SUMMARY OF UPSTREAM AND DOWNSTREAM FISH PASSAGE AT THE YORK HAVEN HYDROELECTRIC PROJECT IN 2015

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EXECUTIVE SUMMARY

The fish ladder was opened on 1 April allowing volitional (unmanned) passage for 40 days prior to initiating manned Fishway operation. In 2015, the Fishway was manned on a total of 26 days between 11 May and 5 June. After manned operation ended on 5 June, the fish ladder and North fixed wheel gate were set to deliver a minimum flow of 400 cfs into the East Channel. While permission was granted to close the facility on 16 December, the availability of crews and staging of material delayed the actual closure of the facility. Fishway closure began on 21 December but was not completed until 28 December due to issues with stop logs that required several visits.

During manned operation some 57,404 fish of 12 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (53,341) was the dominant fish species passed and comprised over 92.9% of the fish passed. Some 43 American shad were counted as they passed through the ladder. Other predominant fishes passed included channel catfish (1,155), quillback (990), carp (816), walleye (366) and smallmouth bass (312). Passage varied daily and ranged from 5,307 fish on 19 May when 9.2% of the season total was passed to 527 fish on 2 June.

A total of 43 American shad passed upstream through the ladder in 2015. American shad passed upstream between 11 May and 19 May. American shad were collected and passed at water temperatures of 74.8°F to 67.1°F, River flows of 14,775 cfs to 19,150 cfs and East Channel flows of 2,025 cfs to 2,150 cfs. The majority of shad (24 shad) passed between 1200 hrs and 1559 hrs; hourly passage varied from one to eight shad.

As in previous years YHPC agreed to make periodic observations for adult shad in the forebay and open the sluice gate if/when large numbers of adults were observed. While no adult shad were observed by Station Personnel that made periodic observations of the forebay area from 1 May through 15 June and the sluice gate was opened 15 times.

The station also planned to implement the juvenile Downstream Passage Protocol that was developed in concert with the FPTAC. Daily monitoring of the York Haven forebay for the presence of juvenile shad began on 21 September when water temperature was 74.0°F. Monitoring continued through 27 November. During this period River flows ranged from 4,140 cfs to 47,300 cfs and exceeded station hydraulic capacity (17,000 cfs) on three separate occasions. The detection of fish activity during this period was noted as being generally non-existent and/or extremely light by station personnel that monitored the forebay nightly for fish activity. Given fish activity was non-existent there was no need to implement "Downstream Operation".

1.0 INTRODUCTION

In 1993, York Haven Power Company (YHPC), the licensees of the Safe Harbor and Holtwood Projects, the U.S. Department of the Interior represented by the Fish and Wildlife Service ("USFWS"), the Susquehanna River Basin Commission ("SRBC"), the states of Maryland and Pennsylvania and their involved agencies – Maryland Department of Natural Resources ("MDNR"), Pennsylvania Fish and Boat Commission ("PFBC") and Pennsylvania Department of Environmental Resources ("PADEP"), and two other parties signed the Susquehanna River Fish Passage Settlement Agreement.

This agreement established for each project a Fish Passage Technical Advisory Committee ("FPTAC") comprised of representatives of the affected licensee, USFWS, PFBC and MDNR. Each FPTAC is responsible for reviewing and monitoring the design, construction, maintenance and operation of the fish passage facilities at the respective project, preparing an annual report, and recommending studies and/or modifications to improve upstream and downstream passage. As in previous years, objectives of 2015 operation were to monitor passage of migratory and resident fishes through the Fishway during the spring migration and continue to assess operation. Though the FPTAC did not schedule a specific meeting to discuss Fishway operation, committee members had the opportunity to discuss Fishway operation with station personnel during relicensing meetings.

2.0 YORK HAVEN FISHWAY OPERATIONS

The installation and operation of the Fishway are part of a cooperative private, state and federal effort to restore American shad (*Alosa sapidissima*) and other migratory fish to the Susquehanna River. In 1997, YHPC and the resource agencies reached a new settlement agreement to revise the type and location of the York Haven fish passage facility. The Fishway is located in Dauphin County, PA at the Three Mile Island end of the East Channel Dam at the York Haven Hydroelectric Project (FERC No. 1888). The Fishway was placed in service by YHPC in April 2000.

Fishway operation coincides with a springtime minimum flow release. As part of the 1997 agreement, YHP agreed to maintain a spill of up to 4,000 cfs over the Main Dam and a minimum release of approximately 2,000 cfs in the East Channel through the Fishway during spring operation. River flow in excess of spring minimum flow requirements and station capacity is spilled over the Main and East Channel Dams and through the Fishway. A nominal 2,000 cfs East Channel minimum flow is released through the fishway 24 hrs a day during the entire Fishway operating season. When River flows are less than 23,000 cfs, a nominal minimum spill of 4,000 cfs is maintained over the Main Dam during daily Fishway operation by reducing the number of Units in operation.

2.1 Project Operation

The hydroelectric station located in York Haven, PA built in 1904, is situated on the River (river mile 55) in Dauphin and York counties, Pennsylvania (Figure 1). It is the fourth upstream hydroelectric facility on the River. The Project is a 20 unit run-of-river facility capable of producing approximately 19 MW and has an estimated hydraulic capacity of 17,000 cfs. It includes two dams that impound approximately 5 miles of the River forming Lake Frederic. The Main Dam is approximately 5,000-ft long, with a maximum height of 17-ft. The East Channel Dam is approximately 925-ft long with a maximum height of 9-ft. When River flow exceeds station hydraulic capacity (55% of the year), water is spilled over the two dams.

2.2 Fishway Design and Operation

2.2.1 Fishway Design

Fishway design incorporated numerous criteria established by the USFWS and the other resource agencies. The Fishway has an operating limit of 150,000 cfs River flow (East Channel flow limit of approximately 22,000 cfs). The Fishway includes two sections; a "weir cut" and a vertical notch fish ladder. Figure 2 provides the general arrangement of the Fishway. A detailed description of the Fishway and its major components is located in 2000 and 2001 summary reports (Kleinschmidt 2000 & 2002).

2.2.2 Fishway Operation

Fishway preparations began in early March and volitional passage (unmanned) began on 1 April. Only the entrance and exit gate were open during a 40 day unmanned period of Fishway operation between 1 April and 10 May.

Manned Fishway operation, commenced on Monday 11 May, 4 days after the Safe Harbor Fish Lift had passed 1,146 American shad. In 2015, the Fishway was manned on a total of 26 days between 11 May and 5 June. Fish were counted and allowed to pass upstream between 0800 hrs and 1600 hrs. Given that no shad were observed passing the ladder since 19 May manned Fishway operation ended at 1600 hrs on 5 June, the same day that the Safe Harbor fish lift was shut down for the 2015 season.

Between 11 May and 5 June both fixed wheel gates and the diffuser gate were opened. These gates remained opened throughout the spawning migration. The entrance gate was the only gate that was adjusted throughout the season. This gate was adjusted manually maintaining a 0.4-ft to 0.9-ft differential between the surface water elevation downstream of the entrance and the water elevation in the diffuser area of the fish ladder. This range of settings resulted in an average velocity of 4 ft/sec to 8.0 ft/sec at the entrance to the ladder. The 7-ft wide stop gate, located between the weir and the fish ladder entrance, remained closed during the entire period of operation.

Excluding the first and last day of manned operation, the Fishway was typically staffed by one person. This person, a biologist or technician, adjusted the position of the entrance gate, counted and recorded the number of fish that passed through the ladder hourly, removed debris from the exit of the ladder, made visual observations of fish activity and movement in and through the ladder, and made observations once each day below the Main Dam. These individuals also recorded water elevations several times each day on staff gauges located throughout the Fishway.

After manned Fishway operation ended on 5 June, the South fixed wheel gate was closed and the North fixed wheel gate and ladder were set to deliver a minimum flow of 400 cfs into the East Channel. The Fishway was set to deliver a minimum stream flow of at least 400 cfs to the East Channel. While permission was granted to close the facility on 16 December, the availability of crews and staging of material delayed the actual closure of the facility. Fishway closure began on 21 December but was not completed until 28 December due to issues with stop logs that required several visits.

2.3 Fish Counts

Fish that passed through the ladder were identified to species and enumerated as they passed the counting window by a biologist and/or technician. A description of the procedures used to count fish is described in prior annual operating reports (Kleinschmidt 2000 and 2002). Fish passage by the viewing window was controlled by opening or closing an aluminum grating gate with an electric hoist that was controlled from inside the viewing room. The stop gate was opened each morning at 0800 hrs and closed nightly at 1600 hrs when the Fishway was

manned. Occasionally, it was closed for brief periods of time as needed each day to enable personnel manning the Fishway to remove debris from screens and the fishway exit other conduct other activities. In addition, in an effort to improve viewing, the adjustable crowder screen was adjusted as needed to allow all fish that passed to be observed. Gate settings on the days the Fishway was manned varied from 12 to 24 inches.

As in previous seasons, fish passage data was entered on a field data sheet and uploaded into a computer. Files were uploaded each evening, checked and corrected as necessary. Data reporting was PC-based and accomplished by program scripts, or macros, created within Microsoft Excel spreadsheets. Passage data and operational conditions were supplied electronically to YHPC's on-site coordinator/manager and other appropriate YHPC personnel on a daily basis. Passage information was subsequently provided electronically by YHPC personnel to members of the FPTAC.

2.4 Results

2.4.1 Spring Fishway Operation

2.4.1.1 Relative Abundance

The number of fish that passed through the York Haven fish ladder is presented in Table 1. Some 57,404 fish of 12 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (53,341) was the dominant fish species passed and comprised over 92.9% of the fish passed. Some 43 American shad were counted as they passed through the ladder. Other predominant fishes passed included channel catfish (1,155), quillback (990), carp (816), walleye (366) and smallmouth bass (312). Passage varied daily and ranged from 5,307 fish on 19 May when 9.2% of the season total was passed to 527 fish on 2 June.

2.4.1.2 American Shad Passage

A total of 43 American shad passed upstream through the ladder in 2015. American shad passed upstream between 11 and 19 May. American shad were collected and passed at water temperatures of 74.8°F to 67.1°F, River flows of 14,775 cfs to 19,150 cfs and East Channel flows of 2,025 cfs to 2150 cfs (Tables 2 and 3, Figures 3 and 4).

The hourly passage of American shad through the fish ladder is given in Table 4. The majority of shad (24 shad) passed between 1200 hrs and 1559 hrs; hourly passage varied from one to eight shad.

2.4.1.3 Other Alosids

No other alosids (alewife, blueback herring and hickory shad) were observed passing through the ladder (Table 1).

2.4.1.4 Observations

Observations were made at the "weir cut" several times each day in an attempt to see if American shad or other fishes passed upstream through this section of the Fishway. On several occasions carp, quillback and gizzard shad were observed trying to swim over the 67 ft. weir. However, no fish were observed trying to swim through the fixed wheel gates.

3.0 DOWNSTREAM FISH PASSAGE

As in previous years, YHPC anticipated making periodic observations for adult shad in the forebay and opening the trash gate if/when large numbers of adults were observed. They also planned to implement the juvenile Downstream Passage Protocol that was developed in concert with the FPTAC.

3.1 Adult Passage

No physical observations of post-spawned adult American shad were noted by Station personnel that made periodic observations of the forebay area between 1 May and 15 June 2015. During this period, the sluice gate was opened every two to three days for a total of 15 days.

3.2 Juvenile Passage

The Juvenile Downstream Passage Protocol provides for:

- Monitoring the forebay to determine when outmigrating juveniles arrive at the project
- Starting "Downstream Operation" when juveniles arrive at York Haven; Downstream Operation begins each evening at sunset and continue until about 11:30 p.m. Downstream Operation includes:
  - Turning on temporary lighting at the trash sluiceway and opening the sluiceway
  - Operating only Units 1-6 when river flow is insufficient for operation of any of the remaining units
  - Operating Units 7-20 only when river flow exceeds the hydraulic capacity of available Units 1-6; the operating priority for Units 7-20 is Unit 7, Unit 8, Unit 9 etc.
- Monitoring and sampling in the forebay as river water temperatures drop and/or River flows increase to determine when the juvenile shad emigration has ended for the season
- Ceasing "Downstream Operation" at the end of the run, in consultation with members of the FPTAC.

In accordance with the protocol, monitoring of the York Haven forebay for the presence of juvenile American shad began on 21 September when water temperature was 74.0°F and River flow at Harrisburg was 4,620 cfs (Figure 5). River flow remained relatively stable between 21 and 30 September prior to increasing to 26,300 cfs on 4 October. River flow declined steadily to 5,870 cfs on 26 October before it increased to 32,300 cfs on 31 October. Flows declined again (10,400 cfs on 10 November, before it increased to a season high of 47,300 cfs on 14 November. Average daily water temperature during the fall observation period (21 September to 27 November) dropped a total of 31 degrees and ranged from a high of 74.0°F to a low of 43.0°F.

The detection of fish activity during this period was noted as being generally non-existent and/or extremely light by station personnel that typically monitored the forebay twice daily. Observations were typically made daily by station personnel between 0700 hrs and 0800 hrs and within one hour of dusk. In addition, cast netting was conducted and observations in the

forebay were made at dusk by a Kleinschmidt biologist on 5 October and 11 November that supported and verified observations made by station personnel.

Given that fish activity was non-existent there was no need to implement "Downstream Operation". As a means of ensuring the downstream migration wasn't occurring without being noticed routine contact was maintained with the PFBC contractor conducting juvenile shad haul seine sampling in the lower River. According to personnel conducting this sampling program juvenile shad abundance was low in 2015. No juveniles were collected at Columbia while haul seining in 2015.

4.0 LITERATURE CITED

Kleinschmidt. 2000. Summary of operation at the York Haven Fishway in 2000. Prepared for York Haven Power Company, GPU Energy by Kleinschmidt, Strasburg, Pennsylvania. 21 pp.

Kleinschmidt. 2002. Summary of operation at the York Haven Fishway in 2001. Prepared for York Haven Power Company, GPU Energy/FirstEnergy by Kleinschmidt, Strasburg, Pennsylvania. 21 pp.

TABLES

Table 1. Summary of the daily number of fish that passed by the York Haven Hydroelectric Project through the serpentine vertical notch ladder at the East Channel Dam in 2015.

Date	11-May	12-May	13-May	14-May	15-May	16-May	17-May	18-May	19-May	20-May
Observation Time (hrs.)	8.0	8.0	9.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (^{o}F)	74.8	75.8	69.4	67.1	67.8	68.2	70.0	73.6	74.1	69.0
AMERICAN SHAD	1	4	1	9	10	8	4	3	3	0
ALEWIFE	0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	2,208	4,484	4,013	3,022	2,903	4,327	3,852	4,114	5,142	2,030
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	0	0	0	0	0	0	0	0	0
WHITE PERCH	0	0	0	0	0	0	0	0	0	0
AMERICAN EEL	0	0	0	0	0	0	0	0	0	0
RAINBOW TROUT	0	0	0	0	0	0	0	1	0	0
BROWN TROUT	0	1	0	0	1	0	0	0	0	0
CARP	11	115	42	16	13	55	39	44	34	17
QUILLBACK	35	119	96	61	41	76	65	78	31	11
WHITE SUCKER	0	0	0	0	1	0	0	1	0	0
SHORTHEAD REDHORSE	4	28	25	41	59	41	30	28	1	1
CHANNEL CATFISH	19	133	89	48	36	35	87	78	70	16
SMALLMOUTH BASS	14	39	16	15	23	15	32	30	8	0
WALLEYE	8	39	26	14	22	31	43	37	13	0
FLATHEAD CATFISH	0	1	0	0	0	0	0	0	5	22
Total	**2,300**	**4,963**	**4,308**	**3,226**	**3,109**	**4,588**	**4,152**	**4,414**	**5,307**	**2,097**

Table 1. ***(continued)***

Date	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (^{o}F)	66.9	65.1	64.2	67.2	71.7	74.5	75.7	76.4	76.7	77.9
AMERICAN SHAD	0	0	0	0	0	0	0	0	0	0
ALEWIFE	0	0	0	0	0	0	0	0	0	0
BLUEBACK HERRING	0	0	0	0	0	0	0	0	0	0
GIZZARD SHAD	3,259	1,556	778	1,288	3,265	1,304	712	673	633	722
HICKORY SHAD	0	0	0	0	0	0	0	0	0	0
STRIPED BASS	0	0	0	0	0	0	0	0	0	0
WHITE PERCH	0	0	0	0	0	0	0	0	0	0
AMERICAN EEL	0	0	0	0	0	0	0	0	0	0
RAINBOW TROUT	0	0	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	0	0	0	1	0	0	0	0
CARP	20	19	19	20	27	45	28	36	41	38
QUILLBACK	38	26	5	30	43	55	20	12	36	31
WHITE SUCKER	0	0	0	0	0	0	0	0	0	0
SHORTHEAD REDHORSE	8	10	0	0	2	2	3	3	4	3
CHANNEL CATFISH	31	37	12	19	28	41	32	55	26	53
SMALLMOUTH BASS	5	16	0	0	12	18	9	7	10	22
WALLEYE	9	14	2	3	8	27	8	5	6	8
FLATHEAD CATFISH	4	0	3	7	8	0	4	1	0	0
Total	**3,374**	**1,678**	**819**	**1,367**	**3,393**	**1,493**	**816**	**792**	**756**	**877**

Table 1. ***(continued)***

Date	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	Total
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8	8.0	**169.0**
Water Temperature (^{o}F)	79.5	77.4	70.7	64.9	65.8	67.6	
AMERICAN SHAD	0	0	0	0	0	0	**43**
ALEWIFE	0	0	0	0	0	0	**0**
BLUEBACK HERRING	0	0	0	0	0	0	**0**
GIZZARD SHAD	535	609	470	471	465	506	**53,341**
HICKORY SHAD	0	0	0	0	0	0	**0**
STRIPED BASS	0	0	0	0	0	0	**0**
WHITE PERCH	0	0	0	0	0	0	**0**
AMERICAN EEL	0	0	0	0	0	0	**0**
RAINBOW TROUT	0	0	0	0	0	0	**1**
BROWN TROUT	0	0	0	0	0	0	**3**
CARP	43	20	13	20	23	18	**816**
QUILLBACK	9	18	10	19	8	17	**990**
WHITE SUCKER	0	0	0	0	0	0	**2**
SHORTHEAD REDHORSE	6	2	1	0	1	1	**304**
CHANNEL CATFISH	47	38	20	28	33	44	**1,155**
SMALLMOUTH BASS	10	7	2	0	0	2	**312**
WALLEYE	9	14	4	2	6	8	**366**
FLATHEAD CATFISH	0	2	7	6	1	0	**71**
Total	**659**	**710**	**527**	**546**	**537**	**596**	**57,404**

Table 2. Summary of daily average river flow (USGS, Harrisburg Gage), average flow in the East channel, sum of average flow from power station and main dam, water temperature, secchi, stop log gate position, and East channel and fishway water elevations during operation of the York Haven fishway complex in 2015.

Date	River Flow (cfs)	East Channel Flow (cfs)	Main Channel Flow (cfs)	Water Temp. (^{o}F)	Secchi (in)			Stop Log Gate	Elevation (ft)					
									Head Pond			Tailwater		
					Avg.	Min.	Max.		Avg.	Min.	Max.	Avg.	Min.	Max.
11-May	20,000	2,050	17,950	74.8	16	12	18	Closed	278.6	278.5	278.7	273.5	273.3	273.6
12-May	18,700	2,050	16,650	75.8	18	18	18	Closed	278.6	278.5	278.6	273.6	273.6	273.7
13-May	17,500	2,050	15,450	69.4	10	10	10	Closed	278.6	278.5	278.7	273.8	273.5	273.7
14-May	16,800	2,025	14,775	67.1	20	20	20	Closed	278.5	278.5	278.5	273.5	273.5	273.6
15-May	16,800	2,025	14,775	67.8	18	18	18	Closed	278.5	278.5	278.5	273.5	273.4	273.5
16-May	18,100	2,025	16,075	68.2	20	20	20	Closed	278.5	278.4	278.5	273.5	273.5	273.5
17-May	17,900	2,050	15,850	70.0	24	24	24	Closed	278.6	278.5	278.6	273.4	273.4	273.5
18-May	17,500	2,025	15,475	73.6	22	22	22	Closed	278.5	278.4	278.5	273.4	273.4	273.4
19-May	21,300	2,150	19,150	74.1	17	14	20	Closed	278.9	278.8	278.9	273.6	273.5	273.6
20-May	21,600	2,100	19,500	69.0	12	12	12	Closed	278.8	278.8	278.8	273.6	273.6	273.6
21-May	21,300	2,050	19,250	66.9	20	20	20	Closed	278.6	278.5	278.6	273.4	273.4	273.4
22-May	26,500	2,200	24,300	65.1	20	20	20	Closed	279.0	278.9	279.0	273.7	273.7	273.7
23-May	24,200	2,200	22,000	64.2	20	20	20	Closed	279.0	279.0	279.0	273.7	273.7	273.7
24-May	20,400	2,075	18,325	67.2	20	20	20	Closed	278.7	278.7	278.7	273.5	273.5	273.5
25-May	18,100	2,025	16,075	71.7	22	22	22	Closed	278.5	278.5	278.5	273.5	273.5	273.5
26-May	16,200	2,025	14,175	74.5	22	22	22	Closed	278.5	278.4	278.5	273.5	273.5	273.5
27-May	15,100	2,000	13,100	75.7	24	24	24	Closed	278.4	278.4	278.4	273.5	273.4	273.5
28-May	13,900	2,000	11,900	76.4	24	24	24	Closed	278.4	278.4	278.5	273.4	273.4	273.4
29-May	13,200	2,025	11,175	76.7	24	24	24	Closed	278.5	278.5	278.5	273.4	273.4	273.4
30-May	12,300	2,000	10,300	77.9	24	24	24	Closed	278.4	278.4	278.4	273.4	273.4	273.4
31-May	11,800	2,000	9,800	79.5	24	24	24	Closed	278.4	278.4	278.4	273.4	273.4	273.4
1-Jun	11,900	2,000	9,900	77.4	24	24	24	Closed	278.4	278.4	278.4	273.4	273.4	273.4
2-Jun	14,100	2,000	12,100	70.7	18	18	18	Closed	278.4	278.4	278.4	273.4	273.4	273.4
3-Jun	20,000	2,050	17,950	64.9	18	18	18	Closed	278.6	278.5	278.7	273.5	273.5	273.5
4-Jun	21,000	2,200	18,800	65.8	24	24	24	Closed	279.0	279.0	279.0	273.5	273.5	273.5
5-Jun	18,100	2,050	16,050	67.6	24	24	24	Closed	278.6	278.6	278.6	273.4	273.4	273.4

Table 3. Summary of surface water elevations recorded during operation of the York Haven Fishway in 2015.

		Elevation (ft)																				
	River Flow	Head Pond			Tailwater			Inside Fishway			Inside Weir			Above Counting Room			Below Fixed Wheel Gate			Counting Room		
Date	(cfs)	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
11-May	20,000	278.6	278.5	278.7	273.5	273.3	273.6	274.2	274.0	274.3	276.7	276.6	276.8	278.2	278.1	278.3	276.6	276.6	276.7	278.1	278.0	278.2
12-May	18,700	278.6	278.5	278.6	273.6	273.6	273.7	274.2	274.2	274.3	276.7	276.7	276.7	278.2	278.1	278.3	276.6	276.5	276.6	278.0	278.0	278.2
13-May	17,500	278.6	278.5	278.7	273.8	273.5	273.7	274.1	274.1	274.1	276.3	276.1	276.7	278.1	278.1	278.1	276.5	276.4	276.5	278.0	277.9	278.0
14-May	16,800	278.5	278.5	278.5	273.5	273.5	273.6	274.2	274.0	274.3	276.7	276.7	276.7	278.1	278.1	278.2	276.6	276.5	276.7	278.0	277.9	278.0
15-May	16,800	278.5	278.5	278.5	273.5	273.4	273.5	274.2	274.1	274.3	276.6	276.6	277.7	278.1	278.1	278.1	276.5	276.5	276.5	278.0	277.9	278.1
16-May	18,100	278.5	278.4	278.5	273.5	273.5	273.5	274.3	274.3	274.3	276.7	276.7	276.7	278.1	278.1	278.2	276.5	276.5	276.5	278.0	277.9	278.0
17-May	17,900	278.6	278.5	278.6	273.4	273.4	273.5	274.2	274.1	274.3	276.7	276.6	276.7	278.0	277.9	278.1	276.5	276.5	276.6	277.8	277.8	278.0
18-May	17,500	278.5	278.4	278.5	273.4	273.4	273.4	274.2	274.2	274.2	276.7	276.7	276.7	278.1	278.1	278.1	276.7	276.6	276.7	278.0	277.7	278.0
19-May	21,300	278.9	278.8	278.9	273.6	273.5	273.6	274.4	274.3	274.5	276.8	276.8	276.8	278.3	278.2	278.4	276.9	276.8	276.9	278.3	278.2	278.3
20-May	21,600	278.8	278.8	278.8	273.6	273.6	273.6	274.3	274.3	274.4	276.9	276.9	276.9	278.5	278.4	278.6	276.7	276.7	276.7	278.5	278.3	278.5
21-May	21,300	278.6	278.5	278.6	273.4	273.4	273.4	274.2	274.2	274.2	276.8	276.7	276.8	278.3	278.3	278.3	276.7	276.7	276.7	278.2	278.2	278.2
22-May	26,500	279.0	278.9	279.0	273.7	273.7	273.7	274.5	274.5	274.5	277.2	277.2	277.2	278.6	278.6	278.6	277.0	277.0	277.0	278.5	278.5	278.5
23-May	24,200	279.0	279.0	279.0	273.7	273.7	273.7	274.5	274.5	274.5	277.2	277.2	277.2	278.6	278.6	278.6	277.0	277.0	277.0	278.5	278.5	278.5
24-May	20,400	278.7	278.7	278.7	273.5	273.5	273.5	274.3	274.3	274.3	276.9	276.9	276.9	278.3	278.3	278.4	276.8	276.8	276.8	278.2	278.2	278.3
25-May	18,100	278.5	278.5	278.5	273.5	273.5	273.5	274.3	274.3	274.3	276.8	276.8	276.9	278.2	278.2	278.2	276.8	276.7	276.8	278.1	278.1	278.1
26-May	16,200	278.5	278.4	278.5	273.5	273.5	273.5	274.3	274.3	274.3	276.8	276.8	276.8	278.1	278.0	278.1	276.8	276.7	276.8	278.0	277.9	278.0
27-May	15,100	278.4	278.4	278.4	273.5	273.4	273.5	274.2	274.1	274.3	276.8	276.8	276.9	278.0	278.0	278.1	276.6	276.6	277.7	277.9	277.8	278.0
28-May	13,900	278.4	278.4	278.5	273.4	273.4	273.4	274.2	274.2	274.2	276.9	276.9	276.9	278.1	278.1	278.1	276.7	276.7	276.7	278.0	277.9	278.0
29-May	13,200	278.5	278.5	278.5	273.4	273.4	273.4	274.2	274.2	274.2	276.9	276.9	276.9	278.0	278.0	278.0	276.6	276.6	276.6	277.9	277.9	277.9
30-May	12,300	278.4	278.4	278.4	273.4	273.4	273.4	274.1	274.1	274.1	276.8	276.8	276.8	277.9	277.9	277.9	278.7	278.7	278.7	277.8	277.8	277.8
31-May	11,800	278.4	278.4	278.4	273.4	273.4	273.4	274.1	274.1	274.1	276.8	276.8	276.8	277.9	277.9	277.9	276.7	276.7	276.7	278.0	278.0	278.0
1-Jun	11,900	278.4	278.4	278.4	273.4	273.4	273.4	274.2	274.2	274.2	276.8	276.8	276.8	278.0	278.0	278.0	276.8	276.8	276.8	278.0	277.9	278.1
2-Jun	14,100	278.4	278.4	278.4	273.4	273.4	273.4	274.2	274.2	274.2	276.9	276.9	276.9	278.2	278.2	278.2	276.8	276.8	276.8	278.1	278.1	278.1
3-Jun	20,000	278.6	278.5	278.7	273.5	273.5	273.5	274.2	274.2	274.3	277.0	277.0	277.1	278.4	278.3	278.5	276.8	276.8	276.9	278.3	278.2	278.4
4-Jun	21,000	279.0	279.0	279.0	273.5	273.5	273.5	274.3	274.3	274.3	277.2	277.1	277.2	278.6	278.6	278.6	277.0	277.0	277.0	278.5	278.5	278.5
5-Jun	18,100	278.6	278.6	278.6	273.4	273.4	273.4	274.2	274.2	274.2	276.9	276.9	276.9	278.2	278.2	278.3	276.8	276.8	276.8	278.1	278.1	278.2

Table 4. Hourly summary of American shad passage through the serpentine vertical notch fish ladder at the York Haven Hydroelectric Project in 2015.

Date	11-May	12-May	13-May	14-May	15-May	16-May	17-May	18-May	19-May
Observation Time (Start)	0800	0800	0800	0800	0800	0800	0800	0800	0800
Observation Time (End)	1600	1700	1600	1600	1600	1600	1600	1600	1600
Military Time (Hours)									
0800 - 0859	0	0	0	0	1	0	0	0	0
0900 - 0959	0	0	0	0	1	1	2	0	0
1000 - 1059	0	2	0	0	0	3	0	0	3
1100 - 1159	0	1	1	1	0	2	1	0	0
1200 - 1259	1	0	0	0	3	0	0	0	0
1300 - 1359	0	0	0	6	2	0	0	0	0
1400 - 1459	0	0	0	2	2	0	0	0	0
1500 - 1559	0	1	0	0	1	2	1	3	0
1600 - 1700	-		-	-	-	-	-	-	-
Total Catch	**1**	**4**	**1**	**9**	**10**	**8**	**4**	**3**	**3**

Date	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May
Observation Time (Start)	0800	0800	0800	0800	0800	0800	0800	0800	0800
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	1600	1600
Military Time (Hours)									
0800 - 0859	0	0	0	0	0	0	0	0	0
0900 - 0959	0	0	0	0	0	0	0	0	0
1000 - 1059	0	0	0	0	0	0	0	0	0
1100 - 1159	0	0	0	0	0	0	0	0	0
1200 - 1259	0	0	0	0	0	0	0	0	0
1300 - 1359	0	0	0	0	0	0	0	0	0
1400 - 1459	0	0	0	0	0	0	0	0	0
1500 - 1559	0	0	0	0	0	0	0	0	0
Total Catch	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 4. ***(continued)***

Date	29-May	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun
Observation Time (Start)	0800	0800	0800	0800	0800	0800	0800	0800
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	1600
Military Time (Hours)								
0800 - 0859	0	0	0	0	0	0	0	0
0900 - 0959	0	0	0	0	0	0	0	0
1000 - 1059	0	0	0	0	0	0	0	0
1100 - 1159	0	0	0	0	0	0	0	0
1200 - 1259	0	0	0	0	0	0	0	0
1300 - 1359	0	0	0	0	0	0	0	0
1400 - 1459	0	0	0	0	0	0	0	0
1500 - 1559	0	0	0	0	0	0	0	0
Total Catch	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Date Observation Time (Start) Observation Time (End)	Total	%
Military Time (Hours)		
0800 - 0859	1	2.3
0900 - 0959	4	9.3
1000 - 1059	8	18.6
1100 - 1159	6	14.0
1200 - 1259	4	9.3
1300 - 1359	8	18.6
1400 - 1459	4	9.3
1500 - 1559	8	18.6
Total Catch	**43**	**100.0**

FIGURES

Figure 1. General Layout of the York Haven Hydroelectric Project Showing the Location of the Fishway.

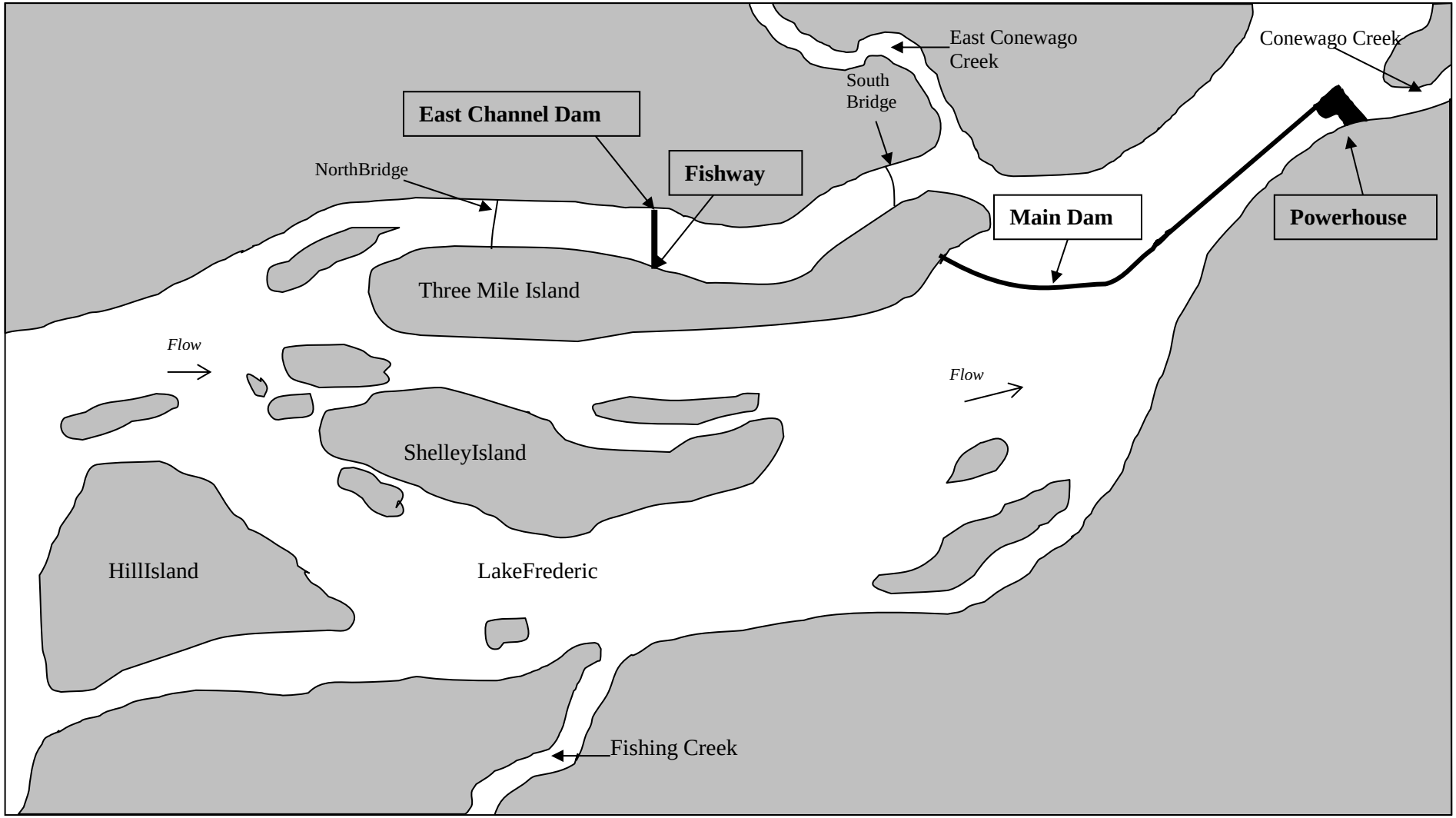

Figure 2. General Arrangement - York Haven Fishway.

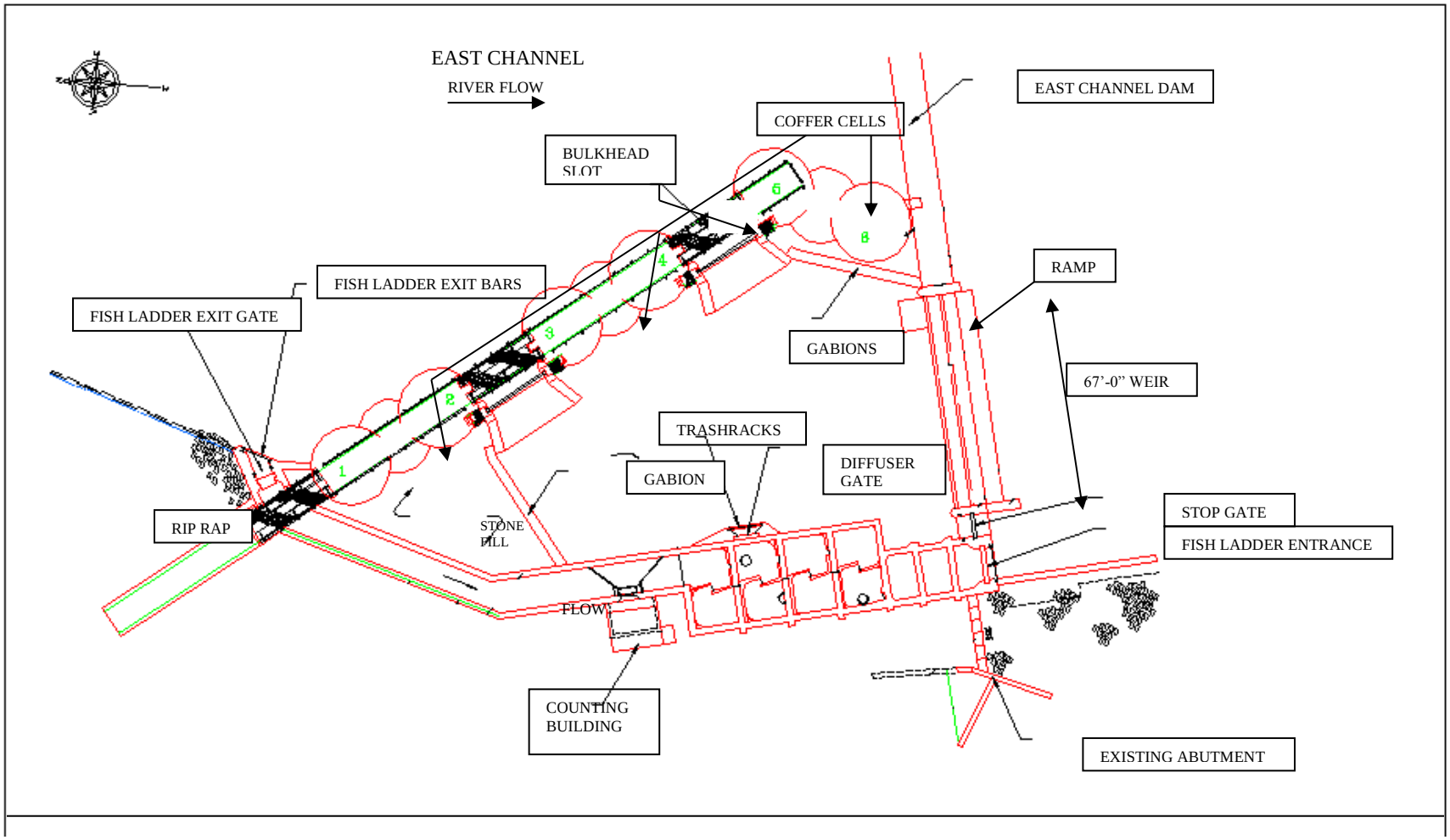

Figure 3. Plot of River Flow (x 1000 cfs) & Water Temperature (F) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2015.

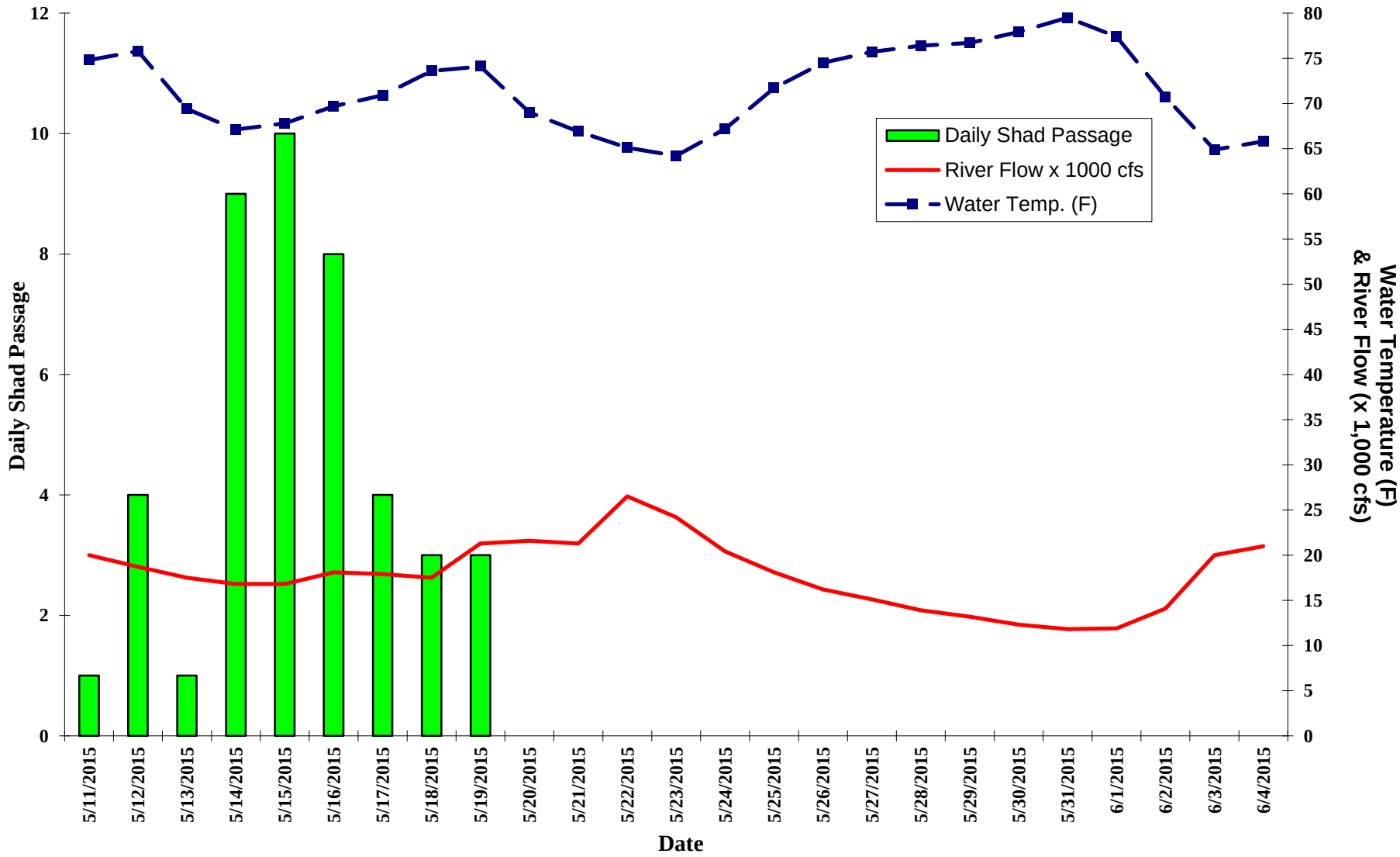

Figure 4. Plot of River Flow (x 1000 cfs) & East Channel Flow (x 1000 cfs) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2015.

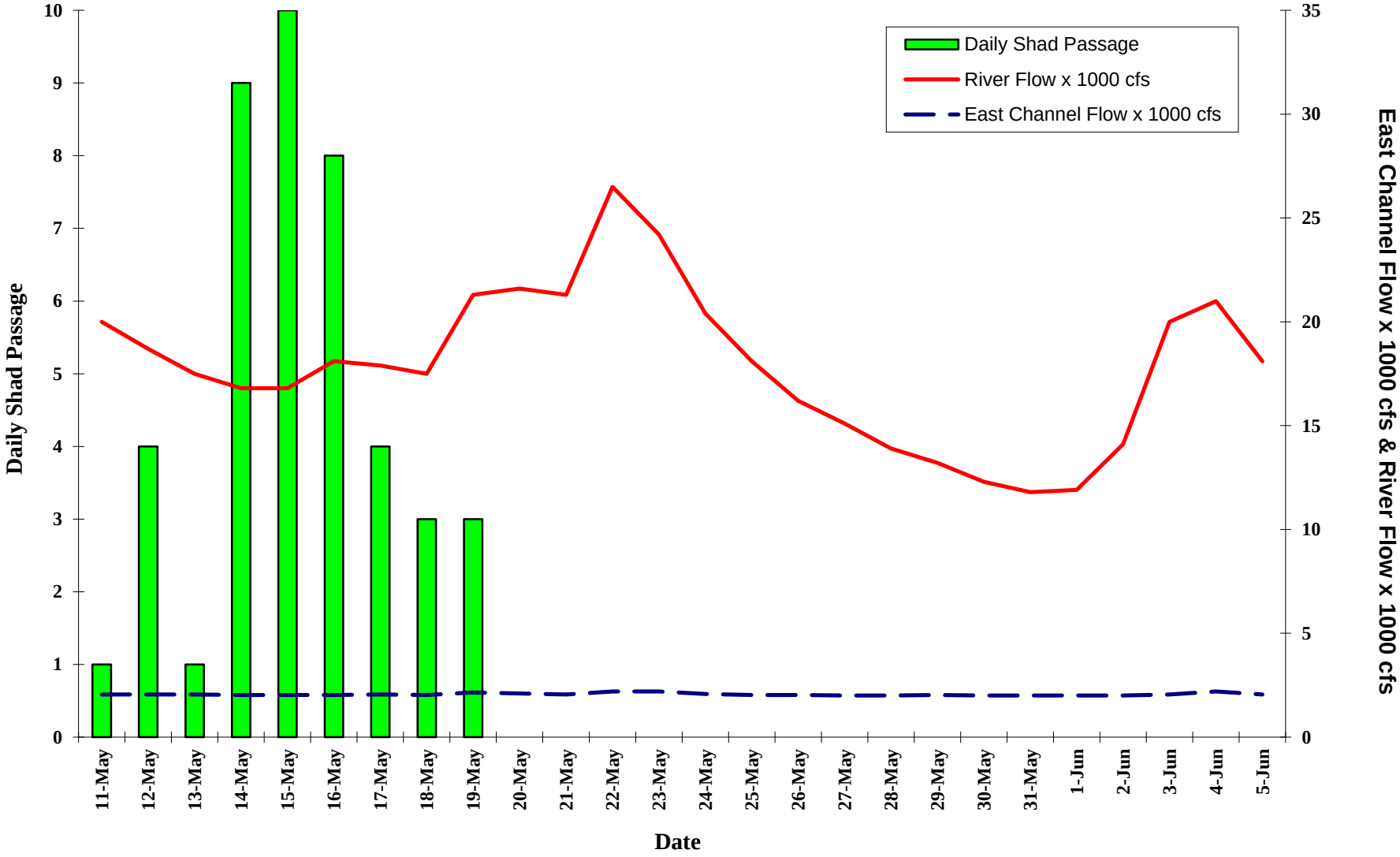

Figure 5. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River and Average Daily Water Temperature at the York Haven Power Station, 10 September to 16 November, 2015.