes | no | no | no |
| 54-77 | 5/2/2012 14:10 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | yes | no | no |
| 54-78 | 5/2/2012 14:16 | Downstream of "C" Gate | Non tailrace | no | yes | yes | yes | no | no | no |
| 54-79 | 5/2/2012 14:27 | Downstream of "C" Gate | Passage | yes | yes | yes | yes | yes | no | no |
| 54-80 | 5/2/2012 14:53 | Downstream of "C" Gate | Passage | yes | yes | yes | yes | yes | no | yes |
| 54-81 | 5/4/2012 10:09 | Downstream of "C" Gate | Passage | yes | yes | yes | yes | yes | yes | yes |
| 54-82 | 5/4/2012 10:04 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | no | no | no |
| 54-83 | 5/4/2012 10:26 | Downstream of "C" Gate | Non tailrace | yes | yes | yes | yes | no | no | no |
| 54-84 | 5/4/2012 10:29 | Downstream of "C" Gate | Non tailrace | yes | no | yes | yes | no | no | no |
| 54-85 | 5/5/2012 9:40 | Downstream of "C" Gate | Non tailrace | no | yes | yes | yes | no | no | no |
| 54-86 | 5/5/2012 10:06 | Downstream of "C" Gate | Non tailrace | no | no | yes | yes | no | no | no |
| 54-87 | 5/5/2012 10:16 | Downstream of "C" Gate | Non tailrace | no | no | yes | yes | yes | no | no |
| 54-88 | 5/5/2012 10:17 | Downstream of "C" Gate | Non tailrace | no | yes | no | yes | yes | no | no |
| 54-89 | 5/4/2012 10:29 | Downstream of "C" Gate | Passage | no | no | no | yes | yes | yes | no |
| 54-90 | 5/5/2012 10:23 | Downstream of "C" Gate | EFL No passage | yes | yes | yes | yes | yes | no | no |
| 54-91 | 5/17/2012 11:40 | Shures Landing | Non tailrace | no | no | yes | no | no | no | no |
| 54-92 | 5/17/2012 11:40 | Shures Landing | Non tailrace | no | no | yes | yes | no | no | no |

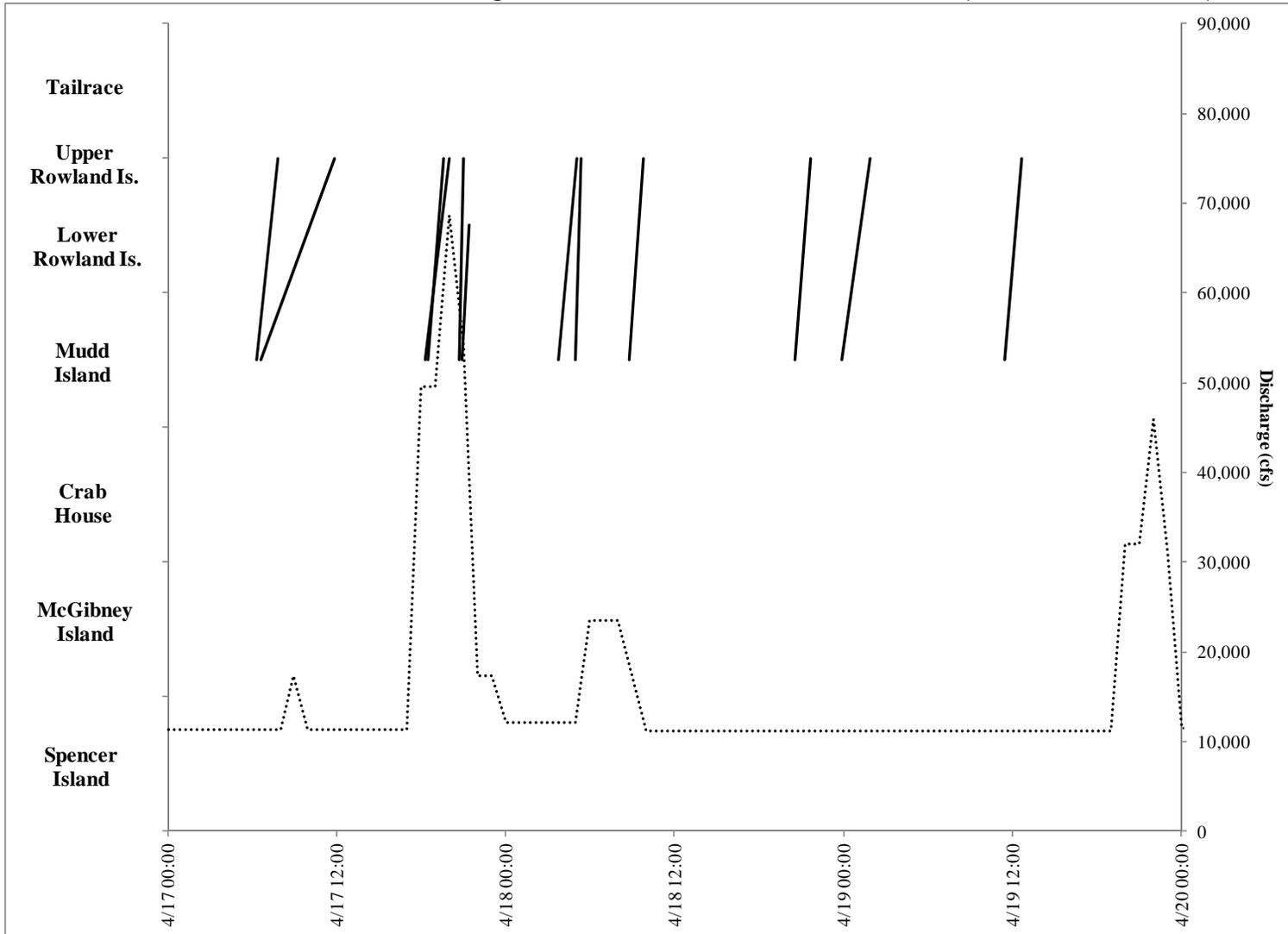
**APPENDIX H: DEPCITION OF RADIO-TAGGED AMERICAN SHAD INDIVIDUAL
UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA
RIVER BETWEEN APRIL 13, 2012 AND APRIL 17, 2012.**

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 13, 2012 AND APRIL 17, 2012.



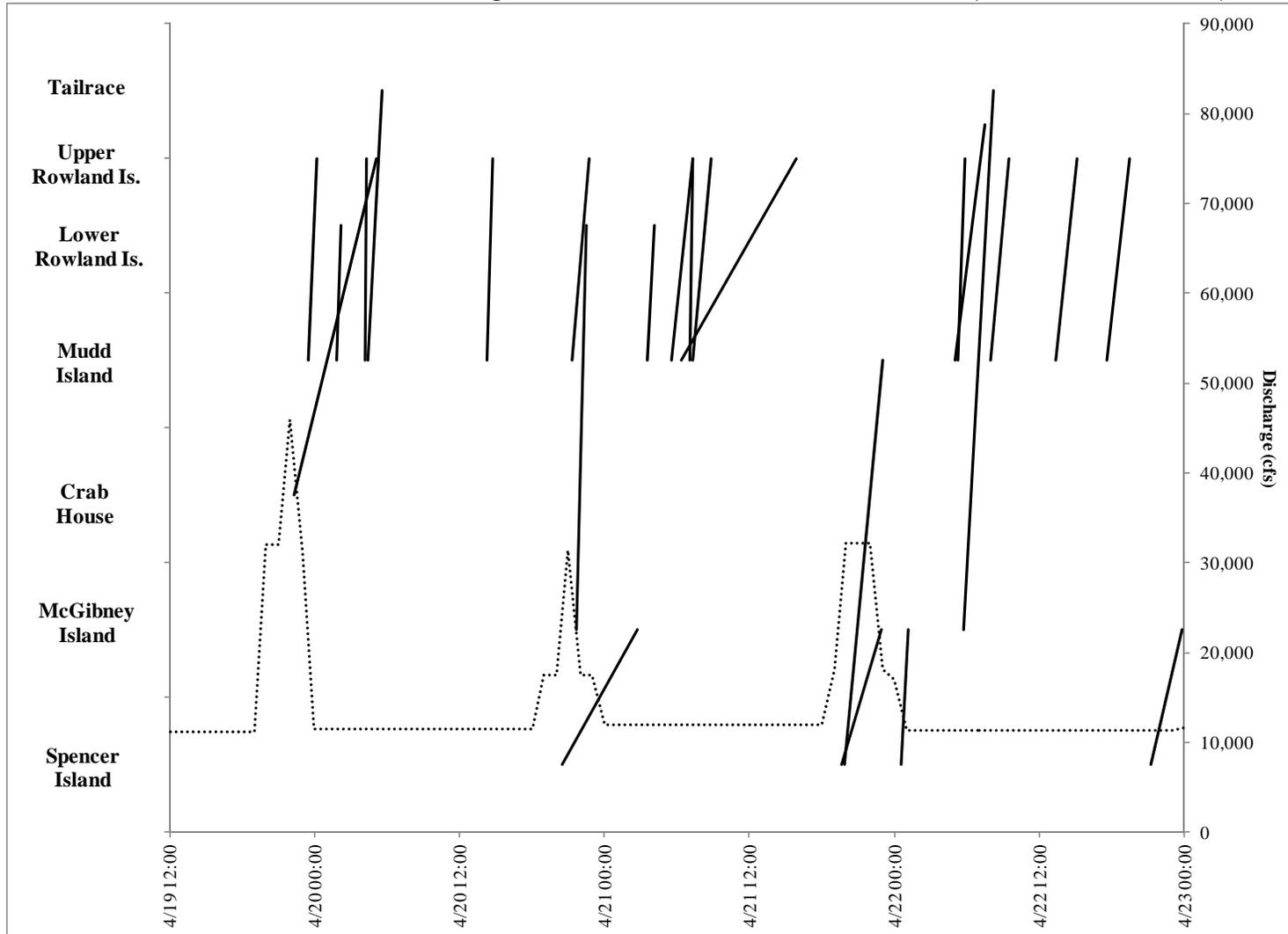
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Thirteen separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 17, 2012 AND APRIL 20, 2012.



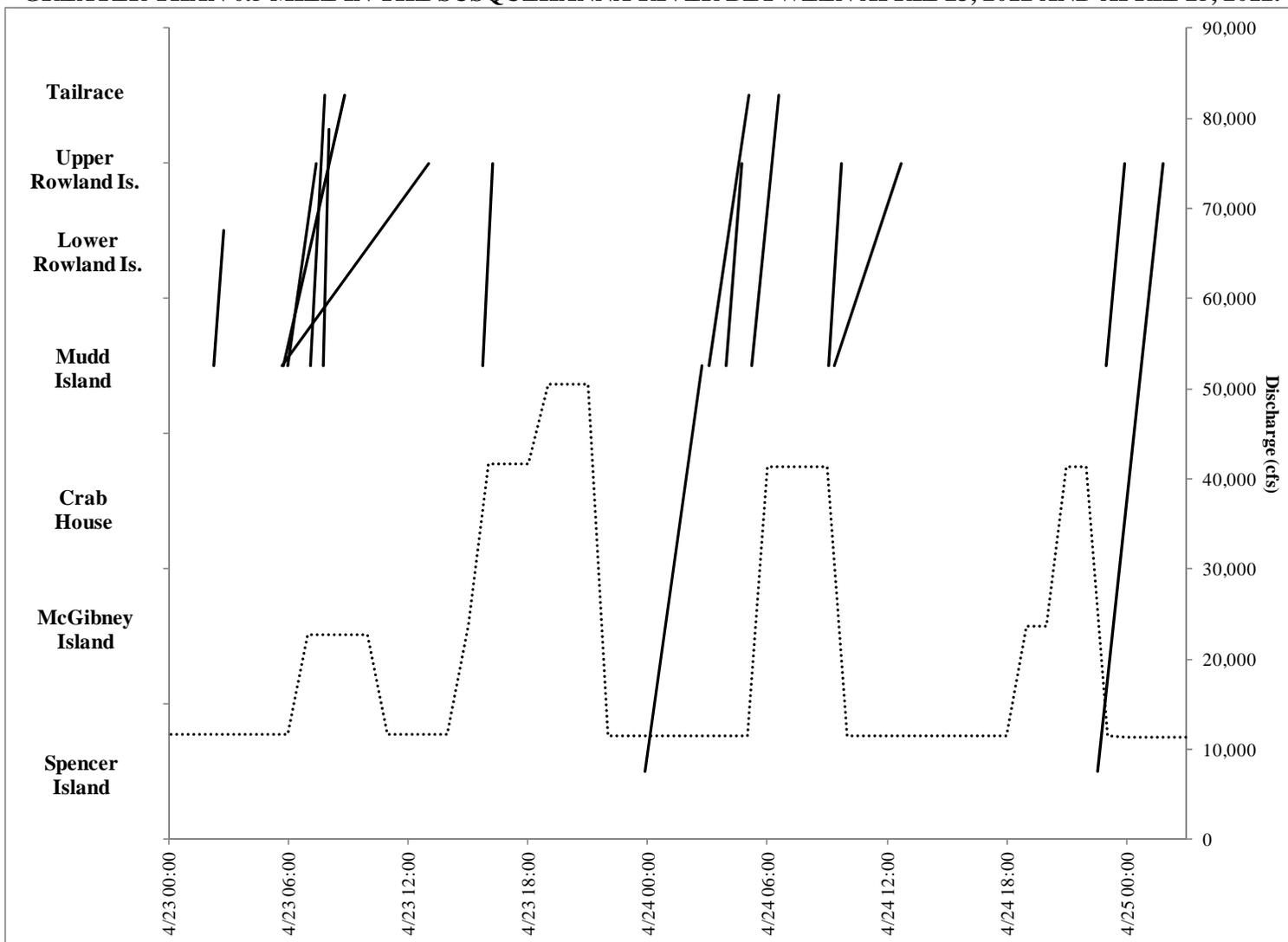
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twelve separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 19, 2012 AND APRIL 23, 2012.



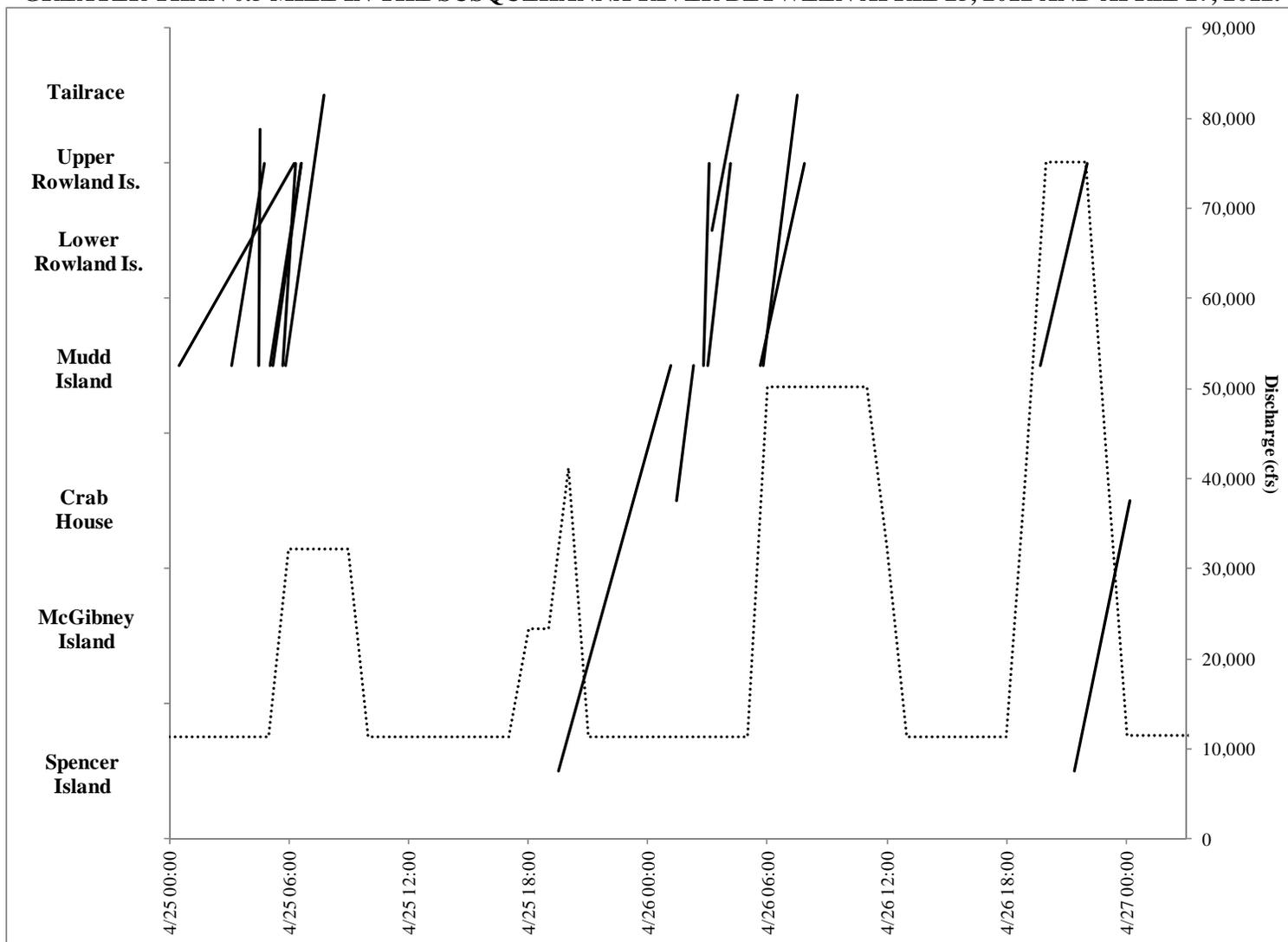
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty four separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 23, 2012 AND APRIL 25, 2012.



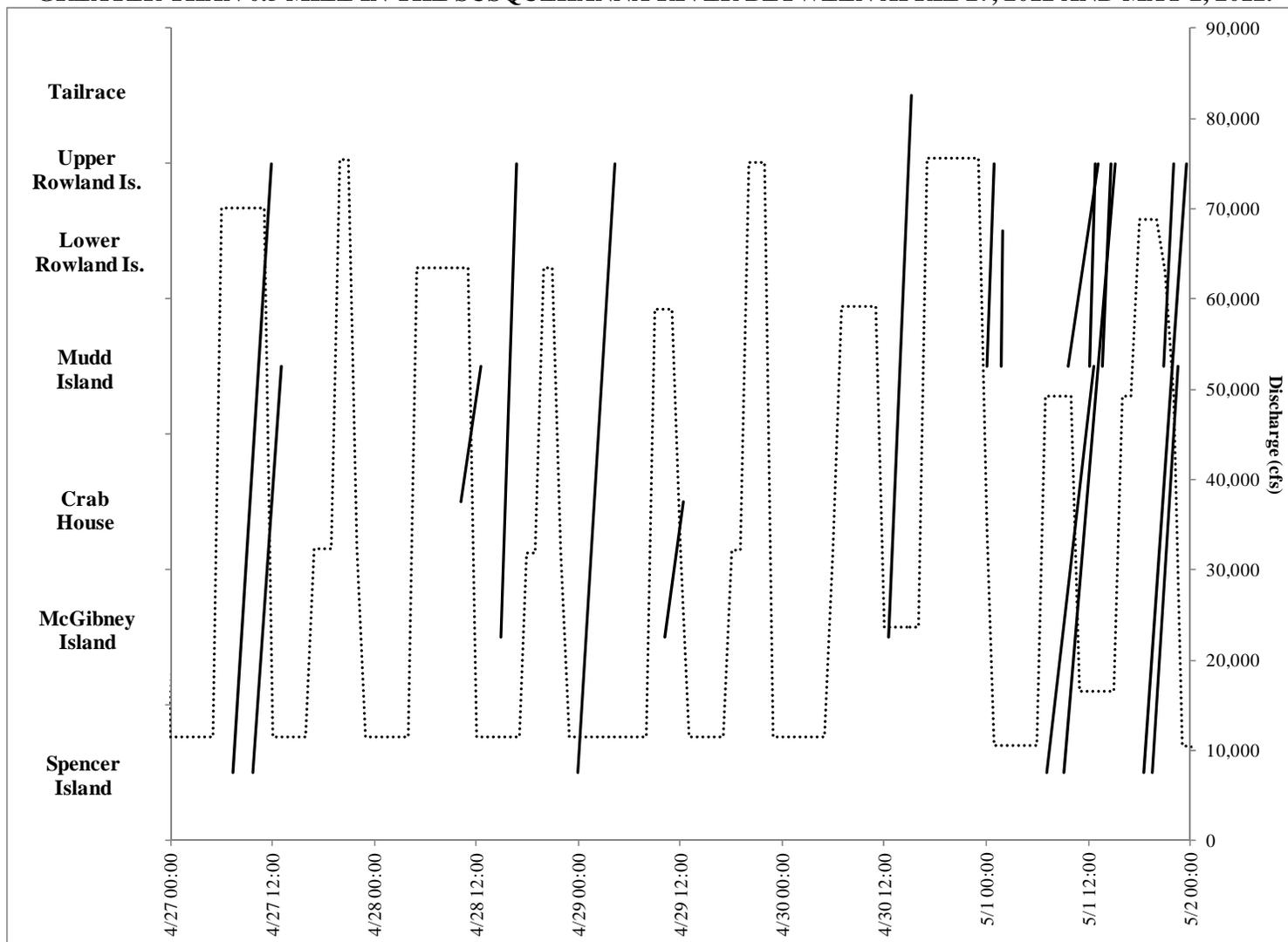
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Fifteen separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 25, 2012 AND APRIL 27, 2012.



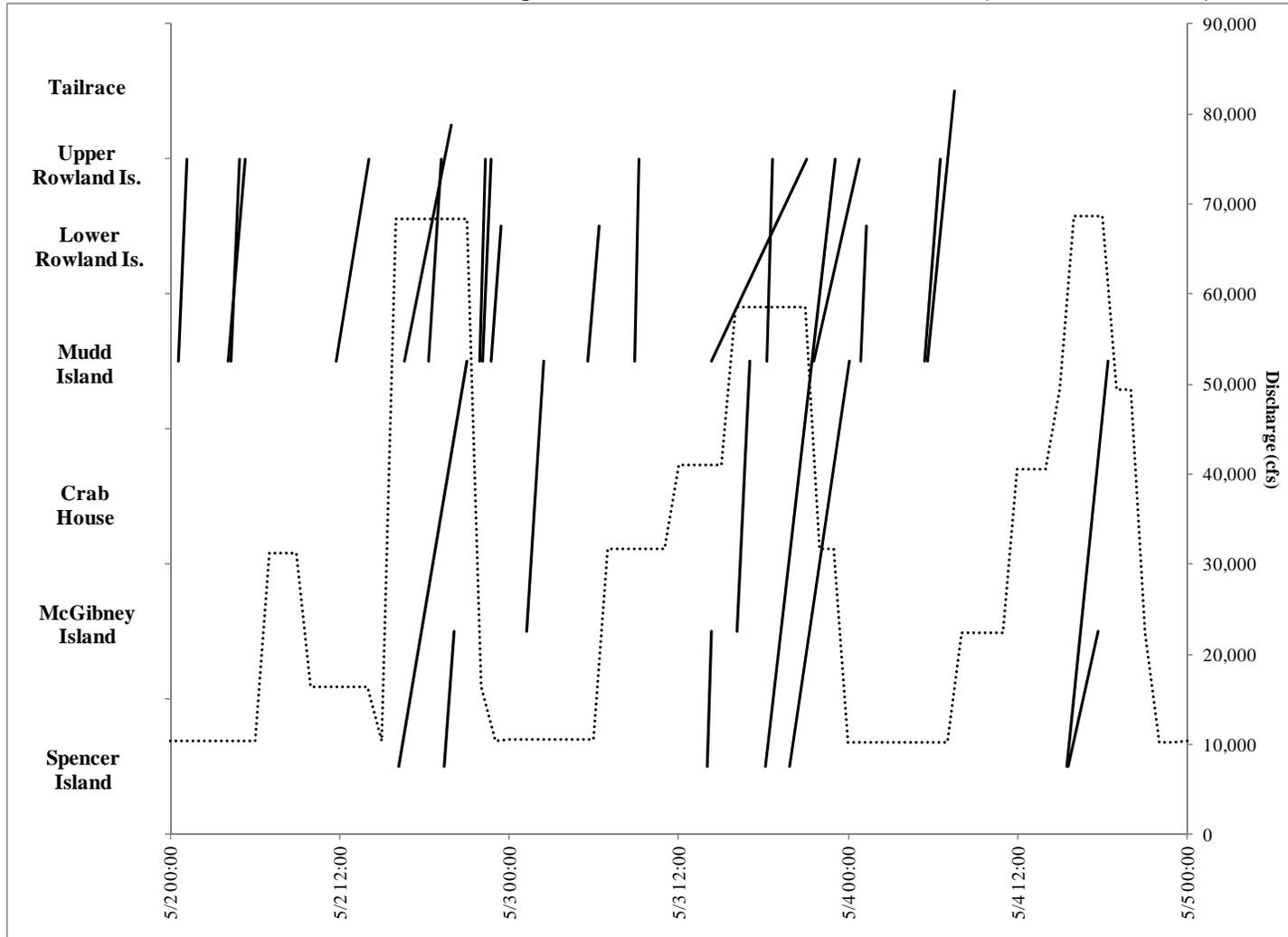
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Sixteen separate forays are illustrated.

**APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS
GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 27, 2012 AND MAY 2, 2012.**



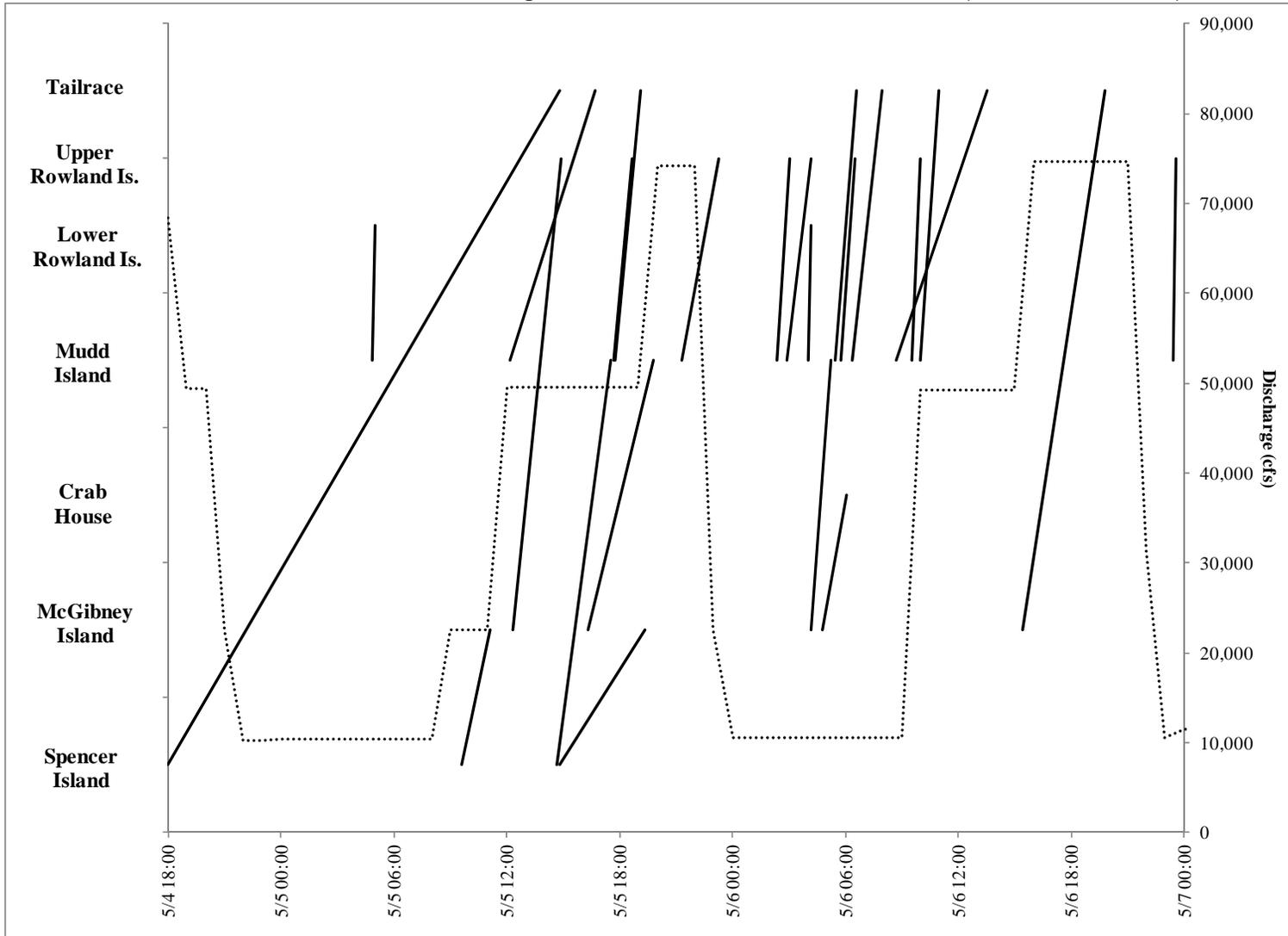
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Seventeen separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 2, 2012 AND MAY 5, 2012.



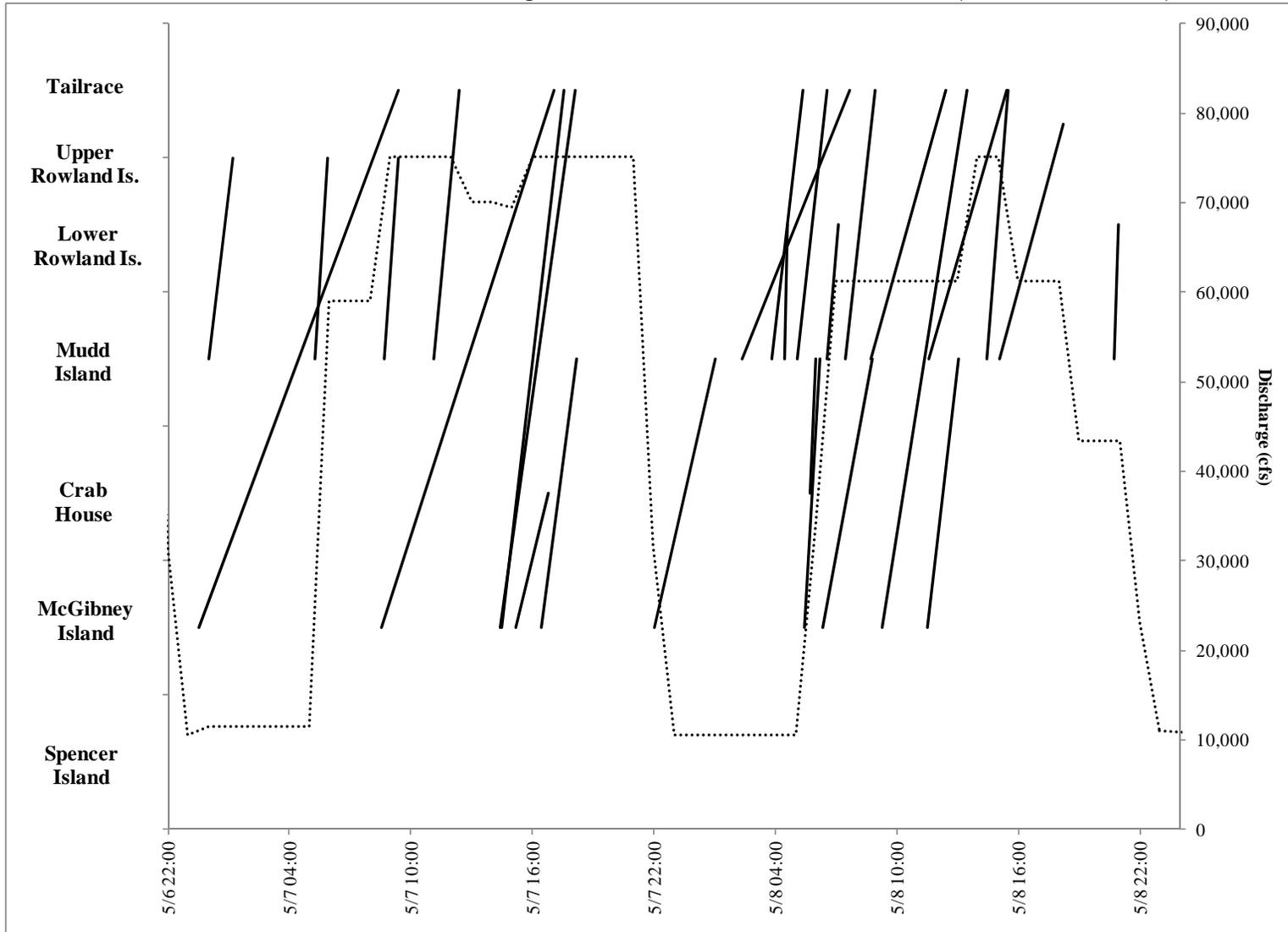
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty six separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 4, 2012 AND MAY 7, 2012.



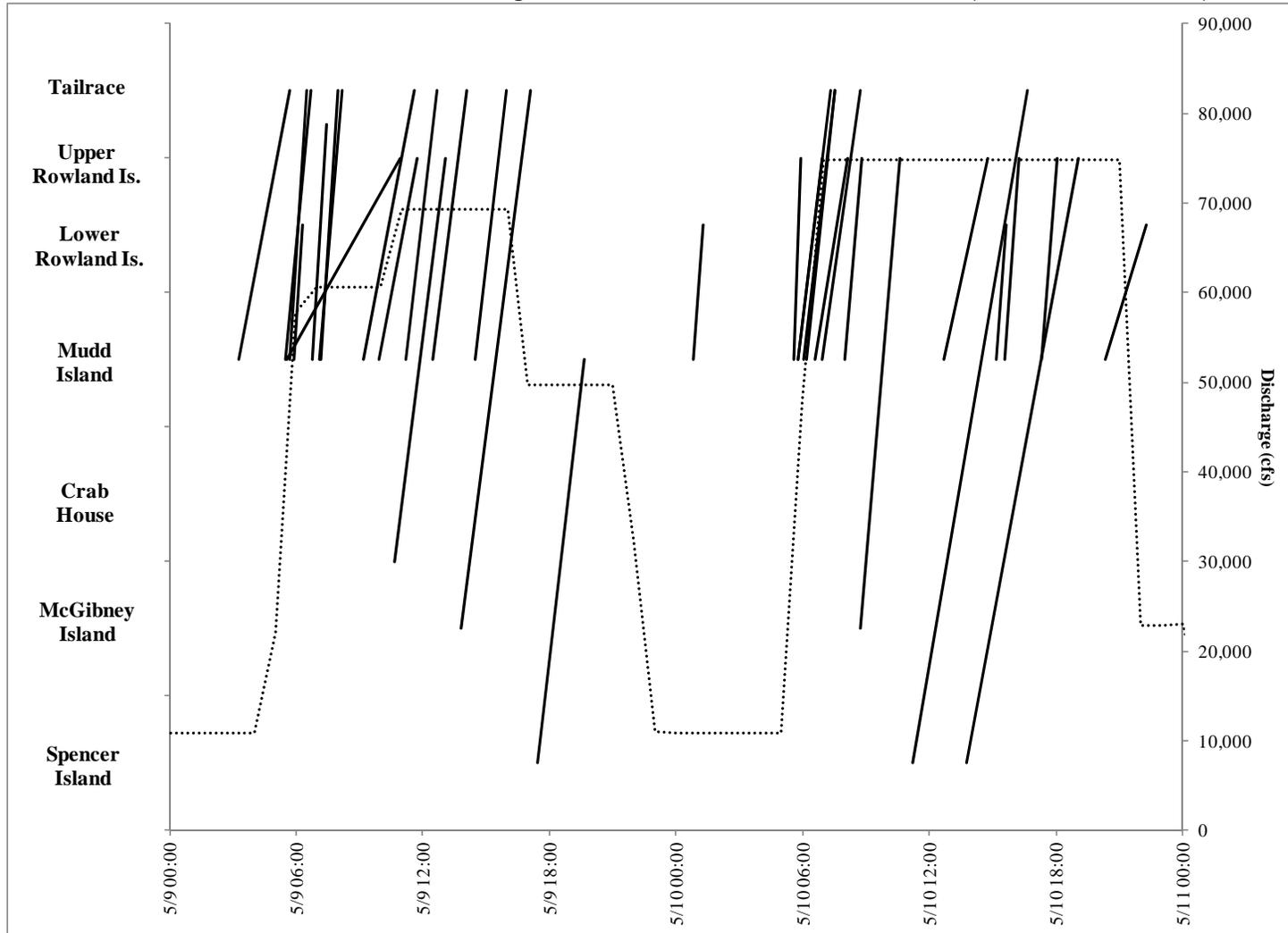
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty four separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 6, 2012 AND MAY 8, 2012.



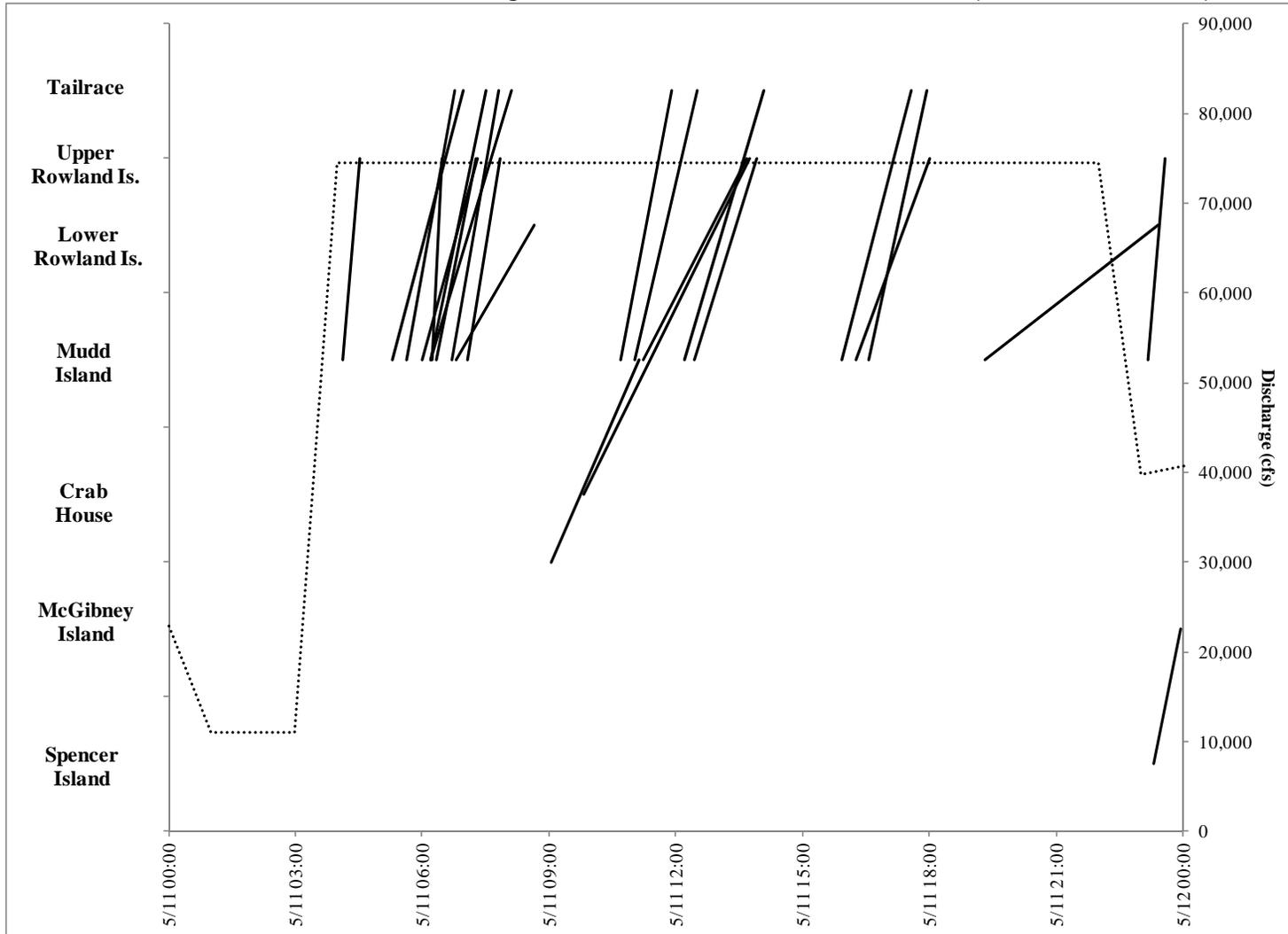
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty seven separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 9, 2012 AND MAY 11, 2012.



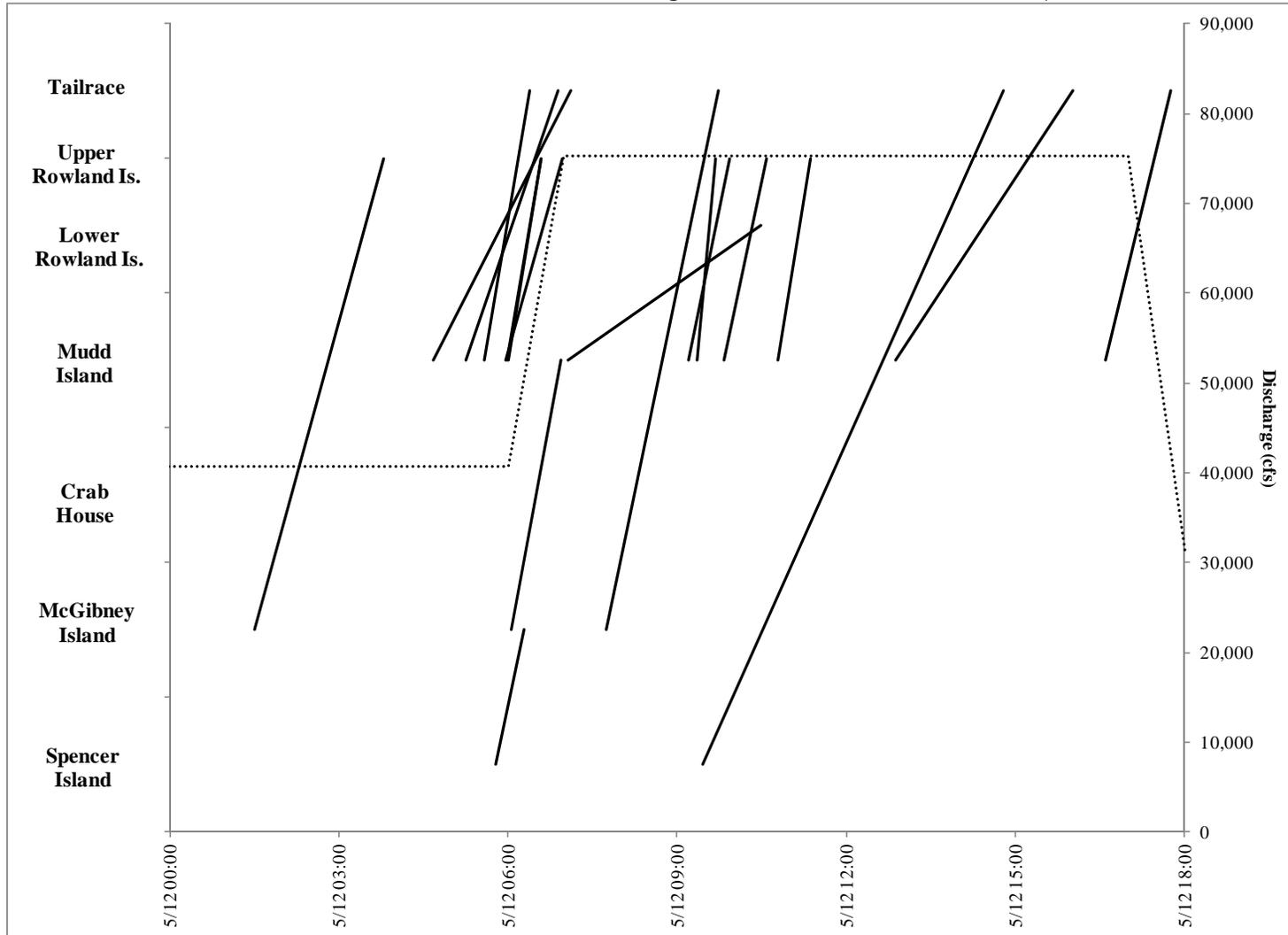
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Thirty three separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 11, 2012 AND MAY 12, 2012.



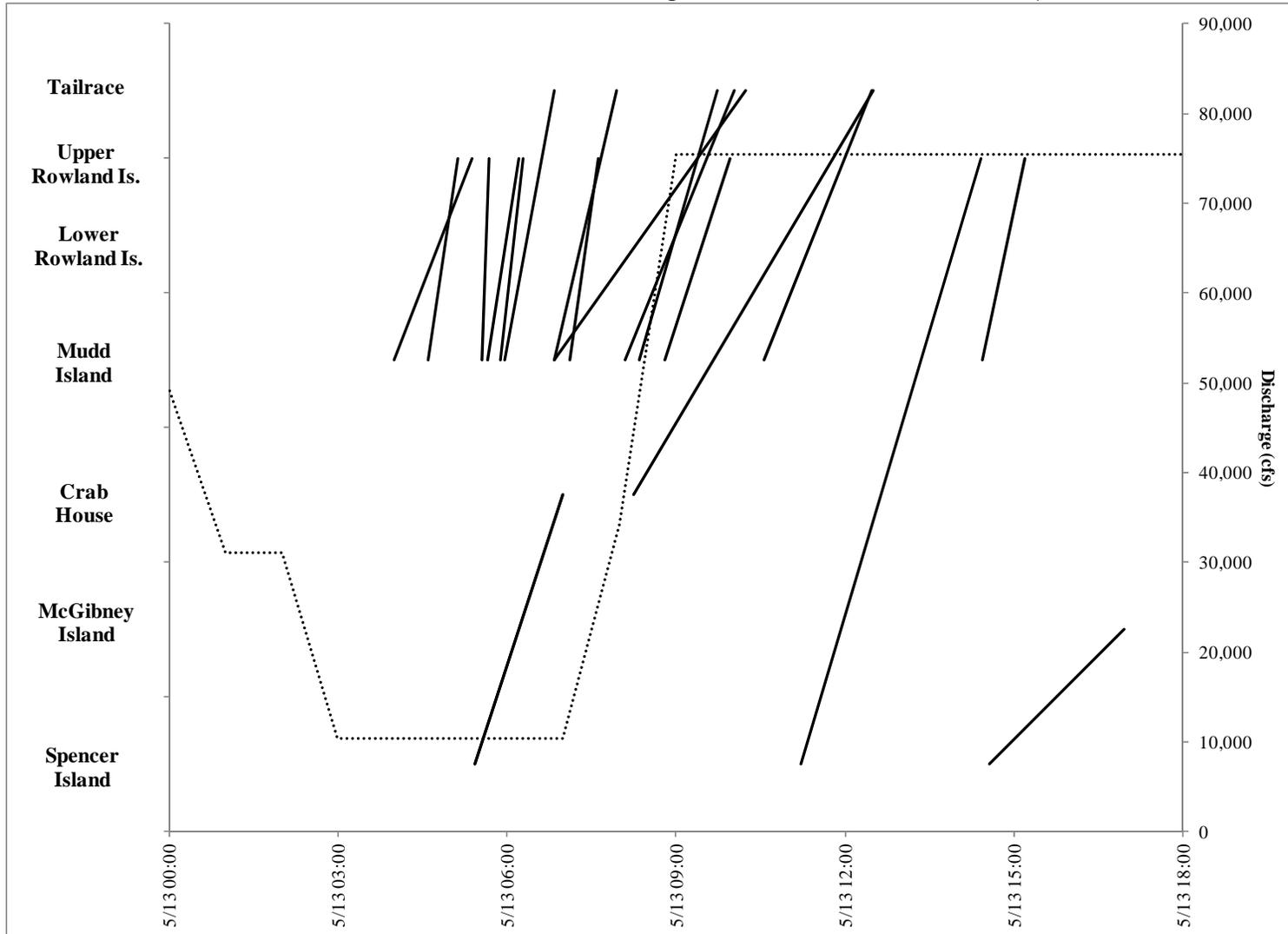
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty four separate forays are illustrated.

**APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS
GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER ON MAY 12, 2012.**



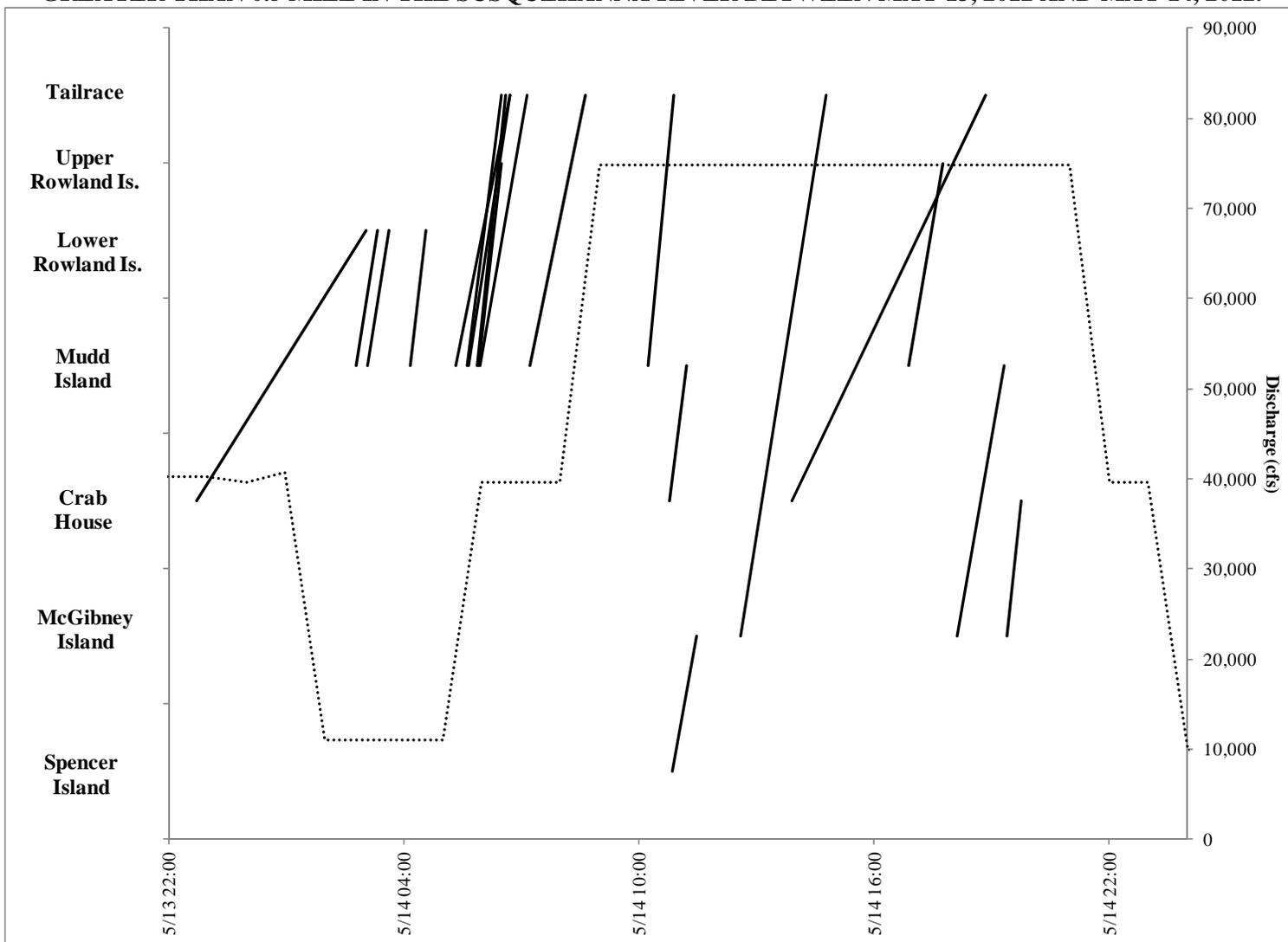
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Eighteen separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER ON MAY 13, 2012.



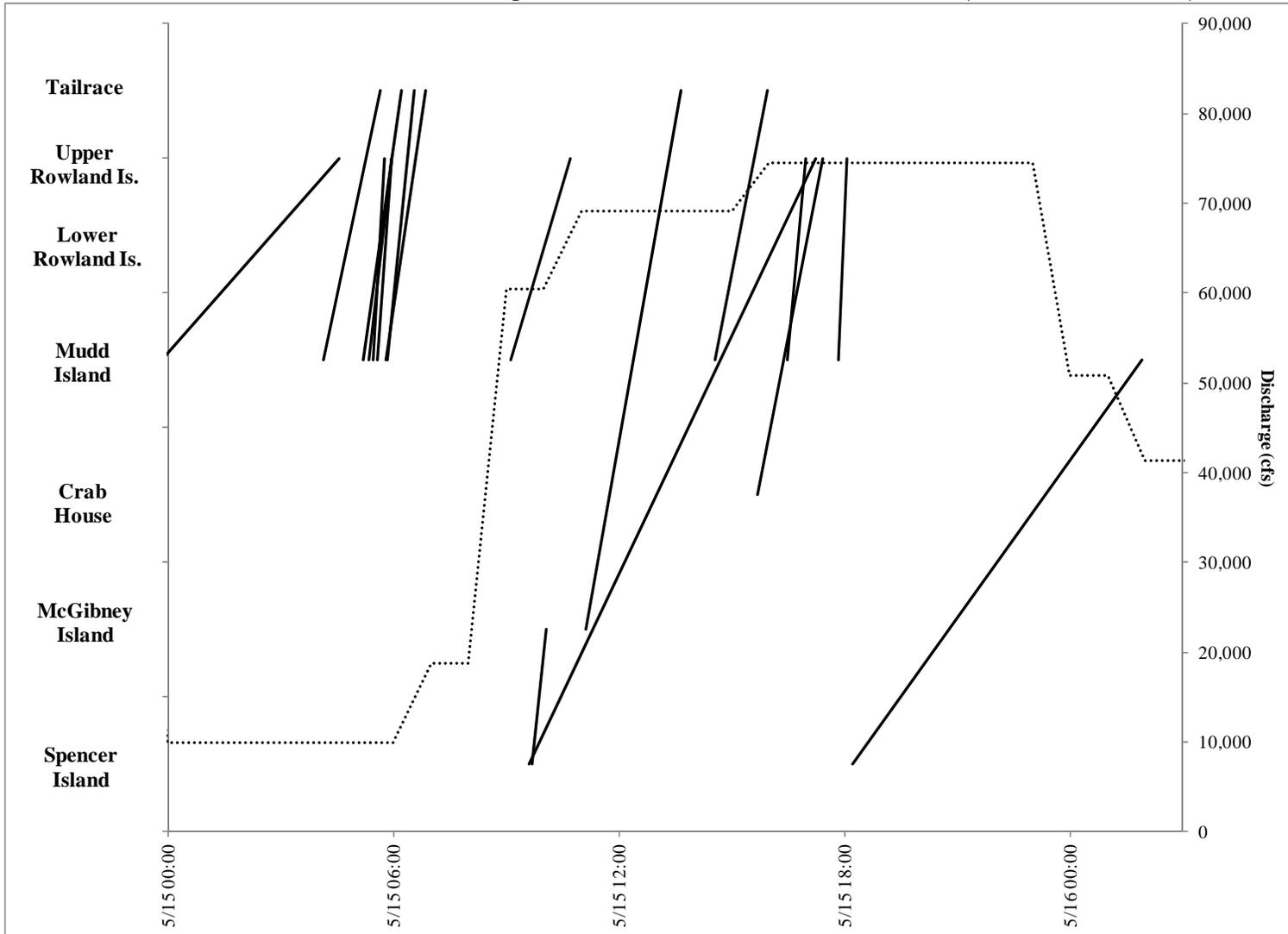
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 13, 2012 AND MAY 14, 2012.



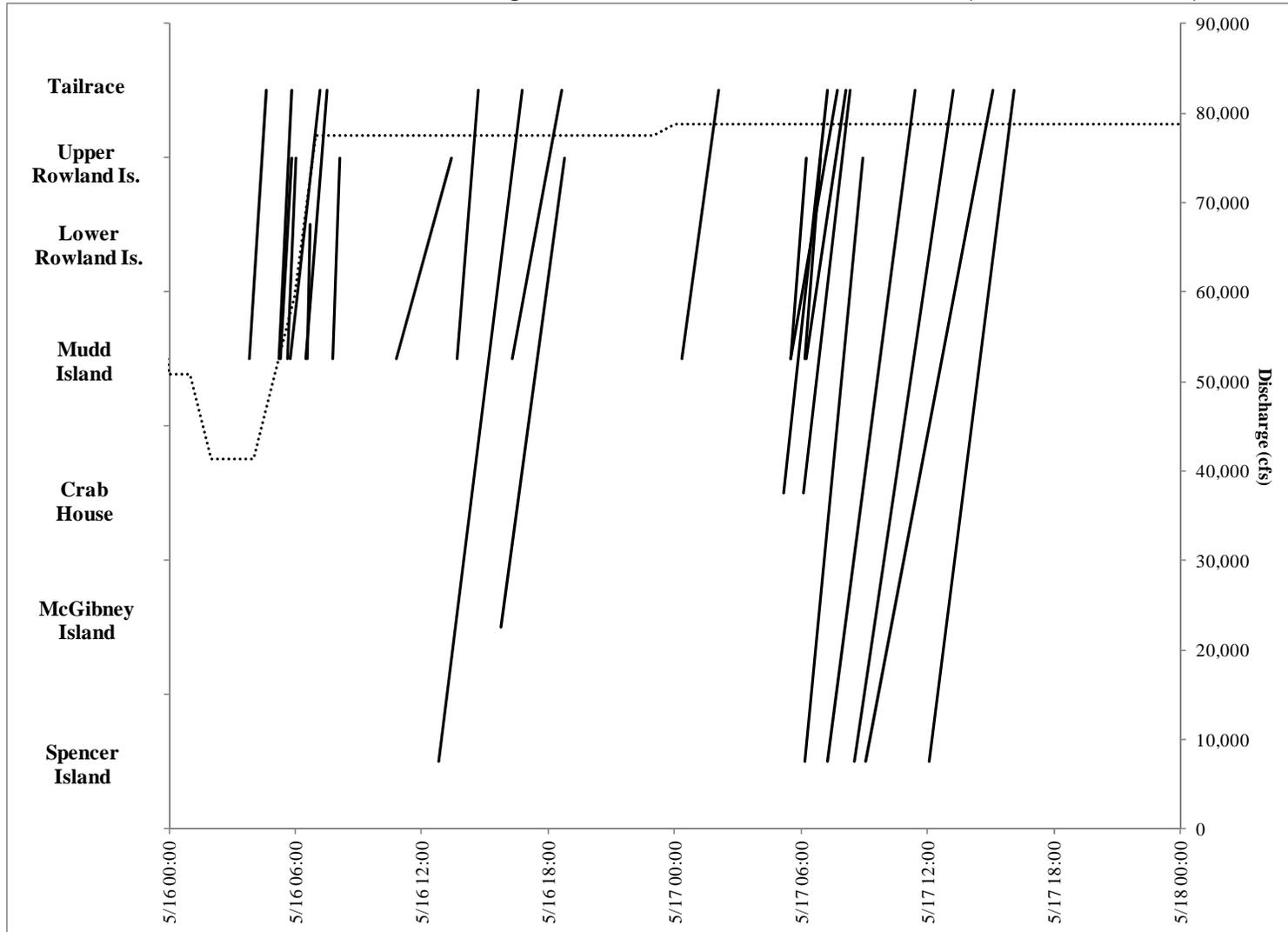
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Nineteen separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 15, 2012 AND MAY 16, 2012.



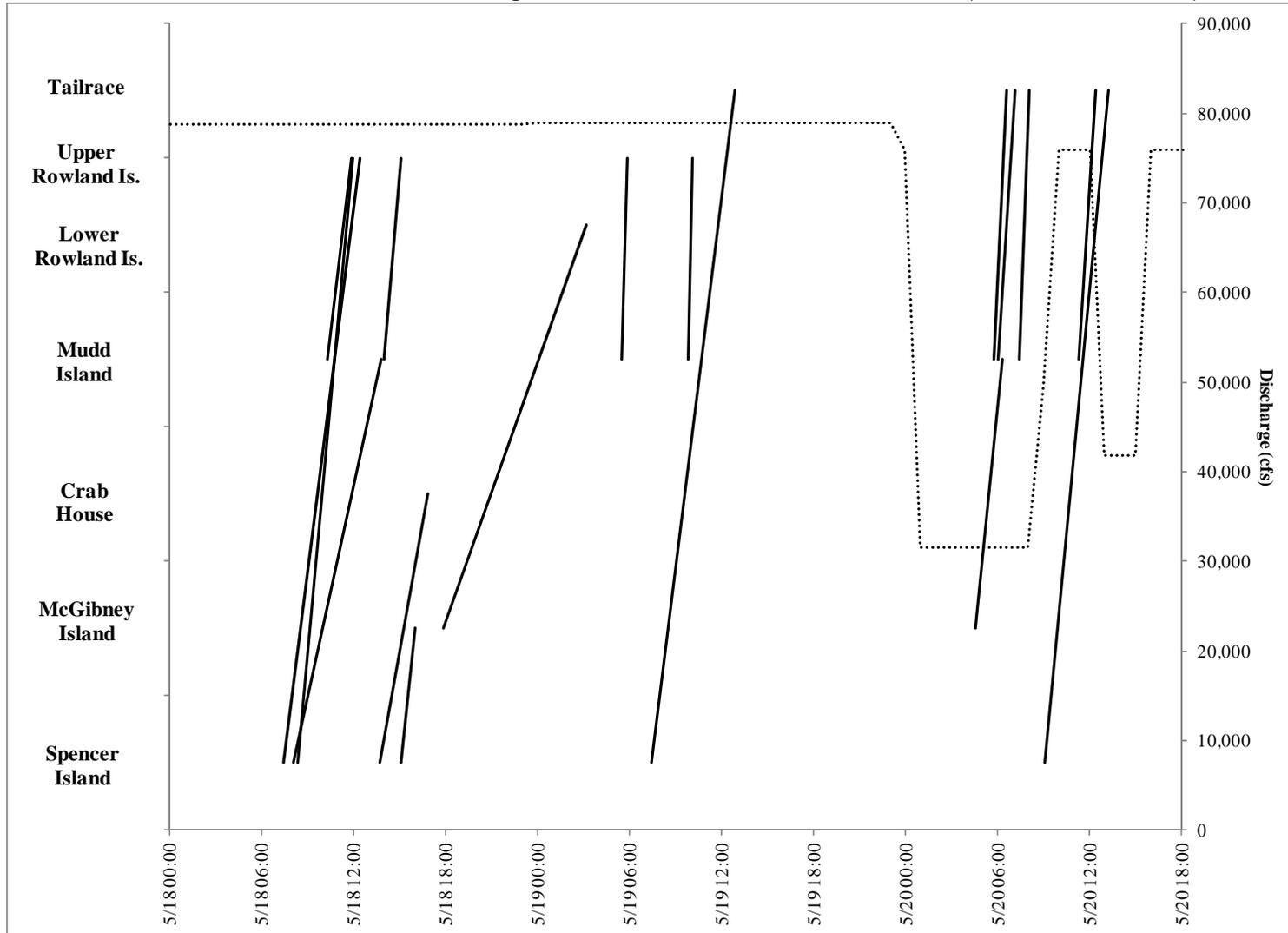
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Seventeen separate forays are illustrated.

**APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS
GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 16, 2012 AND MAY 18, 2012.**



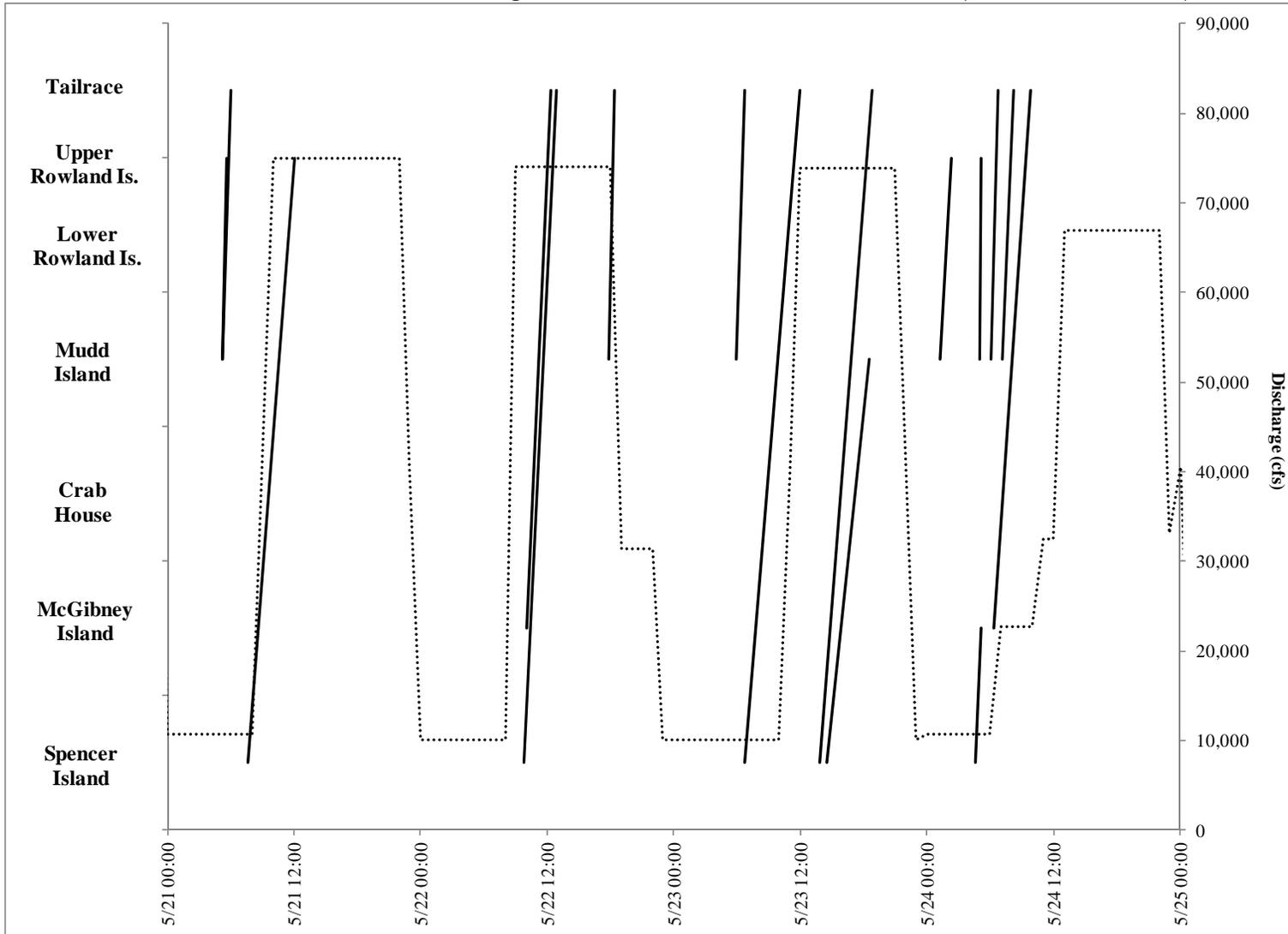
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty five separate forays are illustrated.

**APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS
GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 18, 2012 AND MAY 20, 2012.**



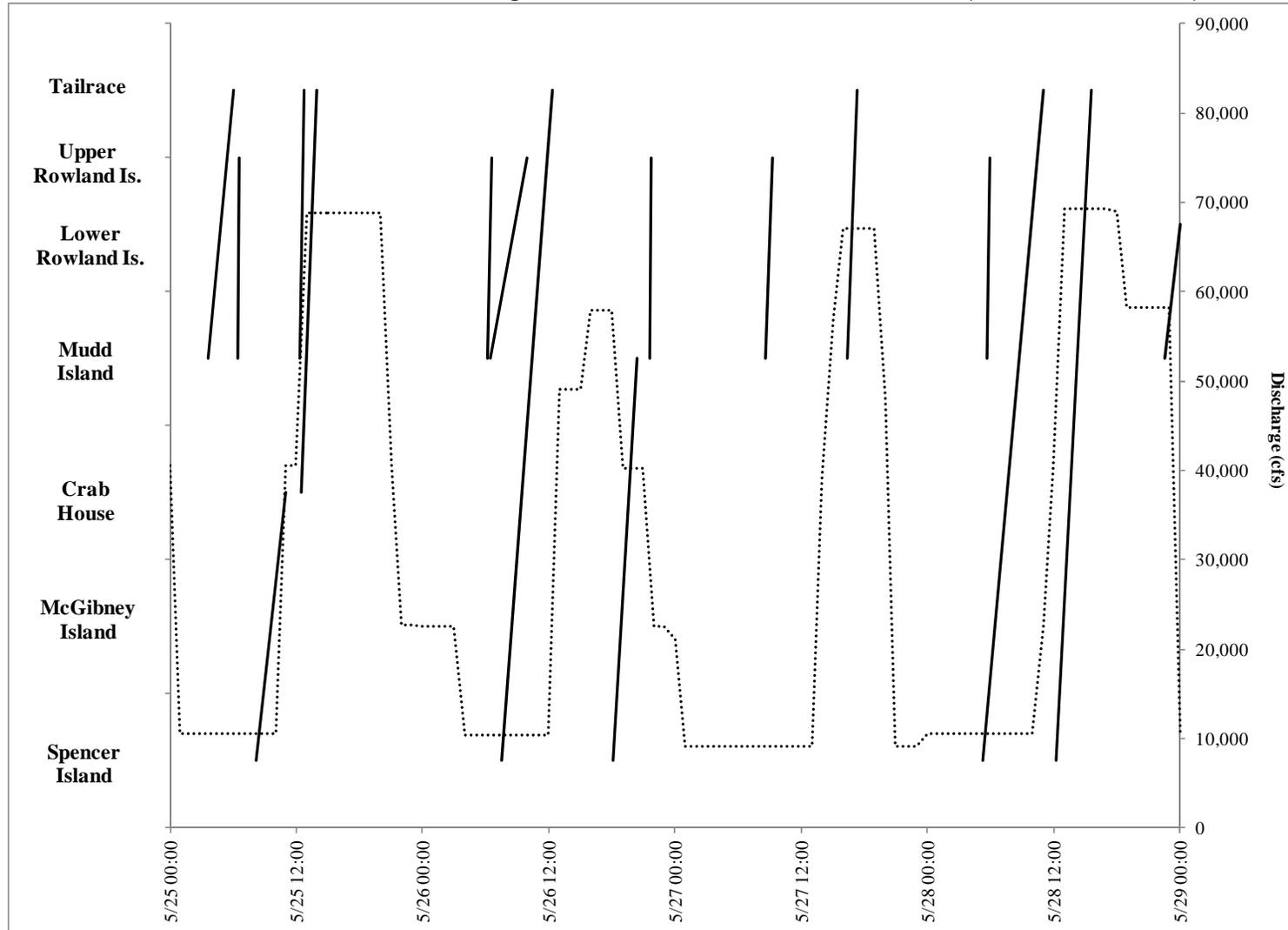
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Eighteen separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 21, 2012 AND MAY 25, 2012.



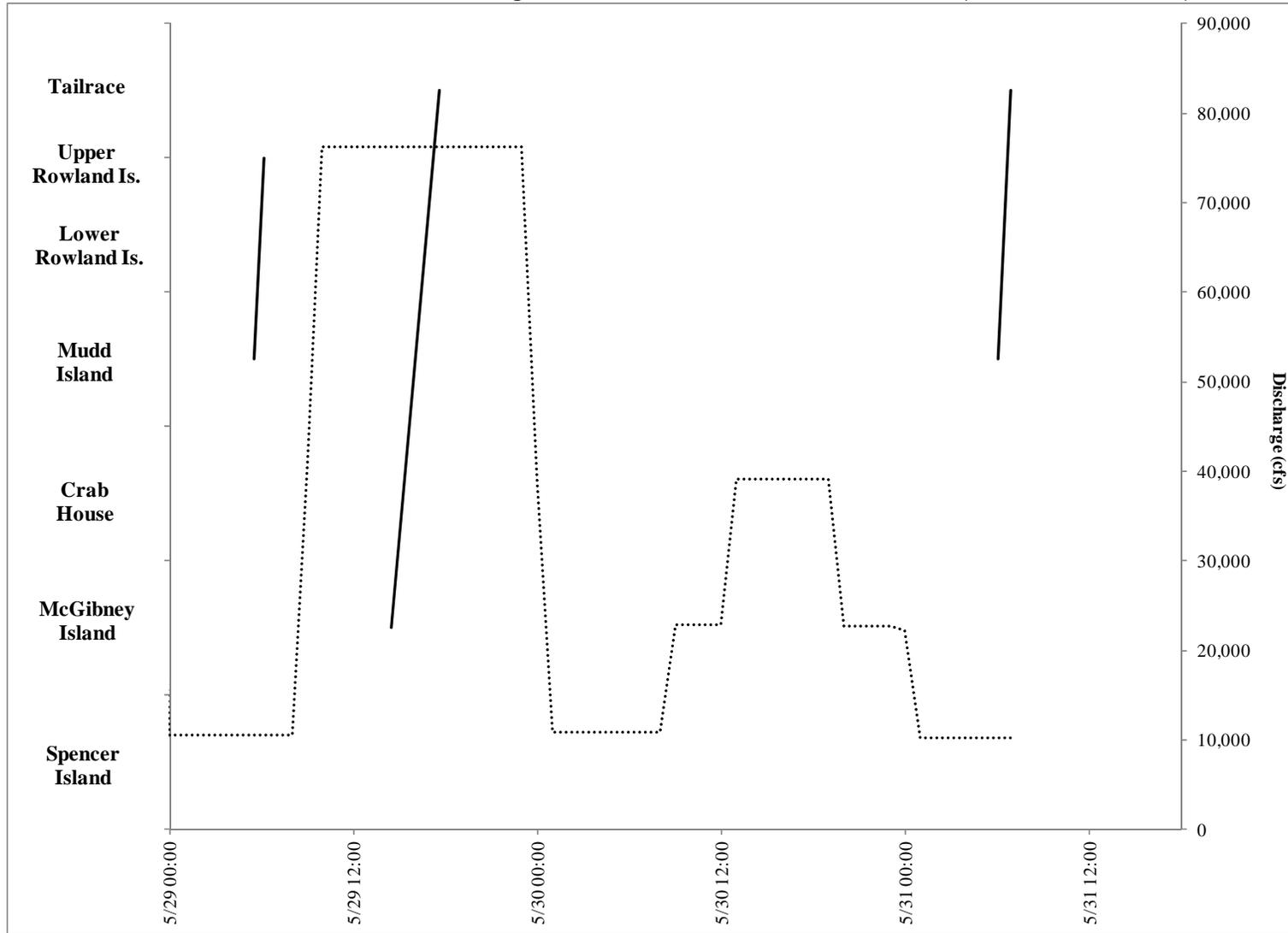
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Sixteen separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 25, 2012 AND MAY 29, 2012.



Discharge is represented by the dashed line and is derived from Conowingo discharge records. Seventeen separate forays are illustrated.

APPENDIX H: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS GREATER THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 29, 2012 AND MAY 31, 2012.



Discharge is represented by the dashed line and is derived from Conowingo discharge records. Three separate forays are illustrated.

**APPENDIX I: LISTING BY INDIVIUDAL RADIO-TAGGED AMERICAN SHAD WHICH
MADE A UPSTREAM MOVEMENTS OF GREATER THAN 0.5 MILE DURING SPRING 2012.**

APPENDIX I: LISTING BY INDIVIDUAL RADIO TAGGED AMERICAN SHAD WHICH MADE A UPSTREAM MOVEMENTS OF GREATER THAN 0.5 MILE DURING SPRING 2012.

| Fish | Date | Time | General | General | Date | Time | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|------------------------------|--------------------------|------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | | | Downstream Location | Upstream Location | | | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-13 | 4/17 | 20:56 | Mudd Island | Lower Rowland Is. West | 4/17 | 21:26 | 0.77 | 0.50 | 1.53 | 2.24 | 68720 | 56213 | 54360 |
| 21-13 | 4/20 | 21:41 | Opposite McGibney Island | Lower Rowland Is. West | 4/20 | 22:27 | 2.23 | 0.77 | 2.89 | 4.23 | 31460 | 23173 | 17550 |
| 21-14 | 4/13 | 23:53 | McGibney Island- Crab House | Crab House - Mudd Island | 4/14 | 4:01 | 0.93 | 4.13 | 0.23 | 0.33 | 11050 | 11181 | 11230 |
| 21-14 | 4/14 | 20:53 | Crab House - Mudd Island | Upper Rowland - West | 4/14 | 22:57 | 1.24 | 2.08 | 0.60 | 0.88 | 23040 | 23040 | 23040 |
| 21-14 | 4/17 | 18:30 | Mudd Island | Upper Rowland - West | 4/17 | 19:39 | 0.87 | 1.14 | 0.76 | 1.11 | 49490 | 20523 | 68720 |
| 21-14 | 4/19 | 23:28 | Mudd Island | Upper Rowland - West | 4/20 | 0:08 | 0.87 | 0.67 | 1.29 | 1.89 | 11260 | 11027 | 11450 |
| 21-14 | 5/9 | 10:41 | McGibney Island- Crab House | Upper Rowland - West | 5/9 | 13:05 | 1.80 | 2.41 | 0.75 | 1.09 | 69250 | 69250 | 69250 |
| 21-14 | 5/15 | 9:36 | Spencer - West | Upper Rowland - West | 5/15 | 17:13 | 4.09 | 7.61 | 0.54 | 0.79 | 60430 | 68845 | 74440 |
| 21-14 | 5/17 | 8:32 | Spencer - West | Spillway - East | 5/17 | 13:12 | 4.59 | 4.66 | 0.98 | 1.44 | 78780 | 78780 | 78780 |
| 21-16 | 4/16 | 4:34 | Mudd Island | Tailrace - East | 4/16 | 5:16 | 1.24 | 0.71 | 1.75 | 2.56 | 11450 | 11450 | 11450 |
| 21-16 | 4/17 | 20:42 | Mudd Island | Upper Rowland - West | 4/17 | 20:58 | 0.87 | 0.28 | 3.14 | 4.60 | 68720 | 68720 | 68720 |
| 21-16 | 4/24 | 5:14 | Mudd Island | Tailrace - East | 4/24 | 6:34 | 1.24 | 1.34 | 0.93 | 1.36 | 26620 | 40333 | 41430 |
| 21-16 | 4/25 | 0:29 | Mudd Island | Upper Rowland - West | 4/25 | 6:18 | 0.87 | 5.82 | 0.15 | 0.22 | 11290 | 14694 | 32190 |
| 21-16 | 5/6 | 23:30 | McGibney Island | Tailrace - East | 5/7 | 9:22 | 2.85 | 9.87 | 0.29 | 0.42 | 10530 | 30453 | 75100 |
| 21-16 | 5/7 | 22:00 | McGibney Island | Mudd Island | 5/8 | 1:01 | 1.61 | 3.02 | 0.53 | 0.78 | 31680 | 31680 | 10580 |
| 21-16 | 5/8 | 2:20 | Mudd Island | Tailrace - East | 5/8 | 7:40 | 1.24 | 5.33 | 0.23 | 0.34 | 10580 | 21447 | 61170 |
| 21-16 | 5/9 | 5:54 | Mudd Island | Lower Rowland - West | 5/9 | 6:19 | 0.77 | 0.42 | 1.85 | 2.71 | 22130 | 55065 | 57810 |
| 21-16 | 5/10 | 8:44 | McGibney Island | Upper Rowland - West | 5/10 | 10:37 | 2.48 | 1.88 | 1.32 | 1.93 | 74890 | 74890 | 74890 |
| 21-16 | 5/11 | 9:03 | McGibney Island - Crab House | Mudd Island | 5/11 | 11:07 | 1.18 | 2.06 | 0.57 | 0.84 | 74540 | 74540 | 74540 |
| 21-16 | 5/11 | 12:12 | Mudd Island | Near Field Powerhouse | 5/11 | 14:04 | 1.10 | 1.88 | 0.59 | 0.86 | 74540 | 74540 | 74540 |
| 21-16 | 5/13 | 4:00 | Mudd Island | Upper Rowland - West | 5/13 | 5:23 | 0.87 | 1.38 | 0.63 | 0.93 | 10370 | 10370 | 10370 |
| 21-18 | 4/15 | 4:02 | Mudd Island | Mid Field Powerhouse | 4/15 | 12:03 | 1.24 | 8.00 | 0.15 | 0.23 | 11410 | 11230 | 11590 |

APPENDIX I: CONTINUED.

| | | | General | General | | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|----------------------|---------------------------|------|-------|---------------|-----------|---------------|-------|---------------------|---------|-------|
| Fish | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-18 | 4/16 | 4:16 | Mudd Island | Upper Rowland - West | 4/16 | 7:30 | 0.87 | 3.24 | 0.27 | 0.39 | 11450 | 13861 | 17400 |
| 21-18 | 4/22 | 5:04 | Mudd Island | Mid Field Powerhouse | 4/22 | 7:27 | 1.12 | 2.38 | 0.47 | 0.69 | 11330 | 11330 | 11330 |
| 21-18 | 5/2 | 16:37 | Opposite Mudd Island | Mid Field Powerhouse | 5/2 | 19:57 | 1.20 | 3.35 | 0.36 | 0.53 | 68300 | 68300 | 68300 |
| 21-21 | 4/20 | 21:19 | Mudd Island | Upper Rowland - East | 4/20 | 22:42 | 0.99 | 1.38 | 0.72 | 1.06 | 31460 | 24339 | 17550 |
| 21-21 | 4/25 | 3:09 | Mudd Island | Upper Rowland - West | 4/25 | 4:47 | 0.87 | 1.64 | 0.53 | 0.78 | 11290 | 11290 | 11290 |
| 21-21 | 5/1 | 1:46 | Mudd Island | Lower Rowland - West | 5/1 | 1:54 | 0.77 | 0.13 | 5.79 | 8.49 | 10520 | 10520 | 10520 |
| 21-21 | 5/2 | 22:45 | Mudd Island | Lower Rowland - West | 5/2 | 23:23 | 0.77 | 0.63 | 1.21 | 1.78 | 10360 | 10360 | 10360 |
| 21-21 | 5/9 | 6:47 | Mudd Island | Mid Field Powerhouse | 5/9 | 7:27 | 1.12 | 0.67 | 1.68 | 2.46 | 57810 | 60260 | 60600 |
| 21-21 | 5/9 | 12:29 | Mudd Island | Near Field Powerhouse | 5/9 | 14:06 | 1.10 | 1.62 | 0.68 | 1.00 | 69250 | 69250 | 69250 |
| 21-23 | 4/15 | 5:28 | Crab House | Mudd Island | 4/15 | 6:06 | 0.81 | 0.64 | 1.26 | 1.85 | 11410 | 11410 | 11410 |
| 21-23 | 4/21 | 7:21 | Mudd Island | Upper Rowland - West | 4/21 | 8:49 | 0.87 | 1.47 | 0.59 | 0.86 | 11980 | 11980 | 11980 |
| 21-23 | 5/1 | 7:09 | Spencer West | Mudd Island | 5/1 | 12:44 | 3.22 | 5.57 | 0.58 | 0.85 | 49230 | 33503 | 16610 |
| 21-25 | 4/30 | 12:26 | McGibney Island | Tailrace - East | 4/30 | 15:11 | 2.60 | 2.75 | 0.95 | 1.39 | 23600 | 23600 | 23600 |
| 21-25 | 5/1 | 9:05 | Spencer East | Upper Rowland - West | 5/1 | 15:09 | 4.09 | 6.08 | 0.67 | 0.99 | 49230 | 21793 | 16610 |
| 21-25 | 5/2 | 4:20 | Mudd Island | Upper Rowland - West | 5/2 | 4:54 | 0.87 | 0.57 | 1.53 | 2.24 | 10360 | 10360 | 10360 |
| 21-25 | 5/10 | 13:47 | Spencer East | Upper Rowland - East | 5/10 | 19:03 | 4.22 | 5.27 | 0.80 | 1.17 | 74890 | 74890 | 74890 |
| 21-27 | 4/17 | 6:38 | Mudd Island | Upper Rowland - West | 4/17 | 11:52 | 0.87 | 5.23 | 0.17 | 0.24 | 11330 | 11330 | 11330 |
| 21-27 | 4/21 | 6:21 | Mudd Island | Upper Rowland - West | 4/21 | 15:56 | 0.87 | 9.58 | 0.09 | 0.13 | 11980 | 11980 | 11980 |
| 21-27 | 4/23 | 7:44 | Mudd Island | Mid Field Powerhouse | 4/23 | 8:04 | 1.12 | 0.33 | 3.36 | 4.93 | 22760 | 22760 | 22760 |
| 21-27 | 4/25 | 4:27 | Mudd Island | Mid Field Powerhouse | 4/25 | 4:35 | 1.12 | 0.13 | 8.28 | 12.15 | 11290 | 11290 | 11290 |
| 21-36 | 5/3 | 14:18 | Mudd Island | Upper Rowland - West | 5/3 | 21:02 | 0.87 | 6.73 | 0.13 | 0.19 | 41020 | 56273 | 58520 |
| 21-37 | 5/5 | 14:40 | Spencer West | Mudd Island | 5/5 | 17:31 | 3.22 | 2.84 | 1.13 | 1.66 | 49530 | 49530 | 49530 |
| 21-37 | 5/5 | 17:43 | Mudd Island | Upper Rowland - West | 5/5 | 18:40 | 0.87 | 0.95 | 0.91 | 1.34 | 49530 | 49530 | 49530 |
| 21-37 | 5/6 | 8:41 | Mudd Island | Near Field Powerhouse | 5/6 | 13:31 | 1.10 | 4.83 | 0.23 | 0.34 | 10530 | 46153 | 49210 |
| 21-37 | 5/6 | 15:27 | McGibney Island | Near Field Powerhouse | 5/6 | 19:46 | 2.72 | 4.32 | 0.63 | 0.92 | 74680 | 74680 | 74680 |
| 21-37 | 5/8 | 15:03 | Mudd Island | Mid Field Powerhouse-East | 5/8 | 18:11 | 1.30 | 3.14 | 0.41 | 0.61 | 75100 | 65371 | 61170 |
| 21-37 | 5/9 | 5:35 | Mudd Island | Upper Rowland - West | 5/9 | 10:57 | 0.87 | 5.37 | 0.16 | 0.24 | 22130 | 58686 | 69250 |

APPENDIX I: CONTINUED.

| | | | General | General | | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|---------------------|-----------------------|------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| Fish | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-37 | 5/10 | 5:44 | Mudd Island | Upper Rowland - East | 5/10 | 6:54 | 0.99 | 1.16 | 0.86 | 1.26 | 30840 | 64206 | 74890 |
| 21-37 | 5/11 | 6:20 | Mudd Island | Upper Rowland - West | 5/11 | 7:17 | 0.87 | 0.95 | 0.92 | 1.35 | 74540 | 74540 | 74540 |
| 21-37 | 5/11 | 11:13 | Mudd Island | Upper Rowland - East | 5/11 | 13:41 | 0.99 | 2.47 | 0.40 | 0.59 | 74540 | 74540 | 74540 |
| 21-37 | 5/11 | 16:16 | Mudd Island | Upper Rowland - East | 5/11 | 17:59 | 0.99 | 1.73 | 0.57 | 0.84 | 74540 | 74540 | 74540 |
| 21-37 | 5/12 | 6:00 | Mudd Island | Upper Rowland - West | 5/12 | 6:34 | 0.87 | 0.56 | 1.54 | 2.26 | 40670 | 40670 | 40670 |
| 21-37 | 5/12 | 9:12 | Mudd Island | Upper Rowland - West | 5/12 | 9:56 | 0.87 | 0.74 | 1.18 | 1.73 | 75360 | 75360 | 75360 |
| 21-37 | 5/12 | 16:36 | Mudd Island | Near Field Powerhouse | 5/12 | 17:44 | 1.00 | 1.14 | 0.88 | 1.29 | 75360 | 75360 | 75360 |
| 21-37 | 5/13 | 5:53 | Mudd Island | Upper Rowland - West | 5/13 | 6:16 | 0.87 | 0.39 | 2.24 | 3.29 | 10370 | 10370 | 10370 |
| 21-37 | 5/14 | 7:13 | Mudd Island | Near Field Powerhouse | 5/14 | 8:39 | 1.10 | 1.43 | 0.77 | 1.13 | 39590 | 49716 | 74830 |
| 21-37 | 5/14 | 23:50 | Mudd Island | Upper Rowland - West | 5/15 | 4:34 | 0.87 | 4.73 | 0.18 | 0.27 | 39590 | 10465 | 9930 |
| 21-37 | 5/15 | 9:07 | Mudd Island | Upper Rowland - East | 5/15 | 10:42 | 0.99 | 1.59 | 0.62 | 0.91 | 60430 | 60430 | 60430 |
| 21-37 | 5/15 | 15:42 | Crab House | Upper Rowland - West | 5/15 | 17:25 | 1.67 | 1.72 | 0.97 | 1.43 | 74440 | 74440 | 74440 |
| 21-37 | 5/16 | 5:47 | Mudd Island | Near Field Powerhouse | 5/16 | 7:09 | 1.10 | 1.35 | 0.82 | 1.20 | 50830 | 70704 | 77520 |
| 21-37 | 5/16 | 16:19 | Mudd Island | Near Field Powerhouse | 5/16 | 18:39 | 1.29 | 2.34 | 0.55 | 0.81 | 77520 | 77520 | 77520 |
| 21-37 | 5/17 | 5:32 | Mudd Island | Upper Rowland - West | 5/17 | 6:14 | 0.87 | 0.71 | 1.23 | 1.80 | 78780 | 78780 | 78780 |
| 21-39 | 5/2 | 0:37 | Mudd Island | Upper Rowland - East | 5/2 | 1:14 | 0.99 | 0.61 | 1.62 | 2.37 | 10360 | 10360 | 10360 |
| 21-39 | 5/8 | 20:46 | Mudd Island | Lower Rowland - West | 5/8 | 20:57 | 0.77 | 0.19 | 3.99 | 5.85 | 43420 | 43420 | 43420 |
| 21-39 | 5/11 | 19:19 | Mudd Island | Lower Rowland - West | 5/11 | 23:24 | 0.77 | 4.09 | 0.19 | 0.28 | 74540 | 63647 | 39740 |
| 21-41 | 5/5 | 14:51 | Spencer East | McGibney Island | 5/5 | 19:21 | 1.61 | 4.50 | 0.36 | 0.52 | 49530 | 50442 | 74250 |
| 21-41 | 5/8 | 11:31 | McGibney Island | Mudd Island | 5/8 | 13:03 | 1.61 | 1.53 | 1.05 | 1.55 | 61170 | 61170 | 61170 |
| 21-41 | 5/8 | 14:28 | Mudd Island | Near Field Powerhouse | 5/8 | 15:31 | 1.00 | 1.04 | 0.97 | 1.42 | 75100 | 75100 | 75100 |
| 21-41 | 5/9 | 7:08 | Mudd Island | Near Field Powerhouse | 5/9 | 8:09 | 1.00 | 1.02 | 0.98 | 1.44 | 60600 | 60600 | 60600 |
| 21-41 | 5/10 | 6:12 | Mudd Island | Near Field Powerhouse | 5/10 | 7:31 | 1.10 | 1.32 | 0.84 | 1.23 | 74890 | 74890 | 74890 |
| 21-41 | 5/10 | 12:39 | Mudd Island | Upper Rowland - West | 5/10 | 14:44 | 0.87 | 2.09 | 0.42 | 0.61 | 74890 | 74890 | 74890 |
| 21-41 | 5/11 | 9:48 | Crab House | Upper Rowland - West | 5/11 | 13:45 | 1.57 | 3.95 | 0.40 | 0.58 | 74540 | 74540 | 74540 |
| 21-41 | 5/12 | 10:47 | Mudd Island | Upper Rowland - West | 5/12 | 11:22 | 0.87 | 0.59 | 1.47 | 2.16 | 75360 | 75360 | 75360 |
| 21-41 | 5/17 | 12:05 | Spencer West | Near Field Powerhouse | 5/17 | 16:07 | 4.23 | 4.03 | 1.05 | 1.54 | 78780 | 78780 | 78780 |

APPENDIX I: CONTINUED.

| Fish | General | | Downstream Location | Upstream Location | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|---------|-------|---------------------|----------------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | Date | Time | | | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-41 | 5/19 | 8:41 | Spencer West | Upper Rowland - West | 5/19 | 12:19 | 4.09 | 3.64 | 1.12 | 1.65 | 69520 | 69520 | 69520 |
| 21-41 | 5/20 | 11:16 | Mudd Island | Near Field Powerhouse | 5/20 | 12:26 | 1.10 | 1.17 | 0.94 | 1.38 | 66880 | 66880 | 66880 |
| 21-41 | 5/22 | 10:01 | McGibney Island | Near Field Powerhouse | 5/22 | 12:24 | 2.62 | 2.39 | 1.10 | 1.61 | 55880 | 55880 | 55880 |
| 21-41 | 5/23 | 6:42 | Spencer West | Near Field Powerhouse | 5/23 | 11:57 | 4.33 | 5.26 | 0.82 | 1.21 | 10170 | 15736 | 41350 |
| 21-43 | 5/7 | 15:09 | McGibney Island | Crab House | 5/7 | 16:49 | 1.61 | 1.66 | 0.97 | 1.42 | 75100 | 75100 | 75100 |
| 21-43 | 5/8 | 11:34 | Mudd Island | Far Field Powerhouse | 5/8 | 15:24 | 1.12 | 3.83 | 0.29 | 0.43 | 61170 | 69673 | 75100 |
| 21-43 | 5/9 | 9:56 | Mudd Island | Upper Rowland - West | 5/9 | 11:43 | 0.87 | 1.79 | 0.48 | 0.71 | 60600 | 67488 | 69250 |
| 21-43 | 5/10 | 6:54 | Mudd Island | Near Field Powerhouse | 5/10 | 8:42 | 1.10 | 1.79 | 0.62 | 0.90 | 74890 | 74890 | 74890 |
| 21-43 | 5/11 | 4:07 | Mudd Island | Upper Rowland - West | 5/11 | 4:30 | 0.87 | 0.39 | 2.24 | 3.28 | 74540 | 74540 | 74540 |
| 21-43 | 5/13 | 7:06 | Mudd Island | Upper Rowland - West | 5/13 | 7:37 | 0.87 | 0.51 | 1.70 | 2.49 | 10370 | 28273 | 34240 |
| 21-43 | 5/14 | 5:54 | Mudd Island | Near Field Powerhouse | 5/14 | 6:36 | 1.10 | 0.70 | 1.58 | 2.31 | 10980 | 36929 | 39590 |
| 21-43 | 5/15 | 5:47 | Mudd Island | Near Field Powerhouse | 5/15 | 6:52 | 1.10 | 1.08 | 1.02 | 1.50 | 9930 | 9930 | 9930 |
| 21-43 | 5/15 | 14:34 | Mudd Island | Near Field Powerhouse | 5/15 | 15:56 | 1.10 | 1.37 | 0.81 | 1.19 | 69110 | 71486 | 74440 |
| 21-43 | 5/17 | 6:04 | Crab House | Near Field Powerhouse | 5/17 | 8:18 | 1.91 | 2.22 | 0.86 | 1.26 | 78780 | 78780 | 78780 |
| 21-43 | 5/27 | 16:21 | Mudd Island | Near Field Powerhouse | 5/27 | 17:23 | 1.10 | 1.03 | 1.07 | 1.57 | 31600 | 31600 | 31600 |
| 21-46 | 5/17 | 9:05 | Spencer East | Near Field Powerhouse | 5/17 | 15:04 | 4.33 | 5.98 | 0.72 | 1.06 | 78780 | 78780 | 78780 |
| 21-46 | 5/20 | 9:04 | Spencer East | Near Field Powerhouse | 5/20 | 13:13 | 4.33 | 4.15 | 1.04 | 1.53 | 40570 | 54714 | 32790 |
| 21-52 | 5/23 | 13:53 | Spencer West | Near Field Powerhouse | 5/23 | 18:48 | 4.45 | 4.91 | 0.91 | 1.33 | 41350 | 41350 | 41350 |
| 21-52 | 5/24 | 1:11 | Mudd Island | Upper Rowland - East | 5/24 | 2:16 | 0.99 | 1.07 | 0.92 | 1.36 | 10740 | 10740 | 10740 |
| 21-52 | 5/25 | 3:37 | Mudd Island | Near Field Powerhouse | 5/25 | 6:00 | 1.23 | 2.38 | 0.52 | 0.76 | 10610 | 10610 | 10610 |
| 21-64 | 5/12 | 9:26 | Spencer East | Near Field Powerhouse-West | 5/12 | 14:47 | 4.38 | 5.35 | 0.82 | 1.20 | 75360 | 75360 | 75360 |
| 21-64 | 5/13 | 22:44 | Crab House | Lower Rowland - West | 5/14 | 3:02 | 0.95 | 4.32 | 0.22 | 0.32 | 40170 | 32442 | 10980 |
| 21-64 | 5/15 | 4:10 | Mudd Island | Near Field Powerhouse-West | 5/15 | 5:40 | 1.28 | 1.50 | 0.85 | 1.25 | 9930 | 9930 | 9930 |
| 21-66 | 5/2 | 22:06 | Mudd Island | Upper Rowland - West | 5/2 | 22:45 | 1.05 | 0.66 | 1.61 | 2.36 | 10360 | 10360 | 10360 |
| 21-66 | 5/7 | 16:26 | McGibney Island | Mudd Island | 5/7 | 18:11 | 0.81 | 1.75 | 0.46 | 0.68 | 75100 | 75100 | 75100 |
| 21-66 | 5/8 | 9:18 | McGibney Island | Near Field Powerhouse | 5/8 | 13:29 | 2.00 | 4.19 | 0.48 | 0.70 | 61170 | 62607 | 75100 |
| 21-66 | 5/9 | 11:10 | Mudd Island | Near Field Powerhouse | 5/9 | 12:40 | 1.10 | 1.51 | 0.73 | 1.07 | 69250 | 69250 | 69250 |

APPENDIX I: CONTINUED.

| | | | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|---------------------|-----------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| Fish | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-66 | 5/11 | 16:33 | Mudd Island | Near Field Powerhouse | 5/11 | 17:55 | 1.10 | 1.38 | 0.80 | 1.17 | 74540 | 74540 | 74540 |
| 21-66 | 5/17 | 7:13 | Spencer West | Near Field Powerhouse | 5/17 | 11:23 | 4.23 | 4.17 | 1.01 | 1.49 | 78780 | 78780 | 78780 |
| 21-68 | 5/7 | 14:28 | McGibney Island | Near Field Powerhouse | 5/7 | 17:32 | 2.00 | 3.06 | 0.65 | 0.96 | 75100 | 75100 | 75100 |
| 21-68 | 5/8 | 5:25 | McGibney Island | Mudd Island | 5/8 | 6:13 | 1.61 | 0.80 | 2.03 | 2.97 | 10580 | 17314 | 34150 |
| 21-68 | 5/8 | 8:42 | Mudd Island | Near Field Powerhouse | 5/8 | 12:24 | 1.00 | 3.70 | 0.27 | 0.40 | 61170 | 61170 | 61170 |
| 21-68 | 5/9 | 5:42 | Mudd Island | Near Field Powerhouse | 5/9 | 6:30 | 1.00 | 0.81 | 1.25 | 1.83 | 22130 | 47616 | 57810 |
| 21-72 | 5/10 | 11:13 | Spencer West | Near Field Powerhouse | 5/10 | 16:40 | 4.33 | 5.44 | 0.80 | 1.17 | 74890 | 74890 | 74890 |
| 21-72 | 5/11 | 6:12 | Mudd Island | Near Field Powerhouse | 5/11 | 7:31 | 1.10 | 1.31 | 0.84 | 1.24 | 74540 | 74540 | 74540 |
| 21-72 | 5/11 | 10:41 | Mudd Island | Near Field Powerhouse | 5/11 | 11:54 | 1.10 | 1.21 | 0.91 | 1.34 | 74540 | 74540 | 74540 |
| 21-72 | 5/12 | 6:04 | McGibney Island | Mudd Island | 5/12 | 6:56 | 1.61 | 0.87 | 1.85 | 2.71 | 40670 | 40670 | 40670 |
| 21-72 | 5/12 | 9:21 | Mudd Island | Upper Rowland - West | 5/12 | 9:41 | 0.87 | 0.34 | 2.54 | 3.73 | 75360 | 75360 | 75360 |
| 21-72 | 5/12 | 12:52 | Mudd Island | Near Field Powerhouse | 5/12 | 16:01 | 1.23 | 3.15 | 0.39 | 0.57 | 75360 | 75360 | 75360 |
| 21-72 | 5/13 | 5:33 | Mudd Island | Upper Rowland - West | 5/13 | 5:41 | 0.87 | 0.13 | 6.73 | 9.88 | 10370 | 10370 | 10370 |
| 21-72 | 5/13 | 10:33 | Mudd Island | Near Field Powerhouse | 5/13 | 12:28 | 1.10 | 1.91 | 0.58 | 0.85 | 75500 | 75500 | 75500 |
| 21-72 | 5/13 | 14:25 | Mudd Island | Upper Rowland - West | 5/13 | 15:11 | 0.87 | 0.76 | 1.14 | 1.67 | 75500 | 75500 | 75500 |
| 21-73 | 4/18 | 20:33 | Mudd Island | Upper Rowland - West | 4/18 | 21:38 | 0.87 | 1.08 | 0.80 | 1.17 | 11240 | 11240 | 11240 |
| 21-74 | 5/3 | 19:54 | Spencer West | Mudd Island | 5/4 | 0:06 | 3.22 | 4.20 | 0.77 | 1.13 | 58520 | 39843 | 10210 |
| 21-74 | 5/6 | 2:22 | Mudd Island | Upper Rowland - West | 5/6 | 3:04 | 0.87 | 0.70 | 1.24 | 1.82 | 10530 | 10530 | 10530 |
| 21-75 | 5/1 | 0:03 | Mudd Island | Upper Rowland - West | 5/1 | 0:52 | 0.87 | 0.80 | 1.08 | 1.58 | 34530 | 15322 | 10520 |
| 21-75 | 5/1 | 20:52 | Mudd Island | Upper Rowland - West | 5/1 | 21:58 | 0.87 | 1.10 | 0.79 | 1.16 | 62970 | 62970 | 62970 |
| 21-75 | 5/2 | 18:19 | Mudd Island | Upper Rowland - West | 5/2 | 19:10 | 0.87 | 0.85 | 1.03 | 1.50 | 68300 | 68300 | 68300 |
| 21-75 | 5/3 | 5:32 | Mudd Island | Lower Rowland - West | 5/3 | 6:25 | 0.77 | 0.89 | 0.86 | 1.26 | 10640 | 13541 | 22690 |
| 21-75 | 5/4 | 5:38 | Mudd Island | Near Field Powerhouse | 5/4 | 7:31 | 1.10 | 1.88 | 0.59 | 0.86 | 10210 | 11706 | 22390 |
| 21-77 | 4/20 | 4:10 | Mudd Island | Upper Rowland - West | 4/20 | 4:20 | 0.87 | 0.18 | 4.89 | 7.17 | 11450 | 11450 | 11450 |
| 21-77 | 4/21 | 5:36 | Mudd Island | Upper Rowland - West | 4/21 | 7:16 | 0.87 | 1.67 | 0.52 | 0.76 | 11980 | 11980 | 11980 |
| 21-77 | 4/22 | 5:14 | Mudd Island | Upper Rowland - West | 4/22 | 5:50 | 0.87 | 0.60 | 1.43 | 2.10 | 11330 | 11330 | 11330 |
| 21-77 | 4/22 | 7:56 | Mudd Island | Upper Rowland - West | 4/22 | 9:32 | 0.87 | 1.60 | 0.54 | 0.80 | 11330 | 11330 | 11330 |

APPENDIX I: CONTINUED.

| | | | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|---------------------|-----------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| Fish | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-77 | 4/23 | 5:47 | Mudd Island | Near Field Powerhouse | 4/23 | 8:48 | 1.10 | 3.02 | 0.37 | 0.54 | 11600 | 20920 | 22760 |
| 21-77 | 4/24 | 3:54 | Mudd Island | Upper Rowland - West | 4/24 | 4:44 | 0.87 | 0.85 | 1.02 | 1.50 | 11580 | 11580 | 11580 |
| 21-80 | 4/19 | 22:17 | Crab House | Upper Rowland - West | 4/20 | 5:09 | 1.67 | 6.87 | 0.24 | 0.36 | 45880 | 15365 | 11450 |
| 21-81 | 5/2 | 19:24 | Spencer West | McGibney Island | 5/2 | 20:09 | 1.61 | 0.75 | 2.15 | 3.15 | 68300 | 68300 | 68300 |
| 21-81 | 5/3 | 1:13 | McGibney Island | Mudd Island | 5/3 | 2:26 | 1.61 | 1.21 | 1.33 | 1.95 | 10640 | 10640 | 10640 |
| 21-81 | 5/5 | 21:19 | Mudd Island | Upper Rowland - West | 5/5 | 23:15 | 0.87 | 1.94 | 0.45 | 0.66 | 74250 | 54373 | 22570 |
| 21-85 | 4/20 | 20:28 | Spencer West | McGibney Island | 4/21 | 2:44 | 1.61 | 6.27 | 0.26 | 0.38 | 31460 | 17700 | 11980 |
| 21-85 | 4/21 | 19:35 | Spencer East | McGibney Island | 4/21 | 22:55 | 1.61 | 3.33 | 0.48 | 0.71 | 18160 | 18160 | 18160 |
| 21-85 | 4/22 | 21:11 | Spencer West | McGibney Island | 4/22 | 23:45 | 1.61 | 2.58 | 0.63 | 0.92 | 11330 | 11330 | 11330 |
| 21-87 | 4/22 | 13:24 | Mudd Island | Upper Rowland - West | 4/22 | 15:09 | 0.87 | 1.74 | 0.50 | 0.73 | 11330 | 11330 | 11330 |
| 21-87 | 4/23 | 5:57 | Mudd Island | Upper Rowland - West | 4/23 | 7:23 | 0.87 | 1.44 | 0.60 | 0.89 | 11600 | 20194 | 22760 |
| 21-87 | 5/7 | 8:35 | McGibney Island | Near Field Powerhouse | 5/7 | 17:04 | 2.72 | 8.50 | 0.32 | 0.47 | 58990 | 73097 | 75100 |
| 21-87 | 5/8 | 6:19 | Mudd Island | Near Field Powerhouse | 5/8 | 8:47 | 1.23 | 2.47 | 0.50 | 0.73 | 34150 | 53735 | 61170 |
| 21-87 | 5/9 | 9:13 | Mudd Island | Near Field Powerhouse | 5/9 | 11:36 | 1.10 | 2.40 | 0.46 | 0.68 | 60600 | 65345 | 69250 |
| 21-87 | 5/11 | 6:47 | Mudd Island | Lower Rowland - West | 5/11 | 8:38 | 0.77 | 1.85 | 0.42 | 0.61 | 74540 | 74540 | 74540 |
| 21-87 | 5/13 | 8:20 | Mudd Island | Near Field Powerhouse | 5/13 | 9:44 | 1.10 | 1.40 | 0.79 | 1.16 | 75500 | 75500 | 75500 |
| 21-87 | 5/14 | 5:20 | Mudd Island | Near Field Powerhouse | 5/14 | 6:44 | 1.10 | 1.39 | 0.79 | 1.16 | 10980 | 26800 | 39590 |
| 21-87 | 5/15 | 5:34 | Mudd Island | Upper Rowland - West | 5/15 | 5:57 | 0.87 | 0.39 | 2.24 | 3.29 | 9930 | 9930 | 9930 |
| 21-87 | 5/16 | 7:46 | Mudd Island | Upper Rowland - West | 5/16 | 8:06 | 0.87 | 0.34 | 2.56 | 3.75 | 77520 | 77520 | 77520 |
| 21-87 | 5/16 | 10:45 | Mudd Island | Upper Rowland - East | 5/16 | 13:26 | 0.99 | 2.67 | 0.37 | 0.54 | 77520 | 77520 | 77520 |
| 21-87 | 5/17 | 6:11 | Mudd Island | Upper Rowland - West | 5/17 | 6:56 | 0.87 | 0.75 | 1.15 | 1.69 | 78780 | 78780 | 78780 |
| 21-89 | 5/26 | 18:05 | Spencer West | Mudd Island | 5/26 | 20:20 | 3.22 | 2.24 | 1.44 | 2.11 | 22560 | 22560 | 22560 |
| 21-89 | 5/26 | 21:36 | Mudd Island | Upper Rowland - West | 5/26 | 21:45 | 0.87 | 0.13 | 6.43 | 9.43 | 22560 | 22560 | 22560 |
| 54-12 | 4/24 | 22:34 | Spencer - West | Upper Rowland - West | 4/25 | 1:49 | 4.09 | 3.25 | 1.26 | 1.85 | 11580 | 11358 | 11290 |
| 54-12 | 4/27 | 7:24 | Spencer - West | Upper Rowland - West | 4/27 | 11:55 | 4.09 | 4.51 | 0.91 | 1.33 | 70100 | 69239 | 11530 |
| 54-13 | 4/15 | 0:31 | McGibney Island | Crab House | 4/15 | 1:30 | 0.81 | 0.98 | 0.82 | 1.20 | 11410 | 11410 | 11410 |
| 54-13 | 4/15 | 3:13 | Crab House | Mudd Island | 4/15 | 3:45 | 0.81 | 0.53 | 1.52 | 2.23 | 11410 | 11410 | 11410 |

APPENDIX I: CONTINUED.

| Fish | General | | Downstream Location | Upstream Location | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|---------|-------|---------------------|------------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | Date | Time | | | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-13 | 4/17 | 18:21 | Mudd Island | Upper Rowland - West | 4/17 | 20:03 | 0.87 | 1.70 | 0.51 | 0.75 | 49490 | 20523 | 68720 |
| 54-13 | 5/3 | 18:10 | Spencer - West | Upper Rowland - West | 5/3 | 23:06 | 4.09 | 4.94 | 0.83 | 1.21 | 58520 | 52195 | 10640 |
| 54-13 | 5/5 | 4:53 | Mudd Island | Lower Rowland Is. West | 5/5 | 5:00 | 0.77 | 0.12 | 6.51 | 9.55 | 10450 | 10450 | 10450 |
| 54-13 | 5/12 | 5:15 | Mudd Island | Near Field Powerhouse | 5/12 | 6:53 | 1.10 | 1.63 | 0.68 | 1.00 | 40670 | 40670 | 40670 |
| 54-13 | 5/18 | 15:05 | Spencer - West | McGibney Island | 5/18 | 16:00 | 1.61 | 0.93 | 1.73 | 2.54 | 69390 | 69390 | 69390 |
| 54-13 | 5/18 | 17:51 | McGibney Island | Lower Rowland Is. West | 5/19 | 3:12 | 2.38 | 9.34 | 0.25 | 0.37 | 69390 | 69435 | 69520 |
| 54-14 | 4/25 | 19:30 | Spencer - West | Mudd Island | 4/26 | 1:11 | 3.22 | 5.68 | 0.57 | 0.83 | 41240 | 19141 | 11300 |
| 54-14 | 4/26 | 2:48 | Mudd Island | Upper Rowland - West | 4/26 | 3:03 | 0.87 | 0.25 | 3.42 | 5.02 | 11300 | 11300 | 11300 |
| 54-15 | 4/18 | 3:47 | Mudd Island | Upper Rowland - East | 4/18 | 5:07 | 1.23 | 1.33 | 0.93 | 1.36 | 12090 | 12090 | 12090 |
| 54-15 | 5/1 | 19:34 | Spencer - West | Mudd Island | 5/1 | 22:36 | 3.22 | 3.04 | 1.06 | 1.55 | 68830 | 62658 | 49230 |
| 54-15 | 5/2 | 4:05 | Mudd Island | Upper Rowland - West | 5/2 | 5:20 | 0.87 | 1.25 | 0.69 | 1.02 | 10360 | 10360 | 10360 |
| 54-15 | 5/2 | 21:53 | Mudd Island | Upper Rowland - West | 5/2 | 22:17 | 0.87 | 0.39 | 2.21 | 3.23 | 16420 | 13026 | 10360 |
| 54-15 | 5/3 | 21:31 | Mudd Island | Upper Rowland - West | 5/4 | 0:47 | 0.87 | 3.26 | 0.27 | 0.39 | 58520 | 24401 | 10210 |
| 54-15 | 5/6 | 9:33 | Mudd Island | Upper Rowland - West | 5/6 | 10:00 | 0.87 | 0.44 | 1.95 | 2.86 | 49210 | 49210 | 49210 |
| 54-15 | 5/9 | 7:09 | Mudd Island | Near Field Powerhouse | 5/9 | 8:00 | 1.10 | 0.85 | 1.30 | 1.91 | 60600 | 60600 | 60600 |
| 54-15 | 5/10 | 6:01 | Mudd Island | Near Field Powerhouse | 5/10 | 7:29 | 1.10 | 1.48 | 0.75 | 1.10 | 48000 | 74588 | 74890 |
| 54-15 | 5/11 | 5:17 | Mudd Island | Near Field Powerhouse | 5/11 | 6:57 | 1.10 | 1.66 | 0.66 | 0.97 | 74540 | 74540 | 74540 |
| 54-15 | 5/11 | 15:55 | Mudd Island | Near Field Powerhouse | 5/11 | 17:35 | 1.29 | 1.66 | 0.78 | 1.14 | 74540 | 74540 | 74540 |
| 54-15 | 5/12 | 5:34 | Mudd Island | Near Field Powerhouse | 5/12 | 6:22 | 1.17 | 0.80 | 1.45 | 2.12 | 40670 | 40670 | 40670 |
| 54-15 | 5/13 | 5:38 | Mudd Island | Upper Rowland - West | 5/13 | 6:12 | 0.87 | 0.56 | 1.56 | 2.29 | 10370 | 10370 | 10370 |
| 54-15 | 5/14 | 10:52 | Spencer - West | McGibney Island | 5/14 | 11:29 | 1.61 | 0.61 | 2.64 | 3.87 | 74830 | 74830 | 74830 |
| 54-15 | 5/14 | 12:35 | McGibney Island | Near Field Powerhouse | 5/14 | 14:46 | 2.72 | 2.18 | 1.24 | 1.82 | 74830 | 74830 | 74830 |
| 54-15 | 5/15 | 5:12 | Mudd Island | Near Field Powerhouse | 5/15 | 6:12 | 1.10 | 1.01 | 1.10 | 1.61 | 9930 | 9930 | 9930 |
| 54-15 | 5/15 | 17:51 | Mudd Island | Upper Rowland - West | 5/15 | 18:04 | 0.87 | 0.23 | 3.84 | 5.64 | 74440 | 74440 | 74440 |
| 54-15 | 5/16 | 5:16 | Mudd Island | Upper Rowland - West | 5/16 | 5:49 | 0.87 | 0.55 | 1.59 | 2.34 | 50830 | 50830 | 50830 |
| 54-17 | 4/27 | 9:38 | Spencer - West | Mudd Island | 4/27 | 13:03 | 3.22 | 3.42 | 0.94 | 1.38 | 70100 | 49629 | 11530 |
| 54-17 | 5/5 | 9:36 | Spencer - West | McGibney Island | 5/5 | 11:07 | 1.61 | 1.52 | 1.06 | 1.56 | 22570 | 22570 | 22570 |

APPENDIX I: CONTINUED.

| Fish | General | | Downstream Location | Upstream Location | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|---------|-------|------------------------|------------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | Date | Time | | | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-17 | 5/5 | 12:19 | McGibney Island | Upper Rowland - West | 5/5 | 14:55 | 2.48 | 2.60 | 0.95 | 1.40 | 49530 | 49530 | 49530 |
| 54-18 | 4/21 | 19:52 | Spencer - West | Mudd Island | 4/21 | 23:01 | 3.22 | 3.15 | 1.02 | 1.50 | 32130 | 31615 | 18160 |
| 54-18 | 4/22 | 17:33 | Mudd Island | Upper Rowland - West | 4/22 | 19:28 | 0.87 | 1.92 | 0.45 | 0.66 | 11330 | 11330 | 11330 |
| 54-18 | 4/23 | 15:42 | Mudd Island | Upper Rowland - West | 4/23 | 16:15 | 0.87 | 0.54 | 1.61 | 2.36 | 41700 | 41700 | 41700 |
| 54-18 | 4/25 | 5:11 | Mudd Island | Upper Rowland - West | 4/25 | 6:39 | 0.87 | 1.46 | 0.60 | 0.87 | 11290 | 29607 | 32190 |
| 54-18 | 5/4 | 18:01 | Spencer - West | Near Field Powerhouse | 5/5 | 14:48 | 4.33 | 20.78 | 0.21 | 0.31 | 68680 | 24499 | 49530 |
| 54-18 | 5/6 | 2:53 | Mudd Island | Upper Rowland - West | 5/6 | 4:09 | 0.87 | 1.26 | 0.69 | 1.01 | 10530 | 10530 | 10530 |
| 54-18 | 5/6 | 6:23 | Mudd Island | Near Field Powerhouse | 5/6 | 7:55 | 1.10 | 1.53 | 0.72 | 1.06 | 10530 | 10530 | 10530 |
| 54-18 | 5/13 | 14:34 | Spencer - East | McGibney Island | 5/13 | 16:56 | 1.61 | 2.37 | 0.68 | 1.00 | 75500 | 75500 | 75500 |
| 54-18 | 5/13 | 19:03 | McGibney Island | Crab House | 5/13 | 19:32 | 0.81 | 0.49 | 1.66 | 2.44 | 75500 | 75500 | 75500 |
| 54-18 | 5/14 | 10:47 | Crab House | Mudd Island | 5/14 | 11:13 | 0.81 | 0.43 | 1.88 | 2.75 | 74830 | 74830 | 74830 |
| 54-18 | 5/14 | 19:24 | McGibney Island | Crab House | 5/14 | 19:45 | 0.81 | 0.36 | 2.27 | 3.33 | 74830 | 74830 | 74830 |
| 54-18 | 5/15 | 18:12 | Spencer - East | Mudd Island | 5/16 | 1:55 | 3.22 | 7.71 | 0.42 | 0.61 | 74440 | 67564 | 41370 |
| 54-18 | 5/16 | 3:51 | Mudd Island | Near Field Powerhouse | 5/16 | 4:38 | 1.10 | 0.79 | 1.39 | 2.04 | 41370 | 41370 | 41370 |
| 54-20 | 4/26 | 21:22 | Spencer - West | Crab House | 4/27 | 0:10 | 2.42 | 2.80 | 0.86 | 1.27 | 75060 | 45635 | 11530 |
| 54-21 | 4/23 | 23:50 | Spencer - West | Mudd Island | 4/24 | 2:44 | 3.22 | 2.89 | 1.11 | 1.63 | 11560 | 11579 | 11580 |
| 54-21 | 4/24 | 9:22 | Mudd Island | Upper Rowland - West | 4/24 | 12:42 | 0.87 | 3.34 | 0.26 | 0.38 | 41430 | 17224 | 11580 |
| 54-21 | 4/25 | 5:50 | Mudd Island | Near Field Powerhouse | 4/25 | 7:45 | 1.10 | 1.91 | 0.58 | 0.85 | 32190 | 32190 | 32190 |
| 54-21 | 4/26 | 5:46 | Mudd Island | Near Field Powerhouse | 4/26 | 7:31 | 1.10 | 1.75 | 0.63 | 0.93 | 50170 | 50170 | 50170 |
| 54-21 | 5/18 | 13:43 | Spencer - East | Crab House | 5/18 | 16:52 | 2.42 | 3.15 | 0.77 | 1.13 | 69390 | 69390 | 69390 |
| 54-24 | 4/15 | 12:11 | Mudd Island | Upper Rowland - West | 4/15 | 16:17 | 0.87 | 4.11 | 0.21 | 0.31 | 11590 | 11590 | 11590 |
| 54-24 | 4/16 | 1:57 | Mudd Island | Lower Rowland Is. West | 4/16 | 2:12 | 0.77 | 0.27 | 2.89 | 4.24 | 11450 | 11450 | 11450 |
| 54-24 | 4/16 | 3:17 | Lower Rowland Is. West | Near Field Powerhouse | 4/16 | 5:32 | 0.76 | 2.25 | 0.34 | 0.50 | 11450 | 11450 | 11450 |
| 54-24 | 4/17 | 6:20 | Mudd Island | Upper Rowland - West | 4/17 | 7:51 | 0.87 | 1.52 | 0.57 | 0.84 | 11330 | 11330 | 11330 |
| 54-24 | 4/18 | 4:58 | Mudd Island | Upper Rowland - East | 4/18 | 5:22 | 0.99 | 0.40 | 2.50 | 3.67 | 12090 | 14372 | 23500 |
| 54-24 | 4/20 | 4:23 | Mudd Island | Near Field Powerhouse | 4/20 | 5:36 | 1.10 | 1.20 | 0.92 | 1.35 | 11450 | 11450 | 11450 |
| 54-24 | 4/20 | 14:20 | Mudd Island | Upper Rowland - West | 4/20 | 14:45 | 0.87 | 0.41 | 2.10 | 3.08 | 11450 | 11450 | 11450 |

APPENDIX I: CONTINUED.

| Fish | General | | Downstream Location | Upstream Location | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|---------|-------|---------------------|------------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | Date | Time | | | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-24 | 4/21 | 7:06 | Mudd Island | Upper Rowland - West | 4/21 | 7:20 | 0.87 | 0.23 | 3.85 | 5.65 | 11980 | 11980 | 11980 |
| 54-24 | 4/22 | 0:35 | Spencer - West | McGibney Island | 4/22 | 1:08 | 1.61 | 0.56 | 2.87 | 4.20 | 11330 | 11330 | 11330 |
| 54-24 | 4/22 | 5:41 | McGibney Island | Near Field Powerhouse | 4/22 | 8:13 | 2.72 | 2.53 | 1.07 | 1.57 | 11330 | 11330 | 11330 |
| 54-24 | 4/23 | 7:06 | Mudd Island | Near Field Powerhouse | 4/23 | 7:51 | 1.10 | 0.74 | 1.49 | 2.18 | 22760 | 22760 | 22760 |
| 54-24 | 4/24 | 3:05 | Mudd Island | Near Field Powerhouse | 4/24 | 5:03 | 1.47 | 1.98 | 0.74 | 1.09 | 11580 | 11580 | 11580 |
| 54-24 | 4/24 | 9:05 | Mudd Island | Upper Rowland - West | 4/24 | 9:41 | 0.87 | 0.60 | 1.46 | 2.14 | 41430 | 41430 | 41430 |
| 54-24 | 4/25 | 5:42 | Mudd Island | Upper Rowland - West | 4/25 | 6:19 | 0.87 | 0.62 | 1.41 | 2.07 | 32190 | 32190 | 32190 |
| 54-24 | 4/26 | 3:01 | Mudd Island | Upper Rowland - East | 4/26 | 4:09 | 1.23 | 1.13 | 1.09 | 1.60 | 11300 | 11300 | 11300 |
| 54-24 | 4/26 | 19:39 | Mudd Island | Upper Rowland - West | 4/26 | 22:00 | 0.87 | 2.35 | 0.37 | 0.54 | 75060 | 75060 | 75060 |
| 54-24 | 4/28 | 14:58 | McGibney Island | Upper Rowland - West | 4/28 | 16:49 | 2.48 | 1.85 | 1.34 | 1.97 | 11500 | 11500 | 11500 |
| 54-24 | 5/1 | 12:14 | Mudd Island | Upper Rowland - West | 5/1 | 12:47 | 0.87 | 0.55 | 1.59 | 2.33 | 16610 | 16610 | 16610 |
| 54-24 | 5/2 | 11:48 | Mudd Island | Upper Rowland - West | 5/2 | 14:04 | 0.87 | 2.27 | 0.38 | 0.56 | 16420 | 16420 | 16420 |
| 54-24 | 5/4 | 0:53 | Mudd Island | Lower Rowland Is. West | 5/4 | 1:19 | 0.77 | 0.42 | 1.81 | 2.65 | 10210 | 10210 | 10210 |
| 54-24 | 5/7 | 14:26 | McGibney Island | Near Field Powerhouse | 5/7 | 18:06 | 2.72 | 3.68 | 0.74 | 1.08 | 75100 | 75100 | 75100 |
| 54-24 | 5/8 | 5:05 | Mudd Island | Near Field Powerhouse | 5/8 | 6:33 | 1.10 | 1.47 | 0.75 | 1.10 | 10580 | 19584 | 34150 |
| 54-24 | 5/9 | 3:15 | Mudd Island | Near Field Powerhouse | 5/9 | 5:40 | 1.10 | 2.42 | 0.46 | 0.67 | 10900 | 14054 | 22130 |
| 54-24 | 5/10 | 5:35 | Mudd Island | Upper Rowland - West | 5/10 | 5:55 | 0.87 | 0.34 | 2.56 | 3.75 | 30840 | 30840 | 30840 |
| 54-24 | 5/11 | 6:14 | Mudd Island | Upper Rowland - West | 5/11 | 6:27 | 0.87 | 0.23 | 3.77 | 5.53 | 74540 | 74540 | 74540 |
| 54-24 | 5/11 | 23:09 | Mudd Island | Upper Rowland - West | 5/11 | 23:33 | 0.87 | 0.40 | 2.17 | 3.18 | 39740 | 39740 | 39740 |
| 54-24 | 5/12 | 9:49 | Mudd Island | Upper Rowland - West | 5/12 | 10:35 | 0.87 | 0.76 | 1.15 | 1.68 | 75360 | 75360 | 75360 |
| 54-24 | 5/13 | 8:05 | Mudd Island | Near Field Powerhouse | 5/13 | 10:02 | 1.10 | 1.96 | 0.56 | 0.83 | 34240 | 74451 | 75500 |
| 54-24 | 5/18 | 8:04 | Spencer - East | Mudd Island | 5/18 | 13:52 | 3.22 | 5.80 | 0.56 | 0.82 | 69390 | 69390 | 69390 |
| 54-27 | 4/18 | 8:46 | Mudd Island | Upper Rowland - West | 4/18 | 9:46 | 0.87 | 0.99 | 0.88 | 1.29 | 17390 | 17390 | 17390 |
| 54-28 | 4/15 | 11:37 | Mudd Island | Upper Rowland - West | 4/15 | 12:21 | 0.87 | 0.74 | 1.17 | 1.71 | 11590 | 11590 | 11590 |
| 54-28 | 4/16 | 12:26 | Mudd Island | Upper Rowland - West | 4/16 | 15:14 | 0.87 | 2.79 | 0.31 | 0.46 | 23480 | 26081 | 32270 |
| 54-30 | 4/19 | 11:30 | Mudd Island | Upper Rowland - West | 4/19 | 12:37 | 0.87 | 1.11 | 0.78 | 1.15 | 11260 | 11260 | 11260 |
| 54-30 | 4/21 | 3:36 | Mudd Island | Lower Rowland Is. West | 4/21 | 4:10 | 0.77 | 0.58 | 1.32 | 1.93 | 11980 | 11980 | 11980 |

APPENDIX I: CONTINUED.

| Fish | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | | | |
|-------|---------|-------|------------------------|------------------------|--------|-------|---------------|-----------|---------------------|------|-------|---------|-------|
| | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-30 | 4/23 | 2:16 | Mudd Island | Lower Rowland Is. West | 4/23 | 2:48 | 0.77 | 0.53 | 1.45 | 2.13 | 11600 | 11600 | 11600 |
| 54-30 | 4/25 | 5:04 | Mudd Island | Upper Rowland - West | 4/25 | 6:38 | 0.87 | 1.57 | 0.55 | 0.81 | 11290 | 28230 | 32190 |
| 54-30 | 4/26 | 3:15 | Lower Rowland Is. West | Near Field Powerhouse | 4/26 | 4:30 | 0.76 | 1.26 | 0.61 | 0.89 | 11300 | 11300 | 11300 |
| 54-30 | 5/4 | 15:35 | Spencer - West | McGibney Island | 5/4 | 17:42 | 1.61 | 2.12 | 0.76 | 1.12 | 49340 | 66262 | 68680 |
| 54-30 | 5/5 | 16:20 | McGibney Island | Mudd Island | 5/5 | 19:47 | 0.99 | 3.46 | 0.29 | 0.42 | 49530 | 53808 | 74250 |
| 54-30 | 5/6 | 5:27 | Mudd Island | Near Field Powerhouse | 5/6 | 6:37 | 1.00 | 1.17 | 0.86 | 1.26 | 10530 | 10530 | 10530 |
| 54-32 | 5/4 | 15:28 | Spencer - West | Mudd Island | 5/4 | 18:24 | 3.22 | 2.92 | 1.10 | 1.62 | 49340 | 66167 | 68680 |
| 54-32 | 5/5 | 12:11 | Mudd Island | Near Field Powerhouse | 5/5 | 16:42 | 1.10 | 4.51 | 0.24 | 0.36 | 49530 | 49530 | 49530 |
| 54-34 | 4/18 | 23:54 | Mudd Island | Upper Rowland - West | 4/19 | 1:52 | 0.87 | 1.96 | 0.44 | 0.65 | 11240 | 11163 | 11260 |
| 54-36 | 5/1 | 18:31 | Spencer - West | Upper Rowland - West | 5/1 | 23:30 | 4.09 | 4.98 | 0.82 | 1.21 | 68830 | 56634 | 10520 |
| 54-36 | 5/5 | 17:44 | Mudd Island | Near Field Powerhouse | 5/5 | 19:05 | 1.10 | 1.36 | 0.81 | 1.19 | 49530 | 49530 | 49530 |
| 54-36 | 5/7 | 0:02 | Mudd Island | Upper Rowland - East | 5/7 | 1:12 | 0.99 | 1.17 | 0.85 | 1.24 | 11570 | 11570 | 11570 |
| 54-39 | 4/26 | 1:28 | Crab House | Mudd Island | 4/26 | 2:16 | 0.81 | 0.81 | 1.00 | 1.46 | 11300 | 11300 | 11300 |
| 54-39 | 4/26 | 5:37 | Mudd Island | Upper Rowland - East | 4/26 | 7:51 | 0.99 | 2.23 | 0.44 | 0.65 | 50170 | 50170 | 50170 |
| 54-39 | 5/1 | 13:39 | Mudd Island | Upper Rowland - West | 5/1 | 14:45 | 0.87 | 1.09 | 0.80 | 1.17 | 16610 | 16610 | 16610 |
| 54-39 | 5/6 | 4:10 | McGibney Island | Mudd Island | 5/6 | 5:14 | 1.61 | 1.06 | 1.51 | 2.22 | 10530 | 10530 | 10530 |
| 54-39 | 5/6 | 23:25 | Mudd Island | Upper Rowland - West | 5/6 | 23:35 | 0.87 | 0.17 | 5.06 | 7.42 | 10530 | 10530 | 10530 |
| 54-39 | 5/11 | 5:37 | Mudd Island | Near Field Powerhouse | 5/11 | 6:47 | 1.10 | 1.17 | 0.95 | 1.39 | 74540 | 74540 | 74540 |
| 54-39 | 5/13 | 5:57 | Mudd Island | Near Field Powerhouse | 5/13 | 6:50 | 1.10 | 0.88 | 1.25 | 1.83 | 10370 | 10370 | 10370 |
| 54-39 | 5/14 | 2:47 | Mudd Island | Lower Rowland Is. West | 5/14 | 3:20 | 0.77 | 0.56 | 1.38 | 2.03 | 10980 | 10980 | 10980 |
| 54-39 | 5/14 | 16:54 | Mudd Island | Upper Rowland - West | 5/14 | 17:45 | 0.87 | 0.85 | 1.02 | 1.49 | 74830 | 74830 | 74830 |
| 54-39 | 5/16 | 15:47 | McGibney Island | Upper Rowland - East | 5/16 | 18:47 | 2.60 | 3.01 | 0.87 | 1.27 | 77520 | 77520 | 77520 |
| 54-39 | 5/18 | 10:21 | Mudd Island | Upper Rowland - West | 5/18 | 11:51 | 0.87 | 1.50 | 0.58 | 0.85 | 69390 | 69390 | 69390 |
| 54-39 | 5/21 | 7:41 | Spencer - East | Upper Rowland - East | 5/21 | 12:05 | 4.22 | 4.41 | 0.96 | 1.40 | 10670 | 53325 | 65780 |
| 54-39 | 5/24 | 4:32 | Spencer - West | McGibney Island | 5/24 | 5:10 | 1.61 | 0.64 | 2.50 | 3.67 | 10740 | 10740 | 10740 |
| 54-39 | 5/24 | 6:18 | McGibney Island | Near Field Powerhouse | 5/24 | 9:51 | 2.72 | 3.56 | 0.76 | 1.12 | 16800 | 16800 | 16800 |
| 54-39 | 5/26 | 7:31 | Spencer - West | Near Field Powerhouse | 5/26 | 12:20 | 4.33 | 4.82 | 0.90 | 1.32 | 10480 | 11063 | 22560 |

APPENDIX I: CONTINUED.

| Fish | General | | Downstream Location | Upstream Location | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|---------|-------|---------------------|------------------------|---------|-------|---------------|-----------|---------------|-------|---------------------|---------|-------|
| | Date | Time | | | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-42 | 5/3 | 13:59 | Spencer - West | McGibney Island | 5/3 | 14:18 | 1.61 | 0.32 | 5.06 | 7.43 | 41020 | 41020 | 41020 |
| 54-42 | 5/3 | 16:10 | McGibney Island | Mudd Island | 5/3 | 17:05 | 1.61 | 0.91 | 1.78 | 2.60 | 58520 | 58520 | 58520 |
| 54-42 | 5/3 | 18:14 | Mudd Island | Upper Rowland - West | 5/3 | 18:39 | 0.87 | 0.43 | 2.03 | 2.98 | 58520 | 58520 | 58520 |
| 54-42 | 5/4 | 5:22 | Mudd Island | Upper Rowland - West | 5/4 | 6:30 | 0.87 | 1.12 | 0.77 | 1.14 | 10210 | 10210 | 10210 |
| 54-42 | 5/6 | 5:43 | Mudd Island | Upper Rowland - West | 5/6 | 6:30 | 0.87 | 0.78 | 1.11 | 1.62 | 10530 | 10530 | 10530 |
| 54-42 | 5/7 | 5:14 | Mudd Island | Upper Rowland - West | 5/7 | 5:56 | 0.87 | 0.69 | 1.26 | 1.84 | 32830 | 32830 | 32830 |
| 54-42 | 5/8 | 3:48 | Mudd Island | Near Field Powerhouse | 5/8 | 5:22 | 1.10 | 1.57 | 0.70 | 1.03 | 10580 | 10580 | 10580 |
| 54-42 | 5/8 | 7:29 | Mudd Island | Near Field Powerhouse | 5/8 | 8:54 | 1.10 | 1.43 | 0.77 | 1.13 | 61170 | 61170 | 61170 |
| 54-42 | 5/9 | 14:30 | Mudd Island | Near Field Powerhouse | 5/9 | 15:59 | 1.29 | 1.48 | 0.87 | 1.28 | 69250 | 69250 | 69250 |
| 54-43 | 5/2 | 16:09 | Spencer - West | Mudd Island | 5/2 | 20:59 | 3.22 | 4.83 | 0.67 | 0.98 | 68300 | 68300 | 68300 |
| 54-44 | 4/20 | 1:53 | Mudd Island | Lower Rowland Is. West | 4/20 | 2:14 | 0.77 | 0.35 | 2.19 | 3.21 | 11450 | 11450 | 11450 |
| 54-44 | 4/23 | 5:40 | Mudd Island | Upper Rowland - West | 4/23 | 13:02 | 0.87 | 7.36 | 0.12 | 0.17 | 11600 | 18738 | 11630 |
| 54-44 | 4/24 | 22:59 | Mudd Island | Upper Rowland - West | 4/24 | 23:55 | 0.87 | 0.94 | 0.93 | 1.36 | 11580 | 11580 | 11580 |
| 54-44 | 4/28 | 10:15 | Crab House | Mudd Island | 4/28 | 12:32 | 0.81 | 2.28 | 0.35 | 0.52 | 63520 | 38478 | 11500 |
| 54-44 | 4/29 | 10:09 | McGibney Island | Crab House | 4/29 | 12:17 | 0.81 | 2.13 | 0.38 | 0.56 | 58880 | 55166 | 32260 |
| 54-45 | 4/28 | 23:56 | Spencer - West | Upper Rowland - West | 4/29 | 4:18 | 4.09 | 4.36 | 0.94 | 1.38 | 11500 | 11500 | 11440 |
| 54-45 | 5/1 | 9:43 | Mudd Island | Upper Rowland - West | 5/1 | 13:12 | 0.87 | 3.49 | 0.25 | 0.37 | 49230 | 19717 | 16610 |
| 54-50 | 5/23 | 14:34 | Spencer - East | Mudd Island | 5/23 | 18:32 | 3.22 | 3.97 | 0.81 | 1.19 | 41350 | 41350 | 41350 |
| 54-50 | 5/24 | 7:07 | Mudd Island | Near Field Powerhouse | 5/24 | 8:10 | 1.10 | 1.04 | 1.06 | 1.55 | 16800 | 16800 | 16800 |
| 54-50 | 5/25 | 6:23 | Mudd Island | Upper Rowland - West | 5/25 | 6:30 | 0.87 | 0.12 | 7.28 | 10.68 | 10610 | 10610 | 10610 |
| 54-50 | 5/25 | 12:18 | Mudd Island | Near Field Powerhouse | 5/25 | 12:48 | 1.10 | 0.50 | 2.21 | 3.24 | 27610 | 27610 | 27610 |
| 54-50 | 5/26 | 6:12 | Mudd Island | Upper Rowland - West | 5/26 | 6:31 | 0.87 | 0.32 | 2.72 | 4.00 | 10480 | 10480 | 10480 |
| 54-65 | 5/25 | 8:10 | Spencer - East | Crab House | 5/25 | 11:01 | 2.42 | 2.85 | 0.85 | 1.25 | 10610 | | 22730 |
| 54-65 | 5/25 | 12:26 | Crab House | Near Field Powerhouse | 5/25 | 14:00 | 1.29 | 1.57 | 0.82 | 1.20 | 27610 | 27610 | 27610 |
| 54-65 | 5/26 | 6:27 | Mudd Island | Upper Rowland - West | 5/26 | 9:59 | 0.87 | 3.53 | 0.25 | 0.36 | 10480 | 10480 | 10480 |
| 54-65 | 5/27 | 8:36 | Mudd Island | Upper Rowland - West | 5/27 | 9:18 | 0.87 | 0.69 | 1.25 | 1.84 | 9200 | 9200 | 9200 |
| 54-65 | 5/28 | 5:43 | Mudd Island | Upper Rowland - West | 5/28 | 5:56 | 0.87 | 0.21 | 4.18 | 6.14 | 10600 | 10600 | 10600 |

APPENDIX I: CONTINUED.

| Fish | General | | Downstream Location | Upstream Location | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|---------|-------|---------------------|------------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | Date | Time | | | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-65 | 5/29 | 5:32 | Mudd Island | Upper Rowland - West | 5/29 | 6:11 | 0.87 | 0.64 | 1.36 | 1.99 | 10500 | 10500 | 10500 |
| 54-65 | 5/31 | 6:03 | Mudd Island | Near Field Powerhouse | 5/31 | 6:53 | 1.10 | 0.84 | 1.31 | 1.92 | 10180 | 10180 | 10180 |
| 54-71 | 5/9 | 13:48 | McGibney Island | Near Field Powerhouse | 5/9 | 17:04 | 2.68 | 3.27 | 0.82 | 1.20 | 69250 | 68753 | 49660 |
| 54-71 | 5/10 | 0:49 | Mudd Island | Lower Rowland Is. West | 5/10 | 1:18 | 0.77 | 0.47 | 1.62 | 2.38 | 10860 | 10860 | 10860 |
| 54-71 | 5/10 | 15:36 | Mudd Island | Upper Rowland - West | 5/10 | 16:13 | 0.87 | 0.62 | 1.41 | 2.07 | 74890 | 74890 | 74890 |
| 54-71 | 5/10 | 20:21 | Mudd Island | Lower Rowland Is. West | 5/10 | 22:18 | 0.77 | 1.94 | 0.40 | 0.58 | 74890 | 62096 | 22830 |
| 54-71 | 5/11 | 6:41 | Mudd Island | Near Field Powerhouse | 5/11 | 7:49 | 1.10 | 1.13 | 0.98 | 1.44 | 74540 | 74540 | 74540 |
| 54-71 | 5/11 | 12:26 | Mudd Island | Upper Rowland - East | 5/11 | 13:55 | 0.99 | 1.47 | 0.67 | 0.99 | 74540 | 74540 | 74540 |
| 54-71 | 5/11 | 23:18 | Spencer - West | McGibney Island | 5/11 | 23:56 | 1.61 | 0.63 | 2.56 | 3.76 | 39740 | 39740 | 39740 |
| 54-71 | 5/12 | 1:30 | McGibney Island | Upper Rowland - West | 5/12 | 3:47 | 2.48 | 2.28 | 1.09 | 1.59 | 40670 | 40670 | 40670 |
| 54-71 | 5/13 | 11:13 | Spencer - East | Upper Rowland - West | 5/13 | 14:25 | 4.09 | 3.20 | 1.28 | 1.88 | 75500 | 75500 | 75500 |
| 54-71 | 5/14 | 5:55 | Mudd Island | Upper Rowland - West | 5/14 | 6:31 | 0.87 | 0.60 | 1.45 | 2.12 | 10980 | 37270 | 39590 |
| 54-71 | 5/14 | 18:08 | McGibney Island | Mudd Island | 5/14 | 19:20 | 1.61 | 1.19 | 1.35 | 1.98 | 74830 | 74830 | 74830 |
| 54-71 | 5/15 | 5:27 | Mudd Island | Upper Rowland - West | 5/15 | 5:45 | 0.87 | 0.30 | 2.91 | 4.27 | 9930 | 9930 | 9930 |
| 54-71 | 5/16 | 12:48 | Spencer - West | Near Field Powerhouse | 5/16 | 16:46 | 4.34 | 3.95 | 1.10 | 1.61 | 77520 | 77520 | 77520 |
| 54-71 | 5/17 | 0:21 | Mudd Island | Near Field Powerhouse | 5/17 | 2:05 | 1.29 | 1.72 | 0.75 | 1.10 | 78780 | 78780 | 78780 |
| 54-73 | 5/15 | 9:40 | Spencer - West | McGibney Island | 5/15 | 10:04 | 1.61 | 0.39 | 4.10 | 6.01 | 60430 | 60430 | 60430 |
| 54-73 | 5/15 | 11:06 | McGibney Island | Near Field Powerhouse | 5/15 | 13:39 | 2.72 | 2.55 | 1.07 | 1.56 | 69110 | 69110 | 69110 |
| 54-73 | 5/16 | 5:11 | Mudd Island | Near Field Powerhouse | 5/16 | 5:49 | 1.10 | 0.63 | 1.75 | 2.57 | 50830 | 50830 | 50830 |
| 54-73 | 5/16 | 13:40 | Mudd Island | Near Field Powerhouse | 5/16 | 14:41 | 1.10 | 1.03 | 1.08 | 1.58 | 77520 | 77520 | 77520 |
| 54-73 | 5/17 | 6:09 | Spencer - West | Upper Rowland - West | 5/17 | 8:57 | 4.09 | 2.79 | 1.47 | 2.15 | 78780 | 78780 | 78780 |
| 54-73 | 5/18 | 7:29 | Spencer - East | Upper Rowland - East | 5/18 | 12:25 | 4.46 | 4.93 | 0.90 | 1.33 | 69390 | 69390 | 69390 |
| 54-73 | 5/22 | 9:44 | Spencer - West | Near Field Powerhouse | 5/22 | 12:52 | 4.33 | 3.13 | 1.38 | 2.03 | 55880 | 55880 | 55880 |
| 54-73 | 5/22 | 17:54 | Mudd Island | Near Field Powerhouse | 5/22 | 18:20 | 1.10 | 0.43 | 2.55 | 3.74 | 55880 | 55880 | 55880 |
| 54-73 | 5/23 | 5:52 | Mudd Island | Near Field Powerhouse | 5/23 | 6:45 | 1.10 | 0.89 | 1.24 | 1.82 | 10170 | 10170 | 10170 |
| 54-73 | 5/24 | 5:02 | Mudd Island | Upper Rowland - West | 5/24 | 5:11 | 0.87 | 0.15 | 5.87 | 8.61 | 10740 | 10740 | 10740 |
| 54-79 | 5/3 | 8:55 | Mudd Island | Upper Rowland - West | 5/3 | 9:12 | 0.87 | 0.28 | 3.06 | 4.49 | 31740 | 31740 | 31740 |

APPENDIX I: CONTINUED.

| Fish | General | | Downstream Location | Upstream Location | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|---------|-------|---------------------|------------------------|---------|-------|---------------|-----------|---------------|-------|---------------------|---------|-------|
| | Date | Time | | | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-79 | 5/6 | 4:02 | Mudd Island | Lower Rowland Is. West | 5/6 | 4:10 | 0.77 | 0.14 | 5.52 | 8.10 | 10530 | 10530 | 10530 |
| 54-79 | 5/8 | 4:29 | Mudd Island | Lower Rowland Is. West | 5/8 | 4:35 | 0.77 | 0.10 | 7.67 | 11.24 | 10580 | 10580 | 10580 |
| 54-79 | 5/10 | 17:18 | Mudd Island | Upper Rowland - West | 5/10 | 18:04 | 0.87 | 0.77 | 1.13 | 1.65 | 74890 | 74890 | 74890 |
| 54-79 | 5/11 | 6:12 | Mudd Island | Near Field Powerhouse | 5/11 | 8:05 | 1.10 | 1.89 | 0.58 | 0.86 | 74540 | 74540 | 74540 |
| 54-79 | 5/12 | 5:46 | Spencer - West | McGibney Island | 5/12 | 6:16 | 1.61 | 0.50 | 3.21 | 4.71 | 40670 | 40670 | 40670 |
| 54-79 | 5/12 | 7:45 | McGibney Island | Near Field Powerhouse | 5/12 | 9:43 | 2.72 | 1.98 | 1.37 | 2.01 | 75360 | 75360 | 75360 |
| 54-79 | 5/13 | 5:26 | Spencer - West | Crab House | 5/13 | 6:58 | 2.42 | 1.54 | 1.57 | 2.30 | 10370 | 10370 | 10370 |
| 54-79 | 5/13 | 8:15 | Crab House | Near Field Powerhouse | 5/13 | 12:29 | 1.91 | 4.23 | 0.45 | 0.66 | 75500 | 75500 | 75500 |
| 54-79 | 5/14 | 4:11 | Mudd Island | Lower Rowland Is. West | 5/14 | 4:34 | 0.77 | 0.37 | 2.08 | 3.05 | 10980 | 10980 | 10980 |
| 54-79 | 5/14 | 10:15 | Mudd Island | Near Field Powerhouse | 5/14 | 10:54 | 1.10 | 0.65 | 1.70 | 2.49 | 74830 | 74830 | 74830 |
| 54-79 | 5/15 | 16:28 | Mudd Island | Upper Rowland - West | 5/15 | 16:57 | 0.87 | 0.48 | 1.79 | 2.63 | 74440 | 74440 | 74440 |
| 54-79 | 5/16 | 5:38 | Mudd Island | Upper Rowland - West | 5/16 | 6:01 | 0.87 | 0.38 | 2.26 | 3.31 | 50830 | 54447 | 59510 |
| 54-79 | 5/17 | 5:10 | Crab House | Near Field Powerhouse | 5/17 | 7:16 | 1.91 | 2.10 | 0.91 | 1.33 | 78780 | 78780 | 78780 |
| 54-79 | 5/19 | 7:24 | Spencer - East | Near Field Powerhouse | 5/19 | 12:54 | 4.33 | 5.49 | 0.79 | 1.16 | 69520 | 69520 | 69520 |
| 54-79 | 5/20 | 6:05 | Mudd Island | Near Field Powerhouse | 5/20 | 7:10 | 1.10 | 1.09 | 1.01 | 1.48 | 22610 | 22610 | 22610 |
| 54-79 | 5/21 | 5:10 | Mudd Island | Upper Rowland - West | 5/21 | 5:41 | 0.87 | 0.52 | 1.65 | 2.42 | 10670 | 10670 | 10670 |
| 54-80 | 5/9 | 17:25 | Spencer - West | Mudd Island | 5/9 | 19:39 | 3.22 | 2.24 | 1.44 | 2.11 | 49660 | 49660 | 49660 |
| 54-80 | 5/10 | 7:59 | Mudd Island | Upper Rowland - West | 5/10 | 8:46 | 0.99 | 0.78 | 1.28 | 1.87 | 74890 | 74890 | 74890 |
| 54-80 | 5/11 | 11:01 | Mudd Island | Near Field Powerhouse | 5/11 | 12:30 | 1.10 | 1.48 | 0.74 | 1.09 | 74540 | 74540 | 74540 |
| 54-80 | 5/12 | 5:57 | Mudd Island | Upper Rowland - East | 5/12 | 6:58 | 1.23 | 1.02 | 1.21 | 1.77 | 40670 | 40670 | 40670 |
| 54-80 | 5/13 | 6:50 | Mudd Island | Near Field Powerhouse | 5/13 | 7:57 | 1.10 | 1.11 | 0.99 | 1.45 | 10370 | 25815 | 34240 |
| 54-80 | 5/14 | 5:38 | Mudd Island | Near Field Powerhouse | 5/14 | 6:30 | 1.10 | 0.86 | 1.29 | 1.89 | 10980 | 28794 | 39590 |
| 54-81 | 5/8 | 5:44 | Crab House | Mudd Island | 5/8 | 6:02 | 0.81 | 0.29 | 2.75 | 4.04 | 10580 | 14302 | 34150 |
| 54-81 | 5/12 | 7:03 | Mudd Island | Lower Rowland Is. West | 5/12 | 10:28 | 0.77 | 3.42 | 0.23 | 0.33 | 75360 | 75360 | 75360 |
| 54-81 | 5/14 | 3:05 | Mudd Island | Lower Rowland Is. West | 5/14 | 3:37 | 0.77 | 0.53 | 1.44 | 2.11 | 10980 | 10980 | 10980 |
| 54-81 | 5/14 | 13:55 | Crab House | Near Field Powerhouse | 5/14 | 18:52 | 2.05 | 4.94 | 0.41 | 0.61 | 74830 | 74830 | 74830 |
| 54-81 | 5/15 | 5:20 | Mudd Island | Upper Rowland - East | 5/15 | 5:57 | 1.23 | 0.62 | 1.99 | 2.92 | 9930 | 9930 | 9930 |

APPENDIX I: CONTINUED.

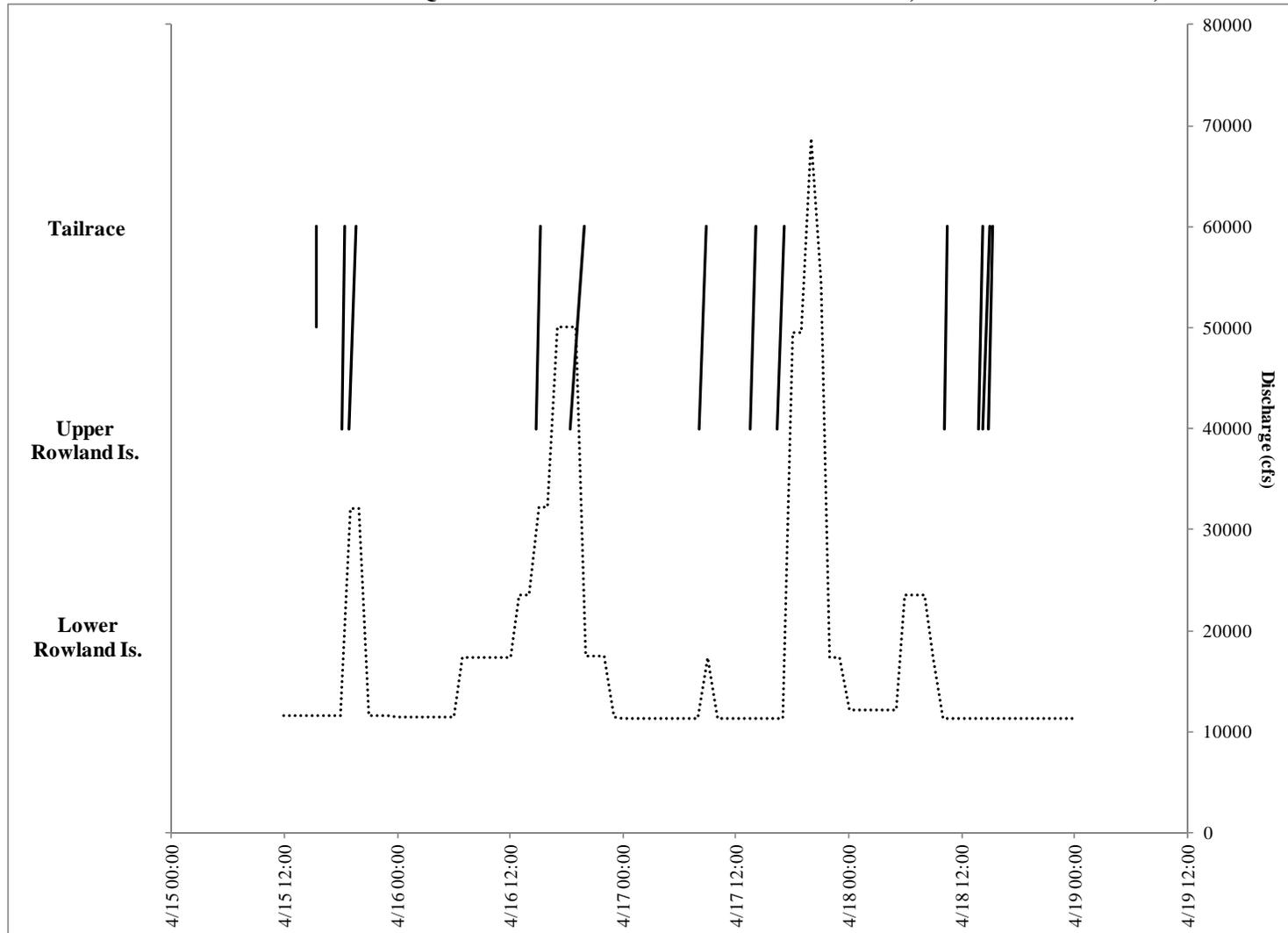
| | | | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|---------------------|------------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| Fish | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-81 | 5/16 | 6:34 | Mudd Island | Lower Rowland Is. West | 5/16 | 6:41 | 0.77 | 0.12 | 6.62 | 9.71 | 77520 | 77520 | 77520 |
| 54-81 | 5/17 | 5:31 | Mudd Island | Spillway - East | 5/17 | 7:43 | 1.36 | 2.20 | 0.62 | 0.91 | 78780 | 78780 | 78780 |
| 54-81 | 5/20 | 4:35 | McGibney Island | Mudd Island | 5/20 | 6:21 | 1.61 | 1.78 | 0.91 | 1.33 | 22610 | 22610 | 22610 |
| 54-81 | 5/20 | 7:26 | Mudd Island | Near Field Powerhouse | 5/20 | 8:04 | 1.10 | 0.63 | 1.76 | 2.59 | 22610 | 22610 | 22610 |
| 54-81 | 5/21 | 5:13 | Mudd Island | Near Field Powerhouse | 5/21 | 6:01 | 1.29 | 0.80 | 1.60 | 2.35 | 10670 | 10670 | 10670 |
| 54-81 | 5/24 | 6:00 | Mudd Island | Near Field Powerhouse | 5/24 | 6:46 | 1.10 | 0.76 | 1.45 | 2.12 | 10740 | 16668 | 16800 |
| 54-81 | 5/28 | 5:13 | Spencer - East | Near Field Powerhouse | 5/28 | 11:05 | 4.85 | 5.86 | 0.83 | 1.21 | 10600 | 11513 | 16680 |
| 54-81 | 5/29 | 14:30 | McGibney Island | Near Field Powerhouse | 5/29 | 17:34 | 2.72 | 3.07 | 0.89 | 1.30 | 33820 | 33820 | 33820 |
| 54-89 | 5/6 | 10:01 | Mudd Island | Near Field Powerhouse | 5/6 | 10:58 | 1.10 | 0.95 | 1.16 | 1.70 | 49210 | 49210 | 49210 |
| 54-89 | 5/7 | 8:43 | Mudd Island | Upper Rowland - West | 5/7 | 9:25 | 0.87 | 0.71 | 1.22 | 1.79 | 58990 | 68731 | 75100 |
| 54-89 | 5/7 | 11:08 | Mudd Island | Near Field Powerhouse | 5/7 | 12:24 | 1.10 | 1.25 | 0.88 | 1.29 | 75100 | 75100 | 75100 |
| 54-89 | 5/8 | 6:32 | Mudd Island | Lower Rowland Is. West | 5/8 | 7:06 | 0.77 | 0.57 | 1.35 | 1.98 | 34150 | 39554 | 61170 |
| 54-89 | 5/9 | 5:30 | Mudd Island | Near Field Powerhouse | 5/9 | 6:40 | 1.10 | 1.18 | 0.94 | 1.38 | 22130 | 44744 | 57810 |
| 54-89 | 5/10 | 5:47 | Mudd Island | Near Field Powerhouse | 5/10 | 7:20 | 1.10 | 1.56 | 0.71 | 1.04 | 30840 | 68226 | 74890 |
| 54-89 | 5/10 | 15:11 | Mudd Island | Lower Rowland Is. West | 5/10 | 15:37 | 0.77 | 0.43 | 1.77 | 2.60 | 74890 | 74890 | 74890 |
| 54-89 | 5/11 | 7:05 | Mudd Island | Upper Rowland - West | 5/11 | 7:50 | 0.87 | 0.76 | 1.15 | 1.68 | 74540 | 74540 | 74540 |
| 54-89 | 5/12 | 5:59 | Mudd Island | Upper Rowland - West | 5/12 | 6:35 | 0.87 | 0.60 | 1.44 | 2.12 | 40670 | 40670 | 40670 |
| 54-89 | 5/13 | 6:50 | Mudd Island | Near Field Powerhouse | 5/13 | 10:14 | 1.22 | 3.40 | 0.36 | 0.52 | 10370 | 57007 | 75500 |
| 54-89 | 5/14 | 5:56 | Mudd Island | Near Field Powerhouse | 5/14 | 7:09 | 1.10 | 1.21 | 0.91 | 1.34 | 10980 | 38817 | 39590 |
| 54-89 | 5/15 | 5:50 | Mudd Island | Near Field Powerhouse | 5/15 | 6:34 | 1.10 | 0.73 | 1.51 | 2.22 | 9930 | 9930 | 9930 |
| 54-89 | 5/16 | 6:29 | Mudd Island | Near Field Powerhouse | 5/16 | 7:28 | 1.10 | 0.98 | 1.12 | 1.65 | 77520 | 77520 | 77520 |
| 54-89 | 5/17 | 6:14 | Mudd Island | Near Field Powerhouse | 5/17 | 8:07 | 1.10 | 1.88 | 0.59 | 0.86 | 78780 | 78780 | 78780 |
| 54-89 | 5/19 | 9:48 | Mudd Island | Upper Rowland - West | 5/19 | 10:08 | 0.87 | 0.33 | 2.63 | 3.86 | 69520 | 69520 | 69520 |
| 54-89 | 5/20 | 5:46 | Mudd Island | Near Field Powerhouse | 5/20 | 6:38 | 1.10 | 0.86 | 1.29 | 1.89 | 22610 | 22610 | 22610 |
| 54-90 | 5/6 | 4:48 | McGibney Island | Crab House | 5/6 | 6:05 | 0.81 | 1.28 | 0.63 | 0.92 | 10530 | 10530 | 10530 |
| 54-90 | 5/10 | 6:36 | Mudd Island | Upper Rowland - West | 5/10 | 8:06 | 0.87 | 1.51 | 0.57 | 0.84 | 74890 | 74890 | 74890 |
| 54-90 | 5/11 | 5:59 | Mudd Island | Upper Rowland - East | 5/11 | 7:19 | 0.99 | 1.33 | 0.75 | 1.10 | 74540 | 74540 | 74540 |

APPENDIX I: CONTINUED.

| | | | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|---------------------|------------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| Fish | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-90 | 5/12 | 4:41 | Mudd Island | Near Field Powerhouse | 5/12 | 7:06 | 1.29 | 2.43 | 0.53 | 0.78 | 40670 | 42333 | 75360 |
| 54-90 | 5/13 | 4:36 | Mudd Island | Upper Rowland - West | 5/13 | 5:07 | 0.99 | 0.52 | 1.91 | 2.80 | 10370 | 10370 | 10370 |
| 54-90 | 5/13 | 8:47 | Mudd Island | Upper Rowland - East | 5/13 | 9:57 | 0.99 | 1.15 | 0.86 | 1.26 | 75500 | 75500 | 75500 |
| 54-90 | 5/14 | 5:40 | Mudd Island | Near Field Powerhouse | 5/14 | 6:43 | 1.10 | 1.04 | 1.06 | 1.56 | 10980 | 31543 | 39590 |
| 54-90 | 5/18 | 8:24 | Spencer - West | Upper Rowland - East | 5/18 | 11:57 | 4.46 | 3.56 | 1.25 | 1.84 | 69390 | 69390 | 69390 |
| 54-90 | 5/18 | 13:59 | Mudd Island | Upper Rowland - East | 5/18 | 15:06 | 0.99 | 1.11 | 0.89 | 1.31 | 69390 | 69390 | 69390 |
| 54-90 | 5/19 | 5:32 | Mudd Island | Upper Rowland - West | 5/19 | 5:50 | 0.87 | 0.29 | 2.96 | 4.34 | 69520 | 69520 | 69520 |
| 54-90 | 5/25 | 11:17 | Spencer - East | Near Field Powerhouse | 5/25 | 16:06 | 4.45 | 4.82 | 0.92 | 1.35 | 22730 | 20917 | 27610 |
| 54-90 | 5/28 | 12:15 | Spencer - West | Near Field Powerhouse | 5/28 | 15:39 | 4.45 | 3.40 | 1.31 | 1.92 | 16680 | 25414 | 27870 |
| 54-90 | 5/28 | 22:37 | Mudd Island | Lower Rowland Is. West | 5/28 | 23:59 | 0.77 | 1.37 | 0.56 | 0.82 | 22700 | 22700 | 22700 |

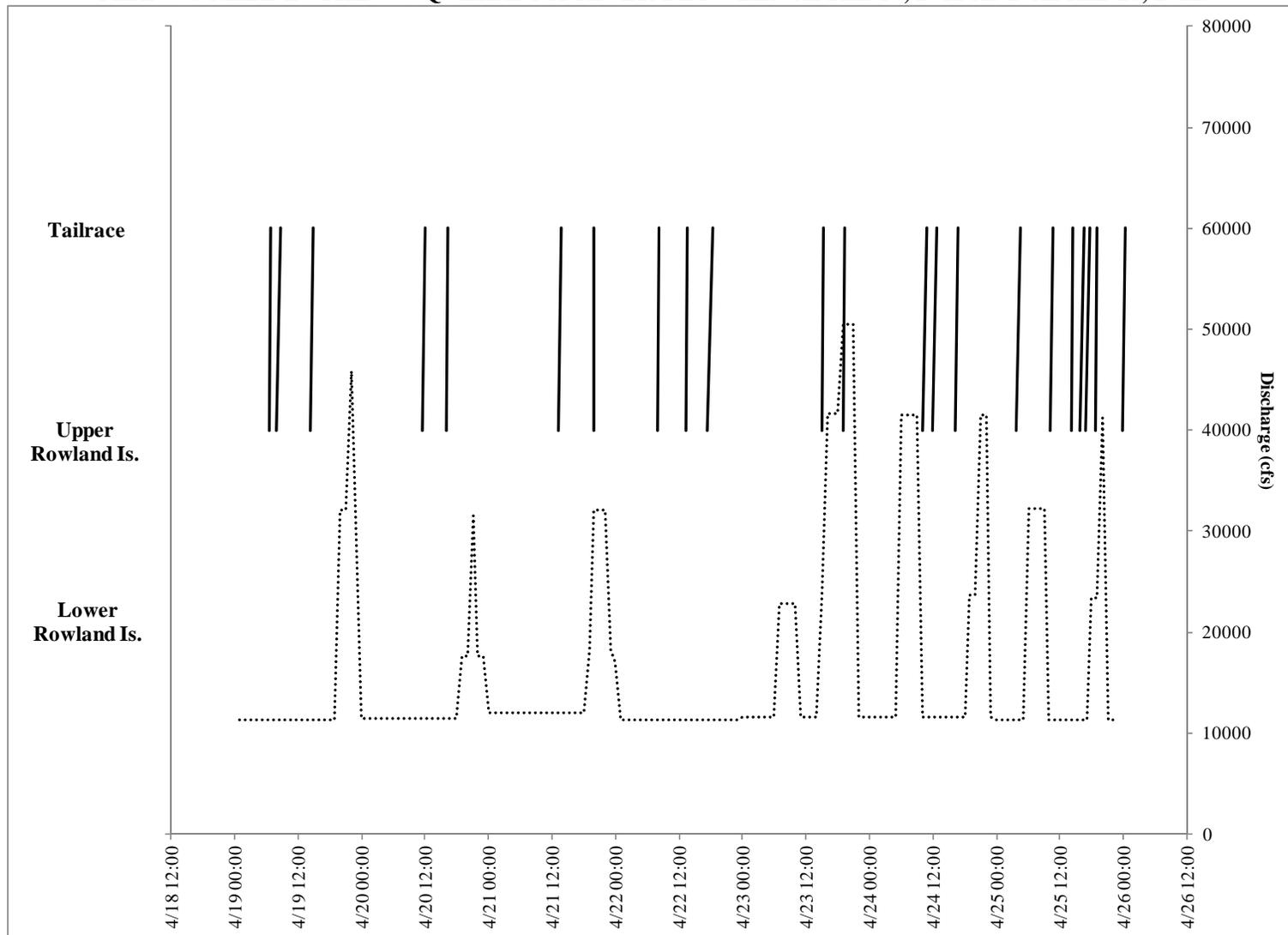
**APPENDIX J: DEPICTION OF RADIO-TAGGED AMERICAN SHAD INDIVIDUAL
UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER
BETWEEN APRIL 15, 2012 AND APRIL 19, 2012.**

APPENDIX J: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 15, 2012 AND APRIL 19, 2012.



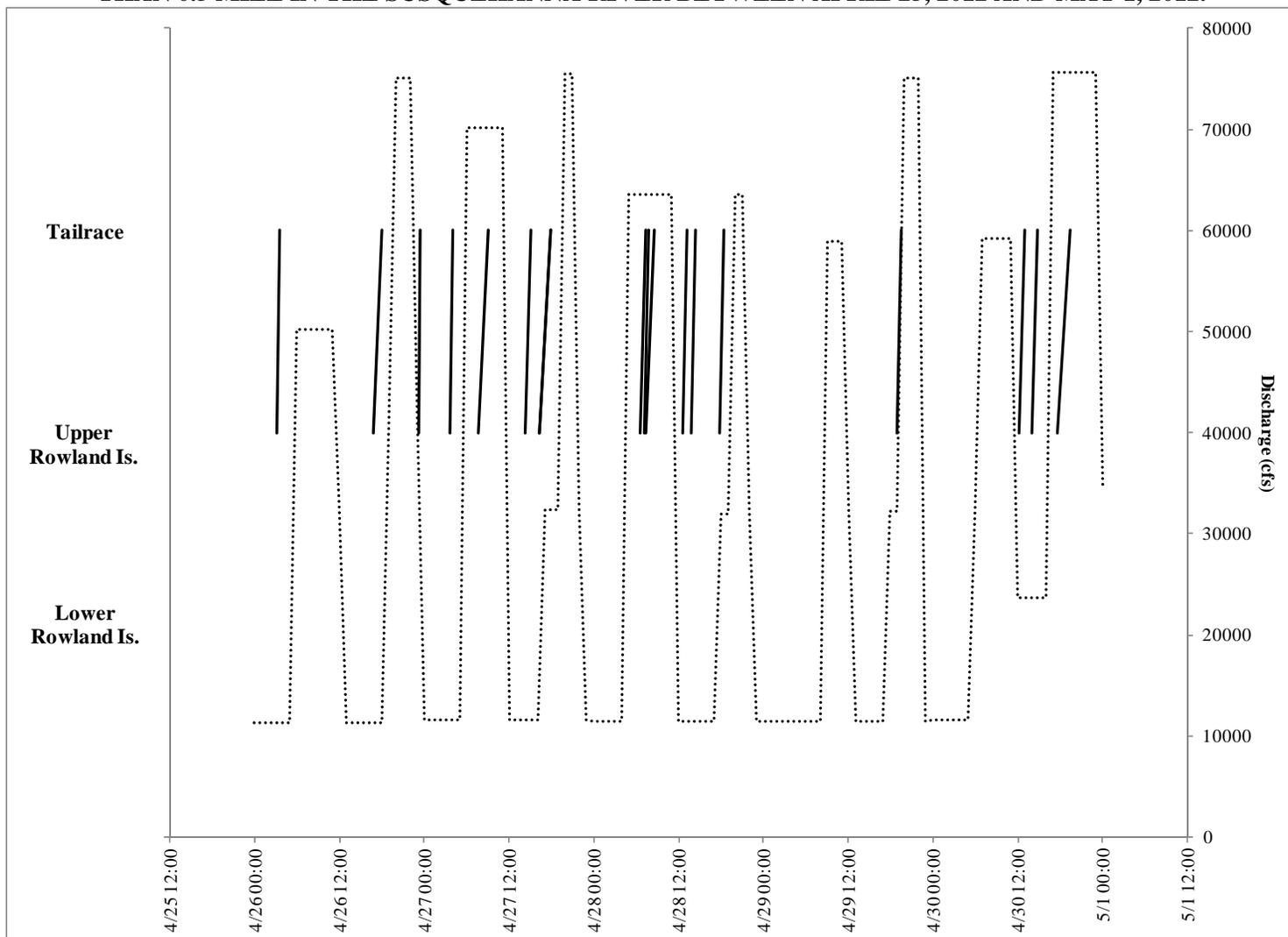
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twelve separate forays are illustrated.

APPENDIX J: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 18, 2012 AND APRIL 26, 2012.



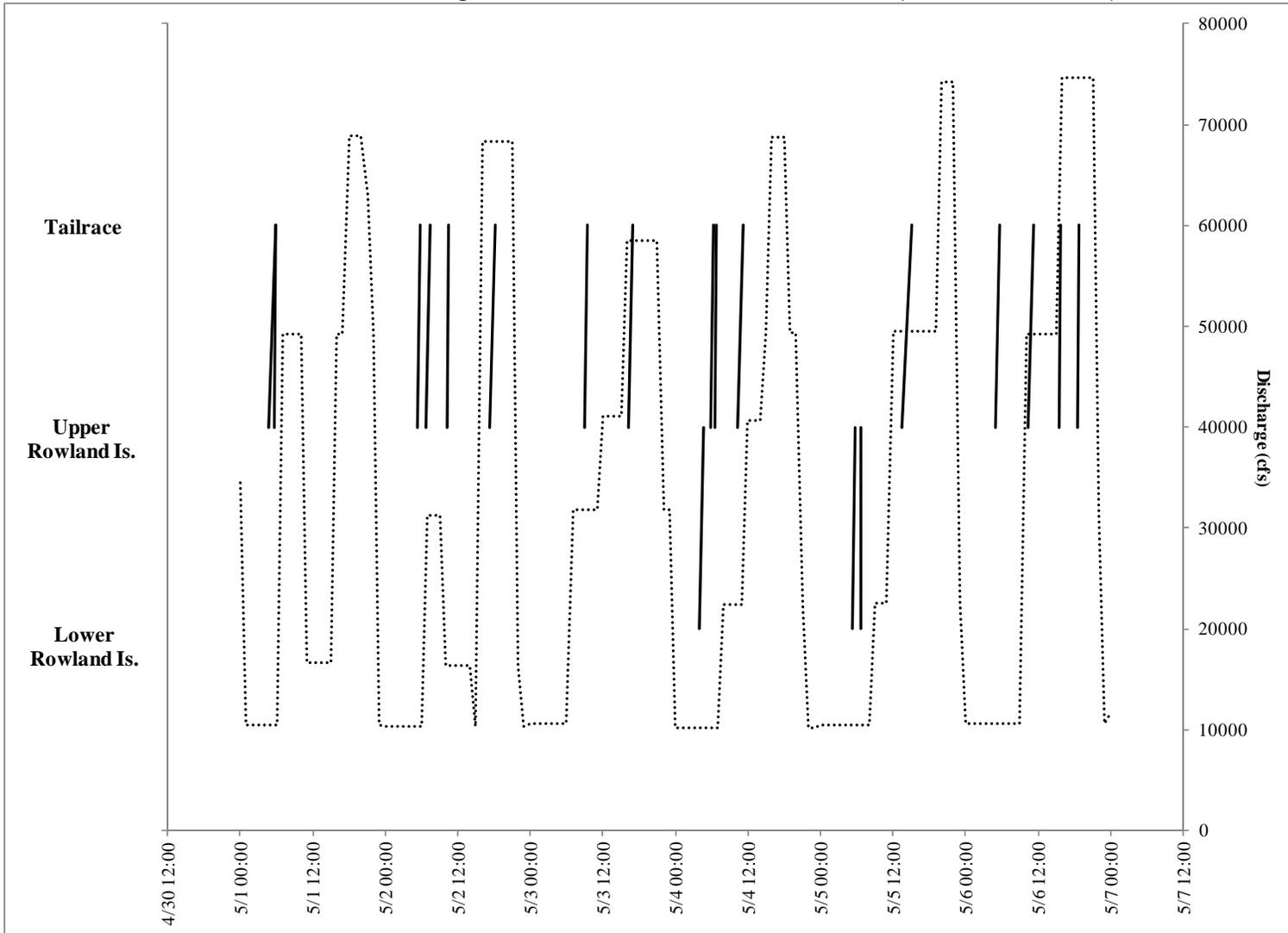
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty three separate forays are illustrated.

APPENDIX J: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN APRIL 25, 2012 AND MAY 1, 2012.



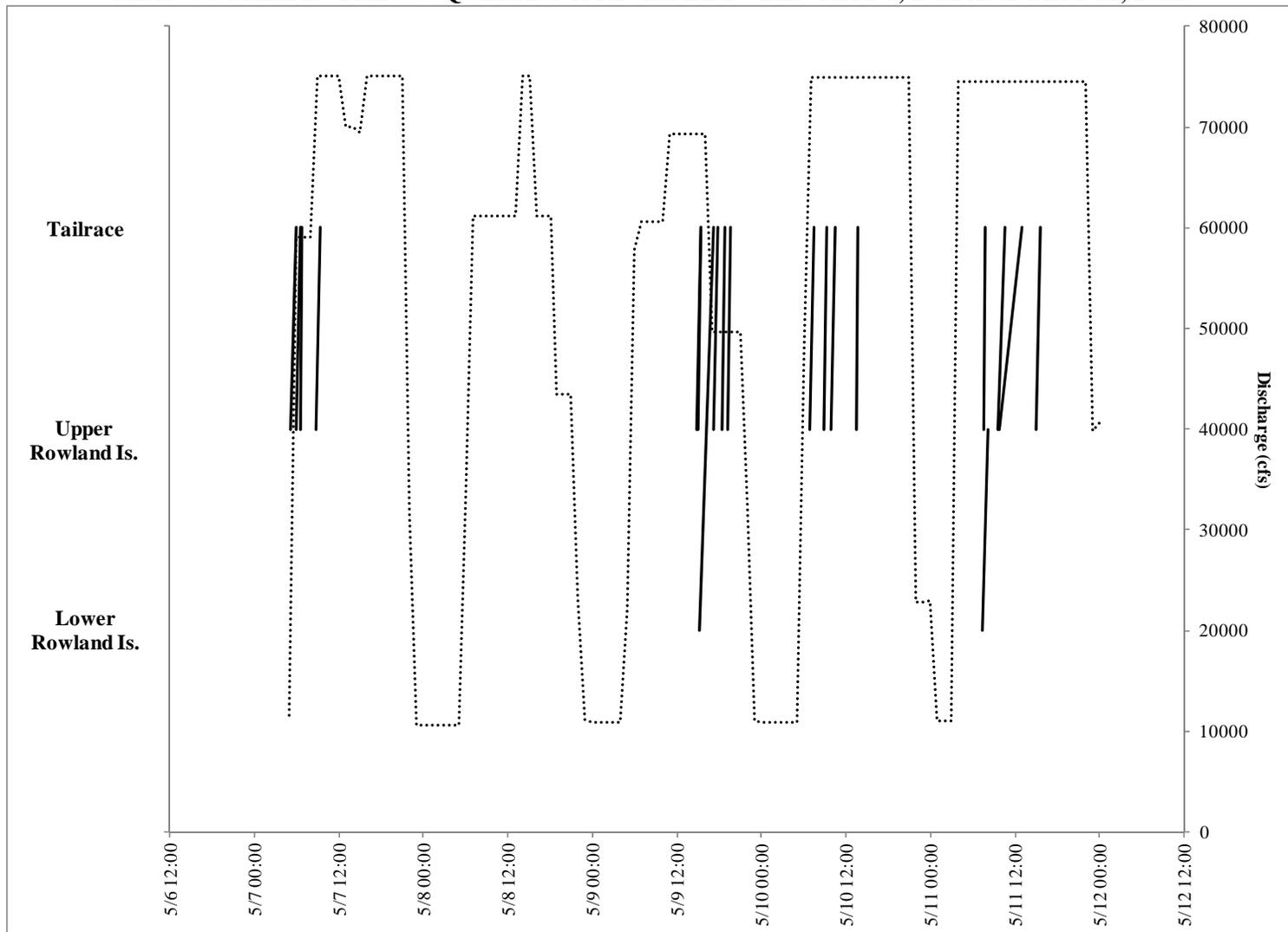
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Seventeen separate forays are illustrated.

APPENDIX J: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 1, 2012 AND MAY 7, 2012.



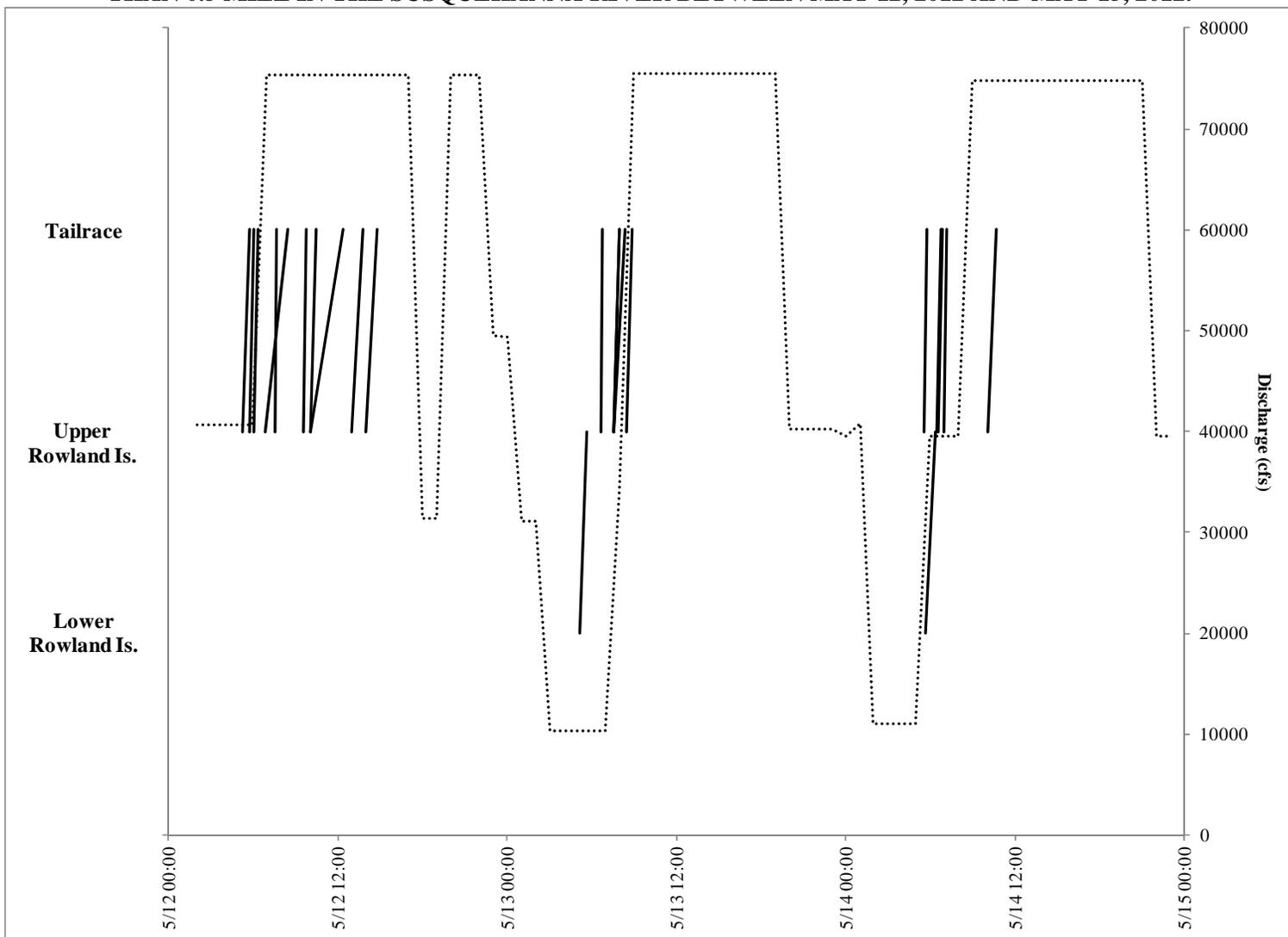
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Nineteen separate forays are illustrated.

APPENDIX J: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 6, 2012 AND MAY 12, 2012.



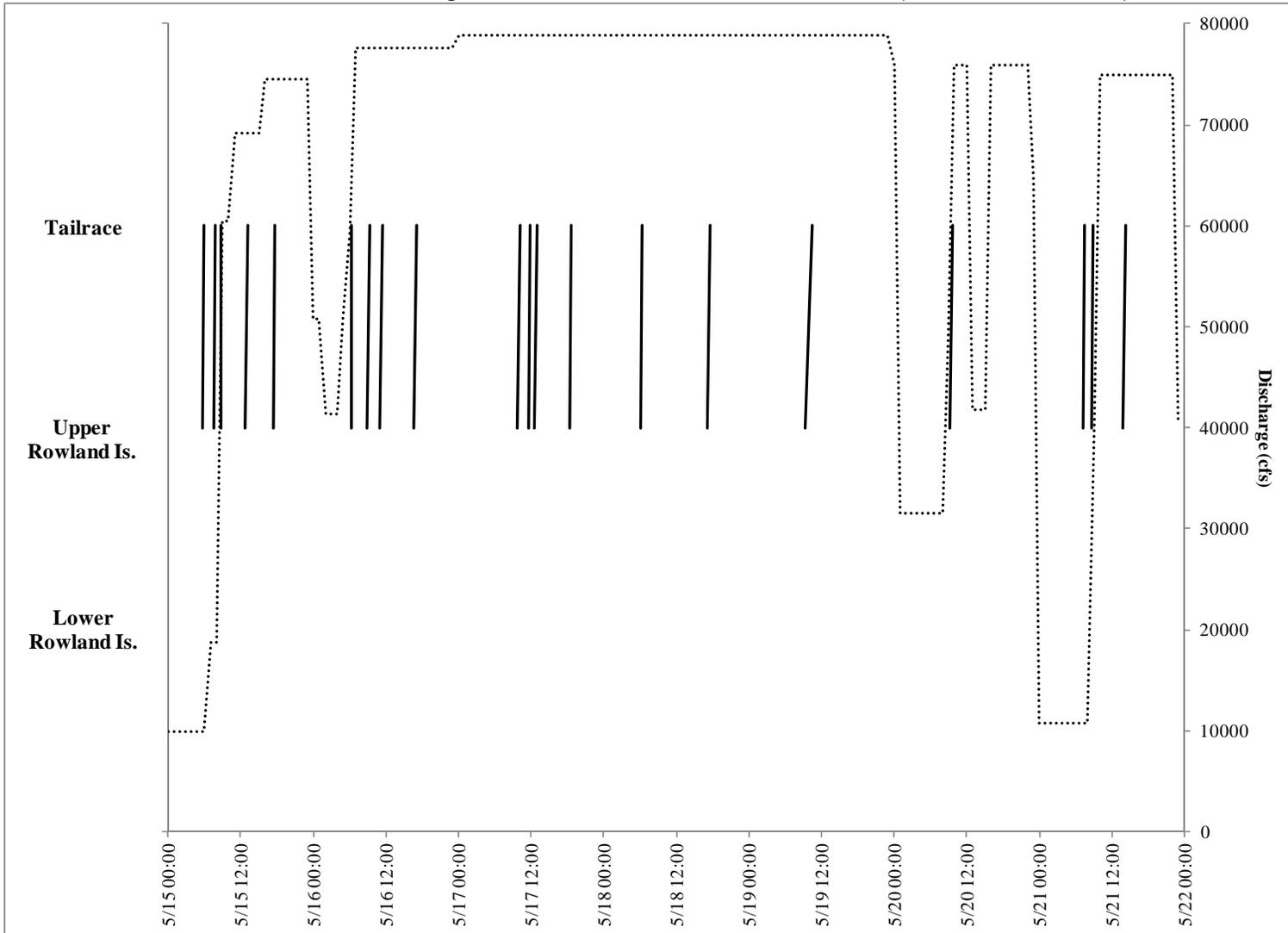
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Nineteen separate forays are illustrated.

APPENDIX J: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 12, 2012 AND MAY 15, 2012.



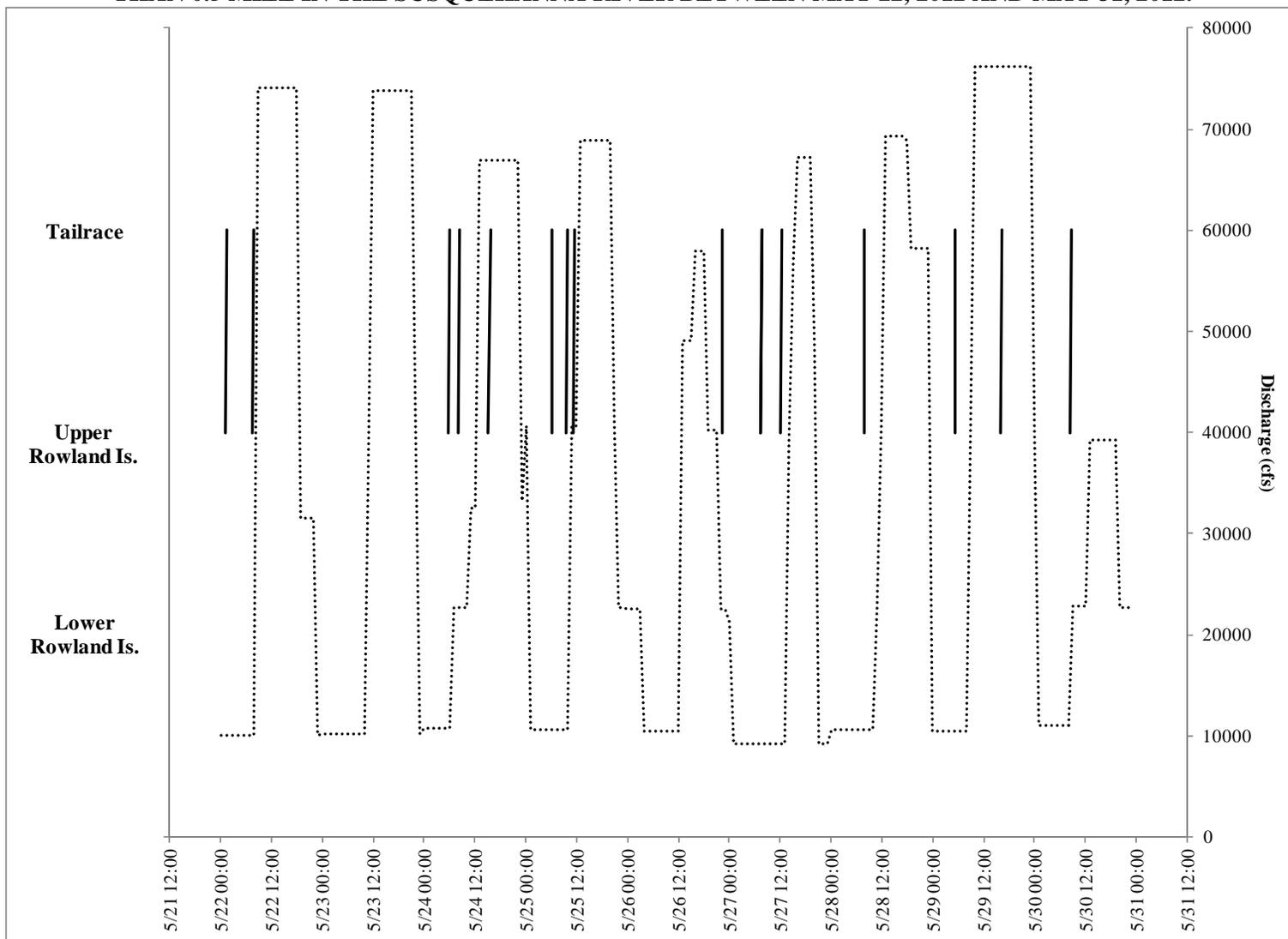
Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty two separate forays are illustrated.

APPENDIX J: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 15, 2012 AND MAY 22, 2012.



Discharge is represented by the dashed line and is derived from Conowingo discharge records. Twenty separate forays are illustrated.

APPENDIX J: DEPICTION OF RADIO TAGGED AMERICAN SHAD INDIVIDUAL UPSTREAM MOVEMENT EVENTS LESS THAN 0.5 MILE IN THE SUSQUEHANNA RIVER BETWEEN MAY 22, 2012 AND MAY 31, 2012.



Discharge is represented by the dashed line and is derived from Conowingo discharge records. Sixteen separate forays are illustrated.

**APPENDIX K: LISTING BY INDIVIDUAL RADIO-TAGGED AMERICAN SHAD UPSTREAM
MOVEMENTS OF LESS THAN 0.5 MILE DURING SPRING 2012.**

APPENDIX K: LISTING BY INDIVIDUAL RADIO TAGGED AMERICAN SHAD UPSTREAM MOVEMENTS OF LESS THAN 0.5 MILE DURING SPRING 2012.

| Fish | Date | Time | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|----------------------|-----------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | | | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-14 | 4/15 | 18:49 | Upper Rowland - East | Near Field Powerhouse | 4/15 | 19:33 | 0.30 | 0.73 | 0.41 | 0.60 | 32070 | 32070 | 32070 |
| 21-14 | 4/16 | 18:21 | Upper Rowland - East | Near Field Powerhouse | 4/16 | 19:49 | 0.30 | 1.46 | 0.20 | 0.30 | 50110 | 50110 | 50110 |
| 21-14 | 4/21 | 19:46 | Upper Rowland - West | Near Field Powerhouse | 4/21 | 19:58 | 0.24 | 0.20 | 1.19 | 1.75 | 18160 | 26757 | 32130 |
| 21-14 | 4/22 | 17:19 | Upper Rowland - West | Near Field Powerhouse | 4/22 | 18:23 | 0.24 | 1.06 | 0.22 | 0.33 | 11330 | 11330 | 11330 |
| 21-14 | 4/23 | 14:55 | Upper Rowland - West | Near Field Powerhouse | 4/23 | 15:19 | 0.24 | 0.41 | 0.58 | 0.85 | 23810 | 23810 | 23810 |
| 21-14 | 5/9 | 19:12 | Upper Rowland - East | Near Field Powerhouse | 5/9 | 19:31 | 0.30 | 0.33 | 0.91 | 1.34 | 49660 | 49660 | 49660 |
| 21-14 | 5/10 | 6:54 | Upper Rowland - West | Near Field Powerhouse | 5/10 | 7:29 | 0.24 | 0.59 | 0.40 | 0.59 | 74890 | 74890 | 74890 |
| 21-16 | 5/10 | 13:30 | Upper Rowland - West | Near Field Powerhouse | 5/10 | 13:43 | 0.24 | 0.22 | 1.09 | 1.60 | 74890 | 74890 | 74890 |
| 21-16 | 5/12 | 6:50 | Upper Rowland - East | Mid Field Powerhouse | 5/12 | 8:25 | 0.17 | 1.59 | 0.11 | 0.16 | 40670 | 71746 | 75360 |
| 21-16 | 5/13 | 7:35 | Upper Rowland - West | Near Field Powerhouse | 5/13 | 8:00 | 0.24 | 0.42 | 0.57 | 0.83 | 34240 | 34240 | 34240 |
| 21-18 | 4/15 | 15:23 | Mid Field Powerhouse | Near Field Powerhouse | 4/15 | 15:27 | 0.10 | 0.07 | 1.35 | 1.98 | 11590 | 11590 | 11590 |
| 21-21 | 4/25 | 17:08 | Upper Rowland - West | Near Field Powerhouse | 4/25 | 17:19 | 0.19 | 0.20 | 0.95 | 1.40 | 11290 | 11290 | 11290 |
| 21-37 | 5/9 | 17:12 | Upper Rowland - West | Near Field Powerhouse | 5/9 | 17:43 | 0.24 | 0.51 | 0.46 | 0.67 | 49660 | 49660 | 49660 |
| 21-37 | 5/12 | 10:03 | Upper Rowland - West | Near Field Powerhouse | 5/12 | 12:23 | 0.24 | 2.35 | 0.10 | 0.15 | 75360 | 75360 | 75360 |
| 21-37 | 5/13 | 7:35 | Upper Rowland - West | Near Field Powerhouse | 5/13 | 8:20 | 0.24 | 0.75 | 0.31 | 0.46 | 34240 | 45900 | 75500 |
| 21-37 | 5/15 | 17:27 | Upper Rowland - West | Near Field Powerhouse | 5/15 | 17:43 | 0.24 | 0.28 | 0.84 | 1.24 | 74440 | 74440 | 74440 |
| 21-39 | 5/2 | 17:16 | Upper Rowland - West | Near Field Powerhouse | 5/2 | 18:09 | 0.24 | 0.88 | 0.27 | 0.39 | 68300 | 68300 | 68300 |
| 21-39 | 5/9 | 15:15 | Lower Rowland - West | Near Field Powerhouse | 5/9 | 17:15 | 0.47 | 2.00 | 0.23 | 0.34 | 69250 | 66660 | 49660 |
| 21-39 | 5/12 | 5:13 | Upper Rowland - West | Near Field Powerhouse | 5/12 | 5:43 | 0.24 | 0.49 | 0.48 | 0.70 | 40670 | 40670 | 40670 |
| 21-41 | 5/20 | 9:15 | Upper Rowland - West | Near Field Powerhouse | 5/20 | 9:39 | 0.24 | 0.39 | 0.60 | 0.88 | 40570 | 40570 | 40570 |
| 21-43 | 5/28 | 7:43 | Upper Rowland - West | Near Field Powerhouse | 5/28 | 7:56 | 0.24 | 0.21 | 1.13 | 1.66 | 10600 | 10600 | 10600 |
| 21-46 | 5/17 | 18:28 | Upper Rowland - West | Near Field Powerhouse | 5/17 | 18:38 | 0.24 | 0.15 | 1.55 | 2.27 | 78780 | 78780 | 78780 |
| 21-72 | 5/13 | 8:28 | Upper Rowland - West | Near Field Powerhouse | 5/13 | 8:55 | 0.24 | 0.44 | 0.53 | 0.78 | 75500 | 75500 | 75500 |
| 21-72 | 5/14 | 6:56 | Upper Rowland - East | Near Field Powerhouse | 5/14 | 7:08 | 0.28 | 0.20 | 1.39 | 2.04 | 39590 | 39590 | 39590 |
| 21-75 | 5/1 | 4:49 | Upper Rowland - West | Near Field Powerhouse | 5/1 | 5:54 | 0.24 | 1.08 | 0.22 | 0.32 | 10520 | 10520 | 10520 |
| 21-75 | 5/3 | 8:57 | Upper Rowland - West | Near Field Powerhouse | 5/3 | 9:33 | 0.24 | 0.61 | 0.39 | 0.57 | 31740 | 31740 | 31740 |
| 21-77 | 4/20 | 11:36 | Upper Rowland - West | Near Field Powerhouse | 4/20 | 11:56 | 0.24 | 0.34 | 0.69 | 1.02 | 11450 | 11450 | 11450 |

APPENDIX K: CONTINUED.

| | | | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|------------------------|-----------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| Fish | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 21-77 | 4/21 | 13:04 | Upper Rowland - West | Near Field Powerhouse | 4/21 | 13:45 | 0.24 | 0.68 | 0.35 | 0.51 | 11980 | 11980 | 11980 |
| 21-77 | 4/22 | 13:23 | Upper Rowland - West | Near Field Powerhouse | 4/22 | 13:29 | 0.24 | 0.10 | 2.37 | 3.47 | 11330 | 11330 | 11330 |
| 21-77 | 4/24 | 10:05 | Upper Rowland - West | Near Field Powerhouse | 4/24 | 10:43 | 0.24 | 0.64 | 0.37 | 0.54 | 11580 | 11580 | 11580 |
| 21-87 | 4/26 | 16:48 | Upper Rowland - East | Near Field Powerhouse | 4/26 | 17:54 | 0.29 | 1.10 | 0.26 | 0.38 | 11300 | 11300 | 11300 |
| 21-87 | 4/27 | 16:16 | Upper Rowland - West | Near Field Powerhouse | 4/27 | 17:51 | 0.24 | 1.60 | 0.15 | 0.22 | 32420 | 32420 | 32420 |
| 21-87 | 4/28 | 6:31 | Upper Rowland - West | Near Field Powerhouse | 4/28 | 7:18 | 0.24 | 0.79 | 0.30 | 0.44 | 63520 | 63520 | 63520 |
| 21-87 | 5/12 | 6:05 | Upper Rowland - West | Near Field Powerhouse | 5/12 | 6:20 | 0.24 | 0.24 | 0.98 | 1.44 | 40670 | 40670 | 40670 |
| 21-87 | 5/12 | 13:57 | Upper Rowland - West | Near Field Powerhouse | 5/12 | 14:47 | 0.24 | 0.83 | 0.28 | 0.42 | 75360 | 75360 | 75360 |
| 21-87 | 5/15 | 7:39 | Upper Rowland - West | Near Field Powerhouse | 5/15 | 7:53 | 0.24 | 0.24 | 0.99 | 1.46 | 18780 | 18780 | 18780 |
| 21-89 | 5/26 | 22:19 | Upper Rowland - East | Near Field Powerhouse | 5/26 | 22:28 | 0.29 | 0.15 | 1.91 | 2.80 | 22560 | 22560 | 22560 |
| 21-89 | 5/27 | 7:23 | Upper Rowland - East | Near Field Powerhouse | 5/27 | 7:35 | 0.29 | 0.20 | 1.46 | 2.14 | 9200 | 9200 | 9200 |
| 54-12 | 4/25 | 3:39 | Upper Rowland - West | Near Field Powerhouse | 4/25 | 4:23 | 0.24 | 0.73 | 0.32 | 0.47 | 11290 | 11290 | 11290 |
| 54-12 | 4/25 | 15:52 | Upper Rowland - West | Near Field Powerhouse | 4/25 | 16:27 | 0.24 | 0.58 | 0.41 | 0.60 | 11290 | 11290 | 11290 |
| 54-12 | 4/27 | 14:14 | Upper Rowland - West | Near Field Powerhouse | 4/27 | 15:08 | 0.24 | 0.91 | 0.26 | 0.38 | 11530 | 11530 | 11530 |
| 54-13 | 4/17 | 8:08 | Upper Rowland - West | Near Field Powerhouse | 4/17 | 8:51 | 0.24 | 0.73 | 0.32 | 0.47 | 17350 | 17350 | 17350 |
| 54-13 | 4/18 | 14:47 | Upper Rowland - West | Near Field Powerhouse | 4/18 | 15:13 | 0.24 | 0.43 | 0.55 | 0.81 | 11240 | 11240 | 11240 |
| 54-13 | 5/5 | 5:14 | Lower Rowland Is. West | Upper Rowland - East | 5/5 | 5:46 | 0.47 | 0.53 | 0.88 | 1.29 | 10450 | 10450 | 10450 |
| 54-13 | 5/5 | 6:34 | Lower Rowland Is. West | Upper Rowland - East | 5/5 | 6:47 | 0.47 | 0.22 | 2.10 | 3.08 | 10450 | 10450 | 10450 |
| 54-13 | 5/12 | 12:57 | Upper Rowland - West | Near Field Powerhouse | 5/12 | 13:45 | 0.24 | 0.80 | 0.29 | 0.43 | 75360 | 75360 | 75360 |
| 54-15 | 5/2 | 10:08 | Upper Rowland - West | Near Field Powerhouse | 5/2 | 10:35 | 0.24 | 0.44 | 0.53 | 0.78 | 16420 | 16420 | 16420 |
| 54-15 | 5/4 | 6:26 | Upper Rowland - West | Near Field Powerhouse | 5/4 | 6:42 | 0.24 | 0.27 | 0.88 | 1.30 | 10210 | 10210 | 10210 |
| 54-15 | 5/7 | 6:36 | Upper Rowland - West | Near Field Powerhouse | 5/7 | 6:43 | 0.24 | 0.12 | 1.99 | 2.92 | 58990 | 58990 | 58990 |
| 54-15 | 5/9 | 15:00 | Upper Rowland - East | Near Field Powerhouse | 5/9 | 15:18 | 0.30 | 0.31 | 0.96 | 1.40 | 69250 | 69250 | 69250 |
| 54-15 | 5/10 | 8:56 | Upper Rowland - West | Near Field Powerhouse | 5/10 | 9:12 | 0.24 | 0.27 | 0.88 | 1.30 | 74890 | 74890 | 74890 |
| 54-15 | 5/12 | 9:36 | Upper Rowland - West | Near Field Powerhouse | 5/12 | 9:48 | 0.24 | 0.21 | 1.14 | 1.67 | 75360 | 75360 | 75360 |
| 54-15 | 5/13 | 7:31 | Upper Rowland - West | Near Field Powerhouse | 5/13 | 7:58 | 0.24 | 0.45 | 0.53 | 0.78 | 34240 | 34240 | 34240 |
| 54-15 | 5/16 | 11:06 | Upper Rowland - East | Near Field Powerhouse | 5/16 | 11:33 | 0.30 | 0.45 | 0.66 | 0.96 | 77520 | 77520 | 77520 |

APPENDIX K: CONTINUED.

| Fish | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | | | |
|-------|---------|-------|------------------------|-----------------------|--------|-------|---------------|-----------|---------------------|------|-------|---------|-------|
| | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-18 | 4/23 | 19:09 | Upper Rowland - East | Near Field Powerhouse | 4/23 | 19:14 | 0.30 | 0.08 | 3.95 | 5.80 | 50470 | 50470 | 50470 |
| 54-18 | 4/25 | 18:45 | Upper Rowland - West | Near Field Powerhouse | 4/25 | 19:06 | 0.24 | 0.34 | 0.69 | 1.01 | 23390 | 25824 | 41240 |
| 54-18 | 4/26 | 23:14 | Upper Rowland - East | Near Field Powerhouse | 4/26 | 23:29 | 0.30 | 0.24 | 1.23 | 1.80 | 11300 | 11300 | 11300 |
| 54-18 | 5/6 | 15:34 | Upper Rowland - West | Near Field Powerhouse | 5/6 | 15:50 | 0.24 | 0.27 | 0.86 | 1.26 | 74680 | 74680 | 74680 |
| 54-21 | 4/25 | 16:53 | Upper Rowland - West | Near Field Powerhouse | 4/25 | 17:40 | 0.24 | 0.78 | 0.30 | 0.44 | 11290 | 11290 | 11290 |
| 54-21 | 4/28 | 7:26 | Upper Rowland - West | Near Field Powerhouse | 4/28 | 8:36 | 0.24 | 1.16 | 0.20 | 0.30 | 63520 | 63520 | 63520 |
| 54-21 | 4/28 | 17:53 | Upper Rowland - West | Near Field Powerhouse | 4/28 | 18:21 | 0.24 | 0.47 | 0.50 | 0.73 | 31900 | 31900 | 31900 |
| 54-24 | 4/15 | 18:09 | Upper Rowland - West | Near Field Powerhouse | 4/15 | 18:23 | 0.24 | 0.24 | 0.96 | 1.41 | 32070 | 32070 | 32070 |
| 54-24 | 4/16 | 14:42 | Upper Rowland - East | Near Field Powerhouse | 4/16 | 15:10 | 0.30 | 0.47 | 0.63 | 0.93 | 32270 | 32270 | 32270 |
| 54-24 | 4/17 | 16:25 | Upper Rowland - West | Near Field Powerhouse | 4/17 | 17:07 | 0.24 | 0.70 | 0.34 | 0.50 | 11330 | 11330 | 11330 |
| 54-24 | 4/18 | 10:09 | Upper Rowland - West | Near Field Powerhouse | 4/18 | 10:24 | 0.24 | 0.25 | 0.95 | 1.39 | 11240 | 11240 | 11240 |
| 54-24 | 4/18 | 13:50 | Upper Rowland - West | Near Field Powerhouse | 4/18 | 14:10 | 0.24 | 0.34 | 0.70 | 1.02 | 11240 | 11240 | 11240 |
| 54-24 | 4/19 | 6:32 | Upper Rowland - West | Near Field Powerhouse | 4/19 | 6:41 | 0.24 | 0.15 | 1.53 | 2.25 | 11240 | 11240 | 11260 |
| 54-24 | 4/19 | 7:59 | Upper Rowland - East | Near Field Powerhouse | 4/19 | 8:46 | 0.30 | 0.78 | 0.38 | 0.56 | 11240 | 11260 | 11260 |
| 54-24 | 4/19 | 14:14 | Upper Rowland - West | Near Field Powerhouse | 4/19 | 14:56 | 0.24 | 0.70 | 0.34 | 0.49 | 11260 | 11260 | 11260 |
| 54-24 | 4/20 | 15:56 | Upper Rowland - West | Near Field Powerhouse | 4/20 | 16:13 | 0.24 | 0.30 | 0.80 | 1.17 | 11450 | 11450 | 11450 |
| 54-24 | 4/27 | 7:38 | Upper Rowland - East | Near Field Powerhouse | 4/27 | 9:04 | 0.30 | 1.44 | 0.21 | 0.30 | 70100 | 70100 | 70100 |
| 54-24 | 4/30 | 14:04 | Upper Rowland - West | Near Field Powerhouse | 4/30 | 14:46 | 0.24 | 0.70 | 0.34 | 0.50 | 23600 | 23600 | 23600 |
| 54-24 | 5/1 | 5:39 | Upper Rowland - West | Near Field Powerhouse | 5/1 | 5:57 | 0.24 | 0.31 | 0.76 | 1.12 | 10520 | 10520 | 10520 |
| 54-24 | 5/2 | 6:45 | Upper Rowland - West | Near Field Powerhouse | 5/2 | 7:19 | 0.24 | 0.56 | 0.42 | 0.61 | 31200 | 31200 | 31200 |
| 54-24 | 5/4 | 3:57 | Lower Rowland Is. West | Upper Rowland - East | 5/4 | 4:42 | 0.47 | 0.75 | 0.62 | 0.91 | 10210 | 10210 | 10210 |
| 54-24 | 5/4 | 5:50 | Upper Rowland - West | Near Field Powerhouse | 5/4 | 6:12 | 0.24 | 0.37 | 0.64 | 0.94 | 10210 | 10210 | 10210 |
| 54-24 | 5/4 | 10:21 | Upper Rowland - West | Near Field Powerhouse | 5/4 | 11:16 | 0.24 | 0.93 | 0.25 | 0.37 | 22390 | 23368 | 40640 |
| 54-24 | 5/11 | 7:32 | Upper Rowland - West | Near Field Powerhouse | 5/11 | 7:42 | 0.24 | 0.17 | 1.40 | 2.06 | 74540 | 74540 | 74540 |
| 54-24 | 5/12 | 5:43 | Upper Rowland - West | Near Field Powerhouse | 5/12 | 6:01 | 0.24 | 0.31 | 0.76 | 1.12 | 40670 | 40670 | 40670 |
| 54-30 | 4/17 | 13:27 | Upper Rowland - West | Near Field Powerhouse | 4/17 | 14:10 | 0.24 | 0.71 | 0.33 | 0.48 | 11330 | 11330 | 11330 |
| 54-30 | 4/18 | 14:17 | Upper Rowland - West | Near Field Powerhouse | 4/18 | 15:02 | 0.24 | 0.75 | 0.31 | 0.46 | 11240 | 11240 | 11240 |

APPENDIX K: CONTINUED.

| Fish | Date | Time | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|----------------------|-----------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | | | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-30 | 4/22 | 7:54 | Upper Rowland - West | Near Field Powerhouse | 4/22 | 8:18 | 0.24 | 0.40 | 0.59 | 0.87 | 11330 | 11330 | 11330 |
| 54-30 | 4/25 | 10:14 | Upper Rowland - East | Near Field Powerhouse | 4/25 | 10:40 | 0.30 | 0.43 | 0.69 | 1.01 | 11290 | 11290 | 11290 |
| 54-36 | 4/24 | 11:56 | Upper Rowland - West | Near Field Powerhouse | 4/24 | 12:39 | 0.24 | 0.71 | 0.33 | 0.48 | 11580 | 11580 | 11580 |
| 54-36 | 4/24 | 16:15 | Upper Rowland - West | Near Field Powerhouse | 4/24 | 16:41 | 0.24 | 0.44 | 0.54 | 0.79 | 11580 | 11580 | 11580 |
| 54-36 | 4/25 | 14:07 | Upper Rowland - West | Near Field Powerhouse | 4/25 | 14:33 | 0.24 | 0.43 | 0.54 | 0.80 | 11290 | 11290 | 11290 |
| 54-36 | 4/26 | 3:04 | Upper Rowland - West | Near Field Powerhouse | 4/26 | 3:29 | 0.24 | 0.41 | 0.58 | 0.85 | 11300 | 11300 | 11300 |
| 54-36 | 4/27 | 3:40 | Upper Rowland - West | Near Field Powerhouse | 4/27 | 4:06 | 0.24 | 0.43 | 0.54 | 0.80 | 11530 | 11530 | 11530 |
| 54-36 | 4/28 | 7:11 | Upper Rowland - West | Near Field Powerhouse | 4/28 | 7:51 | 0.24 | 0.66 | 0.36 | 0.52 | 63520 | 63520 | 63520 |
| 54-36 | 4/28 | 12:36 | Upper Rowland - East | Near Field Powerhouse | 4/28 | 13:11 | 0.30 | 0.58 | 0.51 | 0.75 | 11500 | 11500 | 11500 |
| 54-36 | 5/2 | 5:21 | Upper Rowland - West | Near Field Powerhouse | 5/2 | 5:51 | 0.24 | 0.51 | 0.47 | 0.68 | 10360 | 10360 | 10360 |
| 54-36 | 5/6 | 4:59 | Upper Rowland - West | Near Field Powerhouse | 5/6 | 5:40 | 0.24 | 0.67 | 0.35 | 0.51 | 10530 | 10530 | 10530 |
| 54-36 | 5/6 | 18:27 | Upper Rowland - West | Near Field Powerhouse | 5/6 | 18:50 | 0.24 | 0.38 | 0.62 | 0.91 | 74680 | 74680 | 74680 |
| 54-36 | 5/7 | 5:08 | Upper Rowland - West | Near Field Powerhouse | 5/7 | 5:55 | 0.24 | 0.78 | 0.30 | 0.44 | 32830 | 32830 | 32830 |
| 54-36 | 5/9 | 14:44 | Upper Rowland - West | Near Field Powerhouse | 5/9 | 15:18 | 0.24 | 0.58 | 0.41 | 0.60 | 69250 | 69250 | 69250 |
| 54-36 | 5/9 | 18:21 | Upper Rowland - East | Near Field Powerhouse | 5/9 | 18:43 | 0.30 | 0.36 | 0.84 | 1.22 | 49660 | 49660 | 49660 |
| 54-39 | 4/28 | 13:51 | Upper Rowland - East | Near Field Powerhouse | 4/28 | 14:25 | 0.30 | 0.58 | 0.51 | 0.75 | 11500 | 11500 | 11500 |
| 54-39 | 4/30 | 12:09 | Upper Rowland - West | Near Field Powerhouse | 4/30 | 13:04 | 0.24 | 0.91 | 0.26 | 0.38 | 23600 | 23600 | 23600 |
| 54-39 | 5/7 | 5:55 | Upper Rowland - West | Near Field Powerhouse | 5/7 | 6:34 | 0.24 | 0.65 | 0.36 | 0.53 | 32830 | 55720 | 58990 |
| 54-39 | 5/14 | 6:28 | Upper Rowland - West | Near Field Powerhouse | 5/14 | 6:46 | 0.24 | 0.30 | 0.79 | 1.16 | 39590 | 39590 | 39590 |
| 54-39 | 5/21 | 13:52 | Upper Rowland - East | Near Field Powerhouse | 5/21 | 14:18 | 0.30 | 0.43 | 0.69 | 1.01 | 65780 | 65780 | 65780 |
| 54-39 | 5/22 | 1:15 | Upper Rowland - East | Near Field Powerhouse | 5/22 | 1:39 | 0.30 | 0.39 | 0.76 | 1.12 | 10030 | 10030 | 10030 |
| 54-39 | 5/22 | 7:35 | Upper Rowland - West | Near Field Powerhouse | 5/22 | 7:53 | 0.24 | 0.29 | 0.80 | 1.17 | 10030 | 10030 | 10030 |
| 54-39 | 5/24 | 15:09 | Upper Rowland - West | Near Field Powerhouse | 5/24 | 15:42 | 0.24 | 0.54 | 0.43 | 0.63 | 33100 | 33100 | 33100 |
| 54-39 | 5/25 | 9:26 | Upper Rowland - West | Near Field Powerhouse | 5/25 | 9:44 | 0.24 | 0.30 | 0.77 | 1.13 | 10610 | 10610 | 10610 |
| 54-39 | 5/25 | 11:17 | Upper Rowland - West | Near Field Powerhouse | 5/25 | 11:39 | 0.24 | 0.36 | 0.66 | 0.96 | 22730 | 22730 | 22730 |
| 54-39 | 5/27 | 7:16 | Upper Rowland - West | Near Field Powerhouse | 5/27 | 7:33 | 0.24 | 0.27 | 0.86 | 1.26 | 9200 | 9200 | 9200 |
| 54-42 | 5/7 | 8:41 | Upper Rowland - West | Near Field Powerhouse | 5/7 | 9:17 | 0.24 | 0.59 | 0.40 | 0.58 | 58990 | 66827 | 75100 |

APPENDIX K: CONTINUED.

| Fish | Date | Time | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|----------------------|-----------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| | | | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-44 | 4/25 | 23:49 | Upper Rowland - East | Near Field Powerhouse | 4/26 | 0:19 | 0.30 | 0.50 | 0.59 | 0.87 | 11290 | 11297 | 11300 |
| 54-45 | 4/29 | 18:49 | Upper Rowland - West | Near Field Powerhouse | 4/29 | 19:29 | 0.24 | 0.67 | 0.35 | 0.52 | 32260 | 49827 | 75080 |
| 54-45 | 4/30 | 17:39 | Upper Rowland - West | Near Field Powerhouse | 4/30 | 19:23 | 0.24 | 1.73 | 0.14 | 0.20 | 75550 | 75550 | 75550 |
| 54-65 | 5/27 | 12:10 | Upper Rowland - West | Near Field Powerhouse | 5/27 | 12:23 | 0.24 | 0.21 | 1.13 | 1.65 | 9200 | 9200 | 9200 |
| 54-65 | 5/29 | 16:06 | Upper Rowland - West | Near Field Powerhouse | 5/29 | 16:21 | 0.24 | 0.24 | 0.96 | 1.41 | 33820 | 33820 | 33820 |
| 54-65 | 5/30 | 8:12 | Upper Rowland - West | Near Field Powerhouse | 5/30 | 8:36 | 0.24 | 0.40 | 0.59 | 0.86 | 16990 | 16990 | 16990 |
| 54-71 | 5/11 | 15:05 | Upper Rowland - East | Near Field Powerhouse | 5/11 | 15:31 | 0.30 | 0.43 | 0.70 | 1.02 | 74540 | 74540 | 74540 |
| 54-71 | 5/12 | 7:36 | Upper Rowland - West | Near Field Powerhouse | 5/12 | 7:42 | 0.24 | 0.10 | 2.47 | 3.63 | 75360 | 75360 | 75360 |
| 54-71 | 5/12 | 10:03 | Upper Rowland - East | Near Field Powerhouse | 5/12 | 10:31 | 0.30 | 0.46 | 0.65 | 0.95 | 75360 | 75360 | 75360 |
| 54-73 | 5/24 | 5:44 | Upper Rowland - East | Near Field Powerhouse | 5/24 | 5:56 | 0.30 | 0.20 | 1.49 | 2.19 | 10740 | 10740 | 10740 |
| 54-73 | 5/24 | 7:58 | Upper Rowland - West | Near Field Powerhouse | 5/24 | 8:19 | 0.24 | 0.35 | 0.68 | 1.00 | 16800 | 16800 | 16800 |
| 54-79 | 5/3 | 16:18 | Upper Rowland - East | Near Field Powerhouse | 5/3 | 16:52 | 0.30 | 0.57 | 0.52 | 0.76 | 58520 | 58520 | 58520 |
| 54-79 | 5/5 | 13:24 | Upper Rowland - West | Near Field Powerhouse | 5/5 | 15:07 | 0.24 | 1.70 | 0.14 | 0.20 | 49530 | 49530 | 49530 |
| 54-79 | 5/6 | 10:24 | Upper Rowland - West | Near Field Powerhouse | 5/6 | 11:17 | 0.24 | 0.89 | 0.27 | 0.39 | 49210 | 49210 | 49210 |
| 54-79 | 5/14 | 5:33 | Upper Rowland - West | Near Field Powerhouse | 5/14 | 5:46 | 0.24 | 0.22 | 1.06 | 1.55 | 10980 | 10980 | 10980 |
| 54-79 | 5/15 | 5:36 | Upper Rowland - West | Near Field Powerhouse | 5/15 | 5:51 | 0.24 | 0.25 | 0.95 | 1.39 | 9930 | 9930 | 9930 |
| 54-79 | 5/15 | 12:47 | Upper Rowland - West | Near Field Powerhouse | 5/15 | 13:11 | 0.24 | 0.41 | 0.58 | 0.84 | 69110 | 69110 | 69110 |
| 54-79 | 5/16 | 6:13 | Upper Rowland - West | Near Field Powerhouse | 5/16 | 6:21 | 0.24 | 0.14 | 1.69 | 2.47 | 59510 | 71517 | 77520 |
| 54-79 | 5/16 | 8:47 | Upper Rowland - West | Near Field Powerhouse | 5/16 | 9:17 | 0.24 | 0.50 | 0.47 | 0.70 | 77520 | 77520 | 77520 |
| 54-79 | 5/16 | 16:34 | Upper Rowland - West | Near Field Powerhouse | 5/16 | 16:59 | 0.24 | 0.43 | 0.55 | 0.81 | 77520 | 77520 | 77520 |
| 54-79 | 5/17 | 9:46 | Upper Rowland - East | Near Field Powerhouse | 5/17 | 10:10 | 0.30 | 0.40 | 0.74 | 1.09 | 78780 | 78780 | 78780 |
| 54-79 | 5/17 | 11:36 | Upper Rowland - West | Near Field Powerhouse | 5/17 | 11:54 | 0.24 | 0.29 | 0.81 | 1.18 | 78780 | 78780 | 78780 |
| 54-79 | 5/17 | 12:28 | Upper Rowland - West | Near Field Powerhouse | 5/17 | 12:56 | 0.24 | 0.47 | 0.50 | 0.74 | 78780 | 78780 | 78780 |
| 54-79 | 5/18 | 6:06 | Upper Rowland - East | Near Field Powerhouse | 5/18 | 6:27 | 0.30 | 0.34 | 0.86 | 1.27 | 69390 | 69390 | 69390 |
| 54-79 | 5/21 | 7:08 | Upper Rowland - West | Near Field Powerhouse | 5/21 | 7:34 | 0.24 | 0.43 | 0.54 | 0.80 | 10670 | 10670 | 10670 |
| 54-79 | 5/21 | 8:38 | Upper Rowland - West | Near Field Powerhouse | 5/21 | 8:46 | 0.24 | 0.13 | 1.80 | 2.64 | 31560 | 31560 | 31560 |
| 54-80 | 5/10 | 9:51 | Upper Rowland - West | Near Field Powerhouse | 5/10 | 10:27 | 0.24 | 0.60 | 0.39 | 0.57 | 74890 | 74890 | 74890 |

APPENDIX K: CONTINUED.

| | | | General | | General | | Travel | | Average Speed | | Conowingo Discharge | | |
|-------|------|-------|------------------------|-----------------------|---------|-------|---------------|-----------|---------------|------|---------------------|---------|-------|
| Fish | Date | Time | Downstream Location | Upstream Location | Date | Time | Distance (mi) | Time (hr) | mph | fps | Start | Average | End |
| 54-81 | 5/11 | 7:22 | Lower Rowland Is. West | Upper Rowland - East | 5/11 | 8:06 | 0.47 | 0.73 | 0.64 | 0.94 | 74540 | 74540 | 74540 |
| 54-81 | 5/11 | 9:45 | Upper Rowland - East | Near Field Powerhouse | 5/11 | 12:58 | 0.30 | 3.22 | 0.09 | 0.14 | 74540 | 74540 | 74540 |
| 54-81 | 5/13 | 5:08 | Lower Rowland Is. West | Upper Rowland - West | 5/13 | 5:42 | 0.22 | 0.57 | 0.39 | 0.58 | 10370 | 10370 | 10370 |
| 54-81 | 5/13 | 6:38 | Upper Rowland - West | Near Field Powerhouse | 5/13 | 6:46 | 0.24 | 0.12 | 1.92 | 2.82 | 10370 | 10370 | 10370 |
| 54-81 | 5/14 | 5:43 | Lower Rowland Is. West | Upper Rowland - West | 5/14 | 6:25 | 0.22 | 0.70 | 0.32 | 0.47 | 10980 | 29610 | 39590 |
| 54-81 | 5/14 | 6:33 | Upper Rowland - East | Near Field Powerhouse | 5/14 | 6:50 | 0.30 | 0.29 | 1.04 | 1.53 | 39590 | 39590 | 39590 |
| 54-81 | 5/15 | 8:38 | Upper Rowland - West | Near Field Powerhouse | 5/15 | 8:44 | 0.24 | 0.10 | 2.40 | 3.51 | 60430 | 60430 | 60430 |
| 54-81 | 5/25 | 6:01 | Upper Rowland - West | Near Field Powerhouse | 5/25 | 6:09 | 0.24 | 0.13 | 1.86 | 2.73 | 10610 | 10610 | 10610 |
| 54-90 | 5/11 | 9:35 | Upper Rowland - East | Near Field Powerhouse | 5/11 | 10:38 | 0.30 | 1.04 | 0.29 | 0.42 | 74540 | 74540 | 74540 |
| 54-90 | 5/14 | 10:06 | Upper Rowland - East | Near Field Powerhouse | 5/14 | 10:44 | 0.30 | 0.62 | 0.48 | 0.71 | 74830 | 74830 | 74830 |
| 54-90 | 5/18 | 17:06 | Upper Rowland - East | Near Field Powerhouse | 5/18 | 17:29 | 0.30 | 0.38 | 0.78 | 1.14 | 69390 | 69390 | 69390 |
| 54-90 | 5/19 | 9:17 | Upper Rowland - East | Near Field Powerhouse | 5/19 | 10:22 | 0.30 | 1.07 | 0.28 | 0.41 | 69520 | 69520 | 69520 |
| 54-90 | 5/29 | 5:12 | Upper Rowland - West | Near Field Powerhouse | 5/29 | 5:20 | 0.24 | 0.12 | 1.91 | 2.80 | 10500 | 10500 | 10500 |

**APPENDIX L: POST PASSAGE RE-ENTRY DATES AND TIMES INTO CONOWINGO
TAILRACE, SPRING 2012.**

Appendix L

Post passage re-entry dates and times into Conowingo Tailrace, spring 2012.

| Fish | Release | | Movement Classification | Unit | Re-entry into Conowingo tailrace | | |
|-------|-----------|------------------------|----------------------------|---------|---|----------|----------|
| | Group | Location | | | Comment | Date | Time |
| 21-27 | Early-Mid | Downstream of "C" Gate | Passage | No.1-11 | Confirmed | 5/15/12 | 12:28:35 |
| 21-66 | Mid-Late | Downstream of "C" Gate | Passage | Unit 8 | Confirmed | 6/2/2012 | 12:57:22 |
| 54-28 | Early-Mid | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo | 4/23/12 | 8:05:46 |
| 54-42 | Early-Mid | Downstream of "C" Gate | Passage | No.1-11 | Confirmed | 5/27/12 | 18:27:08 |
| 21-39 | Mid-Late | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 21-41 | Mid-Late | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 21-72 | Early-Mid | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 21-75 | Early-Mid | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 21-77 | Early-Mid | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 54-12 | Early-Mid | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 54-73 | Mid-Late | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 54-81 | Mid-Late | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 54-89 | Mid-Late | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo Stationary | NA | NA |
| 54-19 | Early-Mid | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo | 4/23/12 | 13:49:19 |
| 54-39 | Early-Mid | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo | 5/27/12 | 10:08:22 |
| 54-79 | Mid-Late | Downstream of "C" Gate | Passage | NA | Remained upstream of Conowingo | 5/22/12 | 15:48:59 |
| 54-80 | Mid-Late | Downstream of "C" Gate | Passage | Unit 1 | Confirmed | 5/28/12 | 13:56:22 |

**APPENDIX M: LAST DETECTION AND PRIOR MOVEMENT OF RADIO-TAGGED SHAD,
SPRING 2012.**

Appendix M

Last detection and prior movement of radio tagged shad, spring 2012

| Fish | Rel Date & Time | Release Location | Release Classification | Movement classification | Last Detection Location | Date & Time | Previous Movement | Date & Time | Activity |
|-------|-------------------|----------------------------|------------------------|-------------------------|--|--------------------|---|--------------------|---------------------|
| 21-13 | 04/13/12 10:23:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | W. shore across from Tomes, downstream of Lapidum | 5/2/12 17:25:00 | Spencer Island East | 5/2/12 4:50:29 | Milling around |
| 21-14 | 04/13/12 14:57:00 | Downstream of "C" Gate | Early-Mid | EFL without Passage | Tomes general area/location | 6/13/12 8:59:00 | Spencer Island East | 6/11/12 4:14:21 | Milling around |
| 21-15 | 04/13/12 15:28:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | LT - Upper Rowland Is. West | 5/24/12 5:15:12 | T1 - Mudd Is. | 5/13/12 3:01:08 | Upstream movement |
| 21-16 | 04/13/12 13:47:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island East | 5/13/12 20:22:18 | T2 - Crab House | 5/13/12 19:27:21 | Downstream movement |
| 21-17 | 04/13/12 13:33:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T3 - McGibney Is. | 4/13/12 20:42:47 | T2 - Crab House | 4/13/12 19:57:03 | Downstream movement |
| 21-18 | 04/13/12 11:13:00 | Downstream of "C" Gate | Early-Mid | EFL without Passage | WFL | 5/8/12 13:07:22 | WFL | 5/8/12 12:32:17 | Milling around |
| 21-19 | 04/13/12 10:54:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island West | 5/4/12 4:55:14 | Spencer Island West | 5/4/12 3:57:35 | Milling around |
| 21-20 | 04/12/12 14:49:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island West | 5/1/12 18:34:10 | Spencer Island West | 5/1/12 14:54:05 | Milling around |
| 21-21 | 04/13/12 10:21:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island East | 6/6/12 2:41:37 | Spencer Island West | 6/6/12 2:40:51 | Lateral movement |
| 21-23 | 04/12/12 14:28:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T3 - Opp. McGibney | 5/2/12 9:16:24 | T2 - Opp. Crab House | 5/2/12 9:03:12 | Downstream movement |
| 21-24 | 04/12/12 14:38:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T3 - McGibney Is. | 4/13/12 21:15:53 | T2 - Crab House | 4/13/12 20:54:20 | Downstream movement |
| 21-25 | 04/12/12 14:44:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Downstream Tomes Dry-Docks, W. top of St. Catherine I | 5/30/12 10:16:00 | Spencer Island East | 5/11/12 15:39:27 | Upstream movement |
| 21-26 | 04/12/12 12:35:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island West | 4/27/12 13:47:15 | Spencer Island West | 4/27/12 12:20:00 | Milling around |
| 21-27 | 04/12/12 12:17:00 | Downstream of "C" Gate | Early-Mid | Passage | Spencer Island West | 5/15/12 13:44:15 | T3 - Opp. McGibney | 5/15/12 13:10:16 | Downstream movement |
| 21-28 | 04/12/12 12:16:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T3 - Opp. McGibney | 4/17/12 19:59:46 | T2 - Opp. Crab House | 4/17/12 19:14:58 | Downstream movement |
| 21-29 | 04/12/12 12:48:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island East | 5/11/12 3:35:56 | Spencer Island East | 5/11/12 0:22:20 | Milling around |
| 21-30 | 04/12/12 14:13:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | LT - Upper Rowland Is. West | 5/17/12 8:40:47 | T3 - McGibney Is. | 4/12/12 20:14:06 | Upstream movement |
| 21-31 | 04/12/12 12:03:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T3 - McGibney Is. | 4/12/12 21:01:26 | T2 - Crab House | 4/12/12 20:47:58 | Downstream movement |
| 21-32 | 04/13/12 16:15:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T2 - Opp. Crab House | 4/15/12 21:50:01 | T1 - Opp. Mudd Is. | 4/15/12 21:20:56 | Downstream movement |
| 21-34 | 05/04/12 12:19:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Tailrace Unit 9 (Mid) | 5/24/12 6:09:26 | Tailrace Unit 10 (Mid) | 5/18/12 1:45:21 | Lateral movement |
| 21-36 | 05/01/12 12:22:00 | Downstream of "C" Gate | Mid-Late | Tailrace without EFL | T3 - McGibney Is. | 5/6/12 5:12:18 | T1 - Opp. Mudd Is. | 5/6/12 2:23:48 | Downstream movement |
| 21-37 | 05/01/12 14:45:00 | Downstream of "C" Gate | Mid-Late | EFL without Passage | Above Shures Landing almost mid river mid Rowland Is. | 6/20/12 10:55:00 | LT - Upper Rowland Is. East | 5/31/12 7:56:48 | Downstream movement |
| 21-38 | 05/01/12 14:48:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island West | 5/1/12 19:08:55 | T2 - Opp. Crab House | 5/1/12 17:54:40 | Downstream movement |
| 21-39 | 05/01/12 15:03:00 | Downstream of "C" Gate | Mid-Late | Passage | up from fishing creek & between Sicily and 1st mid river t | 6/25/12 11:22:00 | Mid pond out from fishing creek & upper cabin on E. shore, 1/2 mi above upstr of tower | 6/18/12 11:45:00 | Stationary |
| 21-41 | 05/02/12 11:15:00 | Downstream of "C" Gate | Mid-Late | Passage | Could be moving around, 200 yds out from cabin on E. sl | 6/18/12 11:55:00 | 100 ft downstr Wissler's Run, actively tracked to the W. downstr, and eventually back upstr | 6/11/12 12:20:00 | Stationary |
| 21-42 | 05/02/12 12:06:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T2 - Opp. Crab House | 5/2/12 20:25:04 | T1 - Opp. Mudd Is. | 5/2/12 19:07:46 | Downstream movement |
| 21-43 | 05/02/12 12:19:00 | Downstream of "C" Gate | Mid-Late | EFL without Passage | W. side of river mid even with middle of Lapidum, parkin | 5/30/12 14:13:00 | Spencer Island West | 5/28/2012 21:06:22 | Downstream movement |
| 21-44 | 05/02/12 12:40:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T2 - Opp. Crab House | 5/2/2012 17:03:06 | Mid river, very bottom of Fishpot | 5/2/12 16:48:00 | Downstream movement |
| 21-45 | 05/02/12 13:50:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island East | 5/2/2012 22:14:20 | T3 - McGibney Is. | 5/2/2012 21:45:32 | Downstream movement |
| 21-46 | 05/02/12 13:51:00 | Downstream of "C" Gate | Mid-Late | Tailrace without EFL | Spencer Island East | 5/20/2012 20:23:55 | T1 - Mudd Is. | 5/20/2012 19:39:51 | Downstream movement |
| 21-47 | 05/02/12 13:45:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T1 - Mudd Is. | 5/17/2012 20:47:53 | LT - Lower Rowland Is. West | 5/10/2012 4:30:18 | Downstream movement |
| 21-48 | 05/05/12 10:55:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T2 - Opp. Crab House | 5/5/2012 20:27:09 | T1 - Opp. Mudd Is. | 5/5/2012 20:06:56 | Downstream movement |
| 21-49 | 05/09/12 11:38:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | W. side even w/Tomes dry dock upper tip of St. Catherin | 5/16/12 15:45:00 | Spencer Island West | 5/13/2012 23:16:21 | Downstream movement |
| 21-50 | 05/14/12 06:33:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T2 - Opp. Crab House | 5/14/2012 13:36:29 | Spencer Island West | 5/14/2012 10:07:15 | Upstream movement |
| 21-51 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Slightly above VFW 100 yds off E. shore | 6/20/12 9:55:00 | Slightly up from VFW in shallow area near E. shore | 6/13/12 9:55:00 | Stationary |
| 21-52 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | Tailrace without EFL | Tailrace Unit 1 (Mid) | 6/4/2012 21:31:07 | Tailrace Unit 1 (Mid) | 6/4/2012 20:37:50 | Stationary |
| 21-53 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/2012 14:01:10 | T2 - Opp. Crab House | 5/17/2012 12:21:42 | Downstream movement |
| 21-54 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | W. shoreline even w/center of Bird Is. | 6/13/12 11:05:00 | Downstr Bird/upstr Fishpot (W. side of river) | 6/4/12 13:43:00 | Stationary |
| 21-56 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island East | 5/17/2012 14:25:06 | T3 - McGibney Is. | 5/17/2012 13:55:20 | Downstream movement |
| 21-57 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island East | 5/17/2012 12:45:08 | T3 - McGibney Is. | 5/17/2012 12:23:29 | Downstream movement |
| 21-58 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island East | 5/30/2012 20:02:05 | T3 - Opp. McGibney | 5/30/2012 15:24:39 | Downstream movement |
| 21-59 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island East | 5/17/2012 13:33:06 | LT - Upper Rowland Is. West | 5/17/2012 11:40:42 | Downstream movement |
| 21-60 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/2012 12:53:35 | T2 - Opp. Crab House | 5/17/2012 12:15:04 | Downstream movement |
| 21-61 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | T1 - Mudd Is. | 5/29/2012 14:23:57 | T1 - Mudd Is. | 5/28/2012 11:32:28 | Stationary |
| 21-62 | 05/03/12 11:12:00 | Downstream EFL "C" Gate | Mid-Late | non-tailrace | Spencer Island East | 5/3/2012 20:28:25 | T2 - Opp. Crab House | 5/3/2012 19:37:40 | Downstream movement |
| 21-63 | 05/04/12 10:35:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island West | 5/4/2012 22:40:49 | T3 - McGibney Is. | 5/4/2012 21:43:37 | Downstream movement |
| 21-64 | 05/02/12 13:54:00 | Downstream of "C" Gate | Mid-Late | Tailrace without EFL | Spencer Island East | 5/15/2012 20:36:39 | Spencer Island West | 5/15/2012 18:04:16 | lateral movement |
| 21-65 | 05/02/12 14:55:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island East | 5/2/2012 21:34:14 | T3 - McGibney Is. | 5/2/2012 21:09:46 | Downstream movement |
| 21-66 | 05/02/12 15:00:00 | Downstream of "C" Gate | Mid-Late | Passage | Spencer Island West | 6/3/2012 14:34:17 | T3 - McGibney Is. | 6/3/2012 13:54:22 | Downstream movement |
| 21-67 | 05/03/12 11:22:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Downstream of Spencer Is. | 5/11/12 21:25:00 | Lower tip of Robert Is./E. Shoreline | 5/11/12 20:50:00 | Downstream movement |
| 21-68 | 05/02/12 13:55:00 | Downstream of "C" Gate | Mid-Late | EFL without Passage | T2 - Opp. Crab House | 5/10/2012 23:04:11 | T3 - Opp. McGibney | 5/10/2012 18:45:00 | Upstream movement |
| 21-69 | 04/16/12 13:20:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T3 - Opp. McGibney | 4/17/2012 20:45:05 | T2 - Opp. Crab House | 4/17/2012 20:31:37 | Downstream movement |
| 21-70 | 04/18/12 10:43:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Port boat launch mid river | 4/19/12 17:25:00 | T3 - McGibney Is. | 4/19/2012 3:21:52 | Downstream movement |
| 21-71 | 04/18/12 11:23:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island West | 5/3/2012 4:54:34 | Spencer Island West | 5/3/2012 3:53:41 | Stationary |
| 21-72 | 04/18/12 11:34:00 | Downstream of "C" Gate | Early-Mid | Passage | Same location below mouth of Broad Cr. | 6/25/12 9:32:00 | Same location - below mouth of Broad Cr. 100 yds off W. shore | 6/18/12 9:56:00 | Stationary |
| 21-73 | 04/18/12 13:59:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island West | 4/26/2012 20:17:37 | T3 - Opp. McGibney | 4/26/2012 19:41:04 | Downstream movement |
| 21-74 | 04/18/12 12:46:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T2 - Opp. Crab House | 5/7/2012 15:15:43 | T1 - Opp. Mudd Is. | 5/7/2012 14:51:03 | Downstream movement |
| 21-75 | 04/18/12 14:05:00 | Downstream of "C" Gate | Early-Mid | Passage | 100 yds downstr of Beach Is (same location) | 6/25/12 11:31:00 | 100 yds downstr of Beach Is (same location) | 6/18/12 12:00:00 | Stationary |
| 21-76 | 04/18/12 14:15:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Mid-River in between Crabhouse and Mud Is. Sites | 6/20/12 10:29:00 | Mid-River, even w/downstr tip of Bird Is. slightly above Crabhouse | 6/13/12 12:14:00 | Stationary |
| 21-77 | 04/18/12 14:29:00 | Downstream of "C" Gate | Early-Mid | Passage | Upstr of Rollins Pt/mid-river, upstr & W of Elephant Rock | 5/14/12 14:41:00 | Upstr of Rollins Pt/mid-river, upstr & W of Elephant Rock (Forsythe) | 5/14/12 11:57:00 | Stationary |
| 21-78 | 04/18/12 14:37:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T3 - McGibney Is. | 4/18/2012 23:47:41 | T2 - Crab House | 4/18/2012 21:08:44 | Downstream movement |
| 21-79 | 04/18/12 15:53:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T3 - McGibney Is. | 4/19/2012 20:35:17 | T1 - Opp. Mudd Is. | 4/19/2012 19:46:38 | Downstream movement |
| 21-80 | 04/18/12 15:58:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T2 - Opp. Crab House | 4/23/2012 22:48:03 | Spencer Island West | 4/23/2012 20:36:47 | Downstream movement |
| 21-81 | 04/18/12 16:34:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T3 - Opp. McGibney | 5/7/2012 21:27:54 | T1 - Mudd Is. | 5/7/2012 21:00:56 | Downstream movement |
| 21-82 | 04/18/12 16:36:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island West | 4/27/2012 18:49:20 | T3 - Opp. McGibney | 4/27/2012 17:47:50 | Downstream movement |
| 21-83 | 04/19/12 15:12:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island West | 4/19/2012 23:12:32 | T3 - McGibney Is. | 4/19/2012 21:37:56 | |
| 21-84 | 04/19/12 15:01:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island East | 5/3/2012 21:22:29 | Spencer Island West | 5/3/2012 20:42:30 | Lateral movement |
| 21-85 | 04/19/12 13:56:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island East | 5/15/2012 4:11:47 | Spencer Island West | 5/15/2012 3:45:26 | Lateral movement |
| 21-86 | 04/18/12 11:55:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Mid river below Lapidum even w/Port Playground | 5/2/12 9:09:00 | Spencer Island East | 4/28/2012 2:27:32 | Downstream movement |
| 21-87 | 04/19/12 13:29:00 | Downstream of "C" Gate | Early-Mid | EFL without Passage | T3 - McGibney Is. | 5/17/2012 16:49:29 | T1 - Mudd Is. | 5/17/2012 16:20:45 | Downstream movement |
| 21-88 | 04/19/12 13:18:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island East | 5/13/2012 23:20:19 | Mid-River, even w/Tomes and lower end of Lapidum Ramp | 5/12/12 14:28:00 | Upstream movement |
| 21-89 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | EFL without Passage | Spencer Island West | 5/27/2012 20:08:25 | T3 - Opp. McGibney | 5/27/2012 18:35:44 | Downstream movement |
| 21-91 | 05/05/12 10:42:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T2 - Opp. Crab House | 5/5/2012 20:01:09 | T1 - Opp. Mudd Is. | 5/5/2012 19:46:49 | Downstream movement |
| 21-92 | 05/05/12 10:47:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island West | 5/5/2012 19:57:19 | T2 - Opp. Crab House | 5/5/2012 18:38:18 | Downstream movement |
| 54-12 | 04/12/12 13:08:00 | Downstream of "C" Gate | Early-Mid | Passage | Down from twin rocks (below Spencer Is.) mid river | 6/20/12 9:47:00 | Above Lapidum ramp closer to W. shore (mid-river) | 6/13/12 9:38:00 | Stationary |
| 54-13 | 04/12/12 13:00:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island West | 5/20/12 1:08:21 | T3 - Opp. McGibney | 5/20/12 0:09:54 | Downstream movement |
| 54-14 | 04/12/12 13:35:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island West | 4/28/12 3:35:21 | Spencer Island West | 4/28/12 2:22:34 | Stationary |
| 54-15 | 04/12/12 13:17:00 | Downstream of "C" Gate | Early-Mid | EFL without Passage | Mid-Rvier-E. ups Crabhouse hangout | 6/20/12 10:23:00 | Above rockpile near Crabhouse on E. shore | 6/13/12 10:37:00 | Stationary |
| 54-16 | 04/12/12 14:55:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T3 - Opp. McGibney | 4/17/12 19:50:29 | T1 - Opp. Mudd Is. | 4/17/12 18:58:43 | Downstream movement |
| 54-17 | 04/12/12 14:54:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T3 - McGibney Is. | 5/6/12 8:19:48 | T3 - McGibney Is. | 5/6/12 6:36:46 | |

| Fish | Rel Date & Time | Release Location | Release Classification | Movement Classification | Last Detection Location | Date & Time | Previous Movement | Date & Time | Activity |
|-------|-------------------|----------------------------|------------------------|-------------------------|--|------------------|--|------------------|---------------------|
| 21-13 | 04/13/12 10:23:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | W. shore across from Tomes, downstream of Lapidum | 5/2/12 17:25:00 | Spencer Island East | 5/2/12 4:50:29 | Milling around |
| 54-23 | 04/12/12 16:16:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Mid-channel even with Port ramp and upper end of St. C. | 5/12/12 14:25:00 | Spencer Island East | 4/27/12 1:25:09 | Downstream movement |
| 54-24 | 04/13/12 13:11:00 | Downstream of "C" Gate | Early-Mid | EFL without Passage | Spencer Island West | 5/28/12 4:31:05 | Spencer Island East | 5/27/12 14:04:19 | lateral movement |
| 54-25 | 04/13/12 13:15:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T3 - McGibney Is. | 4/13/12 23:05:43 | T2 - Crab House | 4/13/12 22:42:33 | Downstream movement |
| 54-27 | 04/16/12 11:41:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island West | 4/22/12 21:42:40 | T3 - Opp. McGibney | 4/22/12 20:34:40 | Downstream movement |
| 54-28 | 04/13/12 13:24:00 | Downstream of "C" Gate | Early-Mid | Passage | Holtwood Spillway | 4/23/12 8:05:46 | Holtwood Exit Tough | 4/23/12 6:49:41 | Downstream movement |
| 54-29 | 04/16/12 11:51:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T2 - Crab House | 4/17/12 3:41:26 | T2 - Opp. Crab House | 4/17/12 2:56:09 | lateral movement |
| 54-30 | 04/16/12 12:02:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T1 - Opp. Mudd Is. | 5/13/12 0:29:53 | T3 - McGibney Is. | 5/12/12 20:42:17 | Upstream movement |
| 54-31 | 04/16/12 12:11:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island East | 4/26/12 20:10:33 | Spencer Island West | 4/26/12 11:57:05 | lateral movement |
| 54-32 | 04/16/12 12:51:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | T3 - McGibney Is. | 5/5/12 20:09:55 | T2 - Opp. Crab House | 5/5/12 19:21:55 | Downstream movement |
| 54-33 | 04/18/12 12:58:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island East | 4/28/12 4:06:36 | Spencer Island East | 4/28/12 3:05:29 | Stationary |
| 54-34 | 04/18/12 13:05:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island East | 4/19/12 23:41:45 | T3 - McGibney Is. | 4/19/12 20:38:12 | Downstream movement |
| 54-35 | 04/18/12 13:30:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island East | 5/5/12 0:02:14 | Spencer Island West | 5/4/12 23:04:36 | lateral movement |
| 54-36 | 04/18/12 13:45:00 | Downstream of "C" Gate | Early-Mid | EFL without Passage | Spencer Island East | 6/9/12 2:44:23 | Spencer Island East | 6/9/12 0:41:46 | Stationary |
| 54-37 | 04/18/12 13:48:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island West | 4/19/12 21:17:51 | T3 - Opp. McGibney | 4/19/12 20:19:58 | Downstream movement |
| 54-38 | 04/18/12 14:41:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island East | 4/21/12 20:46:37 | Spencer Island East | 4/20/12 1:49:48 | Stationary |
| 54-39 | 04/18/12 14:48:00 | Downstream of "C" Gate | Early-Mid | Passage | EFL Upper Exit Trough | 5/27/12 10:08:22 | ELF Exit Trough - Lower Dropper | 5/27/12 9:08:03 | Upstream movement |
| 54-40 | 04/18/12 14:52:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island East | 4/30/12 21:33:48 | Spencer Island West | 4/26/12 3:39:46 | Upstream movement |
| 54-41 | 04/18/12 15:07:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T2 - Opp. Crab House | 4/22/12 3:51:19 | Spencer Island West | 4/19/12 22:41:02 | Upstream movement |
| 54-42 | 04/18/12 15:31:00 | Downstream of "C" Gate | Early-Mid | Passage | 200 yds off of downstream end of Fishpot, out SE 300 yd | 6/20/12 10:36:00 | Moved to middle river still just down a little from Fishpot | 6/13/12 12:25:00 | Downstream movement |
| 54-43 | 04/19/12 15:43:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T1 - Opp. Mudd Is. | 5/5/12 21:22:13 | T1 - Mudd Is. | 5/5/12 19:02:44 | Lateral movement |
| 54-44 | 04/19/12 15:05:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island West | 5/17/12 10:45:33 | Spencer Island East | 5/17/12 10:05:55 | Lateral movement |
| 54-45 | 04/19/12 14:25:00 | Downstream of "C" Gate | Early-Mid | Tailrace without EFL | Spencer Island West | 5/14/12 5:28:52 | Spencer Island West | 5/14/12 4:38:26 | Stationary |
| 54-46 | 04/19/12 13:35:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | T1 - Mudd Is. | 6/1/12 4:32:44 | T1 - Mudd Is. | 5/31/12 2:35:04 | Stationary |
| 54-48 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 13:44:08 | T3 - McGibney Is. | 5/17/12 13:10:42 | Downstream movement |
| 54-49 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Downstream Twin Rocks, even w/the Tomes' rock jetty | 6/20/12 9:22:00 | Mid-River E. Upstream Tomes, Downstream Long House (Yellow) | 6/13/12 8:54:00 | Lateral movement |
| 54-50 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | Tailrace without EFL | Spencer Island West | 5/26/12 20:16:29 | T1 - Opp. Mudd Is. | 5/26/12 18:54:15 | Downstream movement |
| 54-51 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | W. shore 300 yds up Opp. Crabhouse site in blowdown (| 6/20/12 10:32:00 | W. shore 300 yds up Opp. Crabhouse site in blowdown (stationary) | 6/13/12 10:41:00 | Stationary |
| 54-52 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | T2 - Opp. Crab House | 5/17/12 12:18:28 | Only One Detection | | |
| 54-53 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 13:06:08 | T2 - Opp. Crab House | 5/17/12 12:10:00 | Downstream movement |
| 54-54 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island East | 5/17/12 21:24:34 | T3 - McGibney Is. | 5/17/12 21:01:21 | Downstream movement |
| 54-55 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 18:02:46 | T2 - Opp. Crab House | 5/17/12 17:12:18 | Downstream movement |
| 54-56 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 23:46:16 | Only One Detection | | |
| 54-57 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island East | 5/21/12 13:51:49 | Spencer Island West | 5/20/12 20:37:20 | Lateral movement |
| 54-58 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | T1 - Mudd Is. | 5/26/12 18:48:17 | Spencer Island West | 5/17/12 13:02:09 | Upstream movement |
| 54-59 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island East | 5/17/12 13:31:41 | T3 - McGibney Is. | 5/17/12 12:44:48 | Downstream movement |
| 54-60 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | T1 - Mudd Is. | 5/30/12 12:08:30 | Recovered tag - Stationary same as before in blowdown/oak | 5/30/12 11:47:00 | Recovered Tag |
| 54-61 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 17:21:33 | Spencer Island West | 5/17/12 17:11:33 | Stationary |
| 54-62 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 14:48:14 | T3 - Opp. McGibney | 5/17/12 13:49:22 | Downstream movement |
| 54-63 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 13:52:33 | T2 - Opp. Crab House | 5/17/12 12:23:18 | Downstream movement |
| 54-64 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 13:52:33 | T2 - Opp. Crab House | 5/17/12 12:23:18 | Downstream movement |
| 54-65 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | EFL without Passage | T3 - McGibney Is. | 6/1/12 2:14:57 | T1 - Mudd Is. | 6/1/12 0:39:49 | Downstream movement |
| 54-66 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 13:29:44 | T2 - Opp. Crab House | 5/17/12 12:26:41 | Downstream movement |
| 54-67 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 20:17:27 | Only One Detection | | |
| 54-68 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island East | 5/17/12 12:43:42 | T3 - McGibney Is. | 5/17/12 12:17:59 | Downstream movement |
| 54-69 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | T2 - Opp. Crab House | 5/17/12 12:42:43 | Only One Detection | | |
| 54-70 | 04/19/12 13:20:00 | Downstream of "C" Gate | Early-Mid | non-tailrace | Spencer Island West | 4/20/12 5:42:26 | T2 - Crab House | 4/20/12 1:50:05 | Downstream movement |
| 54-71 | 05/02/12 12:45:00 | Downstream of "C" Gate | Mid-Late | Tailrace without EFL | Downstream of Rowland Is. On East shore of Rowland Is | 6/20/12 10:57:00 | Downstream of Rowland Is. On East shore of Rowland Is. | 6/13/12 12:03:00 | Stationary |
| 54-72 | 05/02/12 13:05:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T2 - Crab House | 5/10/12 0:45:32 | T2 - Opp. Crab House | 5/2/12 16:36:14 | Lateral movement |
| 54-73 | 05/02/12 13:09:00 | Downstream of "C" Gate | Mid-Late | Passage | E. Shore downstream of Sicily Is., 200 yds off 1st cabin (| 6/7/12 12:07:00 | E. Shore downstream of Sicily Is., 200 yds off 1st cabin (old river bed) | 5/31/12 14:04:00 | Stationary |
| 54-74 | 05/02/12 13:31:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Mid-channel even with Port ramp and upper end of St. C. | 5/12/12 14:27:00 | Spencer Island East | 5/12/12 4:46:44 | Downstream movement |
| 54-75 | 05/02/12 13:37:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island West | 5/3/12 6:58:13 | T3 - McGibney Is. | 5/3/12 4:30:02 | Downstream movement |
| 54-76 | 05/02/12 13:58:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island West | 5/2/12 18:55:17 | T2 - Opp. Crab House | 5/2/12 17:23:39 | Downstream movement |
| 54-77 | 05/02/12 14:10:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island East | 5/5/12 0:06:41 | T3 - McGibney Is. | 5/2/12 22:56:25 | Downstream movement |
| 54-78 | 05/02/12 14:16:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island East | 5/2/12 20:40:01 | T3 - McGibney Is. | 5/2/12 20:18:36 | Downstream movement |
| 54-79 | 05/02/12 14:27:00 | Downstream of "C" Gate | Mid-Late | Passage | Holtwood Spillway | 5/22/12 15:48:59 | ELF Exit Trough - Lower Dropper | 5/21/12 11:21:37 | Upstream movement |
| 54-80 | 05/02/12 14:53:00 | Downstream of "C" Gate | Mid-Late | Passage | W. shore, upstream of Fishpot, downstream DO sheds | 6/20/12 10:48:00 | T1 - Mudd Is. | 6/11/12 11:21:59 | Upstream movement |
| 54-81 | 05/04/12 10:09:00 | Downstream of "C" Gate | Mid-Late | Passage | Holtwood Spillway | 6/1/12 10:36:06 | Holtwood Spillway | 6/1/12 8:49:22 | Stationary |
| 54-82 | 05/04/12 10:19:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | E. shore, downstream of Port's Public Fishing Pier | 6/20/12 9:32:00 | E. shore, downstream of Port's Public Fishing Pier | 6/13/12 9:01:00 | Stationary |
| 54-83 | 05/04/12 10:04:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T3 - McGibney Is. | 5/10/12 4:18:36 | T2 - Crab House | 5/10/12 1:02:33 | Downstream movement |
| 54-84 | 05/04/12 10:26:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | Spencer Island West | 5/4/12 23:49:05 | T2 - Opp. Crab House | 5/4/12 20:59:09 | Downstream movement |
| 54-85 | 05/04/12 10:29:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T3 - McGibney Is. | 5/6/12 16:12:30 | T2 - Opp. Crab House | 5/6/12 15:49:52 | Downstream movement |
| 54-86 | 05/05/12 09:40:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | E. 1/4 of River near Steel Is., opposite of lower tip of Rob | 5/24/12 21:20:00 | T2 - Opp. Crab House | 5/5/12 20:06:14 | Downstream movement |
| 54-87 | 05/05/12 10:06:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T2 - Opp. Crab House | 5/5/12 20:33:03 | T1 - Opp. Mudd Is. | 5/5/12 20:16:53 | Downstream movement |
| 54-88 | 05/05/12 10:16:00 | Downstream of "C" Gate | Mid-Late | non-tailrace | T3 - McGibney Is. | 5/6/12 1:10:42 | T1 - Opp. Mudd Is. | 5/6/12 0:33:32 | Downstream movement |
| 54-89 | 05/05/12 10:17:00 | Downstream of "C" Gate | Mid-Late | Passage | W. of Mt. Johnson Is., 200 yds W. of Lower tip of Island | 6/25/12 11:01:00 | W. of Mt. Johnson Is., 200 yds W. of Lower tip of Island | 6/18/12 11:20:00 | Stationary |
| 54-90 | 05/05/12 10:23:00 | Downstream of "C" Gate | Mid-Late | EFL without Passage | "A" Gate Aerial | 5/29/12 8:39:55 | Tailrace Unit 1 (Mid) | 5/29/12 7:37:30 | Lateral movement |
| 54-91 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 18:54:51 | T2 - Opp. Crab House | 5/17/12 18:00:13 | Downstream movement |
| 54-92 | 05/17/12 11:40:00 | Shures Landing Boat Launch | Mid-Late | non-tailrace | Spencer Island West | 5/17/12 14:06:57 | T2 - Opp. Crab House | 5/17/12 12:31:10 | Downstream movement |