

**FINAL STUDY REPORT  
STUDY TO ASSESS TRIBUTARY ACCESS IN  
CONOWINGO POND  
RSP 3.13**

**CONOWINGO HYDROELECTRIC PROJECT**

**FERC PROJECT NUMBER 405**



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## EXECUTIVE SUMMARY

Exelon Generation Company, LLC (Exelon) has initiated with the Federal Energy Regulatory Commission (FERC) the process of relicensing the 573-megawatt Conowingo Hydroelectric Project (Conowingo Project). The current license for the Conowingo Project was issued on August 14, 1980 and expires on September 1, 2014. FERC issued the final study plan determination for the Conowingo Project on February 4, 2010, approving the revised study plan with certain modifications.

The final study plan determination required Exelon to conduct a Tributary Access Study, which is the subject of this report. The objectives of this study are to: 1) identify potential blockages associated with Project operations to fish and recreational boating access into Conowingo Pond tributaries at the reservoir confluence under several commonly encountered water levels; 2) if access to fish is denied at certain water levels due to Project operations, identify those fish species most affected, when it occurs, and at what water levels; 3) develop potential mitigation options to enhance fish or recreational access if problems are encountered.

An initial study report (ISR) was filed on February 22, 2011, containing Exelon's 2010 study findings. An initial study report meeting was held on March 9, 10 and 11, 2011 with resource agencies and interested members of the public. Formal comments on the ISR including requested study plan modifications were filed with FERC on April 27, 2011 by Commission Staff, several resource agencies and interested members of the public. Exelon filed responses to the ISR comments with FERC on May 27, 2011. On June 24, 2011, FERC issued a study plan modification determination order. The order specified what, if any, modifications to the ISRs should be made. For this study, FERC's June 24, 2011 order required no modifications to the original study plan. An updated study report (USR) was filed on January 23, 2012 addressing comments from stakeholders received at the March ISR meeting. This final study report is being filed with the Final License Application for the Project.

Pool levels above Conowingo Dam fluctuate due to several variables including natural river flow, operational status of upstream generating stations, and the operational status of the turbines at Conowingo Dam. When river flows and input from other sources exceed the operational capacity of Conowingo Dam, flood gates at Conowingo Dam are used to regulate pool elevation. Between January 2004 and September 2010, Conowingo Pond elevations ranged from 104.0 to 110.1 (NGVD) which is within the 101.2 to 110.2 NGVD range permitted by the FERC license. During the peak recreation period (weekends from Memorial Day weekend through Labor Day) Pond levels were maintained at 107.2 NGVD or above as mandated by FERC.

Two Conowingo Pond tributary access surveys for recreational boaters and fishes were conducted between June 29 and July 30, 2010; one at full pool (109.2 National Geodetic Vertical Datum (NGVD) and the other at minimum recreational pool 107.2 (NGVD). Minimum Recreational Pool is maintained on weekends from Memorial Day weekend through Labor Day weekend by license agreement. At other times, the operating license permits elevations as low as 101.2 NGVD but levels below 105.2 NGVD are rare. Additional data were as recorded on September 18, 2010 when a pool level of about 106.2 NGVD was maintained for several hours due to an unrelated study.

A total of 18 tributaries were surveyed (9 backwater and 9 shoreline). Backwater tributaries are characterized by a broad mouth at their point of confluence with Conowingo Pond while shoreline tributaries are narrower and end abruptly at their point of confluence with the Pond. The shoreline tributaries as a group offer limited or no recreational access to boaters and only Fishing Creek, the largest of the shoreline tributaries, may attract some resident fish such as suckers (Family: Catostomidae) during their spring spawning runs.

Among the nine backwater tributaries, five stand out because of their recreational value. Peters Creek, Conowingo Creek, Glenn Cove, and Broad Creek contain public boat launches, thus elevating their recreational value. The fifth, Muddy Creek, does not have a public boat launch and is included in this group because of its size. Conowingo Pond elevation did influence recreational boat access at three of the four tributary boat launches surveyed. At full pool (109.2 NGVD), boats with an air draft of greater than 5.2 ft cannot navigate under the arches of the railroad bridge at the confluence of Peters Creek or greater than 4.9 ft at the railroad bridge at the confluence of Conowingo Creek. At minimum recreational pool (107.2 NGVD), a water depth of 2-3 ft near the boat launches at Peters Creek, Conowingo Creek and Broad Creek may exclude larger boats. At a Pond level of 106.2 NGVD, most motorized boats are excluded from these three boat launches. At 106.2 NGVD the Glen Cove Marina boat launch remains usable but the approach to the gas dock is less than 1.5 ft. While none of the backwater tributaries became totally closed to recreational boaters at the lowest pool level recorded (105.8 NGVD) during the current surveys, the navigable portions were reduced by varying distances.

Fish access into Conowingo Pond tributaries, both backwater and shoreline, was not monitored directly, but was based on past studies, stream topography and the lack of obstacles to migration observed at 106.2 NGVD. Fish access into Conowingo Pond tributaries is limited to a greater extent by the natural features of each tributary located above full pool (109.2 NGVD) rather than obstacles discovered below 109.2 NGVD.

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## LIST OF ABBREVIATIONS

cfs	cubic feet per second
CD	Conowingo Datum
Exelon	Exelon Generation Company, LLC
ft	feet
FERC	Federal Energy Regulatory Commission
GPS	Global Positioning System
h	hours
HP	Horse Power
ILP	Integrated Licensing Process
ISR	Initial Study Report
LIDAR	Light Detection and Ranging
MDNR	Maryland Department of Natural Resources
mi	mile/s
MRPSP	Muddy Run Pumped Storage Project
NGVD	National Geodetic Vertical Datum
NOI	Notice of Intent
PAD	Pre-Application Document
PADEP	Pennsylvania Department of Environmental Protection
PFBC	Pennsylvania Fish and Boat Commission
PSP	Proposed Study Plan
RSP	Revised Study Plan
PBAPS	Peach Bottom Atomic Power Station
SAV	submerged aquatic vegetation
SRBC	Susquehanna River Basin Commission
USFWS	United States Fish and Wildlife Service
USR	Updated Study Report

## **1.0 INTRODUCTION**

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

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

Formal comments on the PSP were filed with FERC on November 22, 2009 by Commission staff and several resource agencies. Exelon filed a Revised Study Plan (RSP) for the Project on December 22, 2009. FERC issued the final study plan determination for the Project on February 4, 2010, approving the RSP with certain modifications.

An initial study report (ISR) was filed on February 22, 2011, containing Exelon's 2010 study findings. An initial study report meeting was held on March 9, 10 and 11, 2011 with resource agencies and interested members of the public. Formal comments on the ISR including requested study plan modifications were filed with FERC on April 27, 2011 by Commission Staff, several resource agencies and interested members of the public. Exelon filed responses to the ISR comments with FERC on May 27, 2011. On June 24, 2011, FERC issued a study plan modification determination order. The order specified what, if any, modifications to the ISRs should be made. For this study, FERC's June 24, 2011 order required no modifications to the original study plan. An updated study report (USR) was filed on January 23, 2012 addressing comments from stakeholders received at the March ISR meeting. This final study report is being filed with the Final License Application for the Project.

The objectives of this study are to: 1) identify potential blockages associated with Project operations to fish and recreational boating access into Conowingo Pond tributaries at the reservoir confluence under several commonly encountered water levels; 2) if access to fish is denied at certain water levels due to Project operations, identify those fish species most affected, when it occurs, and at what water levels; 3) develop potential mitigation options to enhance fish or recreational access if problems are encountered.

Separate field studies were scheduled as near as possible to full pool (109.2 National Geodetic Vertical Datum (NGVD)<sup>1</sup> and minimum recreational pool (107.2 NGVD). By license agreement, Exelon maintains a minimum recreation pool during weekends from Memorial Day weekend through Labor Day weekend.

Conowingo dam, the lower most dam on the Susquehanna River creates a 14 mile long reservoir that is commonly called Conowingo Pond. Pond levels fluctuate daily due to river flow, the operation of upstream generating stations, and the total discharge from Conowingo Dam's generators and spill gates. Spill gates are generally utilized to maintain pond elevation within permitted levels when inflow exceeds the capacity of Project generators. Even though the FERC license permits operation at water levels from 101.2 to 110.2 (NGVD), levels below 105.2 NGVD are rare due to the operational needs of Peach Bottom Atomic Power Station (PBAPS) and Muddy Run Pumped Storage Project (MRPSP).

Some information on fish accessibility to Conowingo Pond tributaries is available from published studies and reports. Two tributaries to Conowingo Pond, Fishing Creek and Muddy Creek, were assessed for impediments to fish migration and habitat suitability for anadromous fish in 1993 (Carline *et al.* 1994). Adult alosid (herring) biomonitoring studies in Fishing Creek, Peters Creek and Muddy Creek from 1999 through 2001 (Normandeau Associates 1999a, 1999b, 2000, 2001) documented the numbers of adult alosids found in those tributaries in May and June.

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<sup>1</sup> Subtract 0.7 ft from National Geodetic Vertical Datum to convert to Conowingo Datum (CD).

## **2.0 METHODS**

### **2.1 Selection of Tributaries and Water Levels to be Included in the Field Study**

Preliminary field investigations of the Conowingo Pond tributaries were conducted on 14 and 15 June 2010 to identify which tributaries would be included in the detailed surveys. The original 14 Conowingo Pond tributaries identified in the RSP were augmented with three un-named tributaries on the Lancaster County shoreline of Conowingo Pond and with Burkins Run on the York County shore. Each of the 18 tributaries was visited at least twice (once for each survey). Two tributary access surveys, one at 109.2 NGVD and the other at 107.2 NGVD, were scheduled between 30 June, 2010 and 30 July, 2010. Conowingo Pond elevation was maintained at 109.2 NGVD  $\pm$ 0.5 ft from 0930 to 1530 h on 30 June, 2010 and 1 July, 2010, and on 29 and 30 July, 2010 pond elevation was maintained at 107.2 NGVD  $\pm$ 0.5 ft from 0830 to 1330 h. An additional opportunistic survey was conducted on 18 September, 2010 at selected tributaries when Conowingo Pond elevation was lowered to below 106.2 NGVD for a 7.5 h period to accommodate a Light Detection and Ranging (LIDAR) Survey.

### **2.2 Equipment**

A 16 ft flat-bottom aluminum boat with a 25 HP outboard motor was used for each survey. Water depth was measured with an Eagle Fish ID 128 Depth Finder or a 10 ft long section of PVC pipe marked with one ft graduations. This pipe was also used to measure air draft (vertical clearance from water level to overhead obstruction) at culverts and bridge arches. All depth and air-draft measurements recorded on 30 June and 1 July, 2010 were normalized to 109.2 NGVD by adding or subtracting the difference in actual Pond elevation from 109.2 NGVD to all depth measurements made on both days. Pond elevation and depths recorded on 29 and 30 July, 2010 were normalized to 107.2 NGVD. A Garmin GPS 60 or GPSMAP 60Cx navigator was used to determine location (latitude and longitude) of depth measurements, limits of boat navigation, and location of the first riffles (if present). Photographs of the tributaries and boat launches were taken with a Sony model DSC-P200 digital camera. Distance measurements were estimated with the ruler feature available on the Google Earth website. The accuracy of this ruler varies with magnification, so eye altitude levels of 1,500 ft or lower were utilized to maximize the accuracy of these estimates.

### **2.3 Establish the Frequency of Various Pool Level Ranges**

Semi-hourly elevation data for Conowingo Pond from January 2004 through September 2010 were provided by Exelon and used to generate yearly duration curves of Pond elevation. These data were also

used to generate duration curves for more selective periods such as weekends between Memorial Day and Labor Day when peak recreational boating activity occurs on Conowingo Pond.

### **3.0 RESULTS AND DISCUSSION**

#### **3.1 General Characteristics of Conowingo Tributaries**

All of the 18 tributaries ([Figure 3.1-1](#)) that were selected for the tributary access study discharge into Conowingo Pond, but they vary greatly in their size, recreational value and ecological significance. These tributaries can be broadly categorized into backwater or shoreline types ([Table 3.1-1](#)). Backwater tributaries are characterized by a broad mouth at their point of confluence with Conowingo Pond while shoreline tributaries are narrower and end abruptly at their point of confluence with the Pond. The eight shoreline tributaries as a group offer limited, if any, boat access at pond elevations above 107.7 NGVD and then mostly as temporary harbors of refuge for boaters caught off guard by sudden storms. Three of these shoreline tributaries (Wissler Run, Burkins Run, and Robinson Run) are inaccessible to boats at full pond 109.2 NGVD due to their small size. The East shore of Conowingo Pond is bordered by The Norfolk Southern Rail Line. Thus all Lancaster (PA) and Cecil County (MD) tributaries of Conowingo Pond have railroad bridges or culverts that cross over the entrances to these tributaries.

#### **3.2 Accessibility of Conowingo Tributaries to Recreational Boats**

High water levels (109.2 NGVD and higher) may limit the size of boats that launch from two locations on the Lancaster County side of Conowingo Pond. The three-span railroad bridge across the mouth of Peters Creek with an air draft of 5.2 ft and the five-span railroad bridge across the mouth of Conowingo Creek with an air draft of 4.9 ft limits the size of power boats that can be launched at these two boat launches. The major features and recreational boat accessibility of each tributary visited are summarized in [Table 3.2-1](#). Only six of the 18 tributaries visited during the surveys had estimated discharges of greater than one cubic foot per second (cfs). Four of the low-discharge (< 1 cfs) tributaries (Funks Run, Police Cove, Hopkins Cove, and Glen Cove) are in the backwater group and offer more recreational opportunities for boaters than the eight low discharge shoreline tributaries listed in [Table 3.2-1](#). The eight backwater tributaries as a group offer the most recreational access to boaters and provide more spawning or nursery habitat for resident fishes of Conowingo Pond as well as potential habitat for migratory American eels (*Anguilla rostrata*) and clupeids (herrings).

Boat access to Peters Creek, Conowingo Creek, Glen Cove and Broad Creek is especially important since they contain public boat launches and two (Peters Creek, and Glen Cove) contain full-service marinas. The Peters Creek marina (known as Peach Bottom Marina) and Glen Cove Marina are owned by Exelon and operated by contractors. A third privately-owned marina was formerly located in Fishing Creek but was destroyed in 1984 due to flooding caused by a severe local storm. All that remains of this marina

today is an abandoned launch ramp just inside the railroad arch. This abandoned ramp is narrow but functional at full pond (109.2 NGVD). At 107.2 NGVD, the water depth at this ramp is 1.0 ft and extensive shoals with 1.5-2.0 ft water depths make it difficult to reach the mouth of Fishing Creek from the river.

Small boat (16 ft total length or less) access is currently available at all four operational boat launches inside the backwater tributaries when pond elevations are above 107.0 NGVD. At 107.2 NGVD however, the approach to the Peach Bottom Marina launch is as shallow as 3.0 ft, the approach to Conowingo Creek Boat Launch is 2.0 ft deep, and the approach to the Broad Creek Launch is only 1.5 ft deep. Boaters approaching these three launches are further hampered by dense beds of submerged aquatic vegetation (SAV) that reach the surface of the water at Pond elevations of 107.2 NGVD or less. The principal SAV species observed included *Myriophyllum spicatum*, *Elodea canadensis*, *Ceratophyllum demersum*, *Vallisneria americana* and *Potamogeton spp.*

During an opportunistic tributary access survey conducted on 18 September, 2010 when Conowingo Pond was between 105.8 and 106.0 NGVD, Glen Cove Launch was the only one of the four tributary boat launches with sufficient water at the boat ramp; the depth at this launch was 2.3 ft at the end of the ramp and the approach to the Glen Cove Marina gas dock was 1.5 ft. The Peach Bottom Marina Launch, Conowingo Creek Launch and the Broad Creek Launch were too shallow to launch most motorized boats.

In addition to the tributary boat launches, there are two non-tributary boat launches on Conowingo Pond. The Dorsey Park Launch at PBAPS and the Muddy Creek Boat Launch maintained by the Pennsylvania Fish and Boat Commission were accessible to boaters at the lowest reservoir level (105.8 NGVD) observed on 18 September, 2010.

### **3.3 Fish Access to Conowingo Tributaries**

Fish access into Conowingo Pond tributaries has been raised as a potential problem especially if low Pond levels expose migration barriers that may not be present at higher Pond elevations. A 3.4-ft fluctuation in Pond elevation during the present study did not reveal any migration barriers that were not apparent at full pool elevation.

The majority of resident fish that inhabit Conowingo Pond are warm water species that prefer the conditions found in the open waters of the Pond. A few resident fish such as white suckers (*Catostomus commersoni*) may seek out some of the larger tributaries in early spring when tributary temperatures rise above river temperature, but the majority of the resident fish in Conowingo Pond do not require access

into the tributaries for spawning or feeding purposes. The shallow shoreline areas of backwater tributaries in Conowingo Pond provide spawning habitat for most members of the sunfish (Family: Centrachidae) and catfish (Family: Ictaluridae) families and nursery areas for a multitude of species. During the summer months, large schools of young gizzard shad (*Dorosoma cepedianum*) are often observed near the water surface in these backwater tributaries.

Each of the larger Conowingo Pond tributaries has natural or man-made features that block or limit fish access. A 6-10 ft waterfall 0.6 mi above the mouth of Fishing Creek forms a natural barrier to fish movement from the Pond. Steep cascades in Peters Creek (1.3 miles upstream of mouth), Conowingo Creek (0.5 mi upstream of mouth), and Muddy Creek (1.5 mi above mouth) are obstacles to migrating adult fish. A 36 ft concrete dam at the Broad Creek Memorial Scout Reservation holds back the waters of Broad Creek to form Lake Aaron A. Straus. This dam is located about 3.2 miles above its confluence with Conowingo Pond and blocks all upstream fish movement past that point.

### **3.4 Anadromous Fish in Conowingo Pond**

Carline *et al.* (1994) studied the impediments to fish passage and the habitat suitability for anadromous fish of two Conowingo Pond tributaries from 1993 to 1994. He selected Fishing Creek and Muddy Creek because both met the water quality, substrate type and minimum 5.0 cfs flow requirement for river herring (blueback herring (*Alosa aestivalis*) and alewife (*Alosa pseudoharengus*)). Carline *et al.* (1994) documented multiple blockages (natural and man-made) in both streams. Since his studies were limited to Pennsylvania tributaries he did not study other Conowingo Pond tributaries (Conowingo Creek and Broad Creek) that may meet the 5.0 cfs flow requirement but are located primarily in Maryland.

The Conowingo East Fish Lift has passed over 1.8 million anadromous fish (American shad (*Alosa sapidissima*), river herring and hickory shad (*Alosa mediocris*)) above Conowingo Dam from 1997 through 2010 ([Table 3.4-1](#)). Prior to 1997, most of these anadromous fish were transported by truck to upriver locations. A five year biomonitoring program was initiated in 1999 to document the utilization of selected Susquehanna River tributaries (including Fishing Creek, Peters Creek and Muddy Creek) by anadromous fishes (Normandeau Associates 1999a, 1999b, 2000, 2001). Weekly sampling by electrofishing from a boat (Muddy Creek) or pram raft (Fishing Creek and Peters Creek) was conducted during May and June of 1998, 1999, 2000, and 2001. The total catch of anadromous fish from this effort was two American shad found in Muddy Creek in 2001. No river herring were recorded for any of the three Conowingo tributaries sampled even though a record 193,574 American shad and 292,379 river herring were released into Conowingo Pond by the East Fish Lift in 2001 ([Table 3.4-1](#)). In comparison, a

total of 22 adult American shad was caught in the Conestoga River in 2001 under the same biomonitoring effort. This suggests that American shad are not attracted into Conowingo Pond tributaries due to their small size and prefer larger tributaries such as the Conestoga River. Muddy Creek, with a total length of 17.2 mi and a 71.9 square mile catchment area is much smaller than the 50 plus mile long Conestoga River with a total catchment of 491 square miles. Based on length and catchment size, Muddy Creek is the largest of the tributaries entering Conowingo Pond followed next by the 17 mile long Broad Creek with a 40.6 square mile catchment.

### **3.5 Conowingo Pool Elevation Duration Data**

Examination of yearly Conowingo Pool elevation duration curves from 2004 through September 2010 ([Figure 3.4-1](#)) shows a similar pattern. In most years, the yearly ranges were similar ([Table 3.4-2](#)). Of greater interest to recreational boaters is the pool levels they will encounter during the height of the recreational boating season from Memorial Day through Labor Day. By license agreement, Exelon maintains a minimum recreational pool of 107.2 NGVD on weekends (from 1900 h on Friday night through 2400 h on Sunday night) from Memorial Day weekend through Labor Day. Weekends-only pool elevation curves ([Figure 3.4-2 and Table 3.4-3](#)) for the peak recreation period in Conowingo Pond shows that the minimum recreation pool level of 107.2 NGVD was effectively maintained during peak recreation periods from 2004 through 2010. During non peak periods, Pond elevations ranged from a low of 104.1 to a high of 110.1 NGVD between January 2004 and September 2010 ([Table 3.4-2](#)).

#### 4.0 CONCLUSIONS

Three Conowingo Pond tributary access surveys were conducted from late June through mid September, 2010 to assess recreational boat access and to document potential blockages to fish migration at three Pond elevations (109.2  $\pm$ 0.5, 107.2  $\pm$ 0.5, and 106.2  $\pm$ 0.5 NGVD). Nine of the 18 tributaries included in the surveys have limited if any recreational boat access. The remaining nine tributaries are of the backwater type and are accessible to recreational boaters for varying distances (up to 9,135 ft in Broad Creek at a full Pond elevation of 109.2 (NGVD). Four backwater tributaries (Glen Cove, Broad Creek, Peters Creek and Conowingo Creek) contain public boat launches. All four boat launches are accessible to recreational power boats at Full Pond (109.2 NGVD) and minimum recreational Pond (107.2 NGVD) but only Glen Cove boat launch remained usable when Pond elevation was lowered to 105.9 (NGVD). Recreational boaters also have access to two non-tributary launches (Dorsey Park and Muddy Creek Access) that remained usable at 105.9 (NGVD). Current FERC regulations require that Conowingo Pond elevations are maintained at or above the minimum recreational Pool (107.2 NGVD) on weekends from Memorial Day weekend through Labor Day weekend.

No evidence was found that fish access into Conowingo Pond tributaries was affected by obstacles that might be exposed at lowered Pond levels, at least not within the Pond levels experienced during the current study (109.2 to 105.8 (NGVD)). Anadromous herring and American shad that have been introduced into Conowingo Pond by the Conowingo East Fish Lift have not been attracted into Conowingo Pond tributaries in any significant numbers as evidenced by an extensive sampling effort that produced two adult American shad inside Muddy Creek following the release of over 193,000 American shad and over 290,000 herring into Conowingo Pond in 2001. The warmwater resident fishes of Conowingo Pond have year round access to Pond tributaries but primarily utilize the shallow shoreline areas inside the confluence of backwater tributaries for spawning and nursery purposes.

In summary, it is evident that recreational boat access at tributary boat launches begins to be impacted at Pond elevations below 107.2 NGVD. When Pond elevation reaches 105.9 NGVD, recreational boat access is denied at three of the four tributary boat launches. There is no evidence that fish access to the Conowingo tributaries is denied at certain water levels.

## 5.0 REFERENCES

- Carline, R.F., J.F. Manchung, and D. Genito. 1994. Impediments to fish passage and habitat suitability for anadromous fish in Pennsylvania tributaries to the Susquehanna River-Phase I. Prepared by Penn State University, School of Forest Resources, for Pennsylvania Fish and Boat Commission, State College, PA. 62pp.
- Normandeau Associates, Inc. 1999a. Summary report on 1998 alosid biomonitoring in Conowingo Pond and selected tributaries on the Susquehanna River. Prepared for Pennsylvania Fish and Boat Commission, State College, PA.
- Normandeau Associates, Inc. 1999b. Final report on 1999 adult alosid biomonitoring in selected small tributaries to the Susquehanna River. Prepared for Pennsylvania Fish and Boat Commission, State College, PA.
- Normandeau Associates, Inc. 2000. Final report on biomonitoring for adult alosids in selected small tributaries to the Susquehanna River in 2000. Prepared for Pennsylvania Fish and Boat Commission, State College, PA.
- Normandeau Associates, Inc. 2001. Report on biomonitoring for adult alosids in selected large tributaries to the Susquehanna River in 2001. Prepared for Pennsylvania Fish and Boat Commission, State College, PA.
- Normandeau Associates Inc., 2010. Summary of operation at the Conowingo Dam East Fish Passage Facility, Spring 2010. Report prepared by Normandeau Associates, Inc. for Exelon Generation Company, LLC, August 2010.
- Susquehanna River Basin Commission. 2006. Conowingo Pond Management Plan. Publication No. 242. Susquehanna River Basin Commission. Harrisburg, PA.

**TABLE 3.1-1: LIST OF CONOWINGO POND TRIBUTARIES SURVEYED JUNE-SEPTEMBER, 2010.**

<b>Backwater Tributaries</b>	<b>State/Shore</b>	<b>Shoreline Tributaries</b>	<b>State/Shore</b>
Funks Run	MD-E	Wissler Run	PA-E
Conowingo Creek	MD-E	Fishing Creek	PA-E
Peters Creek	PA-E	Benton Hollow	PA-E
Police Cove	MD-W	Un-named Tributary No.1, above Peters Creek.	PA-E
Hopkins Cove	MD-W	Haines Branch	PA-E
Glen Cove (Peddler Run)	MD-W	Un-named Tributary No. 2, below Haines Br.	PE-E
Broad Creek	MD-W	Un-named Tributary No. 3 above Conowingo. Creek	MD-E
Michaels Run	PA-W	Burkins Run	PA-W
Muddy Creek	PA-W	Robinson Run	PA-W

E=east shore; W= west shore

**TABLE 3.2-1: SMALL BOAT ACCESSABILITY (NAVIGABLE DISTANCE) OF CONOWINGO POND BACKWATER AND SHORELINE TRIBUTARIES AT THREE POND LEVELS (NATIONAL GEODETIC VERTICAL DATUM), JUNE-SEPTEMBER, 2010**

Tributary	Distance (ft) from confluence to limit of navigation			Flow > 1.0 cfs	Boat Launch	Overhead Obstruction	Air Draft (ft) at El.109.2
	El. 109.2	El. 107.2	El. 106.2				
	<i>Backwater Tributaries</i>						
Funks Run	624	600	180	no	no	RR arch	4.8
Conowingo Creek	1,875	1,740	1,690	yes	yes	RR bridge	4.9
Peters Creek	1,422	1,035	786	yes	yes	RR bridge	5.2
Hopkins Cove	1,224	1,224		no	no	no	
Glen Cove	966	900	825	no	yes	no	
Broad Creek	9,135	8,820	7,575	yes	yes	Rt. 623 Bridge	11-13
Michaels Run	1,164	900		yes	no	no	
Muddy Creek	4,125	4,080		yes	no	no	
Police Cove	537	510		no	no	no	
	<i>Shoreline Tributaries</i>						
Wissler Run	0			no	no	small culvert	0
Fishing Creek	438	75	0	yes	no	RR arch	20±
Benton Hollow	0			no	no	RR arch	7.9
Un-named tributary. #1	0			no	no	RR arch	8.0
Haines Branch	0			no	no	RR arch	6.5
Un-named tributary.#2	0			no	no	RR arch	6.0
Un-named tributary.#3	0			no	no	RR arch	6.3
Burkins Run	0			no	no	no	
Robinson Run	0			no	no	no	

**TABLE 3.4-1: ANADROMOUS FISH PASSED BY THE CONOWINGO EAST FISH LIFT  
INTO CONOWINGO POND, 1997-2010**

<b>Year</b>	<b>American Shad</b>	<b>Blueback Herring</b>	<b>Alewife</b>	<b>Hickory Shad</b>	<b>Total</b>
1997	90,971	242,815	63	0	333,849
1998	39,904	700	6	0	40,610
1999	69,712	130,625	14	0	200,351
2000	153,546	14,963	2	0	168,511
2001	193,574	284,921	7,458	0	485,953
2002	108,001	2,037	74	6	110,118
2003	125,135	530	21	0	125,686
2004	109,360	101	89	0	109,550
2005	68,926	4	0	0	68,930
2006	56,899	0	0	4	56,903
2007	25,464	460	429	0	26,353
2008	19,914	1	4	0	19,919
2009	29,272	71	160	0	29,503
2010	37,757	4	1	0	37,762
<b>Total</b>	<b>1,128,435</b>	<b>677,232</b>	<b>8,321</b>	<b>10</b>	<b>1,813,998</b>

Source: (Normandeau Associates, Inc. 2010)

**TABLE 3.4-2: YEARLY SUMMARY OF CONOWINGO POND ELEVATION DATA, 2004-2010.**

	2004	2005	2006	2007	2008	2009	2010 <sup>2</sup>
Cumulative Percent	Pond Elevation (ft) NGVD						
0	109.9	110.0	109.9	110.1	110.1	110.0	109.8
5	109.3	109.3	109.4	109.4	109.4	109.2	109.3
10	109.1	109.1	109.2	109.3	109.2	109.0	109.1
15	109.0	109.0	109.1	109.2	109.0	108.8	108.9
20	108.9	108.9	109.0	109.0	108.9	108.7	108.8
25	108.8	108.8	109.0	108.9	108.8	108.6	108.7
30	108.7	108.7	108.9	108.8	108.7	108.5	108.5
35	108.7	108.6	108.8	108.7	108.5	108.4	108.4
40	108.6	108.5	108.7	108.6	108.4	108.2	108.3
45	108.5	108.4	108.6	108.5	108.3	108.1	108.1
50	108.4	108.3	108.5	108.3	108.2	108.0	108.0
55	108.3	108.1	108.4	108.2	108.1	107.9	107.9
60	108.2	108.0	108.3	108.1	107.9	107.8	107.8
65	108.1	107.9	108.2	107.9	107.8	107.6	107.7
70	108.0	107.8	108.1	107.8	107.7	107.5	107.5
75	107.8	107.6	107.9	107.7	107.5	107.4	107.4
80	107.7	107.4	107.8	107.5	107.4	107.2	107.2
85	107.5	107.3	107.6	107.3	107.1	107.0	107.0
90	107.3	107.0	107.3	107.0	106.9	106.8	106.8
95	106.8	106.5	106.9	106.5	106.5	106.4	106.4
100	104.7	104.2	104.3	104.7	104.7	104.9	104.9

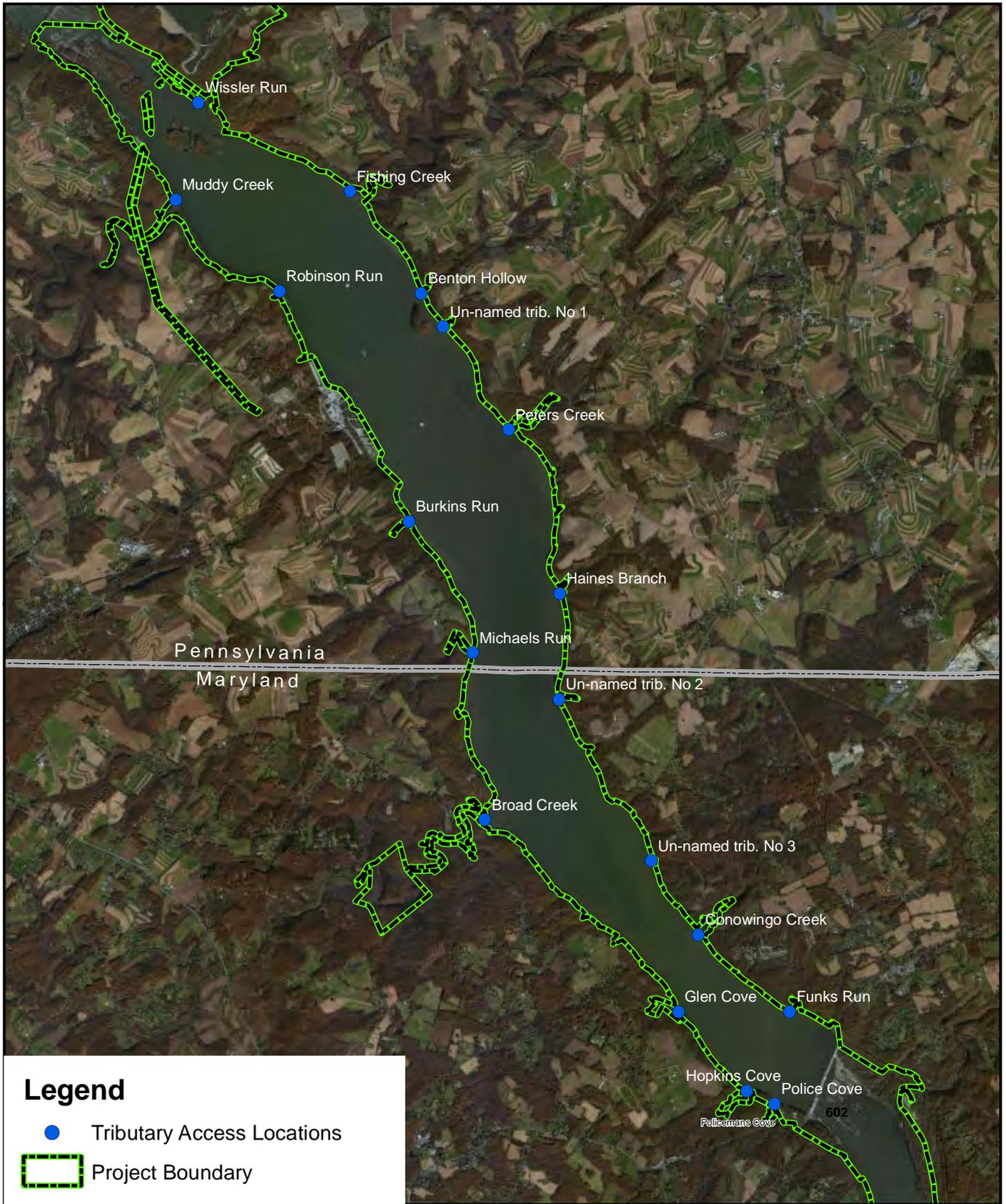
<sup>2</sup> January through 30 September 2010 only

**TABLE 3.4-3: YEARLY SUMMARY OF CONOWINGO POND ELEVATION DATA DURING PEAK RECREATION PERIODS (WEEKENDS FROM MEMORIAL DAY WEEKEND THROUGH LABOR DAY<sup>3</sup>), 2004-2010.**

	2004	2005	2006	2007	2008	2009	2010 <sup>4</sup>
Cumulative Percent	Pond Elevation (ft) NGVD						
0	109.9	109.9	109.9	110.0	110.0	110.0	109.7
5	109.4	109.5	109.5	109.7	109.7	109.5	109.4
10	109.2	109.3	109.4	109.6	109.5	109.4	109.3
15	109.1	109.3	109.3	109.5	109.4	109.3	109.2
20	109.0	109.2	109.2	109.4	109.4	109.2	109.1
25	108.9	109.1	109.1	109.3	109.3	109.1	109.0
30	108.8	109.0	109.1	109.2	109.2	109.1	109.0
35	108.7	108.9	109.0	109.1	109.1	109.0	108.9
40	108.7	108.8	108.9	109.0	109.0	108.9	108.8
45	108.6	108.7	108.9	108.8	108.8	108.8	108.7
50	108.5	108.6	108.8	108.6	108.7	108.8	108.6
55	108.4	108.5	108.7	108.5	108.6	108.7	108.5
60	108.3	108.4	108.7	108.4	108.5	108.6	108.4
65	108.3	108.3	108.6	108.2	108.4	108.6	108.3
70	108.2	108.2	108.5	108.1	108.2	108.5	108.2
75	108.1	108.0	108.4	108.0	108.1	108.4	108.1
80	108.0	107.9	108.3	107.8	108.0	108.4	108.0
85	107.9	107.8	108.2	107.8	107.8	108.3	108.0
90	107.8	107.7	108.0	107.7	107.7	108.1	107.9
95	107.6	107.6	107.8	107.5	107.6	107.9	107.7
100	107.2	107.2	107.4	107.2	107.4	107.5	107.5

<sup>3</sup> Includes 1900 h Friday through 2400 h Sunday.

<sup>4</sup> January through 30 September 2010 only



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**CONOWINGO HYDROELECTRIC PROJECT  
PROJECT NO. 405**

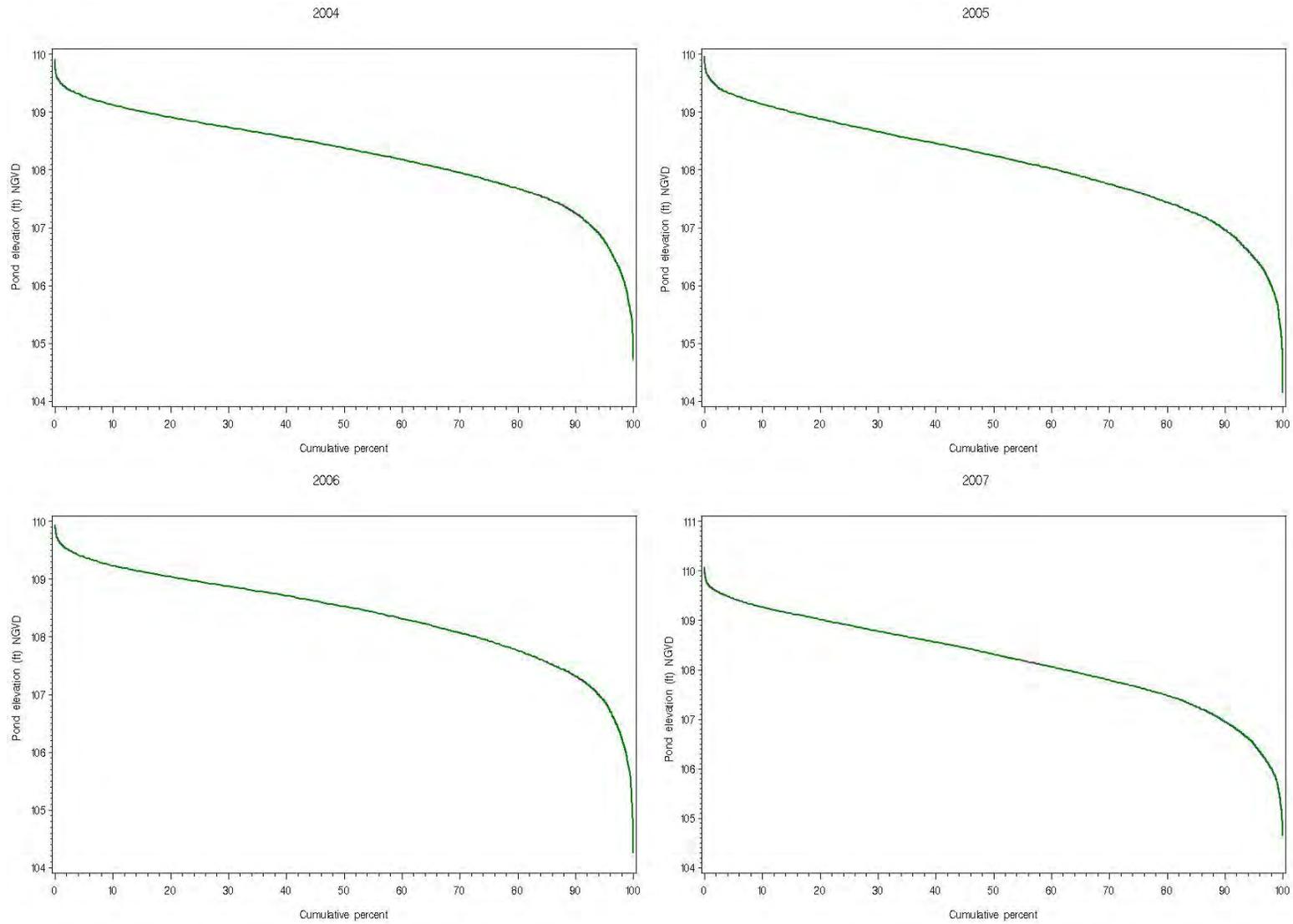
**Figure: 3.1-1  
Figure Title: Location of Conowingo Pond  
Tributaries Surveyed,  
June-September, 2010.**

1 inch = 1.4 miles

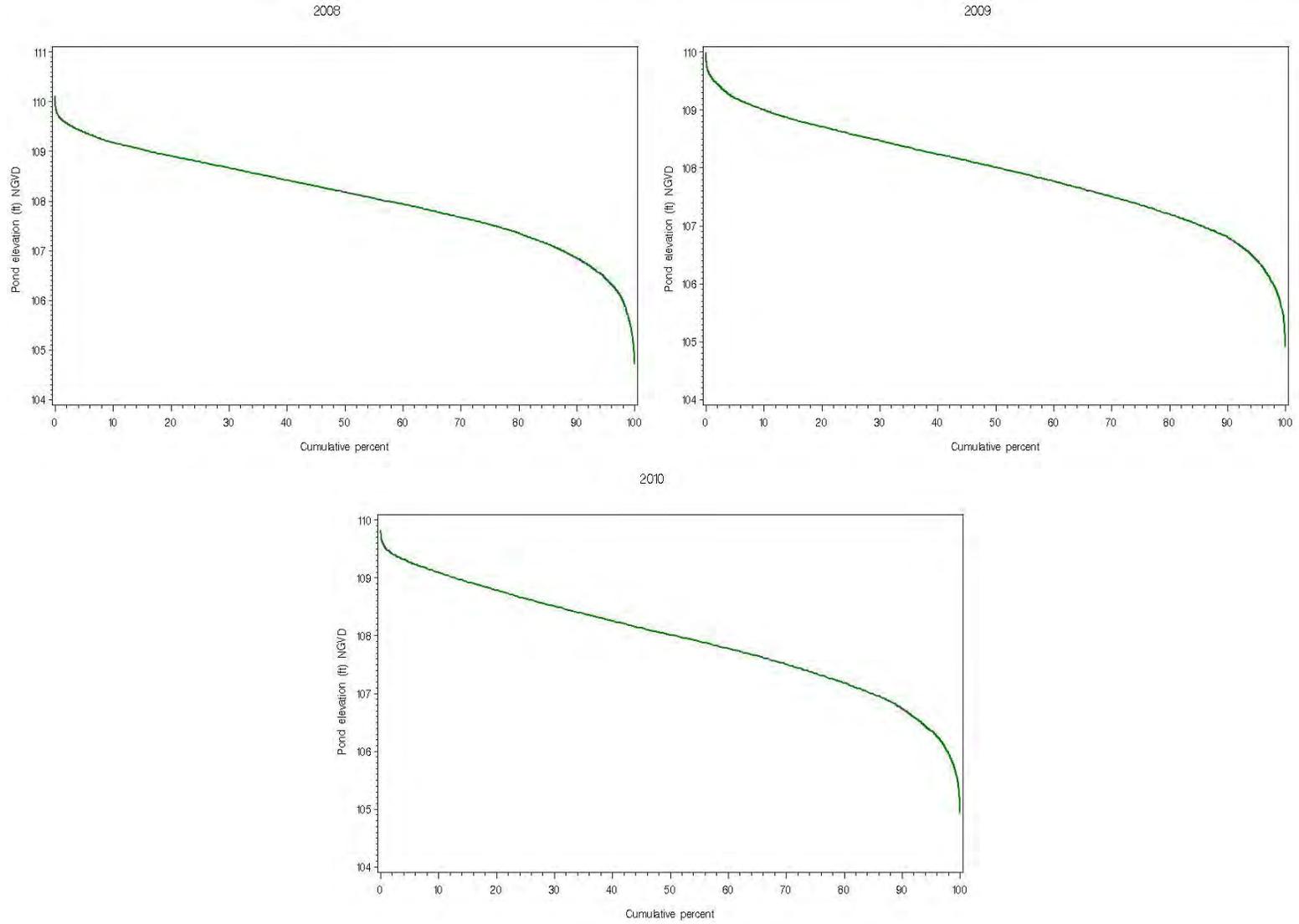
0 0.5 1 2 Miles

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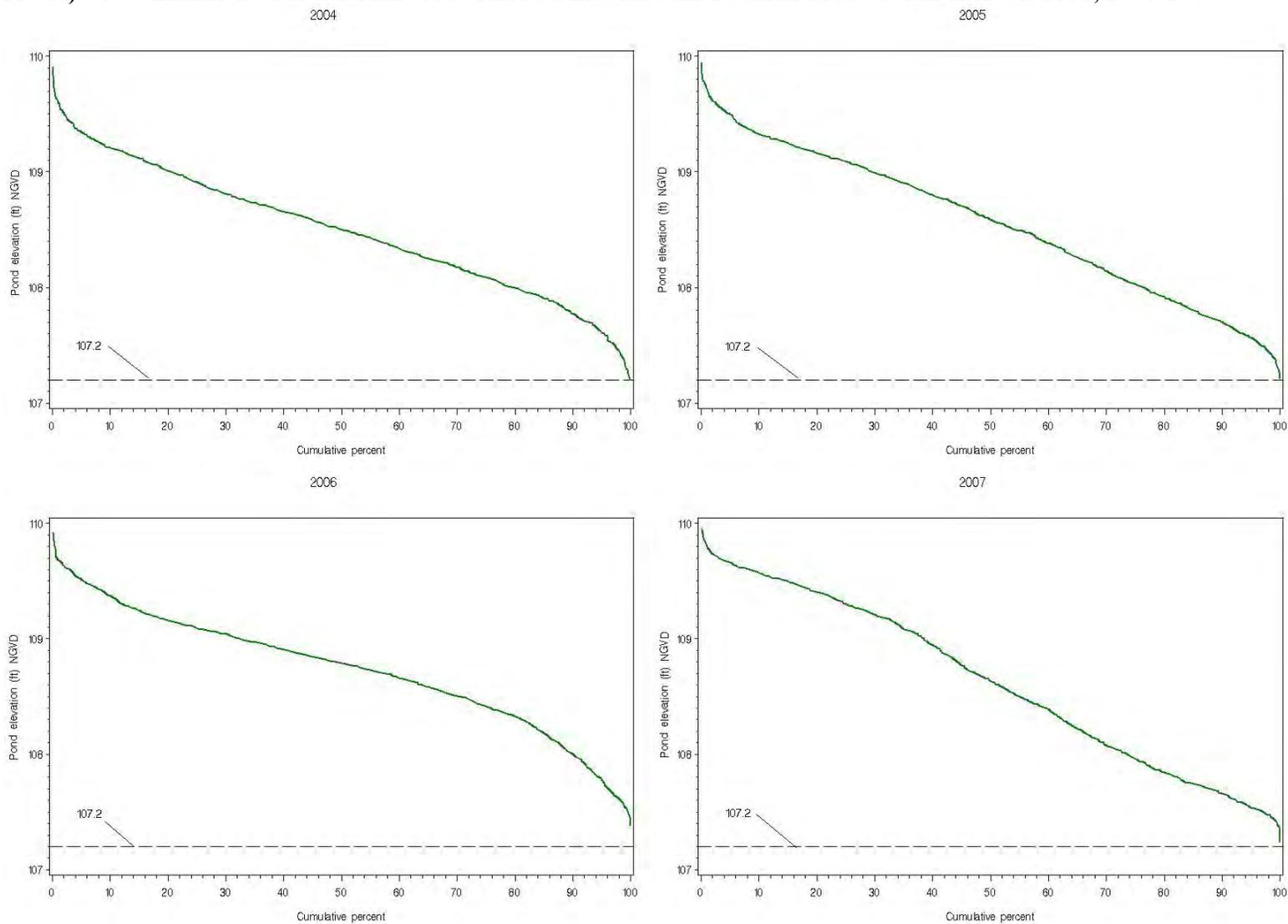
**FIGURE 3.4-1: YEARLY DURATION CURVES OF CONOWINGO POND ELEVATIONS (NATIONAL GEODETIC VERTICAL DATUM), 2004–2010.**



**FIGURE 3.4-1: CONTINUED.**

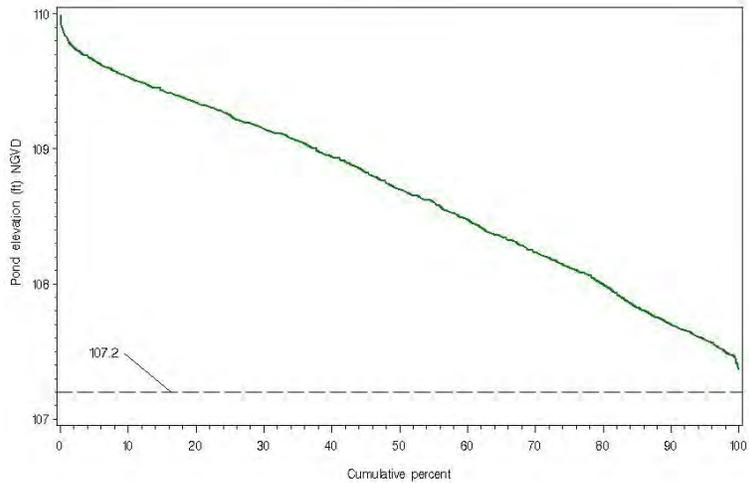


**FIGURE 3.4-2: YEARLY DURATION CURVES OF CONOWINGO POND ELEVATIONS (NATIONAL GEODETIC VERTICAL DATUM) ON WEEKENDS FROM THE SATURDAY BEFORE MEMORIAL DAY UNTIL LABOR DAY, 2004–2010.**

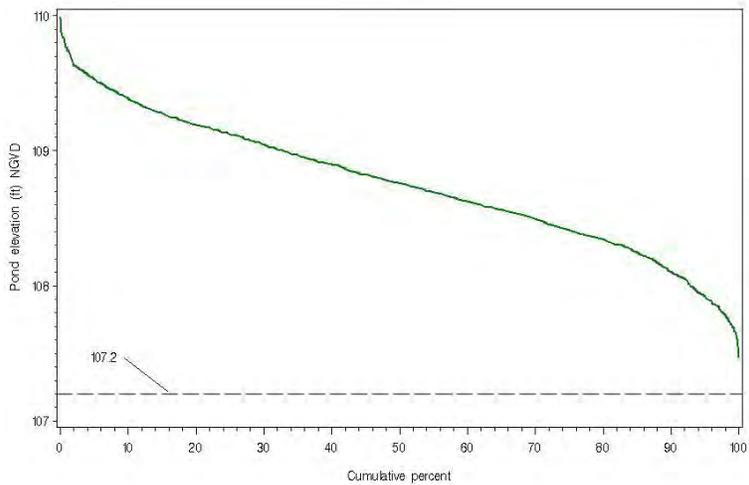


**FIGURE 3.4-2: CONTINUED.**

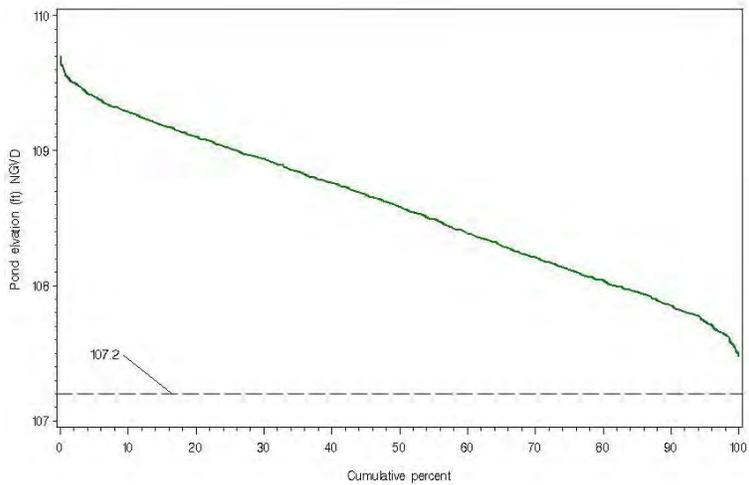
2008



2009



2010



**APPENDIX A- WATER DEPTH AND AIR DRAFT DATA COLLECTED IN OR NEAR  
CONOWINGO POND TRIBUTARIES**

**APPENDIX TABLE A-1: GPS DATA COLLECTED IN OR NEAR CONOWINGO POND TRIBUTARIES DURING PRELIMINARY TRIBUTARY ACCESS SURVEYS ON 14-15 JUNE, 2010**

<b>Tributary Name</b>	<b>Date</b>	<b>Time</b>	<b>Pond El (NGVD).</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Description</b>
Muddy Creek	6/14/2010	0908	107.8	39	39.166	76	10.172	90 ft below 1st riffle
Robinson Run	6/14/2010	0945	108.0	39	46.620	76	16.728	confluence with river
Burkins Run	6/14/2010	1005	108.3	39	44.589	76	15.193	confluence with river
Burkins Run	6/14/2010	1005	108.3	39	44.583	76	15.230	1st riffle
Michaels Run	6/14/2010	1038	108.3	39	43.563	76	14.630	limit of navigation
Michaels Run	6/14/2010	1038	108.3	39	43.583	76	14.626	1st riffle
Broad Creek	6/14/2010	1142	108.4	39	41.492	76	15.168	limit of navigation.
Broad Creek	6/14/2010	1142	108.4	39	41.474	76	15.190	1st riffle
Hopkins Cove	6/14/2010	1258	108.5	39	39.443	76	11.425	limit of navigation.
Police Cove	6/14/2010	1311	108.5	39	39.402	76	10.951	limit of navigation.
Wissler Run	6/15/2010	0818	108.0	39	48.274	76	17.700	limit of navigation.
Wissler Run	6/15/2010	0818	108.0	39	48.200	76	17.689	1st riffle
Fishing Creek	6/15/2010	0839	108.1	39	47.522	76	15.848	limit of navigation. & 1st riffle
Benton Hollow	6/15/2010	0905	107.8	39	46.620	76	15.100	limit of navigation.
Benton Hollow	6/15/2010	0905	107.8	39	46.621	76	15.087	1st riffle
Unnamed trib. No 1	6/15/2010	0920	107.8	39	46.320	76	14.855	limit of navigation.
Unnamed tributary. No 1	6/15/2010	0925	107.8	39	46.334	76	14.840	1st riffle
Peters Creek	6/15/2010	0950	107.9	39	45.454	76	13.840	limit of navigation.
Peters Creek	6/15/2010	0950	107.9	39	45.476	76	13.824	1st riffle
Haines Branch	6/15/2010	1019	107.7	39	43.966	76	13.455	limit of navigation.
Unnamed tributary. No 2	6/15/2010	1032	107.7	39	43.029	76	13.456	limit of navigation.
Unnamed tributary. No 3	6/15/2010	1048	107.7	39	41.604	76	12.374	limit of navigation.
Conowingo Creek	6/15/2010	1109	107.7	39	41.185	76	11.616	limit of navigation.
Conowingo Creek	6/15/2010	1109	107.7	39	41.200	76	11.601	1st riffle
Funks Run	6/15/2010	1150	107.7	39	40.346	76	10.676	limit of navigation.

**APPENDIX TABLE A-2: WATER DEPTH AND AIR DRAFT DATA (NORMALIZED TO EL. 109.2 NGVD) COLLECTED IN OR NEAR CONOWINGO POND TRIBUTARIES ON 30 JUNE, 2010 AND 1 JULY, 2010**

<b>Tributary</b>	<b>Date</b>	<b>Time</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Water Depth (ft)</b>	<b>Air Draft (ft)</b>	<b>Description</b>
Wissler Run	6/30/2010	1100	39	48.279	76	17.697	1.6		confluence with river
Fishing Creek	6/30/2010	1124	39	47.402	76	15.994	1.6		shoal at approach
Fishing Creek	6/30/2010	1130	39	47.507	76	15.937	4.1-7.1	20±	at arch
Fishing Creek	6/30/2010	1141	39	47.538	76	15.840	2.1		limit of navigation.
Benton Hollow	6/30/2010	1200	39	46.612	76	15.104	2.0-2.7	7.7	at arch
Un-named tributary No 1	6/30/2010	1215	39	46.321	76	14.847	1.6	7.9	at arch
Peters Creek	6/30/2010	1230	39	45.423	76	14.092	4.2-4.6	5.2	at upstream arch
Peters Creek	6/30/2010	1230	39	45.414	76	14.078	4.0-4.6	5.2	at middle arch
Peters Creek	6/30/2010	1246	39	45.48	76	14.031	4.2-6.0		channel approaching launch
Peters Creek	6/30/2010	1250	39	45.501	76	13.982	4.6		at launch
Peters Creek	6/30/2010	1252	39	45.474	76	13.913	2.7	8.2	at 1st road bridge
Haines Branch	6/30/2010	1313	39	43.966	76	13.466	1.5-3.0	6.5	inside RR arch
Un-named tributary No 2	6/30/2010	1327	39	43.026	76	13.458	4.0	6.0	inside RR arch
Michaels Run	6/30/2010	1342	39	43.431	76	14.455	7.9		confluence with river
Michaels Run	6/30/2010	1350	39	43.476	76	14.527	3.9		450 ft inside confluence
Michaels Run	6/30/2010	1400	39	43.576	76	14.608	1.9		limit of navigation.
Burkins Run	6/30/2010	1419	39	44.589	76	15.207	1.8		confluence with river
Robinson Run	6/30/2010	1452	39	46.615	76	16.733	1.7		confluence with river
Muddy Creek	6/30/2010	1510	39	47.414	76	17.941	20.1		confluence with river
Muddy Creek	6/30/2010	1515	39	47.386	76	17.909	9.0		inside creek
Muddy Creek	6/30/2010	1520	39	47.325	76	18.040	8.8		inside creek
Muddy Creek	6/30/2010	1525	39	47.229	76	18.078	7.8		inside creek
Muddy Creek	6/30/2010	1530	39	47.152	76	18.134	6.8		inside creek
Muddy Creek	6/30/2010	1532	39	47.080	76	18.256	7.8		inside creek
Muddy Creek	6/30/2010	1535	39	47.023	76	18.346	6.8		inside creek

**APPENDIX TABLE A-2: CONTINUED.**

<b>Tributary</b>	<b>Date</b>	<b>Time</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Water Depth (ft)</b>	<b>Air Draft (ft)</b>	<b>Description</b>
Muddy Creek	6/30/2010	1540	39	47.132	76	18.461	7.3		inside creek
Muddy Creek	6/30/2010	1543	39	47.180	76	18.546	1.6-1.8		inside creek
Muddy Creek	6/30/2010	1547	39	47.196	76	18.578	1.3		limit of navigation.
Conowingo Creek	7/1/2010	1040	39	40.999	76	11.747	4.1		at boat launch
Conowingo Creek	7/1/2010	1042	39	40.984	76	11.808	5.1		approaching RR bridge from launch
Conowingo Creek	7/1/2010	1045	39	40.980	76	11.803	6.6		approaching RR bridge from launch
Conowingo Creek	7/1/2010	1100	39	40.956	76	11.822	8.1-10.1	4.9	at middle arch
Conowingo Creek	7/1/2010	1105	39	40.967	76	11.836	11.6	4.9	at 2nd arch from N
Conowingo Creek	7/1/2010	1515	39	41.023	76	11.788	3.7		inside creek, 525 ft below steel bridge
Conowingo Creek	7/1/2010	1515	39	41.065	76	11.690	7.7		at steel bridge
Funks Run	7/1/2010	1115	39	40.285	76	10.762	9.6-10.6	4.7	confluence with river at RR bridge
Funks Run	7/1/2010	1126	39	40.341	76	10.683	3.1		limit of navigation.
Funks Run	7/1/2010	1133	39	40.281	76	10.764	9.0		at arch
Police Cove	7/1/2010	1143	39	39.464	76	10.922	33.0		confluence with river
Police Cove	7/1/2010	1145	39	39.399	76	10.950	3.4		limit of navigation.
Hopkins Cove	7/1/2010	1200	39	39.576	76	11.244	34.0		confluence with river
Hopkins Cove	7/1/2010	1205	39	39.525	76	11.279	20.0		inside cove
Hopkins Cove	7/1/2010	1210	39	39.514	76	11.326	13.0		inside cove
Hopkins Cove	7/1/2010	1215	39	39.450	76	11.431	1.8		limit of navigation.
Glen Cove	7/1/2010	1230	39	40.269	76	12.041	28.0		confluence with river
Glen Cove	7/1/2010	1233	39	40.275	76	12.095	12.0		inside cove
Glen Cove	7/1/2010	1238	39	40.280	76	12.129	6.0		at launch
Glen Cove	7/1/2010	1243	39	40.285	76	12.166	4.4		inside cove
Glen Cove	7/1/2010	1246	39	40.328	76	12.201	4.4-4.9		limit of navigation.
Broad Creek	7/1/2010	1320	39	41.949	76	14.290	22.4		confluence with river

**APPENDIX TABLE A-2: CONTINUED**

<b>Tributary</b>	<b>Date</b>	<b>Time</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Water Depth (ft)</b>	<b>Air Draft (ft)</b>	<b>Description</b>
Broad Creek	7/1/2010	1325	39	42.016	76	14.412	20.9		inside creek
Broad Creek	7/1/2010	1328	39	42.041	76	14.544	17.9		inside creek
Broad Creek	7/1/2010	1331	39	41.962	76	14.569	13.4		inside creek
Broad Creek	7/1/2010	1335	39	41.821	76	14.49	11.4		inside creek
Broad Creek	7/1/2010	1338	39	41.752	76	14.541	9.1		inside creek
Broad Creek	7/1/2010	1341	39	41.726	76	14.512	6.4		inside creek
Broad Creek	7/1/2010	1344	39	41.702	76	14.461	2.9		inside creek
Broad Creek	7/1/2010	1348	39	41.764	76	14.603	9.4		inside creek
Broad Creek	7/1/2010	1355	39	41.760	76	14.718	5.3	11-13	inside creek
Broad Creek	7/1/2010	1358	39	41.776	76	14.809	8.8		inside creek
Broad Creek	7/1/2010	1400	39	41.710	76	14.908	14.8		inside creek
Broad Creek	7/1/2010	1410	39	41.653	76	14.921	14.7		inside creek
Broad Creek	7/1/2010	1418	39	41.628	76	14.806	6.7		inside creek
Broad Creek	7/1/2010	1425	39	41.535	76	14.805	9.2		inside creek
Broad Creek	7/1/2010	1430	39	41.509	76	15.049	5.1		inside creek
Broad Creek	7/1/2010	1435	39	41.483	76	15.175	3.7		inside creek
Un-named tributary. No 3	7/1/2010	1508	39	41.604	76	12.372	3.2	6.3	at outer side of RR arch

**APPENDIX TABLE A-3: WATER DEPTH AND AIR DRAFT DATA (NORMALIZED TO EL. 107.2 NGVD) COLLECTED IN OR NEAR CONOWINGO POND TRIBUTARIES ON 29-30 JULY, 2010**

<b>Tributary</b>	<b>Date</b>	<b>Time</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Water Depth (ft)</b>	<b>Air Draft (ft)</b>	<b>Description</b>
Wissler Run	7/29/2010	0942	39	48.278	76	17.701	0.1		1st riffle
Fishing Creek	7/29/2010	0954	39	47.480	76	16.109	2.1		shoal at approach
Fishing Creek	7/29/2010	0955	39	47.482	76	16.037	1.5		shoal at approach
Fishing Creek	7/29/2010	1012	39	47.519	76	15.925	1.0		at former boat launch
Benton Hollow	7/29/2010	1035	39	46.615	76	15.095	0.1	9.8	1st riffle
Benton Hollow	7/29/2010	1035	39	46.611	76	15.112	1.4		confluence with river
Un-named tributary. No 1	7/29/2010	1045	39	46.322	76	14.856	0.6		confluence with river
Peters Creek	7/29/2010	1100	39	45.403	76	14.118	3.7		approach to Peters Creek
Peters Creek	7/29/2010	1102	39	45.423	76	14.090	3.0	7.2	confluence with river at 1st arch
Peters Creek	7/29/2010	1105	39	45.447	76	14.067	3.2		approach to boat launch
Peters Creek	7/29/2010	1107	39	45.485	76	14.030	5.5		approach to boat launch
Peters Creek	7/29/2010	1115	39	45.499	76	13.982	4.1		at boat launch
Peters Creek	7/29/2010	1120	39	45.486	76	13.927	1.4		limit of navigation.
Haines Branch	7/29/2010	1135	39	43.965	76	13.465	2.3		10 ft from culvert
Un-named tributary. No 2	7/29/2010	1143	39	43.017	76	13.465	2.7		confluence with river
Michaels Run	7/29/2010	1158	39	43.429	76	14.453	4.5		confluence with river
Michaels Run	7/29/2010	1200	39	43.459	76	14.507	2.7		inside Michaels Run
Michaels Run	7/29/2010	1203	39	43.494	76	14.562	2.5		inside Michaels Run
Michaels Run	7/29/2010	1205	39	43.539	76	14.576	1.9		limit of navigation.
Burkins Run	7/29/2010	1230	39	44.588	76	15.203	0.1		confluence and 1st riffle
Robinson Run	7/29/2010	1245	39	46.618	76	16.723	0.1		confluence with river
Muddy Creek	7/29/2010	1258	39	47.413	76	17.941	2.9		confluence with river
Muddy Creek	7/29/2010	1305	39	47.365	76	18.015	8.6		inside Muddy Creek
Muddy Creek	7/29/2010	1310	39	47.296	76	18.057	4.8		inside Muddy Creek

**APPENDIX TABLE A-3: CONTINUED**

<b>Tributary</b>	<b>Date</b>	<b>Time</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Water Depth (ft)</b>	<b>Air Draft (ft)</b>	<b>Description</b>
Muddy Creek	7/29/2010	1315	39	47.154	76	18.127	4.4		inside Muddy Creek
Muddy Creek	7/29/2010	1320	39	47.172	76	18.520	0.7		limit of navigation.
Conowingo Creek	7/30/2010	0847	39	40.993	76	11.740	2.2		at boat launch
Un-named tributary. No 3	7/30/2010	0915	39	41.604	76	12.372	1.2		at culvert wings
Broad Creek	7/30/2010	0931	39	41.951	76	14.292	22.3		under power line crossing
Broad Creek	7/30/2010	0935	39	42.015	76	14.399	21.7		inside creek
Broad Creek	7/30/2010	0940	39	42.030	76	14.543	13.9		inside creek
Broad Creek	7/30/2010	0942	39	41.885	76	14.497	14.2		inside creek
Broad Creek	7/30/2010	0945	39	41.764	76	14.526	4.2		inside creek
Broad Creek	7/30/2010	0950	39	41.722	76	14.499	3.5		inside creek
Broad Creek	7/30/2010	0955	39	41.716	76	14.461	1.5		inside creek
Broad Creek	7/30/2010	1000	39	41.711	76	14.460	4.0		inside creek
Broad Creek	7/30/2010	1005	39	41.751	76	14.686	3.4		inside creek
Broad Creek	7/30/2010	1007	39	41.800	76	14.901	7.6		inside creek
Broad Creek	7/30/2010	1011	39	41.660	76	14.932	6.1		inside creek
Broad Creek	7/30/2010	1015	39	41.556	76	14.771	7.1		inside creek
Broad Creek	7/30/2010	1020	39	41.506	76	15.058	3.1		inside creek
Broad Creek	7/30/2010	1022	39	41.512	76	15.137	1.5		limit of navigation.
Broad Creek	7/30/2010	1025	39	41.506	76	15.147			1st riffle
Glen Cove	7/30/2010	1105	39	40.268	76	12.033	30.0		confluence with river
Glen Cove	7/30/2010	1107	39	40.277	76	12.098	8.9		approach to boat launch
Glen Cove	7/30/2010	1110	39	40.277	76	12.141	3.7		approach to boat launch
Glen Cove	7/30/2010	1112	39	40.281	76	12.160	6.9		approach to boat launch
Glen Cove	7/30/2010	1115	39	40.299	76	12.177	2.4		approach to gas dock
Glen Cove	7/30/2010	1118	39	40.316	76	12.191	3.1		limit of navigation.
Conowingo Creek	7/30/2010	1126	39	40.968	76	11.837	9.5		depth under arch #2 of RR bridge

**APPENDIX TABLE A-3: CONTINUED**

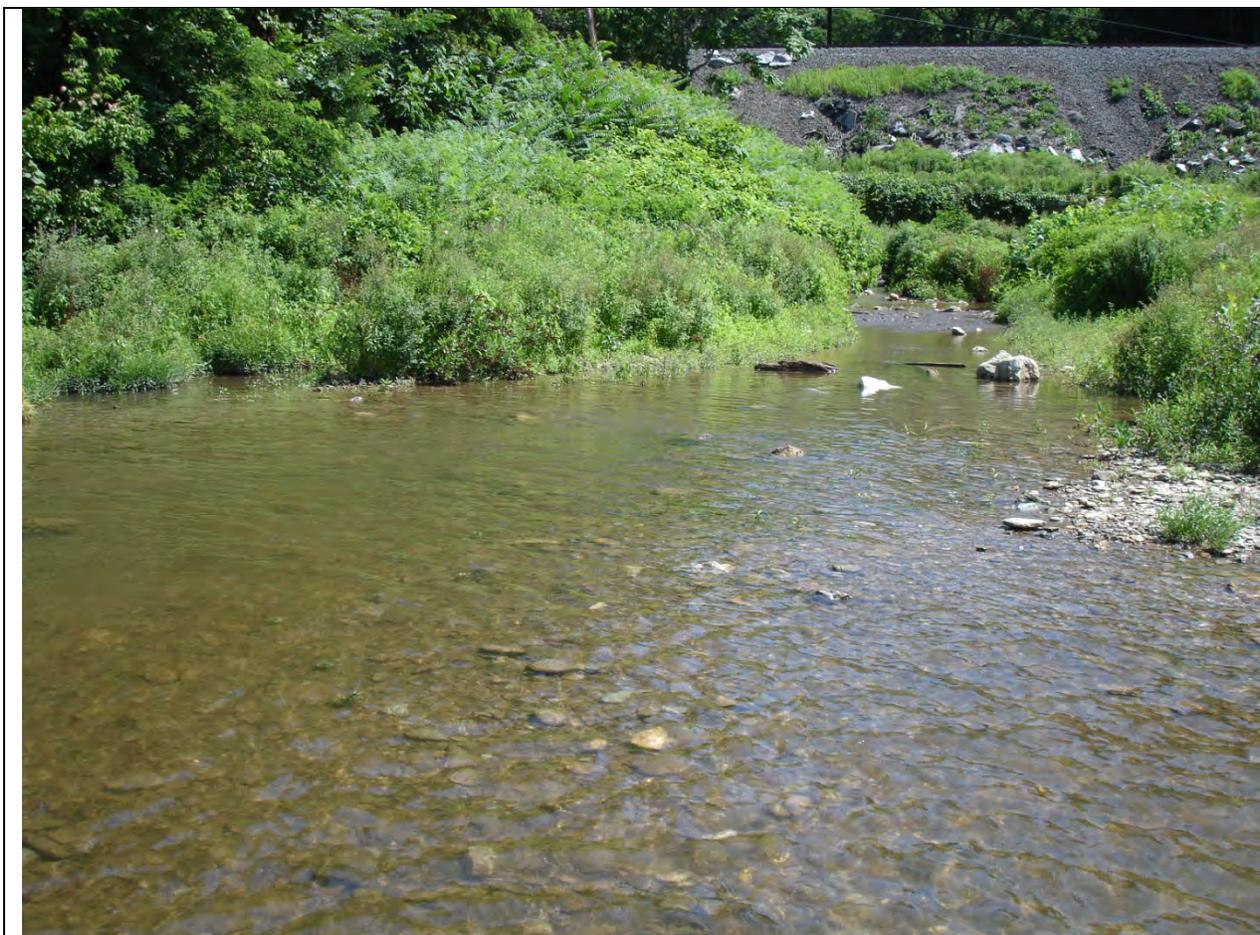
<b>Tributary</b>	<b>Date</b>	<b>Time</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Water Depth (ft)</b>	<b>Air Draft (ft)</b>	<b>Description</b>
Conowingo Creek	7/30/2010	1128	39	40.984	76	11.817	3.9		approach to boat launch
Conowingo Creek	7/30/2010	1130	39	40.994	76	11.786	4.6		approach to boat launch
Conowingo Creek	7/30/2010	1133	39	40.995	76	11.771	2.2		approach to boat launch
Conowingo Creek	7/30/2010	1135	39	40.997	76	11.754	1.9		approach to boat launch
Conowingo Creek	7/30/2010	1136	39	41.000	76	11.745	2.2		approach to boat launch
Conowingo Creek	7/30/2010	1138	39	40.993	76	11.740	2.3		at boat launch
Conowingo Creek	7/30/2010	1140	39	41.045	76	11.716	4.3		approach to Bell Manor Rd. Bridge
Conowingo Creek	7/30/2010	1143	39	40.998	76	11.741	11.7		at bridge
Conowingo Creek	7/30/2010	1145	39	41.116	76	11.618	5.7		435 ft upstream of bridge
Conowingo Creek	7/30/2010	1202	39	41.174	76	11.620	2.6		limit of navigation.
Funks Run	7/30/2010	1217	39	40.280	76	10.761	7.1	6.7	under RR arch at confluence
Funks Run	7/30/2010	1220	39	40.297	76	10.798	3.2		inside Funks Run
Funks Run	7/30/2010	1222	39	40.305	76	10.697	20.8		inside Funks Run
Funks Run	7/30/2010	1225	39	40.334	76	10.676	5.9		limit of navigation.
Funks Run	7/30/2010	1230	39	40.293	76	10.757	3.9		at inside of culvert
Police Cove	7/30/2010	1243	39	39.471	76	10.923	34.7		confluence with river
Police Cove	7/30/2010	1245	39	39.438	76	10.942	17.6		inside Police Cove
Police Cove	7/30/2010	1250	39	39.403	76	10.949	1.0		limit of navigation.
Hopkins Cove	7/30/2010	1253	39	39.573	76	11.230	44.5		confluence with river
Hopkins Cove	7/30/2010	1255	39	39.521	76	11.305	16.5		inside Hopkins Cove
Hopkins Cove	7/30/2010	1300	39	39.478	76	11.387	2.0		inside Hopkins Cove
Hopkins Cove	7/30/2010	1310	39	39.453	76	11.428	1.3		limit of navigation.

**APPENDIX TABLE A-4: WATER DEPTH AND AIR DRAFT DATA COLLECTED IN OR NEAR CONOWINGO POND  
TRIBUTARIES ON 18 SEPTEMBER, 2010.**

<b>Tributary</b>	<b>Time</b>	<b>Pond El. (NGVD)</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Water Depth (ft)</b>	<b>Air Draft (ft)</b>	<b>Description</b>
Conowingo Creek	0902	106.0	39	40.986	76	11.816	3.0		approach to boat launch
Conowingo Creek	0903	106.0	39	41.003	76	11.791	3.0		approach to boat launch
Conowingo Creek	0905	106.0	39	41.003	76	11.772	1.2		approach to boat launch
Conowingo Creek	0910	106.0	39	41.034	76	11.742	3.0		approach to Bell Manor Rd. Bridge
Conowingo Creek	0912	106.0	39	41.062	76	11.687	11.4		deep hole under Bell Manor Rd. bridge
Conowingo Creek	0915	106.0	39	41.067	76	11.673	18.0		deep hole under Bell Manor Rd. bridge
Conowingo Creek	0919	106.0	39	41.159	76	11.625	1.5		limit of navigation.
Conowingo Creek	0930	106.0	39	40.968	76	11.836	5.8-8.0	8.1	under RR bridge, 2nd arch from N
Funks Run	0945	106.0	39	40.299	76	10.760	1.5		limit of navigation.
Glen Cove	0956	106.0	39	40.283	76	12.157	2.8		approach to boat launch
Broad Creek	1015	105.9	39	41.963	76	14.292	21.0		confluence with river
Broad Creek	1018	105.9	39	42.014	76	14.393	21.0		inside Broad Creek
Broad Creek	1021	105.9	39	42.022	76	14.572	15.0		inside Broad Creek
Broad Creek	1024	105.9	39	41.883	76	14.501	13.0		inside Broad Creek
Broad Creek	1026	105.9	39	41.780	76	14.531	6.5		inside Broad Creek
Broad Creek	1027	105.9	39	41.747	76	14.551	3.0		inside Broad Creek
Broad Creek	1028	105.9	39	41.716	76	14.496	1.5		approach to Broad Creek Boat Launch
Broad Creek	1037	106.0	39	41.761	76	14.685	2.0		just above Rt. 623 Bridge
Broad Creek	1040	106.0	39	41.789	76	14.826	7.0		upstream of Rt. 623 Bridge
Broad Creek	1042	106.0	39	41.805	76	14.906	9.2		upstream of Rt. 623 Bridge
Broad Creek	1045	106.0	39	41.646	76	14.925	8.0		upstream of Rt. 623 Bridge
Broad Creek	1049	106.0	39	41.580	76	14.770	5.5		upstream of Rt. 623 Bridge
Broad Creek	1050	106.0	39	41.516	76	14.859	2.0		limit of navigation.
Michaels Run	1131	105.9	39	43.424	76	14.404	1.7		195 ft outside of confluence to Michaels run
Burkins Run	1147	105.9	39	44.586	76	15.195	0.1		confluence with river and 1st riffle
Peters Creek	1204	105.9	39	45.328	76	14.149	3.0		750 ft from Peters Creek RR bridge

**APPENDIX TABLE A-4: CONTINUED**

<b>Tributary</b>	<b>Time</b>	<b>Pond El. (NGVD)</b>	<b>Lat. (°)</b>	<b>Lat. (')</b>	<b>Long. (°)</b>	<b>Long. (')</b>	<b>Water Depth (ft)</b>	<b>Air Draft (ft)</b>	<b>Description</b>
Peters Creek	1214	105.9	39	45.422	76	14.093	1.6		at Peters Creek RR bridge
Peters Creek	1219	105.9	39	45.473	76	14.038	3.0		approach to Peters Creek launch
Peters Creek	1221	105.9	39	45.498	76	13.981	2.2		at end of launch ramp
Peters Creek	1228	105.9	39	45.436	76	14.072	1.0		just inside Peters Creek RR bridge
Benton Hollow	1246	105.9	39	46.610	76	15.116	0.1		confluence with river and 1st riffle
Fishing Creek	1300	105.9	39	47.409	76	16.063	1.5		846 ft outside Fishing Creek confluence
Robinson Run	1309	105.9	39	46.622	76	16.721	0.1		confluence with river and 1st riffle
Wissler Run	1434	105.8	39	48.279	76	17.703	0.1		confluence with river and 1st riffle



Location: Wissler Run, confluence with river  
Conowingo Pond Elevation: 109.0 feet  
Date: June 30, 2010



Location: Fishing Creek, confluence with river  
Conowingo Pond Elevation: 109.0 feet  
Date: June 30, 2010



Location: Benton Hollow  
Conowingo Pond Elevation: 109.1 feet



Location: Un-named Trib. #1  
Conowingo Pond Elevation: 109.0 feet  
Date: June 30, 2010



Location: Peters Creek, confluence with river  
Conowingo Pond Elevation: 109.2 feet  
Date: June 30, 2010



Location: Haines Branch, confluence with river  
Conowingo Pond Elevation: 109.3 feet  
Date: June 30, 2010



Location: Un-named Trib. #2  
Conowingo Pond Elevation: 109.3 feet  
Date: June 30, 2010



Location: Michaels Run, at confluence with river  
Conowingo Pond Elevation: 109.2 feet  
Date: June 30, 2010



Location: Burkins Run, at confluence with river  
Conowingo Pond Elevation: 109.3 feet  
Date: June 30, 2010



Location: Robinson Run, at confluence with river  
Conowingo Pond Elevation: 109.4 feet  
Date: June 30, 2010



Location: Robinson Run, limit of nav.  
Conowingo Pond Elevation: 109.4 feet  
Date: June 30, 2010



Location: Muddy Creek, at confluence with river  
Conowingo Pond Elevation: 109.3 feet  
Date: June 30, 2010



Location: Muddy Creek, interior scene  
Conowingo Pond Elevation: 109.4 feet  
Date: June 30, 2010



Location: Conowingo Creek, confluence with river  
Conowingo Pond Elevation: 109.0 feet  
Date: July 1, 2010



Location: Funks Run, confluence with river  
Conowingo Pond Elevation: 109.1 feet  
Date: July 1, 2010



Location: Funks Run, interior  
Conowingo Pond Elevation: 109.1 feet  
Date: July 1, 2010



Location: Police Cove at confluence with river  
Conowingo Pond Elevation: 109.2 feet  
Date: July 1, 2010



Location: Glen Cove, at confluence with river  
Conowingo Pond Elevation: 109.2 feet  
Date: July 1, 2010



Location: Glen Cove, limit of nav. at footbridge  
Conowingo Pond Elevation: 109.2 feet  
Date: July 1, 2010



Location: Glen Cove, boat launch  
Conowingo Pond Elevation: 109.2 feet  
Date: July 1, 2010



Location: Broad Creek, at confluence with river  
Conowingo Pond Elevation: 109.4 feet  
Date: July 1, 2010



Location: Broad Creek, boat launch  
Conowingo Pond Elevation: 109.3 feet  
Date: July 1, 2010



Location: Broad Creek, limit of nav. at 1st riffle  
Conowingo Pond Elevation: 109.4 feet  
Date: July 1, 2010



Location: Un-named Trib. #3  
Conowingo Pond Elevation: 109.5 feet  
Date: July 1, 2010



Location: Peters Creek, boat launch  
Conowingo Pond Elevation: 109.7 feet  
Date: July 1, 2010



Location: Peters Creek, view toward RR bridge  
Conowingo Pond Elevation: 109.7 feet  
Date: July 1, 2010



Location: Peters Creek, upstream view from launch  
Conowingo Pond Elevation: 109.7 feet  
Date: July 1, 2010



Location: Wissler Run, 2nd riffle  
Conowingo Pond Elevation: 107.0 feet  
Date: July 29, 2010



Location: Wissler Run, 1st riffle  
Conowingo Pond Elevation: 107.0 feet  
Date: July 29, 2010



Location: Fishing Creek, approach from Pond  
Conowingo Pond Elevation: 107.1 feet  
Date: July 29, 2010



Location: Fishing Creek, confluence with river  
Conowingo Pond Elevation: 107.1 feet  
Date: July 29, 2010



Location: Fishing Creek, old boat launch and limit of nav.  
Conowingo Pond Elevation: 107.1 feet  
Date: July 29, 2010



Location: Shoals outside Fishing Creek Arch  
Conowingo Pond Elevation: 107.1 feet  
Date: July 29, 2010



Location: Shoals outside Fishing Creek Arch  
Conowingo Pond Elevation: 107.1 feet  
Date: July 29, 2010



Location: Benton Hollow, confluence with river  
Conowingo Pond Elevation: 107.2 feet  
Date: July 29, 2010



Location: Benton Hollow, 1st riffle inside arch  
Conowingo Pond Elevation: 107.2 feet  
Date: July 29, 2010



Location: Un-named Trib. #1, confluence with river  
Conowingo Pond Elevation: 107.2 feet  
Date: July 29, 2010



Location: Un-named Trib. #1, 1st riffle  
Conowingo Pond Elevation: 107.2 feet  
Date: July 29, 2010



Location: Peters Creek, approach to boat launch  
Conowingo Pond Elevation: 107.2 feet  
Date: July 29, 2010



Location: Haines Branch, confluence with river  
Conowingo Pond Elevation: 107.2 feet  
Date: July 29, 2010



Location: Haines Branch, confluence with river  
Conowingo Pond Elevation: 107.2 feet  
Date: July 29, 2010



Location: Un-named Trib. #2  
Conowingo Pond Elevation: 107.2 feet  
Date: July 29, 2010



Location: Michaels Run, limit of nav.  
Conowingo Pond Elevation: 107.3 feet  
Date: July 29, 2010



Location: Burkins Run, confluence with river, 1st riffle  
Conowingo Pond Elevation: 107.3 feet  
Date: July 29, 2010



Location: Burkins Run, confluence and 1st riffle  
Conowingo Pond Elevation: 107.5 feet  
Date: July 29, 2010



Location: Robinson Run, confluence and 1st riffle  
Conowingo Pond Elevation: 107.5 feet  
Date: July 29, 2010



Location: Robinson Run, confluence and 1st riffle  
Conowingo Pond Elevation: 107.7 feet  
Date: July 29, 2010



Location: Muddy Creek, 1st riffle  
Conowingo Pond Elevation: 107.6 feet  
Date: July 29, 2010



Location: Muddy Creek, limit of nav. and 1st riffle  
Conowingo Pond Elevation: 107.6 feet  
Date: July 29, 2010



Location: Conowingo Creek, confluence with river  
Conowingo Pond Elevation: 107.7 feet  
Date: July 30, 2010



Location: Conowingo Creek, boat launch  
Conowingo Pond Elevation: 107.0 feet  
Date: July 30, 2010



Location: Conowingo Creek, boat launch  
Conowingo Pond Elevation: 107.0 feet  
Date: July 30, 2010



Location: Conowingo Creek, boat launch with SAV beds.  
Conowingo Pond Elevation: 107.0 feet  
Date: July 30, 2010



Location: Un-named Trib. #3,  
Conowingo Pond Elevation: 107.0 feet  
Date: July 30, 2010



Location: Broad Creek, SAV along shoreline  
Conowingo Pond Elevation: 106.9 feet  
Date: July 30, 2010



Location: Broad Creek, boat launch  
Conowingo Pond Elevation: 106.9 feet  
Date: July 30, 2010



Location: Broad Creek, beached pontoon boat  
Conowingo Pond Elevation: 107.3 feet  
Date: July 30, 2010



Location: Broad Creek, 1st riffle  
Conowingo Pond Elevation: 107.5 feet  
Date: July 30, 2010



Location: Glen Cove, boat launch  
Conowingo Pond Elevation: 107.2 feet  
Date: July 30, 2010



Location: Hopkins Cove, limit of nav.  
Conowingo Pond Elevation: 107.7 feet  
Date: July 30, 2010



Location: Funks Run, confluence with river  
Conowingo Pond Elevation: 107.4 feet  
Date: July 30, 2010



Location: Police Cove, limit of nav.  
Conowingo Pond Elevation: 107.4 feet  
Date: July 30, 2010



Location: Conowingo Creek boat launch obstructed with vegetation  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



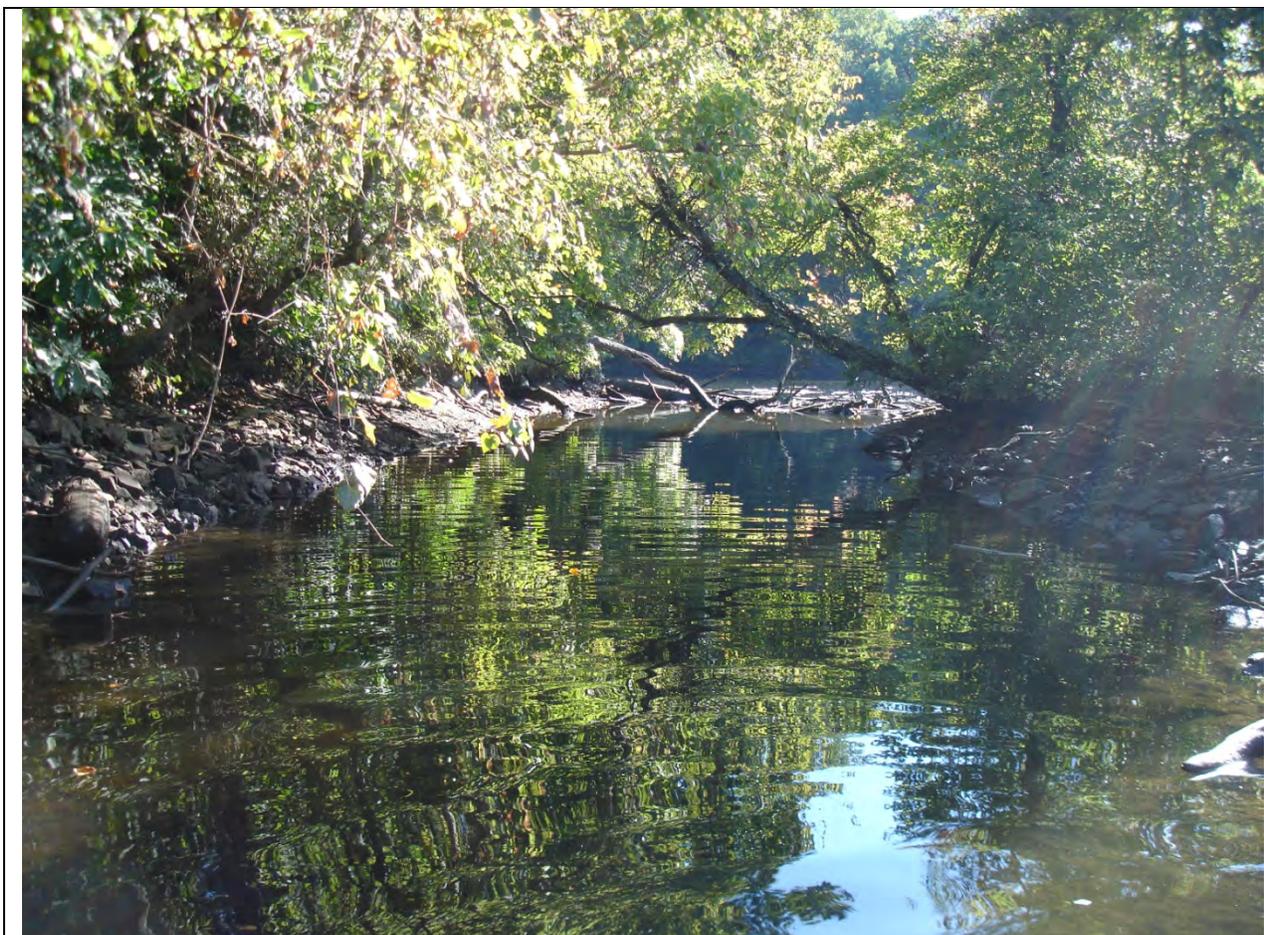
Location: View of RR bridge from inside Conowingo Creek  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Conowingo Creek limit of nav. and 1st riffle  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Conowingo Creek boat launch obstructed with vegetation  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Funks Run limit of nav.  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Glen Cove boat launch  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Broad Creek mud flats on N. shore above Rt. 623  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Broad Creek mud flats on S. shore above Rt. 623  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Broad Creek BSA dock  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Broad Creek boat launch  
Conowingo Pond Elevation: 106.0 feet  
Date: September 18, 2010



Location: Michaels Run view from shoal, 70 yd from confluence  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Burkins Run, confluence with river and 1st riffle  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Aquatic vegetation beds below mouth of Peters Creek  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Peters Creek RR bridge viewed from 150 yd away  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: View of Peach Bottom Marina from RR bridge  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Exposed mud banks S. side of Peters Creek inside RR bridge  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Peach Bottom Marina and courtesy dock  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Peach Bottom Marina boat launch  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Upstream view inside Peters Creek from Marina  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: View toward Conowingo Pond from inside Peters Creek  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Un-named Trib. #1, confluence with river  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Benton Hollow, confluence with river  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: View of Fishing Creek mouth from shoals 840 ft offshore  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Shoals downstream of Fishing Creek mouth  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Robinson Run, confluence with river and 1st riffle  
Conowingo Pond Elevation: 105.9 feet  
Date: September 18, 2010



Location: Wissler Run, confluence with river and first riffle.

Conowingo Pond Elevation: 105.8 feet

Date: September 18, 2010