



Water Power for the Future

**SUMMARY OF UPSTREAM AND DOWNSTREAM
FISH PASSAGE AT THE
YORK HAVEN HYDROELECTRIC PROJECT
IN 2010**

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The fish ladder was opened on 1 April allowing volitional (unmanned) passage for 25 days prior to initiating manned Fishway operation. Manned Fishway operation started on 26 April and ended on 14 June. A total of 66,530 fish of 23 taxa were enumerated as they passed upstream through the ladder into Lake Frederic during manned operation. Gizzard shad (51,497) was the dominant fish species passed and comprised over 77% of the fish passed. Passage varied daily and ranged from one fish on 26 April to 6,678 fish on 16 May.

A total of 907 American shad passed upstream through the ladder in 2010. Some 28 shad passed in April, 773 shad passed in May, and 106 shad passed in June. Peak shad passage occurred in early May (1 and 2 May) when some 286 shad (31.5% of season total) passed. Some 107 and 176 shad passed on 1 and 2 May, respectively. American shad were collected and passed at water temperatures of 54.7°F to 79.7°F, River flows of 13,200 cfs to 47,100 cfs and East Channel flows of 2,108 cfs to 5,240 cfs.

Over 49% of the shad (447) passed between 0801 hrs and 1100 hrs; hourly passage varied from no shad to 62 shad. Some 268 shad passed from 1101 to 1400 hrs. A total of 138 shad passed between 1401 hrs and the end of manned operation each day (1600 and/or 1700 hrs). The peak hourly passage of shad (62) occurred on 2 May between 0800 hrs and 0859 hrs.

In mid-June, YHPC and the Commonwealth of Pennsylvania, Department of Environmental Protection entered into a Consent Order and Agreement (COA) that provides for resident fish passage and minimum stream flow. The Fishway remained open through 6 December and was set to deliver a minimum stream flow of at least 400 cfs to the East Channel. The Fishway was closed with the concurrence of the PFBC since water temperature at the project had dropped to 40°F. Between 15 June and 6 December, station operations were adjusted daily to satisfy Main Channel and East Channel minimum stream flows requirements.

A total of 71 fish were counted as they passed upstream through the York Haven Fishway between 15 October and 13 November during 40 hours of manned Fishway operation (Table 5). Total daily passage varied from six fish on 15 October to 31 fish on 29 October. Walleye (61) was the dominant fish species passed on each of the 5 days and comprised over 85% of the fish passed.

As in previous years YHPC agreed to make periodic observations for adult shad in the forebay and open the trash 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 June through September.

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 20 September when water temperature was 72.0°F. Monitoring continued through 18 November. During this period River flows ranged from 4,060 cfs to 107,000 cfs. 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"

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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.

A draft of the York Haven Fishway Operation Procedure (FPOP), which provides the framework for fishway operation during the spring migration season, was distributed to members of the FPTAC electronically on 22 February, 2010. Receiving no comments, YHPC finalized and implemented the 2010 FPOP. Objectives of 2010 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 flow was less than 23,000 cfs, a nominal minimum spill of 4,000 cfs was maintained over the Main Dam during daily Fishway 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.

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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 for the 2010 spring migration season began in mid-March enabling volitional fish passage (unmanned) through the ladder to commence on 1 April. Only the entrance and exit gate(s) were open during a 25 day unmanned period of Fishway operation between 1 April and 25 April.

Manned Fishway operation, commenced on Monday 26 April, 3 days after the Safe Harbor Fish Lift was placed in service and had passed 3,195 American shad. In 2010, the Fishway was manned on a total of 34 days between 26 April and 14 June. Normally, fish were counted and allowed to pass upstream between 0800 hrs and 1600 hrs. However, per the Fishway Operation Plan, counting was extended to 1700 hrs on 11, 14 and 29 May as five shad had passed between 1600 hrs and 1700 hrs. As only 11 shad were observed passing upstream through the Fishway between 4 June and 12 June a plan to stop manned operation for the 2010 season was developed. The plan, mutually agreed to by members of the FPTAC, called for unmanned operation (volitional passage) of the fishway on 13 June and 14 June with a final day of manned operation on 15 June to confirm that upstream passage of pre-spawned shad had in fact ended. Since no shad were observed passing the ladder on 15 June, manned Fishway operation ended that afternoon at 1600 hrs.

Between 26 April and 14 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 throughout the season maintaining a 0.5-ft to 0.8-ft differential between the surface water elevation downstream of the entrance and the water elevation in the diffuser area of the fish ladder. This setting resulted in an average velocity of 4 ft/sec to 6 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. This individual also recorded water elevations several times each day on staff gauges located throughout the Fishway.

The day after manned fishway operation ended this season, YHPC and the Commonwealth of Pennsylvania, Department of Environmental Protection entered into a Consent Order and Agreement (COA) that provides for resident fish passage. The COA requires that YHPC:

- 1) Count resident fish passage on 5 days between 15 October and 15 November at the East Channel fishway during daylight hours.

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- 2) Operate and maintain the East Channel Fishway to allow passage of resident fish each year from April 1 through the earlier of December 15 or until average daily water temperature, measured at either the USGS gage at Harrisburg or at the York Haven project is equal to or less than 40°F for three consecutive days.
- 3) After the American shad upstream passage season and during the resident fish passage period maintain a minimum stream flow of 400 cfs or greater in the East Channel below the East Channel Fishway during the period the fishway is operated and maintained to allow passage of resident fish species.
- 4) Manage flows above hydraulic capacity of the generating units in accordance with the following objectives:
 - a. Maintain the 400 cfs minimum flow in the East Channel.
 - b. Maintain sufficient flow at the Main Channel Dam to assure flow is released to the main channel in accordance with the FPOP, except during times when reservoir levels are lowered to safely permit maintenance work on the Main Dam.
 - c. Provide additional attraction flows to the East Channel to the East Channel Fishway through operation of the fixed wheel gates.

In the event that River flow is not sufficient to meet all objectives a-c above, these objectives are to be implemented in the order listed above.

After manned Fishway operation ended on 14 June, the South fixed wheel gate was closed. On 15 June, the fish ladder and North fixed wheel gate were set to deliver a minimum flow of 400 cfs into the East Channel. Per the COA, The Fishway remained open through 6 December and was set to deliver a minimum stream flow of at least 400 cfs to the East Channel. The Fishway was closed with the concurrence of the PFBC since water temperature at the project had dropped to 40°F. Between 15 June and 6 December, station operations were adjusted daily to satisfy Main Channel and East Channel minimum stream flows requirements. In addition, the fishway was manned and resident fish were counted as they passed upstream between 0800 hrs and 1600 hrs on 15, 22, and 29 October and 6 and 13 November.

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 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. This gate was closed nightly during periods of manned Fishway operation at 1600 to 1800 hrs based on shad passage. However, at YHPC's request, fish counting was extended to 2300 hrs on 17 and 20 May. The stop gate was usually opened each morning the Fishway was manned at 0800 hrs. Occasionally, it was closed for brief periods of time as needed each day to enable the person manning the Fishway to remove debris from screens and the fishway exit 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 varied from 6 in. to 24 in. depending on river conditions.

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

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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 66,530 fish of 23 taxa were enumerated as they passed upstream into Lake Frederic. Gizzard shad (51,497) was the dominant fish species passed and comprised over 77% of the fish passed. Some 907 American shad were counted as they passed through the ladder. Other predominant fishes passed included quillback (5,556), channel catfish (3,800), walleye (1,374), shorthead redhorse (1,302), and smallmouth bass (1,172). Passage varied daily and ranged from one fish on 26 April to 6,678 fish on 16 May when 10% of the season total were passed.

2.4.1.2 American Shad Passage

A total of 907 American shad passed upstream through the ladder in 2010. Some 28 shad passed in April, 773 shad passed in May and 106 shad passed in June. Peak shad passage occurred in early May (1 and 2 May) when some 286 shad (31.5% of season total) passed. Some 107 and 176 shad passed on 1 and 2 May, respectively.

American shad were collected and passed at water temperatures of 54.7°F to 79.7°F, River flows of 13,200 cfs to 47,100 cfs and East Channel flows of 2,108 cfs to 5,240 cfs (Tables 2 and 3, Figures 3 and 4). Passage during April occurred at Rivers flows that increased from 16,200 cfs to 47,100 cfs. Water temperature during this period ranged from 54.7° F to 58.1° F and East Channel flows varied 2,133 cfs to 5,240 cfs. Passage during May occurred at Rivers flows that varied from 14,092 cfs to 41,860 cfs. Water temperature during this period ranged from 55.4°F to 77.5°F and East Channel flows varied from 2,108 cfs to 5,240 cfs. Passage in June occurred at Rivers flows that averaged 14,997 cfs and ranged from 11,092 cfs to 20,267 cfs and East Channel flows ranged from 2,108 cfs to 2,433 cfs. Water temperature during this period varied from 68.9° F to 79.7°F.

The hourly passage of American shad through the fish ladder is given in Table 4. Over 49% of the shad (447) passed between 0801 hrs and 1100 hrs; hourly passage varied from no shad to 62 shad. Some 268 shad passed from 1101 to 1400 hrs. A total of 138 shad passed between 1401 hrs and the end of manned operation each day (1600 and/or 1700 hrs). The peak hourly passage of shad (62) occurred on 2 May between 0800 hrs and 0859 hrs.

Per the FPOP, counting was extended hourly on 2 of 50 days that the fishway was manned. On 1 May and 2 May between 1601 and 1800 hrs nine shad and 11 shad passed, respectively. On 17 and 21 May, counting was extended at YHPC's request, three shad passed upstream. One shad was observed passing upstream on 17 May while two shad were observed on 21 May; on both days shad passed upstream prior sunset (1900 hrs).

2.4.1.3 Other Alosids

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

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2.4.1.4 Observations

Once each day, visual observations of fish activity were made on a random basis below the Main Dam. On several occasions several gizzard shad and a few were observed trying to swim over the Main Dam. No shad or other alosids were observed below the Main Dam.

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.

2.4.1.5 Summary

The ladder was opened on 1 April allowing unmanned passage for 25 days prior to initiating manned Fishway operation. During 50 days of manned operation between 26 April and 14 June a total of 66,530 fish of 23 taxa were enumerated as they passed upstream through the ladder into Lake Frederic.

A total of 907 shad were observed as they passed upstream through the ladder. Some 28 shad passed in April, 773 shad passed in May, and 56 passed in June. Peak shad passage occurred in early May (1 and 2 May) when some 286 shad (31.5% of the season total passed). Some 107 and 176 shad passed on 1 and 2 May, respectively. Over 49% of the shad (447) passed between 0800 hrs and 1100 hrs, 268 shad passed between 0800 hrs to 1400 hrs and a total of 138 shad passed after 1401 hrs. The peak hourly passage shad (62) occurred on 2 May between 0800 and 0859 hrs. American shad were collected and passed at water temperatures of 54.7°F to 79.7°F, River flows of 13,200 cfs to 47,100 cfs and East Channel flows of 2,108 cfs to 5,240 cfs.

YHPC will continue working with members of the FPTAC to develop and implement practical changes to Fishway operation that are geared toward improving passage through the Fishway.

2.4.2 Fall Fishway Operation

A total of 71 fish were counted as they passed upstream through the York Haven Fishway between 15 October and 13 November during 40 hours of manned Fishway operation (Table 5). Total daily passage varied from 6 fish on 15 October to 31 fish on 29 October. Walleye (61) was the dominant fish species passed on each of the 5 days and comprised over 85% of the fish passed. Other fishes passed included gizzard shad (6), shorthead redhorse (3) and yellow Perch (1).

Considering that on average less than two fish/hour passed upstream during the 5 day/40 hr manned counting period there is limited value counting fish and/or keeping the Fishway open so late in the year as it has the potential to jeopardize operation of the East Channel Fishway during the spring American shad spawning migration. A total of 10 other fish passed; they included gizzard shad (6), shorthead redhorse (3) and yellow perch (1).

Resident fish were passed at water temperatures of 57.2° F to 43.3° F, River flows of 17,000 cfs to 26,300 cfs and East Channel flows of 2,083 cfs to 3,837 cfs (Tables 6 and 7). Main channel flow, flow discharged through the power station over the Main Dam, ranged from 15,217 cfs to 22,463 cfs.

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3.0 DOWNSTREAM FISH PASSAGE

As in previous years, YHPC agreed to make periodic observations for adult shad in the forebay and open 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 observations of post-spawned adult shad were noted by Station personnel that made periodic observations of the forebay area from June through September, 2010. During this period (1 June to 30 September) station personnel opened the trash sluice on 33 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 20 September when water temperature was 72.0°F and River flow at Harrisburg was 4,110 cfs (Figure 5). Monitoring continued through 18 November. River flow between 20 September and 30 September varied from 4,060 cfs to 7,080 cfs. On 3 October, heavy rain caused River flows to increase; flow peaked at to 107,000 cfs. Between 4 October and 28 October flows declined steadily to 14,600 cfs. River flows between 29 October and 18 November averaged 21,790 cfs and ranged from 15,600 cfs to 30,300 cfs. During this period water temperature declined from 72.0°F to 46.0°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

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forebay were made at dusk by a Kleinschmidt biologist on 18 October 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 others conducting juvenile shad sampling programs in the lower River. According to personnel conducting these sampling programs juvenile shad abundance was extremely low again in 2010. Only a few juveniles were collected in the River, two juvenile shad were collected at Columbia and one was collected at City Island while haul seining and as of 31 October.

4.0 LITERATURE CITED

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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 2010.

	Date	26-Apr	27-Apr	28-Apr	29-Apr	30-Apr	1-May	2-May	3-May	4-May	5-May
Observation Time (hrs.)		2.5	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (°F)		58.1	55.4	54.7	55.4	57.2	60.8	64.4	67.1	66.2	66.2
American Shad		0	5	2	2	19	107	176	14	4	54
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		1	551	385	292	560	1611	1661	718	1311	2986
Hickory Shad		0	0	0	0	0	0	0	0	0	0
Striped Bass		0	0	0	0	0	1	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	1	0	0	0	0	0	0	0	0
Brook Trout		0	0	0	0	0	0	0	0	0	0
Muskellunge		0	0	0	0	0	0	1	0	0	0
Carp		0	51	26	0	25	35	47	7	28	26
Quillback		0	69	18	7	73	270	447	35	54	722
White Sucker		0	12	17	1	9	19	12	0	4	3
S. Redhorse		0	84	18	22	139	243	159	5	12	74
White Catfish		0	0	0	0	0	0	0	0	0	0
Yellow Bullhead		0	0	0	0	0	0	0	0	0	0
Brown Bullhead		0	0	0	0	0	0	1	0	0	0
Channel Catfish		0	77	127	34	163	351	209	445	163	209
Rock Bass		0	0	0	0	0	0	0	0	0	0
Redbreast Sunfish		0	0	0	0	0	0	0	0	0	0
Bluegill		0	0	0	0	0	0	0	0	0	0
Smallmouth Bass		0	45	70	5	12	226	204	10	5	66
Largemouth Bass		0	0	0	0	0	1	0	0	0	0
Yellow Perch		0	0	0	0	0	0	0	0	0	0
Walleye		0	44	89	17	42	57	105	18	43	115
Northern Hog Sucker		0	0	0	0	0	0	0	0	0	0
Fallfish		0	0	0	0	0	0	0	0	0	0
Flathead Catfish		0	0	0	0	0	0	0	0	0	0
Total		1	939	752	380	1,042	2,921	3,022	1,252	1,624	4,255

Table 1. *continued*

	Date	6-May	7-May	8-May	9-May	10-May	11-May	12-May	13-May	14-May	15-May
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (°F)	70.7	68.0	63.5	58.1	56.3	56.3	53.6	55.4	60.8	62.6	
American Shad	37	14	5	2	0	5	0	1	3	37	
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	2040	1749	1022	895	247	433	185	184	340	2304	
Hickory Shad	0	0	0	0	0	0	0	0	0	0	
Striped Bass	1	0	0	0	0	0	0	0	0	1	
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	1	0	0	0	0	0	0	0	0	
Brook Trout	0	0	0	0	0	0	0	0	0	0	
Muskellunge	0	0	0	0	0	0	0	0	0	0	
Carp	24	28	13	3	1	1	1	2	3	17	
Quillback	256	156	162	23	8	9	3	14	50	108	
White Sucker	1	1	7	0	1	0	0	0	0	2	
S. Redhorse	77	86	53	9	0	5	1	9	54	61	
White Catfish	0	0	0	0	0	0	0	0	0	0	
Yellow Bullhead	0	0	0	0	0	0	0	0	0	0	
Brown Bullhead	0	0	0	0	0	0	0	0	0	1	
Channel Catfish	97	201	26	9	5	0	1	39	39	172	
Rock Bass	0	0	0	0	0	0	0	0	0	0	
Redbreast Sunfish	0	0	0	0	0	0	0	0	0	1	
Bluegill	0	0	0	0	0	0	0	0	0	0	
Smallmouth Bass	51	44	20	3	0	0	1	0	3	10	
Largemouth Bass	0	0	0	0	0	0	0	0	0	0	
Yellow Perch	0	0	0	0	0	0	0	0	0	0	
Walleye	85	71	56	8	9	13	1	9	43	19	
Northern Hog Sucker	0	0	0	0	0	0	0	0	0	0	
Fallfish	0	0	0	0	0	0	0	0	0	0	
Flathead Catfish	1	0	0	0	0	0	0	0	1	0	
Total		2,670	2,351	1,364	952	271	466	193	258	536	2,733

Table 1. *continued*

	Date	16-May	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	16.0	8.0	8.0	8.0	8.0	8.0
Water Temperature (°F)	63.1	62.6	60.4	59.5	62.6	67.1	68.0	67.6	68.5	69.8	
American Shad	89	15	13	5	15	6	8	15	14	38	
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	6057	2874	1439	1295	1044	593	1257	1207	685	662	
Hickory Shad	0	0	0	0	0	0	0	0	0	0	
Striped Bass	0	1	1	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	
Brook Trout	0	0	0	0	0	0	0	0	0	0	
Muskellunge	0	0	0	0	0	0	0	0	0	0	
Carp	22	37	8	3	11	18	40	8	12	15	
Quillback	226	93	27	22	65	615	264	200	234	142	
White Sucker	1	0	0	0	1	0	0	1	0	0	
S. Redhorse	30	20	10	7	15	19	26	11	19	13	
White Catfish	0	0	0	0	0	0	2	0	0	0	
Yellow Bullhead	0	0	0	0	0	0	0	0	0	0	
Brown Bullhead	0	0	0	0	0	0	0	1	0	1	
Channel Catfish	201	121	26	22	73	47	45	17	17	54	
Rock Bass	0	0	0	0	0	0	0	0	0	2	
Redbreast Sunfish	1	1	0	0	0	0	0	0	0	1	
Bluegill	0	0	0	0	0	0	0	0	0	0	
Smallmouth Bass	20	43	5	3	45	95	25	6	8	15	
Largemouth Bass	0	0	0	0	0	0	0	0	0	0	
Yellow Perch	0	0	0	0	0	0	0	0	0	0	
Walleye	31	45	15	21	49	70	57	47	15	12	
Northern Hog Sucker	0	0	0	0	0	0	0	0	0	1	
Fallfish	0	0	0	0	0	0	0	0	0	0	
Flathead Catfish	0	0	0	0	0	0	0	1	1	0	
Total		6,678	3,250	1,544	1,378	1,318	1,463	1,724	1,514	1,005	956

Table 1. *continued*

Date	26-May	27-May	28-May	29-May	30-May	31-May	1-Jun	2-Jun	3-Jun	4-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 (°F)	73.4	76.6	75.7	73.4	75.7	77.5	77.5	77.5	77.9	79.7
American Shad	16	25	12	22	11	10	8	11	24	12
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	874	962	868	682	559	408	669	1195	417	286
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	1	0	0	0	1	0	0	0
Brook Trout	0	1	0	0	0	0	0	0	0	0
Muskellunge	0	0	0	0	0	0	0	0	0	0
Carp	22	16	21	7	16	5	4	8	8	20
Quillback	278	409	128	62	54	32	9	18	32	39
White Sucker	4	2	0	0	1	6	0	0	0	0
S. Redhorse	7	3	0	2	4	2	0	1	1	0
White Catfish	3	2	3	0	0	2	0	0	2	1
Yellow Bullhead	0	1	2	1	0	0	0	0	0	0
Brown Bullhead	1	0	5	1	4	0	1	2	3	3
Channel Catfish	55	60	32	27	40	45	21	38	61	45
Rock Bass	1	0	0	0	0	0	0	0	0	0
Redbreast Sunfish	0	0	2	0	0	0	0	0	0	1
Bluegill	0	0	0	0	0	1	0	0	0	0
Smallmouth Bass	22	20	12	5	18	11	0	8	5	4
Largemouth Bass	0	0	0	0	2	1	0	0	0	0
Yellow Perch	0	0	0	0	0	0	0	0	0	0
Walleye	25	41	22	24	19	10	4	0	8	2
Northern Hog Sucker	0	0	0	0	0	0	0	0	0	0
Fallfish	0	0	0	0	1	0	0	0	0	0
Flathead Catfish	0	2	2	1	2	0	1	1	1	0
Total	1,308	1,544	1,110	834	731	533	718	1,282	562	413

Table 1. *continued*

	Date	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun	Total
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	339
Water Temperature (°F)	77.0	77.0	72.5	72.1	70.7	68.9	71.6	75.7	77.5	77.9		
American Shad	4	3	17	4	12	2	8	1	0	0	0	907
Alewife	0	0	0	0	0	0	0	0	0	0	0	0
Blueback Herring	0	0	0	0	0	0	0	0	0	0	0	0
Gizzard Shad	314	430	321	360	530	716	663	1310	1729	1616		51,497
Hickory Shad	0	0	0	0	0	0	0	0	0	0	0	0
Striped Bass	0	1	0	0	0	0	0	0	0	0	0	6
White Perch	0	0	0	0	0	0	0	0	0	0	0	0
American Eel	0	0	0	0	0	0	0	0	0	0	0	0
Rainbow Trout	0	0	0	0	0	0	0	0	0	0	0	4
Brook Trout	0	0	0	0	0	0	0	0	0	0	0	1
Muskellunge	0	0	0	0	0	0	0	0	0	0	0	1
Carp	4	1	2	6	1	8	4	9	9	6		689
Quillback	10	3	10	3	4	6	13	45	23	6		5,556
White Sucker	0	0	0	0	0	1	0	0	0	0	0	106
S. Redhorse	0	0	0	0	0	0	1	0	0	0	0	1,302
White Catfish	1	0	0	0	0	1	0	0	0	0	0	17
Yellow Bullhead	0	0	0	0	0	1	0	0	0	0	2	7
Brown Bullhead	2	1	3	0	0	0	1	0	4	6		41
Channel Catfish	58	16	31	42	8	10	12	40	104	65		3,800
Rock Bass	0	0	0	0	0	0	0	0	0	0	0	3
Redbreast Sunfish	0	0	0	2	0	0	0	0	0	0	0	9
Bluegill	0	0	0	0	0	0	0	0	0	0	0	1
Smallmouth Bass	5	2	3	9	2	2	2	1	0	1		1,172
Largemouth Bass	0	0	0	0	0	0	0	0	0	0	0	4
Yellow Perch	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	1	2	6	0	2	1	0	1	0	0	0	1,374
Northern Hog Sucker	0	0	0	0	0	0	0	0	0	0	0	1
Fallfish	0	0	0	0	0	0	0	0	0	0	0	1
Flathead Catfish	1	3	3	1	0	1	2	2	4	0		31
Total		400	462	396	427	559	749	706	1,409	1,873	1,702	66,530

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 2010.

Date	River Flow (cfs)	East Channel Flow (cfs)	Main Channel Flow (cfs)	Water Temp. (°F)	Secchi (in)			Stop Log Gate	Elevation (ft)					
					Secchi (in)				Head Pond			Tailwater		
					Avg.	Min.	Max.		Avg.	Min.	Max.	Avg.	Min.	Max.
26-Apr	19,900	2,133	17,767	58.1	8	8	8	closed	278.9	278.9	278.9	274.5	274.5	274.5
27-Apr	23,200	2,233	20,967	55.4	20	12	24	closed	279.0	279.0	279.0	273.5	273.5	273.6
28-Apr	30,600	3,035	27,565	54.7	24	24	24	closed	279.3	279.3	279.4	273.8	273.7	273.8
29-Apr	39,800	4,037	35,763	55.4	24	24	24	closed	279.7	279.7	279.8	274.4	274.4	274.5
30-Apr	44,600	5,240	39,360	55.4	24	24	24	closed	280.0	280.0	280.0	274.9	274.9	274.9
1-May	39,500	4,540	34,960	60.8	17	15	18	closed	279.8	279.7	279.8	274.7	274.6	274.7
2-May	34,400	3,837	30,563	64.4	18	18	18	closed	279.6	279.6	279.6	274.3	274.2	274.3
3-May	35,700	5,240	30,460	67.1	6	6	6	closed	280.0	279.9	280.0	275.0	274.7	275.2
4-May	33,900	4,037	29,863	66.2	9	7	12	closed	279.8	279.7	279.8	274.5	274.4	274.5
5-May	31,300	3,837	27,463	66.2	24	24	24	closed	279.6	279.6	279.6	274.2	274.2	274.3
6-May	28,500	3,537	24,963	70.7	23	12	24	closed	279.5	279.5	279.5	274.0	273.9	274.0
7-May	26,300	3,235	23,065	67.1	24	24	24	closed	279.4	279.3	279.4	273.8	273.8	273.8
8-May	23,700	3,235	20,465	63.5	24	24	24	closed	279.3	279.3	279.3	273.7	273.6	273.7
9-May	22,500	2,785	19,715	58.1	24	24	24	closed	279.2	279.2	279.2	273.4	273.4	273.5
10-May	23,800	2,785	21,015	56.3	24	24	24	closed	279.2	279.2	279.2	273.5	273.5	273.6
11-May	24,100	2,785	21,315	56.3	24	24	24	closed	279.2	279.2	279.2	273.5	273.5	273.5
12-May	25,700	2,785	22,915	53.6	24	24	24	closed	279.2	279.2	279.3	273.5	273.5	273.6
13-May	30,400	3,235	27,165	55.4	24	24	24	closed	279.4	279.3	279.4	273.8	273.7	273.8
14-May	42,000	4,540	37,460	60.8	22	18	24	closed	279.8	279.7	279.9	274.5	274.2	274.7
15-May	47,100	5,240	41,860	62.6	12	10	15	closed	280.0	280.0	280.1	274.8	274.8	274.9
16-May	45,300	5,240	40,060	63.1	24	24	24	closed	280.0	280.0	280.0	274.9	274.9	274.9
17-May	40,300	4,537	35,763	62.6	24	24	24	closed	279.8	279.8	279.8	274.5	274.5	274.6
18-May	36,700	4,037	32,663	60.4	24	24	24	closed	279.7	279.7	279.8	274.3	274.2	274.3
19-May	33,600	3,837	29,763	59.5	24	24	24	closed	279.6	279.6	279.6	274.1	274.1	274.1
20-May	31,700	3,837	27,863	62.6	24	24	24	closed	279.6	279.6	279.6	274.0	274.0	274.0
21-May	30,400	3,235	27,165	67.1	24	24	24	closed	279.4	279.4	279.5	273.8	273.8	273.8
22-May	29,600	3,235	26,365	68.0	24	24	24	closed	279.4	279.4	279.4	273.8	273.8	273.8

Table 2. *continued*

Date	River Flow (cfs)	East Channel Flow (cfs)	Main Channel Flow (cfs)	Water Temp. (°F)	Secchi (in)			Stop Log Gate	Elevation (ft)					
					Avg.	Min.	Max.		Head Pond			Tailwater		
									Avg.	Min.	Max.	Avg.	Min.	Max.
23-May	27,600	3,235	24,365	67.6	24	24	24	closed	279.4	279.3	279.4	273.7	273.7	273.8
24-May	32,200	3,235	28,965	68.5	24	24	24	closed	279.4	279.3	279.4	273.7	273.7	273.8
25-May	33,700	4,037	29,663	69.8	24	24	24	closed	279.7	279.6	279.7	274.2	274.1	274.4
26-May	26,800	2,433	24,367	73.4	24	24	24	closed	279.3	279.3	279.3	273.7	273.7	273.7
27-May	23,700	2,433	21,267	76.6	24	24	24	closed	279.1	279.1	279.1	273.6	273.6	273.6
28-May	20,400	2,233	18,167	75.7	24	24	24	closed	279.0	279.0	279.0	273.5	273.5	273.5
29-May	18,500	2,133	16,367	73.4	24	24	24	closed	278.9	278.9	278.9	273.5	273.4	273.5
30-May	17,100	2,108	14,992	75.7	24	24	24	closed	278.7	278.7	278.8	273.4	273.4	273.4
31-May	16,200	2,108	14,092	77.5	24	24	24	closed	278.7	278.7	278.7	273.4	273.4	273.4
1-Jun	15,900	2,108	13,792	77.5	17	12	24	closed	278.7	278.7	278.7	273.4	273.4	273.4
2-Jun	14,300	2,108	12,192	77.5	18	15	24	closed	278.7	278.7	278.7	273.3	273.3	273.4
3-Jun	13,900	2,083	11,817	77.9	24	24	24	closed	278.6	278.6	278.6	273.3	273.3	273.4
4-Jun	14,800	2,108	12,692	79.7	24	24	24	closed	278.7	278.7	278.7	273.4	273.4	273.4
5-Jun	16,100	2,108	13,992	77.0	24	24	24	closed	278.7	278.7	278.8	273.4	273.4	273.4
6-Jun	15,400	2,108	13,292	77.0	14	13	18	closed	278.7	278.6	278.7	273.4	273.4	273.4
7-Jun	14,200	2,133	12,067	72.5	21	13	24	closed	278.5	278.5	278.5	273.4	273.4	273.4
8-Jun	13,200	2,108	11,092	72.1	17	13	18	closed	278.7	278.6	278.7	273.4	273.4	273.4
9-Jun	13,900	2,108	11,792	70.7	24	24	24	closed	278.7	278.6	278.7	273.4	273.4	273.4
10-Jun	22,400	2,433	19,967	68.9	24	24	24	closed	279.1	279.0	279.1	273.6	273.5	273.6
11-Jun	22,100	2,233	19,867	71.6	16	15	24	closed	279.0	278.9	279.1	273.5	273.5	273.6
12-Jun	20,600	2,233	18,367	75.7	9	8	12	closed	279.0	279.0	279.0	273.5	273.5	273.5
13-Jun	22,500	2,233	20,267	77.5	9	9	12	closed	279.0	279.0	279.0	273.6	273.6	273.6
14-Jun	20,900	2,133	18,767	77.9	21	11	24	closed	278.9	278.9	279.0	273.5	273.5	273.6

Table 3. Summary of surface water elevations recorded during operation of the York Haven Fishway in 2010.

Date	River Flow (cfs)	Elevation (ft)																				
		Head Pond			Tailwater			Inside Fishway			Inside Weir			Above Counting Room			Below Fixed Wheel Gate			Counting Room		
		Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
26-Apr	19,900	278.9	278.9	278.9	274.5	274.5	274.5	273.5	273.5	273.5	278.5	278.5	278.5	278.8	278.8	278.8	277.5	277.5	277.5	278.6	278.5	278.6
27-Apr	23,200	279.0	279.0	279.0	273.5	273.5	273.6	274.3	274.0	274.7	277.6	277.5	277.6	278.9	278.9	278.9	277.4	277.4	277.5	278.8	278.8	278.8
28-Apr	30,600	279.3	279.3	279.4	273.8	273.7	273.8	274.8	274.8	274.8	277.6	277.6	277.6	279.2	279.1	279.2	277.5	277.4	277.5	279.0	279.0	279.1
29-Apr	39,800	279.7	279.7	279.8	274.4	274.4	274.5	275.3	275.1	275.5	277.9	277.8	277.9	279.6	279.6	279.6	277.6	277.6	277.6	279.5	279.4	279.5
30-Apr	44,600	280.0	280.0	280.0	274.9	274.9	274.9	275.7	275.7	275.7	278.0	278.0	278.0	279.8	279.8	279.8	277.8	277.8	277.8	279.7	279.7	279.7
1-May	39,500	279.8	279.7	279.8	274.7	274.6	274.7	275.4	275.3	275.4	277.9	277.9	278.0	279.7	279.6	279.8	277.7	277.7	277.7	279.6	279.6	279.6
2-May	34,400	279.6	279.6	279.6	274.3	274.2	274.3	275.1	275.0	275.1	278.8	278.8	278.8	279.5	279.5	279.5	279.6	279.6	279.6	279.4	279.4	279.4
3-May	35,700	280.0	279.9	280.0	275.0	274.7	275.2	275.8	275.5	276.0	278.0	277.9	278.0	279.9	279.8	279.9	277.8	277.8	277.8	279.8	279.7	279.8
4-May	33,900	279.8	279.7	279.8	274.5	274.4	274.5	275.3	275.2	275.3	277.9	277.9	277.9	279.6	279.6	279.7	277.7	277.6	277.7	279.6	279.5	279.6
5-May	31,300	279.6	279.6	279.6	274.2	274.2	274.3	275.0	275.0	275.0	277.8	277.8	277.8	279.5	279.5	279.5	277.6	277.6	277.6	279.3	279.3	279.4
6-May	28,500	279.5	279.5	279.5	274.0	273.9	274.0	274.8	274.7	274.9	277.7	277.7	277.8	279.3	279.3	279.3	277.5	277.5	277.5	279.2	279.1	279.2
7-May	26,300	279.4	279.3	279.4	273.8	273.8	273.8	274.7	274.7	274.7	277.6	277.6	277.6	279.3	279.2	279.3	277.4	277.4	277.4	279.1	279.0	279.1
8-May	23,700	279.3	279.3	279.3	273.7	273.6	273.7	274.6	274.5	274.6	277.6	277.6	277.6	279.1	279.1	279.1	277.4	277.4	277.4	279.0	279.0	279.0
9-May	22,500	279.2	279.2	279.2	273.4	273.4	273.5	274.5	274.5	274.5	277.5	277.5	277.5	279.0	279.0	279.0	277.3	277.3	277.3	278.9	278.9	278.9
10-May	23,800	279.2	279.2	279.2	273.5	273.5	273.6	274.5	274.5	274.5	277.5	277.5	277.6	279.0	279.0	279.0	277.3	277.3	277.4	278.9	278.9	278.9
11-May	24,100	279.2	279.2	279.2	273.5	273.5	273.5	274.5	274.5	274.5	277.5	277.5	277.5	279.0	279.0	279.0	277.3	277.3	277.3	278.9	278.9	278.9
12-May	25,700	279.2	279.2	279.3	273.5	273.5	273.6	274.5	274.5	274.5	277.5	277.5	277.5	279.1	279.1	279.1	277.4	277.4	277.4	279.0	279.0	279.0
13-May	30,400	279.4	279.3	279.4	273.8	273.7	273.8	274.7	274.6	274.7	277.7	277.6	277.7	279.3	279.2	279.3	277.5	277.5	277.5	279.2	279.1	279.2
14-May	42,000	279.8	279.7	279.9	274.5	274.2	274.7	275.2	275.0	275.5	277.8	277.6	278.0	279.7	279.6	279.8	277.7	277.6	277.8	279.6	279.5	279.7
15-May	47,100	280.0	280.0	280.1	274.8	274.8	274.9	275.6	275.6	275.7	278.1	278.1	278.1	279.9	279.9	279.9	277.8	277.8	277.8	279.8	279.8	279.9
16-May	45,300	280.0	280.0	280.0	274.9	274.9	274.9	275.7	275.7	275.7	278.1	278.1	278.1	279.9	279.9	279.9	277.8	277.8	277.8	279.8	279.7	279.8
17-May	40,300	279.8	279.8	279.8	274.5	274.5	274.6	275.3	275.3	275.4	277.9	277.9	277.9	279.7	279.7	279.7	277.7	277.7	277.7	279.6	279.6	279.6
18-May	36,700	279.7	279.7	279.8	274.3	274.2	274.3	275.1	275.0	275.1	277.9	277.9	277.9	279.6	279.6	279.6	277.6	277.6	277.6	279.5	279.5	279.5
19-May	33,600	279.6	279.6	279.6	274.1	274.1	274.1	275.0	275.0	275.0	277.8	277.8	277.8	279.5	279.5	279.5	277.5	277.5	277.5	279.4	279.4	279.4
20-May	31,700	279.6	279.6	279.6	274.0	274.0	274.0	274.9	274.9	274.9	277.7	277.7	277.7	279.4	279.4	279.4	277.5	277.5	277.5	279.3	279.3	279.3
21-May	30,400	279.4	279.4	279.5	273.8	273.8	273.8	274.8	274.8	274.8	277.6	277.6	277.6	279.3	279.3	279.3	277.5	277.4	277.5	279.2	279.2	279.3
22-May	29,600	279.4	279.4	279.4	273.8	273.8	273.8	274.7	274.7	274.7	277.7	277.7	277.7	279.3	279.3	279.3	277.5	277.5	277.5	279.2	279.2	279.2
23-May	27,600	279.4	279.3	279.4	273.7	273.7	273.8	274.7	274.7	274.7	277.6	277.6	277.6	279.2	279.2	279.3	277.4	277.4	277.4	279.2	279.1	279.2
24-May	32,200	279.4	279.3	279.4	273.7	273.7	273.8	274.7	274.7	274.7	277.6	277.6	277.7	279.2	279.2	279.3	277.4	277.4	277.5	279.1	279.1	279.2
25-May	33,700	279.7	279.6	279.7	274.2	274.1	274.4	275.0	274.9	275.1	277.9	277.8	277.9	279.5	279.5	279.6	277.6	277.6	277.6	279.5	279.4	279.6
26-May	26,800	279.3	279.3	279.3	273.7	273.7	273.7	274.6	274.6	274.6	277.6	277.6	277.7	279.2	279.1	279.2	277.4	277.4	277.5	279.1	279.1	279.1
27-May	23,700	279.1	279.1	279.1	273.6	273.6	273.6	274.5	274.5	274.5	277.5	277.5	277.5	279.0	279.0	279.0	277.3	277.3	277.3	279.0	278.9	279.0
28-May	20,400	279.0	279.0	279.0	273.5	273.5	273.5	274.4	274.4	274.4	277.4	277.4	277.4	278.8	278.8	278.8	277.2	277.2	277.2	278.8	278.7	278.8
29-May	18,500	278.9	278.9	278.9	273.5	273.4	273.5	274.4	274.4	274.4	277.3	277.3	277.3	278.7	278.7	278.7	277.1	277.1	277.1	278.7	278.6	278.7
30-May	17,100	278.7	278.7	278.8	273.4	273.4	273.4	274.4	274.4	274.4	277.3	277.2	277.3	278.6	278.6	278.7	277.1	277.1	277.1	278.6	278.5	278.6
31-May	16,200	278.7	278.7	278.7	273.4	273.4	273.4	274.3	274.3	274.4	277.2	277.2	277.3	278.6	278.6	278.6	277.1	277.0	277.1	278.5	278.5	278.5
1-Jun	15,900	278.7	278.7	278.7	273.4	273.4	273.4	274.3	274.3	274.3	277.2	277.2	277.3	278.6	278.6	278.6	277.1	277.1	277.1	278.5	278.5	278.5
2-Jun	14,300	278.7	278.7	278.7	273.3	273.3	273.4	274.3	274.3	274.3	277.2	277.2	277.2	278.6	278.6	278.6	277.0	277.0	277.1	278.5	278.5	278.5
3-Jun	13,900	278.6	278.6	278.6	273.3	273.3	273.4	274.3	274.3	274.3	277.2	277.2	277.2	278.5	278.5	278.5	277.0	277.0	277.1	278.4	278.4	278.4
4-Jun	14,800	278.7	278.7	278.7	273.4	273.4	273.4	274.3	274.3	274.4	277.2	277.2	277.3	278.6	278.6	278.6	277.1	277.1	277.1	278.6	278.5	278.6
5-Jun	16,100	278.7	278.7	278.8	273.4	273.4	273.4	274.4	274.3	274.4	277.3	277.3	277.3	278.7	278.6	278.7	277.1	277.1	277.1	278.6	278.6	278.6
6-Jun	15,400	278.7	278.6	278.7	273.4	273.4	273.4	274.4	274.4	274.4	277.3	277.3	277.4	278.5	278.5	278.6	277.0	277.0	277.1	278.5	278.4	278.5
7-Jun	14,200	278.5	278.5	278.5	273.4	273.4	273.4	274.3	274.3	274.3	277.2	277.2	277.2	278.4	278.4	278.4	277.0	277.0	277.0	278.4	278.3	278.4
8-Jun	13,200	278.7	278.6	278.7	273.4	273.4	273.4	274.3	274.3	274.3	277.2	277.2	277.2	278.5	278.5	278.5	277.0	277.0	277.0	278.5	278.4	278.5
9-Jun	13,900	278.7	278.6	278.7	273.4	273.4	273.4	274.3	274.3	274.3	277.1	277.1	277.2	278.5	278.5	278.5	277.0	277.0	277.1	278.4	278.4	278.5
10-Jun	22,400	279.1	279.0	279.1	273.6	273.5	273.6	274.5	274.4	274.5	277.5	277.5	277.5	279.0	278.9	279.0	277.3	277.3	277.3	278.9	278.9	278.9
11-Jun	22,100	279.0	278.9	279.1	273.5	273.5	273.6	274.5	274.5	274.5	277.5	277.4	277.5	278.9	278.9	278.9	277.3	277.2	277.3	278.8	278.9	278.9
12-Jun	20,600	279.0	279.0	279.0	273.5	273.5	273.5	274.4	274.4	274.4	277.5	277.4	277.5	278.8	278.8	278.9	277.2	277.2	277.2	278.8	278.7	278.8
13-Jun	22,500	279.0	279.0	279.0	273.6	273.6	273.6	274.4	274.4	274.5	277.5	277.5	277.5	279.0	278.9	279.0	277.3	277.3	277.3	278.9	278.9	278.9
14-Jun	20,900	278.9	278.9	279.0	273.5	273.5	273.6	274.4	274.4	274.4	277.5	277.4	277.5	278.9	278.8	279.0	277.2	277.2	277.2	278.8	278.8	278.9

Table 4. Hourly summary of American shad passage through the serpentine vertical notch fish ladder at the York Haven Hydroelectric Project in 2010.

	Date	26-Apr	27-Apr	28-Apr	29-Apr	30-Apr	1-May	2-May	3-May	4-May
Observation Time (Start)		1330	0801	0801	0801	0801	0801	0801	0801	0801
Observation Time (End)		1600	1600	1600	1700	1600	1800	1800	1600	1600
Military Time (Hours)										
0801 - 0900		-	0	0	0	3	27	62	7	0
0901 - 1000		-	0	0	0	0	7	32	4	0
1001 - 1100		-	0	0	1	1	11	24	2	1
1101 - 1200		-	0	0	0	2	3	10	0	0
1201 - 1300		-	1	1	0	6	15	8	0	1
1301 - 1400		0	0	1	0	3	10	15	1	2
1401 - 1500		0	2	0	0	3	18	4	0	0
1501 - 1600		0	2	0	1	1	7	10	0	0
1601 - 1700		-	-	-	-	-	5	7	-	-
1701 - 1800		-	-	-	-	-	4	4	-	-
1801 - 1900		-	-	-	-	-	-	-	-	-
Total Catch		0	5	2	2	19	107	176	14	4

	Date	5-May	6-May	7-May	8-May	9-May	10-May	11-May	12-May	13-May
Observation Time (Start)		0801	0801	0801	0801	0801	0801	0801	0801	0801
Observation Time (End)		1600	1600	1600	1600	1600	1600	1600	1600	1600
Military Time (Hours)										
0801 - 0900		15	20	9	0	0	0	0	0	0
0901 - 1000		8	9	2	0	0	0	1	0	0
1001 - 1100		4	4	1	0	1	0	0	0	0
1101 - 1200		9	0	0	0	1	0	2	0	0
1201 - 1300		8	2	0	1	0	0	0	0	0
1301 - 1400		6	0	1	2	0	0	0	0	0
1401 - 1500		2	2	1	2	0	0	2	0	0
1501 - 1600		2	0	0	0	0	0	0	0	1
1601 - 1700		-	-	-	-	-	-	-	-	-
1701 - 1800		-	-	-	-	-	-	-	-	-
1801 - 1900		-	-	-	-	-	-	-	-	-
Total Catch		54	37	14	5	2	0	5	0	1

Table 4. *continued*

	Date	14-May	15-May	16-May	17-May*	18-May	19-May	20-May*	21-May	22-May
Observation Time (Start)		0801	0801	0801	0801	0801	0801	0801	0801	0801
Observation Time (End)		1600	1600	1700	2300	2300	1600	1600	1600	1600
Military Time (Hours)										
0801 - 0900		1	2	10	1	0	2	0	1	0
0901 - 1000		0	2	16	0	1	0	0	2	3
1001 - 1100		1	11	10	4	0	0	1	0	0
1101 - 1200		0	7	17	3	0	2	0	0	2
1201 - 1300		0	5	9	0	2	1	4	0	1
1301 - 1400		1	5	13	3	5	0	5	1	2
1401 - 1500		0	1	5	3	2	0	1	2	0
1501 - 1600		0	4	5	0	3	0	2	0	0
1601 - 1700		-	-	4	0	-	-	1	-	-
1701 - 1800		-	-	-	1	-	-	1	-	-
1801 - 1900		-	-	-	0	-	-	0	-	-
Total Catch		3	37	89	15	13	5	15	6	8

* Observation continued until 2300 hrs; No American shad observed between 1801 hrs and 2300 hrs

	Date	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May
Observation Time (Start)		0801	0801	0801	0801	0801	0801	0801	0801	0801
Observation Time (End)		1600	1600	1600	1600	1600	1600	1600	1600	1600
Military Time (Hours)										
0801 - 0900		2	5	5	7	8	3	8	4	2
0901 - 1000		1	1	10	4	3	2	1	1	2
1001 - 1100		6	1	7	3	3	2	0	0	1
1101 - 1200		1	1	4	1	5	3	1	5	0
1201 - 1300		2	0	7	0	0	2	9	1	3
1301 - 1400		0	1	2	0	6	0	1	0	2
1401 - 1500		3	5	1	0	0	0	0	0	0
1501 - 1600		0	0	2	1	0	0	2	0	0
1601 - 1700		-	-	-	-	-	-	-	-	-
1701 - 1800		-	-	-	-	-	-	-	-	-
1801 - 1900		-	-	-	-	-	-	-	-	-
Total Catch		15	14	38	16	25	12	22	11	10

Table 4. (continued)

	Date	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun
Observation Time (Start)	0801	0801	0801	0801	0801	0801	0801	0801	0801	0801
Observation Time (End)	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Military Time (Hours)										
0801 - 0900		3	5	9	6	0	2	1	0	2
0901 - 1000		0	0	5	0	1	0	1	0	2
1001 - 1100		2	2	3	0	0	0	9	1	0
1101 - 1200		1	1	1	2	1	0	4	0	3
1201 - 1300		2	3	2	3	1	0	1	2	1
1301 - 1400		0	0	0	0	0	0	0	0	1
1401 - 1500		0	0	2	0	0	0	0	1	1
1501 - 1600		0	0	2	1	1	1	1	0	2
1601 - 1700		-	-	-	-	-	-	-	-	-
1701 - 1800		-	-	-	-	-	-	-	-	-
1801 - 1900		-	-	-	-	-	-	-	-	-
Total Catch		8	11	24	12	4	3	17	4	12

	Date	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun		
Observation Time (Start)	0801	0801	0801	0801	0801	0801		
Observation Time (End)	1600	1600	1600	1600	1600	1600	Total	%
Military Time (Hours)								
0801 - 0900		0	1	0	0		218	24.0
0901 - 1000		1	0	1	0	0	115	12.7
1001 - 1100		0	1	0	0	0	114	12.6
1101 - 1200		0	1	0	0	0	84	9.3
1201 - 1300		0	0	0	0	0	96	10.6
1301 - 1400		1	4	0	0	0	88	9.7
1401 - 1500		0	1	0	0	0	62	6.8
1501 - 1600		0	0	0	0	0	49	5.4
1601 - 1700		-	-	-	-	-	17	1.9
1701 - 1800		-	-	-	-	-	10	1.1
1801 - 1900		-	-	-	-	-	0	0.0
Total Catch		2	8	1	0	0	907	94.0

Table 5. 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 on 5 days, 15 October to 13 November 2010.

Date	15-Oct	22-Oct	29-Oct	6-Nov	13-Nov	Total
Observation Time (hrs.)	8.0	8.0	8.0	8.0	8.0	40
Water Temperature (°F)	57.2	52.7	55.4	43.3	46.4	
Gizzard Shad	2	0	3	1	0	6
Shorthead Redhorse	0	0	2	1	0	3
Yellow Perch	0	0	1	0	0	1
Walleye	4	10	25	15	7	61
Total	6	10	31	17	7	71

Table 6. 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, 15 October to 13 November 2010.

Date	River Flow (cfs)	East Channel Flow (cfs)*	Main Channel Flow (cfs)	Water Temp. (°F)	Secchi (in)			Stop Log Gate	Elevation (ft)					
					Secchi (in)				Head Pond			Tailwater		
					Avg.	Min.	Max.		Avg.	Min.	Max.	Avg.	Min.	Max.
15-Oct	26,300	3,837	22,463	57.2	22	22	22	closed	279.5	279.4	279.5	273.5	273.4	273.5
22-Oct	19,700	2,233	17,467	52.7	24	24	24	closed	279.0	278.9	279.0	273.6	273.5	273.6
29-Oct	18,800	2,108	16,692	55.4	24	24	24	closed	278.7	278.6	278.7	273.0	273.0	273.0
6-Nov	18,300	2,183	16,117	43.3	24	24	24	closed	278.8	278.8	278.8	273.5	273.5	273.5
13-Nov	17,300	2,083	15,217	46.4	24	24	24	closed	278.6	278.5	278.6	273.4	273.4	273.4

* Based on Headpond Curve (Figure 28) from August 1998 Alden Report

Table 7. Summary of surface water elevations recorded during operation of the York Haven Fishway, 15 October to 13 November 2010.

Date	River Flow (cfs)	Elevation (ft)																				
		Head Pond			Tailwater			Inside Fishway			Inside Weir			Above Counting Room			Below Fixed Wheel Gate			Counting Room		
		Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
15-Oct	26,300	279.5	279.4	279.5	273.5	273.4	273.5	274.0	273.9	274.0	276.3	276.2	276.3	279.3	279.2	279.3	276.1	276.0	276.1	279.0	278.9	279.0
22-Oct	19,700	279.0	278.9	279.0	273.6	273.5	273.6	274.4	274.3	274.4	277.4	277.4	277.4	278.8	278.7	278.8	277.3	277.2	277.3	278.6	278.6	278.6
29-Oct	18,800	278.7	278.6	278.7	273.0	273.0	273.0	273.6	273.6	273.6	276.3	276.3	276.3	278.6	275.5	278.6	276.1	276.0	276.1	278.4	278.3	278.4
6-Nov	18,300	278.8	278.8	278.8	273.5	273.5	273.5	274.0	274.0	274.0	277.3	277.3	277.3	278.6	278.6	278.6	278.1	278.1	278.1	278.5	278.5	278.5
13-Nov	17,300	278.6	278.5	278.6	273.4	273.4	273.4	273.9	273.9	273.9	277.2	277.2	277.2	278.4	278.4	278.4	277.0	277.0	277.0	278.3	278.2	278.3

FIGURES

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

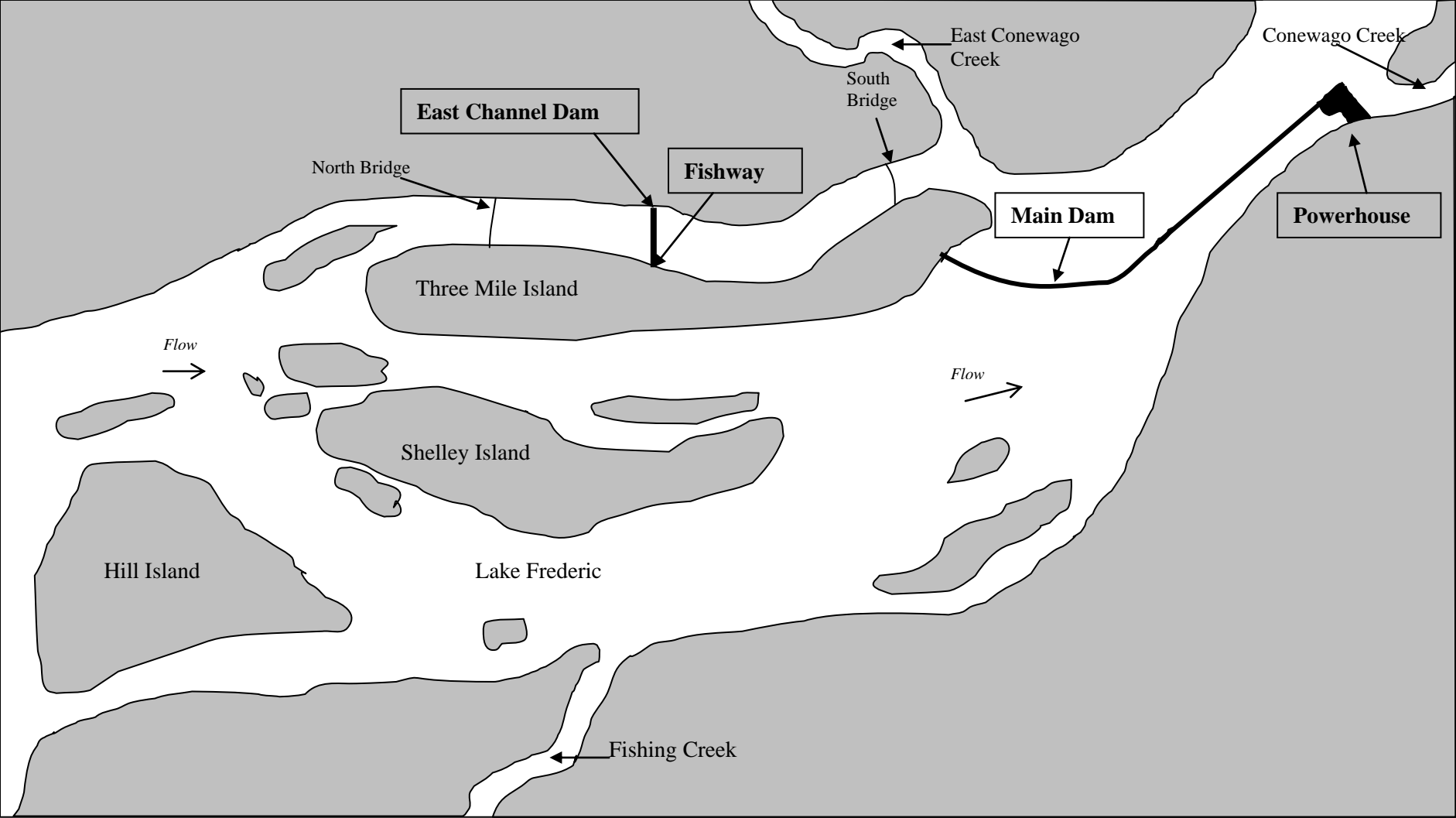


Figure 2. General Arrangement - York Haven Fishway.

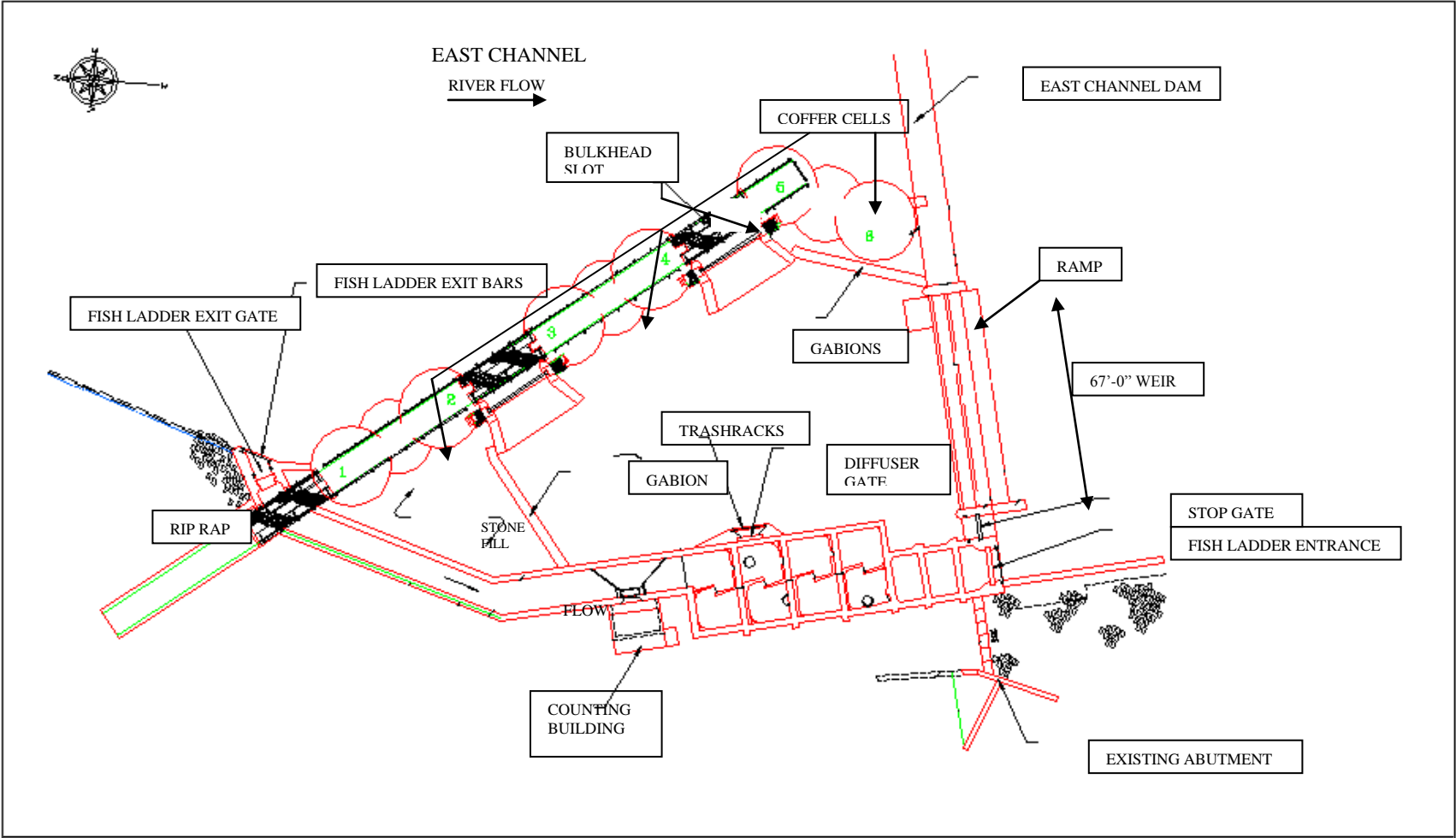


Figure 3. Plot of River Flow (x 1000 cfs) & Water Temperature (F) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2010

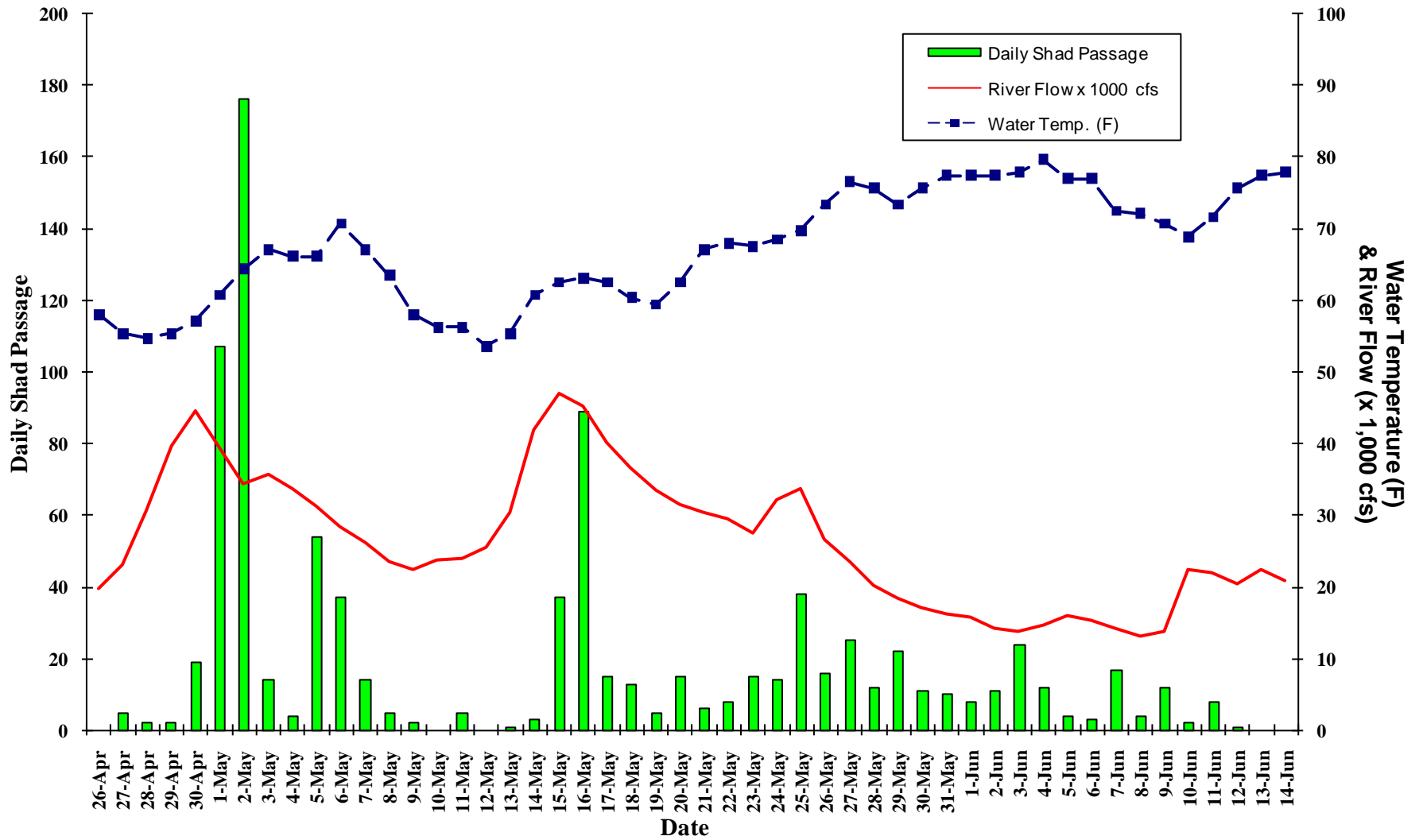


Figure 4. Plot of River Flow (x 1000 cfs) & East Channel Flow (x 1000 cfs) in Relation to the Daily American Shad Passage at the York Haven Fishway in Spring 2010

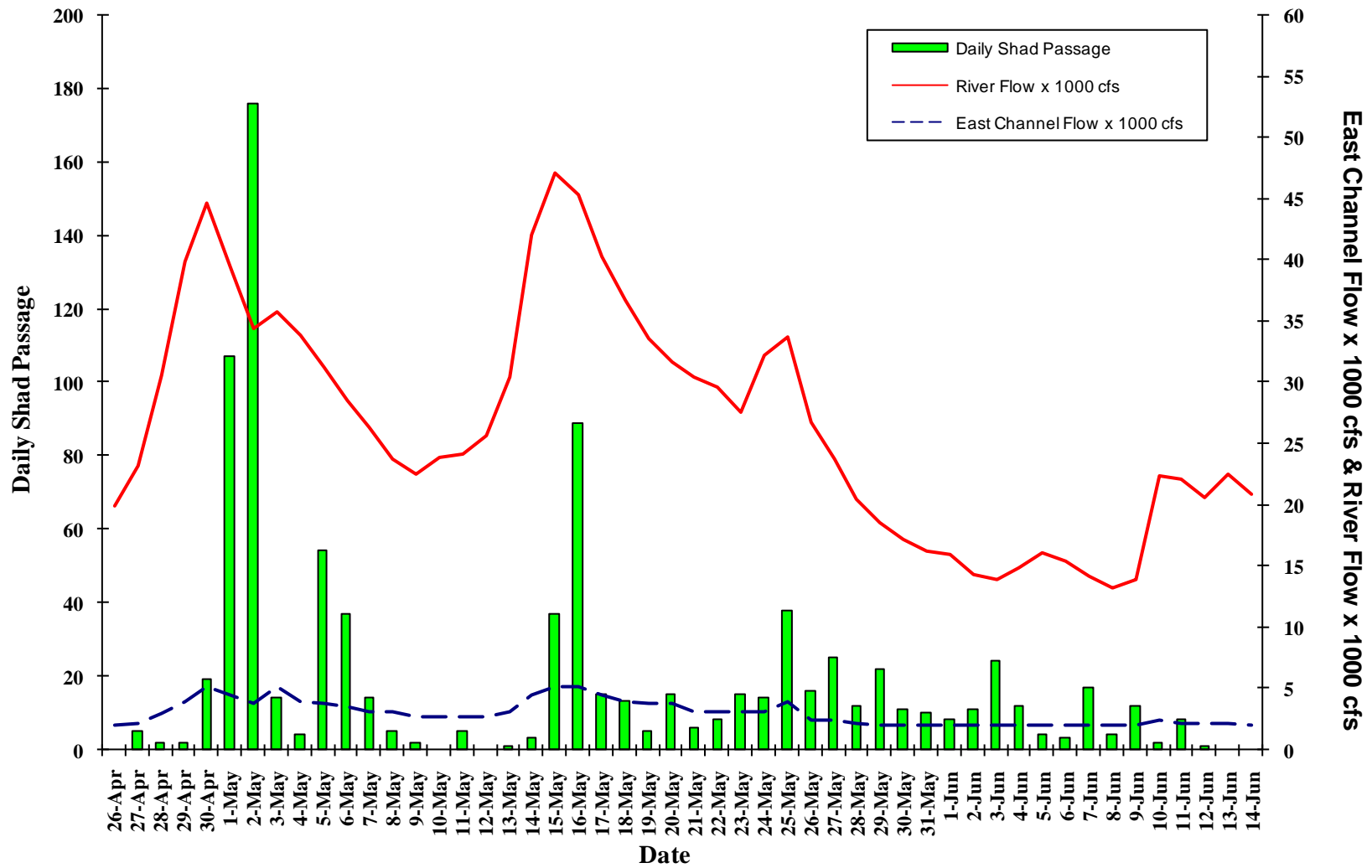


Figure 5. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River and Average Daily Water Temperature at the York Haven Power Station, 18 September to 18 November, 2010

