SUMMARY OF UPSTREAM AND DOWNSTREAM FISH PASSAGE AT THE YORK HAVEN HYDROELECTRIC PROJECT IN 2014

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EXECUTIVE SUMMARY

The fish ladder was opened on 1 April allowing volitional (unmanned) passage for 49 days prior to initiating manned Fishway operation. In 2014, the Fishway was manned on a total of 25 days between 20 May and 13 June. After manned operation ended on 13 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 17 November, the availability of crews and staging of material prevented actual closure of the facility until 8 December and was set to deliver a minimum stream flow of at least 400 cfs to the East Channel.

During manned operation some 63,346 fish of 14 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (59,756) was the dominant fish species passed and comprised almost 94.3% of the fish passed. Eight American shad were counted as they passed through the ladder. Other predominant fishes passed included channel catfish (1,367), carp (773), quillback (703), smallmouth bass (246), and shorthead redhorse (450). Passage varied daily and ranged from 60 fish on 14 May to 5,725 fish 25 May when 9% of the season total was passed.

A total of 8 American shad passed upstream through the ladder in 2014; all shad passed through the latter before 1300 hrs. Six American shad passed upstream between 21 May and 25 May, two shad were observed passing the Fishway in June. Between 21 May and 5 June American shad were collected and passed at water temperatures of 59.1°F to 71.9°F and falling River flows that ranged from 98,200 cfs to 22,600 cfs and East Channel flows of 16,100 to 2,150 cfs.

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. No adult shad were observed by Station Personnel that made periodic observations of the forebay area from May through June.

In 2014, the station implemented 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 15 September when water temperature was 70.0°F. Monitoring continued through 13 November. River flows were relatively stable from 15 September to 15 October and varied from 7,620 cfs 5,590 cfs. Cast netting was conducted and observations were made in the forebay at dusk by a Kleinschmidt biologist on 9, 14, 18 and 19 October.

Based on the collection of YOY juvenile American shad at City Island in a 100 ft haul seine and increased fish activity in the forebay the Station implemented Downstream Operation on the evening of 20 October. Downstream Operation ended on 29 October based on little or no fish activity in the forebay and no fish collected cast netting on 27, 28 and 29 October. On 29 October, River water temperature was 53°F and River flow was 11,300 cfs.

Although the trash sluice was closed on 29 October, station personnel continued making observations nightly in the forebay through 13 November. As no juveniles were observed and water temperatures had fallen to 41.5°F it was determined that the juveniles had passed on the high flow event during mid-October and there was no need to continue making nightly observations in the forebay. Average daily water temperature during the observation period (15 September to 13 November) dropped over 34 degrees and ranged from a high of 76.0°F to a low of 41.5°F.

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.

Due to recent changes in the personnel involved with the York Haven FPTAC a site visit was held at the Fishway during the afternoon on 7 May. Although the FPTAC did not schedule a specific meeting to discuss Fishway operation, committee members had the opportunity to discuss Fishway operation with Station and Kleinschmidt personnel during the site visit. As in previous years, objectives of 2014 operation were to monitor passage of migratory and resident fishes through the Fishway and continue to assess operation.

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 2,100 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 49 day unmanned period of Fishway operation between 1 April and 19 May.

Manned Fishway operation, commenced on Tuesday 20 May, 5 days after the Safe Harbor Fish Lift had passed 1,137 American shad. Manned operation was delayed one day by high river flows that exceeded the operational threshold (150,000 cfs) of the Fishway. In 2014, the Fishway was manned on a total of 25 days between 20 May and 13 June. Fish were counted and allowed to pass upstream between 0800 hrs and 1600 hrs. Given that just two shad were observed passing the ladder in June manned Fishway operation ended at 1600 hrs on 13 June, two days after the Safe Harbor fish lift was shut down for the 2014 season.

Between 20 May and 13 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 1.5-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 10 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 13 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 remained open until December and 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 17 November, the availability of crews and staging of material prevented actual closure of the facility until 8 December.

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 in. to 24 in.

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 63,346 fish of 14 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (59,756) was the dominant fish species passed and comprised over 94.3% of the fish passed. Some 8 American shad were counted as they passed through the ladder. Other predominant fishes passed included channel catfish (1,367), carp (773), quillback (703), smallmouth bass (246), and shorthead redhorse (450). Passage varied daily and ranged from 60 fish on 20 May to 5,725 fish on 25 May when 9.0% of the season total was passed.

2.4.1.2 American Shad Passage

A total of 8 American shad passed upstream through the ladder in 2014. American shad passed upstream between 21 May and 5 June. Six shad passed in May and 2 passed in June.

American shad were collected and passed at water temperatures of 59.1°F to 71.9°F, River flows of 22,600 cfs to 98,200 cfs and East Channel flows of 2,150 cfs to 16,100 cfs (Tables 2 and 3, Figures 3 and 4).

The hourly passage of American shad through the fish ladder is given in Table 4. All of the shad passed between 0800 hrs and 1259 hrs; hourly passage varied from no shad to 2 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 21 May and 13 June 2014. During this period, the sluice gate was opened on 9 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 15 September when water temperature was 70.0°F and River flow at Harrisburg was 7,610 cfs (Figure 5). River flows were relatively stable from 15 September to 15 October and varied from 7,620 cfs 5,590 cfs.

Rain, throughout most of the basin resulted in increased River flows between 17 and 22 October. During this six day period River flows exceed station capacity, flows varied from a high of 29,300 cfs to 18,800 cfs on 20 and 22 October, respectively. Cast netting was conducted and observations were made in the forebay at dusk by a Kleinschmidt biologist on 9, 14, 18 and 19 October. Based on the collection of YOY juvenile American shad at City Island with a 100 ft haul seine and increased fish activity in the forebay the Station implemented Downstream Operation on the evening of 20 October and continued it daily through 29 October (9 days), in accordance with the protocol. Downstream Operation ended on 29 October based on little or no fish activity in the forebay and because no fish were collected cast netting on 27, 28 and 29 October. On 29 October, River water temperature was 53°F and River flow was 11,300 cfs.

Although the trash sluice was closed on 29 October, station personnel continued making observations nightly in the forebay through 13 November. As no juveniles were observed and water temperatures had fallen to 41.5°F it was determined that the juveniles had passed on the high flow event during mid-October and there was no need to continue making nightly observations in the forebay. Average daily water temperature during the observation period (15 September to 13 November) dropped over 34 degrees and ranged from a high of 76.0°F to a low of 41.5°F.

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 2014.

Date	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-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)	59.1	59.1	59.8	62.3	61.8	66.1	66.2	69.3	69.1	64.9
AMERICAN SHAD		1	4			1				
ALEWIFE										
BLUEBACK HERRING										
GIZZARD SHAD	23	399	1,471	1,938	1,416	5,544	5,260	3,146	3,431	2,673
HICKORY SHAD										
STRIPED BASS										
WHITE PERCH										
AMERICAN EEL										
RAINBOW TROUT										
BROWN TROUT										
BROOK TROUT										
MUSKELLUNGE										
CARP		2	5	33	16	46	21	31	66	12
QUILLBACK			4	9		21	29	42	46	22
WHITE SUCKER										
SHORTHEAD REDHORSE			1			6	14	18	46	16
WHITE CATFISH										
YELLOW BULLHEAD										
BROWN BULLHEAD										
CHANNEL CATFISH	28	54	78	41	68	97	105	54	82	55
ROCK BASS										
REDBREAST SUNFISH								1		
GREEN SUNFISH										
PUMPKINSEED										
BLUEGILL										
SMALLMOUTH BASS						3	6	10	13	
LARGEMOUTH BASS										
YELLOW PERCH										
WALLEYE		4								4
NORTHERN HOG SUCKER										
FALLFISH										
FLATHEAD CATFISH	9	3	1	20	19	6		27	7	12
STRIPED BASS HYBRID						1			1	
TIGER MUSKIE										
Total	**60**	**463**	**1,564**	**2,041**	**1,519**	**5,725**	**5,435**	**3,329**	**3,692**	**2,794**

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

Date	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun
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)	64.5	69.4	70.8	68.5	72.5	74.1	71.9	75.2	73.2	74.1
AMERICAN SHAD			1				1			
ALEWIFE										
BLUEBACK HERRING										
GIZZARD SHAD	2,825	3,269	2,211	3,347	3,582	1,596	2,438	2,293	2,335	2,280
HICKORY SHAD										
STRIPED BASS										
WHITE PERCH										
AMERICAN EEL										
RAINBOW TROUT										
BROWN TROUT										
BROOK TROUT										
MUSKELLUNGE			1	1						
CARP	42	37	12	44	49	42	39	32	57	49
QUILLBACK	46	18	48	39	61	16	36	49	57	49
WHITE SUCKER										
SHORTHEAD REDHORSE	16	2	14	9	5		13	17	9	
WHITE CATFISH										
YELLOW BULLHEAD										
BROWN BULLHEAD										
CHANNEL CATFISH	48	62	27	44	70	10	51	45	64	60
ROCK BASS										2
REDBREAST SUNFISH										
GREEN SUNFISH										
PUMPKINSEED										
BLUEGILL										
SMALLMOUTH BASS	4	2	21	32	26	6	20	13	15	21
LARGEMOUTH BASS										
YELLOW PERCH										
WALLEYE	1	2	2	12	17	4	4	10	4	8
NORTHERN HOG SUCKER										
FALLFISH										
FLATHEAD CATFISH		5	20	1		3	6		4	11
STRIPED BASS HYBRID										
TIGER MUSKIE										
Total	**2,982**	**3,397**	**2,357**	**3,529**	**3,810**	**1,677**	**2,608**	**2,459**	**2,545**	**2,480**

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

Date	9-Jun	10-Jun	11-Jun	12-Jun	13-Jun	Total
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8	**169.0**
Water Temperature (^{o}F)	72.6	73.3	70.1	68.9	70.0	
AMERICAN SHAD						**8**
ALEWIFE						**0**
BLUEBACK HERRING						**0**
GIZZARD SHAD	1,960	2,024	1,960	1,218	1,117	**59,756**
HICKORY SHAD						**0**
STRIPED BASS						**0**
WHITE PERCH						**0**
AMERICAN EEL						**0**
RAINBOW TROUT						**0**
BROWN TROUT						**0**
BROOK TROUT						**0**
MUSKELLUNGE						**2**
CARP	35	35	36	15	17	**773**
QUILLBACK	44	31	27	1	8	**703**
WHITE SUCKER						**0**
SHORTHEAD REDHORSE		4	4			**194**
WHITE CATFISH						**0**
YELLOW BULLHEAD						**0**
BROWN BULLHEAD	1					**1**
CHANNEL CATFISH	50	37	51	35	51	**1,367**
ROCK BASS	2					**4**
REDBREAST SUNFISH						**1**
GREEN SUNFISH						**0**
PUMPKINSEED						**0**
BLUEGILL						**0**
SMALLMOUTH BASS	26	14	9	5		**246**
LARGEMOUTH BASS						**0**
YELLOW PERCH						**0**
WALLEYE	19	9	7	1		**108**
NORTHERN HOG SUCKER						**0**
FALLFISH						**0**
FLATHEAD CATFISH		4	6	7	10	**181**
STRIPED BASS HYBRID						**2**
TIGER MUSKIE						**0**
Total	**2,137**	**2,158**	**2,100**	**1,282**	**1,203**	**63,346**

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 2014.

Date	River Flow (cfs)	East Channel Flow (cfs)	Main Channel Flow (cfs)	Water Temp. (°F)	Secchi (in)			Stop Log Gate	Elevation (ft)					
									Head Pond			Tailwater		
					Avg.	Min.	Max.		Avg.	Min.	Max.	Avg.	Min.	Max.
20-May	122,000	18,500	103,500	59.1	4	4	4	Closed	282.0	282.0	282.1	279.1	279.1	279.2
21-May	98,200	16,100	82,100	59.1	3	3	3	Closed	281.6	281.5	281.6	278.1	278.0	278.1
22-May	86,100	13,100	73,000	59.8	4	4	4	Closed	281.2	281.2	281.3	277.3	277.2	277.3
23-May	103,000	17,500	85,500	62.3	4	4	4	Closed	281.7	281.6	281.8	278.1	277.9	278.3
24-May	91,500	15,500	76,000	61.8	5	5	5	Closed	281.5	281.4	281.6	277.6	277.5	277.7
25-May	74,200	10,500	63,700	66.1	6	6	6	Closed	280.9	280.8	281.0	276.8	276.6	277.0
26-May	61,400	8,000	53,400	66.2	6	6	6	Closed	280.5	280.4	280.6	276.0	276.0	276.1
27-May	53,200	6,250	46,950	69.3	12	12	12	Closed	280.2	280.1	280.3	275.5	275.4	275.5
28-May	47,800	5,400	42,400	69.1	12	12	12	Closed	280.0	279.9	280.1	275.1	275.0	275.2
29-May	43,300	4,000	39,300	64.9	12	12	12	Closed	279.9	279.9	279.9	274.8	274.7	274.9
30-May	40,200	4,500	35,700	64.5	18	18	18	Closed	279.8	279.7	279.8	274.6	274.6	274.7
31-May	37,000	4,000	33,000	69.4	16	16	16	Closed	279.7	279.7	279.8	274.6	274.5	274.6
1-Jun	32,200	3,500	28,700	70.8	18	18	18	Closed	279.5	279.5	279.5	274.1	274.1	274.2
2-Jun	28,300	2,700	25,600	68.5	22	22	22	Closed	279.2	279.2	279.2	273.8	273.8	273.9
3-Jun	25,400	2,200	23,200	72.5	24	24	24	Closed	278.9	278.9	279.0	274.6	274.6	274.7
4-Jun	23,100	2,250	20,850	74.1	24	24	24	Closed	279.0	278.9	279.0	273.7	273.7	273.7
5-Jun	22,600	2,150	20,450	71.9	24	24	24	Closed	278.9	278.9	278.9	273.6	273.5	273.6
6-Jun	23,900	2,250	21,650	75.2	24	24	24	Closed	279.0	279.0	279.0	273.7	273.7	273.7
7-Jun	22,600	2,100	20,500	73.2	24	24	24	Closed	278.8	278.7	278.8	273.7	273.7	273.7
8-Jun	20,100	2,100	18,000	74.1	24	24	24	Closed	278.8	278.7	278.8	273.5	273.4	273.5
9-Jun	20,300	2,100	18,200	72.6	24	24	24	Closed	278.8	278.7	278.8	273.6	273.6	273.6
10-Jun	20,100	2,100	18,000	73.3	18	12	24	Closed	278.8	278.8	278.9	273.6	273.6	273.6
11-Jun	20,800	2,150	18,650	70.1	10	10	10	Closed	278.9	278.9	278.9	273.6	273.6	273.6
12-Jun	30,900	3,000	27,900	68.9	16	16	16	Closed	279.3	279.0	279.6	274.0	273.6	274.3
13-Jun	38,900	3,800	35,100	70.0	20	20	20	Closed	279.6	279.5	279.6	274.2	274.1	274.3

Table 3. Summary of surface water elevations recorded during operation of the York Haven Fishway in 2014.

		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.
20-May	122,000	282.0	282.0	282.1	279.1	279.1	279.2	279.6	279.6	279.7	279.8	279.8	279.8	281.9	281.9	282.0	279.4	279.4	279.5	281.8	281.7	281.8
21-May	98,200	281.6	281.5	281.6	278.1	278.0	278.1	278.6	278.5	278.7	279.2	279.2	279.2	281.4	281.4	281.4	278.9	278.9	278.9	281.2	281.1	281.3
22-May	86,100	281.2	281.2	281.3	277.3	277.2	277.3	278.0	277.9	278.1	278.9	278.8	279.0	281.0	281.0	281.0	278.7	278.6	278.7	280.9	280.8	280.9
23-May	103,000	281.7	281.6	281.8	278.1	277.9	278.3	278.6	278.4	278.7	279.3	279.1	279.5	281.5	281.3	281.6	279.2	279.0	279.3	281.3	281.2	281.4
24-May	91,500	281.5	281.4	281.6	277.6	277.5	277.7	278.2	278.1	278.2	278.9	278.9	279.0	281.2	281.1	281.2	278.6	278.5	278.6	281.1	281.0	281.1
25-May	74,200	280.9	280.8	281.0	276.8	276.6	277.0	277.6	277.6	277.7	278.7	278.6	278.7	280.7	280.7	280.8	278.2	278.1	278.3	280.6	280.5	280.6
26-May	61,400	280.5	280.4	280.6	276.0	276.0	276.1	277.2	277.1	277.3	278.5	278.2	278.9	280.3	280.2	280.4	277.8	277.8	277.9	280.2	280.1	280.3
27-May	53,200	280.2	280.1	280.3	275.5	275.4	275.5	276.9	276.6	277.0	278.1	278.0	278.1	280.0	280.0	280.0	277.8	277.7	277.9	279.0	279.0	279.0
28-May	47,800	280.0	279.9	280.1	275.1	275.0	275.2	276.4	276.3	276.5	278.1	278.0	278.1	279.7	279.7	279.8	277.5	277.4	277.7	279.6	279.5	279.7
29-May	43,300	280.0	279.9	280.0	274.8	274.7	274.9	275.5	275.4	275.8	277.9	277.8	277.9	279.6	279.6	279.7	277.6	277.5	277.6	279.5	279.4	279.5
30-May	40,200	279.8	279.7	279.8	274.6	274.6	274.7	275.2	275.2	275.2	277.7	277.6	277.7	279.5	279.4	279.5	277.4	277.3	277.5	279.4	279.3	279.4
31-May	37,000	279.7	279.7	279.8	274.6	274.5	274.6	275.0	275.0	275.1	277.8	277.7	277.8	279.5	279.3	279.8	277.6	277.5	277.7	279.3	279.2	279.4
1-Jun	32,200	279.5	279.5	279.5	274.1	274.1	274.2	274.9	274.9	274.9	277.6	277.5	277.7	279.1	279.1	279.1	277.5	277.5	277.5	279.0	278.9	279.0
2-Jun	28,300	279.2	279.2	279.2	273.8	273.8	273.9	274.8	274.8	274.8	277.5	277.5	277.5	278.9	278.9	279.0	277.3	277.3	277.3	279.0	278.9	279.1
3-Jun	25,400	278.9	278.9	279.0	274.6	274.6	274.7	273.6	273.5	273.7	277.2	277.1	277.3	278.7	278.7	278.8	277.3	277.3	277.3	278.7	278.6	278.7
4-Jun	23,100	279.0	278.9	279.0	273.7	273.7	273.7	274.6	274.5	274.6	277.3	277.2	277.3	278.6	278.6	277.0	277.0	276.9	277.1	278.5	278.5	278.5
5-Jun	22,600	278.9	278.9	278.9	273.6	273.5	273.6	274.5	274.5	274.5	277.2	277.1	277.2	278.6	278.6	278.6	277.0	277.0	277.0	278.5	278.4	278.5
6-Jun	23,900	279.0	279.0	279.0	273.7	273.7	273.7	274.5	274.5	274.5	277.2	277.2	277.2	278.8	278.7	278.8	277.0	277.0	277.0	278.7	278.6	278.7
7-Jun	22,600	278.8	278.7	278.8	273.7	273.7	273.7	274.5	274.5	274.5	277.1	277.1	277.2	278.7	278.7	278.7	276.9	276.9	276.9	278.6	278.6	278.6
8-Jun	20,100	278.8	278.7	278.8	273.5	273.4	273.5	274.4	274.4	274.4	277.2	277.2	277.2	278.5	278.4	278.5	276.8	276.7	276.9	278.4	278.3	278.4
9-Jun	20,300	278.8	278.7	278.8	273.6	273.6	273.6	274.4	274.4	274.4	277.1	277.1	277.1	278.5	278.5	278.5	277.0	276.9	277.0	278.4	278.4	278.4
10-Jun	20,100	278.8	278.8	278.9	273.6	273.6	273.6	274.5	274.5	274.5	277.2	277.2	277.2	278.6	278.6	278.6	277.0	277.0	277.1	278.5	278.4	278.5
11-Jun	20,800	278.9	278.9	278.9	273.6	273.6	273.6	274.4	274.4	274.5	277.1	277.1	277.1	278.6	278.6	278.6	276.9	276.9	277.0	278.5	278.5	278.5
12-Jun	30,900	279.3	279.0	279.6	274.0	273.6	274.3	274.7	274.5	274.9	277.4	277.1	277.5	279.0	278.7	279.3	277.2	277.0	277.4	279.0	278.6	279.2
13-Jun	38,900	279.6	279.5	279.6	274.2	274.1	274.3	274.8	274.8	274.8	277.5	277.5	277.6	279.2	279.1	279.3	277.3	277.2	277.4	279.2	279.1	279.2

Table 4. Hourly summary of American shad passage through the serpentine vertical notch fish ladder at the York Haven Hydroelectric Project in 2014.

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	1700	1600	1600	1600	1600	1600	1600	1600
Military Time (Hours)									
0800 - 0859	0	0	2	0	0	0	0	0	0
0900 - 0959	0	0	0	0	0	1	0	0	0
1000 - 1059	0	1	0	0	0	0	0	0	0
1100 - 1159	0	0	2	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**	**1**	**4**	**0**	**0**	**1**	**0**	**0**	**0**

Date	29-May	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun
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	1	0	0	0	1	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**	**1**	**0**	**0**	**0**	**1**	**0**

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

Date	7-Jun	8-Jun	9-Jun	10-Jun	11-Jun	12-Jun	13-Jun		
Observation Time (Start)	0800	0800	0800	0800	0800	0800	0800		
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	**Total**	%
Military Time (Hours)									
0800 - 0859	0	0	0	0	0	0	0	**2**	**25.0**
0900 - 0959	0	0	0	0	0	0	0	**1**	**12.5**
1000 - 1059	0	0	0	0	0	0	0	**1**	**12.5**
1100 - 1159	0	0	0	0	0	0	0	**2**	**25.0**
1200 - 1259	0	0	0	0	0	0	0	**2**	**25.0**
1300 - 1359	0	0	0	0	0	0	0	**0**	**0.0**
1400 - 1459	0	0	0	0	0	0	0	**0**	**0.0**
1500 - 1559	0	0	0	0	0	0	0	**0**	**0.0**
Total Catch	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**100.0**

FIGURES

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

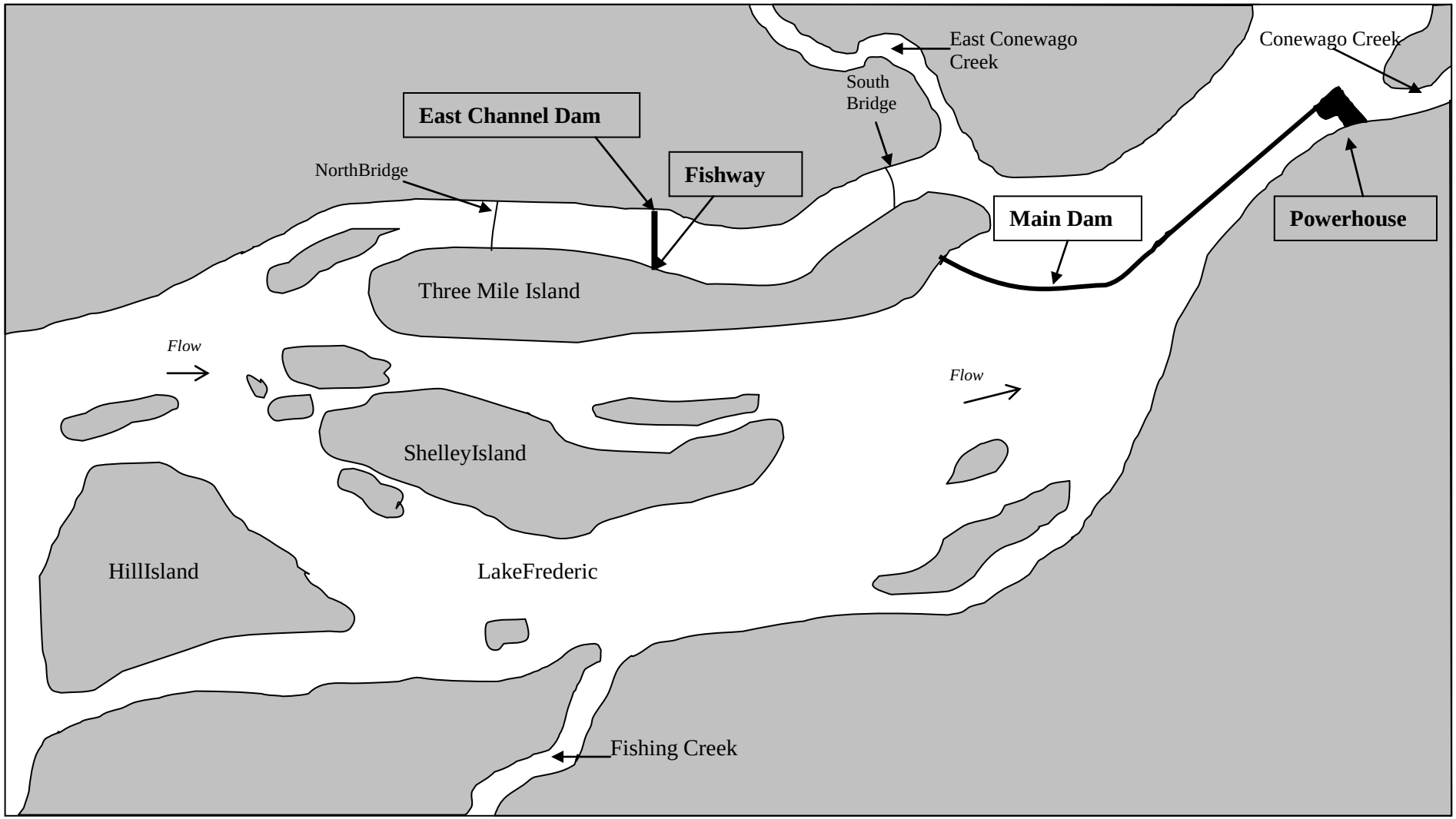

Figure 2. General Arrangement - York Haven Fishway.

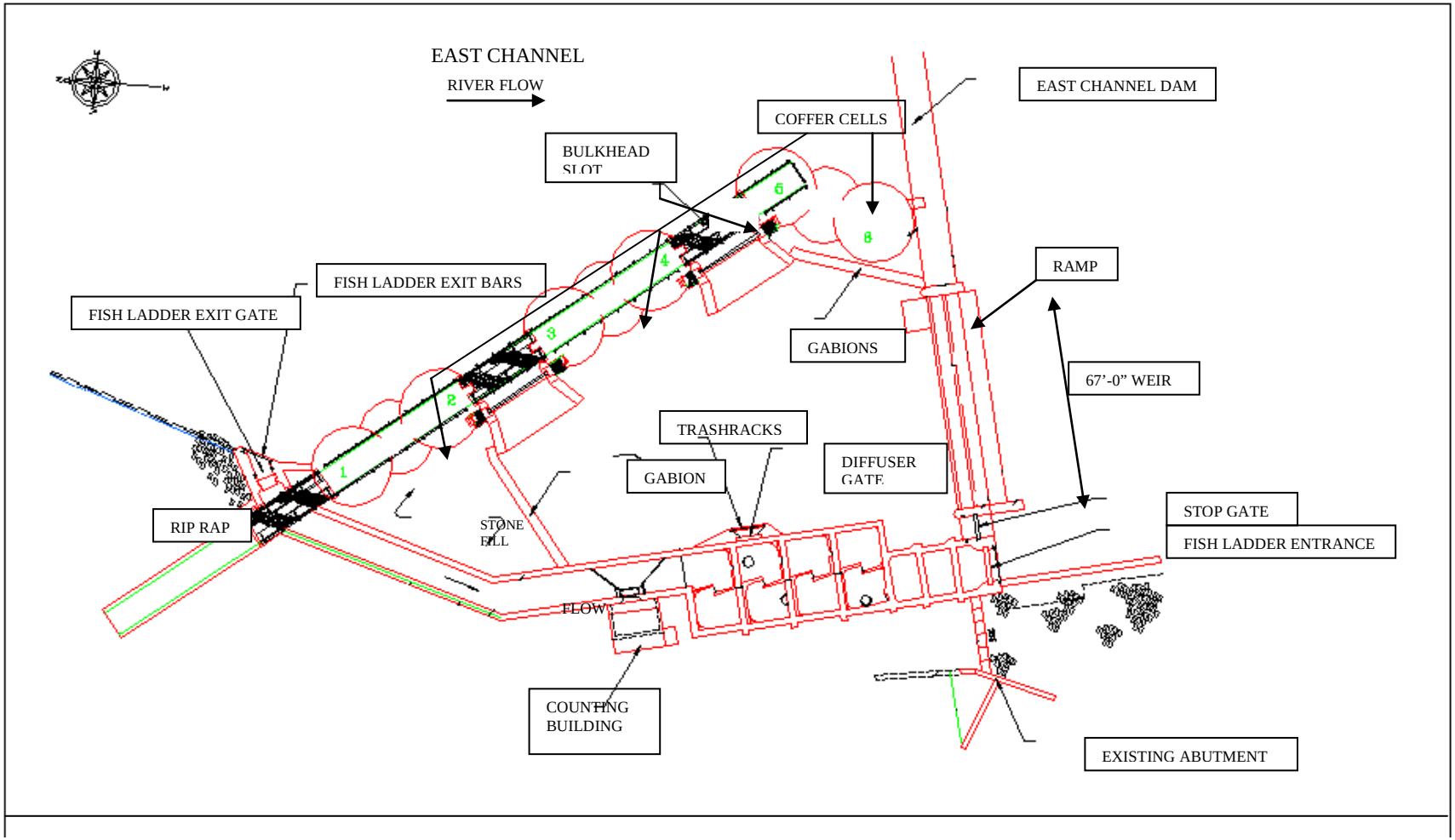

Figure 3. Plot of River Flow (x 1000 cfs) & Water Temperature (F) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2014

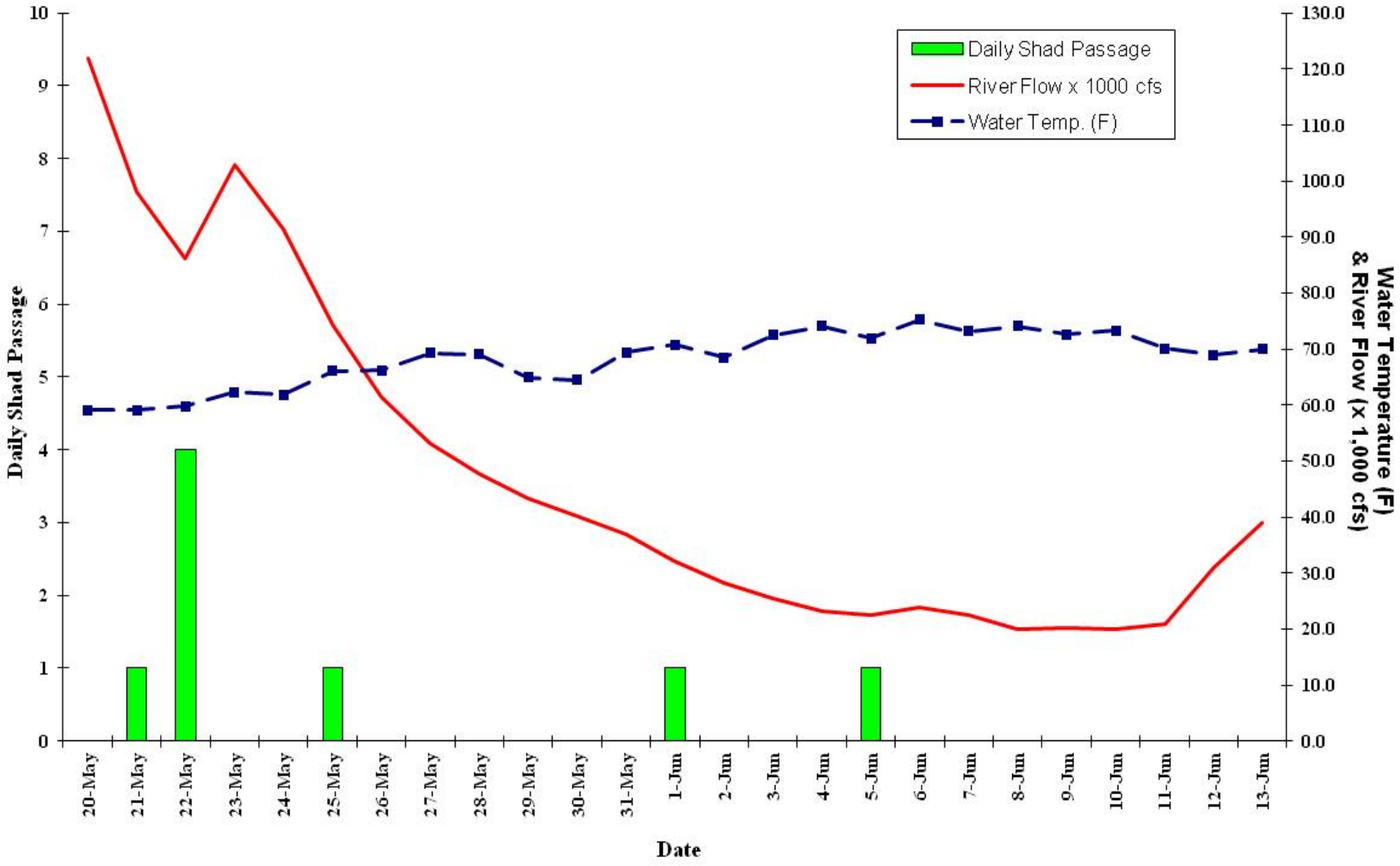

Figure 4. Plot of River Flow (x 1000 cfs) & East Channel Flow (x 1000 cfs) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2014

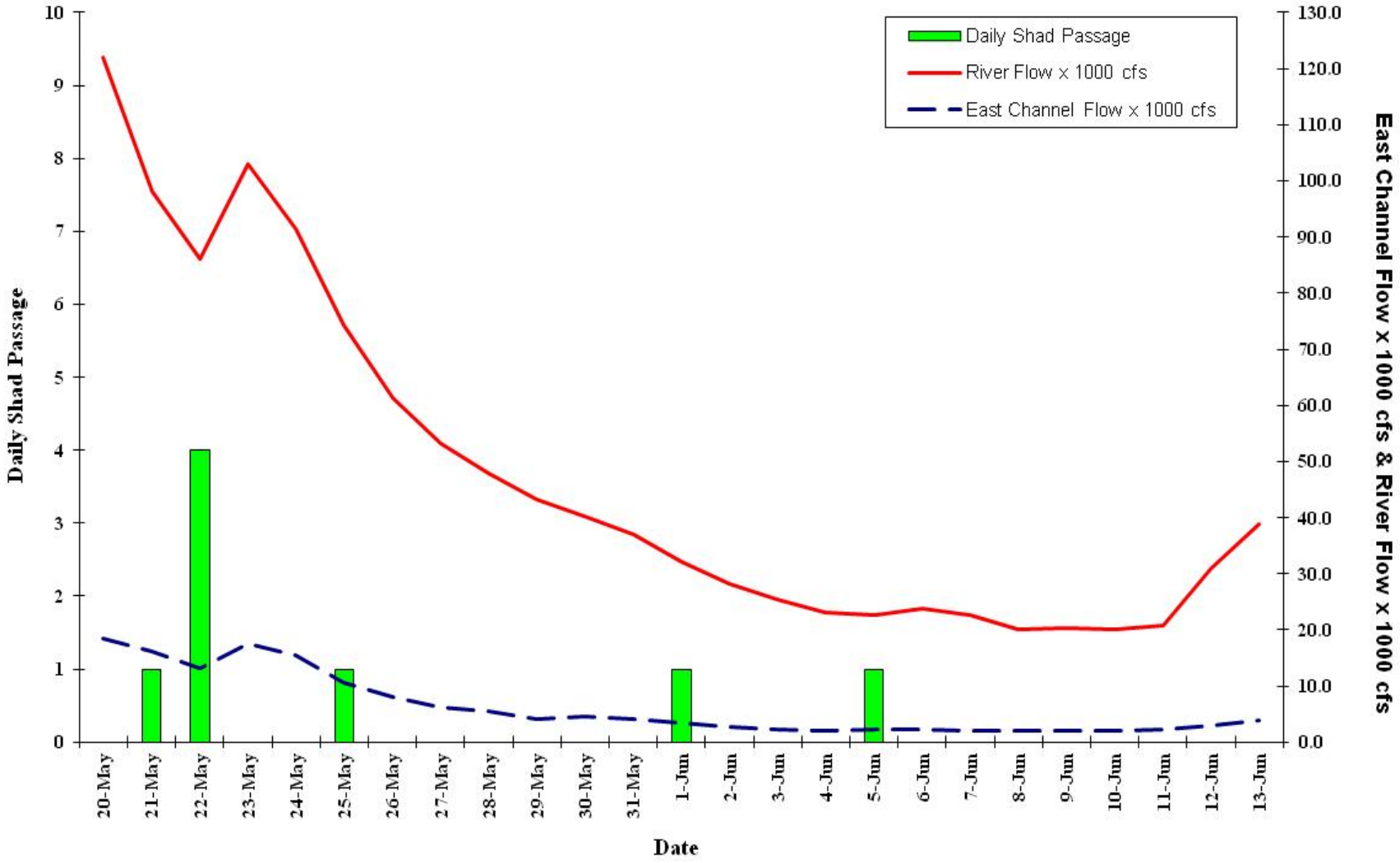

Figure 5. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River and Average Daily Water Temperature at the York Haven Power Station, 15 September to 13 November, 2014