SUMMARY OF UPSTREAM AND DOWNSTREAM FISH PASSAGE AT THE YORK HAVEN HYDROELECTRIC PROJECT IN 2018

PREPARED FOR:

York Haven Power Company
Middletown, Pennsylvania 17057

PREPARED BY:

Kleinschmidt Associates
Strasburg, Pennsylvania 17579

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EXECUTIVE SUMMARY

The East Channel Fishway was opened on 29 March allowing volitional upstream passage. Shad passage this spring was the lowest recorded since the three lower Susquehanna River fish lifts were placed in service in 1997. Some 6,992, 1,456 and 661 shad were passed at Conowingo, Holtwood and Safe Harbor, respectively in 2018. As a result, the East Channel Fishway was not staffed during the spring spawning run for the first time since it was placed in service in 2000. Above average River flows during the 2018 spring spawning season resulted in flows spilled over the Main and East Channel Dams that exceeded springtime minimum flow requirements.

Volitional upstream passage ended on 18 December when the Fishway was closed for the year. During volitional passage, 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. However, due to above average River flows in 2018, flow in the East Channel routinely exceeded 400 cfs. River flows from 29 March to 18 December varied from 10,800 cfs to 307,000 cfs (Figure 4). During this period, River flows were less than or equal to Station hydraulic capacity (17,000 cfs) on 13 days and exceeded the upper Fishway operation criteria (150,000 cfs) on 12 days between 25 July and 29 November.

Downstream passage of adult American shad occurred from 1 May to 30 June. The forebay Sluice Gate was opened as required (~370 cfs) for two hours, Monday through Friday, throughout May and June as river flows exceeded the Stations hydraulic capacity. No physical observations of post-spawned adult American shad were noted by Station personnel.

In accordance with the Projects FERC License and 401 Water Quality Certification, the Sluice Gate was generally left opened daily from 1 October to 30 November to provide downstream passage of juvenile shad. The Sluice Gate was open 98% to 99% of the two-month period. During debris sluicing activities, the operators may have closed the sluice gate occasionally for short periods early in the morning (0600 hrs. to 0800 hrs.) during the week.

During the fall juvenile shad outmigration period, River flows never fell below 29,200 cfs (Figure 5). During this period flows, averaged 76,211 cfs and peaked at 161,000 cfs on 29 November. Average daily water temperature during the fall downstream migration period (1 October to 31 November) dropped over 25 degrees and ranged from a high of 67.5°F on 11 October to a low of 41.7°F on 30 November. Since River flows exceeded the Stations hydraulic capacity during the entire outmigration period, there was no need to cycle turbines as all available turbines operated continuously throughout the period.

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 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. Cube Hydro Partners, LLC and YHPC personnel hosted a conference call with the York Haven FPTAC on February 12th, 2018 to discuss Fishway 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. Upstream and downstream Fishway operation is provided for in the Projects FERC License (FERC, 2015) and the Pennsylvania Department of Environmental Protection Water Quality Certification (PA DEP, 2014) issued on December 15, 2015 and 19 August 2014, respectively.

Fishway operation coincides with a springtime minimum flow release. As part of the 1997 agreement and in accordance with its new License and Water Quality Certification, 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 Fishway 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.

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. During the spring spawning season, river flows in excess of spring minimum flow requirements was spilled over the Main and East Channel dams and through the Fishway.

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). Volitional passage at the Fishway is to begin on or about the 1st of April conditions permitting. Daily operation is scheduled to begin 4 days after the Safe Harbor lift passes 1,000 American shad.

2.2.2 Fishway Operation

Fishway preparations began in early March and volitional passage (staffed) began on 29 March. High flows limited the upstream passage of American shad in 2018 at the lower Susquehanna River Fish Lifts (Table 1). Excluding passage in 2011, which was greatly reduced by construction activities associated with the redevelopment of the Holtwood Project, shad passage this spring was the lowest recorded since the three lower Susquehanna River fish lifts were placed in service in 1997. Some 6,992, 1,456 and 661 shad were passed at Conowingo, Holtwood and Safe Harbor, respectively in 2018. As a result, the Fishway was not staffed during the spring spawning run for the first time since it was placed in service in 2000. Above average River flows during the 2018 spring spawning season resulted in flows spilled over the Main and East Channel Dams (Figure 3) that exceeded springtime minimum flow requirements.

The Fishway provided volitional passage through 18 December when the Fishway was closed for the year. During volitional passage, 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. However, due to the above average river flows in 2018, flow in the East Channel routinely exceeded 400 cfs. River flows from 29 March to 18 December varied from 18,000 cfs to 307,000 cfs. (Figure 4). During this period, River flows were less than or equal to station hydraulic capacity (17,000 cfs) on 13 days and exceeded the upper Fishway operation criteria (150,000 cfs) on 12 days during five discrete periods from 25 July to 29 November.

3.0 DOWNSTREAM FISH PASSAGE

The Projects recently issued FERC license and new Water Quality Certification provide for downstream passage of adult and juvenile shad. Downstream passage of adult shad is expected to occur from 1 May to 30 June while downstream passage of juvenile shad is to occur from 1 October through 30 November.

3.1 Adult Passage

When River flows exceed the sum of Project Hydraulic Capacity, and required flows through the East Channel and required flows (if any) over the Main Dam, the Project, according to its FERC License and 401 Water Quality Certification, the Station is to open and spill water via the forebay Sluice Gate (~370 cfs) to the extent practicable for a period of one to two hours during the morning on weekdays, subject to Project personnel availability and access requirements for operations and maintenance purposes. Spilling may be provided in connection with opening of the forebay Sluice Gate for purposes of passing debris.

As the Fishway was operated to allow volitional upstream fish passage, the forebay Sluice Gate was opened as required (~370 cfs) for two hours, Monday through Friday, throughout May

and June as river flows exceeded the Stations hydraulic capacity (Figure 3). No physical observations of post-spawned adult American shad were noted by Station personnel.

3.2 Juvenile Passage

During the juvenile American shad Passage Period (JASPP), 1 October to 30 November, the Project is to operate its turbines in the following order. Depending on available River flow, Unit 1-6 (Propeller Units) may be operated without restriction up to available River flow, Unit 14 (larger single Francis Unit) may be operated if River flows exceeds capacity of Units 1-6 Units and Units 7-13 and 15-20 (double Francis Units may be operated in ascending order if river flows exceeds capacity of Units 1-6 and Unit 14 during the JASPP, During the downstream juvenile passage period, the Station is to open and spill water via the Forebay Sluice Gate (~370 cfs) between the hours of 5 PM to 11 PM EST. If during the downstream passage period, River flow exceeds the sum of Project hydraulic capacity, required flows through the East Channel and required flows (if any), the Project is also to open and spill water via the Forebay Sluice Gate to the extent practicable for one to two hours during the morning, subject to Project access requirements for operations and maintenance purposes.

In accordance with the Projects FERC License and 401 Water Quality Certification, the Sluice Gate was generally left opened daily from 1 October to 30 November to provide downstream passage of juvenile shad. The Sluice Gate was open 98% to 99% of the two-month period. During debris sluicing activities, operators occasionally closed the sluice gate for short periods early in the morning (0600 hrs. to 0800 hrs.) during the week.

During the fall juvenile shad outmigration period, River flows never fell below 29,200 cfs (Figure 5). During this period flows averaged 76,211 cfs and peaked at 161,000 cfs on 29 November. Average daily water temperature during the fall downstream migration period dropped over 25 degrees and ranged from a high of 67.5°F to a low of 41.7°F. Since River flows exceeded the hydraulic capacity of the station during the entire time period, there was no need to cycle turbines as all available turbines were continuously operated during the entire outmigration period.

4.0 LITERATURE CITED

Commonwealth of Pennsylvania Department of Environmental Protection. August 19, 2014, Water Quality Certification for the York Haven Hydroelectric Project and Related Mitigation, DEP File N0. –EA67-023: York Haven Power Company, LLC, 65 pp.

Federal Energy Regulatory Commission, December 15, 2015. Order Issuing New License for York Haven Power Company, LLC. 135 pp.

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.

TABLE

Table 1. American Shad Passage and the "Perceived Effectiveness" of Fish Passage Facilities at the Four Mainstem Susquehanna River Hydroelectric Projects, 1997 to 2018.

	Conowingo (RM 10)	Holtwood (RM 24)		Safe Harbor (RM 31)		York Haven (RM 55.6)		
Year	Number Passed	Number Passed	% of Conowingo	Number Passed	% of Holtwood	Number Passed	% of Safe Harbor	% of Conowingo
1997	90,971	28,063	30.8%	20,828	74.2%			
1998	39,904	8,235	20.6%	6,054	73.5%			
1999	69,712	34,702	49.8%	34,150	98.4%			
2000	153,546	29,421	19.2%	21,079	71.6%	4,687	22.2%	**3.1%**
2001	193,574	109,976	56.8%	89,816	81.7%	16,200	18.0%	**8.4%**
2002	108,001	17,522	16.2%	11,705	66.8%	1,555	13.3%	**1.4%**
2003	125,135	25,254	20.2%	16,646	65.9%	2,536	15.2%	**2.0%**
2004	109,360	3,428	3.1%	2,109	61.5%	219	10.4%	**0.2%**
2005	68,926	34,189	49.6%	25,425	74.4%	1,772	7.0%	**2.6%**
2006	56,899	35,968	63.2%	24,929	69.3%	1,913	7.7%	**3.4%**
2007	25,464	10,338	40.6%	7,215	69.8%	192	2.7%	**0.8%**
2008	19,914	2,795	14.0%	1,252	44.8%	21	1.7%	**0.1%**
2009	29,272	10,896	37.2%	7,994	73.4%	402	5.0%	**1.4%**
2010	37,757	16,472	43.6%	12,706	77.1%	907	7.1%	**2.4%**
2011	20,571	21	0.1%	8	38.1%	0	0.0%	**0.0%**
2012	22,143	4,238	19.1%	3,089	72.9%	224	7.3%	**1.0%**
2013	12,733	2,503	19.7%	1,927	77.0%	202	10.5%	**1.6%**
2014	10,425	2,589	24.8%	1,336	51.6%	8	0.6%	**0.1%**
2015	8,341	5,286	63.4%	3,896	73.7%	43	1.1%	**0.5%**
2016	14,276	6,718	47.1%	4,242	63.1%	178	4.2%	**1.2%**
2017	16,248	3,169	19.5%	2,007	63.3%	62	3.1%	**0.4%**
2018*	6,992	1,456	20.8%	661	45.4%	*	*	*
AVG			**31.4%**		**68.7%**		**7.6%**	**1.7%**
	1,240,164	393,239		299,074		31,121		

** Due to limited shad passage at downstream lifts, the York Haven Fishway was not manned.*

FIGURES

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

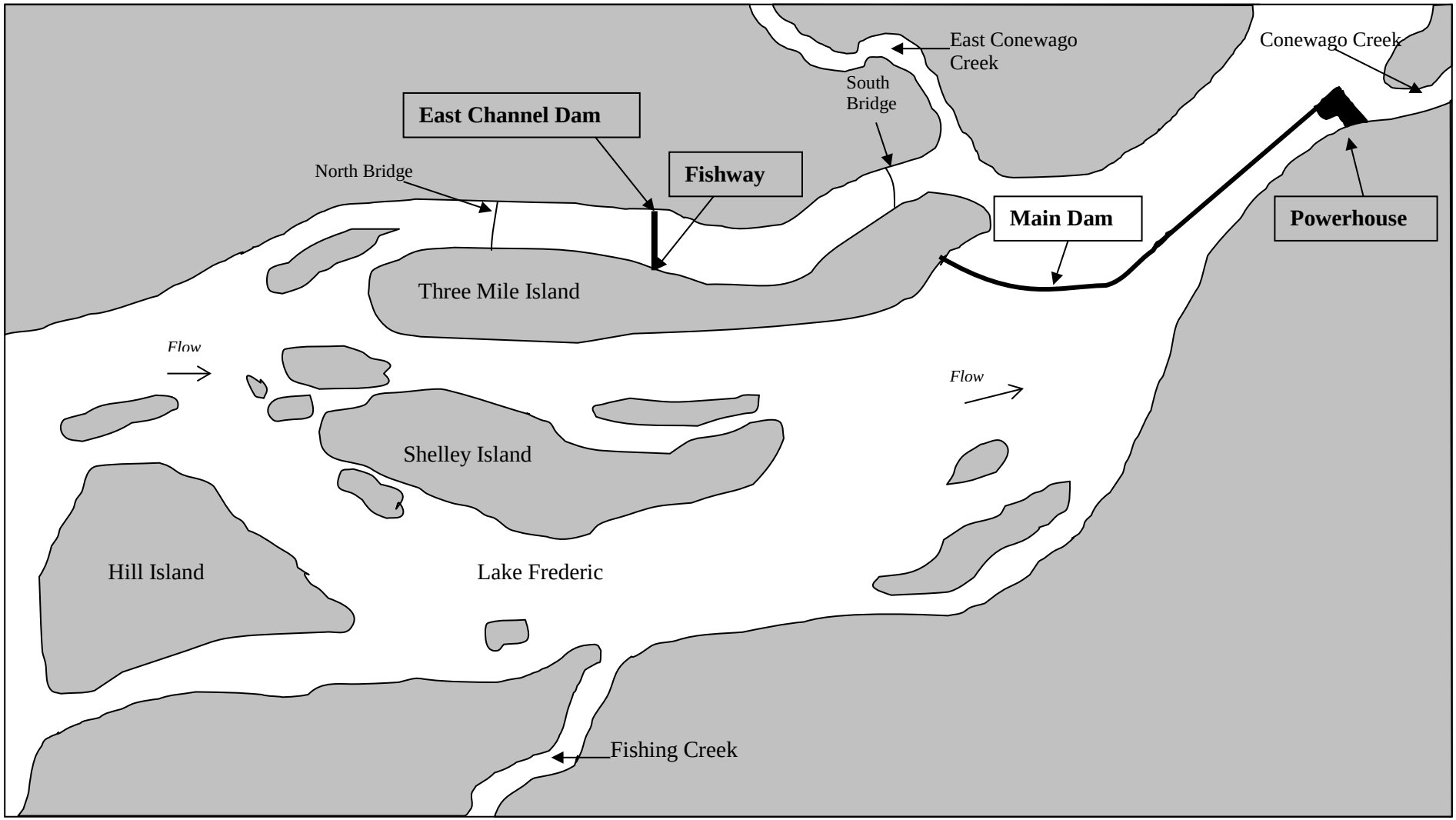

Figure 2. General Arrangement - York Haven Fishway.

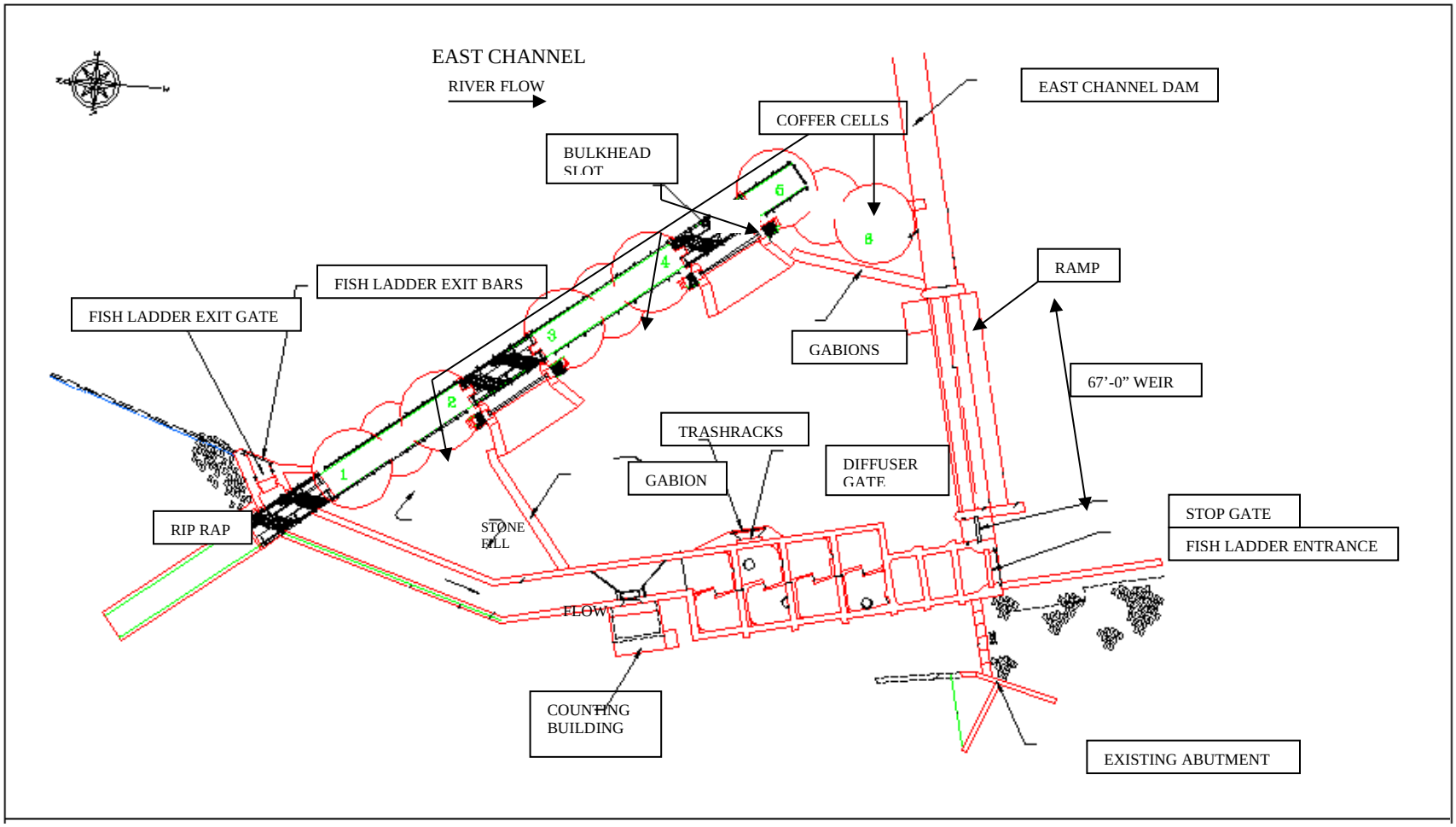

Figure 3. Plot of River Flow (x 1000 cfs) & Water Temperature (F) at the York Haven Hydroelectric Project in 2018 and 18-year average flow values (2000-2017)

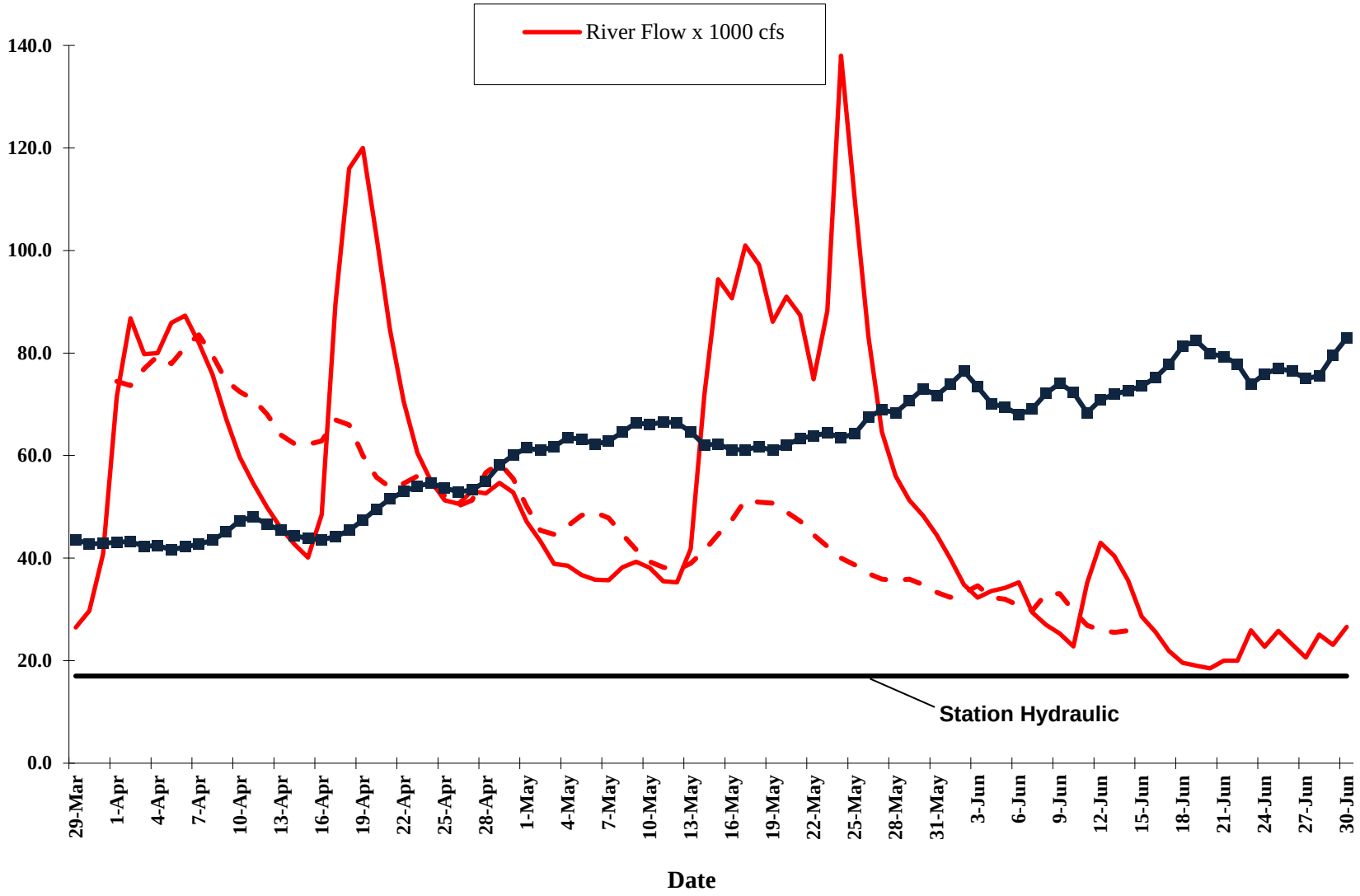

Figure 4. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River, 29 March to 18 December 2018.

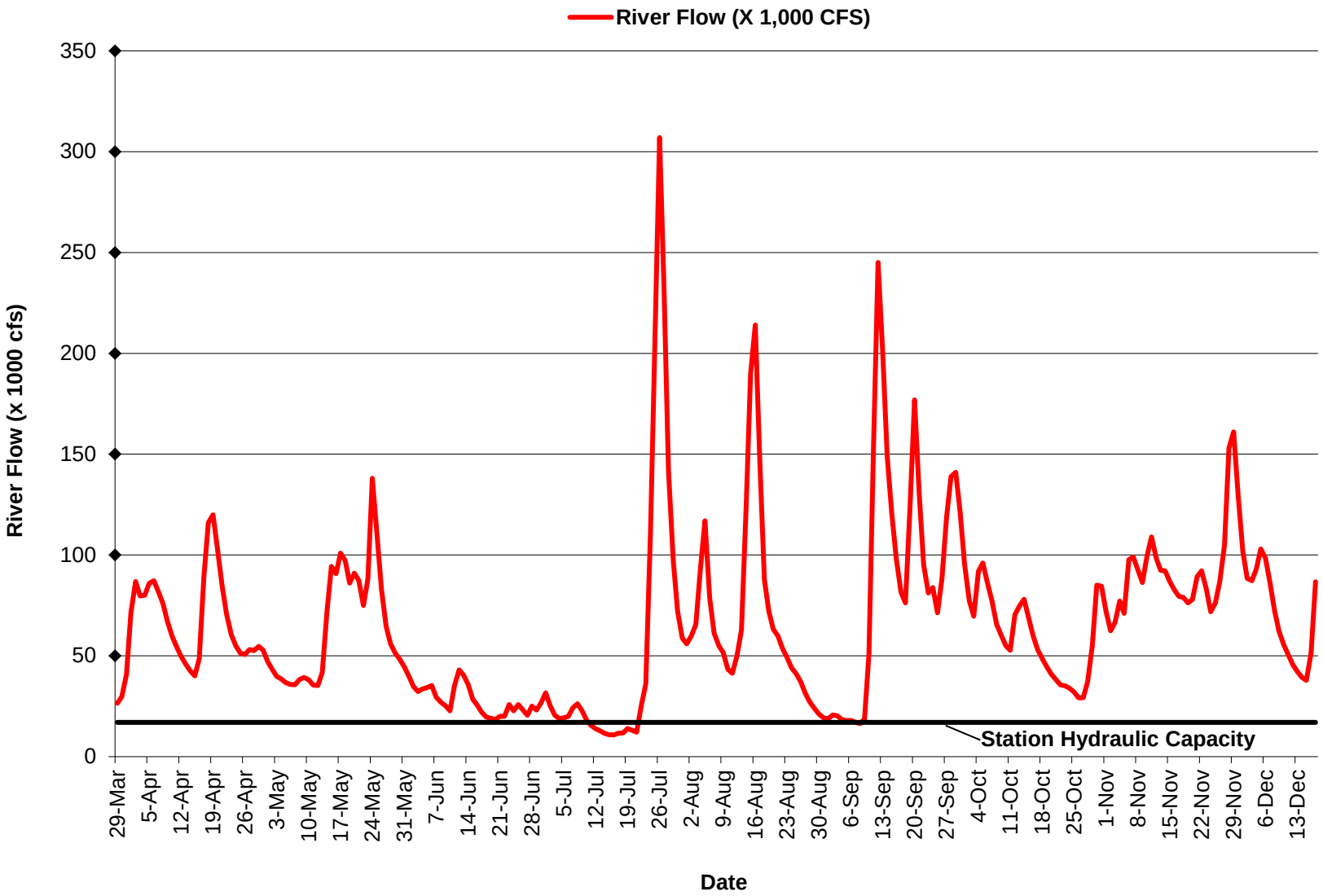

Figure 5. Plot of River Flow (cfs) at the USGS Harrisburg Station (#01570500) on the Susquehanna River and Average Daily Water Temperature at the York Haven Power Station, 1 October to 30 November 2018.