US Army Corps of Engineers®

Pittsburgh District

August 2006

Draft
Detailed Project Report
And
Integrated Environmental Assessment

APPENDIX 7

HYDRAULICS AND HYDROLOGY

North Park Lake
Allegheny County, PA
Section 206 Aquatic Ecosystem Restoration Project

Draft
Detailed Project Report
And
Integrated Environmental Assessment

North Park Lake
Section 206
Aquatic Ecosystem Restoration Project

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2.0 INTRODUCTION

2.1 Background

Originally in 1936, North Park Lake had a surface area of 75 acres and a drainage area of 25 square miles. The land was mainly farmland with rolling hills used for agricultural purposes and woodlands. Over the years, especially during the 1960's to the present time, urbanization has occurred upstream of the lake. Due to this increase in urbanization and continuous stream bank erosion, the lake's capacity has been reduced by almost 50 percent. Sediment has accumulated over the entire lake creating major problems with the open water habitat. At the dam, the depth of the lake has been reduced by about 14 feet with the sediment piling up on the intake control structure and burying the outlet control gate. Fish and other open water habitat have suffered from the sedimentation problem initiating this ecosystem restoration project. The main goal of this project is to enhance and restore the aquatic ecosystem of North Park Lake. Allegheny County, who is the sponsor, will work with the U.S. Army Corps of Engineers (USACE) and many others as a team to help restore the lake. This Detailed Project Report (DPR) Appendix will discuss the hydrology and hydraulic investigations performed.

2.2 Study Area

North Park Lake is located in Allegheny County about 10 miles north of the city of Pittsburgh, Pennsylvania. In 1936, Pine Creek Dam was constructed to impound 568 acre-feet of water to form North Park Lake. The lake has two forks, Pine Creek and North Fork Pine Creek. North Park Lake and Pine Creek Dam are owned and operated by Allegheny County. The park and lake provides recreation including fishing, boating, picnic groves, baseball fields, tennis courts, walking trails, a swimming pool, golf course and much more for people to enjoy. It is heavily used in the summer time with over 240,000 people renting picnic shelters and buildings. Millions of people enjoy the lake and park each year. Some of the winter activities include ice skating and ice fishing. PLATE 1 is a general location map of North Park Lake in respect to the U.S. Army Corps of Engineers Pittsburgh District Plan of Development Map.

Pine Creek Dam is 33 feet high, approximately 1,130 feet long, has a 60-foot wide crest and is located on Pine Creek. It has an uncontrolled spillway set at 10 feet below the top of the dam. The outlet works consist of an intake tower with a manually controlled 5 foot by 5 foot sluice gate which has not been operated recently. Table 1 shows pertinent information about North Park Lake and Pine Creek Dam. PLATE 2 shows photographs of North Park Lake and Pine Creek Dam.

Table 1. Pertinent Data for North Park Lake and Pine Creek Dam

Name	North Park Lake
Owner	Allegheny County, Pennsylvania
Location	Pittsburgh, Pennsylvania
ID #	PA00467
Year completed	1936
Latitude	40° 35’ 54”
Longitude	79° 59’ 54”
Drainage Area	25 square miles
Normal Pool Elevation	960
Top of Dam Elevation	970
Area at Elevation 960	75 acres
Capacity at Elevation 960	568 acre feet
Total Spillway Capacity	10,500 cfs
Top of Dam Storage	1950 acre-feet
Dam	Pine Creek Dam
Tributary	Pine Creek
Height of Dam	33 feet
Outlet – Manual Operation	5’ x 5’ Reinforced Concrete Box
Upstream Invert Elevation	938.5
Downstream Invert Elevation	936
Outlet Length	570 feet
Crest Length	1130 feet

3.0 HYDROLOGY

3.1 Basin Characteristics

The Pine Creek basin is located entirely within Allegheny County in southwestern Pennsylvania. It has a total drainage area of 67.5 square miles and empties into the Allegheny River approximately four miles upstream of the “Point” in Pittsburgh, Pennsylvania. The basin is wedged shaped with deep V-shaped stream valleys and steep hillsides. Local relief above the stream valley varies from approximately 1,300 feet above NGVD in the extreme headwaters to a low of 700 feet NGVD at the mouth.

Pine Creek has its headwaters near the community of Bradford Woods, Pennsylvania near the Allegheny-Butler County line. It flows in a southerly direction into the Borough of Franklin Park where it turns and flows in an easterly direction to North Park Lake.

From the impoundment, it flows in a southerly direction to its mouth at the Borough of Etna, Pennsylvania. Pine Creek Dam, which forms North Park Lake, is located on Pine Creek at mile 13.9 in McCandless Township. PLATE 3 shows the drainage basin of the Pine Creek Watershed and the communities located in and surrounding the basin.

The drainage area above Pine Creek Dam has two major tributaries, Pine Creek and North Fork Pine Creek. The drainage area upstream of the dam on Pine Creek is about 15 square miles and North Fork Pine Creek drains 10 square miles. The basin is irregular in shape with a horizontal width of 3 miles and a length of about 8 miles. The headwater elevation on Pine Creek is approximately 1,300 feet above National Geodetic Vertical Datum (NGVD) and falls to the lake elevation of 960 feet above NGVD for a difference of 340 feet. The North Fork Pine Creek arm has a maximum elevation of 1,320 feet above NVGD. The stream slope for Pine Creek is 33 feet per mile and 58 feet per mile for North Fork Pine Creek. PLATE 4 shows the watershed boundaries upstream of North Park Lake. Table 2 presents the stream characteristics for Pine Creek, North Fork Pine Creek and its tributaries upstream of the lake.

Table 2. Stream Characteristics of Pine Creek, North Fork Pine Creek and Tributaries

Stream Name	Basin Area	Stream Length	Stream Slope	Maximum Headwater Elevation
	Square miles	Miles	Feet per mile	Feet above NGVD
Pine Creek	14.2	7.6	33	1300
Rinaman Run	1.6	2.6	102	1320
Wexford Run	2.2	3.1	55	1300
Fish Run	2.5	2.5	76	1300
North Fork Pine Creek	8.2	4.8	58	1320
Irwin Road Run	1.4	2.6	93	1300

3.2 Climatology

3.2.1 General Description

The climate for the North Park Lake area is temperate with seasonal variations in temperature. Weather is usually moderate but may have frequent and rapid changes. The basin is in a region of variable frontal air mass activity subject to polar, tropical, continental and maritime air masses. Frequent and rapid changes in weather occur due to the passage of fronts associated with low-pressure areas. The prevailing wind direction is from the west. Storms typically follow a west to east route with the exception of tropical storms moving from south to north.

Storms can be classified as either summer type or winter type. Summer type storms typically occur from May to October and can be characterized as relatively short duration, high intensity storms over a small area. Winter type storms typically occur from November to April and produce less intense rainfall for a longer duration over a sizable area. Measurable precipitation occurs on about 150 days per year and averages approximately 38 inches yearly.

Summer months are characterized by warm, humid weather moderated by elevation and orographically induced clouds. Air temperatures can range from lows below zero degrees in the winter months and exceeding ninety degrees in the summer months. Snowfall can be frequent and heavy during the winter months. Snowfall ranges from zero to 55 inches per year. The last frost typically occurs between late in the month of April and mid May depending on elevation.

3.2.2 Precipitation Data

Normal annual precipitation is uniform over most of the basin with an average range of 36 to 42 inches per year as measured at various published National Weather Service (NWS) precipitation stations located near and around the Pine Creek basin. Official NWS stations used were the Acmetonia Lock 3, Beaver Falls 1 NE, Natrona Lock 4, Bakerstown 3 WNW, Butler 2 SW and the Pittsburgh WSCOM 2 AP precipitation gages. An annual summary of representative precipitation stations is presented in Table 3 below:

Table 3. Annual Precipitation Summary for Representative Stations (inches)

Station	Years of Record	Period of Record	Minimum Precip.	Normal Precip.	Maximum Precip.	Minimum Snowfall	Normal Snowfall	Maximum Snowfall
Acmetonia	55	1948-2002	28.4	40.0	54.8	0.0	25.3	62.6
Bakerstown	43	1948-1990	24.1	37.8	51.4	6.0	32.9	55.2
Beaver Falls	55	1948-2002	26.6	36.2	50.7	0.0	27.6	56.9
Butler	36	1967-2002	29.5	41.5	51.6	8.6	33.9	65.0
Natrona	55	1948-2002	28.4	38.8	50.7	0.0	22.1	50.7
Pittsburgh	51	1952-2002	26.8	36.6	52.2	9.1	43.1	76.7

Normal monthly precipitation varies in a consistent pattern over most of the basin with July typically being the wettest month and October the driest. Normal monthly precipitation measured at the Bakerstown station varies between 4.1 inches in July to 2.3 inches in February. The Bakerstown precipitation gage is the closest NWS published station to North Park Lake and is located about four miles northeast of Pine Creek Dam. Although the NWS Bakerstown was discontinued in 1990, it is representative of the area. The other representative stations are currently in operation. A monthly summary of representative NWS stations is presented in Table 4.

Table 4. Monthly Precipitation Summary for Representative Stations (inches)

Station		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acmetonia	Min	0.8	0.5	1.1	0.7	1.1	1.1	1.1	0.7	0.3	0.5	0.7	0.3
	Avg	2.9	2.6	3.5	3.6	3.8	3.9	4.2	3.6	3.2	2.7	3.1	2.9
	Max	6.7	7.2	7.5	6.8	7.3	8.5	9.3	9.2	6.3	9.9	11.3	8.0
Bakerstown	Min	0.1	0.2	0.4	0.6	1.4	0.4	0.5	0.1	0.3	0.3	0.9	0.2
	Avg	2.5	2.3	3.1	3.2	4.0	3.8	4.1	3.4	2.9	2.7	3.0	2.7
	Max	7.3	6.9	6.6	6.9	7.7	9.6	9.7	7.6	5.8	8.6	10.9	5.4
Beaver Falls	Min	0.7	0.1	0.5	0.5	1.2	0.5	0.3	0.3	0.4	0.3	0.5	0.3
	Avg	2.5	2.1	2.9	3.3	3.7	3.7	3.8	3.2	3.0	2.4	2.8	2.6
	Max	6.6	5.3	6.2	6.0	7.4	8.2	10.0	6.6	6.7	8.7	10.7	7.1
Butler	Min	0.5	0.5	1.3	1.0	1.7	1.0	0.7	1.2	0.6	0.4	0.9	1.1
	Avg	2.7	2.3	3.3	3.5	4.2	4.1	4.3	3.8	3.9	2.8	3.5	3.2
	Max	5.1	4.6	5.7	6.2	7.3	10.5	9.7	8.4	7.5	6.0	10.8	7.3
Natrona	Min	0.8	0.4	0.9	0.7	1.4	0.5	0.9	0.3	0.1	0.2	0.6	0.2
	Avg	2.8	2.4	3.4	3.6	3.7	3.8	4.1	3.7	3.2	2.5	3.0	2.8
	Max	6.5	7.3	6.0	6.6	7.4	10.4	8.1	8.3	6.1	9.4	10.1	7.7
Pittsburgh	Min	0.8	0.5	1.1	0.5	1.2	0.6	1.6	0.8	0.3	0.2	0.9	0.4
	Avg	2.6	2.3	3.3	3.2	3.7	3.7	3.8	3.4	2.9	2.3	2.7	2.6
	Max	6.3	6.0	6.1	7.6	6.6	10.3	8.7	7.9	6.0	8.2	11.1	8.5

Normal monthly snowfall varies throughout the basin in a consistent manner. Snowfall typically occurs from November to March with January experiencing the most snow. Normal monthly snowfall measured at the Bakerstown precipitation station varies between 8.6 inches in January and 0.1 inches in October. A monthly summary of snowfall for representative stations is presented in Table 5.

Table 5. Monthly Snowfall Summary for Representative Stations (inches)

Station		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acmetonia	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Avg	6.9	6.0	4.9	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.3	4.6
	Max	25.1	33.6	27.3	6.8	1.8	0.0	0.0	0.0	0.0	1.0	30.5	27.4
Bakerstown	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Avg	8.6	7.8	4.9	0.5	0.1	0.0	0.0	0.0	0.0	0.1	3.0	6.6
	Max	39.6	26.5	15.8	6.0	1.9	0.0	0.0	0.0	0.0	1.9	27.0	18.7
Beaver Falls	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Avg	6.7	6.0	5.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	1.8	4.8
	Max	24.0	23.8	20.0	8.4	0.6	0.0	0.0	0.0	0.0	0.3	33.5	17.5

Butler	Min	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Avg	11.3	8.0	5.1	0.7	0.0	0.0	0.0	0.0	0.0	0.1	1.5	7.0
	Max	31.0	20.0	17.5	7.0	0.0	0.0	0.0	0.0	0.0	3.0	9.0	18.5
Natrona	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Avg	6.4	5.0	4.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.6	3.9
	Max	41.3	17.5	20.1	8.5	2.0	0.0	0.0	0.0	0.0	1.4	28.7	16.0
Pittsburgh	Min	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Avg	11.9	8.7	8.1	1.5	0.1	0.0	0.0	0.0	0.0	0.3	3.2	7.9
	Max	40.2	27.8	34.1	8.1	3.1	0.0	0.0	0.0	0.0	8.5	13.9	21.2

3.2.3 Air Temperature Data

Normal annual temperature is uniform over most of the basin with an average annual temperature of approximately 50 ºF. Daily temperatures range between an average annual low of approximately 37 ºF and an average high of approximately 62 ºF. Temperatures as low as –20 ºF and as high of 100 ºF have been recorded at the NWS representative stations. An annual temperature summary of representative stations is presented in Table 6.

Table 6. Annual Temperature Summary for Representative Stations (°F)

Station	Years of Record	Period of Record	Normal Low Temperature	Normal High Temperature
Bakerstown	43	1948-1990	40.4	61.9
Butler	36	1967-2002	37.4	60.3
Pittsburgh	51	1952-2002	41.3	60.4

Normal monthly temperature varies in a consistent pattern over most of the basin with July typically being the warmest month and January the coldest. Average monthly air temperatures measured at the NWS Bakerstown station recorded a low of 19.1 ºF in January to a high of 36.5 ºF. In July, the air temperature recorded an average monthly low of 60.6 ºF and 83.8 ºF as the high. A monthly temperature summary of representative stations is presented in Table 7.

Table 7. Average Monthly Temperature Summary for Representative Stations (°F)

Station		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bakerstown	Low	19.1	20.6	28.0	38.6	48.1	56.1	60.6	59.1	52.4	41.8	33.2	23.6
	High	36.5	39.5	49.4	62.3	72.2	80.3	83.8	82.2	75.9	65.0	51.7	39.9
Butler	Low	16.6	18.1	25.4	34.6	43.9	53.3	57.7	56.6	49.5	38.3	31.0	22.5
	High	34.7	38.2	47.6	60.3	70.5	79.0	82.9	81.8	74.8	62.9	50.4	39.4
Pittsburgh	Low	19.9	21.9	29.5	39.6	48.8	57.5	62.0	60.7	53.6	42.5	34.1	24.9
	High	35.0	38.4	48.4	61.1	70.8	79.2	82.7	81.3	74.5	62.8	50.4	39.0

3.3 Past Studies

Various studies and reports have been completed throughout the Pine Creek basin including Flood Insurance Studies through the Federal Emergency Management Agency, U.S. Army Corps of Engineers, Commonwealth of Pennsylvania reports and other studies. In 1979, USACE Baltimore District prepared a Phase 1 Inspection Report for Pine Creek Dam. The USACE Pittsburgh District performed a Detailed Project Report for West Little Pine Creek in Etna, Pennsylvania Local Flood Protection Project in January 1984. In September 1987, the USACE Pittsburgh District completed a reconnaissance report on the Pine Creek Watershed for developing an automated flood warning network for Pine Creek which was prepared for the Pennsylvania Department of Environmental Resources. Refer to the References included at the beginning of this Appendix for detailed information.

3.4 Stream Gage Records

There are no stream gages located upstream of North Park Lake. The U.S. Geological Survey (USGS) currently has a stream gage located on Little Pine Creek near Etna, Pennsylvania. The gage has been in operation since October 1962 and has a drainage area upstream of 5.78 square miles. Note: The Little Pine Creek data is rated fair to poor by the USGS and does not represent the entire Pine Creek basin. Table 8 shows the top five highest recorded stream flows at USGS Station No. 03049800, Little Pine Creek near Etna, Pennsylvania:

Table 8. Top Five Recorded Stream Flows at Little Pine Creek at Etna, Pennsylvania

Date	Peak Flow (cfs)
May 30, 1986	7,190
June 30, 1974	2,040
August 28, 1992	1,430
May 26, 1987	1,380
February 23, 1975	960

3.5 Historical Flooding

3.5.1 Flood of 30 May 1986

At approximately 5:00 PM EST on Friday, May 30, 1986, heavy thunderstorms in the North Hills area of Suburban Pittsburgh caused severe flash flooding in the Pine Creek basin. Eight deaths were attributed to the severe thunderstorms and high intensity short duration rainfall event. It was estimated that six to eight inches of rain fell in areas of the basin causing major flooding along Pine Creek and its tributaries. This was the highest flood of record in the Pine Creek Basin. No records were available for North Park Lake for this event.

3.5.2 Flood of 30 June 1974

A low pressure system moved from Lake Erie, Pennsylvania on the morning of 29 June 1974 to New England on 30 June 1974. This system dragged a cold front as far south as the Pennsylvania-Maryland border by the morning of 1 July 1974. Numerous thundershowers with short intense rains developed. The NWS Bakerstown precipitation station measured 4.25 inches of rain for the event and 0.8 inches for the maximum in one hour. High water went over bank and caused flooding along Pine Creek and the tributary streams.

3.5.3 Flood of 26 May 1987

It was estimated that 3 to 5 inches of rain fell over the Pine Creek basin causing first floor and basement flooding and the evacuation of 75 homes. Heavy rains and thunderstorms caused Pine Creek and the tributary streams to go out of bank in some lower elevation areas.

3.5.4 Flood of 22 June 1972

As Hurricane Agnes moved from the Gulf of Mexico, it was a warm humid day in Pittsburgh, Pennsylvania on 19 June 1972. Hurricane Agnes seemed of little concern to the Pittsburgh area and was expected to dissipate as it moved inland. On 20 June 1972, Hurricane Agnes was creating a far-reaching counter-clockwise circulation, which began to bring moist air over Pennsylvania. By 22 June 1972, Agnes had dumped about two to three inches of rain over the Pittsburgh area and continued to move eastward towards the New Jersey coast. A cold front however blocked its advance and it moved towards New York City and stalled. This caused an additional two to four inches of rain in the Allegheny River basin producing widespread flooding in the basin. The Allegheny River basin received unprecedented amounts of rainfall between 20 to 26 June 1972 ranging from four inches to 12 inches. High water was experienced on Pine Creek as the result of Hurricane Agnes. As estimated in the 1979 Phase 1 Inspection Report, the June 1972 flood produced a flow of 600 cubic feet per second (cfs) at Pine Creek Dam.

3.6 Hydrologic Modeling

3.6.1 Flow Frequency

A hydrologic and hydraulic study was needed for use in the sedimentation analysis and other features investigated in the restoration of the lake. For the hydrologic portion of the study various methods were used to determine a range of frequency flows. The Soil Conservation Service TR-55 and Snyder’s Unit Hydrograph methods using HEC-HMS rainfall runoff model, Pittsburgh District Multiple Regression Formulas, U.S. Geological regression methods for Pennsylvania and the Federal Highway Administration methods were all used to determine a range of flow frequencies. Comparison of all the various methods was performed with the Pittsburgh District Multiple Regression method being used. This method agreed with past studies and regional flow-drainage curves. Table 9 presents the adopted flows for various frequency events for Pine Creek upstream of the lake and North Fork Pine Creek upstream of Marshall Lake. Marshall Lake is located on North Fork Pine Creek just upstream of North Park Lake.

Table 9. Flow Frequencies for Pine Creek and North Fork Pine Creek

Frequency (% chance)	Pine Creek upstream of North Park Lake	North Fork Pine Creek at Marshall Lake
	DA=14.0 sq. mi.	DA=7.5 sq. mi.
	Flow (cfs)	Flow(cfs)
50 (2 year)	690	420
10 (10 year)	1,550	990
2 (50 year)	2,480	1,650
1 (100 year)	2,990	2,000
0.2 (500 year)	4,150	2,870

Figures 1 and 2 present flow frequency curves for Pine Creek and North Fork Pine Creek.

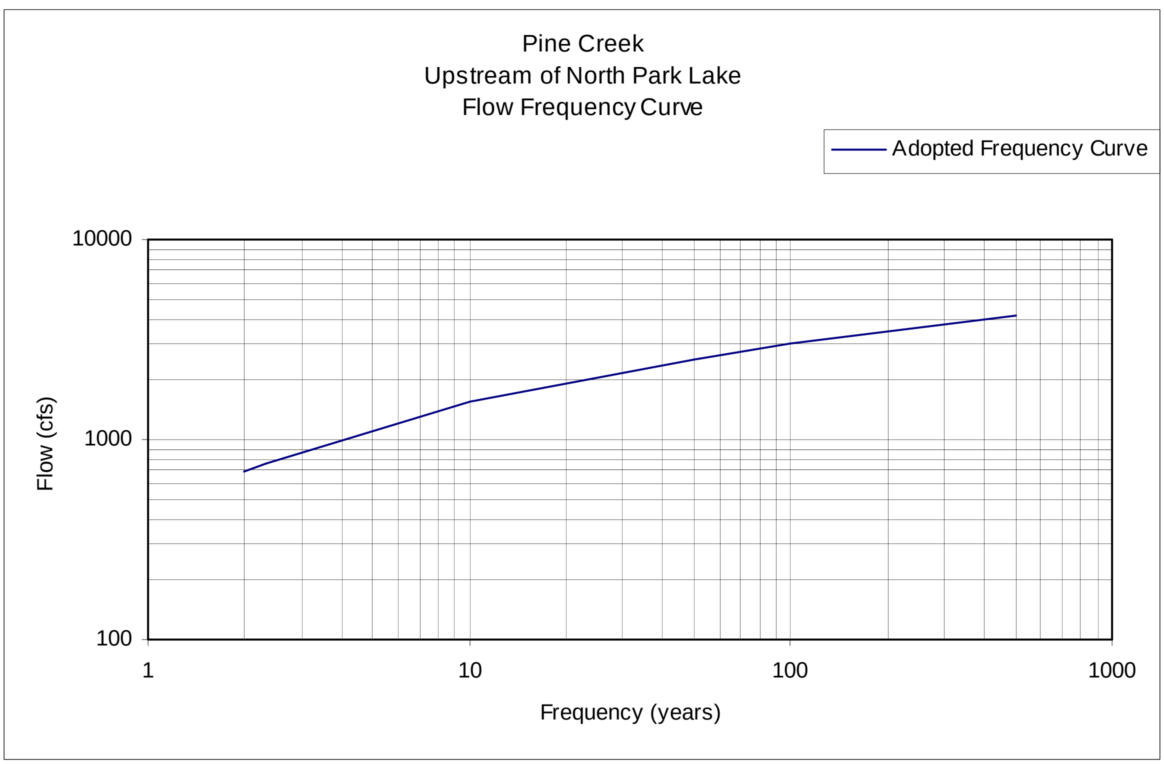

Figure 1. Flow Frequency Curve for Pine Creek Upstream of North Park Lake

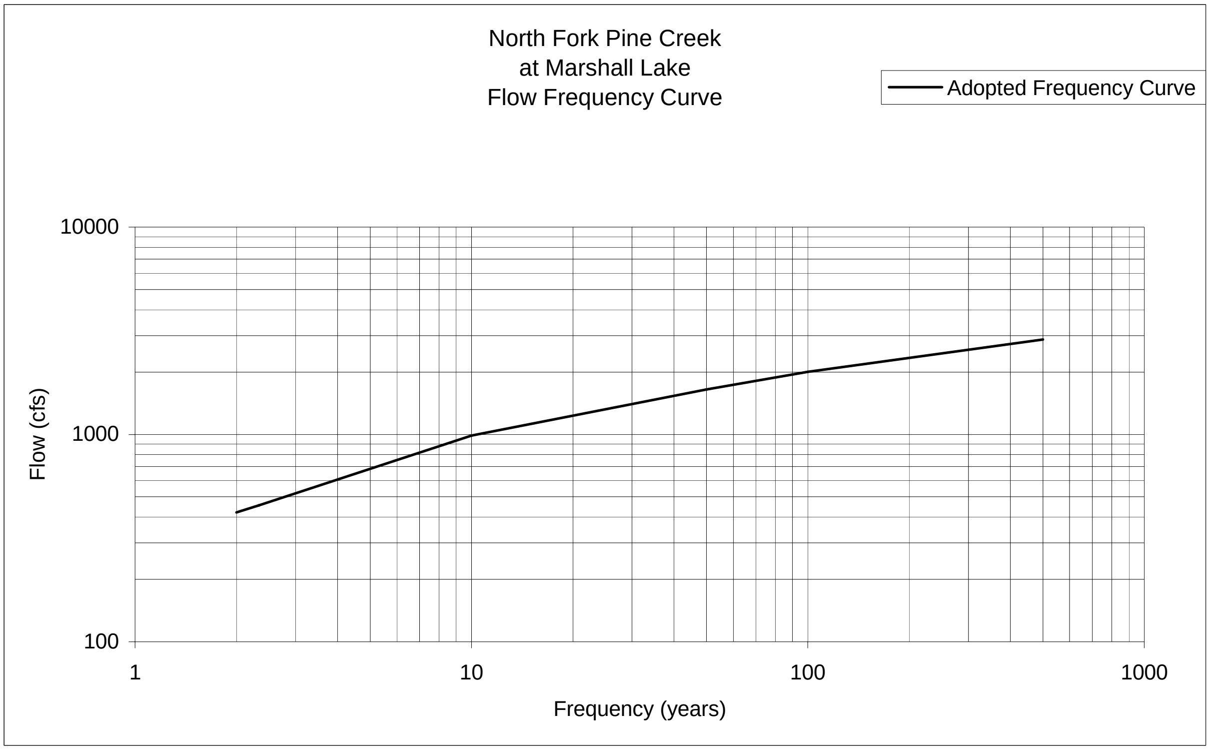

Figure 2. Flow Frequency Curve for North Fork Pine Creek at Marshall Lake

3.6.2 Flow Duration

Flow durations were developed for Pine Creek and North Fork Pine Creek based on a regionalized duration curve method. The USGS stream gage at Little Pine Creek at Etna, Pennsylvania gage was used to relate to Pine Creek and North Fork Pine Creek. The method is based on the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) publication where the flow at the 50% chance flood at the stream gaging station is related to the site being investigated. Table 10 presents the flow durations computed for Pine Creek and North Fork Pine Creek.

Table 10. Flow Durations for Pine Creek and North Fork Pine Creek

Percent equaled or exceeded	Pine Creek upstream of North Park Lake	North Fork Pine Creek at Marshall Lake
	Flow (cfs)	Flow (cfs)
100	0.02	0.01
90	0.71	0.43
70	2.6	1.6
50	5.8	3.5
30	12	7.6
10	32	20
5	52	32
2	82	50
1	114	70

Figure 3 presents the flow duration curves for Pine Creek upstream of North Park Lake and North Fork Pine Creek upstream of Marshall Lake.

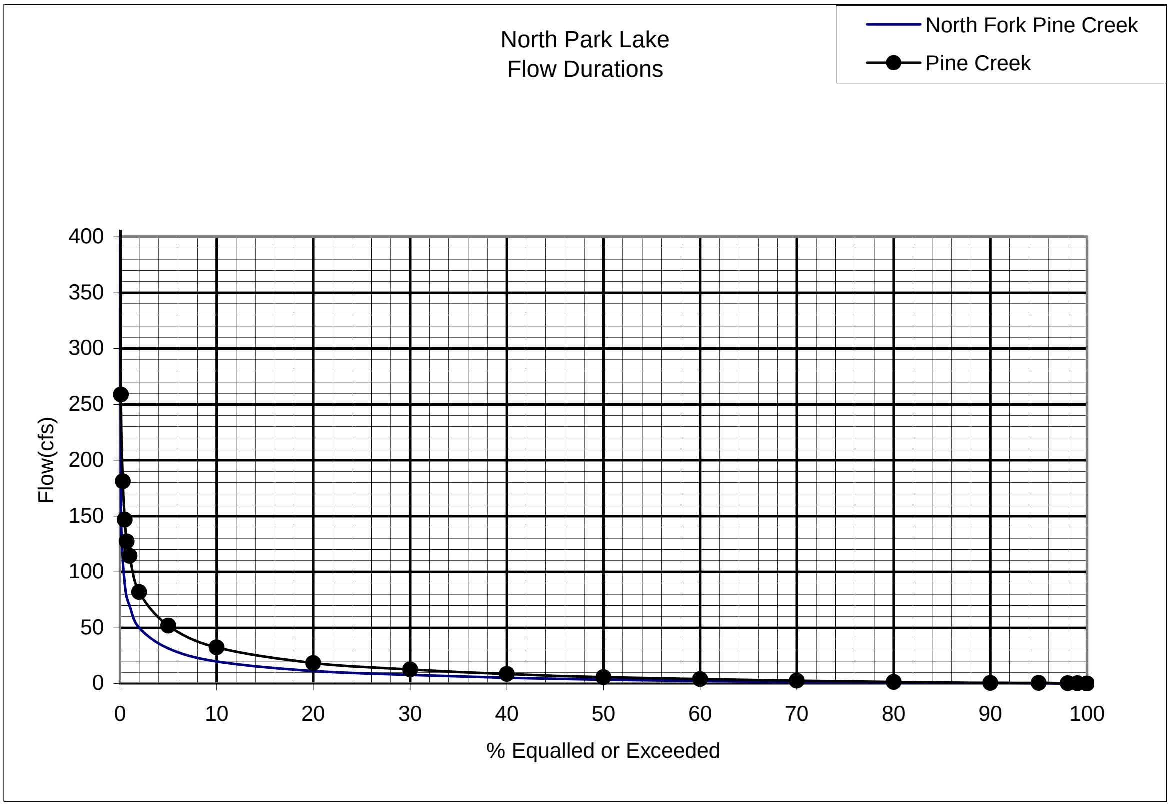

Figure 3. Flow Duration Curves for Pine Creek and North Fork Pine Creek

3.6.3 Area and Storage Capacity Curves

The original area and storage capacity information for North Park Lake was obtained from the original construction drawings for Pine Creek Dam. The original surface area of the lake was 75 acres and the storage capacity was 568 acre-feet. Using the 2001 new topography of the lake, it was estimated that the surface area was reduced to 63 acres and the storage capacity was 297 acre-feet. The percent storage loss from 1936 to 2001 was approximately 48% or almost half of the capacity of the lake lost due to sediment accumulation. Twelve acres of surface area has been lost for this period. It was estimated that in 1979, the lake storage capacity was reduced by 33%. Table 11 shows the comparison of the original and current lake area and storage capacity.

Table 11. Lake Area and Storage Capacity Comparisons

	Surface Area (acres)	Capacity (acre-feet)
1936 (Original)	75	568
2001	63	297
Storage Loss		271 acre-feet
Storage Loss per Year		4 acre-feet/year (5200 tons/year)

	Percentage of Storage Loss
1936	0
1979	33%
2001	48%

Figures 4 shows the original area and capacity curves for North Park Lake and Figure 5 presents the current area capacity curves.

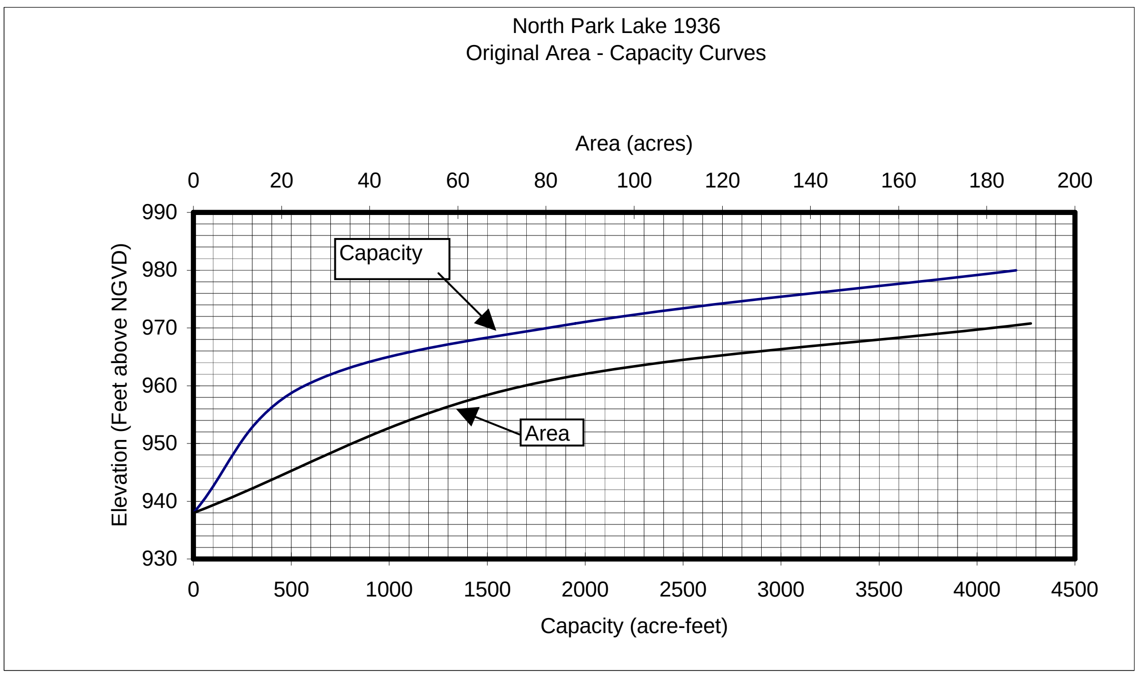

Figure 4. 1936 Original Area Capacity Curves

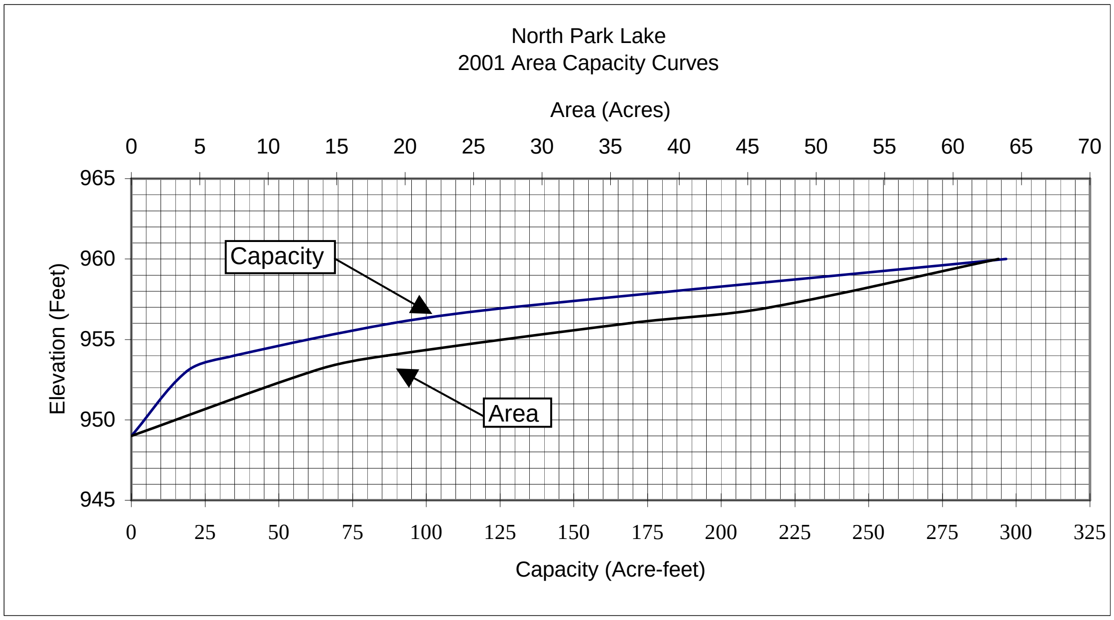

Figure 5. 2001 Area Capacity Curves

4.0 HYDRAULICS

4.1 Wetlands Protection Barrier

For the hydraulic portion of the study, a HEC-RAS model was set up to investigate a wetlands protection barrier on Pine Creek. The barrier was developed as a center type spillway dike to prevent the upper reach wetlands just upstream of the lake on Pine Creek from sliding into the lake. This barrier will be made out of rock and will provide areas for fish and other open water habitat. It will be located at the upper end of the North Park Lake pool on Pine Creek just downstream of the wetlands. PLATE 5 is a location map of the proposed barrier in relation to North Park Lake.

4.2 Water Surface Profiles

Using the HEC-RAS model, various heights of the barrier were analyzed to see the effects of backwater upstream, overtopping and to compute design velocities. Water surface profiles were developed for the 50%, 20%, 10%, 2%, 1% and 0.2% chance floods or formally referred to as the 2,5,10,50,100, and 500-year frequency floods. PLATE 6 presents the water surface profiles for existing conditions without the barrier in place. PLATE 7 presents the water surface profiles for the barrier in place. The reach extended from 300 feet downstream of the proposed structure to about 4500 feet upstream. No major backwater problems resulted in the 3,4 or 5 foot barrier configurations. A 10 foot high barrier will cause problems upstream and was not investigated any further.

Velocities vary from almost zero for the 50% chance flood to 7 feet per second for the 0.2% chance flood.

4.3 Other Investigations

Fringe wetlands creation was also investigated around portions of the perimeter of the lake to create additional wetlands and provide a buffer zone. Placement of rock is necessary for use around the perimeter of the lake where protection is needed. Other areas in the lake are being investigated to help restore the area such as not mowing in the riparian areas to relieve some of the geese overpopulation around the lake.

5.0 SEDIMENTATION

5.1 General

The Pittsburgh District used the sedimentation experts from the Engineering Research and Development Center (ERDC) in Vicksburg, Mississippi to assist in the sedimentation analysis of North Park Lake. The first step in the sedimentation analysis was to investigate the history of the lake. Copies of the original engineering drawings for the construction of the dam were found in the 1979 Dam Safety Report on Pine Creek Dam (USACE–Baltimore District, 1979). Included in the report, were the original surface area and capacity values calculated on the drawings. Original topography of the land before the dam was built was also found.

5.2 Actual Sedimentation Rate

One-foot topography and soundings were surveyed for North Park Lake in 2001. New lake surface area and capacity values were calculated and compared to the original data. The lake's surface area and capacity lost due to the sediment accumulation were computed. The average annual sedimentation rate was determined to be 5,200 tons per year. ERDC's experts recommend using actual data when determining sedimentation rates as the best alternative rather than theoretical equations.

5.3 Theoretical Sedimentation Rate

To further analyze the sedimentation problem, Corps of Engineers EM 1110-2-4000 "Sedimentation Investigations of Rivers and Reservoirs" was followed to determine sedimentation rates (USACE–ERDC, 1995). Sedimentation rates are very important since they will determine future operation and maintenance needs plus provide a frequency of accumulation estimate. The methodology followed included determining a flow duration using the ERDC's publication "Effective Discharge Calculation – A Practical Guide" (USACE–ERDC, 2000). A flow duration curve at a nearby stream gaging station was developed and correlated at each fork that enters the lake. Multiple flow measurements were made at two sites on each fork entering the lake. Sediment samples were taken and processed at a lab to determine sediment characteristics. This data was used to determine a sediment rating curve. The information was consolidated and following the EM, a theoretical sedimentation rate of 1,100 tons per year was computed. This rate was compared to the actual data and it was determined that using the actual rate of 5,200 tons per year was more conservative and consistent with sedimentation rates of nearby lakes and rivers.

The sediment rates in nearby rivers were also analytically determined using the software HEC-6 (Scour and Deposition in Rivers and Reservoirs), but the results were inconsistent and not used in the study. After analyzing all the sediment information, ERDC recommended that the actual volumetric procedure be used.

5.4 Sediment Accumulation and Trap Efficiency

Using the actual sedimentation accumulation rate, it was determined that approximately 400,000 cubic yards of sediment has to be removed from the lake to return it back to the original contours and restore the lake's ecosystem. Trap efficiency of the lake was determined following the EM 1110-2-4000 Appendix F using the Brown, Brune, Churchill and Hazen methods. The trap efficiency was used to estimate the percentage of sediment trapped by Pine Creek Dam. Trap efficiency was estimated at almost 100% for North Park Lake.

5.5 Removal Alternatives

Various alternatives were discussed with the ERDC's dredging experts and the project team that could be used to remove the excessive sediment from the lake. Final dredge method alternatives, including hydraulic and mechanical dredging methods, are presented in detail in the Main Report and Geotechnical Appendix of this DPR.

5.6 Drain Times for North Park Lake

One alternative involves the temporary draining of North Park Lake to mechanically remove the sediment. Average inflow into the lake was estimated at 10 cubic feet per second and drain times are based on this inflow. Drain times were computed using the HEC-HMS model and are summarized in Table 12. Outflow is controlled by 5 foot by 5 foot slide gate. Consideration of downstream effects of outflow must be followed when draining the lake. Varied outflow is based on changing the outlet works to different levels to release the water at different outflow rates. To maintain the stability of the shoreline and reduce the effects on the fishery the lake should be drawn down as quickly as possible without causing sediment erosion. For North Park Lake, the District will determine the optimal rate of drawdown during the next phase of study (Plans and Specifications). Table 12 shows how quickly the lake could be drained.

Table 12. Drain times for North Park Lake

Outflow (cfs)	Inflow (cfs)	Drain Time (hours)	Drain Time (days)
100	10	53	2.21
200	10	24	1.00
300	10	13	0.54
400	10	10	0.42
500	10	8	0.33
Varied Outflow	10	40	1.67

5.7 Placement Areas

Plans are to place the 400,000 cubic yards of sediment as close to the lake as possible to reduce delivery costs. It was estimated that approximately 20-25 acres of land would be needed to place the material. Some potential placement sites are located within the Allegheny County park boundary and some close by to the lake on private property. The Main Report and the Geotechnical Appendix discuss placement sites in more detail.

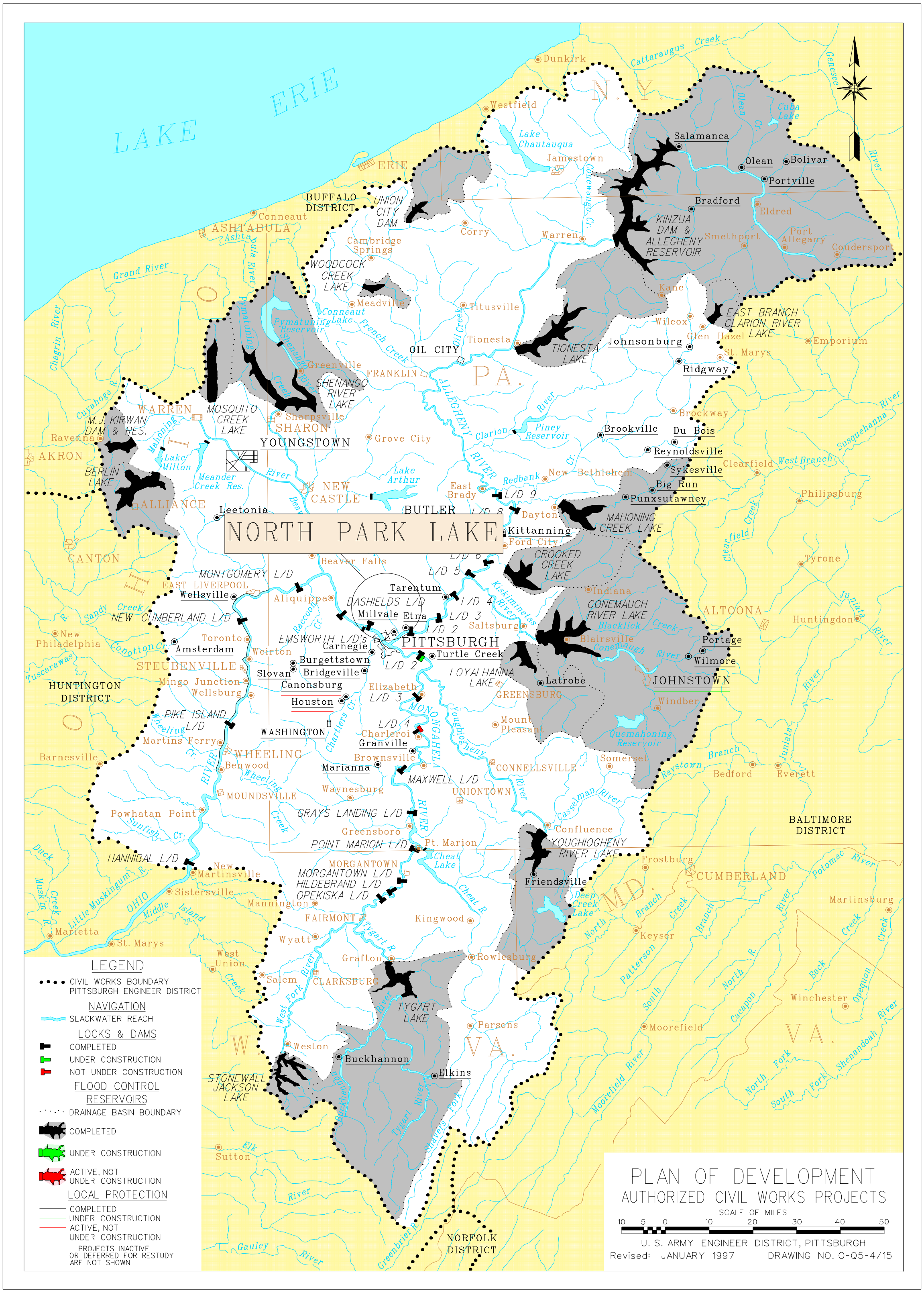

PLATE 1. General Location Map

Photograph 1. North Park Lake

Photograph 2. Pine Creek Dam

PLATE 2. Photographs of North Park Lake and Pine Creek Dam

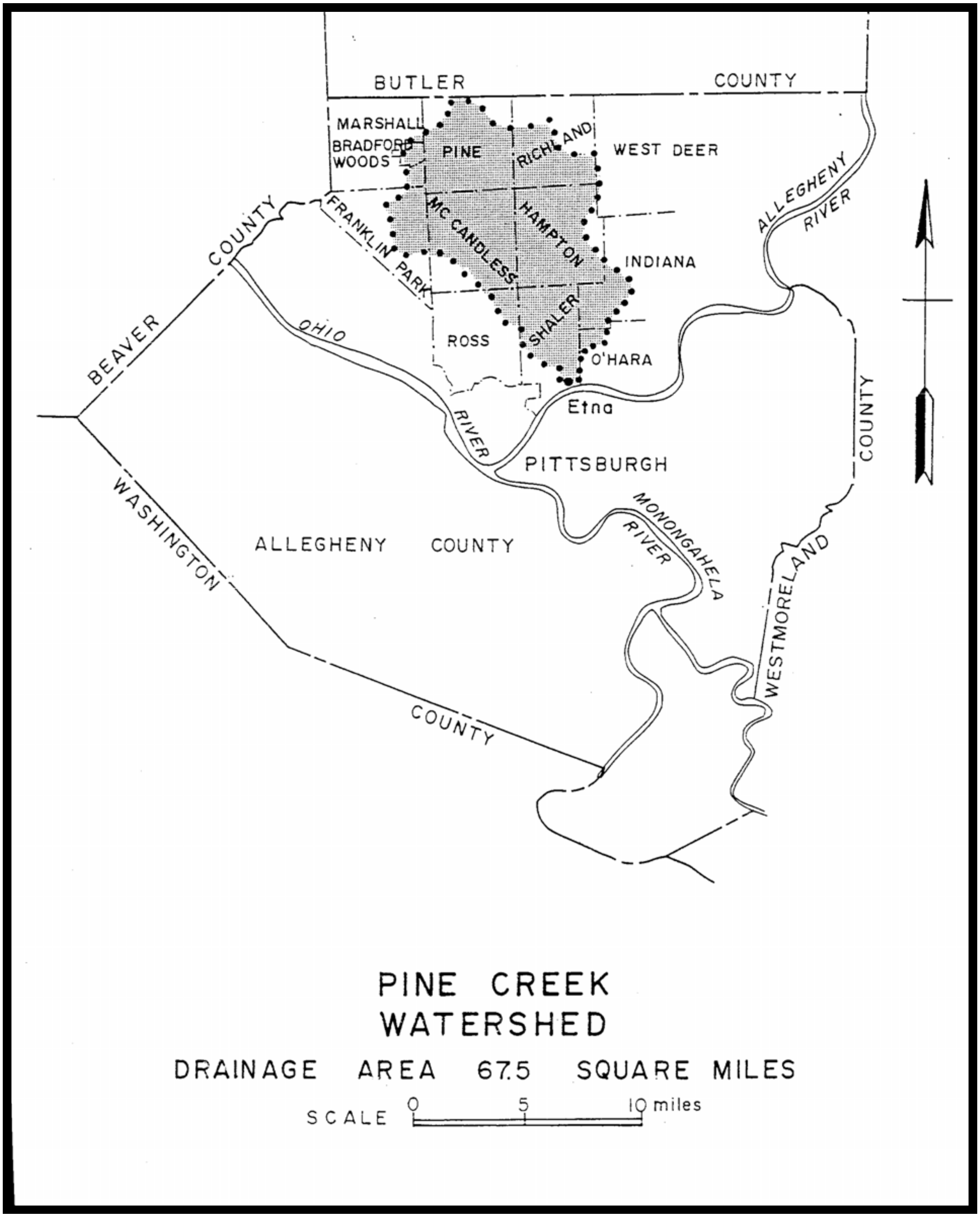

PLATE 3. Pine Creek Watershed

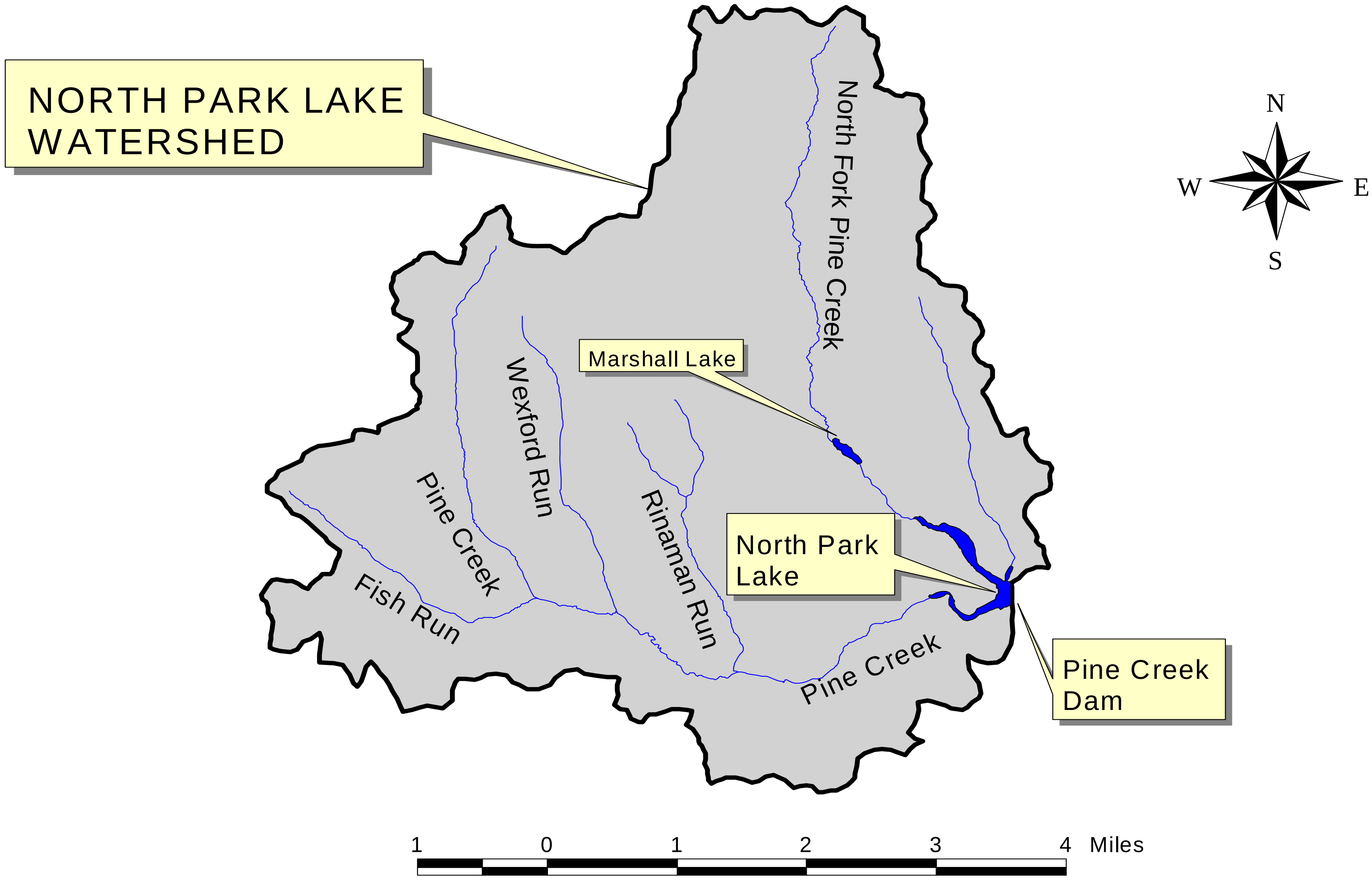

PLATE 4. North Park Lake Watershed Map

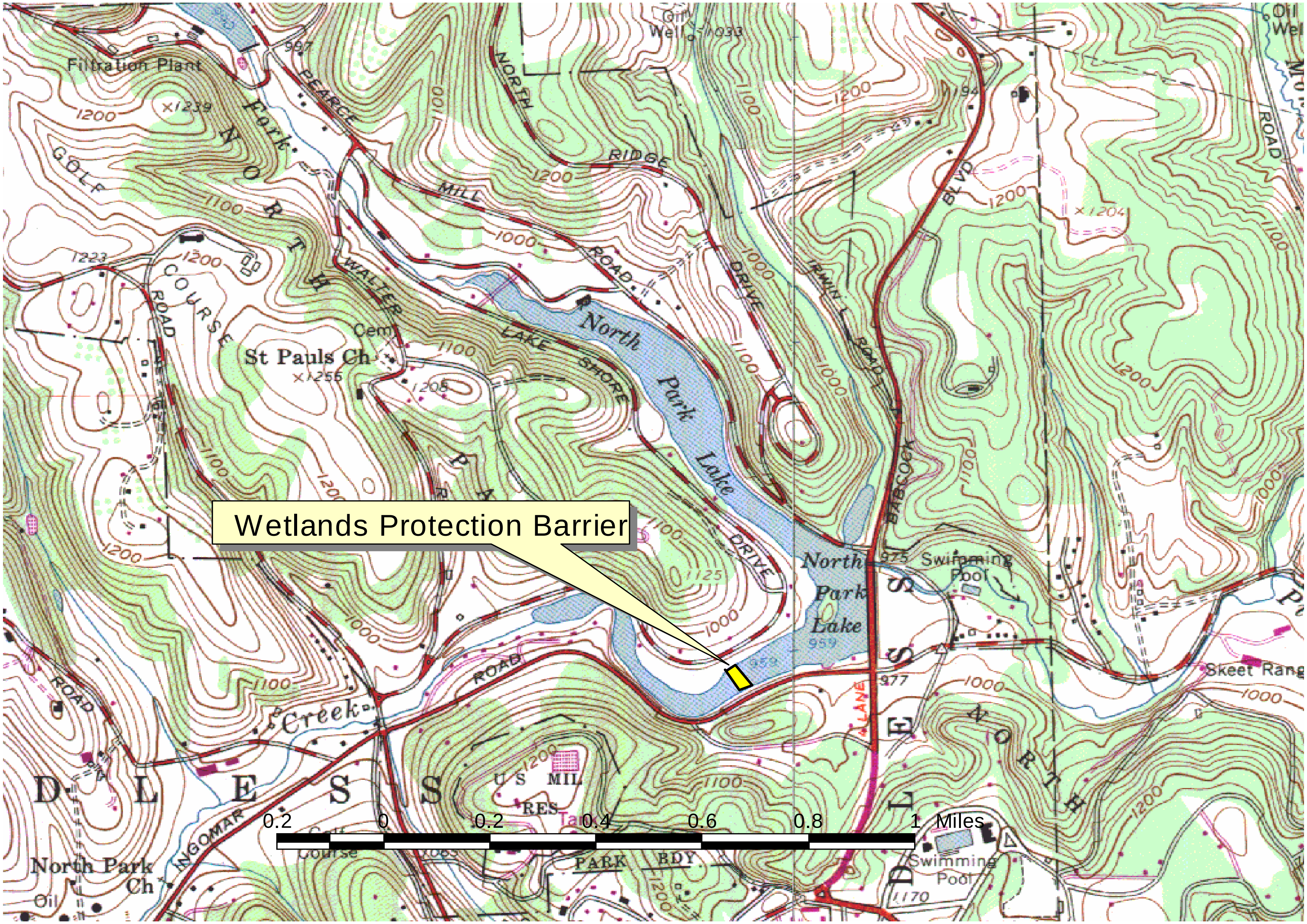

PLATE 5. Wetlands Protection Barrier Location

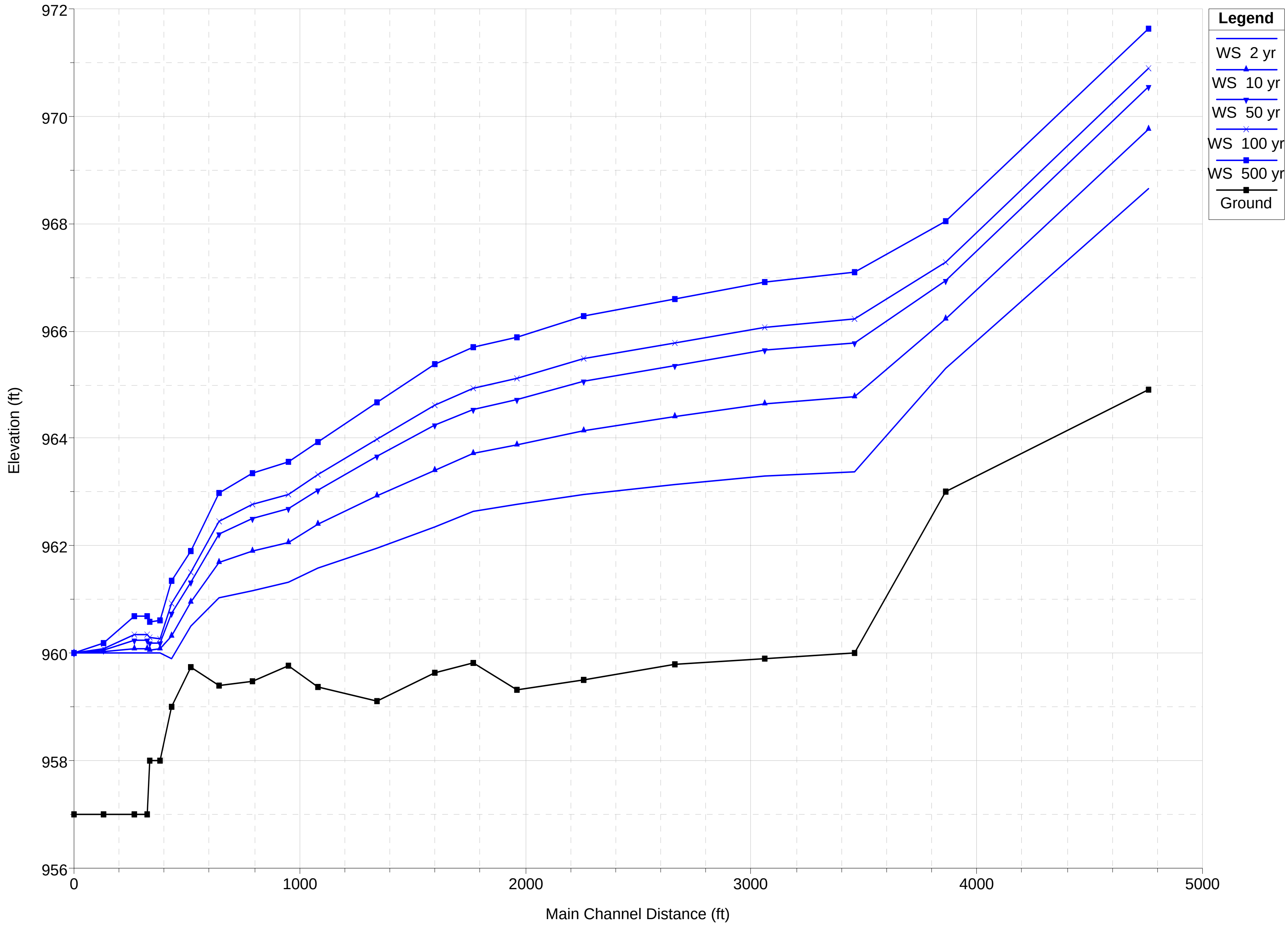

PLATE 6. Water Surface Profiles without Wetlands Protection Barrier

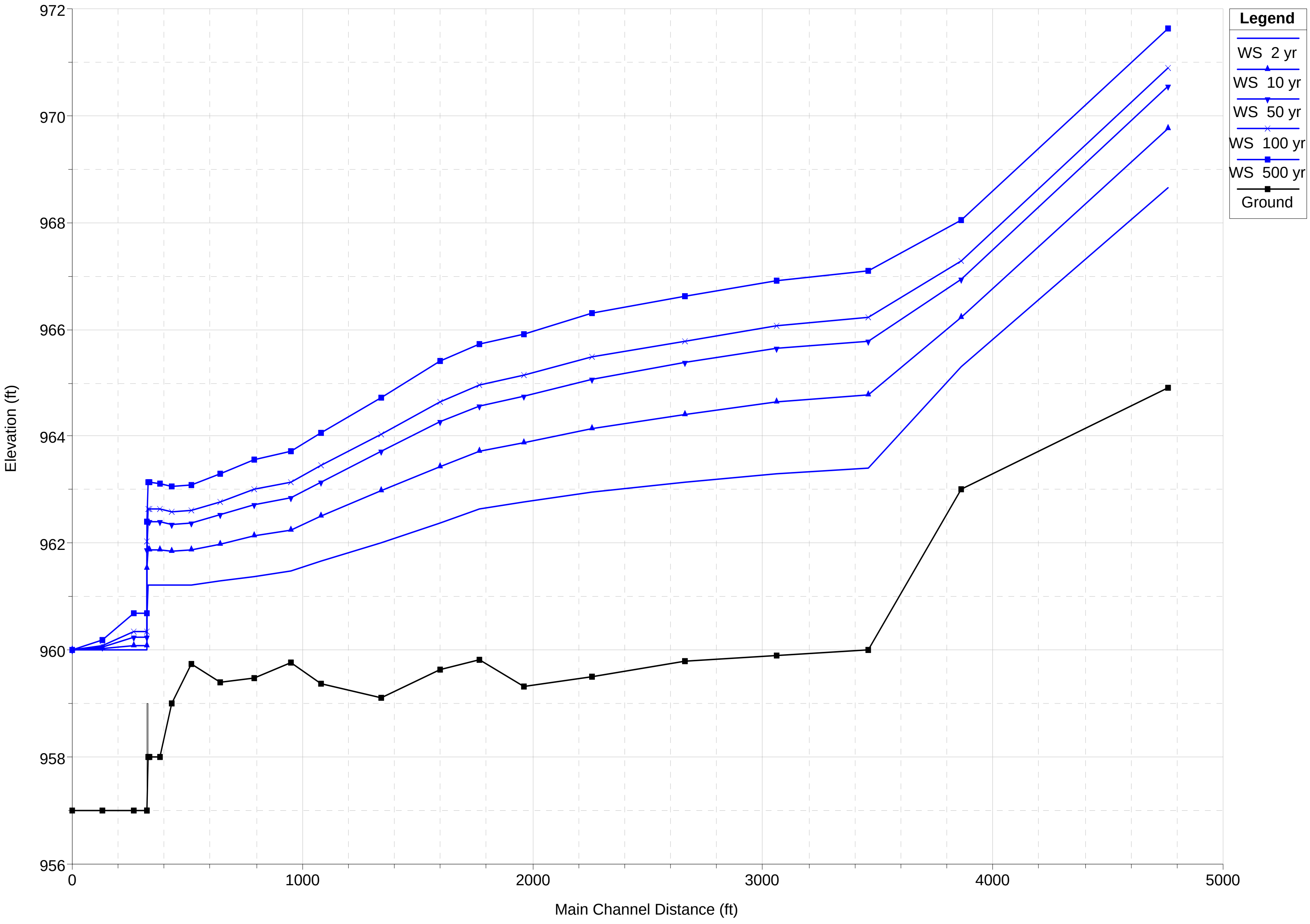

PLATE 7. Water Surface Profiles with Proposed Wetlands Protection Barrier