

FINAL

SUPPLEMENTAL WATERSHED WORK PLAN No. 7
AND ENVIRONMENTAL ASSESSMENT
FOR
HAMILTON DAM (PA-602)
OF THE MARSH CREEK WATERSHED
TIOGA COUNTY, PENNSYLVANIA



PREPARED BY
USDA NATURAL RESOURCES CONSERVATION SERVICE

IN COOPERATION WITH
WELLSBORO BOROUGH MUNICIPAL AUTHORITY
U.S. ARMY CORPS OF ENGINEERS

OCTOBER 2018

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**SUMMARY OF SUPPLEMENTAL WATERSHED
WORK PLAN NO. 7
AND ENVIRONMENTAL ASSESSMENT
FOR HAMILTON DAM (PA-602)
OF THE
MARSH CREEK WATERSHED
(TIOGA COUNTY, PENNSYLVANIA)
CONGRESSIONAL DISTRICT – PA: 10TH
(OFFICE OF MANAGEMENT AND BUDGET FACT SHEET)**

SPONSORS OF HAMILTON DAM PROJECT

Wellsboro Borough Municipal Authority

COOPERATING AGENCY

U.S. Army Corps of Engineers (USACE)

ADDITIONAL SPONSORS OF MARSH CREEK WATERSHED PROJECT

Tioga County Commissioners
Tioga County Conservation District
Pennsylvania Fish and Boat Commission (PFBC)

AUTHORITIES

Marsh Creek Watershed Work Plan was completed and approved in May 1963, executed by the Sponsors and the USDA Soil Conservation Service (now USDA Natural Resources Conservation Service [NRCS]) and became effective on August 15, 1963 under the authority of Public Law (PL) 83-566, Watershed Protection and Flood Prevention Act (16 U.S.C.1001-1008).

Rehabilitation of Public Law 83-566 assisted dams has been authorized under the authority of Section 14 of Public Law 83-566, the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Parts 1001-1008, 1010, and 1012). The responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to NRCS.

PROPOSED ACTION

The proposed action is the rehabilitation of Hamilton Dam (PA-602) to meet current applicable design, performance, and safety criteria with a service life of 100 years.

PROJECT PURPOSE AND NEED

The purpose of the project (Project Purpose) includes the following:

- Provide flood damage reduction, for recurrences up to and including a 100-yr, 24-hr flood, provided by Hamilton Lake Dam (PA-602) for public safety, bridges, roads, agricultural and other lands, buildings, structures, infrastructure, and other features.
- Enhance the existing secondary water supply storage for the Borough of Wellsboro, Pennsylvania.
- Maintain the incidental recreational and habitat values of Hamilton Lake and adjacent riparian lands.
- Comply with current applicable design, performance, and safety criteria for High Hazard potential dams.

The need for federal action arises from the fact that an analysis of the existing Hamilton Dam, based on current NRCS design and safety criteria, determined that the dam did not provide sufficient detention storage for the Principal Spillway Hydrograph, adequate erosion resistance in the auxiliary spillway for the Stability Design Hydrograph, and indicated that the dam would be overtopped during the Freeboard Hydrograph storm event. The dam was originally constructed in 1967 with a 100-year service life. The NRCS and the Pennsylvania Department of Environmental Protection (PADEP), Division of Dam Safety, have categorized Hamilton Lake Dam, as a High Hazard potential dam. The hazard classification is based on the potential for loss of human life due to the prevalence of bridges, roads, and buildings existing in the downstream dam breach inundation zone. This includes 707 residential properties, 324 commercial properties, approximately 18 county roads, and State Routes 6 and 287. The Project Need includes the following:

- Continue providing flood damage reduction for up to and including the 100-year recurrence interval flood event downstream from the dam as established in the original Watershed Work Plan.
- Address current applicable NRCS and Commonwealth of Pennsylvania design, performance and safety criteria to reduce the risk of loss of human life.
- Continue providing secondary source water for public water supply from Hamilton Lake to be utilized by the Borough of Wellsboro to supplement shortages from groundwater wells and as the primary source when well yields drop in the summer at rates up to 1.15 MGD.
- Continue supporting and improving the incidental recreational uses and aquatic and terrestrial wildlife habitat directly dependent upon Hamilton Lake and its surrounding riparian lands to preserve economic benefits generated from spring and winter trout fishing.

PREFERRED ALTERNATIVE

The Preferred Alternative is the National Economic Development (NED) Alternative, which is to rehabilitate the Hamilton Dam. This will:

- Rehabilitate the dam to current applicable NRCS High Hazard potential dam design, performance and safety criteria.
- Continue providing flood damage reduction for up to and including the 100-year recurrence interval flood event.
- Increase public water supply storage
- Maintain incidental recreational use.
- Extend the project life to 100 years.
- Comply with PADEP dam safety regulations.

The Preferred Alternative includes the following actions:

- Maintaining the crest of the dam embankment at settled crest Elevation 1462.4 and flattening the downstream slope to 3 horizontal to 1 vertical to facilitate the economical installation of a chimney drain to upgrade embankment to current NRCS best practice for high hazard embankments.
- Making repairs to concrete and modifying the principal spillway riser to raise orifice crest elevation 2.0 feet to Elevation 1429.5 for an increased 80.73 acre-feet available for municipal water supply.

- Modifying principal spillway riser for low flow augmentation works to provide minimum required discharge for downstream as required by the water allocation permit from the Commonwealth of Pennsylvania requiring a minimum streamflow of not less than 1.24 cfs, equivalent to 800,000 gallons per day, be maintained in Charleston Creek immediately downstream of Hamilton Dam.
- Place additional riprap on upstream face of dam to protect from wave erosion at increased permanent pool elevation.
- Demolishing impact basin.
- Extending the principal spillway conduit for the new dam toe elevation, constructing new impact basin for extended project life, and retrofitting new drain conduits that allow for camera inspection.
- Retrofitting a drainage diaphragm around the principal spillway conduit and installing a chimney drain at the interface of the existing embankment slope and new fill. The drainage diaphragm will be used to control seepage and provide adequate factor of safety for piping resistance. Gradation of sand filter material will be carefully designed for the in-place dam embankment material in consideration of possible dispersive soils identified during planning geology.
- Installing a labyrinth weir and roller-compacted concrete (RCC) spillway in the existing auxiliary spillway on the left abutment of the dam with the following dimensions:
 - Maintaining the existing crest elevation at Elevation 1452.6.
 - A concrete labyrinth weir spillway with a weir height of 5.0 feet and total weir length of 695 feet within the existing 175-foot-wide spillway.
 - A 175-foot-wide channel with 3:1 side slopes for the entrance and exit sections.
 - Training walls at the entrance section to direct flow to the labyrinth weir and protect the dam embankment from erosion.
 - A RCC, stepped exit channel at a 14% grade extending to a RCC basin at Elevation 1393.6.
 - A RCC basin extending 40 feet from the exit channel with a formed concrete end sill with an outlet to a vegetated channel with 5% grade extending to the valley floor at approximate Elevation 1383.6.
 - Purchase or negotiate approximately 0.1 acre of property from one property owner for expansion of auxiliary spillway footprint.

PROJECT BENEFITS

The Preferred Alternative includes these benefits:

- Continued flood damage reduction for 100-year recurrence interval flood event
- Continue to reduce the risk to human life up to the 100-year recurrence interval flood event
- Reduced risk of dam failure and the consequential risks to life and property
- Reduced downstream sedimentation
- Improved downstream water quality
- Maintained land values
- Increase water supply storage

RESOURCE INFORMATION

Hamilton Dam (PA-602) is located on Charleston Run, a tributary to Marsh Creek which flows through the Borough of Wellsboro. The dam is located in Charleston Township; directions to the site from downtown Wellsboro is approximately 1.8 miles southeast on Roosevelt Highway to Round Top Hill Road, then 0.4 mile south to the dam. The dam was built in 1967 and created a 38.5-acre lake at the permanent pool

elevation. The property surrounding Hamilton Dam is owned and operated by the Borough of Wellsboro; Hamilton Lake is available to the public for fishing and boating.

Figure S-1 shows the location of Hamilton Dam (PA-602).

Hamilton Dam (PA-602) is a zoned-earth embankment flood control structure. The dam was designed and constructed as a High Hazard potential dam. The dam is currently classified by the Pennsylvania Department of Environmental Protection – Division of Dam Safety as a Size Category B, Hazard Potential Category 1, and by NRCS as a High Hazard potential dam.

The following resource information was obtained from the NRCS Field Office Technical Guide, Section II, Climate Data for Tioga County, Pennsylvania.

Climate

- ***Temperature***
High temperatures average between 30°F in January and 79°F in July. Low temperatures average between 14°F in January and 56°F in July.
- ***Precipitation***
The average annual precipitation is 34.7 inches. Precipitation is well distributed throughout the year. Monthly precipitation averages between 2.0 inches in February to 3.7 inches in June. The heaviest 1-day rainfall during the period of record was 6.5 inches in August 1937. Precipitation amounts of greater than 0.1 inch occurs on about 75 days each year.
- ***Snowfall***
The average seasonal snowfall is 55 inches. The most snow reported in a month was 63 inches.
- ***Topography and Drainage***
Tioga County is located in the Glaciated Allegheny Plateau common resource area and is a dissected plateau within the Susquehanna River drainage system. Elevations range from 996 feet above mean sea level at Lawrenceville to a maximum elevation of 2,543 feet on Cedar Mountain in the southwestern portion of the county.

Table S-1 provides the most current relevant resource information and the planned land use conditions upstream from the Hamilton Dam.

Table S-1
Hamilton Dam Resource Information

Resource	Hamilton Dam (PA-602) Contributing Watershed
Location of Structure ¹	
Longitude	77° 15' 53.3" W
Latitude	41° 44' 22.8" N
Hydrologic Unit Code ²	020502050301
Hydrologic Unit Code Watershed Name ²	Pine
Congressional District ^{2, 3}	Pennsylvania U.S. Congressional District 10
Drainage Area upstream of dam (square miles) ⁴	8.45
Land Use above dam (acres) ⁴	Total – 5407.77
Open Water	50.58
Developed, Open Space	116.91
Developed, Low Intensity	6.43
Barren Land	2.22
Deciduous Forest	2,439.13
Evergreen Forest	105.40
Mixed Forest	524.47
Shrub/Scrub	66.61
Herbaceous	1.64
Hay/Pasture	1,435.37
Cultivated Crops	616.98
Woody Wetlands	20.10
Emergent Herbaceous Wetlands	21.93

¹ Hamilton Dam Emergency Action Plan

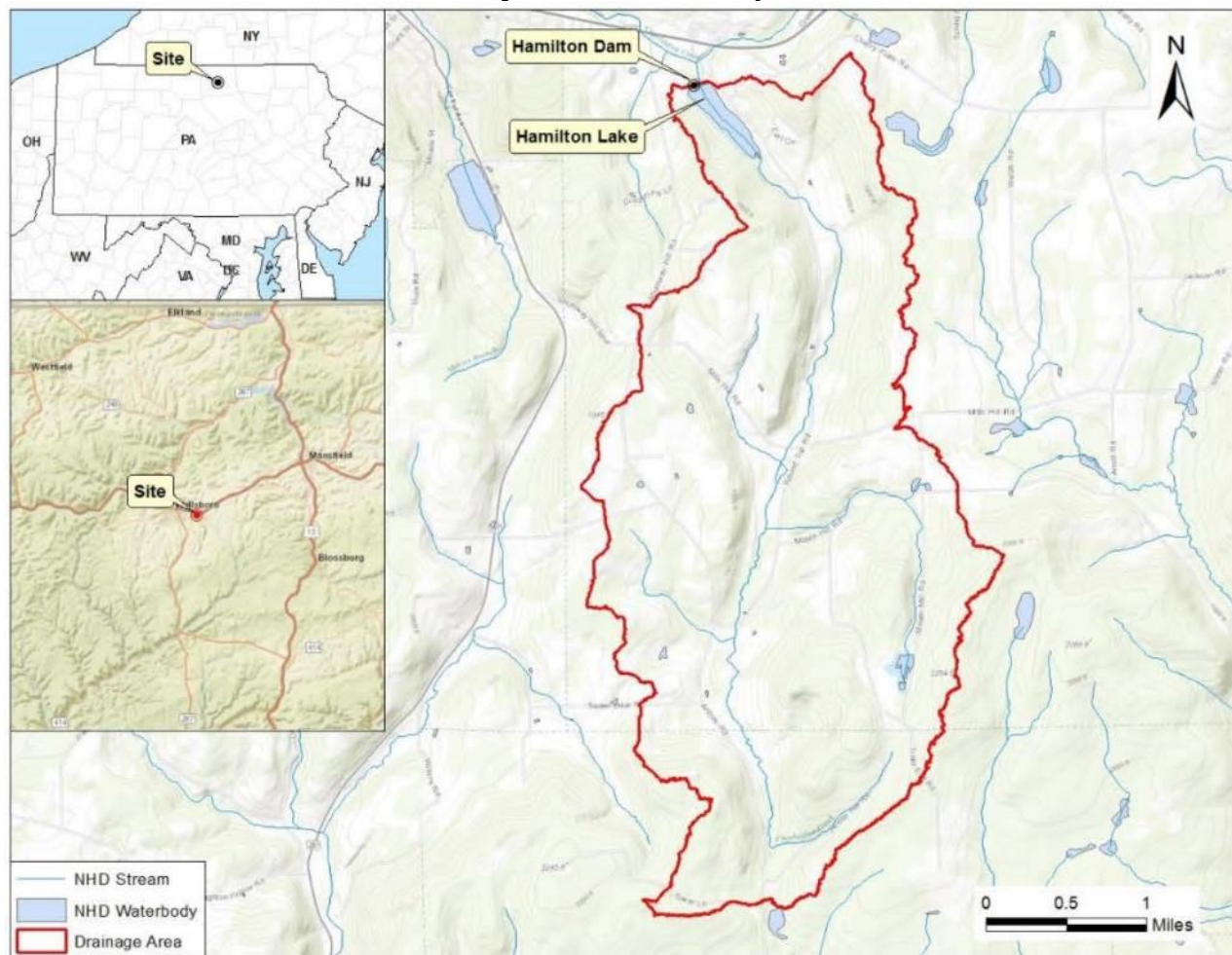
² https://cfpub.epa.gov/surf/huc.cfm?huc_code=02050205

³ <http://marino.house.gov/our-district>

⁴ Amec – Hydrology and Hydraulics – Data Gathering Survey – Table 2: Current Land Use Classification (August 2016)

The property upstream from Hamilton Dam is predominantly private ownership.

Figure S-1
Project Location Map



PROJECT BENEFICIARY PROFILE

Table S-2 provides relevant information regarding the project beneficiary profile.

Table S-2
Project Beneficiary Profile

Beneficiary	Wellsboro ¹	Tioga County ¹	Pennsylvania ¹	U.S. ¹
Population	3,263	41,981	12,702,379	308,745,538
Median Age	47.5 years	42.4 years	40.1 years	37.2 years
Per Capita Income	\$24,042	\$20,358	\$27,824	\$27,915
Median Household Income	\$32,857	\$40,338	\$51,651	\$52,762
Total Number of Households	1,536	17,182	4,952,566	114,761,359
Median Value of Housing Units	\$121,100	\$105,700	\$163,200	\$186,200
Percent of Families Living Below Poverty Level	11.6%	11.6%	8.8%	10.5%

¹ Source: United States Census Bureau, Census 2010

The proposed action directly benefits 1,536 households in Wellsboro. Additionally, the proposed action indirectly benefits approximately 41,981 people which includes the population of Tioga County.

ALTERNATIVE PLANS CONSIDERED

Several alternatives and variations of alternatives were considered. The National Economic Development (NED) Alternative is the alternative that reasonably maximizes net economic benefits consistent with protecting the Nation's environment.

Alternatives included structural and nonstructural measures. The period of analysis for all alternatives was determined to be 100-year Service Life plus 3 years for implementation. All alternatives used the same period of analysis so that they could be consistently compared. Table S-3 provides a summary of criteria for Primary Alternative Plans considered.

Table S-3
Primary Alternative Plans Considered

Alternative	Summary of Alternative	Screening Method			Carried Forward for Detailed Study?
		Estimated Cost	Project Purpose Met	Project Need Met	
No Action/Future Without Federal Project	Minimum constructed breach of the embankment to remove the storage function of the dam and restore the stream to a free-flowing state through the impoundment area and the footprint area of the dam. ▪ Excavate an opening through the dam. ▪ Use the existing auxiliary spillway location for on-site disposal. ▪ Remove the principal spillway inlet structure and conduit. ▪ Connect the old stream bed to the downstream channel. ▪ Provide rock riprap slope protection. ▪ Vegetate the accumulated sediment. ▪ Resume normal stream flow. ▪ Provide new water supply from alternative source as proposed in 2004 study.	\$7,264,000			Yes

Alternative	Summary of Alternative	Screening Method			Carried Forward for Detailed Study?
		Estimated Cost	Project Purpose Met	Project Need Met	
Dam Decommissioning with Nonstructural Measures	Dam Decommissioning: Federally-assisted removal of the entire embankment and restore the stream and 100-year floodplain to a free-flowing state through the impoundment area and the footprint area of the dam.				
	- Excavate an opening through the dam. - Use the existing auxiliary spillway location for on-site disposal. - Remove the principal spillway inlet structure and conduit. - Connect the old stream bed to the downstream channel. - Provide rock riprap slope protection. - Vegetate the accumulated sediment. - Resume normal stream flow.	\$7,179,000			
	Cost to provide new water supply from alternative source (as proposed in 2004 study)	+3,962,000			
	Nonstructural Measures: Floodproof or relocate existing structures in the downstream 100-year floodplain. Replacement of incidental recreation value (not included with cost.)	<u>+\$78,296,000</u>			
	- Floodproofing or relocating 46 Commercial and 106 Residential structures. - The affected municipalities are the Borough of Wellsboro, Charleston Township and Delmar Township.	<u>\$89,437,000</u>	✓	✓	No

Alternative	Summary of Alternative	Screening Method			Carried Forward for Detailed Study?
		Estimated Cost	Project Purpose Met	Project Need Met	
Dam Rehabilitation (NED Alternative)	Federally-assisted rehabilitation of dam to NRCS and Commonwealth of Pennsylvania High Hazard potential dam design criteria. ▪ Maintain auxiliary spillway crest at Elevation 1452.6. ▪ Modify principal spillway riser orifice to raise permanent pool 2.0 feet to Elevation 1429.5 for increased water supply. ▪ Install labyrinth weir structure in auxiliary spillway, regrade exit channel and armor auxiliary spillway channel from crest to stilling basin near valley floor. ▪ Maintain dam crest at settled Elevation 1462.4. ▪ Flatten downstream slope of dam to 3H:1V. ▪ Extend principal spillway conduit and re-construct concrete impact basin at the outlet. ▪ Retrofit drainage diaphragm around principal spillway conduit and install chimney drain at interface with embankment fill. ▪ Repair and/or replace metal components on principal spillway inlet riser; any other items identified as being deficient. ▪ Install low flow augmentation works on riser.	\$6,634,000	✓	✓	Yes
Nonstructural Measures (Acquisition or Relocation of At-Risk Structures)	▪ Maintain dam at current configuration. ▪ Acquire and/or relocate 707 residences and 324 commercial properties within the breach inundation zone. ▪ The affected municipalities are the Borough of Wellsboro, Charleston Township and Delmar Township. ▪ Prevent development in breach inundation area.	\$408,600,000	✓	✓	No
Nonstructural Measures (Floodproofing of At-Risk Structures)	▪ Maintain dam at current configuration. ▪ Construct 34,100 linear feet of levees/floodwalls. ▪ Protect 381 residences and 72 commercial properties by constructing a levee/floodwall. ▪ Acquire and/or relocate 326 residences and 252 commercial properties not protected by the levees and/or floodwalls. ▪ The affected municipalities are the Borough of Wellsboro, Charleston Township and Delmar Township. ▪ Prevent development in breach inundation area	\$308,160,000	✓	✓	No

PROJECT COSTS

Table S-4 summarizes the allocation of project costs for the Preferred Alternative. Funding will be requested annually until the project is funded.

Table S-4
Estimated Project Costs

Rehabilitate to NRCS High Hazard Potential Dam	Source				Total Eligible Installation Costs
	Public Law 83-566 Funds ^{1, 2}		Other Funds ^{1, 2}		
	\$	%	\$	%	
Construction	\$ 3,336,000	65%	\$ 1,780,000	35%	\$ 5,116,000
Engineering	\$ 1,250,000	100%	\$ -	0%	\$ 1,250,000
Relocation	\$ -	0%	\$ -	0%	\$ -
Real Property Rights	\$ -	0%	\$ 12,000	100%	\$ 12,000
Natural Resource Rights	\$ -	0%	\$ -	0%	\$ -
Project Administration	\$ 250,000	98%	\$ 5,000	2%	\$ 255,000
Permits	\$ -	0%	\$ 1,000	100%	\$ 1,000
Total Costs	\$ 4,836,000	73%	\$ 1,798,000	27%	\$ 6,634,000
Annual O & M Costs	\$ -	0%	\$ 14,000	100%	\$ 14,000

October 2018

¹ Price base 2019

² Maximum Public Law 83-566 cost-share is 65% of eligible cost-sharable items, not to exceed 100% of total construction costs. Not all cost-sharable items are included in the table, such as non-NRCS technical and engineering assistance for initial project planning.

Source: NRCS Rehab Cost Comp Est Worksheet

Table S-5 and Table S-6 describe the estimated benefits and costs associated with the Project.

Table S-5
Estimated Project Benefits

Rehabilitate to Current High Hazard Potential Dam	Estimated Average Annual Monetary Benefits¹
Flood Damage Reduction Rural Residential, Commercial, Industrial, Transportation, Sediment and Indirect	\$533,000
Other Benefits Non-Agricultural Water Management Recreation Avoided Cost ²	\$75,000 \$556,000 \$229,000
Total Monetary Benefits	\$1,393,000

October 2018

¹ Price base 2019

² Per Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, 1.7.2 (b) (3) - the avoided cost of the most likely alternative to the planned action.

Table S-6
Estimated Project Benefits and Costs

Item	Value^{1, 2}
Average Annual Costs	\$ 223,000
Net Economic Benefits	\$ 1,170,000
Benefit Cost Ratio	6.25 to 1.0
Period of Analysis	103 years
Project Life	100 years

October 2018

¹ Price base 2019

² Average Annual values are amortized over 100 years – service life and 3 years – implementation at 3.00% discount rate.

ENVIRONMENTAL CONSIDERATIONS AND EFFECTS

Table S-7 describes the resource concerns identified during project scoping and summarizes the potential impacts related to the Preferred Alternative.

Table S-7
Summary of Relevant Resource Concerns and Effects of Rehabilitation

Relevant Resource Concern	Summary of Effects of Preferred Alternative
Air Quality/Clean Air Act	There will be some temporary affects during construction including dust and exhaust. Control measures would be implemented during construction to minimize impacts.
Aquatic Resources	- Fish and waterfowl habitat may be impacted during construction due to the temporary drawdown of Hamilton Lake. The fish and wildlife impacts will be managed in accordance with PFBC requirements. - Maintain habitat for numerous aquatic and terrestrial species; the permanent pool increase will provide an additional 3.4 acres of habitat.
Cultural Resources	No effect.
Environmental Justice and Civil Rights	No disproportionate adverse effects are anticipated to any ethnic, racial, or socioeconomically disadvantaged families or groups downstream of the dam.
Energy Inefficiency	During construction an increase in equipment and facilities will be required. Normal mowing and maintenance routines will be reconvened following project completion.
Erosion and Sediment Yield	No change upstream. Short-term increase in suspended sediment and turbidity downstream during construction, , but proper controls will minimize erosion.
Fish and Wildlife	- Up to 38.5 acres of fish and waterfowl habitat may be impacted during construction due to the temporary drawdown of Hamilton Lake. The fish and wildlife impacts will be managed in accordance with PFBC requirements. - Maintain habitat for numerous aquatic and terrestrial species. - Following construction, no long-term effect is anticipated.
Floodplain Management	- Maintains the 100-year flood discharge at the dam of approximately 440 cfs. - Increases the 500-year discharge at the dam from approximately 1,100 cfs to 2,100 cfs resulting in an increase in flooding depth ranging from 1.5 feet increase in depth at the dam to 0 feet for approximately 1,800 feet downstream of the dam; impacted area consists of stream corridor and a paved lot. . The 500-year floodplain is not impacted beyond 1,800 feet downstream due to timing of the hydrograph from offsite uncontrolled drainage areas. There are no critical structures downstream that will be affected by the increased 500-year discharge from the dam.

Relevant Resource Concern	Summary of Effects of Preferred Alternative
Floodwater Damage	• Maintains the 100-year flood discharge at the dam of approximately 440 cfs. • Increases the 500-year discharge at the dam from approximately 1,100 cfs to 2,100 cfs resulting in an increased in flooding depth ranging from 1.5 feet increase in depth at the dam to 0 feet approximately 1,800 feet downstream of the dam; impacted area consists of stream corridor and a paved lot. • The 500-year floodplain is not impacted beyond 1,800 feet downstream of the dam due to timing of the hydrograph from offsite uncontrolled drainage areas. There are no critical structures downstream that will be affected by the increased 500-year discharge from the dam. • Maintains 500-year flood protection for government housing property for elderly, handicapped and disabled persons that would be within the flood area without Hamilton Dam.
Invasive Species	• Construction and earth disturbance activities may introduce invasive plant species but replanting with appropriate native or non-invasive species will minimize the impact.
Land Use	• Maintain land use in the benefitted area.
Migratory Birds	• The project alternative may temporarily impact migratory birds during construction. Coordination of construction activities and avoidance measures will be implemented.
Parklands	• Maintain lake for year-round recreational fishing and boating with watercraft without gasoline-powered engines. • Access to, and use of, the lake will be temporarily affected during construction.
Plant Condition	• Vegetation will be disturbed during construction. Undesirable plants will be minimized with the replanting of native species and management of noxious plants. • Raising the permanent pool of Hamilton Lake two feet will submerge existing vegetation at and near the shoreline. Hydrologic conditions will support wetland species in currently upland areas.
Prime and Unique Farmlands	• The rise in elevation of Hamilton Lake will inundate approximately 0.5 acres of Philo silt loam soils, designated as prime farmland. However, this area at the point Charleston Creek enters the lake is not located on lands that are or will be used for farming or agriculture.
Public Health and Safety	• Continue providing flood damage reduction benefits for the 100-year recurrence interval flood event downstream from the dam in a manner that minimizes the risk of loss of human life. Reduced breach inundation risk to downstream residents. No effect is anticipated on the fish consumption advisory.
Regional Water Resources Plans	• Continue to support the Susquehanna River Basin Commission's Comprehensive Plan with low flow augmentation and conservation releases.
Riparian Areas	• Vegetation communities within the current riparian areas will be impacted by the rise in elevation of Hamilton Lake. Approximately 3.6 acres of trees and shoreline vegetation along the current shoreline may die off when the elevation of Hamilton Lake rises; vegetation in wetlands along the periphery of the lake will be inundated.
Scenic Beauty	• The scenic quality of the landscape of Hamilton Lake may be temporarily impacted during construction while the lake is drawn down. Construction equipment will temporarily be stored and utilized on-site. Trees along the current shoreline may die off when the elevation of Hamilton Lake rises.

Relevant Resource Concern	Summary of Effects of Preferred Alternative
Social Issues	- Promote public health and safety; continue flood protection; and support local labor and management requirements. - Continue to support the incidental recreation activities at Hamilton Lake.
Water-Based Recreation	Continue to support water-based recreation opportunities that are available at the site.
Water Quality	- A temporary increase in loading of nutrient-laden sediment may be observed downstream during construction and dam drawdown events. - Improvement of the dam would not permanently change the excess sediment and nutrients currently entering the Chesapeake Bay. - Erosion and sediment controls will be utilized during construction to reduce the impact of excess nutrient-laden sediment downstream.
Water Resources – Public Water Supply	The water supply storage will be increased from 333.92 acre-feet to 414.65 acre-feet by raising permanent pool elevation two feet in elevation.
Waters of the United States/Clean Water Act	- Erosion and sedimentation controls consistent with an approved plan will be implemented to minimize discharge of sediment during temporary earth disturbance occurring during construction activities. - Permits will be needed for Sections 401 and 402 (granted by PADEP) and Section 404 (granted by USACE) of the Clean Water Act.
Wetlands	- Wetlands along the periphery of Hamilton Lake will be temporarily impacted during the lake drawdown period associated with construction at the dam. - As the elevation of Hamilton Lake rises, approximately 2.3 acres existing wetlands will be permanently inundated. Approximately 3.6 acres of new wetlands will likely form along the periphery of the new shoreline and head of Hamilton Lake. - Modifications to the auxiliary spillway may affect approximately 0.1 acres of artificial wetlands in existing auxiliary spillway footprint. - Alterations to wetland and aquatic habitat will require authorization by the U.S. Army Corps of Engineers (USACE) via the PASPGP-5 or NWP-27.

MITIGATION

No compensatory mitigation is anticipated. All needed measures will be taken to avoid and minimize any adverse impacts during construction and may include timing of work, sediment controls such as seeding, mulching and silt fences, and wetting construction areas to reduce dust.

The water allocation permit from the Commonwealth of Pennsylvania requires a minimum streamflow of not less than 1.24 cfs, equivalent to 800,000 gallons per day, be maintained in Charleston Creek immediately downstream of Hamilton Dam. Low flow augmentation works are planned to be added at Hamilton Dam to provide for this mitigation.

Any further appropriate mitigation identified or required through permitting will be incorporated into the Project.

MAJOR CONCLUSIONS

The Preferred Alternative is to rehabilitate Hamilton Dam (PA-602) to current applicable Commonwealth of Pennsylvania and NRCS High Hazard potential dam design, performance and safety criteria. The service life of the rehabilitated dam would be 100 years with an additional 3 years for implementation. This is also the National Economic Development Alternative.

AREAS OF CONTROVERSY

No areas of controversy were identified.

ISSUES TO BE RESOLVED

None identified.

EVIDENCE OF UNUSUAL CONGRESSIONAL OR LOCAL INTEREST

No evidence of unusual congressional or local interests was identified.

COMPLIANCE CERTIFICATION

Is this report in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects? Yes X No

1.0 PURPOSE AND NEED FOR ACTION

1.1 CHANGES REQUIRING PREPARATION OF A SUPPLEMENT

Hamilton Dam (PA-602) was designed and constructed as a High Hazard potential dam. Hamilton Dam was designed to meet the dam safety engineering standards in place at the time of its construction. Recent advances in dam safety engineering have resulted in increased design standards above and beyond those originally used for the Hamilton Dam. The 2010 Dam Assessment by NRCS determined insufficient detention storage and freeboard based on current applicable criteria and more recent rainfall data. Therefore, Hamilton Dam does not meet current applicable NRCS and PADEP dam design, performance and safety criteria for a High Hazard potential dam.

1.2 INTRODUCTION

This Supplemental Watershed Work Plan No.7 and Environmental Assessment formulates and evaluates alternatives for the rehabilitation of Hamilton Dam (PA-602).

The Marsh Creek Watershed Work Plan was completed and approved in May 1963. The associated Watershed Agreement has subsequently been supplemented six times. Hamilton Lake Dam was originally authorized as a multi-purpose dam, providing both flood protection and water supply storage.

NRCS completed a Rehabilitation Assessment Report which included an evaluation and estimated risk-based profile of the dam in May 2010. The evaluation indicated that the Hamilton Dam (PA-602) Risk Index was 7,181. NRCS reviewed the breach inundation zone downstream from the dam and determined that the Borough of Wellsboro would be subject to flooding during a breach of the dam.

1.3 PROJECT PURPOSE

The purpose of the project (Project Purpose) includes the following:

- Provide flood damage reduction, for recurrences up to and including a 100-yr, 24-hr flood, provided by the Hamilton Lake Dam (PA-602) for public safety, bridges, roads, agricultural and other lands, buildings, structures, infrastructure, and other features.
- Enhance the existing secondary water supply storage for the Borough of Wellsboro, Pennsylvania to increase availability of treatable water.
- Maintain the incidental recreational and habitat values of Hamilton Lake and adjacent riparian lands.
- Comply with current applicable design, performance, and safety criteria for High Hazard potential dams.

1.4 PROJECT NEED

The need for federal action arises from the fact that an analysis of the existing Hamilton Dam, based on current NRCS design and safety criteria, found that the dam did not provide sufficient detention storage for the Principal Spillway Hydrograph, adequate erosion resistance in the auxiliary spillway for the Stability Design Hydrograph, and indicated that the dam would be overtopped during the Freeboard Hydrograph storm event. The dam was originally constructed in 1967 with a 100-year service life. The NRCS and the PADEP Division of Dam Safety, have categorized Hamilton Lake Dam, as a High Hazard potential dam. The hazard classification is based on the potential for loss of human life due to the prevalence of bridges, roads, and buildings existing in the downstream dam breach inundation zone. This includes 707 residential properties, 324 commercial properties, approximately 18 county roads, and State Routes 6 and 287. The Project Need includes the following:

- Continue providing flood damage reduction for up to and including the 100-year recurrence interval flood event downstream from the dam as established in the original Watershed Work Plan.
- Address current applicable NRCS and Commonwealth of Pennsylvania design, performance and safety criteria to reduce the risk of loss of human life.
- Continue providing secondary source water for public water supply from Hamilton Lake to be utilized by the Borough of Wellsboro to supplement shortages from groundwater wells and as the primary source when well yields drop in the summer at rates up to 1.15 MGD.
- Continue supporting and improving the incidental recreational uses and aquatic and terrestrial wildlife habitat directly dependent upon Hamilton Lake and its surrounding riparian lands to preserve economic benefits generated from spring and winter trout fishing.

1.5 OPPORTUNITIES

The following opportunities will be recognized by implementing an alternative that addresses the project purpose and need. Quantification of these opportunities will be provided in other sections of this report as necessary.

- Comply with dam design, performance and safety criteria established by NRCS and PADEP.
- Reduce the potential for loss of human life associated with a failure of the dam.
- Reduce Sponsor liability associated with operation of non-compliant dam.
- Continue to provide flood protection for downstream agricultural land, houses, businesses, and infrastructure for at least the 100-year, 24-hour flood event.
- Protect real estate values by providing flood damage reduction for at least the 100-year, 24-hour frequency flood event.
- Protect water quality.

2.0 SCOPE OF THE PLAN

2.1 SCOPING PROCESS

A scoping process identified issues of economic, environmental, cultural, and social concerns related to the project. Concerns of Sponsors and local citizens were expressed at planning and public meetings of the Wellsboro Borough Council. Factors that affect soil, water, air, plant, animal, and human resources were identified by engineers, biologists, economists, resource conservationists, water quality specialists and others. The scoping process of the Environmental Assessment for the dam involved site investigations, public meetings, and consultations with jurisdictional agencies.

The scoping process identified (1) the objectives, needs, and primary concerns for the Sponsor, (2) the relevant issues, and (3) the environmental concerns associated with the project.

2.2 IDENTIFIED RESOURCE CONCERNS

Table 2-1 identifies the primary Resource Concerns based on the National Watershed Program Manual, Part 501.24 and the additional Resource Concerns included in the Project Scope-of-Work. Relevancy to the proposed action was determined when sufficient rationale was provided. Irrelevant concerns are eliminated from further consideration. Relevant resource concerns were reviewed in detail for the alternatives comparison.

Table 2-1
Summary of Scoping

Resource Concern	Relevant to Proposed Action	Rationale
National Economic Development (NED)	Yes	- Hamilton Dam is 1 of 3 floodwater retarding dams in the Marsh Creek Watershed designed to reduce floodwater damage. Keeping and maintaining Hamilton Dam provides positive impact to NED by serving to reduce flood damage. - Without Project Conditions may result in adverse NED effects as flood damages would be increased in the downstream areas Hamilton Dam is intended to serve.
Air Quality/Clean Air Act	Yes	There will be some temporary effects during construction (dust and exhaust).
Animal-Livestock Production Limitations	No	Hamilton Dam is not used for livestock production.
Coral Reefs	No	No coral reefs of associated water bodies (e.g. embayment areas) are present in or near the planning area.
Coastal Zone Plans	No	Hamilton Dam is not located within a Coastal Zone Management area.
Cultural Resources	Yes	- No cultural resources are known to exist within the project area immediate to the dam. A Phase I Study was completed within the project area to further evaluate potential impacts. - Nearby cultural resources in the vicinity and downstream may be affected by some alternatives.
Ecologically Critical Areas	No	There are no critical habitat areas within the project area.

Resource Concern	Relevant to Proposed Action	Rationale
Endangered and Threatened Species	No	The PNDI search did not identify any endangered or threatened species within the project area near Hamilton Dam.
Environmental Justice and Civil Rights	Yes	Minority and low-income populations could be affected by some alternatives.
Energy Inefficiency	Yes	- Hamilton Dam is not used for energy production. - Operations at Hamilton Dam do not require energy consumption other than the energy required for routine maintenance.
Essential Fish Habitat	No	There are no essential fish habitats within the project area.
Fish and Wildlife	Yes	Hamilton Dam Lake is designated as a Stocked Trout Waters Open to Year-Round Fishing and Walleye Fingerling Fisheries waterbody. Coordination with the PFBC will be conducted.
Floodplain Management	Yes	- The purpose of Hamilton Dam is to reduce flooding damages in downstream communities. - Based on the review of FEMA's Flood Insurance Rate Maps of the project study area, Charleston Creek is downstream of the Hamilton Dam outfall and contains areas that are situated within Flood Zone A; some alternatives will affect regulatory floodplain upstream and downstream of the dam.
Forest Resources	No	There are no contiguous forest stands in the area. It is not expected that the project or alternatives would have an impact on these resources.
Invasive Species	Yes	- Invasive species are a concern to the Pennsylvania natural environment. - Construction activities have the potential to introduce invasive species.
Land Use	Yes	- Some alternatives have the potential to affect land use. - Hamilton Dam was designed and constructed to prevent flood damage to downstream areas. - Land use has been planned under the premise that the dam would be retained. - Loss of the dam would adversely impact land use in the downstream benefit area.
Migratory Birds	Yes	- Hamilton Lake attracts a variety of migratory water fowl. Some alternatives may have an effect on these species. - Although not classified as an Important Bird Area, Hamilton Dam is near two Important Bird Areas, Marsh Creek Wetlands and Susquehanna Headwaters Forest Block.
Natural Areas	No	No designated natural areas are located within the project area.
Parklands	Yes	Hamilton Dam is not located within a park, but the lake is open for year-round recreation. Fishing and boating with watercraft without a gasoline-powered engine are allowed. Removal of the dam would eliminate open water fishing and incidental recreation. Project alternatives may affect access to and use of certain parts of the lake.

Resource Concern	Relevant to Proposed Action	Rationale
Plant Condition	Yes	Vegetation within the project area are healthy; no degraded plant conditions were observed. These could be disturbed by changes to the reservoir elevation.
Prime and Unique Farmlands and Farmlands of Statewide Importance	Yes	Approximately 63% of the soils within the project area are classified as either Prime Farmland or Farmland of Statewide Importance.
Public Health and Safety	Yes	- Approximately 707 residential properties, 324 commercial properties, 18 county roads and Pennsylvania State Routes 6 and 287 are within the downstream breach inundation area. - Approximately 106 residential properties, 46 commercial properties, 10 county roads and Pennsylvania State Routes 6 and 287 are within the 100-year floodplain without Hamilton Dam. - The purpose of Hamilton Dam is to provide flood protection to downstream residences, road networks, and other facilities.
Regional Water Resources Plans	Yes	Hamilton Dam Lake watershed is part of the Marsh Creek Watershed that feeds into the Susquehanna River Basin and the Chesapeake Bay. The Tioga County Chesapeake Bay Tributary Strategy was written in March 2005. An Act 167 Stormwater Management Plan does not exist for the Marsh Creek watershed. The dam and the lake exist within the planning area of the Susquehanna River Basin Commission.
Riparian Areas	Yes	Riparian areas are present within the project area. These riparian areas are located on the western and southern banks of Lake Hamilton and along Charleston Creek downstream of the Hamilton Dam.
Scenic Beauty	Yes	The scenic quality of the general landscape of Hamilton Lake may be affected by some of the alternatives.
Scientific Resources	No	No scientific resources are known to be in or near the project area.
Sole Source Aquifers	No	Hamilton Dam is not located in a Sole Source Aquifer area.
Social Issues	Yes	- Certain alternatives may involve adjacent private properties thus potential socioeconomic impact. - Hamilton Lake is used for public fishing. Certain alternatives may affect the public's access. - Other social issues that could be affected include; public health and safety and flood damage. - No disproportionate affects are expected to any minority or low-income populations.
Soil Quality Degradation	No	No direct impact to soil quality are anticipated as a result of the alternatives.
Water Quality	Yes	Surface water quality could be affected by some alternatives. Removing the dam will reduce solar exposure to the water, affecting dissolved oxygen levels. Increasing the size of the permanent pool will increase solar exposure.

Resource Concern	Relevant to Proposed Action	Rationale
Water Resources – Public Water Supply	Yes	Project Alternatives may temporarily affect surface water resources in the immediate vicinity of the Dam. Hamilton Lake is listed as an attaining lake. Lakes that have an attaining status are considered suitable for aquatic life, fish consumption, recreational purposes and use as a potable water source. Rehabilitating the dam could increase the dam's water supply storage.
Waters of the United States, Including Special Aquatic Sites	Yes	Surface water quality could be affected by some alternatives.
Wetlands	Yes	Wetlands are present in the immediate vicinity of Hamilton Dam.
Wild and Scenic Rivers	No	Charleston Creek is neither a Federally-listed nor a State-listed Wild and Scenic River.
Floodwater Damage	Yes	The purpose of Hamilton Dam is to provide flood protection for residents, motorists, and other persons using downstream facilities, and minimize the threat of loss of human life or unsafe conditions from the dam failing.
Erosion and Sediment Yield	Yes	- Sedimentation accumulations have occurred behind the impoundment. - Potential erosion during construction could temporarily affect Charleston downstream of the dam. - Some alternatives could result in the movement of currently trapped sediment downstream.
Aquatic Resources	Yes	Project Alternatives may temporarily affect aquatic resources in the immediate vicinity of the dam and downstream along Charleston Creek.
Water-Based Recreation	Yes	Hamilton Lake is designated as a Stocked Trout Waters Open to Year-Round Fishing and Walleye Fingerling Fisheries waterbody. Coordination with the PFBC may be required. Certain alternatives may affect some water-based recreation activities.

3.0 AFFECTED ENVIRONMENT

The affected environment includes ecological, cultural, social, aesthetic, and economic resources that could be affected by the proposed alternatives. The purpose of describing the affected environment is to define the context in which the impacts could occur.

Unless otherwise noted in the following sections, future conditions are projected to remain unchanged.

Additional information regarding the affected environment of the Marsh Creek Watershed can be found in the Marsh Creek Watershed Work Plan dated May 1963. Conditions that have changed specific to Hamilton Dam are provided below.

3.1 PROJECT SETTING

Hamilton Dam (NRCS PA-602) is located in Charleston Township, Tioga County, Pennsylvania. Its geographic coordinates are 77° 15' 53.3" North Latitude and 41° 44' 22.8" West Longitude. The dam is situated at approximately 1,460 feet above mean sea level. The 38.5-acre lake created by the dam is Hamilton Lake, owned by the Wellsboro Borough Municipal Authority. The dam was originally designed as a high hazard potential dam by the U.S. Department of Agriculture Soil Conservation Service (now NRCS) and constructed between 1966 and 1967.

Charleston Township, in which Hamilton Dam is situated, is in the center portion of Tioga County. The Township is situated approximately 2 miles east of Wellsboro and approximately 18 miles south of the Pennsylvania-New York border. The Hamilton Dam is located to the southeast of Wellsboro.

The narrow, rounded to flat, elongated uplands and escarpments of the area are characteristic of the Glaciated High Plateau Section of the Appalachian Plateau Province.

3.2 SOILS

A current soil survey report obtained from the USDA NRCS Web Soil Survey indicates that there are 19 soil map units within the defined study area. For the purposes of this resource (e.g. soils) the defined study area encompasses Hamilton Dam and its spillway, the immediate area surrounding the dam within approximately 600 feet of the dam, the immediate area around the perimeter of Hamilton Lake extending approximately 30 feet from the shoreline, and along the outflow downstream of the dam to its confluence into Charleston Creek approximately 650 feet downstream of Hamilton Dam; an approximately 26-acre area.

For purposes of this description, the soil types are described based on the specific location in relation to the dam (e.g. soils in the immediate vicinity of the dam; soils in the up gradient area; and soils downstream of the dam along Charleston Creek). The predominant soil groups in the overall study area are the Volusia Channery Silt Loam (61.9% of the area) and the Oquaga, Lordstown and Pope soils (13.4% of the area). Approximately 6.1% of the study area is considered open water (including the impoundment [Hamilton Lake] behind Hamilton Dam). Table 3-1 below summarizes the soil units present within the defined study area.

Table 3-1
Summary of Soil Units within Project Study Area

Soil Map Unit Name	Soil Map Unit Symbol	K Factor Erosion Potential*	Prime Farmland**	Hydric Soil***
Soils in the Immediate Vicinity of Hamilton Dam				
Dams	DAMS	N/A	No	N/A
Open Water	W	N/A	N/A	N/A
Volusia channery silt loam, 8 to 15 percent slopes	VoC	.28	FSI	predominantly Non-Hydric
Pope soils	Po	.20	PFL	predominantly Non-Hydric
Volusia channery silt loam, 15 to 25 percent slopes	VoD	.28	No	predominantly Non-Hydric
Soils Downstream of Hamilton Dam along Marsh Creek				
Oquaga and Lordstown soils, very steep	OTF	.10	No	No
Volusia channery silt loam, 3 to 8 percent slopes	VoB	.28	FSI	predominantly Non-Hydric
Volusia channery silt loam, 8 to 15 percent slopes	VoC	.28	FSI	predominantly Non-Hydric
Pope soils	Po	.20	PFL	predominantly Non-Hydric
Chenango gravelly loam, 2 to 12 percent slopes	ChB	.10	PFL	No
Philo silt loam	Ph	.37	PFL	predominantly Non-Hydric
Mardin channery silt loam, 15 to 25 percent slopes	MaD	.20	No	No
Volusia channery silt loam, 15 to 25 percent slopes, eroded	VoD3	.28	No	predominantly Non-Hydric
Soils in Upstream Area of Hamilton Dam				
Open Water	Water	N/A	N/A	N/A
Pope soils	Po	.20	PFL	predominantly Non-Hydric
Volusia channery silt loam, 8 to 15 percent slopes	VoC	.28	FSI	predominantly Non-Hydric
Mardin channery silt loam, 15 to 25 percent slopes	MaD	.20	No	No
Volusia channery silt loam, 15 to 25 percent slopes	VoD	.28	No	predominantly Non-Hydric
Volusia channery silt loam, 3 to 8 percent slopes	VoB	.28	FSI	predominantly Non-Hydric
Chenango gravelly loam, 2 to 12 percent slopes	ChB	.10	PFL	No
Morris gravelly silt loam, 8 to 15 percent slopes	MoC	.24	FSI	predominantly Non-Hydric
Oquaga channery loam, 3 to 12 percent slopes	OgB	.15	FSI	No
Oquaga channery loam, 12 to 20 percent slopes	OgC	.15	FSI	No
Volusia channery silt loam, 25 to 35 percent slopes, eroded	VoE3	.28	No	predominantly Non-Hydric

Notes: * K Factor Erosion Potential indicates the soil unit's susceptibility to sheet and rill erosion, K Factor < .39 = Not Susceptible to Erosion; K Factor > .39 = Susceptible to Erosion.

** PFL Indicates Prime Farm Land; FSI Indicates Farmland of Statewide Importance; No Indicates Not Prime Farm Land

*** Hydric Soil – 100% of soil type rated hydric; Predominantly Hydric – 66-99% of soil type rated hydric;

Partially Hydric – 33-66% of soil type rated as hydric; predominantly Non-Hydric – up to 33% of soil type rated hydric.

Source: USDA-NRCS Web Soil Survey, Custom Soil Report (March 2016)

3.3 SOIL EROSION AND SEDIMENTATION

The sediment survey conducted by the Project Team in May 2016 was utilized to determine the remaining sediment storage capacities. The estimated remaining sediment storage volume in the Hamilton Dam reservoir was approximately 78.15 acre-feet. The sediment survey and storage evaluation analysis indicates a submerged sedimentation rate of 0.64 acre-foot per year and aerated sedimentation rate of 0.06 acre-foot per year. Therefore, at the estimated submerged sedimentation rate, the remaining life of the existing sediment pool would extend to the year 2138. The aerated sediment accumulations will result in minor reductions (less than one percent) in the detention capacity of the dam over the remaining life of the sediment pool.

The presence of the dam reduces the amount of sediment loading downstream and the cost of removal of sediment from downstream bridges and culverts. Additionally, there has been no reporting of scour as an issue related to clear water scour.

Currently, no specific information regarding excessive bank erosion in Hamilton Dam or Charleston Creek is available. During multiple site visits in 2016, the Project Team did not observe evidence of significant soil erosion issues related to ephemeral gullies or stream bank erosion.

3.4 WATER RESOURCES

Hamilton Lake is an impoundment of Charleston Creek, covering an area of approximately 38.5 acres. The lake lies in a northwest to southeast orientation. Total water volume of Hamilton Lake is 534 acre-feet; however, it can detain an additional 1,445 acre-feet before engaging the auxiliary spillway. The reservoir is approximately 32 feet deep at its deepest point.

Excessive Subsurface Water. The Project Team conducted subsurface exploration in May 2016 at four boring locations at the dam embankment and four boring locations at the auxiliary spillway. Water was encountered in two of the four borings at the dam embankment, at depths between 34.9 and 39.2 feet below ground surface. Also, water was encountered in three of the four borings at the auxiliary spillway, at depths between 37.8 and 52.4 feet below ground surface. Based on this data, there does not appear to be an excessive subsurface water issue at Hamilton Dam.

Water is supplied to Charleston Township and Wellsboro by the Wellsboro Municipal Authority. According to the USGS, in *Ground Water in North-Central Pennsylvania (1939)*, the Wellsboro Water Company originally obtained water from three streams and thirteen springs located within five miles of Wellsboro Borough. One of the three stream locations is on Charleston Creek in the vicinity of Hamilton Lake. Seven of the springs are located along Charleston Creek. Water from these sources is carried to two earth reservoirs and is supplied via gravity distribution at pressures ranging from 30 to 75 pounds per square inch. In 1930, the springs went dry and 15 water wells were installed along Charleston Creek as a replacement.

Excessive Seepage. The Project Team conducted seepage analyses as part of the evaluation of the dam. The seepage analysis indicated that the phreatic surface does not reach the ground surface and does not produce exit gradients at the toe of the dam. This condition was consistent with on-site observations. Based on this data, there does not appear to be an excessive seepage issue at Hamilton Dam.

Excessive Runoff, Flooding or Ponding. The Project Team performed a Hydrologic and Hydraulics (H&H) analysis of the existing structure using the SITES model for a set of different rainfall events. The dam was evaluated against the current applicable High Hazard potential criteria set by NRCS and PADEP.

The results of the Principal Spillway Hydrograph (PSH) analysis, using a 1-day/10-day rainfall, indicate that the principal spillway cannot empty the detention storage within 10 days, therefore not meeting the NRCS TR-60 10-day limit for an earth auxiliary spillway. The peak pool elevation during the PSH event is 1,453.60 feet (in the Hamilton Dam 1967 as-built plans reference "local" vertical datum), which exceeds the current auxiliary spillway crest at 1,452.60 feet.

Based on the Stability Design Hydrograph analysis, peak velocity and erosionally effective tractive stress will likely cause sod stripping in the vegetated auxiliary spillway exit channel.

For the Freeboard Hydrograph (FBH), the results of the integrity analysis indicate that the integrity of the auxiliary spillway is compromised during both the 6-hour and 24-hour FBH events. The results of the discharge capacity analysis show that the 24-hour FBH event is the governing scenario that results in the highest maximum water surface elevation in the reservoir (1464.60 feet). This is above the lowest surveyed point along the dam centerline (1462.44 feet) as well as the designed settled top of dam elevation (1462.2 feet). The standard NRCS 6-hour and 5-point curve PMP 24-hour distributions also result in overtopping of the dam.

Surface Water Quality. The Marsh Creek watershed consists of a drainage area of 78 square miles. Approximately 14.8 miles of the creek are impaired due to highway, road and urban runoff. Portions of Charleston Creek downstream of Hamilton Dam have organic enrichment and low dissolved oxygen impairments caused by the impoundment.

Hamilton Lake is listed as an attaining lake by the PADEP 2016 Pennsylvania Integrated Water Report. Lakes that have an attaining status are considered suitable for aquatic life, fish consumption, recreational purposes and use as a potable water source. Hamilton Lake is an extremely popular spot for trout fishing in the spring and fall. Therefore, the lake is regularly stocked as a put-and-take trout fishery. Hamilton Lake is involved in the Catchable Trout Program.

The lake's main inlet, Charleston Creek, is designated as a warm-water fishery as per Title 25 of the Pennsylvania Code Chapter 93. In addition, the section of Charleston Creek immediately downstream of Hamilton Lake dam where it enters Marsh Creek remains designated as a warm-water fishery. No issues pertaining to elevated water temperatures have not been identified.

Excess nutrients, pesticides, pathogens and chemicals have not been identified as a major source of surface water degradation in Hamilton Lake.

Groundwater. Groundwater in Tioga County, Pennsylvania is derived primarily from stratified-drift aquifers that are recharged locally from precipitation. Groundwater was encountered during subsurface explorations at the site.

Groundwater Quality. No specific information concerning the groundwater quality in the immediate location of Hamilton Dam is available. However, yields for larger municipal and industrial wells range from 70 to 300 gallons per minute. The hardness of the water is usually greater than 20 and less than 220 parts per million, generally 160 parts per million. The dissolved solids range from about 60 to 350 parts per million but usually less than 280 parts per million. Iron content is generally less than 0.2 parts per million.

3.5 BIOLOGICAL RESOURCES

Plant Condition. Vegetation present in the immediate vicinity of Hamilton Dam consists of maintained grass cover which is maintained by the Wellsboro Borough Municipal Authority. Table 3-3 provides the observed plant species in the vicinity adjacent to the Hamilton Dam during the wetland delineation:

Table 3-2
Hamilton Dam Plant Species List

Trees (Common Name)	Trees (Scientific Name)
Ash-Leaf Maple	<i>Acer negundo</i>
Silver Maple	<i>Acer saccharinum</i>
Quaking Aspen	<i>Populus tremuloides</i>
Shrubs (Common Name)	Shrubs (Scientific Name)
Multiflora Rose	<i>Rosa multiflora</i>
Staghorn Sumac	<i>Rhus typhina</i>
Pussy Willow	<i>Salix discolor</i>
Herbaceous (Common Name)	Herbaceous (Scientific Name)
Garlic Mustard	<i>Alliaria petiolata</i>
Common Milkweed	<i>Asclepias syriaca</i>
Northern Long Sedge	<i>Carex folliculata</i>
Queen Anne's Lace	<i>Daucus carota</i>
Cut-Leaf Teasel	<i>Dipsacus laciniatus</i>
Wood Aster	<i>Eurybia divaricata</i>
Sweet-Scented Joe-Pye-Weed	<i>Eutrochium purpureum</i>
Fescue Grass	<i>Festuca spp.</i>
White Bedstraw	<i>Galium mollugo</i>
Spotted Crane's Bill	<i>Geranium maculatum</i>
Hypnum Moss	<i>Hypnum cupressiforme</i>
Dense Gayfeather	<i>Liatris spicata</i>
Ryegrass	<i>Lolium spp.</i>
Bluegrass	<i>Poa spp.</i>
Barbed-Bristle Bulrush	<i>Scirpus ancistrochaetus</i>
Goldenrod	<i>Solidago Canadensis</i>
Common Dandelion	<i>Taraxacum officinale</i>
White Clover	<i>Trifolium repens</i>
Broad-Leaf Cattail	<i>Typha latifolia</i>
Great Mullein	<i>Verbascum thapsus</i>
Blue Vervain	<i>Verbena hastata</i>
Vines (Common Name)	Vines (Scientific Name)
Grape Vine	<i>Vitis spp.</i>
Japanese Honeysuckle	<i>Lonicera japonica</i>

Vegetation across the project area is generally healthy and is not in a degraded condition. Vegetation along the Hamilton Dam embankment and auxiliary spillway is maintained grass along the embankment and spillway itself which transition into brush vegetation before giving over to the tree line. No degraded plant conditions were observed.

At this time, there are no identified structural or composition inadequacies in association with Charleston Creek or Hamilton Lake as it relates to biological resource dependencies at Hamilton Dam. No other apparent unique or other biological resource issues were noted in association with Hamilton Dam.

Fish and Wildlife. At this time, the only identified habitat degradation issues in association with Hamilton Lake is that the existing dam is a barrier for the upstream dispersal and distribution of the American eel in the Susquehanna River Basin. No other habitat degradation issues were identified in association with Hamilton Dam or Charleston Creek as it relates to fish and wildlife. Hamilton Lake is designated as an Approved Trout Waterbody and Charleston Creek is designated as a Warm Water Fishery. Hamilton Lake is a Trout Stocked Waters Open to Year-Round Fishing and a Walleye Fingerling Fisheries Waterbody.

3.6 ENERGY

Hamilton Dam is not used for energy production. Operations at the dam that require the consumption of energy include occasional mowing maintenance activities.

3.7 HUMAN, ECONOMIC, AND SOCIAL CONSIDERATIONS

Social Conditions. The Project site is located in a rural area of Tioga County, Pennsylvania. The land use in the Project drainage area is primarily agricultural and rural residential developments. Table 3-3 provides relevant information regarding the social and economic conditions in the study area.

Table 3-3
Social and Economic Profile

Beneficiary	Wellsboro ¹	Tioga County ¹	Pennsylvania ¹	U.S. ¹
Population	3,263	41,981	12,702,379	308,745,538
Median Age	47.5 years	42.4 years	40.1 years	37.2 years
Per Capita Income	\$24,042	\$20,358	\$27,824	\$27,915
Median Household Income	\$32,857	\$40,338	\$51,651	\$52,762
Total Number of Households	1,536	17,182	4,952,566	114,761,359
Median Value of Housing Units	\$121,100	\$105,700	\$163,200	\$186,200
Percent of Families Living Below Poverty Level	11.6%	11.6%	8.8%	10.5%

¹ Source: United States Census Bureau, Census 2010

Land Use and Land Cover. Land use in Tioga County can be characterized as forestland, agricultural land and rural residential land. The most prevalent housing types in Tioga County consist of single-family detached and mobile homes. The rural central Tioga County region is comprised of agricultural lands interspersed between single-family residential developments. Higher density commercial and multi-family developments are situated in Wellsboro located northwest of Hamilton Lake.

Public Health and Safety. Hamilton Dam was constructed for the purposes of flood control and to act as a water supply for Wellsboro Borough. The Dam was built between 1966 and 1967 and funded through NRCS under the Public Law (PL) 566 Program. Flood control and the creation of a secondary water

source are the primary functions of the lake, as authorized purposes, with recreation as a secondary incidental benefit.

The inundation area resulting from a sudden dam failure extends along Charleston Creek from the dam to Wellsboro. The inundation area would continue on to the confluence with Marsh Creek, along State Highway 287 into Delmar Township. There are approximately 707 residential properties and 324 commercial properties within the inundation area.

The Wellsboro Borough Municipal Authority, the Borough of Wellsboro and Tioga County have developed an Emergency Action Plan (EAP) that provides procedures for surveillance, warning, and evacuation measures in the event of a dam failure. Inundation mapping for the non-failure event is currently not included in the EAP. This information will be included when the EAP is updated for the rehabilitated condition.

Labor. There may be differences in labor requirements for alternatives as related to O&M and perhaps flood recovery. The labor needed to maintain the dam is estimated as the equivalent of 0.2 full-time staff, which includes maintenance activities, and other miscellaneous maintenance services.

Management Level. There are differences in management requirements between alternatives. The Sponsor has sufficient education and experience to manage and maintain the dam; in its current configuration. Additionally, consulting firms have been engaged for professional engineering services. The effort to provide management is estimated at 0.2 full-time staff for the current configuration and operation.

3.8 SPECIAL ENVIRONMENTAL CONCERNS

Air Quality/Clean Air Act. Tioga County, in which Hamilton Dam is located, currently has attainment status for ozone and particulate matter.

There are no specific emission sources associated with Hamilton Dam and the dam itself is currently meeting the full compliance of the Clean Air Act.

Clean Water Act/Waters of the US. A wetland, classified as freshwater forested/shrub is present at the southern end of Hamilton Lake where Charleston Creek enters the lake and is approximately 3.1 acres. Any work conducted on the dam or along Charleston Creek downstream of the spillway would be subject to Section 404 of the Clean Water Act.

In addition, Charleston and Marsh Creeks were listed as impaired waterways in 2002 and 2004. The cause of impairment is listed as organic enrichment, low dissolved oxygen and siltation. Total maximum daily loads, have not been established for Charleston Creek. Any work conducted on the dam or along Charleston Creek downstream of the spillway would be subject to Section 303 of the Clean Water Act.

Cultural Resources/Historic Properties. On May 16-20, 2016, the Project Team conducted a Phase IA/IB archaeological resource survey of the proposed project area, which encompassed a total of 27.4 acres around the existing lake.

The archaeological survey involved background research and a Phase IA reconnaissance survey which formed the basis of the predictive model that was employed during the subsequent Phase IB intensive survey. The predictive model included 8.8 acres with a high potential to contain sites and 18.6 acres with a low or no potential to contain archaeological resources. The high probability areas were investigated by shovel testing while the low/no site potential zones were inspected by a walkover survey and judgmentally placed shovel tests.

The archaeological survey resulted in the discovery of one site. Site 36TI0179 (Historic File Key number 203401) is a section of railroad bed and bridge that were constructed in the 1870s. The line was abandoned after flooding that occurred in 1946 and dismantled prior to the construction of Hamilton Lake Dam in the 1960s. The bridge consists of one stone and one concrete abutment and the bed is composed of dense gravel and soil fill. The bridge's superstructure, as well as the tracks and ties have been removed. Though material remnants of the bridge and railroad bed remain, they lack archaeological integrity. Given the loss of integrity due to the dismantling of the railroad, the Project Team recommends

that site 36TI0179 (Historic File Key number 203401) is not to be considered eligible for listing on the National Register of Historic Places. If any additional construction efforts take place in areas not previously submitted to an archaeological survey/evaluation, then an additional archaeological survey is recommended, as per the Pennsylvania State Historic Preservation Office on November 22, 2016.

Additional information pertaining to the Phase IA/IB survey is documented in the *Phase IA/IB Archaeological Survey for the Proposed Hamilton Lake Dam (PA 602) Rehabilitation Project, Charleston Township, Tioga County, Pennsylvania*.

Tioga County has 10 properties and/or historic districts listed on the National Historical Register. These historic resources of local concern within the immediate vicinity of Hamilton Dam include:

- Robinson House
- Jesse Robinson House
- Wellsboro Armory
- Wellsboro Historic District

In consultation with the Pennsylvania State Historic Preservation office, Historical and Museum Commission (letter dated July 12, 2016), it was their opinion that no historic buildings, structures, districts, or objects will be affected by this project. As such, no historic structures survey work is required for this project.

Environmental Justice. The population of Charleston Township, in which Hamilton Dam is located, is 3,360. The census indicates 2% of the population within this area is classified as a minority population. In comparison, the minority population of Tioga County in 2010 was approximately 2.7% and was approximately 18.1% for the Commonwealth of Pennsylvania. The area around Hamilton Dam does not have a disproportionate percentage of minority population in comparison to Tioga County but it does have a disproportionate percentage of minority population in comparison to the Commonwealth of Pennsylvania.

The census indicates 15.2% of the population within Charleston Township is below the poverty line. In comparison, population of Tioga County below the poverty line is approximately 13.9% and is approximately 13.5% for the Commonwealth of Pennsylvania. The area around Hamilton Dam does not have a disproportionate percentage of population below the poverty line in comparison to Tioga County and the Commonwealth of Pennsylvania.

Floodplain Management. Based on the review of FEMA's Flood Insurance Rate Maps of the project study area, both Hamilton Lake, and Charleston Creek downstream of the Hamilton Dam outfall, contain areas that are situated within Flood Zone A. The 1% annual chance flood (e.g. 100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The base flood elevations have not been determined for areas within Flood Zone A. Downstream flood maps for the 100- and 500-year storm events for the existing, FWOP, and dam rehabilitation conditions are included in Appendix C.

Invasive Species. Invasive species are those plants, animals and pathogens that are not native to an area and can cause harm to the environment, to the economy, and to human health. While not all non-native species are invasive, some can really do damage to our public and private lands. Invasive species are highly adaptable to different habitats, grow quickly or reproduce abundantly, are difficult to eradicate, and can negatively impact our native species.

Invasion by invasive species has been identified as one of the greatest threats to species biodiversity. Introduction of these species is one of the most unrecoverable and permanent injuries to native biodiversity and the integrity of ecosystem processes. Once established, invasive species are extremely difficult to remove. When removal is possible, it comes at a high cost financially and ecologically. Even after successful recovery, the intricacies of the original ecosystem are often lost indefinitely.

Over 266 invasive plant species have been identified in Tioga County. Some problematic invasive plant species that may be of concern within the Project area include:

- Multiflora rose (*Rosa multiflora*)
- Japanese knotweed (*Reynoutria japonica*)
- Purple loosestrife (*Lythrum salicaria*)
- Japanese barberry (*Berberis thunbergii*)
- Garlic Mustard (*Alliaria petiolateata*)
- Japanese Honeysuckle (*Lonicera japonica*)

In addition to invasive plants, Pennsylvania now harbors many non-native invasive species of animals including mammal, bird, fish, reptile, and invertebrate species. These invasive animal species directly threaten populations of native animals through competition, predation, or modification of habitat through the alteration of cover and diversity. Some of problematic invasive animal species that may be of concern within the Project area include:

- Zebra Mussel (*Dreissena polymorpha*)
- Rusty Crayfish (*Orconectes rusticus*)
- Asiatic Clam (*Corbicula fluminea*)

Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act. All native wild birds found in the United States, with the exception of the house sparrow, European starling, feral pigeons and resident game birds (e.g. pheasant, grouse, and wild turkey) are protected under the Migratory Birds Treaty Act/Bald and Golden Eagle Protection Act. Habitat for native birds, including nesting sites, exists in and around Hamilton Dam. Although not classified as an Important Bird Area, Hamilton Dam is near an Important Bird Area, Marsh Creek Wetlands.

Prime and Unique Farmlands. According to the NRCS Web Soil Survey, 62.9% all of the soils within the Hamilton Dam project area are listed as either Prime Farmland or Farmland of Statewide Importance. Major classifications of soils within the Project area not considered Prime Farmland or Farmland of Statewide importance are Hamilton Lake and the dam itself (42 acres) and the Chippewa, Lordstown, Kanona and Mardin, Oquaga and Volusia soils with slopes greater than 15% soils, very steep (in total a 1,026-acre area).

Riparian Areas. Riparian areas are present within the Project area. These riparian areas are located on the western and southern banks of Lake Hamilton and along Charleston Creek downstream of the Hamilton Dam. Much of the riparian area along the perimeter of Hamilton Lake is a forested fringe. The riparian area along Charleston Creek downstream of the dam is a relatively thin forested corridor and extends to its confluence with Marsh Creek. The riparian areas at the southern corner of Hamilton Lake contain freshwater forest and shrub wetlands that gradually transition to a forested riparian corridor along Charleston Creek upstream of Hamilton Lake.

Scenic Beauty. Hamilton Dam is in Tioga County which is a predominantly rural community. It is 4,146 mi² and is the third largest county in Pennsylvania. Tioga County contains the Pennsylvania Grand Canyon, rivers, and forest reserves. These areas contribute greatly to the economy through tourism.

Wetlands. Based on the review of National Wetland Inventory (NWI) maps using the United States Fish and Wildlife Service National Wetlands Inventory mapping tool, a wetland is present along the south bank of Hamilton Lake. The wetland is classified as a palustrine scrub-shrub broad-leaved deciduous wetland that is diked and impounded seasonally flooded. Hamilton Lake is listed as a lacustrine limnetic unconsolidated bottom, no additional wetlands are depicted by the NWI. During site visits April and September 2016, four additional wetlands were observed on the west bank, northwest bank, southeast bank and upper reach of Lake Hamilton. An area of artificial wetland located in the existing auxiliary spillway was observed and delineated during an April 2017 site visit.

The Pennsylvania Chapter 105 Water Obstruction and Encroachment permit applies to any activity which changes the course of a waterway. Additionally, a USACE Section 404 Permit or Pennsylvania State Programmatic General Permit joint permit may be required.

3.9 OTHER CONCERNS

Water-Based Recreation. Hamilton Lake is a 38.5-acre lake that is open for year-round recreation. Recreation use is incidental to the flood control and water supply uses. Fishing and boating with watercraft without a gasoline-powered engine is allowed. Minimal park features, including a picnic table and public restroom at the boat ramp, are available around Hamilton Lake. Wildlife watching, boating and fishing are popular activities at Hamilton Lake.

Hamilton Lake is utilized for water-based recreational activities. The PFBC operates a boat permit program and stocks the lake with trout. The lake is a designated "Stocked Trout Waters Open to Year-Round Fishing." PFBC estimates are that Hamilton Lake has 4,945 annual angler trips for spring trout season and 1,652 annual angler trips for winter trout season. Private non-gasoline-engine powered boats are permitted on Hamilton Lake for persons holding a valid Pennsylvania Boat Registration and or Boat Title from PFBC.

Water Resources – Public Water Supply. The Borough of Wellsboro utilizes several sources of water supply. Sources include six groundwater wells, three surface water intakes and an intake at Hamilton Lake. Water supply from Hamilton Lake has typically been used starting in late spring through early fall when yield from the stream intakes and groundwater wells decrease. From 2005 to 2015, water supply has been withdrawn from Hamilton Lake on average 207 days a year at an average rate of 574,000 gallons per day.

The water allocation permit from the Commonwealth of Pennsylvania requires a minimum streamflow of not less than 1.24 cfs, equivalent to 800,000 gallons per day, be maintained in Charleston Creek immediately downstream of Hamilton Dam. The Borough of Wellsboro performs controlled releases from Hamilton Lake as necessary to maintain streamflow.

Regional Water Resource Plans. Hamilton Lake watershed is part of the Marsh Creek Watershed that feeds into the Susquehanna River Basin and the Chesapeake Bay. The Tioga County Chesapeake Bay Tributary Strategy was developed in accordance with the requirements of the Pennsylvania Stormwater Management Act, Act 167 of 1978 and was written in March 2005.

The standards of the Stormwater Management Plan are designed to reduce non-point source run-off and pollution and to take into account how development in any one part of the watershed will affect stormwater runoff in other parts of the watershed. Stormwater runoff control is achieved by providing assistance to Watershed Associations to restore streams and riparian buffers.

The standards of the strategy are designed to improve the health of the Chesapeake Bay through improvement of natural and human health in Tioga County via conservation and resource planning. The strategy's five-year plan will be accomplished through the following:

1. Implement a program to decrease soil erosion through public programs and treating stream banks.
2. Aiding in changing land use through restoration of farmland and wetlands and public education programs.
3. Improving water quality through increasing water quality and chemistry data treating abandoned mines, and public education programs.
4. Managing stormwater quality through improvement of riparian buffer zones, road maintenance, NPDES permits, and watershed programs.
5. Improving riparian buffers through improvement projects and selling trees.
6. Increasing public offices and education to aid in the implantation of the project though and increase in offices, funding, and public education.

Non-Relevant Resource Concerns. The following were determined non-relevant resource concerns:

- Animals – Livestock Production Limitations
- Coral Reefs
- Coastal Zone Management
- Ecological Critical Areas
- Endangered and Threatened Species
- Essential Fish Habitat
- Forest Resources
- Natural Areas
- Scientific Resources
- Sole Source Aquifers
- Soil – Soil Quality Degradation
- Wild and Scenic Rivers

3.10 BACKGROUND AND STATUS OF DAM

Hamilton Dam was designed and constructed under the Watershed Protection and Flood Prevention Act by Tioga County, Wellsboro Borough Council, Wellsboro Municipal Authority and the Tioga County Soil and Water Conservation District with the assistance of the United States Department of Agriculture, Soil Conservation Service. The Dam was built between 1966 and 1967 and funded through the Soil Conservation Service, now NRCS, under the Public Law (PL) 566 Program. Flood control and the creation of a secondary water source are the primary functions and authorized purposes of the lake, with recreation as a secondary incidental benefit.

Hamilton Dam is one of three (3) floodwater retarding structures built within the Marsh Creek Watershed. The structure was completed in 1967 and was designed as a High Hazard potential Structure; meaning there is a potential for loss of human life if the dam should fail.

The original service life of the dam was listed as 100 years and will be reached in 2067. Hamilton Dam is a 76-foot-tall earthen embankment with a drainage area of 8.45 square miles. The permanent pool (Hamilton Lake), or normal pool during non-flooding periods, is approximately 38.5 acres. During major flood events, the pool could enlarge to cover an area of 79.9 acres as measured at the crest of the spillway. From the permanent pool elevation to the crest of the auxiliary spillway, the site can store up to 1,445 acre-feet of floodwater that is then slowly released after the storm event.

Table 3-4 contains existing data about Hamilton Dam (PA-602).

Table 3-4
Existing Project Features

Feature	Hamilton Dam (PA-602) Existing Condition²
Statistics	
Year Completed	1967
Actual Construction Cost	-
Purposes	Flood Damage Reduction, Water Supply, and Incidental Recreation
NRCS Hazard Class	High
Drainage Area Controlled ²	8.45 square miles
AMC II Runoff Curve Number	78.3
Key design elevations	
Crest of dam	1462.44 feet ³
Crest of auxiliary spillway	1452.60 feet ³
Crest of the principal spillway	1441.10 feet ³
Crest of low stage inlet	1427.50 feet ³
Structure components	
Dam height	76 feet
Dam length	1,400 feet
Embankment volume	301,962 cubic yards
Auxiliary spillway	
Type	Vegetated earth
Bottom width	175 feet
Discharge capacity	23,780 cfs
Principal spillway	
Type	Reinforced Concrete Pipe
Length	264 feet
Diameter	48-inches
Capacity	455.9 cfs
Structure capacity	
Total Capacity	2,874.09 acre-feet
Submerged sediment storage	78.15 acre-feet
Beneficial use (water supply)	455.92 acre-feet
Floodwater Retarding	1,445.05 acre-feet
Between ASW crest and TOD	894.97 acre-feet

¹ Source: Hamilton Dam (PA-602) As-Built Plans and Design Folder.

² Based on current measurements.

³ Elevations referenced in the Hamilton Dam 1967 as-built plans local vertical datum which was found to be different than the NGVD29 datum. The datum shift from the as-built plans local vertical datum to NAVD88 is -3.63 feet.

3.11 CURRENT CONDITION OF DAM

The site has been well maintained as evidenced by the favorable comments throughout the inspection reports of the past 10 years. The embankment, outlet structure, and auxiliary spillway have been largely kept in good condition.

The principal spillway system consists of a concrete intake structure in the pool located on the upstream face at the toe of the dam with a concrete outlet pipe through the dam. This system controls the elevation of the permanent pool and release of stored floodwater. The riser is a two-stage, covered structure, with inside dimensions of 4.0 feet wide x 12.0 feet long x 59 feet high. The outlet pipe is a 48-inch diameter reinforced concrete pipe. The outlet pipe discharges into a reinforced concrete stilling basin approximately 23 feet long by 18 feet wide. Potential seepage alongside the pipe system is controlled with six, 10 feet x 14.5 feet concrete anti-seep collars surrounding the concrete principal spillway pipe. The embankment foundation has an internal drainage system consisting of a 6-foot-tall by 3-foot-wide sand/gravel filter surrounding 6-inch diameter bituminous coated steel or iron pipe into the foundation across the valley.

The embankment has a 22 feet top width, an upstream face slope of 3 horizontal (H) :1 vertical (V) and downstream face slope of 2 H:1 V. The vegetated auxiliary spillway is 175 feet wide with a 30-foot-long level control section and 2.5% exit slope located on the west end of the embankment.

Notable observations during the site walk of Hamilton Dam include:

- **Dam Embankment** – The dam crest was observed as generally level, and no significant slope movement or sloughing was observed on the upstream and downstream faces of the embankment. The vegetation on the dam crest and downstream face of the embankment along the berm have isolated exposed areas. Otherwise, generally even vegetative coverage was observed. There was no evidence of uneven settlement observed along the top of the dam or along either abutment.

There was also no evidence of any cracking in the embankment. Thicker vegetative growth was observed along the right abutment. Along both the upstream and downstream faces of the embankment several animal burrows were observed, which could potentially weaken the structural integrity of the embankment by creating pathways for seepage, to be repaired and monitored by the Borough of Wellsboro. Along the reservoir edge, several areas of exposed soils were observed. NRCS personnel have reported that this is most likely caused by fisherman and other visitor foot traffic.

- **Principal Spillway** – Several cracks and deteriorations in the concrete inlet structure were observed. The upper trash rack bars appeared to be in good condition with some minor surface corrosion. No debris blocking the trash rack was observed. However, several cracks in the concrete surrounding the upper trash rack bars and a crack along the top slab of the riser were observed. In general, the inlet structure appeared in adequate condition, but several concrete repairs are necessary to maintain the integrity of the structure. Vegetative coverage observed around the inlet structure was good, with no brushy vegetation.

The 48-inch diameter outlet pipe discharges into the impact basin as anticipated with no observed obstruction or debris and overall appeared in good working order. Some cracks and crumbling were observed at the far-right corner, looking downstream, of the impact basin wall. Additionally, both the left and right walls of the impact basin were observed to have cracking. No riprap displacement around the impact basin was observed. There is increased vegetation surrounding the impact basin.

The right and left toe drains were flowing at the time of inspection. The discharge from the right and left toe drains was constant and clear with no visible turbidity at the time of inspection. The left toe drain outlet was partially blocked by some woody debris at the time of inspection. The outlet and animal grates of both drains were rusted.

- **Auxiliary Spillway** – In general, the vegetation cover on the entrance and channel of the auxiliary spillway was in good condition. Isolated animal burrows were observed along the channel of the

auxiliary spillway. No vehicle trails or rutting were observed. The Project Team did not notice any surface erosion or conditions that would reduce resistance to the design discharge.

The results of the Principal Spillway Hydrograph (PSH) analysis, using 1-day/10-day rainfall entry, indicate that the principal spillway cannot empty the detention storage within 10 days, therefore not meeting the TR-60 10-day limit for an earth auxiliary spillway. The peak pool elevation during the PSH event is 1,453.60 feet which exceeds the current auxiliary spillway crest at 1,452.60 feet.

The results of the Stability Design Hydrograph (SDH) analysis indicate that the maximum peak flow through the auxiliary spillway during the SDH event is 4,191 cfs, with maximum velocities of 11.6 ft/s. The maximum total stress and effective stress experienced by the existing channel of the auxiliary spillway are 3.25 lb/ft² and 0.766 lb/ft² respectively. Based on SITES SDH analysis results, peak velocity and erosionally effective tractive stress will likely cause sod stripping in the exit channel. Using National Engineering Handbook (Part 654, Figure 8-23), the effective stress exceeds the maximum allowable stress (0.12 lb/ft²) for the current surface soil in the auxiliary spillway.

The PADEP commonly requires the temporal distribution of the Probable Maximum Precipitation to follow the USACE and National Oceanic and Atmospheric Administration's Hydrometeorological Report No. 51/52 critically stacked distribution or, for drainage areas less than 10 square miles, a distribution based on USACE EM 1110-2-1411. A USACE HEC-1 model was developed using the hydrologic inputs also used for the SITES model to apply the USACE EM 1110-2-1411 distribution. The results of the discharge capacity analysis show that the 24-hour Freeboard Hydrograph (FBH) event based on the standard USACE EM 110-2-1411 distribution is the governing scenario that results in the highest maximum water surface elevation in the reservoir (1464.60 feet). This is above the lowest surveyed point along the dam centerline (1462.44 feet) as well as the designed settled top of dam elevation (1462.2 feet). The standard NRCS 6-hour and 5-point curve PMP 24-hour distributions also result in overtopping of the dam.

3.12 PRINCIPAL SPILLWAY ASSESSMENT

The Project Team conducted a video (TV) inspection of the principal spillway as part of the documentation of the current conditions of Hamilton Dam on July 20, 2016. This inspection was performed during a period of low discharge through the principal spillway conduit.

Based on the visual inspection the riser structure appears to have sufficient structural and hydraulic integrity to perform its function. The outlet pipe appears to be in good condition, with no indications of movement, significant cracks, deterioration, settlement, or erosion observed. Based on the tooling markings and smeared fillers, the pipe joints have had a joint filler or "plaster" applied sometime since the installation.

Using the on-board laser measurement device on the TV crawler, the Project Team measured the joint gaps of each of the 16 joints where visible. Overall, the joint measurements ranged from 0 inches to 1.375 inches, which is less than the maximum tolerable gap of 1⁷/₈-inches. With a uniform flow of water observed in the pipe, the grade of the pipe is uniform, without any structural compromises.

3.13 INTERNAL DRAINAGE SYSTEM EVALUATION

The Project Team performed a video inspection of the Hamilton Dam toe drains on July 20, 2016. The objective of the inspection was to document the current condition and identify any potential issues of the embankment drains. Due to the complex configuration with multiple 90-degree bends of the toe drains, the Project Team opted to use a "pushcam" apparatus to perform the inspection. This equipment provided video inspection by manually pushing the camera through the 6-inch diameter corrugated metal drain pipe.

The embankment drains run parallel to the crest of the dam, on either side of the principal spillway, and then bend 90 degrees to run parallel to the principal spillway, then three more 90-degree bend before discharging into the impact basin. The as-built drawings show the west embankment drain pipe is approximately 220.75 feet long and the east embankment drain 193.75 feet long.

After removing the animal grate covering the west toe drain pipe, the technician observed that the pipe was more than 50% submerged with water. The line appeared to be sloping downwards and the further the camera was pushed it, the more it kept getting submerged under the debris filled water. The technician tried to push the camera along and on the first 90-degree bend, 2 feet into the pipe, but the camera kept snaking downwards and into the debris. On further attempts, he tried to shake away the debris and push through but the camera head was stuck and wouldn't go any further past the first bend.

The east toe drain presented similar conditions – pipe full of water and debris making it difficult to video the line. The technician only managed to collect video for about 2 feet of pipe in this segment.

It is difficult to assess the condition of the embankment drains due to the difficulty encountered in the field in navigating the camera around the 90-degree bends. It is recommended that any design for modification to the dam consider the alignment of the drains to provide improved accessibility for inspection and cleaning equipment. Periodic inspection should be performed, and the drains cleaned in the event of significant debris build up, as this could impede drainage flow. If such design features are added or inspection camera technology improves, then the drains should be cleaned and re-inspected.

3.14 SLOPE STABILITY

The Project Team estimated the slope stability of the existing dam by numerically modeling a two-dimensional section through the embankment and subgrade using Geo-Slope International's Geo Studio 2012 software entitled SLOPE/W and SEEP/W. The slope stability analyses were based upon methods promulgated by USACE slope stability analysis. The Project Team used the cross section from the as-built plans as a template for the analysis cross-section and analyzed each case using SLOPE/W's optimized failure surfaces with respect to NRCS and PADEP requirements.

PADEP slope stability requirements for earthfill dams are described in Pennsylvania Code 105.97(c) and include the following conditions and required factors of safety:

- P1. Normal pool with steady-state seepage conditions with a factor of safety of 1.5.
- P2. Maximum pool with steady-state seepage conditions with a factor of safety of 1.4.
- P3. Sudden drawdown from normal pool conditions with a factor of safety of 1.2.
- P4. Normal pool with steady-state seepage conditions under seismic forces produced by the maximum credible earthquake with a factor of safety of 1.1.
- P5. Completion of construction with no pool with a factor of safety of 1.3.

NRCS slope stability requirements for earthfill dams are described in the TR-60, Earth Dams and Reservoirs, July 2005 version and 2016 Draft version, Table 5-2 – Slope Stability Criteria include the following conditions and required factors of safety:

- T1. End-of-construction, upstream or downstream with a factor of safety of 1.3 (1.4 for failure through foundation.)
- T2. Sudden Drawdown from permanent pool to lowest ungated discharge with a factor of safety of 1.2.
- T3. The flood stage pool at the maximum design elevation with a factor of safety of 1.5.
- T4. Earthquake at the Maximum Normal stage pool with a factor of safety of 1.1.

The End-of-Construction Case for the existing dam (TR-60, Design Condition 1 and Pennsylvania Code 105.97 (c)(5)) was not needed because dam construction was completed 50 years ago.

Based upon the original design soil parameters, current studies, and conservative assumed conditions, it is the Project Team's opinion that the seepage/stability analyses indicate that the dam meets the current and proposed NRCS TR-60 slope stability requirements. The dam also meets the current 25 PA Code §

105.97 standard for static and earthquake stability at normal pool as well as for the flood case and for sudden drawdown.

3.15 STATUS OF OPERATION AND MAINTENANCE

The NRCS State Conservationist must verify that operation and maintenance is current prior to construction of the planned rehabilitation measures. The Sponsor is responsible for keeping the structure free of brush and trees, burrowing animals and recreational vehicle traffic.

There were no post construction changes to the structure that influence the safety of the dam. No road cuts, quarries or mining activities were observed in the vicinity of the dam or reservoir. At the time of the site walk, the dam and associated structures were found to be functional and operation and maintenance is current. The animal burrows observed during the site walk are to be repaired and monitored by the Borough of Wellsboro.

3.16 BREACH ANALYSIS AND HAZARD CLASSIFICATION

The breach analysis used in this plan was provided by the PADEP Division of Dam Safety. The breach analysis met all of the PADEP Division of Dam Safety's criteria and, provides an incremental breach analysis based on modeling of storage capacity and reservoir surface area for normal pool and maximum storage elevations. The peak breach discharge used for developing the inundation maps was 96,560 cfs using the PADEP incremental analysis. This value falls between the range of the minimum and maximum limit of the minimum peak breach discharges calculated based on TR-60 criteria of 86,289 cfs and 123,512 cfs respectively. The hydrologic and hydraulic analyses were also approved by the PADEP. The NRCS State Conservation Engineer concurs with the hazard classification of high assigned to this dam. The results of the breach were used to generate the flood inundation maps for the current Hamilton Dam Emergency Action Plan.

Wellsboro Borough Municipal Authority, the Borough of Wellsboro, and Tioga County have developed an Emergency Action Plan which details the surveillance, warning, and evacuation procedures in the event of a failure of Hamilton Dam. The Emergency Action plan includes the Inundation Map which depicts the areas downstream of Hamilton Dam that would experience inundation in the event of a dam failure. The inundation area extends downstream from Hamilton Dam along Charleston Creek to Wellsboro and to Charleston Creek's convergence with Marsh Creek. The inundation area extends into Delmar Township.

The dam is currently classified by PADEP as a Size Category B, Hazard Potential Category 1, and an NRCS High Hazard potential dam. Hamilton Dam primarily protects significant residential development and infrastructure and there is an obvious threat to loss of human life in the event of dam failure. The Breach Inundation Map is included in Figure C-1 and C-2.

3.17 POTENTIAL DAM FAILURE MODES

The Project Team examined five potential modes of dam failure during the planning study. These include failure due to sedimentation, insufficient hydrologic capacity, seepage, seismic activity, and material deterioration, which are described below.

Sedimentation – Minor Risk. Sedimentation can fill the designed sediment pool but will not encroach on the detention capacity. The analyses of sediment accumulation indicate that 122 years of functional life remains for the sediment pool as it is currently configured. Consequently, sedimentation presents a minor risk failure mode for the dam.

Insufficient Hydrologic Capacity – High Risk. An auxiliary spillway breach or overtopping of the existing dam during a storm event can cause hydrologic failure. The integrity and stability of the auxiliary spillway is dependent upon depth, velocity and duration of flow, the vegetative cover, and the embankment's resistance to erosion.

The dam was designed as a High Hazard potential dam and is currently classified as a High Hazard potential dam. The dam is subject to overtopping during the design storm event for High Hazard potential dams. Additionally, the auxiliary spillway may have limited resistance to erosion during the design storm

event, and the principal spillway and auxiliary spillway are inadequate according to current applicable High Hazard potential dam design criteria. These deficiencies, resulting from the upgraded design criteria, pose a high risk for hydrologic failure of the dam during extreme runoff events.

Seepage and Slope Stability – Low Risk. The Project Team analyzed the dam for slope stability using soil seepage and strength parameters from the design documentation. The slope stability and seepage analyses did not identify any operational concerns. Based on the review of the available data, seepage and slope stability pose a low risk for failure of the dam.

Seismic Activity – Low Risk. The integrity and stability of an earthen embankment during seism “c activity are dependent on the magnitude of the activity and the presence of unstable embankment or foundation material. Foundation movement through consolidation, compression, or lateral movement can create weak zones within the embankment where voids can form. This can cause conduit joint failure or collapse of the embankment.

Basic seismic indicators were checked, and no seismic concerns were discovered. This will be confirmed during project design. The dam is located in an area designated as Seismic Zone 1. Seismic Zones indicate the effects of an earthquake at a particular place based on geological observations from the affected areas. Zone 1 represents areas with little to no historical seismic activity. Because Seismic Zone 1 is considered an area of low risk for seismic activity, seismic activity poses a low risk for dam failure.

Material Deterioration – Low Risk. Based on the visual inspection, the inlet and outlet of the principal spillway pipe are functioning and there are no reported observations of cracking or deterioration of the conduits. Material deterioration poses a low risk of dam failure.

3.18 CONSEQUENCES OF DAM FAILURE

Inundation due to dam failure potentially has the following consequences.

Loss of Human Life. The breach inundation study indicates that a dam failure may result in inundation of residential structures, commercial structures and transformation facilities. The estimated Population at Risk for Hamilton Dam is 1,650 and the associated Risk Index is 7,181.

Release of Harmful Materials. Large volumes of sediment and eroded embankment material released to the stream would harm water quality, degrade aquatic habitat and reduce downstream channel capacity. Further, the inundation area includes commercial and industrial land uses that may store hazardous materials.

Agricultural Damage. Sedimentation may cause reduced productivity of agricultural land downstream from the structure.

Infrastructure Destruction. Residential dwellings, public buildings, fences, roads, bridges, public utilities, and farm equipment may be damaged or destroyed.

4.0 ALTERNATIVES

4.1 FORMULATION PROCESS

The following alternatives were considered in the development of this plan:

- **No Action/Future Without Federal Project (FWOP)**
The FWOP Alternative describes the most likely future condition that could be expected if NRCS takes no action. It describes what is most likely to happen in the absence of any developed federal alternative or changes in law or public policy.

The FWOP is used to compare other alternatives to determine the magnitude of benefits and adverse effects. Clearly describing the FWOP condition provides the reference necessary to evaluate changes caused by the alternatives. The FWOP may or may not meet the purpose and need for federal action.
- **Rehabilitation to Current High Hazard Potential Dam Standards**
The rehabilitation Alternative includes federally-assisted upgrading of the existing dam to current applicable standards. Four different rehabilitation alternatives were considered. All rehabilitation alternatives are described in Section 4.3 Alternatives Considered but Eliminated from Detailed Study.
- **Decommissioning of Dam with Nonstructural Measures**
The Decommissioning Alternative includes federally-assisted removal of the entire dam and stabilizing the site. This alternative also includes acquisition and demolition of existing residential and public structures in the downstream 100-year floodplain.
- **Nonstructural Measures (Acquisition or Relocation of At-Risk Structures and Floodproofing)**
This alternative includes acquisition and demolition, relocation, and flood protection of structures in the breach inundation area so that the hazard potential can be lowered and less stringent dam safety standards can be evaluated.
- **All other reasonable alternatives**
Other alternatives that meet the purpose and need, including variations to the Rehabilitation Alternatives described in Section 4.3 Alternatives Considered but Eliminated from Detailed Study.
- **National Economic Development (NED) Alternative**
The National Economic Development (NED) Alternative is not an independent option. It is the alternative, or combination of alternatives, with the greatest net national economic benefit consistent with protecting the nation's environment.

Alternative plans, including the NED plan, were formulated with consideration to completeness, effectiveness, efficiency, and acceptability (as required by the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983.) These criteria are described below.

- **Completeness.** Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to the realization of the contributions to the objective.
- **Effectiveness.** Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.
- **Efficiency.** Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.
- **Acceptability.** Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

Table 4-1 summarizes the alternatives considered and the results of the screening process.

Table 4-1
Range of Alternatives and Determination for Detailed Study

Alternative	Screening Criteria ¹				Carried Forward for Detailed Study
	Completeness	Effectiveness	Efficiency	Acceptability	
No Action/Future Without Federal Project (FWOP)	Does not meet Project Purpose and Need.	- Does not meet Project Purpose of providing water supply, incidental recreation, and flood damage reduction for downstream. - Addresses current risk of loss of human life resulting from dam failure through compliance with State regulations.	- Benefit/Costs of the FWOP were evaluated only for comparison of federal alternatives. - Sponsor financial resources may limit timely implementation of FWOP alternative.	Consistent with state and local laws, regulations, and policies.	Yes
Rehabilitation to Current High Hazard Potential Dam Standards/NED Alternative	- Technically reliable. - Meets Project Purpose and Need.	- Meets Project Purpose by maintaining water supply, incidental recreation and flood protection for the 100-year, 24-hour storm event. - Reduces risk of loss of human life resulting from dam failure.	Most cost-effective federal alternative.	Consistent with state and local laws, regulations, and policies.	Yes
Decommissioning with Nonstructural Measures	Meets Project Purpose and Need.	- Meets Project Purpose. - Results in increased flooding and sedimentation. - Addresses current risk of loss of human life resulting from dam failure. - Reconnects the stream. - Reduces future operation and maintenance costs.	- Detailed planning was not conducted due to the exorbitant cost of the alternative. The estimated total cost for decommissioning and nonstructural measures was \$89,437,000, including \$7,179,000 for decommissioning, \$3,962,000 for new water supply and \$78,296,000 for relocation. - A cost to replace the incidental recreation was not determined due to exorbitant costs eliminating this alternative from detailed study. - The estimated total cost of the alternative was 13 times more expensive than rehabilitation.	- Consistent with state and local laws, regulations, and policies. - Results in local social disruption.	No
Nonstructural Measures (Acquisition or Relocation of At-Risk Structures)	Technically reliable and provides for all accounts.	- Meets Project Purpose. - Minimizes risk of loss of human life resulting from dam failure.	- Detailed planning was not conducted due to the exorbitant cost of the alternative. - The estimated cost of the alternative was \$408,600,000 which is 61 times more expensive than rehabilitation.	- Consistent with local laws, regulations, and policies. - Requires special restrictions on future development in breach inundation area. - Results in significant social disruption.	No

Alternative	Screening Criteria ¹				Carried Forward for Detailed Study
	Completeness	Effectiveness	Efficiency	Acceptability	
Nonstructural Measures (Floodproofing of Structures in Inundation Areas)	Technically reliable and provides for all accounts.	- Meets Project Purpose. - Minimizes risk of loss of human life resulting from dam failure.	- Detailed planning was not conducted due to the exorbitant cost of the alternative. - The estimated cost of the alternative was \$308,160,000 which is 46 times more expensive than rehabilitation.	- Consistent with local laws, regulations, and policies. - Requires special restrictions on future development in breach inundation area. - Results in significant social disruption.	No

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¹ Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Section V. — Alternative Plans - 1.6.1 (c)

4.2 SPONSOR'S RATIONALE FOR CONDITIONS OF FUTURE WITHOUT FEDERAL PROJECT

Hamilton Dam does not meet current applicable dam design, performance and safety criteria for a High Hazard potential dam as described above Section 3.11.

PADEP, Division of Dam Safety will likely issue an administrative order requiring that the Sponsor upgrade the dam to current applicable state standards; remove and/or relocate the hazards; or remove the hazard by removing the storage function of the reservoir. If the Sponsor does not comply with the administrative order, PADEP would likely breach the structure to remove the storage functions and bill the Sponsor for the work.

An evaluation of the Sponsor's options for meeting a potential PADEP administrative order, in the absence of NRCS technical and financial assistance, indicated that the likely Sponsor response would be to remove the storage function of the reservoir by constructing a breach, as directed by PADEP. Additional sources of water supply would need to be developed by the Sponsor, such as the alternatives explored in an Alternative Water Supply Proposal completed for the Borough of Wellsboro in 2004.

4.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Decommissioning with Nonstructural Measures. The Federal Decommissioning alternative would include measures to stabilize the sediment and reconnect the stream channel along with meeting the Project Purpose and Need by including floodproofing, relocation, and other nonstructural measures.

The dam would be breached during decommissioning with an opening sized, and stabilized, to safely pass the discharge from the 100-year, 24-hour storm runoff and would include the following modifications:

- Removing the entire dam embankment to restore the landscape and reconnect the stream impounded by the dam. The areas of dam removed will be shaped with a cross section similar to the upstream and downstream channels and sized to provide adequate cross-sectional area for bankfull flow. The channel and overbank areas will be shaped in a manner as not to restrict the 100-year discharge. Rock riprap would be used to stabilize the channel cut through the dam.
- Removing and disposing of principal spillway structures.
- Reconnection, restoration, and stabilization of the stream and 100-year floodplain functions upstream of the dam. The original stream path/length through the pool area was determined from 1959 aerial photography and supplemented with the bathymetric topography to form a basis for new channels to reconnect the stream. Approximately 3,600 feet of stream and floodplain would be restored with dimensions matching the upstream and downstream channel. The pool area and excavated cut through the dam would be planted to riparian forest buffer.

The total estimated construction cost of decommissioning, prior to downstream measures, is \$7,179,000.

Downstream from the dam, properties would need to be floodproofed, acquired, or relocated to continue providing flood protection. A total of 152 structures (46 commercial and 106 residential) are located within the 100-year floodplain of the downstream benefit area. Relocation of the properties was chosen as the most likely and cost-effective choice and would include:

- Purchasing 106 residential properties located in the downstream 100-year flood area at an estimated cost of \$12,837,000.
- Demolition and restoration of the sites at 106 residential properties at an estimated cost of \$2,120,000.
- Purchasing 46 commercial properties, with buildings covering a total footprint of 415,771 square feet, at an estimated cost of \$57,771,000.

- Demolition and restoration of the sites at 46 commercial properties at an estimated cost of \$2,120,000.

The total estimated cost for relocating downstream structures, including five percent for project administration and engineering, is \$78,296,000.

The additional costs to replace the municipal water supply is \$3,962,000 based on a 2004 proposal for an alternative water supply for the Borough of Wellsboro and indexed to 2018 value.

The total estimated cost of the decommissioning alternative, including downstream relocation, is \$89,437,000. The additional costs to replace the incidental recreation purpose and need was not calculated, and would need to be considered for a decommissioning alternative to move forward. Even without considering replacement of the recreation, the downstream costs plus the decommissioning of the dam costs make this option significantly greater than the cost to rehabilitate the dam to meet NRCS High Hazard potential dam standards. The high cost of this alternative and social disruption caused by this approach is considered unreasonable; consequently, Federal Decommissioning will be eliminated as an alternative for detailed study.

Nonstructural Measures (Acquisition or Relocation of At-Risk Structures). The Acquisition and Relocation Alternative is a nonstructural alternative that would result in a change of the hazard classification of the Hamilton Dam to an NRCS Low Hazard Potential Dam by removing identified at-risk structures from the breach inundation zone. Removal of the at-risk structures would be accomplished through means of acquisition of the residential and commercial property for the purpose of relocating the downstream population out of the breach inundation area.

Breach inundation maps, dated January 2006, showing the Hamilton Dam breach inundation areas were used, along with Tioga County's GIS data, to delineate the residential and commercial properties located within the breach inundation area.

This alternative includes the following:

- Purchasing 707 residential properties located in the downstream breach inundation area at an estimated cost of \$85,618,000.
- Demolition and restoration of the sites at 707 residential properties at an estimated cost of \$14,140,000.
- Purchasing 324 commercial properties, with buildings covering a total footprint of 2,129,411 square feet, at an estimated cost of \$295,882,000.
- Demolition and restoration of the sites at 324 commercial properties at an estimated cost of \$12,960,000.

The total estimated downstream cost for the Acquisition and Relocation Alternative is \$408,600,000. The estimated costs of this option are significantly greater than the cost to rehabilitate the dam to meet NRCS High Hazard potential dam criteria. The high cost of this alternative, and social disruption caused, is considered unreasonable; consequently, Acquisition and Relocation will be eliminated as an alternative for detailed study.

Nonstructural Measures (Floodproofing of Structures in Inundation Areas). This alternative is a nonstructural alternative that would result in a change of the hazard classification of the Hamilton Dam to an NRCS Low Hazard Potential Dam by protecting or removing identified at-risk structures from the breach inundation zone. Protection of the at-risk structures would be accomplished through means of constructing levees or floodwalls where feasible and then require the acquisition and removal of the remaining properties from within the breach inundation area.

Breach maps, dated January 2006, showing the Hamilton Dam breach inundation areas were used, along with Tioga County's GIS data, to delineate the residential and commercial properties located within the breach area. Based on interpretation of LiDAR elevations at the extent of the drawn breach inundation area, it was determined which residential and commercial structures could be protected by a levee or floodwall (not exceeding 15 feet tall for practicality and reasons of risk classification) and which would need to be acquired for relocation.

This alternative includes the following:

- Constructing approximately 34,100 linear feet of levee and/or floodwall to protect 381 residential properties and 72 commercial properties at an estimated cost of \$11,935,000.
- Purchasing 326 residential properties located in the downstream breach inundation area at an estimated cost of \$39,478,600.
- Demolition and restoration of the sites at 326 residential properties at an estimated cost of \$6,520,000.
- Purchasing 252 commercial properties, with buildings covering a total footprint of 1,814,181 square feet, at an estimated cost of \$252,080,000.
- Demolition and restoration of the sites at 252 commercial properties at an estimated cost of \$10,080,000.

The total estimated downstream cost for the Floodproofing Alternative is \$308,160,000. The estimated costs of this option are significantly greater than the cost to rehabilitate the dam to meet NRCS High Hazard potential dam standards. The high cost of this alternative, and social disruption caused by this approach, is considered unreasonable; consequently, Floodproofing will be eliminated as an alternative for detailed study.

4.4 REHABILITATION ALTERNATIVES CONSIDERED

Variations of Rehabilitation Alternative. Rehabilitation alternatives were considered in consultation with the Sponsor and all but the preferred was eliminated from detailed evaluation. Rehabilitation alternatives considered modifications to the auxiliary spillway, dam crest and/or principal spillway to upgrade the dam to current applicable NRCS High Hazard potential criteria. Changes included widening and raising the auxiliary spillway, raising the crest elevation, modifying the principal spillway, armoring the spillway and combinations thereof. All the Rehabilitation Alternatives included extending the design life of the project an additional 100-years and upgrading the internal drainage controls in the dam. The following variations, which are also noted in Table 4-2, were evaluated based on effectiveness, efficiency, constructability, and compatibility with the purpose and need for the project:

1. Construct a new RCC armored spillway within the dam embankment with a 280-foot-wide crest at Elevation 1452.6. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Close existing auxiliary spillway. Maintain settled dam crest at Elevation 1462.4 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct the impact basin at the outlet.
2. Install labyrinth weir structure with crest at Elevation 1452.6 in 175-foot auxiliary spillway and regrade channel. Armor auxiliary spillway crest and exit channel with RCC to valley floor. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Maintain settled dam crest at Elevation 1462.4 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct an impact basin at the outlet.
3. Install labyrinth weir structure with crest at Elevation 1452.6 in 175-foot auxiliary spillway and regrade channel. Armor auxiliary spillway crest and exit channel with RCC to 10 feet above valley floor and outlet to vegetated channel to valley floor. Modify riser to raise orifice crest 2.0 feet to

Elevation 1429.5 for increased water supply. Maintain settled dam crest at Elevation 1462.4 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct an impact basin at the outlet.

4. Construct a new labyrinth weir spillway with crest at Elevation 1452.6 within the dam embankment with a 150-foot width and RCC armored spillway. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Close existing auxiliary spillway. Maintain settled dam crest at Elevation 1462.4 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct the impact basin at the outlet.
5. Install labyrinth weir structure with crest at Elevation 1457.9 to increase flood protection to 500-year level; maintain 175-foot auxiliary spillway width and regrade channel. Armor auxiliary spillway crest and exit channel with RCC to valley floor. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Raise dam crest 4.7 feet to Elevation 1467.1 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct an impact basin at the outlet.
6. Construct a RCC armored spillway with crest at Elevation 1453.6 to maintain current level of activation for the auxiliary spillway; keep existing 175-foot auxiliary spillway width and regrade channel. Armor auxiliary spillway crest and exit channel with RCC to valley floor. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Raise dam crest 3.4 feet to Elevation 1465.8 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct an impact basin at the outlet.

Rehabilitation Alternative 4 was determined the most cost-effective alternative, but all alternatives were within the contingency values of the planning cost estimates. With the costs comparable, the environmental and social effects, and operation during passage of the design floods were compared. Consequently, Rehabilitation Alternative 3, will be considered for detailed evaluation in consultation with the Sponsor. Table 4-2 provides summary information regarding the existing condition and rehabilitation alternatives considered.

Table 4-2
Variations of Rehabilitation Alternatives

Feature	Existing Condition	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Top of Dam Elevation (feet ¹)	1462.4	1462.4	1462.4	1462.4	1462.4	1467.1	1465.8
Auxiliary Spillway Crest Elevation (feet ¹)	1452.6	1452.6	1452.6	1452.6	1452.6	1457.9	1453.6
Principal Spillway High Stage Crest Elevation (feet ¹)	1441.1	1441.1	1441.1	1441.1	1441.1	1441.1	1441.1
Principal Spillway Low Stage Crest Elevation (feet ¹)	1427.5	1429.5	1429.5	1429.5	1429.5	1429.5	1429.5
Principal Spillway Type	RCP	RCP	RCP	RCP	RCP	RCP	RCP
Principal Spillway Diameter (inches)	48	48	48	48	48	48	48
Principal Spillway Piping Protection	Cutoff Collars	Drainage Diaphragm	Drainage Diaphragm	Drainage Diaphragm	Drainage Diaphragm	Drainage Diaphragm	Drainage Diaphragm
Auxiliary Spillway Crest Width (feet)	175	280	175/695 ²	175/695 ²	150/606 ²	175/695 ²	175
Auxiliary Spillway Crest Material	Earth	RCC	Labyrinth Weir	Labyrinth Weir	Labyrinth Weir	Labyrinth Weir	RCC
Auxiliary Spillway Exit Channel Material	Earth	RCC	RCC	RCC/ Vegetated	RCC	RCC	RCC
Operation and Maintenance Costs	-	Increased	Increased	Increased	Increased	Increased	Increased
Meets Project Purpose and Need?	No	Yes	Yes	Yes	Yes	Yes	Yes

¹ Elevations referenced in the Hamilton Dam 1967 as-built plans local vertical datum which was found to be different than the NGVD29 datum. The datum shift from the as-built plans local vertical datum to NAVD88 is -3.63 feet.

² Spillway Width/Labyrinth Weir Length

4.5 DESCRIPTION OF ALTERNATIVE PLANS

Future Without Federal Project. The Future Without Federal Project condition is the baseline from which all other alternatives are measured. It reflects the most likely future conditions expected to exist over the life of the project without the potential federal funding identified in this plan.

The Hamilton Dam (PA-602) does not meet current applicable dam design and safety criteria for a High Hazard potential dam. An evaluation of the Sponsor's options indicated that the likely Sponsor response would be to remove the storage function of the reservoir by constructing a minimum level breach as directed by PADEP. The water supply would need to be replaced with a new source. See Figure C-12 – Future Without Federal Project Alternative in Appendix C.

The FWOP alternative would require the Completion of Federal Interest in the project, as Hamilton Lake Dam would not have reached the end of its original project life. The existing Operation and Maintenance agreement between the Wellsboro Borough Municipal Authority and NRCS would be modified to turn all responsibilities over to the sponsor. NRCS would be reimbursed for any unrealized economic benefits provided by the dam.

PADEP has implemented a simplified approval process for dam removals; however, the proposed breach plan “must” essentially restore the stream to its natural, free-flowing state through the impoundment area and the footprint of the dam. The FWOP alternative would be a minimum level breach by the Sponsor and would include the following modifications:

- Removing portions of the dam to reconnect the stream impounded by the dam. The areas of dam removed will be shaped with cross section similar to the downstream channels and sized to provide adequate cross-sectional area for bankfull flow at the 2-year discharge and to pass the 100-year discharge without increasing the flood elevation behind the remaining structure more than one foot. Rock riprap would be used to stabilize the channel cut through the dam.
- Removing and disposing of principal spillway structures.
- Reconnecting, restoring, and stabilizing the stream and 100-year floodplain functions upstream of the dam. The original stream path/length through the pool area was determined from 1959 aerial photography and supplemented with the bathymetric topography to form a basis for new channels to reconnect the stream. The pool area and excavated cut through the dam would be vegetated using typical erosion and sediment control measures.

The Borough of Wellsboro explored additional sources of water supply from wells and surface water with an Alternative Water Supply Proposal completed in 2004. Information from this proposal was used to develop costs for maintaining adequate water supply for Wellsboro. The total estimated cost for the FWOP Alternative is \$7,264,000. This alternative would, however, result in the following downstream impacts:

- ***Periodic Flooding, Sedimentation, and Other Damage***
The existing dam provides sediment storage capacity, flood protection and flood-damage reduction to landowners, residents, motorists, and others using the project benefit area. Without the dam, periodic flood events would result in increased flood damage, sedimentation damage, and other associated damage at or in excess of pre-project levels.
- ***Decreased Flood Protection***
The existing downstream structures are currently protected from damage resulting from the 100-year flood events because the presence of the dam regulates the release of water.

Rehabilitation to Current High Hazard Potential Dam Standards. The Hamilton Dam would be rehabilitated to meet current applicable NRCS and PADEP High Hazard potential dam design and safety criteria. The design life of the dam would be extended an additional 100 years. See Figure C-7 – Rehabilitation Alternative Plan View in Appendix C.

All elevations noted for the rehabilitation alternative are in the Hamilton Dam 1965 as-built plans reference “local” vertical datum. Several Rehabilitation alternatives were considered, and this alternative was selected for detailed engineering analysis. This alternative includes the following modifications:

- Maintaining the crest of the dam embankment at settled crest Elevation 1462.4 and flattening the downstream slope to 3 horizontal to 1 vertical to facilitate the economical installation of a chimney drain to upgrade embankment to current NRCS practice for high hazard embankments.
- Making repairs to concrete and modifying the principal spillway riser to raise orifice crest elevation 2.0 feet to Elevation 1429.5 for an increased 80.73 acre-feet available for municipal water supply.
- Modifying principal spillway riser for low flow augmentation works to provide minimum required discharge for downstream as required by the water allocation permit from the Commonwealth of Pennsylvania requiring a minimum streamflow of not less than 1.24 cfs, equivalent to 800,000 gallons per day, be maintained in Charleston Creek immediately downstream of Hamilton Dam.
- Place additional riprap on upstream face of dam to protect from wave erosion at increased permanent pool elevation.
- Demolishing impact basin.
- Extending the principal spillway conduit for the new dam toe elevation and shifting and constructing new impact basin for extended project life, and retrofitting new drain conduits that allow for camera inspection.
- Retrofitting a drainage diaphragm around the principal spillway conduit and installing a chimney drain at the interface of the existing embankment slope and new fill. The drainage diaphragm will be used to control seepage and provide adequate factor of safety for piping resistance. Gradation of sand filter material should be carefully designed for the in-place dam embankment material in consideration of possible dispersive soils identified during planning geology.
- Installing a labyrinth weir and RCC spillway in the existing auxiliary spillway on the left abutment of the dam with the following dimensions:
 - Maintaining the existing crest elevation at Elevation 1452.6.
 - A concrete labyrinth weir spillway with a weir height of 5.0 feet and total weir length of 695 feet within the existing 175-foot-wide spillway.
 - A 175-foot-wide channel with 3:1 side slopes for the entrance and exit sections.
 - Training walls at the entrance section to direct flow to the labyrinth weir and protect the dam embankment from erosion.
 - A RCC, stepped exit channel at a 14% grade extending to a RCC basin at Elevation 1393.6.
 - A RCC basin extending 40 feet from the exit channel with a formed concrete end sill with an outlet to a vegetated channel with 5% grade extending to the valley floor at approximate Elevation 1383.6.
 - Purchase or negotiate approximately 0.1 acres of property from one property owner for expansion of auxiliary spillway footprint.

The total estimated cost of this alternative is \$6,634,000 resulting in an average annual cost of \$223,000. The average annual benefit of this alternative is \$1,393,000. Rehabilitation is a feasible alternative due to its low cost compared to the other alternatives and limited disturbance to surrounding land and communities.

Rehabilitation to Current High Hazard Potential Dam Standards is the National Economic Development (NED) Alternative and is also the Preferred Alternative for the following reasons:

- It fulfills the Project Purpose and Need, which were defined by the Sponsors and public.
- It has positive impacts on human resources and minimal impacts on natural resources.

- It has the highest benefit to cost ratio of the federally-assisted alternatives considered.
- It maximizes net economic benefits consistent with protecting the nation's environment.

Detailed information for the Rehabilitation to Current High Hazard Potential Dam Standards Alternative is provided in Table 4-3.

Table 4-3
Rehabilitation of Hamilton Dam to
Current High Hazard Potential Dam Criteria

Project Feature	Existing Conditions	Rehabilitation to Current High Hazard Potential Dam Criteria
Primary Spillway Orifice Elevation	1427.5 feet	1429.5 feet
Primary Spillway Conduit	48-inch diameter RCP	48-inch diameter RCP
Auxiliary Spillway Crest Elevation	1452.6 feet	1452.6 feet
Auxiliary Spillway Bottom Width	175 feet	175 feet width for 695 feet weir length in 11 cycles
Auxiliary Spillway Type	Vegetated	Labyrinth Weir/RCC
Top of Dam Elevation	1462.4 feet	1462.4 feet

4.6 SUMMARY AND COMPARISON OF ALTERNATIVE PLANS

Table 2-1 identifies the primary resource concerns and NRCS planning requirements for the Project. The applicable Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) Accounts for each resource concern are the following:

- *Environmental Quality (EQ)*
The EQ account measures the ecological, cultural, and aesthetic attributes of significant natural and cultural resources. Measurements may be in numeric units or non-numeric terms.
- *Other Social Effects (OSE)*
The OSE account communicates other relevant effects that are not reflected in other P&G accounts, including urban and community impacts and effects on life, health, and safety.
- *Regional Economic Development (RED)*
The RED account communicates the effects on rural development, including employment, income, and economic activities. The RED account effects were not included in the study because they were not identified as issues during the scoping process.
- *National Economic Development (NED)*
The NED account includes the estimates of Project benefits and costs used to calculate net economic benefits. The NED account included in Table 4-4 shows these effects on the national economy.

Table 4-4
NED Account Summary and Comparison of
Hamilton Dam Alternative Plans

Item	Alternative ¹	
	No Action/Future Without Project (Sponsor Breach)	Rehabilitate to NRCS High Hazard Potential Dam
Total Investment	\$ 7,264,000	\$ 6,634,000
PL 83-566 Funds	\$ -	\$ 4,836,000
Other Funds	\$ 7,264,000	\$ 1,798,000
Average Annual Benefits ²	\$ -	\$ 1,393,000
Average Annual Costs ²	\$ 229,000	\$ 223,000
Net Beneficial	\$ (229,000)	\$ 1,170,000
Average Annual O&M Costs	\$ -	\$ 14,000

October-2018

¹ Price base 2019.

² Amortized over 100-year service life plus 3 years for implementation at a discount rate of 3.00 percent. Based on total economic benefits and costs of alternatives as compared to existing conditions

Table 4-5 compares the Hamilton Dam alternatives with respect to the relevant resource concerns and NRCS Planning Requirements. Additionally, the table shows in parentheses the applicable P&G Account for each resource concern.

Table 4-5
Summary and Comparison of Hamilton Dam Alternative Plans

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
NED	Project Purpose is to provide flood damage reduction in a manner that minimizes the risk of loss of human life.	• Threat to human health and safety from dam failure would be eliminated. • A constructed breach of the dam would effectively eliminate the ability to store floodwater and sediments. • Flood damage reduction to downstream populations would not be provided, which could increase the risk of loss of human life due to flooding.	• Threat to human health and safety from dam failure would be reduced. • Rehabilitation would bring the dam into compliance with federal and state criteria. • Threat of dam failure during large storms, and the threat of loss of human life or unsafe conditions from dam failure would be reduced.
EQ	Air Quality/Clean Air Act	• There will be some temporary affects during construction including dust and exhaust. • Control measures would be implemented during construction to minimize impacts.	• There will be some temporary affects during construction including dust and exhaust. • Control measures would be implemented during construction to minimize impacts.
EQ	Aquatic Resources	• A controlled breach of the dam would result in the draining of Hamilton Lake, thus changing the current habitat for aquatic species currently in the lake and around the lake periphery. • The reconnected stream would provide habit for species such as the American eel.	• Fish and waterfowl habitat may be impacted during construction due to the temporary drawdown of Hamilton Lake. • The fish and waterfowl impacts will be managed in accordance with Pennsylvania Fish and Boat Commission (PFBC) requirements. • The raised permanent pool elevation will provide an additional 3.4 acres of water surface and inundate approximately 200 feet of stream habitat.

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
EQ	Cultural Resources	• Three of the four historic sites occur within the downstream 100-year inundation zone that would occur if the FWOP is implemented. • The Wellsboro Armory is not within the inundation zone. • No impacts to the bridge abutment are anticipated from dam removal.	• No effect.
EQ	Environmental Justice	• Dam breach would result in loss of flood protection for downstream areas within the inundation zone; however, the effects would not be disproportionately focused on a minority population or any socioeconomically-disadvantaged groups.	• No disproportionate adverse effects are anticipated to any ethnically-, racially-, or socioeconomically-disadvantaged families or groups downstream of the dam. • Improvement of the dam would reduce the risk of flooding downstream including to those socioeconomically-disadvantaged populations that reside downstream; however, the effects would not be disproportionately focused on the socioeconomically-disadvantaged groups.
OSE	Energy Inefficiency	• During construction, an increase in equipment and facilities will be required. • Mowing and maintenance routines for the dam will be discontinued.	• During construction, an increase in equipment and facilities will be required. • Normal mowing and maintenance routines will be reconvened following project completion.

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
EQ	Erosion and Sediment Yield	• No change upstream. • Short-term increase in suspended sediment and turbidity downstream during construction, but proper controls will minimize erosion. • With the dam removed, downstream stream segments will be subject to a future sedimentation rate of up to 0.70 acre-feet/year. • A controlled breach of the dam would result in the draining of Hamilton Lake and exposing what is currently lake bottom. • These newly exposed soils could be subject to increased sheet, rill, and gully erosion if it is not vegetated quickly. • Without the dam, there is the potential for an increase in downstream bank erosion associated with increased flood flows.	• No change upstream. • Short-term increase in suspended sediment and turbidity downstream during construction, is expected, but proper controls will minimize erosion. • It is anticipated that the dam pool will continue to trap 0.64 acre-feet/year of submerged sediment and 0.06 acre-feet/year of aerated sediment. • As the shoreline of Hamilton Lake changes, erosion may occur from wave action at the new shoreline elevation, unless stabilization measures are installed such as rip rap.
EQ	Fish and Wildlife	• A controlled breach of the dam would result in the draining of Hamilton Lake, thus changing the current habitat for aquatic species currently in the lake and around the lake periphery. • A controlled breach could also result in increased sedimentation and nutrient loading downstream, the elimination of stream obstruction for migratory fish passage to upstream habitat (including the American eel), reduced habitat value for waterfowl, reduced solar exposure to the water that could improve low DO, and an increase in the riparian corridor.	• Fish and waterfowl habitat may be impacted during construction due to the temporary drawdown of Hamilton Lake. • The fish and wildlife impacts will be managed in accordance with Pennsylvania Fish and Boat Commission (PFBC) requirements. • Following construction, the permanent pool will provide an additional 3.4 acres of water surface.

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
OSE	Floodplain Management	- Implementation of the FWOP may change the mapping required for Flood Zone A. - Work to remove the dam would be conducted within the flood zone. - Residential, commercial, and transportation resources will be a greater risk of flood damage.	- Maintain flood damage reduction downstream from the dam. - Maintain current FEMA Flood Insurance Rate Map mapping.
OSE	Floodwater Damage	- Residential, commercial, and transportation resources will be a greater risk of flood damage. - Average annual flood damage reduction benefits of \$533,000 will be lost. - Removal of the dam may increase baseflow variability by allowing larger flows to travel downstream during storm events.	- Maintain flood damage reduction downstream from the dam with an average annual value estimated at \$533,000. - Following the transition to the higher elevation of Hamilton Lake, no effect on normal downstream streamflow is anticipated.
EQ	Invasive Species	- A controlled breach of the dam would result in the exposure of bare soils that are presently lake bottom. - Newly exposed bare soils may be subject to invasive plant growth. - Will be minimized by planting adapted species.	- Construction and earth disturbance activities may introduce invasive plant species but replanting with appropriate native or non-invasive species will minimize the impact. - It is estimated that approximately 7.2 acres on the embankment, auxiliary spillway and working areas will be replanted following construction.
EQ	Land Use	Dam would no longer protect downstream area from flooding.	Current and planned land uses in the benefit area would be protected.

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
EQ	Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act	• A controlled breach of the dam would result in the draining of Hamilton Lake. • FWOP could alter migratory bird habits. Migratory birds and nesting activities could also be temporarily disturbed during construction. • Coordinate scheduling of construction activities with appropriate wildlife agency to avoid adverse impacts.	• The project alternative may temporarily impact migratory birds during construction. • The scheduling of construction activities would be coordinated with the appropriate wildlife agencies to avoid adverse impacts.
EQ	Parklands	• Removal of dam will result in loss of lake and associated incidental recreational activities such as fishing, boating, and wildlife watching.	• Maintain lake for year-round incidental recreational fishing and boating with watercraft without gasoline-powered engines. • Access to, and use of, the lake will be temporarily affected during construction.
EQ	Plant Condition	• Flooding in the area or super saturated conditions may impact the health of surrounding downstream vegetation. • A controlled breach of the dam will reduce the ability of vegetation at and near the shoreline of Hamilton Lake to access water.	• Vegetation will be disturbed during construction. Undesirable plants will be minimized with the replanting of native species and management of noxious plants. • Raising the permanent pool of Hamilton Lake two feet will submerge existing vegetation at and near the shoreline. Hydrologic conditions will support wetland species in currently upland areas.
OSE	Prime and Unique Farmlands	• Removal of the dam will result in increased flooding and inundation of prime or unique farmland soils downstream. • The majority of land use downstream is developed and not used for farming.	• The rise in elevation of Hamilton Lake will inundate approximately 0.5 acres of Philo silt loam soils, designated as prime farmland. • This area at the point Charleston Creek enters the lake is not located on lands that are or will be used for farming or agriculture.

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
OSE	Public Health and Safety	- Residential, commercial, and transportation resources will be at a greater risk of flood damage. - Average annual flood damage reduction benefits of \$533,000 will be lost. - Eliminates breach inundation risk to downstream residents. - Increased flooding of downstream residential and commercial properties would disrupt community and potentially force residents to relocate.	- Maintain flood damage reduction downstream from the dam with an average annual value estimated at \$533,000. - Reduce breach inundation risk to downstream residents. - No effect is anticipated on the fish consumption advisory.
OSE	Regional Water Resources Plans	- Supports the Susquehanna River Basin Commission's Comprehensive Plan's ecosystem priorities by removing an obstacle to upstream movement for migratory fish. - Residential, commercial, and transportation resources will be at greater risk of flood damage. - Removal of dam will result in loss of municipal water supply provided by the reservoir.	- Supports the Susquehanna River Basin Commission's Comprehensive Plan's water supply, flooding and ecosystem priorities by providing a multipurpose structure with low flow augmentation and conservation releases. - Maintains flood damage reduction downstream from the dam with an average annual value estimated at \$533,000. - Reduces breach inundation risk to downstream residents.
EQ	Riparian Areas	- With removal of the dam, downstream riparian areas could be inundated with flood waters. - Existing lake shoreline would be lost and riparian area would be extended towards the channel of Charleston Creek which would flow for approximately 2,800 linear feet through the area currently under Hamilton Lake water.	- Vegetation communities within the current riparian areas will be impacted by the rise in elevation of Hamilton Lake. - Approximately 3.6 acres of trees and shoreline vegetation along the current shoreline may die off when the elevation of Hamilton Lake rises. - Estimated 3.6 acres of vegetation in wetlands along the periphery of the lake will be inundated.

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
OSE	Scenic Beauty	• Loss of aesthetic appeal of lake, replaced by stream and riparian scene. • Negative views will regularly occur because of flood damages to downstream areas.	• The scenic quality of the landscape of Hamilton Lake may be temporarily impacted during construction while the lake is drawn down. • Construction equipment will temporarily be stored and utilized on-site. • Trees along the current shoreline may die off when the elevation of Hamilton Lake rises. • The large concrete labyrinth weir provides an area for vandalism and graffiti.
OSE	Social Issues	• Following the completion of the transition period when the dam is removed, staff time required to maintain and manage the site will no longer be needed. • Removal of dam would result in loss of flood protection for downstream areas.	• No change in staff time needed to maintain and manage the dam. • Rehabilitation of the dam would maintain the flood protection for downstream areas.
EQ	Water-Based Recreation	• Loss of water-based incidental recreation opportunities due to removal of dam and reservoir.	• Continue to support water-based incidental recreation opportunities that are available at the site. • PFBC estimates annual angler trips of 4,945 for spring trout season and 1,652 for winter trout season.

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
EQ	Water Quality	- Removal of the dam may allow for improvement of water quality locally in Charleston Creek by reducing the degree of organic enrichment and algae growth occurring within the dam pool. - Nutrients originating from upstream land use will flow through the creek to downstream stream segments without settling out in Hamilton Lake.	- A temporary increase in loading of nutrient-laden sediment may be observed downstream during construction and dam drawdown events. - Improvement of the dam would not permanently change the excess sediment and nutrients currently entering the Chesapeake Bay. - Erosion and sediment controls will be utilized during construction to reduce the impact of excess nutrient-laden sediment downstream.
EQ	Water Resources – Public Water Supply	- Removal of dam would result in loss of water supply storage at the lake. - The cost to replace the municipal water supply is estimated at \$3,962,000 based on a 2004 proposal for an alternative groundwater and surface water supply for the Borough of Wellsboro indexed to 2018 value.	The water supply storage will be increased from 333.92 acre-feet to 414.65 acre-feet by raising the permanent pool two feet in elevation.

P&G Account	Item/Resource Concern/NRCS Planning Requirements	No Action/Future Without Project (Sponsor Breach)	Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternative)
EQ	Waters of the United States/Clean Water Act	• Sponsor will obtain the necessary permits and approvals from PADEP for earth disturbance and work near waterbodies. These will include Stream Obstruction and Encroachment Permits, the State Programmatic General Permit 5 (PASPGP-5), NPDES permit for earth disturbance greater than one acre, and erosion and sediment control plan approval. • Water quality impairments caused by Upstream Impoundment - Organic Enrichment/Low D.O. will be eliminated. Water quality impairments caused by Channelization - Flow Alterations may be reduced. • Erosion and sedimentation controls consistent with an approved plan will be implemented to minimize discharge of sediment during temporary earth disturbance occurring during construction activities. • Upon removal of Hamilton Lake, the PFBC may cease stocking trout and walleye in this area of the Charleston Creek watershed.	• Sponsor will obtain the necessary permits and approvals from PADEP for earth disturbance and work near waterbodies. These will include Stream Obstruction and Encroachment Permits, the State Programmatic General Permit 5 (PASPGP-5), NPDES permit for earth disturbance greater than one acre, and erosion and sediment control plan approval. • Improvement of the dam would have no effect on current impairments occurring on Charleston Creek immediately downstream of the dam. • Erosion and sedimentation controls consistent with an approved plan will be implemented to minimize discharge of sediment during temporary earth disturbance occurring during construction and dredging activities. • No change to Hamilton Lake as an Approved Trout Waterbody.
EQ	Wetlands	• A controlled breach of the dam would result in the draining of Hamilton Lake thus affecting the adjacent and periphery wetlands. • Flooding may alter the function and composition of the wetland area downstream of the project area. • Wetlands at the stilling basin would be removed (and mitigated, if required)	• Wetlands along the periphery of Hamilton Lake will be temporarily impacted during the lake drawdown period associated with construction at the dam. • As the elevation of Hamilton Lake rises, approximately 2.3 acres existing wetlands will be permanently inundated. Approximately 3.6 acres of new wetlands will likely form along the periphery of the new shoreline and head of Hamilton Lake. • Modifications to the auxiliary spillway may affect approximately 0.1 acres of artificial wetland in existing auxiliary spillway footprint. • Alterations to wetland and aquatic habitat will require authorization by the USACE via the PASPGP-5 or NWP-27.

Benefit/Cost Comparison. The Project Team completed a comparative cost analysis for the Hamilton Dam alternative plans carried forward for detailed study, which is shown in Table 4-4. Cost items include:

- The intent of the Sponsor to acquire the necessary land rights to modify the auxiliary spillway.
- Construction-related activities such as mobilization, clearing and grubbing, erosion and sediment control, demolition and removal of existing structures, site work, earthwork, fencing, seeding, sediment removal, drainfill, and conduits.
- Engineering activities such as completing design, surveys, geotechnical investigations, construction observations, and Project administration.

4.7 NATIONAL ECONOMIC DEVELOPMENT (NED) ALTERNATIVE

The NED Alternative is the alternative that reasonably maximizes net economic benefits consistent with protecting the nation's environment.

Rehabilitation to Current High Hazard Potential Dam Standards is the National Economic Development (NED) Alternative and is also the Preferred Alternative for the following reasons:

- It fulfills the Project Purpose and Need, which were defined by the Sponsors and public.
- It has positive impacts on human resources and minimal impacts on natural resources.
- It has the highest benefit to cost ratio of the federally-assisted alternatives considered.
- It maximizes net economic benefits consistent with protecting the nation's environment.

5.0 ENVIRONMENTAL CONSEQUENCES

For the purpose of the following discussions, Project areas are defined below.

Project footprint – The area within the footprint of the proposed rehabilitated structure and auxiliary spillway.

Pool area – This term refers to the permanent pool area comprised of sediment and water supply storage directly upstream from Hamilton Dam.

Breach inundation area – This refers to the area downstream from the dam within the study reach that would be directly impacted by sudden dam failure.

Benefit area – The benefit area includes floodplain areas downstream from the dam, which benefit from reduced flooding as a result of the structure.

Contributing areas – This includes the Charleston Creek watershed above Hamilton Dam (PA-602).

5.1 COMPARATIVE ENVIRONMENTAL EFFECTS OF ALTERNATIVES – HAMILTON DAM (PA-602)

Air Quality/Clean Air Act

- *Existing Conditions*

There are no specific emission sources associated with the dam and the dam itself is currently in full compliance with the Clean Air Act. PADEP has recommended to United States Environmental Protection Agency (USEPA) that Tioga County should continue to be listed as meeting ozone attainment standards. No objectionable odors or odor sources or other air quality issues were noted within the project area.

- *No Action/Future Without Federal Project (FWOP)*

There will be some temporary affects during construction including dust and exhaust. Control measures would be implemented during construction to minimize impacts.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Same as FWOP.

Aquatic Resources

- *Existing Conditions*

Hamilton Dam is 1 of 3 floodwater retarding dams in the Marsh Creek Watershed designed to reduce floodwater damage. Hamilton Dam is located on the perennial stream of Charleston Creek.

The lake's main inlet, Charleston Creek, is designated as a Warm Water Fishery (WWF) as per Title 25 of the Pennsylvania Code Chapter 93. In addition, the section of Charleston Creek immediately downstream of Hamilton Lake dam where it enters Marsh Creek remains designated as a WWF.

The 38.5-acre Hamilton Lake is an extremely popular spot for trout fishing in the spring and fall. Therefore, the lake is regularly stocked as a put-and-take trout fishery. Hamilton Lake is involved in the Catchable Trout Program.

- *No Action/Future Without Federal Project (FWOP)*

A controlled breach of the dam would result in the draining of Hamilton Lake, thus changing the current habitat for aquatic species currently in the 38.5-acre lake and around the lake periphery. The approximately 3,600 linear feet of reconnected stream would provide habit for species such as the American eel.

Rehabilitation to Current NRCS High Hazard Potential Dam Criteria

Up to 38.5 acres of fish and waterfowl habitat may be impacted during construction due to the temporary drawdown of Hamilton Lake. The fish and waterfowl impacts will be managed in accordance with PFBC requirements.

The raised permanent pool elevation will provide an additional 3.4 acres of water surface and inundate approximately 200 feet of stream habitat.

Cultural Resources

- *Existing Conditions*

A Phase I Cultural Resources Study was conducted within the project area. Four sites on the National Register of Historic Places are in the near vicinity of Hamilton Dam:

- Robinson House
- Jesse Robinson House
- Wellsboro Armory
- Wellsboro Historic District

A Phase 1a/1b Archaeological Survey was completed and the remains of a railroad bridge abutment were discovered within the Charleston Creek floodplain upstream of the dam. No eligible structures or sites were identified. Based on this Archaeological Survey, the Pennsylvania Historical and Museum Commission stated in a letter dated November 22, 2016, that no further archaeological work is necessary for the study area around the lake and dam.

- *No Action/Future Without Federal Project (FWOP)*

Three of the four historic sites occur within the 100-year inundation zone that would occur if the FWOP is implemented (the Wellsboro Armory is not within the inundation zone.) No impacts to the upstream bridge abutment are anticipated from dam removal.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

No impacts to cultural resources are anticipated and no mitigation measures are required for this alternative.

Environmental Justice

- *Existing Conditions*

The Hamilton Dam Inundation Zone minority population is 7% (21% in Pennsylvania); the low-income population is 30% (31% in Pennsylvania).

- *No Action/Future Without Federal Project (FWOP)*

Dam breach would result in loss of flood protection for downstream areas within the inundation zone; however, the effects would not be disproportionately focused on a minority population or any socioeconomically disadvantaged groups.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

No disproportionate adverse effects are anticipated to any ethnically-, racially-, or socioeconomically-disadvantaged families or groups downstream of the dam. Improvement of the dam would reduce the risk of flooding downstream including to those socioeconomically-disadvantaged populations that reside downstream; however, the effects would not be disproportionately focused on the socioeconomically-disadvantaged groups.

Energy Inefficiency

- *Existing Conditions*

Hamilton Dam is not used for energy production nor do operations there require consumption of energy except for the occasional mowing and general maintenance activities.

- *No Action/Future Without Federal Project (FWOP)*

During construction, an increase in equipment and facilities will be required. Mowing and maintenance routines for the dam will be discontinued.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

During construction, an increase in equipment and facilities will be required. Normal mowing and maintenance routines will be reconvened following project completion.

Erosion and Sedimentation

- *Existing Conditions*

Soils and Erosion – There is evidence of sedimentation accumulation behind the impoundment; upstream erosion is contributing to sedimentation in the impoundment. Some of the existing soils within the project area have a K-factor value that indicates susceptibility to sheet and rill erosion. Evidence of concentrated flow (gully erosion) was not observed in the project area; however, upstream concentrated flow erosion contributes to sedimentation behind the dam. No excessive stream bank or shoreline erosion issues were noted within the project area.

Sedimentation – There were sedimentation accumulations behind the impoundment observed at the site. The historical average sedimentation rate is 1.26 acre-feet/year and is projected to be 0.64 acre-feet/year submerged sediment and 0.06 acre-feet/year aerated sediment. The estimated remaining sediment storage volume in the Hamilton Dam reservoir is approximately 78.15 acre-feet. Charleston Creek immediately below Hamilton Dam is listed as having impaired water quality. One of these source causes of impairment is Urban Runoff/Storm Sewers - Siltation.

Sediment in the upstream reach of Hamilton Lake has impacted use of the existing boat ramp.

- *No Action/Future Without Federal Project (FWOP)*

A controlled breach of the dam would result in the draining of Hamilton Lake and exposing what is currently lake bottom. These newly exposed soils could be subject to increased sheet, rill and gully erosion if it is not vegetated quickly. Without the dam, there is the potential for an increase in downstream bank erosion associated with increased flood flows.

Short-term increase in suspended sediment and turbidity downstream during construction, but proper controls will minimize erosion. With the dam removed, downstream stream segments will be subject to a future sedimentation rate of 0.70 acre-feet/year, the sum of the submerged and aerated sedimentation captured by the reservoir.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

As the shoreline of Hamilton Lake changes, erosion may occur from wave action at the new shoreline elevation, unless stabilization measures are installed such as riprap. Sediment removed from the upper portion of the reservoir (spoil) shall be spread at Sponsor's designated location and vegetated to stabilize and limit erosion.

Short-term increase in suspended sediment and turbidity downstream during construction is expected, but proper controls will minimize erosion. It is anticipated that the dam pool will continue to trap 0.64 acre-feet/year of submerged sediment and 0.06 acre-ft/year of aerated sediment. The estimated remaining sediment storage volume in the Hamilton Dam reservoir is approximately 78.15 acre-feet.

Fish and Wildlife

- *Existing Conditions*

There is no evidence of habitat degradation identified in the project area. Charleston Creek immediately below Hamilton Dam is listed as having impaired water quality. One of the source causes of this impairment is Upstream Impoundment - Organic Enrichment/Low D.O.

The Susquehanna River Basin Commission communicated (03/29/2017) current American eel reintroduction activities and their request to consider allowing ecological monitoring on the Wellsboro Borough Municipal Authority property and include protective measures to prevent instream sedimentation in Charleston Creek.

Hamilton Lake is designated as an Approved Trout Waterbody and Charleston Creek is designated as a Warm Water Fishery. Hamilton Lake is a Trout Stocked Waters Open to Year-Round Fishing and a Walleye Fingerling Fisheries Waterbody.

- *No Action/Future Without Federal Project (FWOP)*

A controlled breach of the dam would result in the draining of Hamilton Lake, thus changing the current habitat for aquatic species currently in the lake and around the lake periphery.

A controlled breach could also result in increased sedimentation and nutrient loading downstream, the elimination of stream obstruction for migratory fish passage to upstream habitat (including the American eel), reduced habitat value for waterfowl, reduced solar exposure to the water that could improve low DO, and an increase in the riparian corridor.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Fish and waterfowl habitat may be impacted during construction due to the temporary drawdown of Hamilton Lake. The fish and wildlife impacts will be managed in accordance with PFBC requirements. Following construction, no long-term effect is anticipated. There are no anticipated benefits for the American eel in the preferred alternative; the current alternative would maintain the eels existing habitat.

Floodplain Management

- *Existing Conditions*

Based on the review of FEMA's Flood Insurance Rate Maps of the project study area, Charleston Creek is downstream of the Hamilton Dam outfall and contains areas that are situated within Flood Zone A.

- *No Action/Future Without Federal Project (FWOP)*

Implementation of the FWOP may change the mapping required for Flood Zone A. Work to remove the dam would be conducted within the flood zone. Residential, commercial and transportation resources will be a greater risk of flood damage.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

This alternative would maintain the current FEMA Flood Insurance Rate Map mapping and flood damage reduction provided by the dam for the downstream areas.

Floodwater Damage

- *Existing Conditions*

The dam controls runoff and mitigates flooding. No evidence of excessive seepage that would affect the normal pool elevation and pose a risk to the downstream community was observed. Charleston Creek immediately below Hamilton Dam is listed as having impaired water quality. One of the source causes of this impairment is Urban Runoff/Storm Sewers – Water/Flow Variability.

- *No Action/Future Without Federal Project (FWOP)*

Residential, commercial, and transportation resources will be a greater risk of flood damage. The average annual flood damage reduction benefits of \$533,000 will be lost.

Removal of the dam may increase baseflow variability by allowing larger flows to travel downstream during storm events.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

The flood damage reduction benefits downstream from the dam would be maintained with an average annual value estimated at \$533,000.

Following the transition to the higher elevation of Hamilton Lake, no effect on normal downstream streamflow is anticipated.

Invasive Species

- *Existing Conditions*

Invasive species are a concern to the Pennsylvania natural environment. A few of the invasive species that may be problematic at this site include Multiflora rose, Japanese knotweed, Purple Loosestrife, and Japanese barberry.

- *No Action/Future Without Federal Project (FWOP)*

A controlled breach of the dam would result in the exposure of bare soils that are presently lake bottom and newly exposed bare soils may be subject to invasive plant growth. Invasive species will be minimized by planting adapted species.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Construction and earth disturbance activities may introduce invasive plant species but replanting with appropriate native or non-invasive species will minimize the impact.

Land Use

- *Existing Conditions*

The existing land use within the contributing area of Hamilton Dam is primarily wooded, pasture or rural. Specific land use classifications are listed in Table 5-1. Approximately 0.12% of the contributing area is classified as low intensity developed land, with no medium to high intensity developed land in the contributing drainage area. An approximate 28.70% of the drainage area is classified as developed open space and pasture, and approximately 56.75% of the drainage area is classified as forested.

Table 5-1
Existing Land Use in Contributing Area of Hamilton Dam

Land Use	Acres within Contributing Area (acres)	Percent of Contributing Area
Open Water	50.58	0.94%
Developed, Open Space	116.91	2.16%
Developed, Low Intensity	6.43	0.12%
Barren Land	2.22	0.04%
Deciduous Forest	2,439.13	45.10%
Evergreen Forest	105.40	1.95%
Mixed Forest	524.47	9.70%
Shrub/Scrub	66.61	1.23%
Herbaceous	1.64	0.03%
Hay/Pasture	1,435.37	26.54%
Cultivated Crops	616.98	11.41%
Woody Wetlands	20.10	0.37%
Emergent Herbaceous Wetlands	21.93	0.41%
Total	5,407.77	100.0%

Source: National Land Cover Database, 2016

The Borough of Wellsboro is located downstream from Hamilton Dam and land use within the downstream benefit area can be characterized as single-family residential development, industrial use, higher density commercial and multi-family developments. The land use mix below the dam has not changed since dam construction.

- *No Action/Future Without Federal Project (FWOP)*

Removal of dam would no longer protect downstream area from flooding.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Current and planned land uses in the benefit area would be at a lower risk of flooding.

Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act

- *Existing Conditions*

Hamilton Lake and Charleston Creek Watershed attract a variety of migratory water fowl. There are Important Bird Areas (Marsh Creek Wetlands and Susquehanna Headwaters Forest Block) near Hamilton Lake.

- *No Action/Future Without Federal Project (FWOP)*

A controlled breach of the dam would result in the draining of Hamilton Lake and could alter migratory bird habits. Migratory birds and nesting activities could also be temporarily disturbed during construction.

The scheduling of construction activities would be coordinated with the appropriate wildlife agencies to avoid adverse impacts.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

The project alternative may temporarily impact migratory birds during construction. The scheduling of construction activities would be coordinated with the appropriate wildlife agencies to avoid adverse impacts.

Parklands

- *Existing Conditions*

Hamilton Dam is not located within a park, but the lake is open for year-round recreation. Minimal park features, including a picnic table and public restroom at the boat ramp, are available around Hamilton Lake. Wildlife watching, boating, and fishing are popular activities at Hamilton Lake.

- *No Action/Future Without Federal Project (FWOP)*

Removal of dam will result in loss of lake and associated incidental recreational activities such as fishing, boating, and wildlife watching.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Maintain lake for year-round recreational fishing and boating with watercraft without gasoline-powered engines. Access to, and use of, the lake will be temporarily affected during construction.

Plant Condition

- *Existing Conditions*

Vegetation across the project area is generally healthy and well maintained. It does not appear to be in a degraded condition. There were no identified structural or compositional inadequacies noted in project area. There was no excessive plant pest pressure observed or identified in project area. Changes to the elevation of Hamilton Lake will impact vegetation communities at and near the shoreline.

- *No Action/Future Without Federal Project (FWOP)*

Flooding in the area or super saturated conditions may impact the health of surrounding downstream vegetation. A controlled breach of the dam will reduce the ability of vegetation at and near the shoreline of Hamilton Lake to access water.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Vegetation will be disturbed during construction. Undesirable plants will be minimized with the replanting of native species and management of noxious plants. Raising the permanent pool of Hamilton Lake two feet will submerge existing vegetation at and near the shoreline. Hydrologic conditions will support wetland species in currently upland areas.

Prime and Unique Farmland

- *Existing Conditions*

The project area is comprised of a majority of soil types designated as prime or unique farmlands and farmlands of statewide importance. However, no portion of the project area is located on lands that are or will be used for farming or agriculture.

- *No Action/Future Without Federal Project (FWOP)*

Removal of the dam will result in increased flooding and inundation of prime or unique farmland soils downstream. The majority of land use downstream is developed and not used for farming.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

The rise in elevation of Hamilton Lake will inundate small areas of Philo silt loam soils, designated as prime farmland. This area at the point Charleston Creek enters the lake is not located on lands that are or will be used for farming or agriculture.

Public Health and Safety

- *Existing Conditions*

Hamilton Dam was designed and constructed to prevent flood damage downstream. It is classified as a High Hazard potential dam. Approximately 1,650 people reside with over 600 homes and businesses located within the inundation zone. Flooding downstream has been reduced by the dam for high frequency events up to and including the 100-year storm.

The dam is structurally sound; however, the 2010 Dam Assessment by NRCS found insufficient detention storage and freeboard based on current applicable criteria and more recent rainfall data, so it does not meet current applicable safety and performance standards for High Hazard potential dams. If breached, there is a significant threat to human life and safety for residents, motorists, and others using downstream facilities.

Per Executive Order 11988, *Floodplain Management*, NRCS shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains while acquiring, managing, and disposing of federal lands and facilities; providing federally-undertaken, financed, or assisted construction and improvements; and conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

- *No Action/Future Without Federal Project (FWOP)*

Residential, commercial, and transportation resources will be at a greater risk of flood damage. Average annual flood damage reduction benefits of \$533,000 will be lost. Eliminates breach inundation risk to downstream residents.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Maintain flood damage reduction downstream from the dam with an average annual value estimated at \$533,000. Reduced breach inundation risk to downstream residents. No effect is anticipated on the fish consumption advisory.

Regional Water Resources Plans

- *Existing Conditions*

Hamilton Lake watershed is part of the Marsh Creek Watershed that feeds into the Susquehanna River Basin and the Chesapeake Bay. The Tioga County Chesapeake Bay Tributary Strategy was

developed in accordance with the requirements of the Pennsylvania Stormwater Management Act, Act 167 of 1978 and was written in March 2005. The Susquehanna River Basin Commission has developed a comprehensive plan for priorities in the basin.

- *No Action/Future Without Federal Project (FWOP)*

Support the Susquehanna River Basin Commission's Comprehensive Plan's ecosystem priorities by removing an obstacle to upstream movement for migratory fish. Residential, commercial, and transportation resources will be at a greater risk of flood damage. Removal of dam will result in loss of municipal water supply provided by the reservoir.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Continue to support the Susquehanna River Basin Commission's Comprehensive Plan's water supply, flooding, and ecosystem priorities by providing a multipurpose structure with low flow augmentation and conservation releases. Maintains flood damage reduction downstream from the dam with an average annual value estimated at \$533,000. Reduces breach inundation risk to downstream residents.

Riparian Areas

- *Existing Conditions*

Riparian areas are present within the project area.

- *No Action/Future Without Federal Project (FWOP)*

With removal of the dam, downstream areas could be inundated with flood waters. Existing lake shoreline would be lost and riparian area would be extended towards the channel of Charleston Creek which would flow for approximately 2,800 linear feet through the area currently under Hamilton Lake water.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Vegetation communities within the current riparian areas will be impacted by the rise in elevation of Hamilton Lake. Trees and shoreline vegetation along the current shoreline may die off when the elevation of Hamilton Lake rises. Vegetation in wetlands along the periphery of the lake will be inundated.

Scenic Beauty

- *Existing Conditions*

The Hamilton Dam project area is located within the predominately rural community within Tioga County. Tioga County contains the Pennsylvania Grand Canyon, rivers, and forest reserves. These areas contribute greatly to the economy through tourism.

- *No Action/Future Without Federal Project (FWOP)*

Loss of aesthetic appeal of lake, replaced by stream and riparian scene. Negative views will regularly occur because of flood damages to downstream areas.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

The scenic quality of the landscape of Hamilton Lake may be temporarily impacted during construction while the lake is drawn down. Construction equipment will temporarily be stored and utilized on-site. Trees along the current shoreline may die off when the elevation of Hamilton Lake rises.

Social Issues

- *Existing Conditions*

One of the primary purposes of the existing dam is flood control, which is considered the significant social issue. Hamilton Dam is maintained by the Wellsboro Municipal Authority. The Borough of Wellsboro reports that annual costs of routine operations and maintenance is \$12,400 and routine engineering (inspection and Emergency Action Plan) is \$1,600 in labor.

- *No Action/Future Without Federal Project (FWOP)*

Following the completion of the transition period when the dam is removed, staff time required to maintain and manage the site will be minimal. Removal of dam would result in loss of flood protection for downstream areas.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

No change in staff time needed to maintain and manage the dam. Rehabilitation of the dam would maintain the flood protection for downstream areas.

Water-Based Recreation

- *Existing Conditions*

Hamilton Lake is designated as a Stocked Trout Waters Open to Year-Round Fishing and Walleye Fingerling Fisheries waterbody. Fishing and boating with watercraft without a gasoline-powered engine are allowed. PFBC estimate annual angler trips to Hamilton Dam are 4,945 for spring trout season and 1,652 for winter trout season.

- *No Action/Future Without Federal Project (FWOP)*

Loss of water-based incidental recreation opportunities due to removal of dam and reservoir.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Continue to support water-based incidental recreation opportunities that are available at the site.

Water Quality

- *Existing Conditions*

Charleston Creek immediately below Hamilton Dam is listed as having impaired water quality. One of the source causes of this impairment is Upstream Impoundment - Organic Enrichment/Low D.O.

- *No Action/Future Without Federal Project (FWOP)*

Removal of the dam may allow for improvement of water quality locally in Charleston Creek by reducing the degree of organic enrichment and algae growth occurring within the dam pool. Nutrients originating from upstream land use will flow through the creek to downstream stream segments without settling out in Hamilton Lake.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

A temporary increase in loading of nutrient-laden sediment may be observed downstream during construction and dam drawdown events. Improvement of the dam would not permanently change the excess sediment and nutrients currently entering the Chesapeake Bay.

Erosion and sediment controls will be utilized during construction to reduce the impact of excess nutrient-laden sediment downstream.

Water Resources – Public Water Supply

- *Existing Conditions*

Hamilton Dam was constructed for the purposes of flood control and to act as a water supply for Wellsboro Borough. The Borough of Wellsboro drinking water supply is a combination of wells and surface water sources that require filtration to meet DEP and EPA Regulations. Water supply from Hamilton Lake has typically been used starting in late spring through early fall when yield from the stream intakes and groundwater wells decrease. Water shortages occur in the late summer and early fall when lake water quality diminishes as precipitation and inflow lessens and water temperature increases. During drought conditions, supplying water to the community has become difficult.

Wellsboro must also provide discharge from Hamilton Lake at a monthly average of 800,000 gallons per day to meet requirements of the water allocation permit. The average daily use from the Wellsboro water system is 950,000 gallons per day. The maximum daily use is 1.385 million gallons.

From 2005 to 2015, water supply has been withdrawn from Hamilton Lake on average 207 days per year at an average rate of 574,000 gallons per day.

- *No Action/Future Without Federal Project (FWOP)*

Removal of dam would result in loss of water supply storage at the lake. Additional sources of water supply would need to be developed by the Sponsor, such as the alternatives explored in an Alternative Water Supply Proposal completed for the Borough of Wellsboro in 2004. These alternatives included development of a replacement well and/or development of a new large capacity well in the Stokesdale Area. The cost to replace the municipal water supply is estimated at \$3,962,000 based on the 2004 proposal and indexed to 2018 value.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

The water supply storage will be increased from 333.92 acre-feet to 414.65 acre-feet by raising the permanent pool two feet in elevation. A model of the available water supply from the lake was conducted based on the maximum recorded yearly average daily withdrawal along with required 1.24 cfs, equivalent to 800,000 gallons per day. stream discharges, evaporation and precipitation over the last 36-year period. The model results indicated that raising the pool by two feet will reduce the number of months without water available from the lake by 27%.

Waters of the United States/Clean Water Act

- *Existing Conditions*

Wetlands are present in the immediate vicinity of Hamilton Dam downstream of the spillway.

Charleston Creek immediately downstream of the dam is impaired by: Urban Runoff/Storm Sewers - Water/Flow Variability; Urban Runoff/Storm Sewers - Siltation; Channelization - Flow Alterations; Upstream Impoundment - Organic Enrichment/Low D.O.

Total Maximum Daily Loads (TMDL) apply to the West Branch Susquehanna River for Acid Mine Drainage-Metals, PCB, and Pathogens. No wasteload allocations have been assigned to the site for either TMDL. No Watershed Restoration Action Strategy or Act 167 Plan exists for the watershed.

Hamilton Lake is designated as an Approved Trout Waterbody. Charleston Creek is designated as a Warm Water Fishery. Hamilton Lake is designated as a Trout Stocked Waters Open to Year-Round Fishing and a Walleye Fingerling Fisheries Waterbody.

- *No Action/Future Without Federal Project (FWOP)*

Sponsor will obtain the necessary permits and approvals from PADEP for earth disturbance and work near waterbodies. These will include Stream Obstruction and Encroachment Permits, the State Programmatic General Permit 5 (PASPGP-5), NPDES permit for earth disturbance greater than one acre, and erosion and sediment control plan approval.

Water quality impairments caused by Upstream Impoundment - Organic Enrichment/Low D.O. will be eliminated. Water quality impairments caused by Channelization - Flow Alterations may be reduced.

Erosion and sedimentation controls consistent with an approved plan will be implemented to minimize discharge of sediment during temporary earth disturbance occurring during construction activities.

Upon removal of Hamilton Lake, the PFBC may cease stocking trout and walleye in this area of the Charleston Creek watershed.

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Sponsor will obtain the necessary permits and approvals from PADEP for earth disturbance and work near waterbodies. These will include Stream Obstruction and Encroachment Permits, the State Programmatic General Permit 5 (PASPGP-5), NPDES permit for earth disturbance greater than one acre, and erosion and sediment control plan approval.

Improvement of the dam would have no effect on current impairments occurring on Charleston Creek immediately downstream of the dam.

Erosion and sedimentation controls consistent with an approved plan will be implemented to minimize discharge of sediment during temporary earth disturbance occurring during construction and dredging activities. No change to Hamilton Lake as an Approved Trout Waterbody.

Wetlands

- *Existing Conditions*

Wetlands are present in the immediate vicinity of Hamilton Dam (0.68 acre), along the periphery of the lake (2.27 acres), and at the auxiliary spillway (0.11 acre).

- *No Action/Future Without Federal Project (FWOP)*

A controlled breach of the dam would result in the draining of Hamilton Lake thus affecting the adjacent and periphery wetlands. Flooding may alter the function and composition of the wetland area downstream of the project area. Wetlands at the in the vicinity of Hamilton Dam (stilling basin) and periphery of the lake would be removed (and mitigated, if required).

- *Rehabilitation to Current NRCS High Hazard Potential Dam Criteria*

Wetlands along the periphery of Hamilton Lake will be temporarily impacted during the lake drawdown period associated with construction at the dam. As the elevation of Hamilton Lake rises, existing wetlands will be permanently inundated. Approximately 3.6 acres of new wetlands will likely form along the periphery of the new shoreline and head of Hamilton Lake.

Alterations to wetland and aquatic habitat will require authorization by the USACE via the PASPGP-5 or NWP-27.

5.2 CUMULATIVE IMPACTS

There are presently no known past, present, or reasonably foreseeable future actions that were not addressed in the Plan/EA.

There are two other dams within the Marsh Creek Watershed, Kelsey Dam (PA-600) and Nessmuk Dam (PA-601.) Nessmuk Dam was recently rehabilitated, and Kelsey Dam has been assessed and requested for the rehabilitation program. The downstream hydrologic and hydraulic study completed for Hamilton Dam as part of the planning showed the contribution of each dam for providing flood protection.

Construction of Hamilton Dam has had long-term direct effects on the environment through the excavation of the site, filling of the structure, and development of a permanent impoundment behind the dam that now provides flood control, incidental recreational opportunities, fish and wildlife habitat, and other incidental benefits.

The dam has indirectly affected the natural environment by permanently flooding areas, by temporarily inundating the floodplain upstream of the dam during rain events, and by trapping sediment that would otherwise move downstream during rain events. The dam has also altered the hydrology of downstream channels by reducing downstream peak flows during storm events, and consequently protecting property and people in otherwise flood-prone areas.

Rehabilitation of the dam under the alternatives considered would not change the hydrology downstream except for protecting the downstream area from catastrophic flooding that could occur if the dam was to fail. Rehabilitation of the dam under the Preferred Alternative would allow downstream areas within the floodplain to support continued residential, industrial, and commercial development.

5.3 CONTROVERSY

There are no known areas of controversy.

5.4 RISK AND UNCERTAINTY

Project risk and uncertainty primarily exist in the engineering and economics analyses of the Project alternatives. The Project Team based all preliminary designs and cost estimates on an additional 100 years of evaluated life plus 3-year implementation time, using data from the as-built plans, available GIS data, recent topographic surveys, and bathymetry. Abbreviated geotechnical explorations were conducted, and the designs relied on soil mechanics data from the original dam design, as-built plans, field observations and experience. Hydrologic data was measured using available GIS data, and field observations. Accuracy of the data impacts uncertainty of the reservoir operation levels, discharge capacities, breach inundation areas, flood damage area, design life, and structure function. Failure of the dam would most likely occur as a result of (1) breach of the embankment due to extreme storm events, or (2) deterioration and failure of the principal spillway conduit.

The Project Team used the Economics and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies to account for flood control benefits associated with the alternatives. Predicting economic benefits naturally involves a moderate degree of uncertainty. The economic analysis used an indexing approach to predict benefits.

The original 1957 benefits for the Project were indexed to current dollars using applicable indexes. The scope of the study did not include re-evaluation or reconsideration of the original benefits. Estimated average annual flood damage reduction benefits and intensification benefits determined with a comprehensive flood damage assessment could vary from those determined through indexing of the original 1957 benefits with the improved computational power for modeling, spatial and elevation data.

Uncertainties with the analysis of environmental impacts lie with the identification of wetland areas, riparian habitat, and streams. Trained specialists identified environmentally-significant areas using standard, well-accepted protocols.

Within the context of this study, all alternatives were considered on a comparable basis. There does not appear to be any area that would have resulted in a different decision by using different procedures or conducting more intensive studies.

6.0 CONSULTATION, COORDINATION AND PUBLIC PARTICIPATION

6.1 PUBLIC PARTICIPATION

NRCS completed a Rehabilitation Assessment Report and estimated risk-based profile of the Hamilton Dam in May 2010. The evaluation indicated the Risk Index was 7,181. NRCS reviewed the breach inundation zone downstream from the dam and determined that developments in the community of Wellsboro and rural Tioga County were subject to flooding during a breach of the dam. The evaluations indicated that the dam did not meet NRCS and Commonwealth of Pennsylvania Dam Safety requirements with respect to the current hazard classification and recommended modifications to meet current applicable design criteria.

The Sponsor submitted a formal request for assistance to NRCS on August 27, 2014. The request for assistance listed concerns about compliance with current applicable dam safety standards, including the function of the auxiliary spillway.

NRCS, the Borough of Wellsboro and members of the Project Team (listed in Table 9-1) conducted a project kickoff meeting at the Borough of Wellsboro Office, 14 Crafton Street, Wellsboro PA on March 2, 2016. Shortly after this meeting, a Public Participation Plan was prepared to serve as a guide for carrying out the activities related to consultation, coordination and public participation. The planning effort was conducted in close coordination with the Pennsylvania Department of Environmental Protection's Bureau of Waterways Engineering Division of Dam Safety and in coordination with the US Army Corps of Engineers.

Public scoping open forums were conducted by the Wellsboro Borough Council and Wellsboro Borough Municipal Authority at their regular meetings. The Wellsboro Borough Council received input, discussed problems and opportunities, and issued updates on progress. All Wellsboro Borough Council and Wellsboro Borough Municipal Authority meetings are open forums conducted in compliance with the Commonwealth of Pennsylvania Sunshine Act which requires public agencies to hold certain meetings and hearings open to the public.

April 11, 2017, 2:00 PM – Borough of Wellsboro Public Scoping Meeting. The Project Team and NRCS met with representatives from the Borough of Wellsboro, interested state and federal agencies during the public scoping meeting at the Borough of Wellsboro Office, 14 Crafton Street, Wellsboro PA. The meeting was advertised with public notice with a targeted mailing to interested agencies. This meeting provided instruction and guidance on the project scope and the extent of activities required for developing the Supplemental Watershed Plan and Environmental Assessment. The following topics were discussed:

- Project History
- Problems and opportunities identified
- Sponsor objectives
- Alternatives considered
- Alternatives evaluated and comparison of effects

April 11, 2017, 4:00 PM – Wellsboro Borough Municipal Authority Meeting – Public Forum. Members of the Project Team and NRCS attended the Wellsboro Municipal Authority meeting and conducted an open forum to discuss the Project. The meeting was advertised with public notice. The following topics were discussed:

- Project History
- Problems and opportunities identified
- Sponsor objectives
- Alternatives considered
- Alternatives evaluated and comparison of effects

The Sponsor allowed public input at all meetings prior to and during the planning process. The Draft Supplemental Watershed Work Plan No. 7 and Environmental Assessment for Hamilton Dam (PA-602) of the Marsh Creek Watershed was available upon request.

6.2 AGENCY CONSULTATION

The following agencies and elected officials will receive the Abstract and Summary Sheet for the Draft Supplemental Watershed Plan No. 7 and Environmental Assessment for Hamilton Dam of the Marsh Creek Watershed.

- Appalachian Regional Commission
- Susquehanna River Basin Commission
- Wellsboro Borough Council
- Wellsboro Borough Municipal Authority
- Tioga County Commissioners
- Tioga County Conservation District
- Tioga County Department of Emergency Services
- Tioga County Planning Commission
- Pennsylvania Department of Environmental Protection (PADEP) North-Central Office
- PADEP Division of Dam Safety, Bureau of Waterways, Engineering & Wetlands
- Pennsylvania Emergency Management Agency
- Pennsylvania Fish & Boat Commission (PFBC)
- Pennsylvania Governor's Policy Office
- Pennsylvania Department of Agriculture
- Pennsylvania Department of Conservation and Natural Resources
- Pennsylvania State Conservation Commission
- Pennsylvania Game Commission
- Pennsylvania Historical and Museum Commission
- The Honorable Matthew Baker
- The Honorable Joseph Scarnati III
- The Honorable Tom Marino
- The Honorable Patrick Toomey
- The Honorable Robert B. Casey, Jr.
- USDA NRCS, Tioga County Field Office
- USACE, Baltimore District
- U.S. Fish & Wildlife Service (USFWS), Pennsylvania Ecological Services Field Office
- Delmar Township Supervisor
- Charleston Township Supervisor

The USACE was requested by NRCS to be a cooperating agency and formally accepted the request December 21, 2016, along with providing scoping comments for the preparation of the Environmental Assessment. The USACE correspondence stated that "...the EA should thoroughly evaluate the permanent and temporary impacts to the waters of the U.S., including jurisdictional wetlands, resulting from the total project. This includes all project elements such as: grading, access roads, construction pads, storm water management structures, dewatering, all construction impacts, stream diversions, etc."

NRCS met with the PADEP Division of Dam Safety on January 26, 2017, at the Rachael Carson State Office Building in Harrisburg, PA. This meeting reviewed the proposed rehabilitation alternatives and provided guidance as to acceptability through PADEP.

Since the dam was built in the footprint previously cleared for such resources, none of the proposed project alternatives pose a risk of impact to archeological or historic resources. A Phase I Cultural Resources Study identified four sites on the National Register of Historic Places downstream from the

dam. A Phase 1a/1b Archaeological Survey identified the remains of a railroad bridge abutment upstream from the dam in the Charleston Creek floodplain. None of the identified historic or archeologic locations will be affected by the rehabilitation alternative. On November 22, 2016, the Pennsylvania Historical and Museum Commission stated that no further archaeological work is necessary for the study area around Hamilton Dam and Lake.

No impacts to federally-listed species were identified within the Project study area based on the Pennsylvania Natural Diversity Inventory (PNDI) review. Consultation with U.S. Fish and Wildlife Service, as required by Section 12 of Public Law 83-566, was conducted and documented with correspondence dated February 15, 2017. No federally-listed Threatened or Endangered species were identified.

Correspondence from John Balay of the Susquehanna River Basin Commission, dated March 29, 2017, provided comments based on the Commission's "Comprehensive Plan for the Water Resources of the Susquehanna River Basin." For Hamilton Dam, it was requested that prospects for low flow augmentation be explored for conservation releases to prevent water quality degradation and adverse lowering of streamflow levels downstream of the impoundment. The correspondence also stated that an "extensive effort" is being made by the USFWS to reintroduce the American eel into the Susquehanna River Basin in Marsh and Pine Creek downstream from Hamilton Dam. It was requested that rehabilitation actions include provisions to allow for the PFBC and/or PADEP to "conduct ecological and water quality monitoring" at the Hamilton Dam property and "include protective measures to prevent instream sedimentation and preserve water quality" from disturbances at Hamilton Dam and in Charleston Creek.

6.3 PUBLIC REVIEW

The Draft Supplemental Watershed Work Plan No. 7 and Environmental Assessment for Hamilton Dam of the Marsh Creek Watershed in Tioga County, Pennsylvania was advertised and posted for public comments from October 19, 2018 to November 26, 2018.

Responses with comments were received from three agencies. A letter was also received from one agency confirming no changes to prior comments that had already been incorporated. All comments received back are included in Appendix A. Responses to the comments received on the Draft Supplemental Watershed Work Plan and Environmental Assessment are provided below.

Comment: An agency suggested that NRCS conduct and submit a Pennsylvania Natural Diversity Inventory (PNDI) search.

Response: A search of the PNDI was completed as part of the environmental studies and determined no known impacts within the project area. The results of the PNDI search were incorporated in the Plan-EA document.

Comment: An agency suggested that a wetland assessment should be conducted for the perimeter of the reservoir and a mitigation plan should be developed if necessary.

Response: Three field surveys were completed of wetlands during the planning, including the shoreline. The wetlands in the headwaters of the lake will be impounded by the 2.0 feet increase in permanent pool elevation to accommodate the additional water supply storage. Based on conversations with USACE, this impact is not subject to USACE permitting as the planned method to raise the pool (plugging the existing orifice in the riser and constructing a new orifice at this elevation) does not require fill. Any potential mitigation measures identified during the permitting process will be incorporated into the project.

Comment: An agency suggested that NRCS work with PFBC to develop a plan to install fish habitat into the lake to enhance recreational value.

Response: The Sponsor's project purpose includes maintaining the incidental recreation and habitat values at Hamilton Lake. The planning and Plan-EA document did not consider enhancing recreation or habitat values and any enhancement will be a local cost. NRCS will provide notification to PFBC staff of project schedule during permitting and construction.

Comment: An agency commented on the probability of archaeologic resources and above ground historical properties located in the project area. The comment indicated that the planned rehabilitation of Hamilton Dam would have no effect these resources, but if the scope increased or new information was discovered, the Pennsylvania SHPO should be contacted, and additional study made.

Response: A Phase IA/IB archaeological resource survey of the proposed project area was completed during the planning and consultation made with the Pennsylvania SHPO to determine that no historic structures survey work is required for this project. The Plan-EA document includes the recommendation that if construction is to occur outside of areas previously investigated, additional archaeological survey should be completed.

Comment: An agency commented that the Tioga County Conservation District may need large woody debris for in-stream protection and restoration concurrent to the rehabilitation at Hamilton Dam. It was requested that the Conservation District be made aware of any logs or fallen trees removed while the lake is drawn down.

Response: This was not considered and is outside the purview of resources considered with the Plan-EA document. This can be considered during the design and construction phases of this project in coordination with the Sponsor.

Comment: An agency commented that the project would likely be considered a "Reporting" activity in accordance with PASPGP-5 and PADEP would send a copy of the Dam Permit Application to the USACE for their review. PADEP would need a Dam Permit, including 401 Water Quality Certification, for the rehabilitation project.

Response: Concur, the Borough of Wellsboro will be responsible for obtaining Dam Permit.

7.0 PREFERRED ALTERNATIVE: REHABILITATION TO CURRENT HIGH HAZARD POTENTIAL DAM STANDARDS

7.1 RATIONALE FOR PREFERRED ALTERNATIVE

The following alternatives were developed and presented to the Wellsboro Municipal Authority on April 11, 2017:

- No Action/Future Without Federal Project (FWOP)
- Rehabilitation to Current High Hazard Potential Dam Standards
- Acquisition or Relocation of At Risk Structures
- Floodproofing, Floodplain Regulation, and other Nonstructural Alternatives
- Decommissioning with Nonstructural Measures (Floodproofing in the Inundation Areas)
- Variations of Dam Rehabilitation Alternative

Two of these alternatives (FWOP and Rehabilitation to Current High Hazard Potential Dam Standards) merited detailed evaluation. The Wellsboro Borough Municipal Authority selected on April 11, 2017 their preferred alternative to be the rehabilitation of the dam as identified by NRCS; with the understanding that the rehabilitation items will be developed during the design phase to minimize disturbance, construction cost, and operation and maintenance costs. Thus, the Rehabilitation to Current High Hazard Potential Dam Standards Alternative is the Preferred Alternative of both NRCS and the Sponsor.

The Hamilton Dam (PA-602) Supplemental Watershed Work Plan No. 7 – Environmental Assessment meets all applicable USDA-NRCS and Commonwealth of Pennsylvania dam safety and performance standards for the Hamilton Dam. The service life of the rehabilitated dam would be 100 years with an additional 3 years for implementation.

The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council, 1983) require the evaluation of a National Economic Development (NED) Alternative. This alternative is defined as that which maximizes the net economic benefits, consistent with protecting the Nation's environment. The Rehabilitation to Current High Hazard Potential Dam Standards Alternative meets the tests of completeness, effectiveness, efficiency and acceptability. The Preferred Alternative is the NED Alternative with net annual economic benefits of \$1,170,000 and a Benefit/Cost ratio of 6.25 to 1.0.

7.2 MEASURES TO BE INSTALLED

Based on review of the Project Purpose and Project Need, the overall impacts on human and natural environmental resources, and consideration of the NED Alternative, the Preferred Alternative is to rehabilitate Hamilton Dam (PA-602) to current applicable NRCS and Commonwealth of Pennsylvania High Hazard potential dam design criteria. The service life of the rehabilitated dam would be 100 years with an additional 3 years for implementation. The Preferred Alternative will sustain the present level of flood protection, maintain the axis of the dam at the present location, and reduce the threat to public health and safety.

All elevations noted for the rehabilitation alternative are in the Hamilton Dam 1965 as-built plans reference "local" vertical datum. The Preferred Alternative (See Figure C-5 – Rehabilitation Alternative Plan View in Appendix C) includes the following modifications to the dam:

- Maintaining the crest of the dam embankment at settled crest Elevation 1462.4 and flattening the downstream slope to 3 horizontal to 1 vertical to facilitate the economical installation of a chimney drain to upgrade embankment to current NRCS practice for high hazard embankments.
- Making repairs to concrete and modifying the principal spillway riser to raise orifice crest elevation 2.0 feet to Elevation 1429.5 for increased municipal water supply.

- Modifying the principal spillway riser for low flow augmentation will provide the minimum required discharge for downstream as required by the water allocation permit from the Commonwealth of Pennsylvania requiring a minimum streamflow of not less than 1.24 cfs, equivalent to 800,000 gallons per day, be maintained in Charleston Creek immediately downstream of Hamilton Dam.
- Place additional riprap on upstream face of dam to protect from wave erosion at increased permanent pool elevation.
- Demolishing impact basin.
- Extending principal spillway conduit for the new dam toe elevation and shifting and constructing new impact basin for extended project life, and retrofitting new drain conduits that allow for camera inspection.
- Retrofitting a drainage diaphragm around the principal spillway conduit and installing a chimney drain at the interface of the existing embankment slope and new fill. The drainage diaphragm will be used to control seepage and provide adequate factor of safety for piping resistance. Gradation of sand filter material should be carefully designed for the in-place dam embankment material in consideration of possible dispersive soils identified during planning geology.
- Installing a labyrinth weir and RCC spillway in the existing auxiliary spillway on the left abutment of the dam with the following dimensions:
 - Maintaining the existing crest elevation at Elevation 1452.6.
 - A concrete labyrinth weir spillway with a weir height of 5.0 feet and total weir length of 695 feet within the existing 175-foot-wide spillway.
 - A 175-foot-wide channel with 3:1 side slopes for the entrance and exit sections.
 - Training walls at the entrance section to direct flow to the labyrinth weir and protect the dam embankment from erosion.
 - A RCC, stepped exit channel at a 14% grade extending to a RCC basin at Elevation 1393.6.
 - A RCC basin extending 40 feet from the exit channel with a formed concrete end sill with an outlet to a vegetated channel with 5% grade extending to the valley floor at approximate Elevation 1383.6.
 - Purchase or negotiate approximately 0.1 acres of property from one property owner for expansion of auxiliary spillway footprint.

Several rehabilitation options, as described in 4.3 Alternatives Considered but Eliminated from Detailed Study, were formulated for Hamilton Dam in order to meet the current applicable High Hazard potential dam design and safety criteria, and allow for continued operation of the structure for an additional 100 years.

The construction will be conducted to minimize erosion and sedimentation, including the development of an erosion and sediment control plan as part of the permitting process. The construction site will be seeded and mulched immediately as phases of work are completed to establish vegetation immediately following construction on all land disturbed by construction activities. Appropriate plants for erosion control and wildlife habitat will be selected based upon the installation season, soils, surrounding vegetation, and Sponsor's preference. The rehabilitated dam will meet all current applicable NRCS and Commonwealth of Pennsylvania dam safety and performance standards.

Detailed information for the Preferred Alternative is provided in Table 7-1.

Table 7-1
Preferred Alternative Design Features

Resource	Unit	Existing Condition	Rehabilitate to NRCS High Hazard Potential Dam ¹
Elevation, Crest of dam	Feet ²	1462.44 feet	1462.44 feet
Elevation, Crest of auxiliary spillway	Feet ²	1452.60 feet	1452.60 feet
Elevation, Principal spillway crest	Feet ²	1441.10 feet	1441.10 feet
Elevation, Principal spillway low stage	Feet ²	1427.50 feet	1429.50 feet
Dam crest length	Feet	1400	1400
Auxiliary spillway type	Type	Vegetated Earth	Labyrinth Weir - RCC
Auxiliary spillway bottom width	Feet	175	175 (695 weir length)
Principal spillway type	Type	48-inch diameter RCP 264 feet long	48-inch diameter RCP 336 feet long
Sediment storage	Acre-Feet	78.15	78.15
Water supply storage	Acre-Feet	333.92	414.65
Total storage capacity – top of dam	Acre-Feet	2874.09	2874.09

¹Information in this table is based on the results of the planning study and may vary from the General Work Plan and As-Built Drawings.

²Elevations referenced in the Hamilton Dam 1967 as-built plans local vertical datum which was found to be different than the NGVD29 datum. The datum shift from the as-built plans local vertical datum to NAVD88 is -3.63 feet.

7.3 MITIGATION

Wetland mitigation will be coordinated under USACE jurisdiction. All construction will be conducted to minimize erosion and sedimentation, including the development of an erosion and sediment control plan, and a Stormwater Pollution Prevention Plan, as part of the permitting process. Vegetation will be established immediately following construction on all land disturbed by construction activities. Appropriate plants for erosion control and wildlife habitat will be selected based upon the installation season, soils, surrounding vegetation, and the Sponsor's preference.

In order to take precautions regarding introduction of invasive species as disturbed areas are being revegetated, the construction contract will include standards and specifications drawn from the NRCS Field Office Technical Guide requiring mechanical and/or chemical means of control.

All needed measures will be taken to mitigate (avoid, minimize, and compensate for) any adverse impacts during construction and may include timing of the work, sediment controls such as seeding, mulching and silt fences and wetting construction areas to reduce dust.

The water allocation permit from the Commonwealth of Pennsylvania requires a minimum streamflow of 800,000 gallons per day be maintained in Charleston Creek immediately downstream of Hamilton Dam. Low flow augmentation works are planned to be added at Hamilton Dam to provide for this mitigation.

As of now, based on site discussion with USACE, there are no likely wetland mitigation requirements, so anticipated cost would be minimal. In the planning cost estimate, \$115,500 was estimated for mitigation costs related to low flow augmentation and addressing impacts to the wetland areas by the increased pool elevation. Fringe wetlands are expected to be created around the new pool area to and will be allowed to self-vegetate from the wetland vegetation currently present. Wetlands in ASW are to be avoided. During construction activities, any impact to natural areas will be managed and stabilized with the appropriate erosion and sediment control practices and planting schedules. Any additional potential mitigation measures identified during the permitting process will be incorporated into the Project.

7.4 COMPLIANCE WITH FEDERAL, STATE, AND LOCAL LAWS

All applicable local, state, and federal laws will be complied with in the installation of this Project.

Commonwealth and Federal Regulations, Permits, and Compliance

- ***Dam Permit and General Permits***

The Dam Owner, the Borough of Wellsboro, will be responsible for obtaining a Dam Permit, or other appropriate authorization from PADEP, Bureau of Waterways Engineering, prior to commencing construction. Work is planned downstream of the principal spillway impact basin, therefore a General Permit 3 (GP3) may be required. There will likely be no fee or minimal fees for the following permits based on a possible exemption for local government.

- ***Section 404 of the Clean Water Act Permit***

The Project (i.e., the Preferred Alternative) would impact Charleston Creek, surface waters associated with the impoundments of this tributary, and potential jurisdictional wetlands. Wetlands and surface waters adjacent to the stream would be considered Waters of the United States. Section 404 requires a permit for the discharge of dredged or fill material into Waters of the United States. The Project is subject to Clean Water Act Section 404 regulations enforced by the USACE and the Environmental Protection Agency. The Project must be in compliance with Environmental Protection Agency's 404(b)(1) guidelines. NRCS formally requested the USACE to be a Cooperating Agency in further planning and development of the Plan-EA. On December 21, 2016, USACE accepted status as a Cooperating Agency.

- ***Section 402 of the Clean Water Act – National Pollutant Discharge Elimination System (NPDES) Permit***

The Phase I NPDES discharge program requires all operators of large construction activities which will disturb five or more acres of land to obtain permit coverage. More recently, NPDES Phase II regulations added permit coverage for small construction activities that disturb one to less than five acres. Effective December 7, 2002, PADEP integrated the federal Phase II NPDES requirements into the existing Pennsylvania Phase I NPDES permit for stormwater discharges associated with construction activities (NPDES Construction Permit). An important distinction between Phase I and II is that the small construction activities only require permit coverage when the activity disturbs one to less than five acres and will result in a point source discharge to surface waters of the Commonwealth. The Wellsboro Borough Municipal Authority will be responsible for obtaining an NPDES permit from PADEP. This will be need for disturbances not covered under the Major Dam Design Revision permitting from PADEP.

- ***Section 401 of the Clean Water Act-Water Quality Certification***

Projects requiring a Section 404 permit also require a Section 401 Water Quality Certification from the State. PADEP administers the 401 Water Quality Certification Program. The USACE 404 permit is not valid until PADEP grants Section 401 Water Quality Certification.

- ***50 CFR 17.2(b), 402.01(b), Endangered Species Act of 1973***

Section 7 of the Endangered Species Act applies to NRCS and it imposes an affirmative duty on NRCS to ensure that the Project is not likely to jeopardize the continued existence of a listed species or result in the destruction or modification of critical habitat. The Endangered Species Act is enforced by the U.S. Fish and Wildlife Service. U.S. Fish and Wildlife Service correspondence February 15, 2017 provided clearance for the Project relating to federally-listed species potentially occurring in Tioga County, Pennsylvania.

- ***36 CFR Part 800 – National Historic Preservation Act***

Section 106 requires NRCS to identify and assess the effects of the Project on historic properties. NRCS must consult the appropriate state and local officials, the SLO, and members of the public and consider their views and concerns about historic preservation issues when making final Project decisions. A Phase I Cultural Resources Study and Phase 1a/1b Archaeological Survey were conducted to identify and assess historic properties. November 22, 2016 correspondence from the

Pennsylvania Historical and Museum Commission stated that no further archaeological work is necessary for the study area around Hamilton Dam and Lake.

- *16 U.S.C. 668-668d, 54 Stat. 250, Bald and Golden Eagle Protection Act*
The Bald Eagle and Golden Eagle Protection Act provides protection to the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession, and commerce of such birds. NRCS must ensure that the Project is not likely to jeopardize the continued existence of bald eagles or golden eagles.
- *50 CFR Parts 10, 14, 20 and 21, Migratory Bird Treaty Act (MBTA)*
Legislation (16 U.S.C. 703 et seq.) makes it unlawful to *take* migratory birds, their eggs, feathers or nests. *Take* is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof. A migratory bird is any species or family of birds that live, reproduce, or migrate within or across international borders at some point during their annual life cycle. NRCS must ensure that the Project would not result in a take of migratory birds.
- *Executive Order 11988, Floodplain Management*
Executive Order 11988 requires federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. This Executive Order requires NRCS to provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains for federally-funded activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.
- *Executive Order 11990, Protection of Wetlands*
The purpose of Executive Order 11990 is to "minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands." Executive Order 11990 requires federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. This Executive Order applies to federally-funded activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.
- *Executive Order 13112, Invasive Species*
Executive Order 13112 directs federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States unless the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.
- *Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds*
Executive Order 13186 requires NRCS to consider the impacts of planned actions on migratory bird populations and habitats for all planning activities.
- *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*
Executive Order 12898 requires that federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. Socioeconomic and demographic data for the Project area were analyzed to determine if a disproportionate number of minority or low-income persons have the potential to be adversely affected by the proposed Project. The U.S. Census Bureau data for indicates 2% of the population within this area is classified as a minority population. In comparison, the minority population of Tioga County in 2010 was approximately 2.7% and was approximately 18.1% for the Commonwealth of Pennsylvania. No concentration of minority or low-income populations was identified near the proposed Project sites.

- ***Pennsylvania Clean Streams Law***

The Borough of Wellsboro will be responsible for preparing and submitting an Erosion & Sediment Control Plan to the Tioga County Conservation District to comply with Title 25 Chapter 102, the Clean Streams Law of Pennsylvania.

Local Permits and Compliance Actions

- The Project may be subject to local permits and compliance actions.

7.5 COSTS AND COST SHARING

Tables 1 through 6 are located at the end of Chapter 7, and describe the Project costs, Project benefits, and structure data for the Preferred Alternative. Estimated installation costs for the Preferred Alternative are shown in Table 1 and Table 2. Total annualized costs are shown in Table 4. The costs shown in Tables 1, 2, and 4 and throughout the document are based on standard cost accounting practices required of federal watershed planning agencies, such as NRCS. The cost accounting guidance is the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. The basis for cost sharing between NRCS and the Sponsor is different and is based on the provisions of the dam rehabilitation amendments of the Watershed Protection and Flood Prevention program. Cost sharing for authorized projects under the dam rehabilitation amendments is based on 390-USDA-NRCS, National Watershed Program Manual, Part 506, Subpart B, April 2014:

Total eligible rehabilitation Project costs for the purpose of cost sharing include: all costs associated with construction, acquisition of property rights, easements or rights-of-way, non-federal Project administration and contracting, and non-federal technical and engineering assistance for Project planning, design, and installation. Technical engineering and Project administration assistance provided by NRCS shall not be considered as part of the total cost. Sponsor shall be responsible for the cost of all water, mineral and other resource rights and all required permits. These costs shall not be considered part of the total cost. Federal funds will be 65% of the above-defined costs, not to exceed 100% of the construction costs. The Sponsor shall be responsible for 35% of the calculated total cost of the rehabilitation Project based on the above definitions using non-federal funds. In-kind contributions and the value of property rights acquired may be counted as agreed to under a separate Memorandum of Understanding (MOU) between the Sponsor and NRCS.

The estimated cost sharing allocation for the planned Project is shown in the Watershed Agreement.

7.6 INSTALLATION AND FINANCING

The works of improvement for rehabilitation of the dam are planned for installation in year one of the evaluation period. The actual installation period is contingent on the availability of funds for design and installation.

If possible, installation should be completed in one construction season in order to minimize the disturbance to plant, wildlife, and human communities. During construction, equipment will not be allowed to operate when conditions are such that soil erosion and water, air, and noise pollution cannot be satisfactorily controlled. NRCS will provide assistance to the Sponsor. The Sponsor has the needed authorities to carry out the Plan and intends to use them as appropriate.

NRCS Responsibilities. NRCS is responsible for the following implementation components of the Preferred Alternative:

- Design of the dam rehabilitation and preparation of construction drawings and construction specifications.
- Execute a Project Agreement with the Sponsor before either party initiates work. This Agreement sets forth detailed financial and working arrangements and other applicable conditions.
- Verify the Memorandum of Understanding with the Sponsor that allocates cost-share funding is up to date.
- Execute an updated O&M Agreement for the dam. This Agreement is based on the NRCS National Operation and Maintenance Manual.

- Determine that an Emergency Action Plan is prepared prior to the execution of fund-obligating documents for construction of the structure.
- Provide contract administration technical assistance.
- Provide construction management technical assistance (Inspector and Contracting Officer Technical Representative).
- Provide engineering support, technical assistance, and approval during the design and construction of the project.
- Provide financial assistance equal to 65 percent of eligible project costs, not to exceed 100 percent of actual construction costs, as appropriations become available under the Watershed Rehabilitation component of the Watershed Protection and Flood Prevention Act (Public Law 83-566).
- Certify, in conjunction with PADEP – Bureau of Waterways Engineering, completion of all installed measures.

Sponsor Responsibilities. The Borough of Wellsboro is responsible for the following implementation components of the Preferred Alternative:

- Provide written assurance that they have the legal authority and sufficient funding; that they are willing and able to obtain all necessary land rights, easements, and permits, and that they will be responsible for ensuring the operation, maintenance and replacement of installed measures.
- Participate in and comply with applicable federal floodplain management and flood insurance programs.
- Update/complete an Emergency Action Plan based on the planned changes for Hamilton Dam (PA-602).
- Secure all needed permits, easements, and rights for installation, operation, and maintenance.
- Execute any needed updates to the Memorandum of Understanding with NRCS which provides a framework within which cost-share funds are credited.
- Execute an Operation and Maintenance Agreement for Hamilton Dam (PA-602) with NRCS.
- Execute a Project Agreement or similar implementation agreement with NRCS to obligate funds for cost-share payments.
- Be responsible for all buried waste (if any) found during construction activities and all associated costs, although such costs could be included for in-kind credit at the Sponsor's request.
- Be responsible for designating spoil area for sediment removed from upper portion of lake.
- Provide financial assistance or qualifying in-kind services at a rate equal to, or greater than, 35 percent of Project construction costs using non-federal funds.
- Provide local administrative services necessary for installation of the project.

Other Organizations Responsibilities. No organizations other than the Borough of Wellsboro and NRCS have any responsibilities in implementation of this plan.

7.7 EMERGENCY ACTION PLAN

Prior to construction, the Sponsor shall prepare an updated Emergency Action Plan (EAP) for the dam or similar structure where failure may cause loss of human life or as required by state and local regulations. The EAP shall meet the minimum content specified in the NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund-obligating documents for construction of the structure. EAPs shall be reviewed and updated by the Sponsor as required by the PADEP.

7.8 CONTRACTING

The project will be installed by means of a federal contract administered by NRCS, as requested by the Sponsor. Other contracting arrangements will be agreed upon by NRCS and the Sponsor before either

party commences work activities. A project or other implementation agreement between NRCS and the Sponsor will detail the work activities and financial responsibilities for both parties.

7.9 REAL PROPERTY

The Borough of Wellsboro will be responsible for all needed land rights to implement the Project. It is estimated that approximately 0.1 acre of land will need to be acquired for the rehabilitation construction. NRCS obtained information from the Borough of Wellsboro indicating that the Sponsor currently holds flood easements upstream from the dam to the top of dam elevation.

7.10 SOLID AND HAZARDOUS WASTES

There are no known solid or hazardous wastes identified in the Project area. If such wastes are discovered during construction, the Sponsor will ensure that such wastes are identified and disposed of in accordance with all applicable federal, state and local rules and regulations. The Sponsor will be responsible for waste identification and disposal, and if warranted, testing of soil and ground water and remediation plans. These activities will generally require the services of a hazardous waste consultant certified by the PADEP, Bureau of Waste Management.

7.11 CULTURAL RESOURCES

In November 2016, the Pennsylvania State Historical Preservation Office (SHPO) confirmed there are no known cultural resources located in the construction, borrow, and spoils areas for the rehabilitation of Hamilton Dam.

If during the design phase it is determined that other areas will be impacted during construction, consultation with Pennsylvania Historical Museum Commission (PHMC) will be done prior to completion of design. If cultural resources are discovered during installation, NRCS will require construction to stop and follow policy contained in NRCS General Manual, 420 Part 401 and will take action in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and the regulations (36 CFR 800) of the Advisory Council on Historic Preservation. In the case of a discovery during construction, NRCS will work closely with the PHMC and SHPO to reduce project effects on cultural resources.

7.12 FINANCING

The NRCS share of installation costs will be provided from funds appropriated under the Watershed Protection and Flood Prevention Act (Public Law 83-566), Watershed Rehabilitation. This is not a fund-obligating document, and federal assistance is subject to the availability of Congressional appropriations. The Sponsor has analyzed their financial requirements for carrying out the plan, including components that are not eligible for federal assistance as part of this plan. The Sponsor will arrange for funds to be available, when needed, from donations, non-federal grants, cash reserves, tax revenues and other non-federal sources. Credit for in-kind contributions will be as specified in the Memorandum of Understanding.

The cost, if any, of all water, mineral and other resource rights and all required permits are not eligible for federal financial assistance. These costs shall be borne, in full, by the Sponsor. The Sponsor also understands that they will be fully responsible for costs incurred for the operation, maintenance and replacement of installed measures.

7.13 OPERATION, MAINTENANCE, AND REPLACEMENT

Measures installed in this plan, and previously installed measures, will be operated and maintained by the Sponsor with technical assistance from federal, state, and local agencies in accordance with their delegated authority. A new Operation and Maintenance (O&M) Agreement will be developed for Hamilton Dam (PA-602) utilizing the NRCS-National Operation and Maintenance Manual, and will be executed when the implementation agreement is executed. The O&M agreement will be for the evaluated life of the rehabilitation project, which is 100 years with an additional 3 years for implementation. The Sponsor will be fully responsible for all operation, maintenance, repair and replacement of installed measures until such time that the structure is formally decommissioned in accordance with applicable laws and regulations.

The O&M agreement will specify responsibilities of the Sponsor and include detailed provisions for retention, use, and disposal of property acquired or improved with Public Law 83-566 cost sharing, requirements for operation and inspection, financial plan for conducting O&M activities, consultation requirements for modifications to works of improvement, notification requirements for emergency situations, policy related to violations of the agreement, recurring review and update of the agreement, preparation and review requirements for an Emergency Action Plan, recordkeeping requirements, and other such requirements. Provisions will be made for free access of Sponsor, state, and federal representatives to inspect all structural measure and their appurtenances at any time.

The operation and maintenance costs for the Preferred Alternative are based on Table 7-2.

Table 7-2
Hamilton Dam Annual Operation and Maintenance Costs

Routine Annual O&M Engineering Costs Inspection ²	\$ 600
Emergency Action Plan ³	\$ 1,000
Routine Annual O&M Maintenance Costs ²	\$ 12,400
Total Annual Operation and Maintenance Cost	\$ 14,000

October 2018

¹ Price base 2019.

² Source data provided by Borough of Wellsboro.

³ Based on average annual EAP costs for Pennsylvania dams.

Table 1
Total Estimated Project Installation Cost

Preferred Alternative ¹	Source		Total Estimated Installation Costs ²
	Public Law 83-566 Funds	Other Funds	
Rehabilitation to Current High Hazard Potential Dam Standards	\$4,836,000	\$1,798,000	\$6,634,000

October 2018

¹ Price base 2019

² Estimated total Project installation costs include NRCS engineering and project administration costs.

Table 2
Estimated Cost Distribution

Works of Improvement	Installation Cost - Public Law 83-566 ¹			Public Law 83-566 Funds	Installation Cost - Other Funds ¹								Total Installation Costs
	Construction	Engineering	Project Administration ²		Construction	Engineering	Real Property	Natural Resource Rights	Relocation Payments	Permits ³	Administration ²	Total Other	
Rehabilitation to Current High Hazard Potential Dam Standards	\$3,336,000	\$1,250,000	\$250,000	\$4,836,000	\$1,780,000	\$0	\$12,000	\$0	\$0	\$1,000	\$5,000	\$1,798,000	\$6,634,000

October 2018

¹ Price base 2019.

² Contract administration will be by Federal Contract.

³ Includes fees, time and cost for obtaining required permits.

Table 3
Rehabilitated Structure Data

Item	Unit	Hamilton Dam (PA-602) ¹
NRCS Hazard Potential		High
Seismic zone		1
Uncontrolled drainage area	Square miles	8.45
Controlled drainage area	Square miles	0
Total drainage area	Square miles	8.45
Runoff curve number (1-day) (AMC II)		78.5
Time of concentration (Tc)	Hours	4.30
Elevation Top of Dam	Feet ²	1462.44
Elevation crest auxiliary spillway	Feet ²	1452.60
Elevation crest principal spillway	Feet ²	1441.10
Elevation crest low stage inlet	Feet ²	1429.50
Auxiliary spillway type	Type	Labyrinth Weir/RCC
Auxiliary spillway bottom width	Feet	175 (695 Weir Length)
Auxiliary spillway exit slope	Percent	14
Maximum height of dam	Feet	76
Storage capacity		
Total capacity	Acre feet	2874.09
Sediment submerged	Acre feet	78.15
Sediment aerated	Acre feet	6.0
Beneficial use (water supply)	Acre feet	536.65
Floodwater retarding	Acre feet	1358.32
Between auxiliary spillway crest and top of dam	Acre feet	894.97
Surface Area		
Sediment Pool ³	Acres	(12.54)
Water Supply Pool	Acres	41.80
Floodwater Retarding Pool	Acres	79.88
Principal spillway design		
Rainfall volume (1-day)	Inches	5.35
Rainfall volume (10-day)	Inches	8.01
Runoff volume (1-day)	Inches	2.96
Runoff volume (10-day)	Inches	7.41
Capacity of Principal Spillway	cfs	450.0
Dimensions of conduit	Inches	48
Type of conduit	Type	Reinforced Concrete Pipe
Auxiliary spillway hydrograph		
Percent Chance of Use	Percent	0.47%
Rainfall volume	Inches	9.29
Storm duration	Hours	6
Velocity of flow (Ve)	ft/s	23.11
Maximum reservoir water surface elevation	Feet ²	1455.00
Freeboard hydrograph		
Rainfall volume	Inches	25.51
Storm duration	Hours	6
Maximum reservoir water surface elevation	Feet ²	1461.93
Capacity equivalents		
Sediment volume	Inches	0.17
Floodwater retarding volume	Inches	3.03

¹ Information in this table is based on the results of the planning study and may vary from the General Work Plan and As-Built Drawings for structures.

² Elevations referenced in the Hamilton Dam 1967 as-built plans local vertical datum which was found to be different than the NGVD29 datum. The datum shift from the as-built plans local vertical datum to NAVD88 is -3.63 feet.

³ The sediment pool area is shown in parentheses since the reservoir contains beneficial water supply storage above the sediment storage.

Table 4
Estimated Average Annual NED Costs

Item	Rehabilitate to Current High Hazard Potential Dam ¹
Annual Costs²	
Amortized Installation Costs	\$ 209,000
O&M and Replacement Costs	\$ 14,000
Total Average Annual Costs	\$ 223,000

October 2018

¹ Price base 2019

² Amortized over 103 years (100 years – service life and 3 years – implementation) at 3.00% interest rate.

Table 5
Average Annual Flood Damage Reduction Benefits

Condition	Average Annual Ag-related Flood Damage ^{1, 2}		Damage Reduction
	Without Project	With Project	
Floodwater Damage			
Residential	\$ 40,000	\$ -	\$ 40,000
Commercial	\$ 279,000	\$ -	\$ 279,000
Industrial	\$ 138,000	\$ -	\$ 138,000
Bridge and Road	\$ 8,000	\$ -	\$ 8,000
Railroad	\$ 4,000	\$ -	\$ 4,000
Subtotal	\$ 469,000	\$ -	\$ 469,000
Sediment Damage	\$ 4,000	\$ 2,000	\$ 2,000
Indirect	\$ 55,000	\$ -	\$ 55,000
More Intensive Land Use			\$ 7,000
Total			\$ 533,000

October 2018

¹ Price base 2019

² Agriculture-related damage includes damage to rural communities. The Borough of Wellsboro is classified as a rural community by the USDA.

Table 5a
Estimated Average Annual Non-Flood Benefits

Condition	Average Annual Ag-related Non-Flood Benefits ^{1, 2}
Municipal Water Supply	\$ 75,000
Recreation – Trout Fishing	\$ 556,000
FWOP Costs Avoided	\$ 229,000
Total	\$ 860,000

¹ Price base 2019.

² Agriculture-related damage includes damage to rural communities. The Borough of Wellsboro is classified as a rural community by the USDA.

Table 6
Comparison of NED Benefits and Costs

Works of Improvement	Average Annual Benefits								Average Annual Cost ^{1,4}	Benefit Cost Ratio
	Damage Reduction			More Intensive Land Use ^{1,2}	Recreation ^{1,2}	Municipal Water Supply ^{1,2}	Other Benefits ^{1,3}	Total		
	Floodwater ^{1,2}	Sediment ^{1,2}	Indirect ^{1,2}							
Rehabilitate to Current High Hazard Potential Dam	\$ 469,000	\$ 2,000	\$ 55,000	\$ 7,000	\$ 556,000	\$ 75,000	\$ 229,000	\$ 1,393,000	\$ 223,000	6.25 to 1.0

¹ Price base 2019.

² From Tables 5 and 5A.

³ Per Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, 1.7.2 (b) (3) – the avoided cost of the most likely alternative to the planned action.

⁴ From Table 4.

8.0 REFERENCES

- Amec Foster Wheeler Environment & Infrastructure, Inc., Hamilton Dam (PA-602) Item 1.2.5.1 Sediment Survey and Storage Evaluation, November 17, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Hamilton Dam (PA-602) Item 1.2.5.2 Water Supply Reliable Yield, November 15, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Hamilton Dam (PA-602) Items 1.2.5.2.a, d & e Site Walk, September 30, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Hamilton Dam (PA-602) Item 1.2.6.1 Hydrology and Hydraulics (H&H) Data Gathering and Survey, August 31, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Hamilton Dam (PA-602) Item 1.2.7.1 H&H of Existing Structure and Future Without Project, August 9, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Hamilton Dam (PA-602) Item 1.2.8.2 Wetlands Delineation, October 24, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Phase IA/IB Archaeological Survey for the Proposed Hamilton Lake Dam (PA 602) Rehabilitation Project, December 7, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Report of Dam Embankment and Auxiliary Spillway Subsurface Exploration at Hamilton Dam (PA-602), October 25, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Report of Item 1.2.5.2.B: TV Inspection of Principal Spillway, Embankment Toe Drains, and Auxiliary Spillway Underdrain at Hamilton Dam (PA-602), November 16, 2016.
- Amec Foster Wheeler Environment & Infrastructure, Inc., Report of Seismic Hazard Assessment and Slope Stability Evaluation, Revision 1 at Hamilton Dam (PA-602), August 31, 2016.
- Geo-Slope International, Ltd. (2012). Geostudio 2012, SLOPE/W® and SEEP/W. Calgary, ALB, CA: Geo-Slope International, Ltd.
- KLA Environmental Services, Inc., Acquisition and Relocation Alternative Analysis for Marsh Creek Watershed Hamilton Dam (PA-602), March 2017.
- KLA Environmental Services, Inc., Federal Decommissioning Alternative Analysis for Marsh Creek Watershed Hamilton Dam (PA-602), March 2017.
- KLA Environmental Services, Inc., Floodproofing Alternative Analysis for Marsh Creek Watershed Hamilton Dam (PA-602), March 2017.
- KLA Environmental Services, Inc., Future Without Federal Project (FWOP) Alternative Analysis for Marsh Creek Watershed Hamilton Dam (PA-602), March 2017.
- KLA Environmental Services, Inc., Marsh Creek Watershed Hamilton Dam (PA-602), Supplemental Watershed Work Plan and Environmental Assessment “Statement on Sponsor Purpose, Need and Objectives,” February 25, 2016.
- KLA Environmental Services, Inc., Memorandum, Hamilton Dam (PA-602) – Marsh Creek Watershed Supplemental Watershed Plan/EA – 2.2.3.1 Conceptual/Preliminary Engineering Analysis of Dam Rehabilitation Alternatives, March 7, 2017.
- KLA Environmental Services, Inc., Memorandum, Hamilton Dam Watershed Plan/EA – Alternatives Considered but Eliminated from Detailed Study Work Item 2.2.3.2, June 7, 2017.

- KLA Environmental Services, Inc., Plan of Work, Marsh Creek Watershed Hamilton Dam (PA-602), February 17, 2016.
- KLA Environmental Services, Inc., Preferred Alternative Meeting Presentation, Marsh Creek Watershed Hamilton Dam (PA-602), April 11, 2017.
- KLA Environmental Services, Inc., Project Benefit Analysis for Supplement No. 7 to the Watershed Work Plan for Marsh Creek Watershed Hamilton Dam (PA-602), April 2017.
- KLA Environmental Services, Inc., Public Participation Plan, Marsh Creek Watershed Hamilton Dam (PA-602), February 25, 2016.
- KLA Environmental Services, Inc., Rehabilitation Planning Study Fact Sheet, Marsh Creek Watershed Hamilton Dam (PA-602), February 25, 2016.
- KLA Environmental Services, Inc., Rehabilitation Alternative Analysis for Marsh Creek Watershed Hamilton Dam (PA-602), March 2017.
- Landscape America. Pennsylvania, Threats and Issues. Invasive Species.
http://www.landscape.org/pennsylvania/Threats%20and%20Issues/pa_invasives/ Accessed March 25, 2016
- Pennsylvania Code 25 Chapter 93. Water Quality Standards.
- Pennsylvania Code. 25 - Chapter 105. Dam Safety and Waterway Management.
- Pennsylvania Department of Conservation and Natural Resources. Glaciated High Plateau Section Appalachian Plateaus Providence, <http://www.dcnr.state.pa.us/topogeo/field/map13/13ghps/index.htm> Accessed April 1, 2016
- Pennsylvania Department of Conservation and Natural Resources. Invasive Species Management Plan. 2011.
- Pennsylvania Department of Environmental Protection Emap. <http://www.depgis.state.pa.us/emappa/>. Accessed April 28, 2016.
- Pennsylvania Department of Environmental Protection, Office of Water Management - Bureau of Watershed Management, Storm Water Management Act. November 2008.
- Pennsylvania Natural Diversity Inventory, Hamilton Dam Project Environmental Review, May 5, 2016.
- Susquehanna River Basin Commission Marsh Creek Watershed – Watershed Profile.
http://mdw.srbcc.net/remotewaterquality/watershed_profiles/marshtioga.htm . July 2015
- Tioga County Chesapeake Bay Tributary Strategy. Tioga County Conservation District. March 16, 2005.
- Tioga County Comprehensive Plan. Cummings & Smith, Inc. April 2005.
- Tioga County Conservation District Strategic Plan. Tioga County Conservation District. June 15, 2006
- Tioga County Conservation District. Tioga County Chesapeake Bay Tributary Strategy. 2005.
- U.S. Environmental Protection Agency. Currently Designated Nonattainment Areas for All Criteria Pollutants. <http://www.epa.gov/oaqps001/greenbk/ancl.html> . April 22, 2016.
- United States Census Bureau, Census 2010.
- United States Census Bureau. Selected Housing Characteristics 2009-2013, American Community Survey 5-Year Estimates. Retrieved April 12, 2016, from American FactFinder:
<http://factfinder.census.gov/>
- United States Department of Agriculture, National Agricultural Statistic Service, Quick Stats Ad-hoc Query Tool.

- United States Department of Agriculture, Natural Resources Conservation Service, Environmental Evaluation Worksheet (Form NRCS-CPA-52), Marsh Creek Watershed Hamilton Dam (PA-602), Tioga County Pennsylvania, September 29, 2017.
- United States Department of Agriculture, Natural Resources Conservation Service, National Engineering Manual.
- United States Department of Agriculture, Natural Resources Conservation Service, National Operation and Maintenance Manual.
- United States Department of Agriculture, Natural Resources Conservation Service, National Planning Procedures Handbook.
- United States Department of Agriculture, Natural Resources Conservation Service, Technical Release – 60. Earth Dams and Reservoirs.
- United States Department of Agriculture, Natural Resources Conservation Service, National Watershed Program Manual, April 2014 4th edition, amended January 2015.
- United States Department of Agriculture, Natural Resources Conservation Service, National Watershed Program Handbook, April 2014 2nd edition.
- United States Department of Agriculture, Natural Resources Conservation Service, National Resource Economic Handbook, July 2012, 3rd amendment.
- United States Department of Agriculture, Natural Resources Conservation Service, Technical Release – 55. Urban Hydrology for Small Watersheds. Washington, DC: USDA, 1986.
- United States Department of Agriculture, Natural Resources Conservation Service, Water Resources Site Analysis Computer Program, SITES Integrated Development Environment.
- United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey. Retrieved from <http://websoilsurvey.sc.egov.usda.gov/>. 2016.
- United States Department of Agriculture, Natural Resources Conservation Service, Dam Rehabilitation Assessment Report, Marsh Creek Watershed, Site PA-602, May 19, 2010.
- United States Department of Agriculture, Natural Resources Conservation Service, NB-210-16-9 ENG – Review of Draft Technical Release 60, “Earth Dams and Reservoirs,” 2016.
- United States Department of Agriculture, Soil Conservation Service, As-Built Plans for “Marsh Creek Watershed Project Multiple Purpose Dam PA-602,” 1965.
- United States Department of Agriculture, Soil Conservation Service, Final Design Report for “Marsh Creek Watershed Project Multiple Purpose Dam PA-602,” 1964.
- United States Department of Agriculture. National Environmental Compliance Handbook. USDA and NRCS. All U.S. Government Documents (Utah Regional Depository). Paper 163. May 2016 3rd edition
- United States Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 2 Version 3.0. revised 2006.
- United States Department of Commerce, National Oceanic and Atmospheric Administration, Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 25 Hours and Return Periods from 1 to 100 Years, May 1961.
- United States Department of Homeland Security, Federal Emergency Management Agency. Flood Insurance Rate Map, Tioga County, Pennsylvania, Panel 482 of 730, Map Number 42117C0482D. July 16, 2015.

United States Department of the Army, Corps of Engineers, "Engineering Manual (EM) 1110-2-1902, Slope Stability," DEPARTMENT OF THE ARMY, U.S. Army Corps of Engineers, CECW-EW, Washington, D.C. 31 Oct 2003.

United States Department of the Army, Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center, Hydrology Modeling System (HEC-HMS), Version 4.0, December 2013.

United States Department of the Army, Corps of Engineers, Institute for Water Resources. National Economic Development Manual – Flood Risk Management. IWR Report 2013-R-05. June 2013.

United States Department of the Army, Corps of Engineers. Seepage Analysis and Control for Dams. Engineering Manual (EM) 1110-2-1901. Washington, DC: U. S. Army Corps of Engineers. 1993.

United States Environmental Protection Agency. Currently Designated Nonattainment Areas for All Criteria Pollutants. <http://www.epa.gov/oaqps001/greenbk/ancl.html>.

United States Fish and Wildlife Service. National Wetlands Inventory. Wetlands Mapper Tool. www.FWS.gov/wetlands/Data/Mapper.html. Accessed November 12, 2015

United States Water Resources Council, Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983.

University of Georgia – Center for Invasive Species and Ecosystem Health, Early Detection and Distribution Mapping System. Status of Invasive Plants in Pennsylvania. [www.eddmaps.org/tools/statereport.cfm?id=us pa](http://www.eddmaps.org/tools/statereport.cfm?id=us%20pa). Accessed May 3, 2016.

Wellsboro Municipal Authority PWSID 2590042, Source Water Assessment Public Summary. February 2003.

9.0 LIST OF PREPARERS

Table 9-1 List of Preparers

Name	Present Title	Education	Years Experience
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Donald Murray	Agricultural Engineer	BS Agricultural Engineering Pennsylvania State University	37
Tim Ridley, PE, PS	Dam Safety Engineer	BS Civil Engineering West Virginia University	37
Jeff McClure, PG	Geologist	BA Biology, BA Geology, BS Geology West Virginia University	33
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Amec Foster Wheeler (cont.)			
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Todd Hunter, LIT	Surveyor	Associate of Applied Science, Architecture and Civil Engineering Technology Central Maine Technical College	24
Steven Mazza	Engineering Technician	BA History Franciscan University of Steubenville	14
Sarah Dickert	Engineering Technician / GIS Analyst	BS Civil Engineering, Bucknell University	1
Ashley Husted	Environmental Scientist	BS Environmental Studies, Minor in Biology Ursinus College	7
Ghazoll Motlagh, EIT, CFM	Engineering Technician	BS Civil Engineering –Water Resources Pennsylvania State University	8
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Nathan Walker, AICP	Senior Water Resources Planner	BS-BS Earth and Environmental Sciences MS Community and Regional Planning - Temple University	18
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10.0 DISTRIBUTION LIST

10.1 DISTRIBUTION LIST

The following agencies will receive a copy of the final copy of the Supplemental Watershed Plan No. 7 and Environmental Assessment for Marsh Creek Watershed, Hamilton Dam (PA-602):

- Appalachian Regional Commission
- Borough of Wellsboro
- Pennsylvania Department of Environmental Protection – Bureau of Waterways Engineering and Wetlands
- Pennsylvania Fish and Boat Commission
- Tioga County Conservation District
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service

11.0

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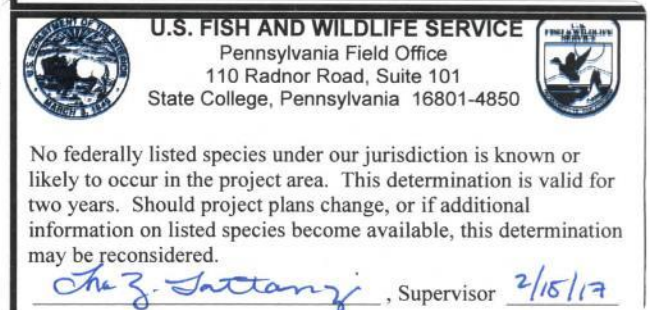
Appendix A

COMMENTS AND RESPONSES



United States Department of Agriculture

Lora Zimmerman, Project Leader/Supervisor
U.S. Fish & Wildlife Service
Pennsylvania Field Office
110 Radnor Rd, Suite 101
State College, PA 16801



RE: Supplemental Watershed Project Plan Environmental Assessment
Rehabilitation of Marsh Creek Watershed, Hamilton Dam, PA-602
Tioga County, Pennsylvania

Dear Ms. Zimmerman:

The Wellsboro Municipal Authority and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) are currently preparing a Supplemental Watershed Project Plan Environmental Assessment (Plan-EA) for **Hamilton Dam, PA-602**, in the Marsh Creek Watershed. This existing dam is embankment is located at 41.7396 N, -77.2643 E to the west of Round Top Hill Road, in Tioga County, Pennsylvania.

The Marsh Creek Watershed Work Plan was originally prepared in May 1963 by the Tioga County Soil Conservation District, the Tioga County Commissioners, the Wellsboro Council, and the Pennsylvania Fish Commission, with assistance from the USDA Soil Conservation Service and the USDA Forest Service. The Commissioners, Tioga County Conservation District, Wellboro Borough Council, and Wellsboro Municipal Authority were original sponsors of the dam. The main objective of the project was to reduce floodwater damages to the floodplain. Secondary objectives included water supply for the Borough of Wellsboro.

Hamilton Dam, PA-602, constructed in 1967, is maintained by the Wellsboro Municipal Authority. Hamilton Dam does not meet Federal safety standards for a High Hazard dam. Therefore, the Wellsboro Municipal Authority and NRCS are preparing this Plan-EA to evaluate alternatives to meet the current needs with respect to floodwater protection.

Specifically, the purpose of the project includes the following:

- Meet or exceed state and federal dam safety criteria.
- Maintain or enhance the current level of flood protection provided by Hamilton Dam.
- Enhance the current level of backup source water for public water supply for the Borough of Wellsboro, Pennsylvania.
- Maintain the current recreational values, and aquatic and terrestrial wildlife habitat values provided by Hamilton Lake and its adjoining riparian lands.

The Plan-EA will consider alternatives for Hamilton Dam and may include: 1) No Action (future without Federal project), 2) Structural Rehabilitation (with and without non-structural measures), 3) Decommissioning (with and without non-structural measures), and 4) National Economic Development (NED) Alternative (generally rehabilitation). Specific alternatives are currently being developed.

Natural Resources Conservation Service
359 East Park Drive, Suite 2
Harrisburg, Pa 17111
Voice: (717) 237-2214 Fax: (855) 813-2861

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United States Department of Agriculture

October 7, 2016

Wade B. Chandler, Chief, PA Section
U.S. Army Corps of Engineers
1631 South Atherton Street
State College, PA 16801

RE: Formal Request to be a Cooperating Agency on the Supplemental Watershed Plan -
Environmental Assessment (Plan-EA), Marsh Creek Watershed, Hamilton Dam (PA-602), Tioga
County, Pennsylvania

Dear Mr. Chandler:

In accordance with the Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) at 40 CFR Section 1501.6, the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) is formally requesting that your agency become a cooperating agency in the planning and development of the Hamilton Dam (PA-602) Environmental Assessment (EA). This request is being made because your agency has been identified as having special expertise or jurisdiction by law related to this project.

The EA is being prepared to fulfill NRCS's NEPA compliance responsibilities pertaining to our potential federal financial assistance through the Watershed Protection and Flood Prevention Program (Public Law 83-566) for this project. As your agency may also have NEPA compliance responsibilities concerning this project or other future projects that may be evaluated in this EA, preparation of this EA should also assist in fulfilling environmental review requirements for your agency or other Federal agencies and meet NEPA's intent of reducing duplication and delay between agencies.

The included enclosures, a project description, site map, and wetlands delineation, will give a better description of the planned project.

If your agency is unable to participate as a cooperating agency, then please return a written explanation why your agency cannot participate. Please note that a response declining to be a cooperating agency is required to be submitted to the Council on Environmental Quality per 40 CFR Section 1501.6(c). Upon acceptance of this invitation, our agencies can work together to define each's role throughout this process.

Thank you for your timely response and cooperation with this project. If you have any questions or comments, please contact Hosea Latshaw, PE, State Conservation Engineer at hosea.latshaw@pa.usda.gov or by phone at (717) 237-2212 or Heather Smeltz at heather.smeltz@pa.usda.gov or by phone at (717) 237-2214..

Sincerely,

A handwritten signature in dark ink, appearing to read "Denise Coleman", written over a light blue horizontal line.

Denise Coleman
State Conservationist

Cc: W. Hosea Latshaw, PE, State Conservation Engineer, NRCS

Natural Resources Conservation Service
359 East Park Drive, Suite 2
Harrisburg, Pa 17111
Voice: (717) 237-2210| Fax: (855) 813-2861

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Heather Gonia
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
STATE COLLEGE FIELD OFFICE
1631 SOUTH ATHERTON STREET, SUITE 101
STATE COLLEGE, PA 16801-6260

December 21, 2016

Ms. Denise Coleman, State Conservationist
Natural Resources Conservation Service
359 East Park Drive, Suite 2
Harrisburg, Pennsylvania 17111

Dear Ms. Coleman:

This is in response to the Natural Resources Conservation Service's (NRCS) October 7, 2016 request for cooperating agency participation in the preparation of an Environmental Assessment (EA) under the National Environmental Policy Act (NEPA) for the proposed rehabilitation of Hamilton Dam project (PA-602). The U.S. Army Corps of Engineers, Baltimore District (Corps) is accepting NRCS's request for the Corps to be a formal cooperating agency in the preparation of the EA for the project. We appreciate the opportunity to provide scoping comments. This office has established the following project identification for the project: CENAB-OPR-P-2016-01627.

In general, the EA should thoroughly evaluate the permanent and temporary impacts to waters of the U.S., including jurisdictional wetlands, resulting from the total project. This includes all project elements such as: grading, access roads, construction pads, storm water management structures, dewatering, all construction impacts, stream diversions, etc.

We understand that the project will result in impacts to waters of the U.S. Therefore, Corps authorization under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act is required. In this regard, to ensure that the information presented in the EA is adequate to fulfill the requirements of the Corps regulations, the Clean Water Act Section 404(b)(1) Guidelines, and the Corps public interest review process, the Corps requests that the following topics be scoped and evaluated in the EA:

1. Purpose and need for the project. The EA should clearly describe the purpose and need for the project.
2. Avoidance and minimization. A fundamental precept of the Clean Water Act Section 404 Department of the Army (DA) Regulatory Program is that impacts to wetlands and other waters of the United States will be avoided and minimized, where it is practicable to do so. Under Section 404, only the least damaging practicable alternative can receive DA authorization. Note that an alternative is practicable if it is available and capable of being done after taking into consideration cost, logistics,

-2-

and existing technology in light of overall project purposes. At a minimum, the NEPA document must evaluate the practicability of the following avoidance and minimization methods:

- a. Designs to improve the stability of the dam and the capacity of the reservoir and auxiliary spillway that do not involve a discharge of dredged and/or fill material into waters of the U.S., i.e., fill placement on the downstream side of the dam rather than on the upstream side; avoiding wetlands northeast of the dam;
 - b. Use of access routes that are not located in wetlands, or use of timber mats in wetland areas where unavoidable; and
 - c. Construction material/equipment staging locations outside of wetland boundaries.
3. Corps public interest review factors. The decision to issue a permit or permit verification will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity and its intended use on the public interest. Among the factors that must be evaluated as part of the Corps public interest review include: conservation, economics, aesthetics, general environmental concerns, wetlands and streams, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, energy needs, safety, food and fiber production, mineral needs, water quality, considerations of property ownership, air and noise impacts, and, in general, the needs and welfare of the people.
 4. Delineation of all waters of the United States, including jurisdictional wetlands, in the project area. The data sheets for the sample plot located on the spillway indicate presence of a wetland but the investigators did not flag the area as wetlands because they felt the area was only wet due to seasonal runoff from the northeast. If this area meets the Corps definition of wetlands then it needs to be flagged in the field and shown on the plans.
 5. Aquatic Impacts. Quantify impacts to waters of the United States (both temporary and permanent) to all waters of the United States (e.g., perennial, intermittent, ephemeral streams; rivers, lakes, ponds), including jurisdictional wetlands. For streams and rivers, include both the linear feet of the stream/river impacts (measure along the centerline of the stream/river channel, and measure from top of the stream bank to top of stream bank—the linear footage of stream impact, for categorical determination, is the greater of these two measurements) and square feet of impact. For jurisdictional wetlands impacts (both temporary and permanent), identify the wetland classification (e.g., palustrine or lacustrine system; forested, scrub-shrub, or emergent wetlands) to be impacted, quantify each classification of wetlands to be impacted in square feet, differentiate between temporary or permanent impacts, and

-3-

quantify any change in wetland classification in square feet (e.g., palustrine forested to palustrine emergent, etc.).

6. Cumulative, direct and indirect impacts. Define the direct and indirect effects resulting from the project, which resources, ecosystems and human communities are affected, and which effects on these resources are important from a cumulative effects perspective.
7. Describe any dewatering/diversion plans and show locations of any proposed dewatering/diversion systems on the plans.
8. Wetlands and stream mitigation plans for unavoidable permanent impacts to wetlands and streams.
9. Analysis of the project's compliance with Section 7 of the Endangered Species Act, Section 106 of the National Historic Preservation Act, Section 401 of the Clean Water Act, and the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 04-267) [essential fish habitat].
10. Project review schedule, and NEPA document preparation schedule. Other important milestones (e.g., public hearings, etc.) should also be listed in the NEPA document.
11. Air quality impacts (i.e., Section 176(c) of the Clean Air Act General Conformity Rule Review).
12. Compliance with Executive Order 11988 - Floodplain Management.
13. Compliance with Executive Order 12898 – Environmental Justice

Again, thank you for allowing the Corps to provide comments on the project. Should you have any questions concerning this letter or work within Pennsylvania, please contact Ms. Terry Eucker at (570) 835-4262 or email at Terry.P.Eucker@usace.army.mil.

Sincerely,


Wade B. Chandler
Chief, Pennsylvania Section
Regulatory Branch



SUSQUEHANNA RIVER
BASIN COMMISSION

4423 N. Front Street | Harrisburg, PA 17110-1788 | 717.238.0423 | srbc.net

NY ■ PA ■ MD ■ USA

March 29, 2017

Ms. Heather L. Smeltz, P.E.
Civil Engineer
United States Department of Agriculture
Natural Resources Conservation Service
359 East Park Drive, Suite 2
Harrisburg, PA 17111

Re: Proposed Rehabilitation Projects – Hamilton and Beechwood Dams

Dear Ms. Smeltz:

The Susquehanna River Basin Commission (Commission) appreciates the interagency coordination by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) regarding the proposed rehabilitation projects at Hamilton and Beechwood Dams, Tioga County, Pennsylvania. Per the Commission's *Comprehensive Plan for the Water Resources of the Susquehanna River Basin* (Comprehensive Plan), water supply, flooding, and ecosystems are identified as priority management areas. Related goals and actions identified in the Comprehensive Plan provide the framework for the following comments concerning the proposed evaluations.

It is noted that Hamilton Dam currently provides backup source water for public water supply for the Borough of Wellsboro. The Commission's Comprehensive Plan contains project guidance that outlines a sound basis for rational, well-considered decisions among alternatives or competing uses of basin water resources, and forms major considerations upon which the Commission evaluates project proposals of federal, state, local and private sectors. This guidance contains an item specifying that conjunctive use of multiple water sources to meet water supply needs should be encouraged to optimize water availability and minimize adverse impacts. Alternatives tailored to maintaining or enhancing the current level of backup source water supply at Hamilton Dam should be considered.

The Commission adopted consumptive water use regulations to minimize impacts to streamflows for public water supplies, industries, agriculture and recreation, and to protect aquatic life, habitat and water quality during times of critical low flows. All project sponsors whose consumptive use of water is subject to review and approval are required to mitigate such use. Mitigation may be provided by various methods including use of water storage to satisfy consumptive use, release of stored water to offset consumptive use, and discontinuance of consumptive use during low flow periods. Where physical mitigation is not feasible, monetary payment for consumptive use may be accepted. Consumptive use mitigation fee payments enable the Commission to build a source of funding to support large-scale mitigation projects. Many of these projects involve evaluating reservoir operations for opportunities to provide low flow augmentation during infrequent, critical low flow or drought events. While engineering attributes of Hamilton and Beechwood Dams may preclude this opportunity, the Commission is very much interested in exploring prospects for low flow augmentation at NRCS-sponsored water storage projects and has resources available to commit to such projects.



Ms. Heather L. Smeltz

- 2 -

March 29, 2017

The desired result for the flooding priority management area identified in the Commission's Comprehensive Plan is to prevent loss of life and significantly reduce future damages from floods within the basin through an integrated system of structural and nonstructural flood damage reduction measures. As both Hamilton and Beechwood Dams have project purposes that include meeting or exceeding dam safety criteria and maintaining or enhancing current levels of flood protection, they are directly aligned with this objective. Beyond structural features, the Commission encourages consideration of nonstructural flood hazard mitigation measures in the Marsh and Mill Creek watersheds to provide citizens and communities with information and other tools to assist them in flood preparedness, response, and recovery, including public education and outreach, flood forecasting and warning, the National Flood Insurance Program, and local floodplain regulations.

The Commission's Low Flow Protection Policy contains specifications for determining passby flow and conservation release requirements associated with approved water withdrawal projects to avoid significant adverse impacts to the water resources of the basin. A conservation release is defined as a prescribed quantity of flow from an impoundment structure that must be continuously maintained downstream of the impoundment for low flow protection. Reservoirs and other large impoundments can capture low, seasonal, and high flows and completely alter the natural flow regime of a receiving stream. Conservation releases are intended to prevent water quality degradation and adverse lowering of streamflow levels downstream of the impoundment, thereby protecting aquatic resources and other water uses. As part of the Plan Environmental Evaluation for both Hamilton and Beechwood Dams, conservation releases should be assessed in order to avoid downstream impacts.

An extensive effort to reintroduce the American eel into the Susquehanna River Basin has been ongoing by the United States Fish and Wildlife Service (USFWS) since 2008. The Commission and its partner agencies are continuing to reintroduce eels and monitor the ecological response of receiving streams through time. Since 2010, a significant number of eels have been stocked in Pine and Marsh Creeks, both directly downstream of Hamilton Dam. A Commission fish survey completed in 2013 showed high densities of eels located immediately downstream of Hamilton Dam, which serves as a barrier to dispersal as eels distribute themselves throughout the watershed. Any rehabilitation actions considered should: (1) allow provisions for the Commission, the Pennsylvania Fish and Boat Commission (PFBC), and/or the Pennsylvania Department of Environmental Protection (PADEP) to conduct ecological and water quality monitoring on Wellsboro Municipal Authority property to facilitate reintroduction of the American eel in the basin; and (2) include protective measures to prevent instream sedimentation and preserve water quality if land/instream disturbance occurs on Charleston Creek or Hamilton Dam.

If you have any questions regarding the above information, please feel free to contact me at (717) 238-0423, extension 1217.

Sincerely,



John W. Balay
Manager, Planning & Operations

363594.1

Jarred Green

From: Smeltz, Heather - NRCS, Harrisburg, PA <Heather.Smeltz@pa.usda.gov>
Sent: Thursday, April 13, 2017 10:24 AM
To: Borzok
Cc: Dan Strausser; Scot Boyce; Renner, Ben - NRCS, Wellsboro, PA; Jarred Green
Subject: RE: Hamilton Lake

Hi Bob,

Thanks so much for your participation this week as well as your thoughtful comments and questions, below. I am cc'ing the local folks, both Borough and NRCS, as some of your suggestions would best be implemented by them.

Dredging around the boat launch area will be extensive. The true extents will be determined by testing of the material to determine if there's anything risky in it. Providing it's all clean, it is currently slated to find a home at the quarry where some of the dam material originally came from. If clean, I would think that the Borough might be able to coordinate with locals for access to the material. If there's heavy metals or something else, it actually may be cost prohibitive to remove. Since it technically isn't a dam safety issue, there's a chance it would end up staying and being a nuisance. Raising the water 2 will help.

You correctly identified the overarching issue though; keeping the sediment from coming in. NRCS is not a regulatory agency, but works with landowners on a voluntary basis and can often provide financial incentive for applying conservation practices on the landscape. Your best bet would be to talk with Ben Renner, the District Conservationist, at our Wellsboro Field Office about any ideas you may have as to accomplish this within the Marsh Creek watershed.

Thanks again, Bob, for being an active participant within the planning process for Hamilton Lake Dam.

~ Heather

~~~~~  
Heather L. Smeltz, PE  
Civil Engineer  
Cultural Resources Coordinator  
Natural Resources Conservation Service  
359 East Park Drive, Suite 2, Harrisburg, PA 17111  
(717) 237-2214

-----Original Message-----

**From:** Borzok [mailto:Borzok@ptd.net]  
**Sent:** Wednesday, April 12, 2017 8:46 PM  
**To:** Smeltz, Heather - NRCS, Harrisburg, PA <Heather.Smeltz@pa.usda.gov>; jgreen@klaenviro.com  
**Subject:** Hamilton Lake

Dear Heather and Jarred,

Thank you for your informative presentation in Wellsboro this week. I had to leave when the comment period started but wanted to offer just a couple of suggestions since I live near the Lake and fish there regularly.

For a dam that seems to be in excellent condition and has never had to use its overflow spillway, it is unfortunate that it will need to be drawn down completely; however, I can see the rationale for doing it.

Of course, an option might be to let the other 50 years go by since the regulations will probably change again during that time anyway.

Regarding the boat launch area. If I am reading the map correctly, the dredging will be extensive and this is a good thing. As you know, the silt extends not only in front of the boat launch, but quite a bit further down the lake. In dry summers, even if a boat was able to be launched, it would not be able to get out into the lake proper.

That said, even with the two foot proposed rise in water level, during dry summers there may still be ten feet or so between the concrete at the end of the ramp and the water. I say this to suggest that an extension of the ramp might be prudent while doing all of this work anyway.

A couple of years ago, a number of us upstream of the lake were involved with a study and some stream bank stabilization. I urge you to continue addressing the causes of erosion upstream by educating farmers and landowners about riparian buffers, etc. and encouraging them to enroll in the many conservation programs available.

Speaking of silt (topsoil), wouldn't it be a nice gesture for the Borough to offer this stuff to anyone who would like some? This would go a long way to establishing good public relations with residents that have already been inconvenienced with Nessmuck Lake for the last couple of years, and now Hamilton. Now is the time to put it in the plan because, as we know, a disposal sight will need to be identified anyway and to modify it later will be impossible.

Sincerely,

Bob Borzok, Wellsboro

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<https://www.avast.com/antivirus>

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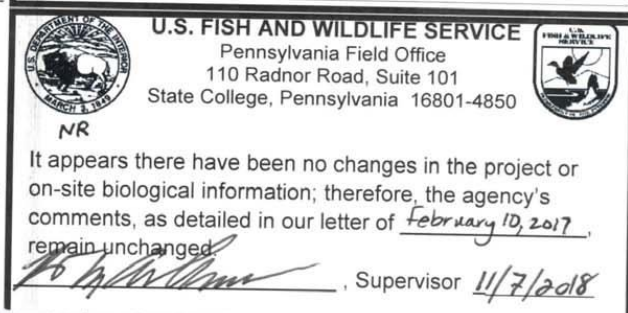


2017-0408



United States Department of Agriculture

Sonja Jahrsdoerfer  
Project Leader/Supervisor  
U.S. FISH & WILDLIFE SERVICE, Pennsylvania  
110 Radnor Rd, Suite 101  
State College, PA 16801



The USDA Natural Resources Conservation Service (NRCS), with assistance from local watershed sponsors, has completed a draft watershed plan supplement and environmental assessment (Plan-EA) for the proposed rehabilitation of PA-602 Hamilton Lake Dam of the Marsh Creek Watershed, Tioga County, Pennsylvania. Marsh Creek is located within the Susquehanna River Basin. The lead sponsoring local organization for the project is the Wellsboro Borough Municipal Authority. Other sponsoring local organizations of the original work plan include:

Wellsboro Borough Council  
Tioga County Commissioners  
Tioga County Soil and Water Conservation District  
Pennsylvania Fish and Boat Commission

The project is a federally assisted action authorized by section 14 of the Watershed Protection and Flood Prevention Act, 16 U.S.C. Section 1012, as amended by section 313 of Public Law 106-472. This section authorizes NRCS to provide technical and financial assistance to local sponsors for rehabilitation of aging dams constructed under the Watershed Protection and Flood Prevention Act (Public Law 83-566), the Flood Control Act of 1944 (Public Law 78-534), the Pilot Watershed Program, and the Resource Conservation and Development (RC&D) Program.

The draft plan supplement and environmental assessment is available for your review and comment and can be accessed on the internet by clicking on the appropriate link at on the PA NRCS Public Notices webpage by going to [www.pa.nrcs.usda.gov](http://www.pa.nrcs.usda.gov) and hovering on the Newsroom tab, then selecting Public Notices. It may also be accessed directly from <https://www.nrcs.usda.gov/wps/portal/nrcs/main/pa/newsroom/pnotice/>. As a courtesy, the Abstract and Summary is enclosed.

The purpose of this project is to maintain the present level of flood control benefits and comply with current performance and safety standards. There is a need to protect downstream properties and infrastructures as well as reduce the risk of potential loss of life.

We are requesting that you review this project in accordance with section 102(2)(C) of the National Environmental Protection Policy Act of 1969 (Public Law 91-190). We request that comments be received in writing by this office on or before November 26, 2018. If your comments are not received by the due date, we will assume you do not wish to comment. Written comments may be directed to Heather Smeltz, Civil Engineer, USDA-NRCS, 359 East Park Drive, Harrisburg, PA 17111.

Natural Resources Conservation Service  
359 East Park Drive, Suite 2  
Harrisburg, Pa 17111  
Voice: (717) 237-2100| Fax: (855) 813-2861

*Helping People Help the Land*

*USDA is an equal opportunity provider, employer, and lender.*



Pennsylvania State Historic Preservation Office  
PENNSYLVANIA HISTORICAL AND MUSEUM COMMISSION

November 20, 2018

Denise Coleman  
USDA Natural Resources Conservation Service  
359 East Park Drive, Suite 2  
Harrisburg, PA 17111

Re: File No. ER 2016-1524-117-D  
USDA Draft Watershed Plan Supplement & Environmental Assessment: Proposed  
Rehabilitation of PA-602 Hamilton Lake Dam of the Marsh Creek Watershed, Wellsboro  
Borough, Tioga County

Dear Ms. Coleman:

Thank you for submitting information concerning the above referenced project. The Pennsylvania State Historic Preservation Office (PA SHPO) reviews projects in accordance with state and federal laws. Section 106 of the National Historic Preservation Act of 1966, and the implementing regulations (36 CFR Part 800) of the Advisory Council on Historic Preservation, is the primary federal legislation. The Environmental Rights amendment, Article 1, Section 27 of the Pennsylvania Constitution and the Pennsylvania History Code, 37 Pa. Cons. Stat. Section 500 et seq. (1988) is the primary state legislation. These laws include consideration of the project's potential effects on both historic and archaeological resources.

**Archaeological Resources**

There is a high probability that archaeological resources are located in this project area. In our opinion, the activity described in your proposal should have no effect on such resources. Should the scope of the project be amended to include additional ground disturbing activity this office should be contacted immediately and a Phase I Archaeological Survey may be necessary to locate all potentially significant archaeological resources.

**Above Ground Resources**

Based on our files and the information provided, it is our opinion that there are no above ground historic properties present. Should new information be brought to your attention regarding historic properties located within the project area of potential effect, please notify the PA SHPO at (717) 783-8947 for reconsideration of the project.

Sincerely,

Douglas C. McLearen, Chief  
Division of Environmental Review

DCM/tmw

Commonwealth Keystone Building | 400 North Street | 2nd Floor | Harrisburg, PA 17120 | 717.783.8947



## Pennsylvania Fish & Boat Commission

**Bureau of Fisheries**  
**Division of Environmental Services**  
595 East Rolling Ridge Drive  
Bellefonte, PA 16823  
Phone: 814-359-5228

November 20, 2018

Heather Smeltz  
USDA Natural Resources Conservation Service  
359 East Park Drive, Suite 2  
Harrisburg, PA 17111

Dear Ms. Smeltz,

In response to the draft watershed plan supplement and environmental assessment for the proposed rehabilitation of PA-602 Hamilton Lake Dam in the Marsh Creek Watershed in Tioga County Pennsylvania, the Pennsylvania Fish and Boat Commission (PFBC) Division of Environmental Services (DES) would like to offer the following comments.

Hamilton Dam is managed as a naturally reproducing warmwater fishery and as a stocked trout fishery. It is a very popular four season recreational angling destination in Tioga County. The primary purpose of the rehabilitation activities is to improve flood water capacity, flood damage reduction, secondary water supply storage and incidental recreational and habitat values. Within the list of rehabilitation plans, the Natural Resources Conservation Service (NRCS) is proposing to modify the principal spillway riser to raise the permanent pool two feet for additional water supply.

With consideration of the proposed activities, DES suggests that:

- NRCS conduct and submit a Pennsylvania Natural Diversity Inventory (PNDI) search. The PA Natural Heritage website is located at <http://naturalheritage.state.pa.us>.
- NRCS conduct a functional wetland assessment of the current riparian habitat along the perimeter of Hamilton Lake for that area proposed for inundation. A mitigation plan should be developed to address wetland habitat impacted by the proposed inundation and coordinated with the resource and regulatory agencies if necessary.
- NRCS work with the PFBC Division of Habitat Management (DHM) to develop a plan to install fish habitat into the lake to further enhance the recreational value of the aquatic resources of Hamilton Dam.

### Our Mission:

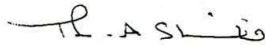
[www.fish.state.pa.us](http://www.fish.state.pa.us)

*To protect, conserve and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities.*

Ms. Heather Smeltz  
November 20, 2018  
Page 2

The PFBC understands and concurs with the proposed performance and safety criteria outlined in the Environmental Assessment for this High Hazard Class dam. We appreciate the opportunity to comment on this proposed project.

Sincerely,



Tom Shervinskie, Chief  
Watershed Analysis Section

c: PFBC - Shiels, Smiles, Whitaker



**From:** [Kimberlie Gridley](#)  
**To:** [Smeltz, Heather - NRCS, Harrisburg, PA](#)  
**Cc:** [Kerry Nelson](#); [Mark Hamilton](#); [Erica Tomlinson](#)  
**Subject:** Plan-EA comments: PA -602 Hamilton Lake Dam, Marsh Creek Watershed  
**Date:** Monday, November 26, 2018 8:58:02 AM

---

Hi Heather,

Thank you for your availability this morning and for bringing me up to speed on the rehabilitation of the Hamilton Lake Dam.

My sole comment is: during drawdown, when the fallen trees are being collected and removed from the basin, that the Conservation District is made aware and offered any logs able to be utilized for in-stream projects. The Marsh Creek Watershed is one of our priority watersheds in the county for protection and restoration. It is likely that a project within the watershed will be in need of large woody debris (LWD) concurrent with the Hamilton Lake Dam Rehabilitation Project.

Thank you and please keep me apprised of developments related to this and other Tioga County dam projects. I am happy to assist as the project progresses.

Best,

Kim

*Kimberlie Gridley, Planning Specialist*

**Tioga County Planning Commission**

118 Main Street

Wellsboro, PA 16901

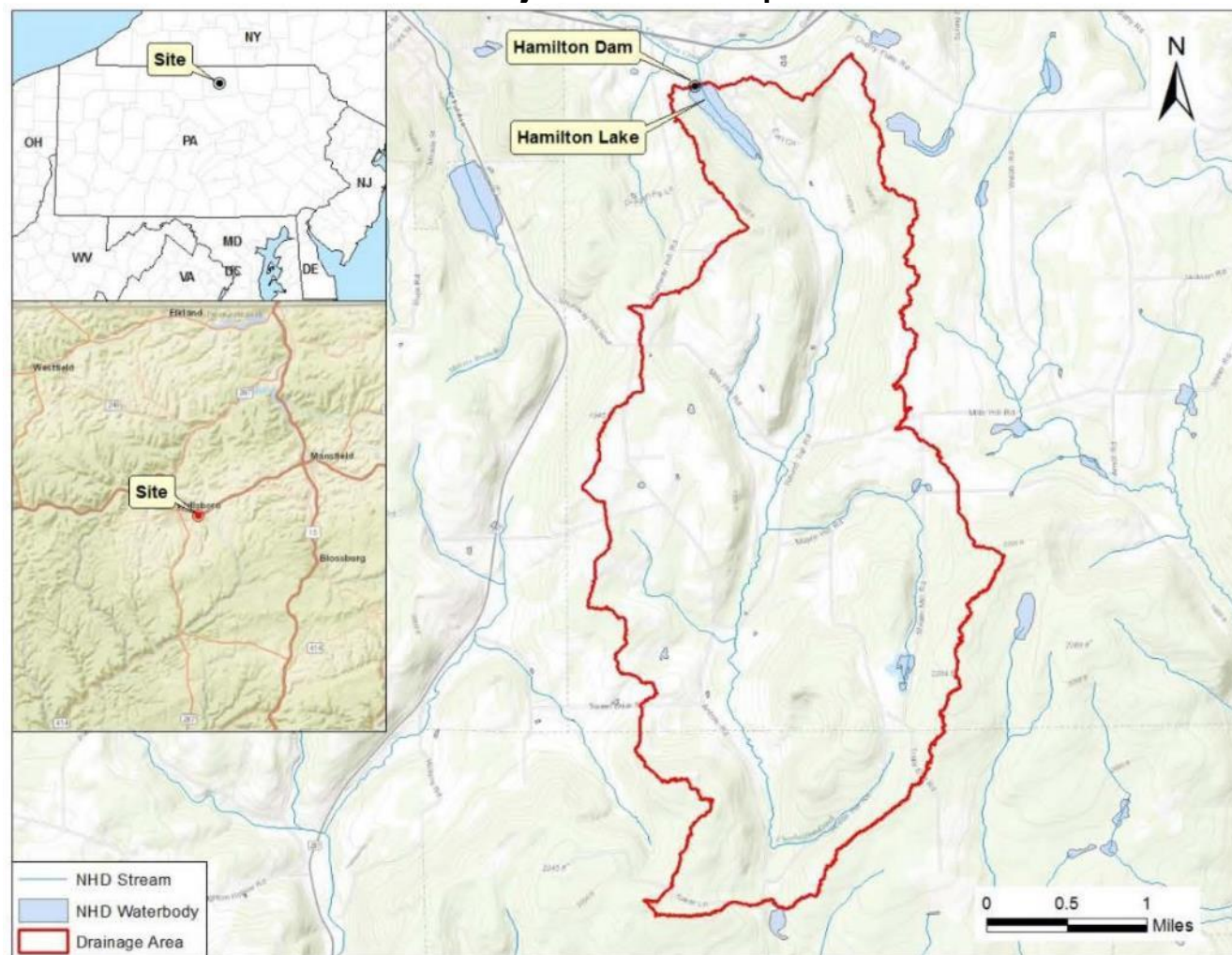
570-723-8251

[kgridley@tiogacountypa.us](mailto:kgridley@tiogacountypa.us)

## **Appendix B**

### **PROJECT MAPS**

**Figure B-1**  
**Project Location Map**





**Figure B-2**  
**Project Watershed Map**

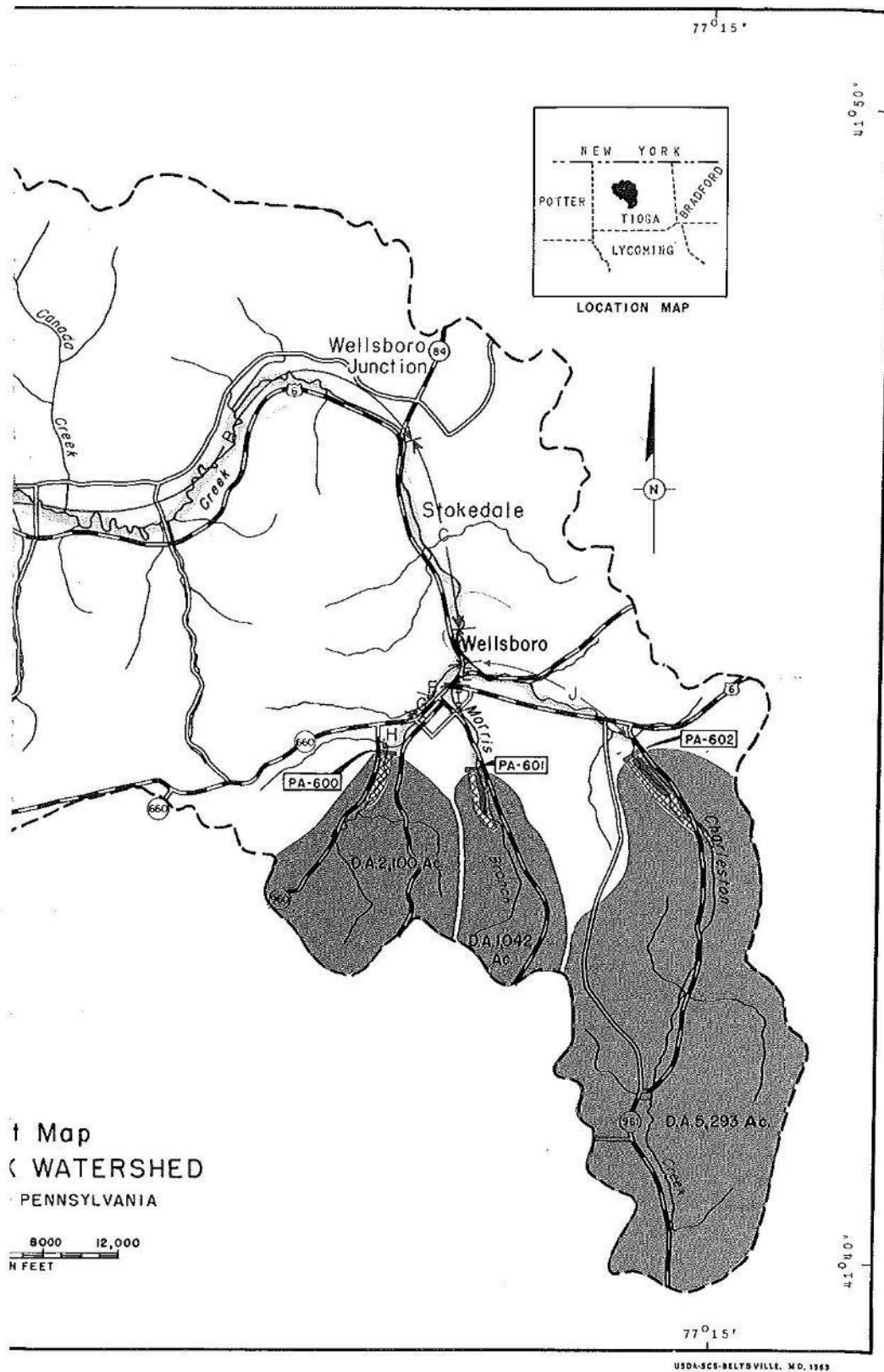
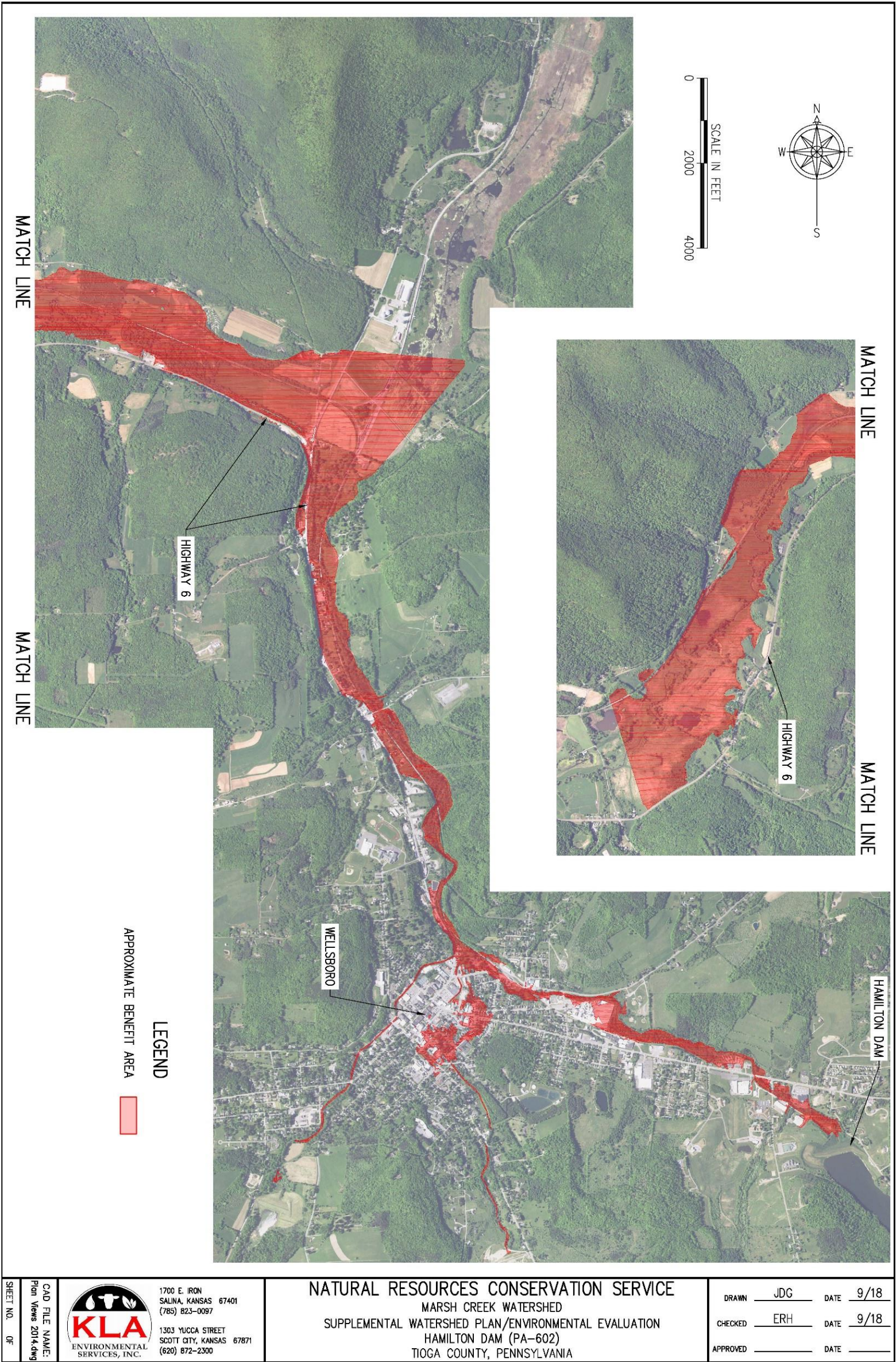




Figure B-3  
Project Benefit Area Map





## **Appendix C**

### **SUPPORT MAPS**

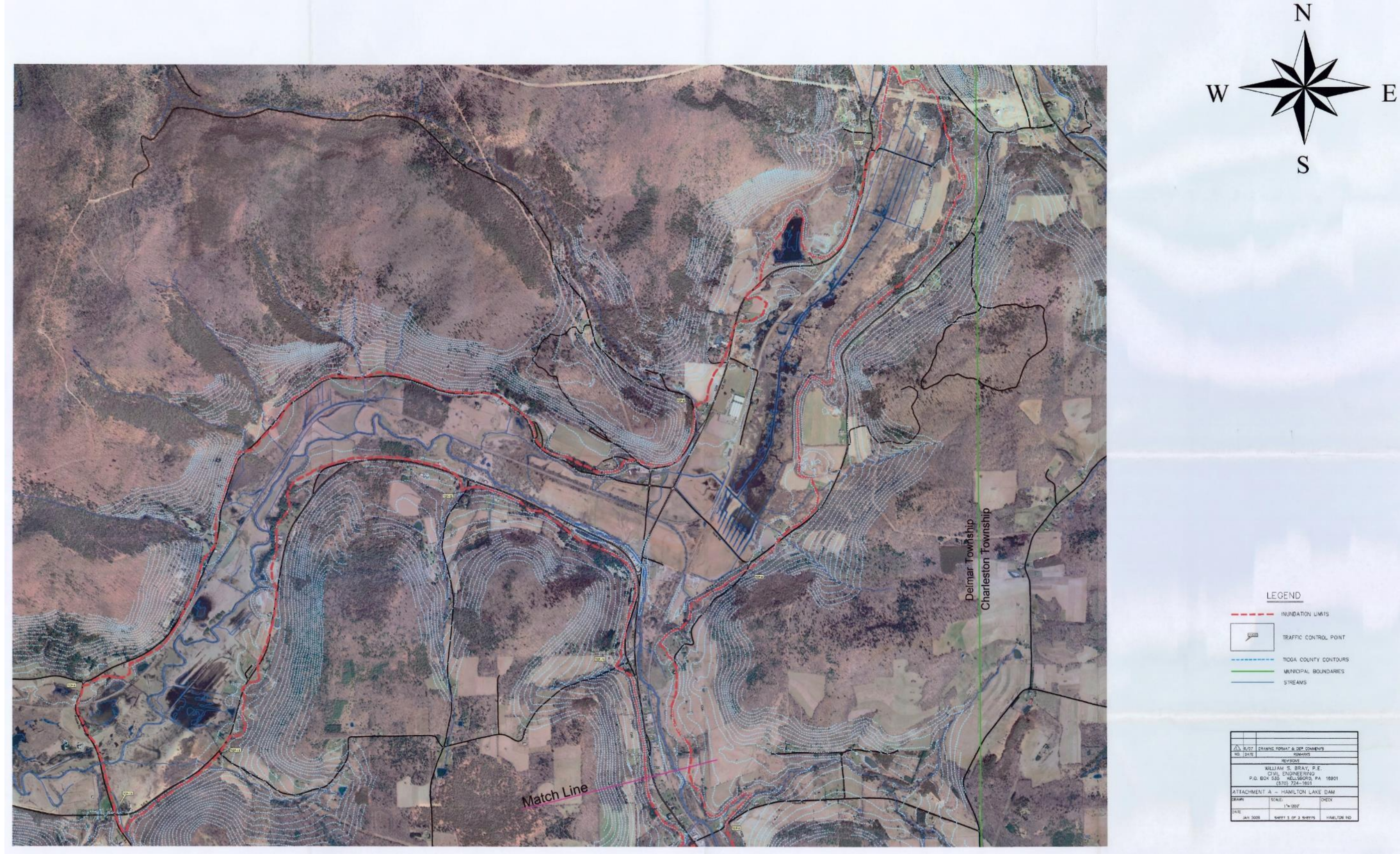


Figure C-1  
Approximate Breach Inundation Map



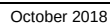


Figure C-2  
Approximate Breach Inundation Map



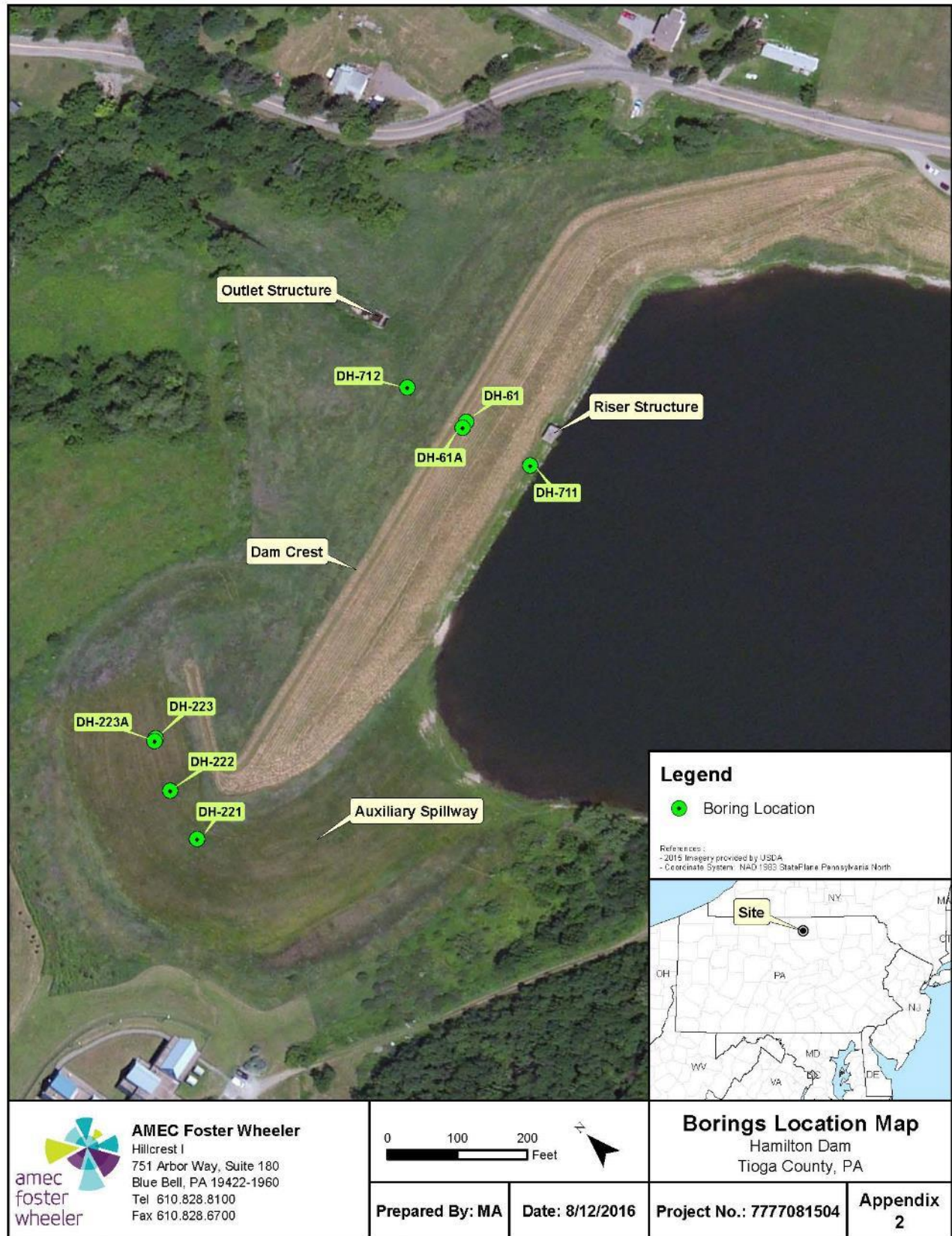


C-4



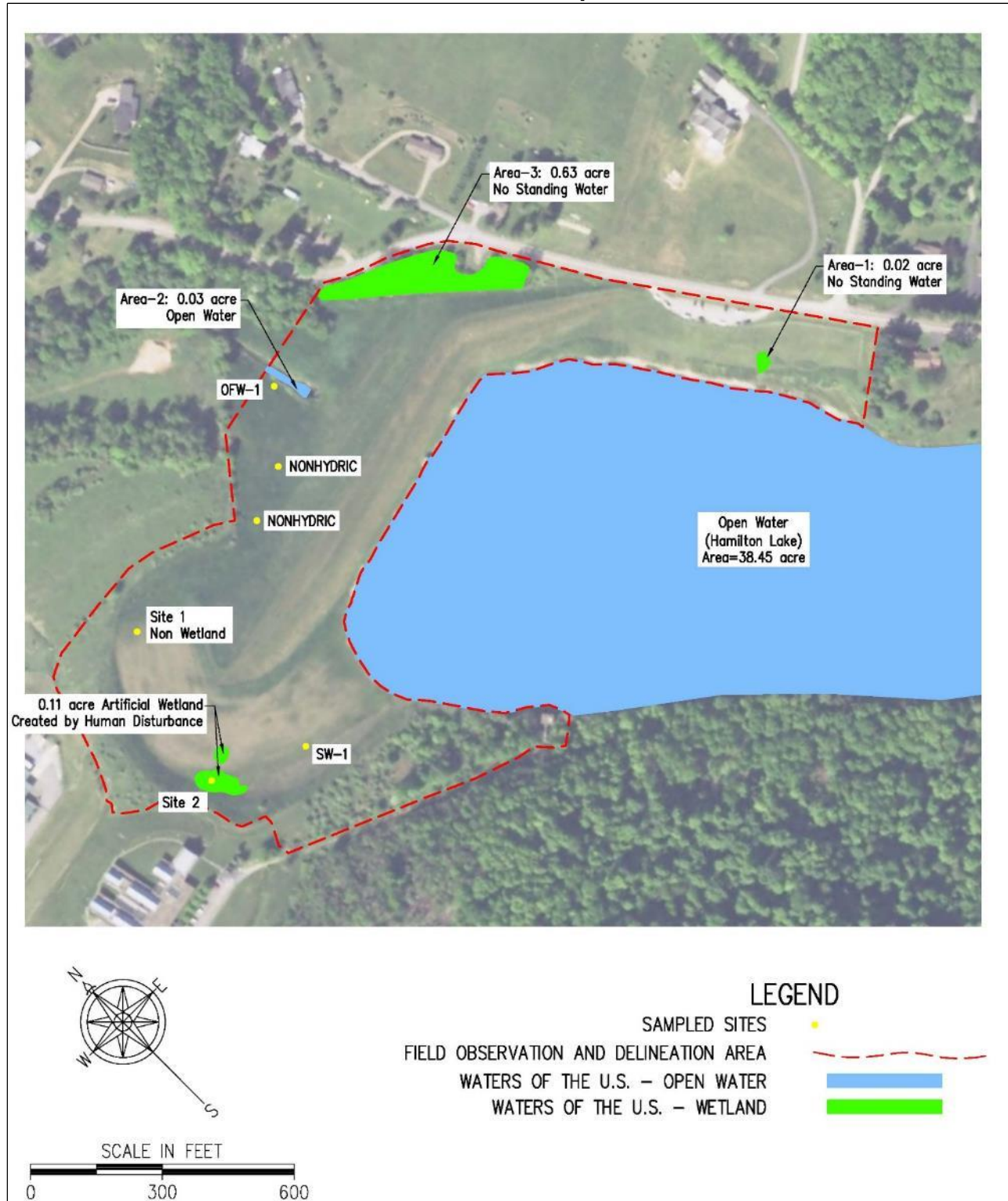


# Figure C-4 Geotechnical Investigation Borings





**Figure C-5  
Wetlands Map**



## Figure C-6 Wetlands Map

Hamilton Dam Project  
Tioga County, PA



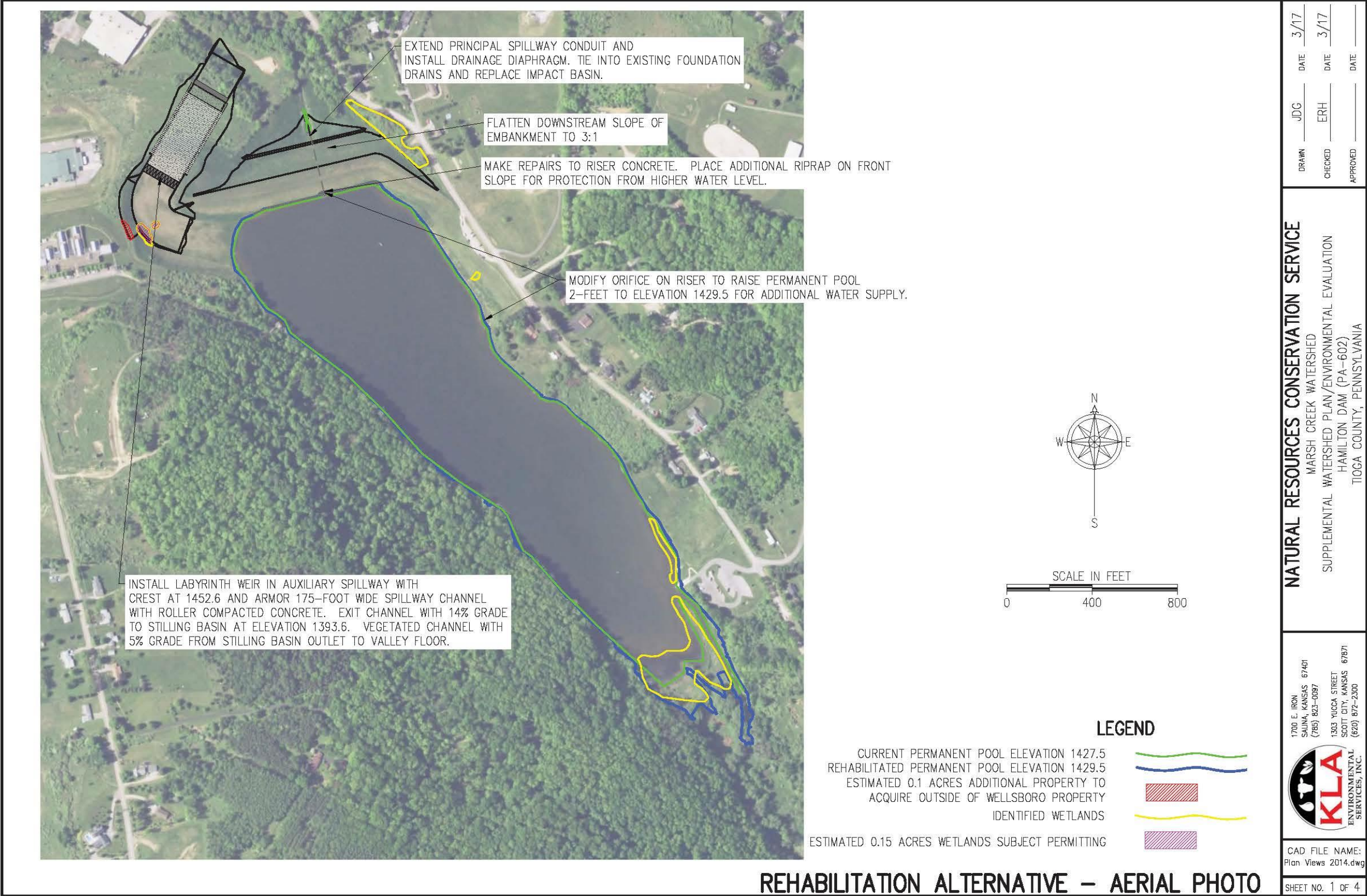
### Legend

- obs\_sites
- wetlands\_NE\_PA\_a
- Estimated water level
- W** - Wetland
- NW** - Non Wetland

Onsite Determination made by Yuri Plowden  
Ecological Site Index Specialist  
Natural Resources Conservation Service  
216 Spring Run Rd. Room 102  
Mill Hall, PA 17751  
570-726-3196 x 122  
Basemap created 09/22/2016



Figure C-7  
Rehabilitation Alternative Plan View



REHABILITATION ALTERNATIVE – AERIAL PHOTO



Figure C-8  
Rehabilitation Alternative Plan View

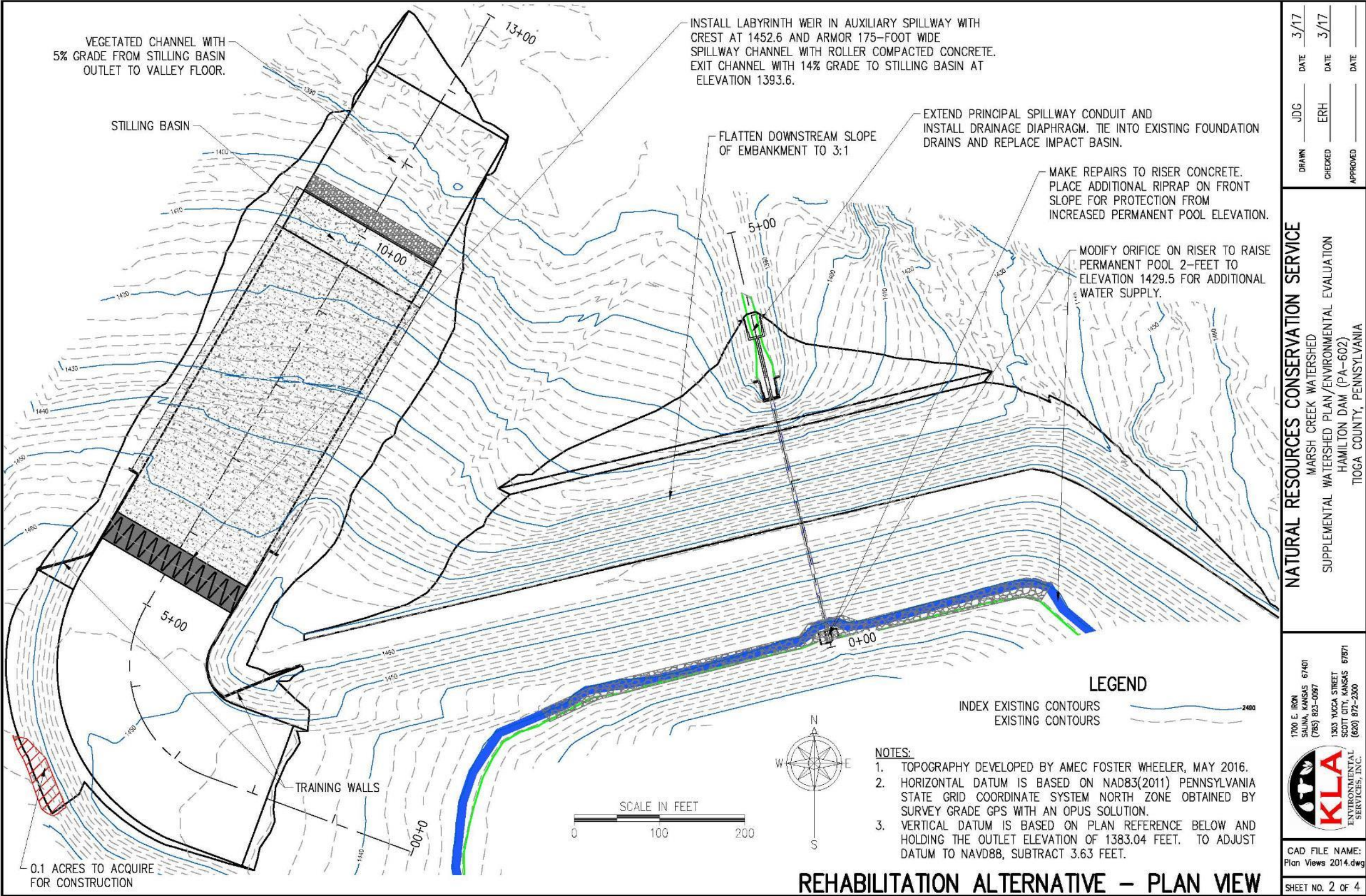




Figure C-9  
Rehabilitation Alternative Principal Spillway Profile

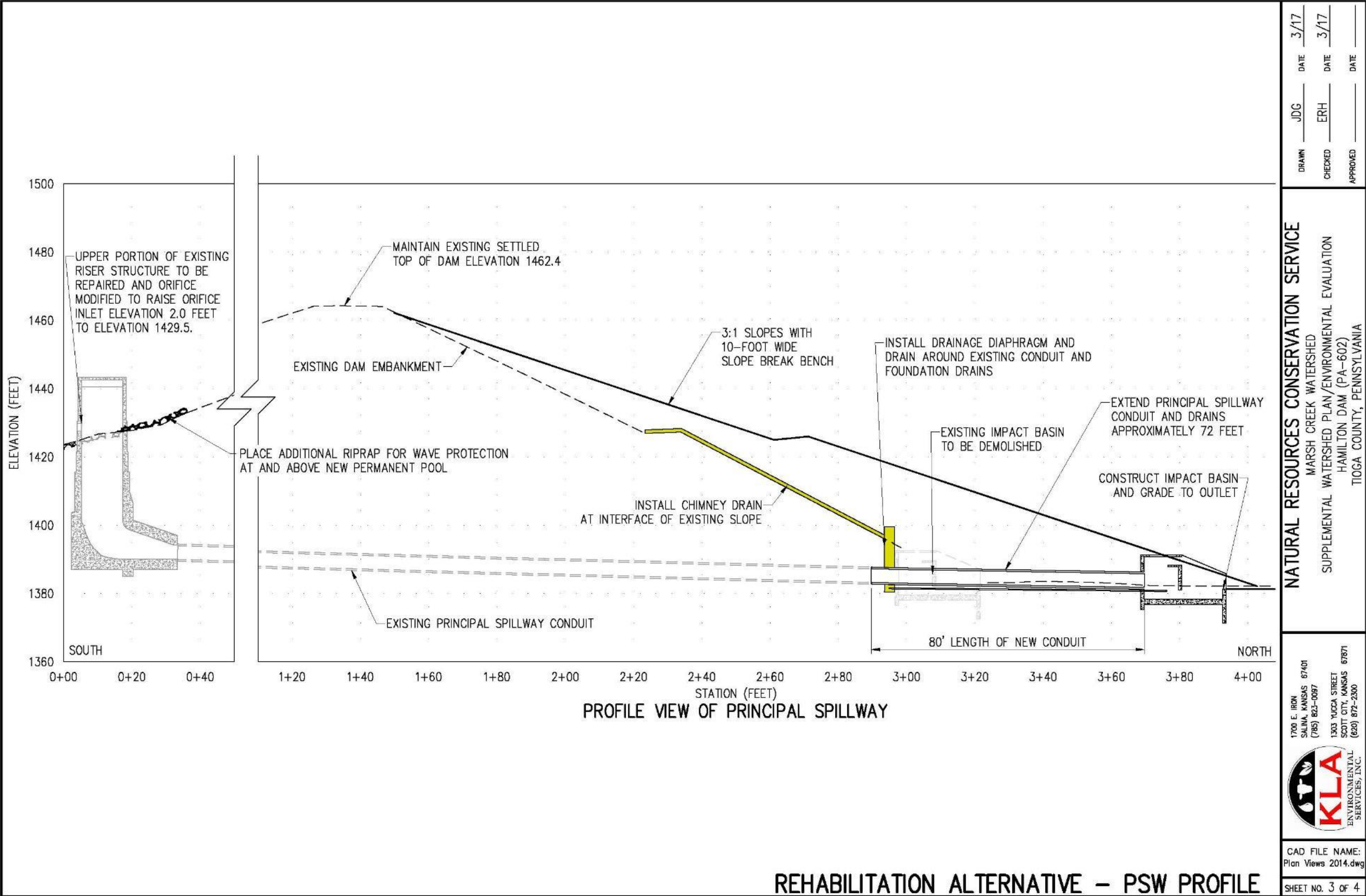
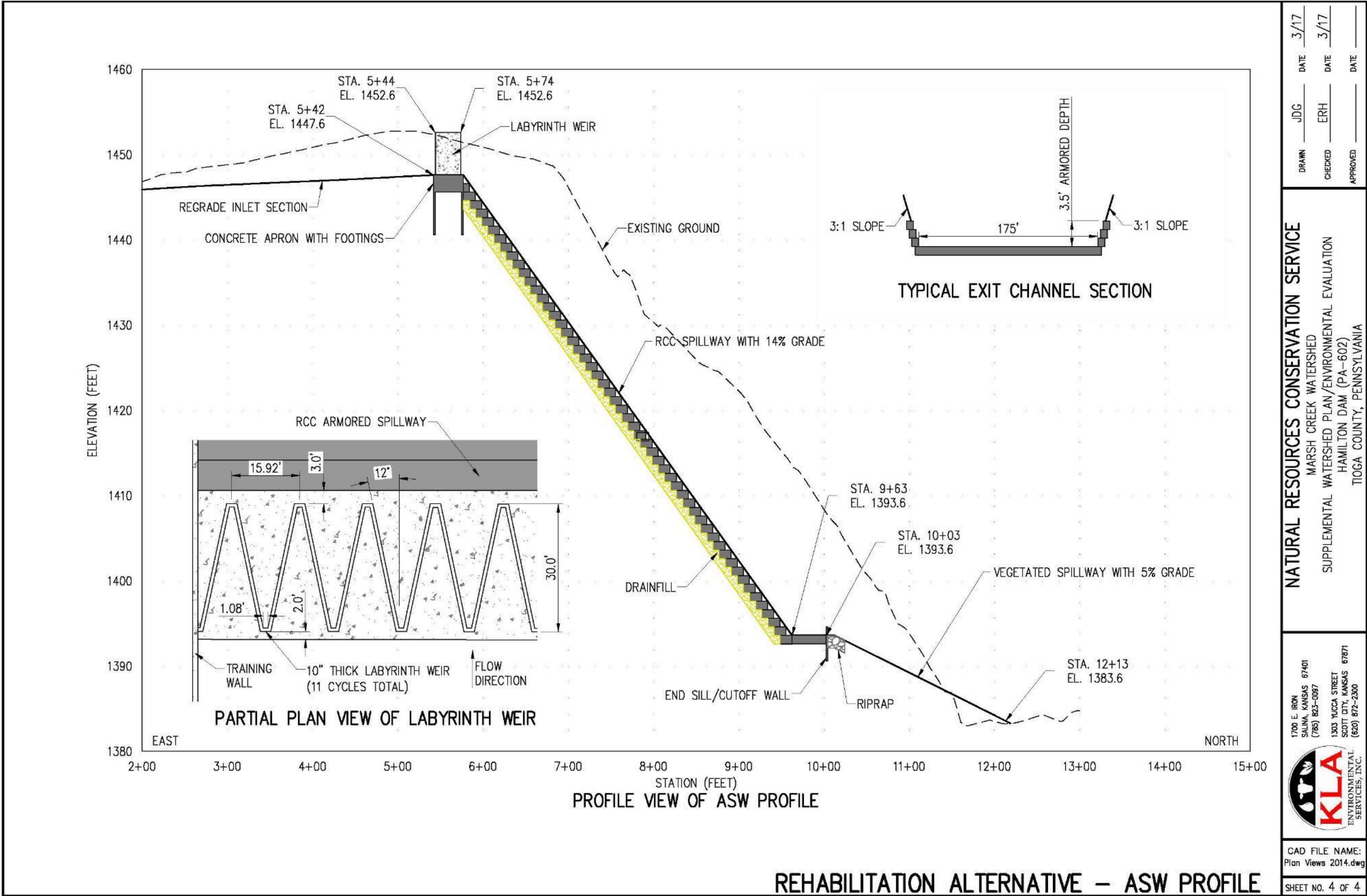




Figure C-10  
Rehabilitation Alternative Auxiliary Spillway Profile



|          |     |      |      |
|----------|-----|------|------|
| DRAWN    | JDG | DATE | 3/17 |
| CHECKED  | ERH | DATE | 3/17 |
| APPROVED |     | DATE |      |

NATURAL RESOURCES CONSERVATION SERVICE  
MARSH CREEK WATERSHED  
SUPPLEMENTAL WATERSHED PLAN/ENVIRONMENTAL EVALUATION  
HAMILTON DAM (PA-602)  
TIOGA COUNTY, PENNSYLVANIA

1700 E. IRON  
SALINA, KANSAS 67401  
(785) 823-0087  
1303 YUCCA STREET  
SCOTT CITY, KANSAS 67871  
(620) 872-2300

**KLA**  
ENVIRONMENTAL  
SERVICES, INC.

CAD FILE NAME:  
Plan Views 2014.dwg

SHEET NO. 4 OF 4



Figure C-11  
Future Without Federal Project Alternative Plan View

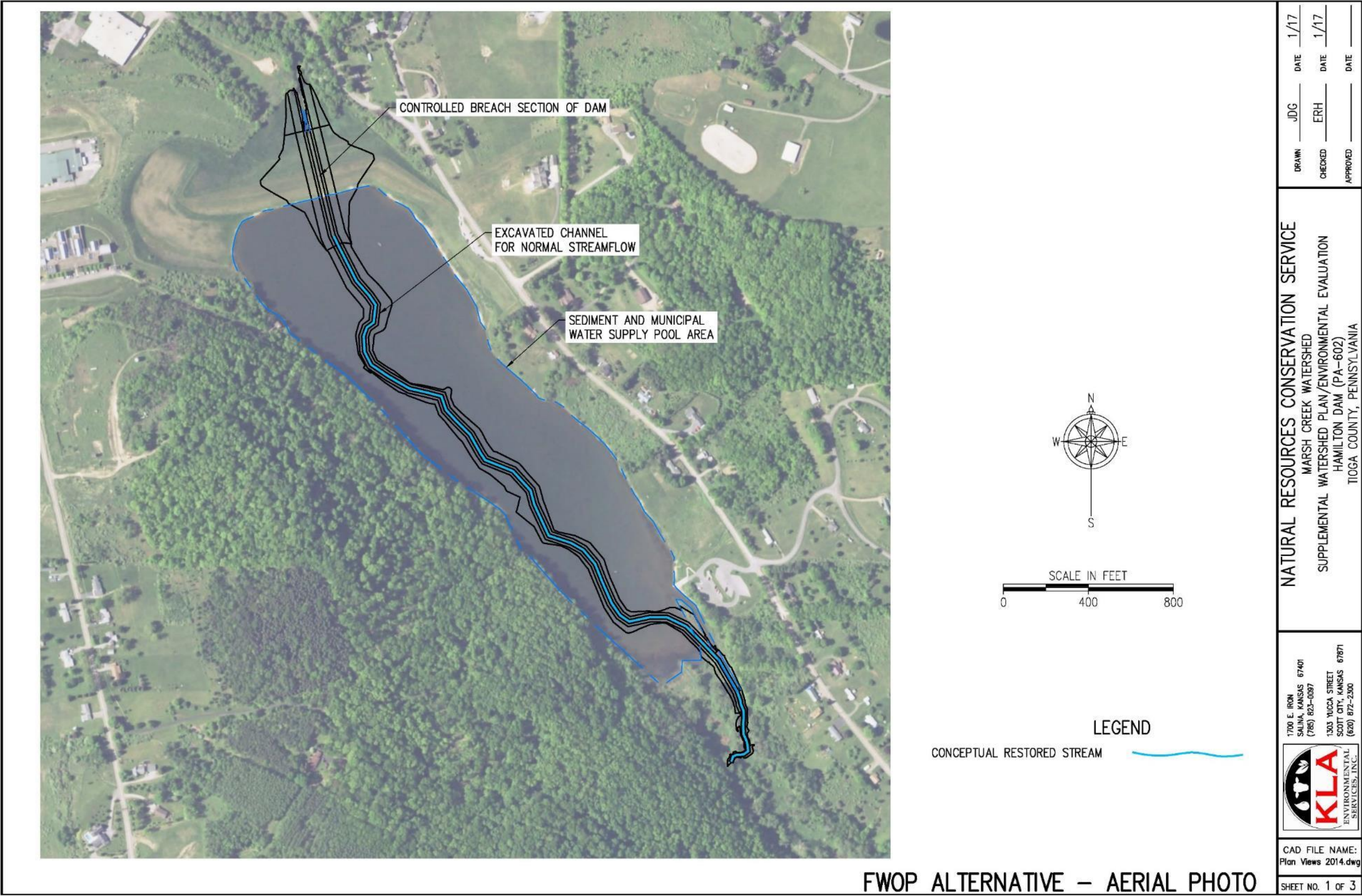




Figure C-12  
Future Without Federal Project Alternative Plan View

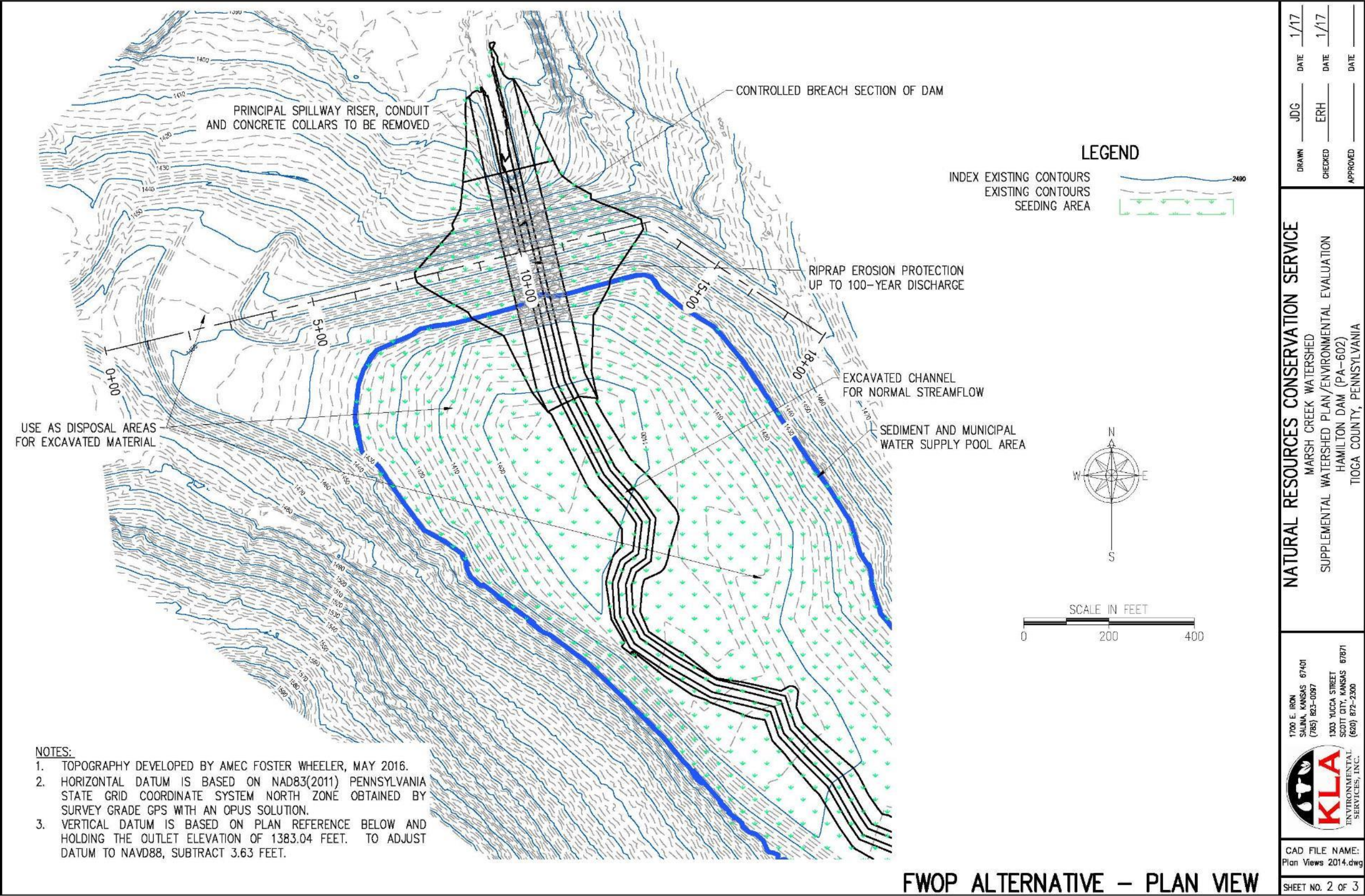








Figure C-14  
FEMA Approximate Floodplain

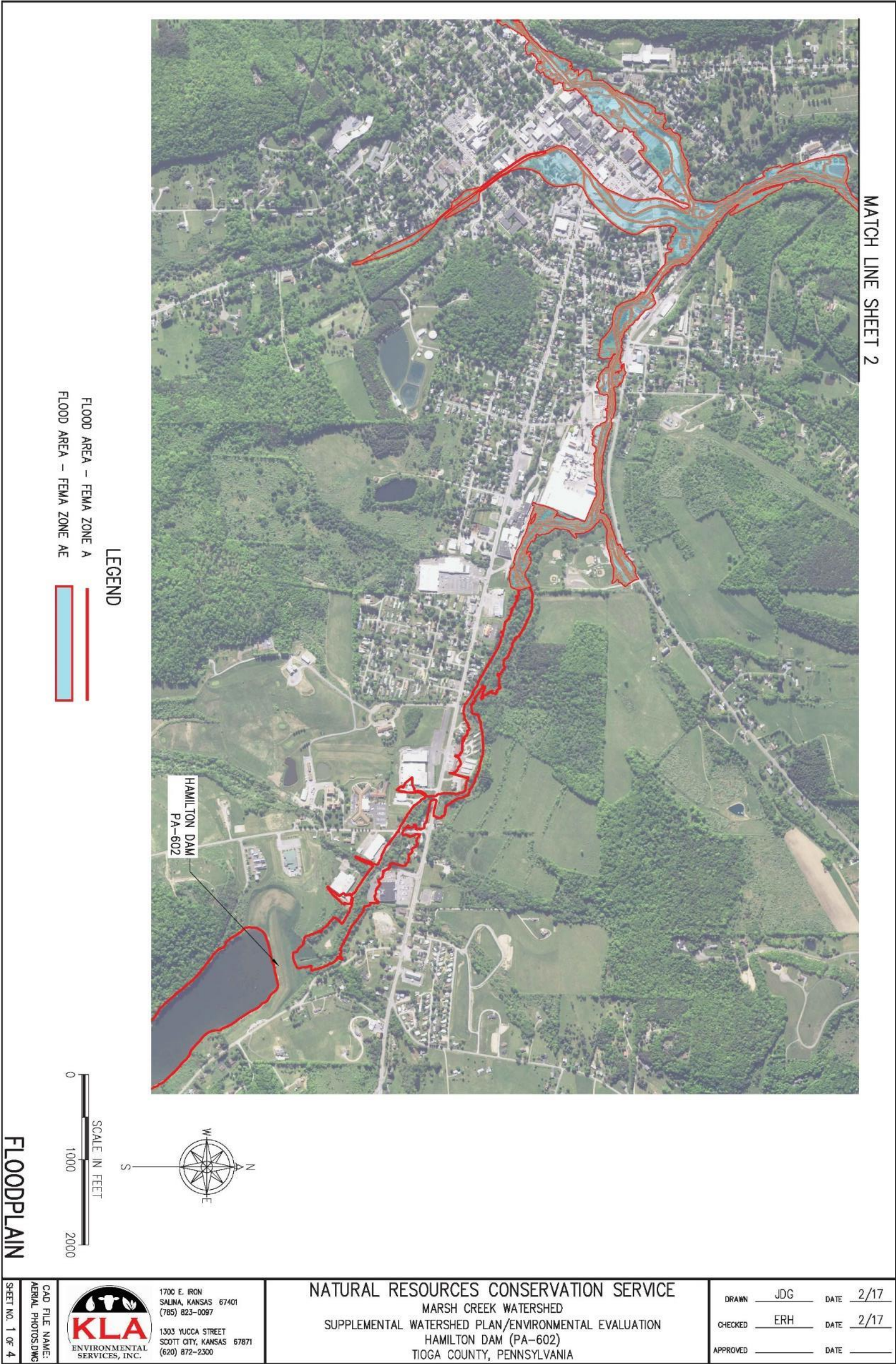




Figure C-15  
FEMA Approximate Floodplain

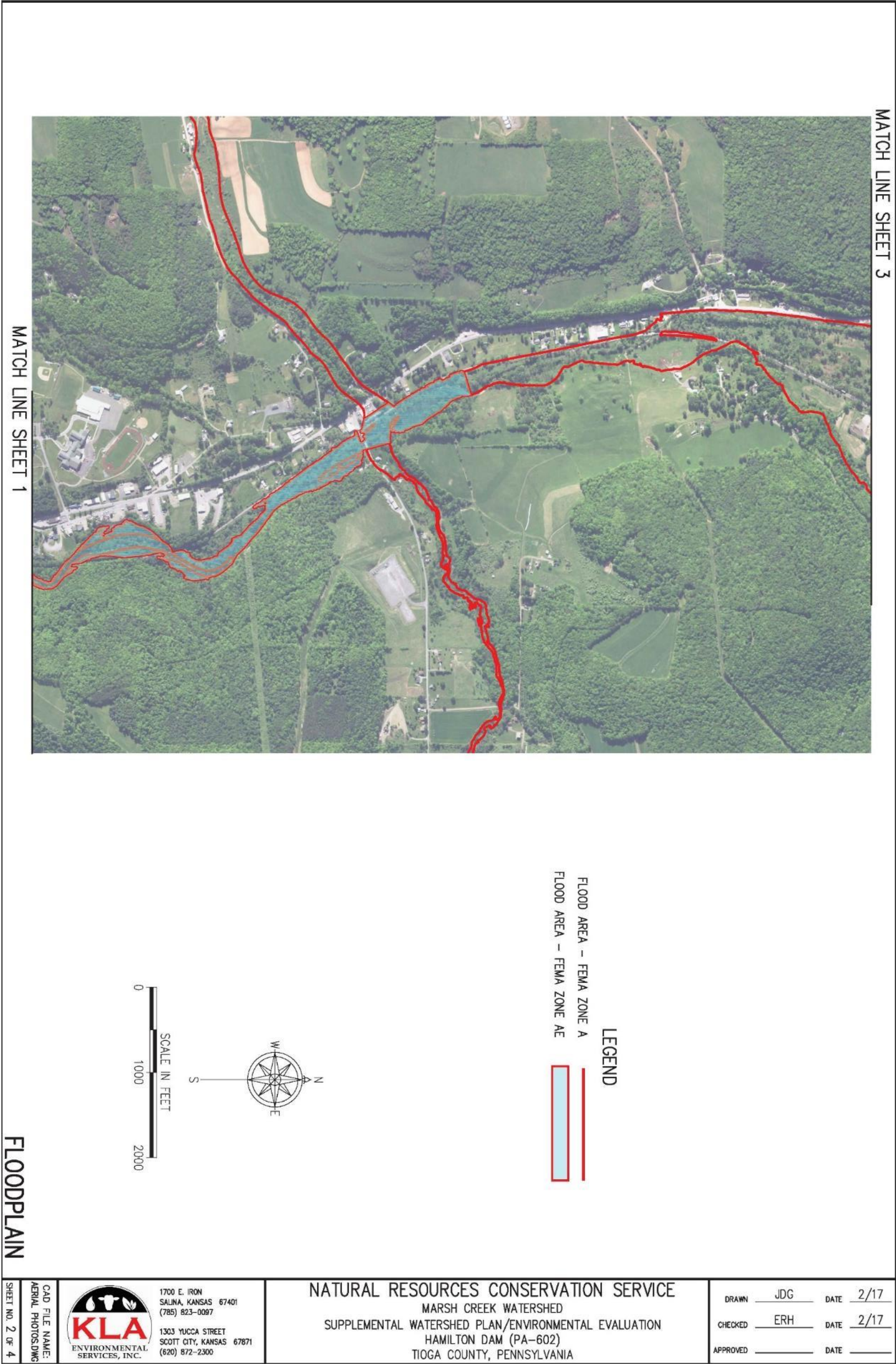




Figure C-16  
FEMA Approximate Floodplain

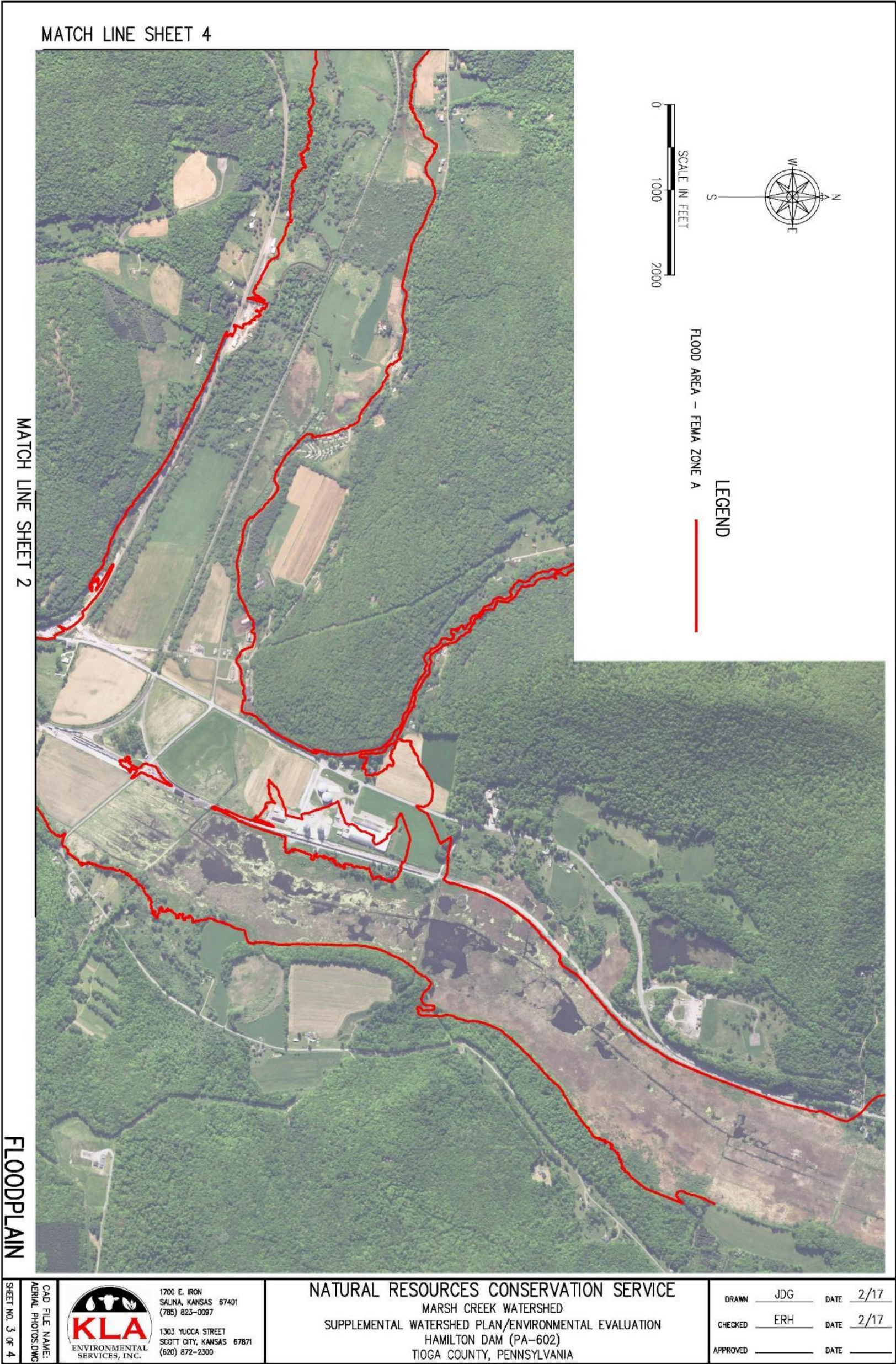




Figure C-17  
FEMA Approximate Floodplain

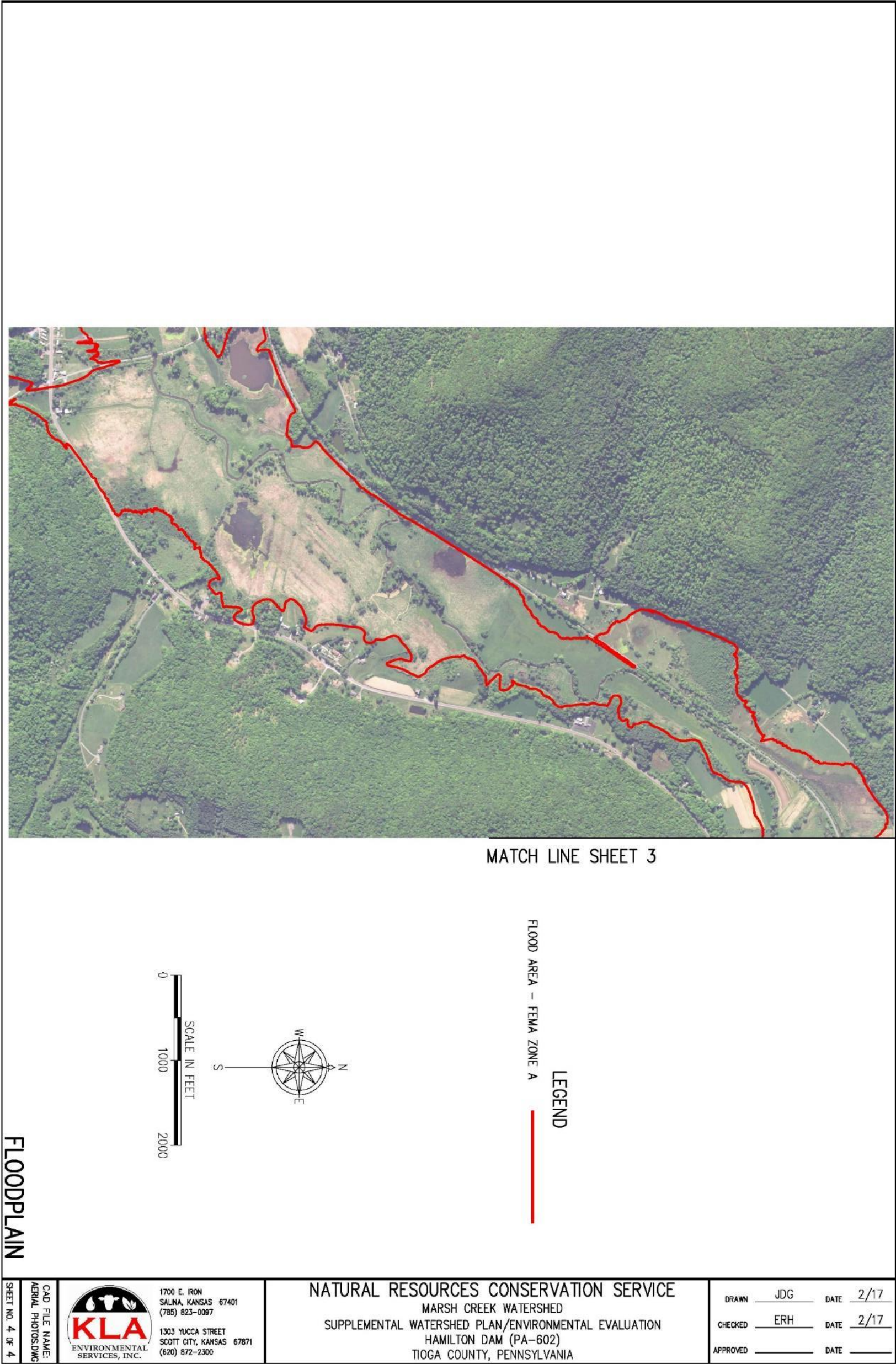




Figure C-18  
Hamilton Dam (PA-602) Frequency Flood – 100-Year

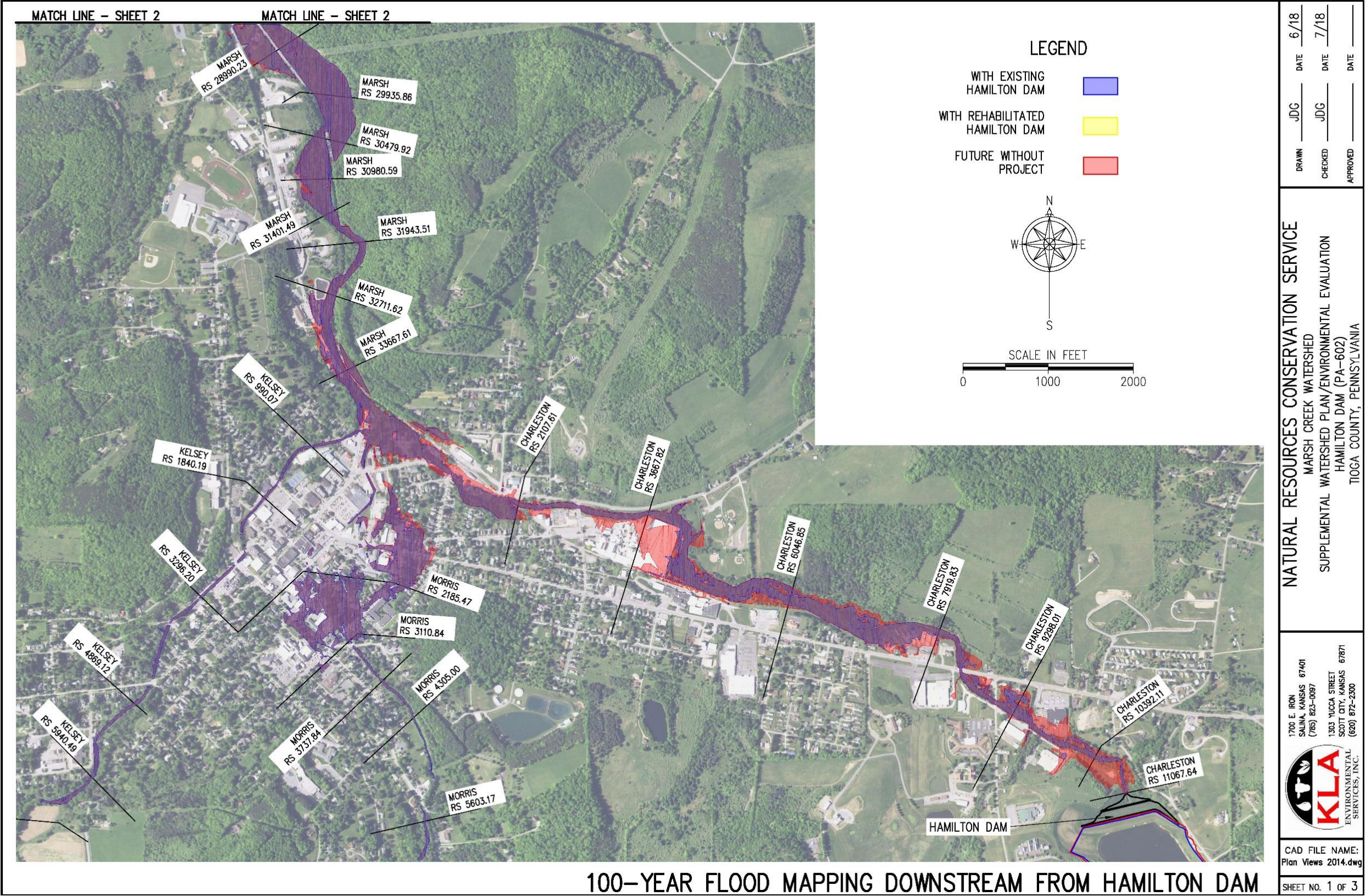




Figure C-19  
Hamilton Dam (PA-602) Frequency Flood – 100-Year

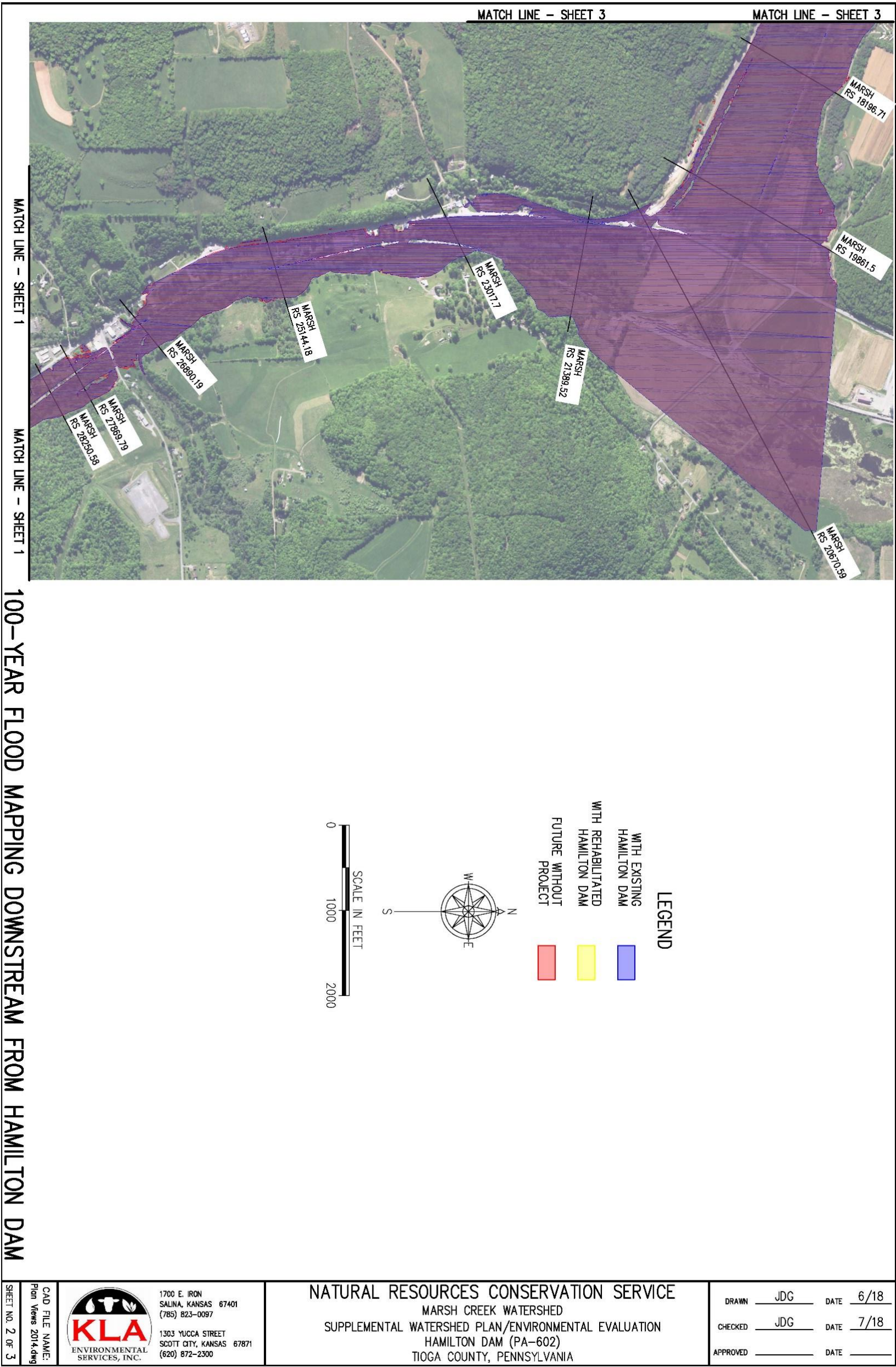




Figure C-20  
Hamilton Dam (PA-602) Frequency Flood – 100-Year

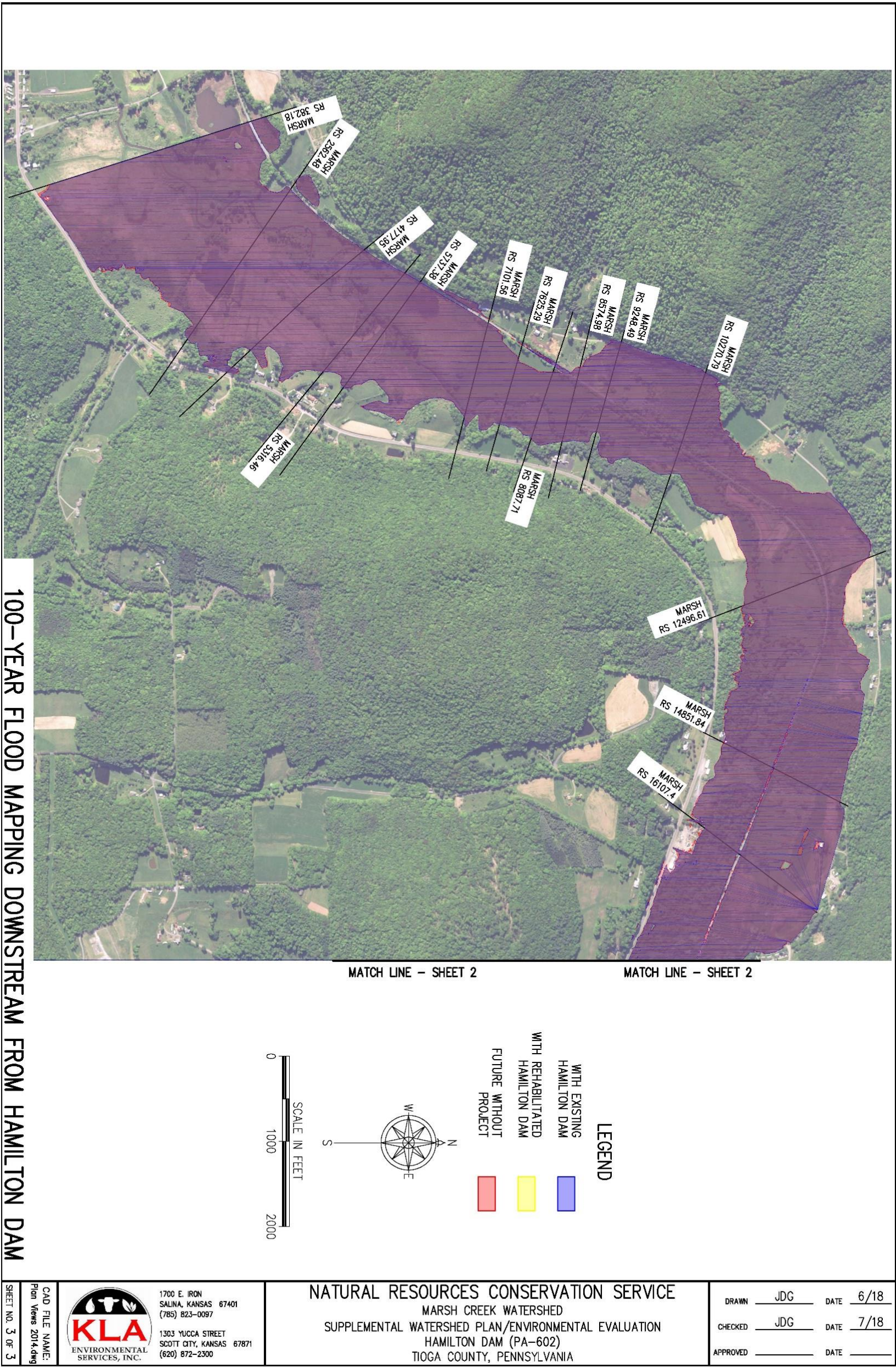




Figure C-21  
Hamilton Dam (PA-602) Frequency Flood – 500-Year

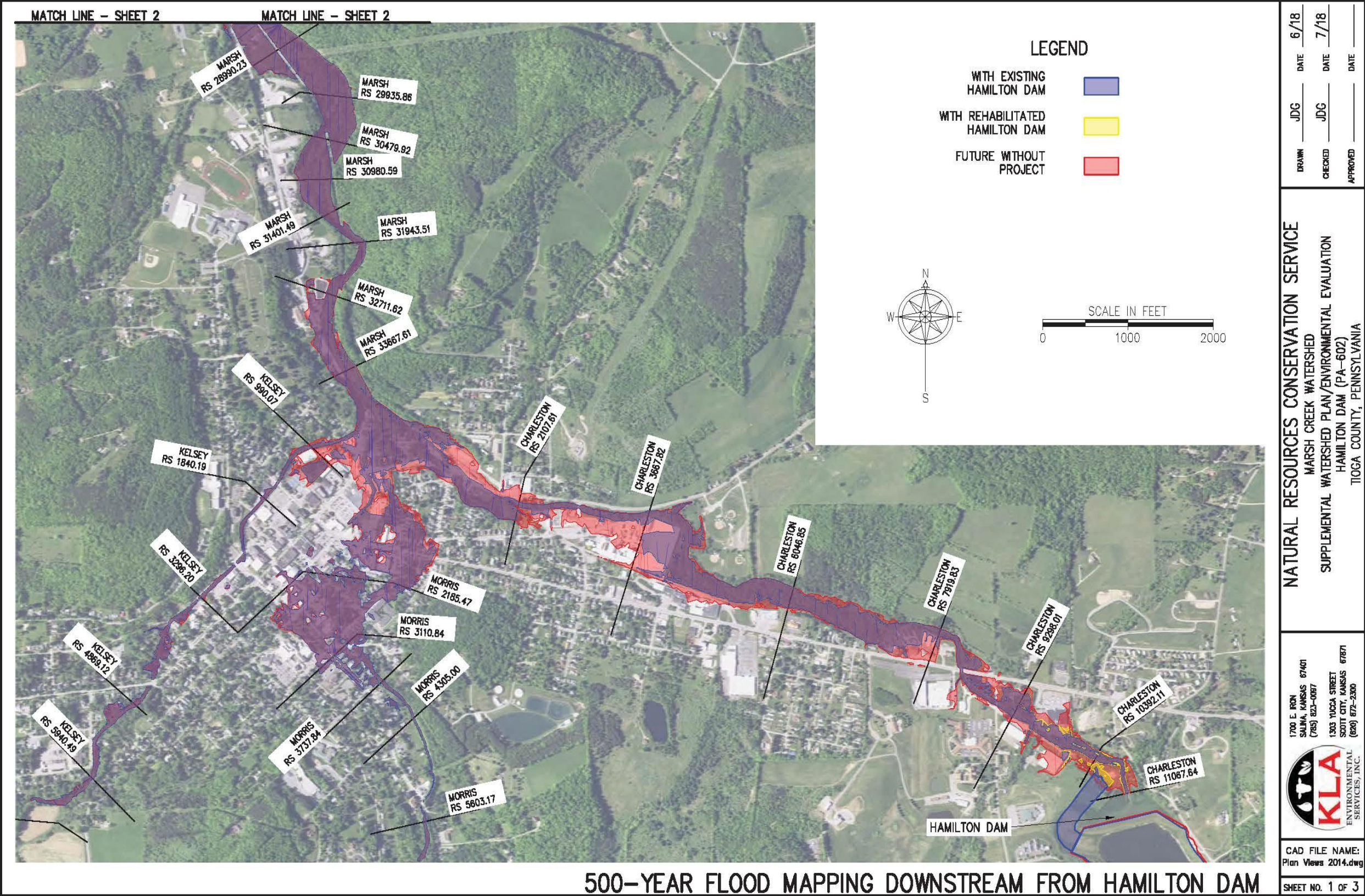




Figure C-22  
Hamilton Dam (PA-602) Frequency Flood – 500-Year

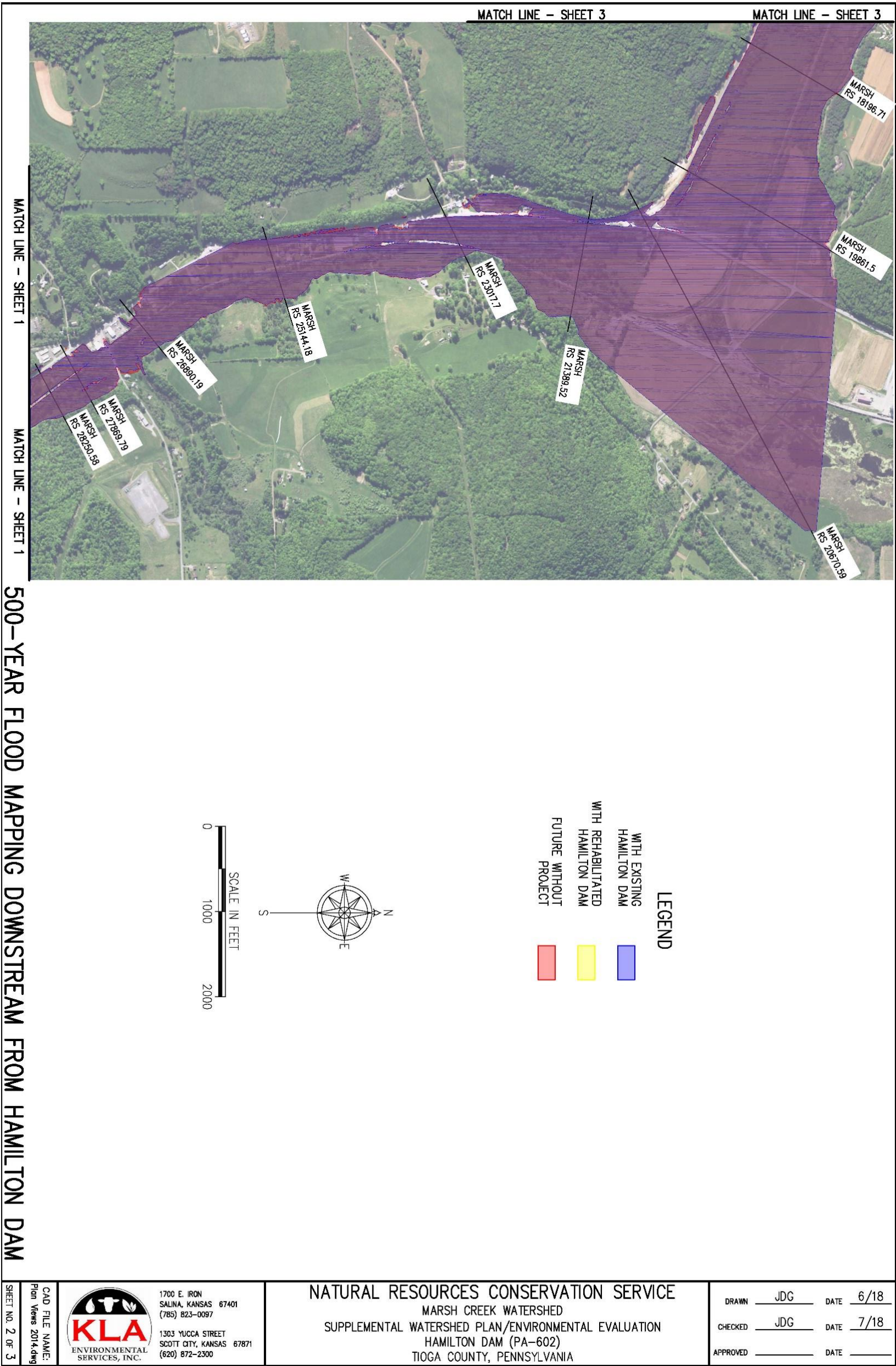
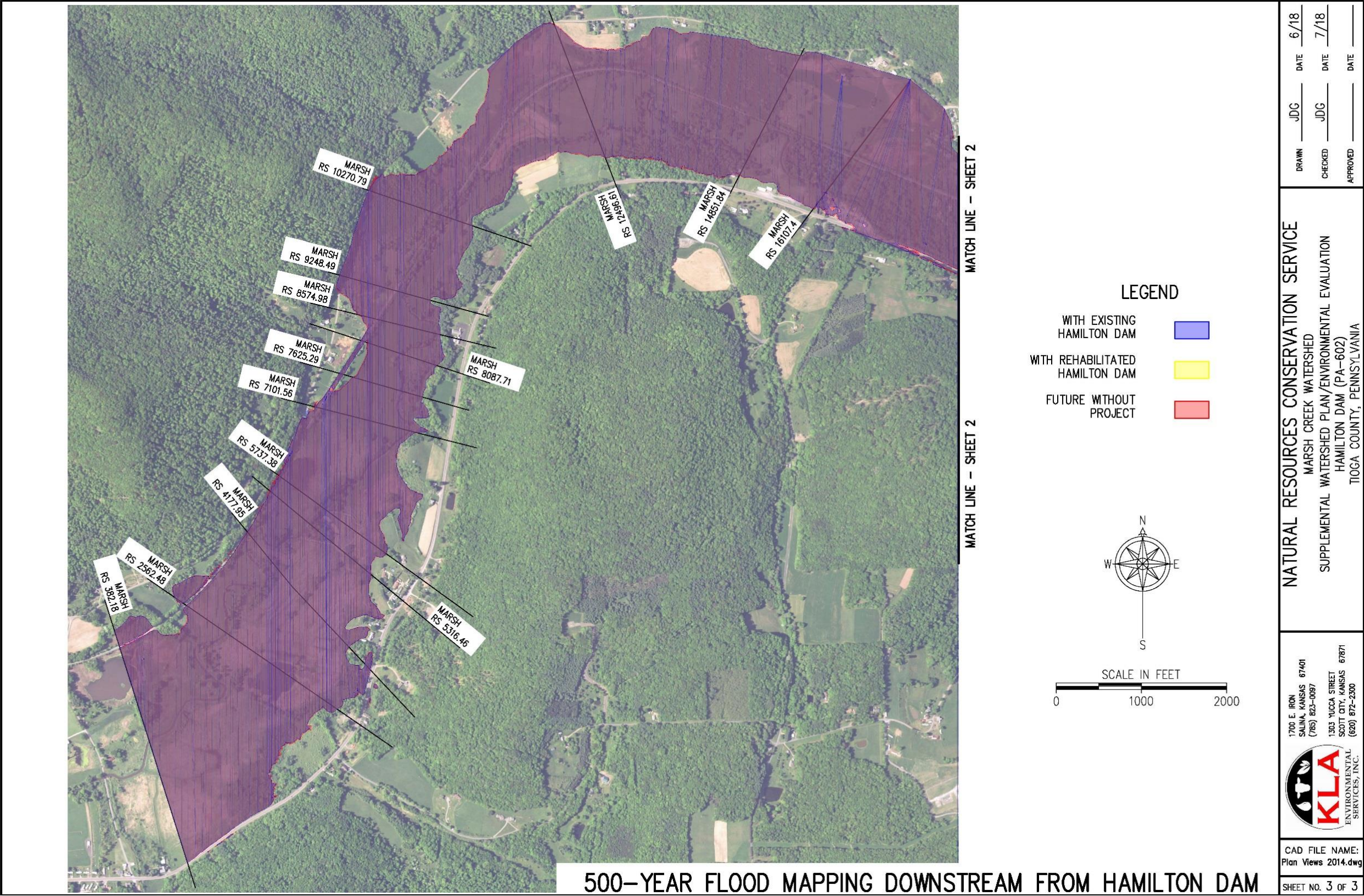




Figure C-23  
Hamilton Dam (PA-602) Frequency Flood – 500-Year





## **Appendix D**

# **INVESTIGATIONS AND ANALYSES REPORT**

## D.1 INTRODUCTION

This Appendix provides supplementary information regarding the investigations and analyses conducted for the project. The administrative record contains additional information relevant to each of the sections in this Appendix.

## D.2 EXISTING DATA

NRCS provided the following existing data from its archived files to the Project Team:

- As-Built Plans
- Detailed Report of Geology Investigations
- Soil Mechanics Reports
- Breach Inundation Studies
- Environmental Studies
- Design Documentation
- General Work Plan & Supplements
- Watershed Work Plans
- Supporting Documentation

## D.3 EFFECTS ANALYSIS

Ecological, cultural, and socio-economic effects of alternatives were evaluated using the NRCS-CPA-52 – Environmental Assessment form. This analysis was conducted with consideration to the public participation scoping requirements set forth in the National Watershed Program Manual (NWPM). Consideration was made of the potential occurrences of and/or project impacts/risks to the list of 31 natural resources and other issues of concern presented in Section 501.24 Part B of the NWPM. The information presented in the Plan-EA is an overview of the relevant watershed characteristics compiled from existing information. In addition, various websites, as referenced, were used to provide information on natural resource conditions at the site. On-site observations were made to confirm and supplement the compiled site information presented in this report.

Once alternatives were formulated, the Project Team evaluated the effect of each alternative on relevant resource concerns and special environmental concerns. The Dam Rehabilitation alternative involves minimal changes to the existing features and functions of the dam and the construction will be confined to the existing dam and auxiliary spillway.

The No Action/Future Without Federal Project (FWOP) includes removal of the existing embankment to allow flood flows to pass unimpeded. Consequently, the flood flows would impact the hydrology upstream and downstream from the dam resulting in transport of sediment downstream of the dam. The hydrologic changes would have some effect on wetlands located in the existing reservoir storage pool, by changing the depth and duration of floodwater. The change would also increase flood flow depth and duration downstream, including increased streambank erosion and increased flood damages. The portion of the existing dam removed with the FWOP has little or no habitat value. Primary on-site effects will be small improvements in habitat value at the site of the removal.

## D.4 ECONOMIC AND SOCIAL EFFECTS

**Benefit Analysis Summary.** The Project Team observed the dam site and the flood impact zones below the dam. The predominant land uses in the benefit area were qualitatively inventoried and the changes observed from the original plan and supplements were noted. The previously formulated flood damage benefits were adjusted consistent with the increase in floodplain development observed since the original evaluation. After adjusting the flood damage reduction benefits based on the changes in land use, all benefits were indexed to reflect current values (Fiscal Year 2019) and prorated for Hamilton Dam based on the ratio of Average Annual Flood Prevention Benefits for each dam in the original Watershed Work Plan. Indexing was completed using procedures consistent with National Watershed Program Handbook 604.1 (B).



The results of this project benefit analysis will be used to determine the relative benefit/cost ratio for each project alternative by comparing the average annual benefit with the amortized rehabilitation costs.

The following is brief outline of the Project Benefit Analysis:

1. Inventory the previous Supplemental Watershed Plans and determine the most recently calculated benefits.
2. Allocate the Watershed Work Plan benefits to the appropriate project (Hamilton Dam).
3. Evaluate substantial changes in number of houses and businesses with reduced flood damages.
4. Determine the appropriate economic indices for each of the benefit items.
5. Calculate all economic indices for each price base.
6. Update the flood damage reduction benefits allocated to Hamilton Dam to current values.
7. Update the water supply benefits at Hamilton Dam Lake to current values.
8. Determine the current value of recreation benefits associated with Hamilton Dam Lake.

The original benefits in the Marsh Creek Watershed Plan and supplements were assigned to each planned measure in the 1963 Watershed Plan based on a September 1957 Price Base. Supplemental Watershed Plans No. 1 through No. 3 made no revisions to the original benefits attributed to Hamilton Dam. Therefore, the original benefits for Hamilton Dam will be based on Table 5 – Estimated Average Annual Flood Damage Reduction Benefits, found on page 31, and Table 6 – Comparison of Benefits and Costs for Structural Measures, found on page 32 in the original Watershed Work Plan.

The total benefits attributed to Hamilton Dam (PA-602) were determined based on the assigned evaluation units and ratio of controlled drainage area provided in the original Watershed Work Plan. A review of the downstream properties was performed as part of the downstream FWOP and Decommissioning Alternatives analyses. A total of 106 residential and 46 commercial/industrial properties, with approximate property values of thirteen and fifty-eight million dollars respectively, were identified as receiving damage reduction benefits from Hamilton Dam.

Although the benefit analysis, starting with original 1957 benefits, described results in a large amount of uncertainty in the potential National Economic Development (NED) benefits and costs of the respective alternatives, the potential variation did not affect the NED plan selection, thus an abbreviated analysis can be used per Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) section 1.7.2(a)(4)(ii) and 2.1.1(b)(2).

**Land Use Change Analyses.** The Project Team reviewed land use changes within the floodplain downstream from Hamilton Dam. The qualitative analysis considered 1959 and 2015 historical aerial photography of the areas identified as FEMA Zone A regions downstream from Hamilton Dam.

Tioga County, Pennsylvania image scans of historical aerial photography for 1959 were obtained from the USDA-FS, Aerial Photography Field Office, 222 West 2300 South, Salt Lake City UT 84119. The 2015 National Agriculture Imagery Program Mosaic for Tioga County, Pennsylvania was obtained from the USDA-NRCS, Geospatial Data Gateway at the following website:

<http://datagateway.nrcs.usda.gov/GDGHome.aspx>

The FEMA Zone A regions, as noted previously, were overlaid on 1959 and 2015 historical aerial photography of the downstream flood damage reduction benefit areas with a total area of approximately 1,240 acres. Developed areas were delineated and measured for both years. The historical land use changes in the FEMA Zone A regions downstream from Hamilton Dam are described in Table D-1.

**Table D-1 – Historical Land Use Changes**

| Type of Development                                                        | Observed Floodplain Development <sup>1</sup> |                   |                 |                 |
|----------------------------------------------------------------------------|----------------------------------------------|-------------------|-----------------|-----------------|
|                                                                            | 1959<br>(Sq. Ft.)                            | 2015<br>(Sq. Ft.) | 1959<br>(Acres) | 2015<br>(Acres) |
| Non-Agricultural<br>Residential, Commercial, or<br>Industrial <sup>1</sup> | 1,841,640                                    | 3,150,762         | 42.28           | 72.33           |

<sup>1</sup>Observed land use changes for increased development will be considered in updating benefits.

A comprehensive review of the land use changes in the benefit area found an increase in land developed as residential, commercial, and industrial. Consequently, the average annual residential, commercial and industrial flood damage benefits for Hamilton Dam (PA-602) noted in Table 4-3 were updated with equal weight to account for development in the benefit area based on the ratio of the observed floodplain development in 2015 and 1959 (72.33 acres/42.28 acres = 1.71074).

It is assumed that the land treatment measures accounted in the original Watershed Work Plan and Supplements have been implemented. Therefore, the estimated average annual damage values identified as “After Land Treatment” were carried forward as the estimated average annual damage without project.

**Economic Index.** P&G section 1.7.2(a)(4)(ii) and 2.1.1(b)(2) allows abbreviated procedures to evaluate project benefits. The review of the downstream benefit area found the same land uses (residential, commercial and industrial) as were used in determining benefits the original watershed work plan and no significant change (less than 3 percent) to the composition of the benefit area. Consequently, indexing will be used instead of hydrologic and economic evaluation for updating the benefits. The original and supplemented project benefits were indexed to Price Base 2019 consistent with the tools provided at the NRCS Economics Web Site:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/tools>

The project benefits were last updated in 1962 (Price Base 1957) in the original Watershed Work Plan for Marsh Creek Watershed. For this analysis, benefits allocated to Hamilton Dam were updated to Price Base 2019 using the price and cost indices.

Updated flood control benefits were calculated consistent with P&G and NREH Part 611. Benefits represent costs or damages that would occur in the absence of the Project. Indexing methods are described in P&G 2.1.1(b)(2).

**Table D-2 – Price and Cost Index**

| Benefit Item               | Index                              | 1957   | October 2018 | Index from 1957 |
|----------------------------|------------------------------------|--------|--------------|-----------------|
| Residential                | Consumer Price Index <sup>1</sup>  | 28.10  | 252.146      | 8.97            |
| Commercial                 | Consumer Price Index <sup>1</sup>  | 28.10  | 252.146      | 8.97            |
| Industrial                 | Consumer Price Index <sup>1</sup>  | 28.10  | 252.146      | 8.97            |
| Road and Bridge            | ENR Construction Cost <sup>1</sup> | 724.00 | 11012.77     | 15.21           |
| Railroad                   | ENR Construction Cost <sup>1</sup> | 724.00 | 11012.77     | 15.21           |
| Sediment Damage            | ENR Construction Cost <sup>1</sup> | 724.00 | 11012.77     | 15.21           |
| Indirect                   | Consumer Price Index <sup>1</sup>  | 28.10  | 252.146      | 8.97            |
| More Intensive Land Use    | Consumer Price Index <sup>1</sup>  | 28.10  | 252.146      | 8.97            |
| Municipal Water Supply     | Consumer Price Index <sup>1</sup>  | 28.10  | 252.146      | 8.97            |
| Benefit Item               | Index                              | 1992   | October 2018 | Index from 1992 |
| Recreation - Trout Fishing | Consumer Price Index <sup>1</sup>  | 140.30 | 252.146      | 1.80            |

October-2018

<sup>1</sup> <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/prices/>

**Municipal Water Supply Benefits.** Water supply is an authorized purpose for Hamilton Dam, with assigned benefits shown in the original Watershed Work Plan for Marsh Creek Watershed. Water supply benefits were indexed to present day value based on the Consumer Price Index.

**Recreation Benefits.** Recreation benefits for Hamilton Dam were not considered in the original Watershed Work Plan or subsequent supplemental plans. Hamilton Dam is owned and operated by the Borough of Wellsboro who identified an objective and need to provide recreational use at the lake. Hamilton Lake is stocked for trout fishing by the PFBC; information was provided by PFBC concerning the value of these recreation benefits at Hamilton Lake. A summary of the recreation use, unit day values and annual benefits are provided in the table below.

**Table D-3 – Recreation Benefits**

| Recreational Fishing      | Annual Angler Trips <sup>1</sup> | Unit Day Value <sup>2</sup> | Annual Recreational Fishing Benefit |
|---------------------------|----------------------------------|-----------------------------|-------------------------------------|
| Spring Trout Season       | 4,945                            | \$ 84.29                    | \$ 416,814                          |
| Winter Trout Season       | 1,652                            | \$ 84.29                    | \$ 139,247                          |
| Total Recreation Benefits |                                  |                             | \$ 556,061                          |

Price Base 2019

<sup>1</sup> Estimate by PFBC Commission staff based on 2001 creel survey conducted at Cowan's Gap Lake in Fulton County, PA adjusted down by ratio of Hamilton Dam surface area (38.5 acres) to Cowan's Gap Lake surface area (41.99 acres).

<sup>2</sup> Provided by PFBC staff based on information from "Investigation and Valuation of Fish Kills, AFS special publication 24, 1992" (1992 unit day value of \$46.83) and indexed to 2018 dollar value.

**National Economic Development Alternative (NED) Analysis.** The P&G was used to determine the NED Alternative. This alternative is defined as that which maximizes the net benefits consistent with



protecting the Nation's environment. The economic evaluation was performed in accordance with Chapter 2, Section 4 of the P&G and the NRCS National Watershed Program Manual (Parts 501.11 A(2); 501.12 C; 505.35 B (1) (iii)-(1V); 505.35 E-F).

## D.5 ENVIRONMENTAL STUDIES

The environmental evaluation identifies and analyzes the environmental concerns related to the planning alternatives and the recommended plan. The evaluation is an NRCS planning process that is described in the National Planning Procedures Handbook. The Project Team used the NRCS-CPA-52 Environmental Evaluation Worksheet for scoping and documenting environmental impacts. This Worksheet documents the planning and environmental evaluation process and the need for an Environmental Assessment. The Project Team conducted studies and evaluations regarding the following resource concerns.

***Wetland Determinations.*** For the purposes of this Environmental Assessment, estimates of wetland type and extent within the Project boundaries were analyzed using existing data from U.S. Fish and Wildlife Service National Wetlands Inventory (NWI) maps combined with field surveys. A visual inspection of the existing plant community and surficial hydrology included an observation of a 500-foot radius around the Dam located at the north end of Hamilton Lake.

Three field surveys were conducted by the Project Team and NRCS to delineate wetlands near Hamilton Dam, on the shoreline and south site of Hamilton Lake, and in the existing auxiliary spillway.

***Federally-Listed Threatened and Endangered Species.*** A Pennsylvania Natural Heritage Diversity Inventory (PNDI) review for Hamilton Dam was conducted. The Pennsylvania Game Commission (PGC), Pennsylvania Department of Conservation and Natural Resources (PA DCNR), PFBC and United States Fish and Wildlife Service (U.S. FWS) determined that there was no known impact within the project area. The U.S. FWS determination is valid for two years and further review will only be required if the project changes or new information becomes available on listed species.

***Cultural Resources.*** On May 16-20, 2016, the Project Team archaeologists conducted a Phase IA/IB archaeological resource survey of the proposed Hamilton Lake Dam (PA 602) Rehabilitation project area near the city of Wellsboro, Tioga County, Pennsylvania. This survey was conducted at the request of the Natural Resources Conservation Service in order to assess the potential impact on archaeological resources within the area of potential effect. The project area consists of 27.4 acres (11.0 hectares) around the existing lake that will be inundated by the proposed rehabilitation of the dam. This survey was conducted to ensure compliance with Section 106 of the National Historic Preservation Act, and other Federal and state cultural resource management regulations. In consultation with the Pennsylvania State Historic Preservation Office, Historical and Museum Commission (letter dated July 12, 2016), it was their opinion that no historic buildings, structures, districts, or objects will be affected by this project. As such, no historic structures survey work is required for this project.

The archaeological survey involved background research and a Phase IA reconnaissance survey which formed the basis of the predictive model that was employed during the subsequent Phase IB intensive survey. The predictive model included 8.8 acres with a high potential to contain sites and 18.6 acres with a low or no potential to contain archaeological resources. The high probability areas were investigated by shovel testing while the low/no site potential zones were inspected by a walkover survey and judgmentally placed shovel tests.

## D.6 GEOLOGY

The Report of Dam Embankment and Auxiliary Spillway Subsurface Exploration for Hamilton Dam, completed by Amec Foster Wheeler, documents the geology investigation completed at the dam.

**Scope.** The purpose of this study was to perform a geotechnical evaluation of the existing Hamilton Dam in Tioga County, Pennsylvania. The scope of the geotechnical evaluation included performing a subsurface exploration along the dam embankment and its emergency spillway.

**Area Geology.** Based on published geologic information for the site, as well as the examination of the soils recovered during this exploration, the site surficial deposits in the auxiliary spillway consist of the Volusia channery silt loam in the area of the ASW and the Pope Soil and the Volusia channery silt loam in the area of the embankment.

The soil in the embankment area are man-made fill). The project area is underlain by the Devonian Age Lock Haven Formation. The Lock Haven Formation is described as a light-olive-gray very fine grained, fossiliferous, thin and medium bedded sandstone, light-gray, very thin to medium bedded siltstone, and gray, thin to very thick bedded silty shale and mudstone.

The PA DCNR Map Viewer and the USGS Interactive Fault Map show no mapped faults within 100 km of the site. Furthermore, the majority of the area within 100-km of the site is covered in glacial moraine and till which may obscure faulting in the bedrock. Given the current geological and seismological data, we assess that the existing data is not suitable to determine definitively if faults exist at the site.

**Subsurface Exploration.** The subsurface exploration included advancing eight geotechnical soil borings at the site. The geotechnical engineer established the boring locations in the field using aerial photography and a handheld GPS unit. After the exploration was complete, boring locations were surveyed.

Triad Engineering, Inc. (Triad) of Scott Depot, West Virginia performed a PA One-Call to locate any potential utilities prior to mobilizing to the site. Triad performed the subsurface exploration between May 9 and 19, 2016. The Project Team's on-site representative laid out the boring locations and observed Triad's drilling and sampling work.

Triad advanced the borings using a CME-55 ATV-mount drilling rig equipped with 2 ¼"-inch inner diameter hollow stem augers. Triad sampled the borings using Standard Penetration Test (SPT) with a 2-inch split-spoon sampler in accordance with ASTM D1586 and relatively undisturbed, thin-walled (Shelby) tubes per ASTM D1587. The Project Team's on-site representative visually examined and logged the soil samples and placed the soil samples in sealed containers to preserve moisture content during transport to the material testing laboratory. SPT blow counts were used to calculate the SPT N-values for each sample. The Shelby Tube samples that yielded enough sample for laboratory were capped and sealed for transport to the materials testing laboratory. Shelby Tubes that did not yield enough material were discarded.

For the auxiliary spillway borings, upon auger refusal, rock-coring techniques per ASTM D2113 were used to advance the boring to plan termination depth. Rock core samples were removed and boxed from the core barrel; then logged for the core hardness, recovery (REC), rock quality designation (RQD), bedding, flaws, joint, etc.

Triad initially drilled three borings along the dam embankment. Triad drilled Boring DH-61 along the dam embankment crest, Boring DH-711 upon the upstream slope, and DH-712 upon the downstream slope. Triad sampled each of these borings using SPT techniques generally on approximate five-foot centers. At select depths within each boring, Triad attempted to collect undisturbed samples of the embankment materials (Zones 1 and 2) using Shelby tube samplers. Undisturbed sample recovery was low for each of the borings. Therefore, we performed an additional boring along the dam crest (Boring DH-61A), offset west (left) about 10 feet from DH-61, in an attempt to collect two additional undisturbed samples. Overall, we attempted to collect 12 undisturbed samples from the embankment borings and sample recovery ranged from 0.3 feet to 1.3 feet (average of about 0.6 feet). We believe the thin-wall refusal and limited

recovery amounts were due to significant fraction of gravel in the soil. Triad terminated each of the embankment borings at their planned termination depth without encountering refusal.

Triad drilled three borings (DH-221 through DH-223) and one offset boring (DH-223A) along the auxiliary spillway alignment. Triad sampled each of these borings using SPT techniques generally on approximate five-foot centers to refusal or the planned termination depth. At select depths within each boring, Triad attempted to collect undisturbed samples of the overburden materials within the auxiliary spillway using Shelby tube samplers. Triad extended Boring DH-222 to the planned termination depth of 77 feet without encountering refusal. Boring DH-221 encountered refusal at a depth of about 52½ feet and we used rock coring techniques to advance the boring to plan termination at a depth of about 77 feet. Boring DH-223 encountered auger refusal at eight feet below existing ground surface (bgs). Due to the shallow refusal depth, we directed Triad to drill offset Boring DH-223A, about 4.5 feet to the west of DH-223. They advanced it using augers to 50 feet bgs, where it encountered refusal. Triad then cored through about 1.5 feet of sandstone boulders to a depth of 51.5 feet. Because the SPT samplers would not fit through the core hole in the boulder, we directed Triad to core the underlying clay to the planned termination depth of 77 feet bgs. We recovered soil samples from the core barrel and sealed them in containers for laboratory testing. Upon drilling completion, Triad placed a continuous 1-inch tremie pipe to the bottom of each boring in the auxiliary spillway.

Triad attempted to take six undisturbed samples within the auxiliary spillway borings. Sample recoveries ranged between 0.3 and 1.3 feet of sample. We believe the thin-wall refusal and limited recovery amounts were due to significant fraction of gravel in the soil.

After drilling, the boreholes remained open, with a continuous one-inch tremie pipe placed to the bottom of the boring, to allow for a stabilized groundwater level measurement. Subsequently, the borings were sealed by pumping a Portland cement slurry with six-percent Bentonite through the tremie pipe while the tremie pipe was slowly lifted and removed from the boring. Triad spread the soil cuttings generated during drilling flat upon the ground surface in a manner to minimize erosion. The grass cover and shallow slopes were sufficient to control drilling water without the aid of erosion and sediment controls. Damage from egress and the drilling activity was minimal and subsequently repaired, as needed where the rig and support vehicles were driven and small areas of exposed soils at boring locations. Triad performed site restoration (raking grass, spreading cuttings) in the areas immediately surrounding the borings.

**Seismic Potential.** The Project Team performed a Seismic Hazard Assessment of the Hamilton Dam. NRCS TR-60 requires a “Special Investigation” only for dams in Zones 3 and 4, Alaska, Puerto Rico, and the Virgin Islands, and High Hazard potential dams in Zone 2. The Hamilton Dam is located in Zone 1, so it did not require a “Special Investigation.” The NRCS scope-of-work for this project required the Project Team to prepare a “Discussion of Seismic Potential at Site by completing a Seismic Hazard Assessment,” as defined below.

- a. Obtain and evaluate existing geologic, geophysical, and seismologic information available and prepare a seismotectonic evaluation of the area to determine that there are no active or capable faults at the site. The study shall include an assessment of the suitability of existing data to evaluate definitively the existence of faults at the site.
- b. Obtain a probabilistic seismic hazard curve for the site from the USGS Earthquakes Hazard Program (<http://earthquake.usgs.gov/hazards/>). Base earthquake loading on an annual exceedance probability of  $1 \times 10^{-4}$  (a Return Period of 10,000 years or an approximate probability of exceedance in 50 years of 0.5%).
- c. Complete a short earthquake history as defined in TR-60.

The intent of this directive is to comply to the extent possible with the Draft TR-60 that NRCS will likely promulgate before the design work for this project is complete. The 2016 Draft TR-60 provides guidance on selecting the exceedance probability for the peak ground acceleration (PGA) at dams with low, significant, and high consequences of a seismic failure. The 10,000-year return period corresponds to a potential consequence for loss of human life or serious damage to homes, industrial and commercial buildings, important public utilities, main highways, or railroads if an earthquake causes a breach of embankment.



Hamilton Dam is located near Latitude 41.740° North, Longitude 77.265° west, just east of Wellsboro, Pennsylvania. The Project Team reviewed the location of magnitude (M) = 4+ earthquakes since 1700 within a 100-kilometer radius of the site using USGS archive search. We found no records of earthquakes that met our search criteria within a 100 km radius circle around the site. The area reviewed includes portions of Pennsylvania and New York.

The USGS bases the “U.S. Seismic Design Maps” tool upon the 2% probability of exceedance in 50 years (~2,500-year return). The Peak Ground Acceleration (PGA) for the 2,500-year return is 0.049g. We used the USGS Geographic Deaggregation Seismic Hazard Program (GDSH) web tool to evaluate the 1% probability of exceedance in 100 years (i.e., ~10,000-year return) at the Hamilton Dam coordinates. The GDSH tool provided the PGA of 0.118g at the bedrock “BC” boundary. The web tool does not provide correction of the PGA for amplification due to the overburden soil. We estimated the amplification factor  $F_{pga}$  for the soil overburden using USGS Design Maps Detailed Report web tool for a Site Soil Classification “Site Class D” (Stiff soil), which gave  $F_{pga} = 1.60$ . Using this factor, we calculated a peak ground horizontal acceleration of  $P_{GAM} = 0.189g$  for the 10,000-year return period and  $P_{GAM} = 0.079g$  for the 2,500-year return period.

**Laboratory Testing.** Triad transported the soil samples to their soils laboratory in St. Albans, West Virginia for testing. The laboratory testing for this project included Moisture Content (ASTM D2216), Specific Gravity (ASTM D854), Particle Size Analysis with Hydrometer (ASTM D422), Atterberg Limits (ASTM D4318), Unit Weight - Density, and Crumb Test (ASTM D6572).

We were unable to perform Hydraulic Conductivity (ASTM D5084) and Triaxial Shear Test, Consolidated Undrained (ASTM D4767) because we recovered no thin-walled samples suitable for testing due to the abundant gravel in the soil. Using the unaltered field notes, we confirmed or modified descriptions on the typed logs, as necessary to provide accurate information.

**Subsurface Conditions.** The subsurface conditions at the site are characterized as engineered fill soil for the embankment and glacial till within the auxiliary spillway. The subsurface descriptions for fill and native soils are of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs represent the Project Team’s interpretation of the subsurface conditions based on the visual classification of field samples and laboratory tests of field samples.

We encountered engineered fill soil throughout the entire depth of Borings DH-61, DH-61A, DH-711, and DH-712. Based upon the design documents reviewed, the fill soil is composed of natural soil materials generated from the embankment borrow areas and placed to construct the embankment in the 1960s. The design document indicate that fill soil encountered in DH-61 (embankment crest) and DH-711 (upstream embankment) were Zone 1 fill from ground surface to boring termination. The design document indicate that fill soil encountered in boring DH-712 (downstream embankment slope) was Zone 2 fill soil from surface to 25 feet bgs, and Zone 3 fill soil from 25 feet bgs to boring termination. We did not encounter SPT refusals in DH-61 or DH-711.

Based upon the borings, we observed that the Zone 1 fill materials consist primarily of gravelly clay (CL) and clayey gravel (GC) with lesser amounts of variably silty gravelly clay (CL). Zone 1 SPT N-values range between 8 and 61 blows per foot (bpf) and average about 28 bpf. The laboratory tests for the current study show that the testable samples from Zone 1 soil generally contain significant fraction of coarse-grained material (the sand and gravel material larger than 0.075 mm); the percentage of coarse-grained material ranged from 11% to 46% and averaged about 33.5%. Many of the samples recovered in the borings were not testable due to insufficient recovery, especially in strata that contained greater amount of gravel.

The Zone 2 samples consists primarily of gravelly clay (CL) and poorly-graded gravel (GP) with SPT N-values ranging between 8 and 50+ bpf and averaging about 23 bpf. A Zone 2 sample contains about 75% coarse-grained material.

Zone 3 samples consisted of gravelly clay or sandy clay with SPT N-values ranging from 26 to 63 and averaging about 38 bpf. A Zone 3 sample contains about 45% coarse-grained material.

Triad extracted Shelby tube samples from Boring DH-61 at 12 feet bgs and 66.5 feet bgs and Boring DH-711 from 40 feet bgs to analyze dry unit weight. Triad extracted Shelby tube samples from boring DH-61A at 24.5 feet bgs and DH-711 at 11.5 feet and analyzed for Atterberg Limits, grain size, specific gravity and moisture. Other Shelby Tubes contained insufficient material for testing. None of the samples recovered were acceptable for triaxial shear or hydraulic conductivity testing.

The auxiliary spillway borings, Borings DH-221, DH-222, DH-223, and DH-223A are located within the auxiliary spillway cut. Beneath the topsoil interval, the borings encountered natural soil horizon (glacial till) primarily composed of complexly interbedded gravel, gravelly clay, clayey gravel, and clay. The residual soil includes minor fractions of sand and boulders. Triad encountered cobbles or boulders at 50 to 60 feet bgs as evidenced by difficulty augering. We observed a thin interval of weathered decomposed rock (saprolite) in Boring DH-221 from 52.5 to 53 feet bgs. SPT N-values ranged between 10 and 92 bpf and included 10 split spoon refusals.

Triad analyze the sample for particle size, moisture content, and Atterberg Limits. Triad was unable to extract viable undisturbed samples for hydraulic conductivity and triaxial shear tests from any of the Shelby tubes. Triad analyzed two samples, Boring DH-222 at 70 feet bgs and DH-223 from the surface to 2 feet, for unconfined compressive strength.

Triad performed eight crumb tests, per ASTM D6572, on samples nearest to the assigned specimens. Due to the limited recovery of samples and the amount of gravel in the recovered samples, we had to combine samples and/or test similar specimens to the sample assigned. Results indicate that the clay in the embankment fill soil contain some dispersive clay.

Bedrock was not encountered in the embankment borings (DH-61, DH-61A, DH-711 and DH-712), and three of the AS borings (DH-222, DH-223, and DH-223A). We encountered bedrock in AS Boring DH-221 at a depth of 52.5 feet bgs. Based on visual observation of the rock specimens, bedrock was primarily dark gray sandy siltstone, calcareous, medium bedded with occasional vertical fractures and rare fossils. Available geologic mapping and our observations indicate that this bedrock is part of the Devonian Age Lock Haven Formation. We observed weathering and fractures.

A groundwater level measurement was made at the completion of drilling the overburden at each boring. For the boring that we terminated at plan depth, a continuous 1-inch diameter tremie pipe was run to the total boring depth immediately upon completion of drilling. For the cored borings, coring was completed prior to installing the tremie pipe. Subsequent water level measurements were made through the tremie pipe.

The tremie pipe was left in all borings from the time of completion of drilling to grouting. Water level measurements were collected from borings approximately every 24 hours that the borings were open and immediately prior to grouting each boring to the surface. Groundwater levels can fluctuate with time and discontinuous zones of perched water may exist within the subsurface materials.

In Borings DH-61, DH-221, and DH-223A, we added water after completing the overburden drilling. We added a limited amount of water at Boring DH-61 to assist in extracting broken drill tools; we estimate we added less than 100 gallons. We added water for rock coring at Boring DH-221 and DH-223A

## D.7 ENGINEERING

**Surveys.** To supplement data from available as-built drawings, the Project Team conducted an Existing Conditions survey of the Hamilton Dam, dated May of 2016. Equipment utilized was Topcon Hyper survey grade GPS units, Topcon Robotic Total Station (3-second), fathometer, and a sediment spud bar. The initial establishment of controls for this site was based on two control points placed in open areas that were void of trees, vegetation, and buildings. The Project Team occupied these points with GPS for a minimum of 3 to 5 hours each, and collected the necessary data for a submission to OPUS for a correction. The Project Team also cross checked this data between the initial controls with additional control points utilized on this survey. All closures met the accuracies required and were consistent with each other.

The intent of this survey was to locate the x, y, and z's of specifically designed elevations (of the structures) that were shown on the original design as-built plans set. These items included the inlet, outlet structures, inverts, concrete slabs, retaining walls, and manhole rims. The Project Team also attempted to locate and tie into any of the original recited benchmarks shown on the original plans. With no benchmarks found or remaining, the Project Team surveyors were able to adjust and rest the vertical datum on the referenced outlet structure invert, utilizing the as built elevation of 1383.04 feet. Utilizing this structure, the Project Team surveyors were able to adjust all collected field data survey points to agree with the original plans of record. The Project Team then reviewed other important reference points for consistencies from the as-built plans of 1967 and found them to agree.

No reference or basis listed for the vertical datum of this site was shown in the as-built plans, therefore all elevations noted for the rehabilitation alternative are in the Hamilton Dam 1965 as-built plans reference "local" vertical datum. A datum shift of -3.63 feet was determined to convert the as built plans local datum to NAVD88 datum.

The field data was collected with survey grade GPS and radial topography with a Robotic Total Station. Field data collection included the location of: principal spillway inlet (riser) and outlet (impact basin) structures; impact basin downstream channel; any visible utilities, including culverts, manholes, light poles, structures and other improvements; earthen dam with top of dam, embankments, toe of slope including any signs of erosion or drainage issues, wetland flags (delineated by the Project Team), subsurface exploration borings (performed by the Project Team), auxiliary spillway including side slopes, and the normal pool elevation at time of survey.

Additional field data collected involved an establishment of a field bathymetric/sediment survey grid which encompasses cross sections every 200 feet with measurements taken about every 100 feet on each cross section. This grid resulted in approximately 100 measurement locations within the normal pool area, including a small tributary to the southeastern side of the lake. The Project Team then navigated by boat to each established coordinate and located the x, y, and z of each bathymetric point (bottom of normal pool). The Project Team surveyors reviewed the actual pool elevation at the time (for verification) and proceeded to drop a steel rod and tape to establish the depth to sediment at each point located. The depth of the water at each point was also collected and then verified utilizing a fathometer. Additional measurements within the inlet structure area were also collected.

The Project Team developed Digital Terrain Model (DTM) files into 1-foot contour intervals. This surface included existing conditions of the dam, embankments, auxiliary spillway, and the bottom of the existing base of sediment (below normal pool area). Due to the deep waters in the reservoir, The Project Team surveyors developed a 2-inch diameter by 4-foot-long coated steel spud bar that was attached to a rope. The spud bar was then dropped under the influence of the heavy steel density which was enough to drive the rod through the sediment layer. Thickness readings were then taken by measuring the loose sediments retained by the granular surface of the rod. The sediment thickness was determined by measuring the loose sediment on the outside of the spud bar, which was raised up through the water prior to each reading. The weight of the spud bar was sufficient enough to penetrate the aerated sediment, but not so much so that it penetrated the base, making it difficult to pull back up through the water. Location of each reading was collected by a GPS unit. Bottom of sediment elevations were collected by subtracting the wet rope length from the normal pool elevation at each location. Top of sediment elevations were calculated by adding the measured thickness to the bottom elevation at each location. Project Team also developed a DTM surface of the top of the existing sediment surface (below normal pool area).

**Breach Inundation Study.** The breach analysis used in this plan was provided by the PADEP Division of Dam Safety. The breach analysis met all of the PADEP Division of Dam Safety's criteria and, provides an incremental breach analysis based on modeling of storage capacity and reservoir surface area for normal pool and maximum storage elevations. The peak breach discharge used for developing the inundation maps was 96,560 cfs using the PADEP incremental analysis. This value falls between the range of the minimum and maximum limit of the minimum peak breach discharges calculated based on TR-60 criteria of 86,289 cfs and 123,512 cfs respectively. The hydrologic and hydraulic analyses were also approved by the PADEP. The NRCS State Conservation Engineer concurs with the hazard

classification of high assigned to this dam. The results of the breach were used to generate the flood inundation maps for the current Hamilton Dam Emergency Action Plan.

**Flood Storage Capacity.** The flood storage curve for existing conditions was developed using the ArcGIS Surface-Volume Tool. The floodwater retarding storage capacity of Hamilton Dam was determined by evaluating the cumulative storage capacity between the normal pool elevation and auxiliary spillway crest elevation.

**Runoff Curve Number.** The Runoff Curve Number (RCN) development for the Hamilton Dam watershed followed TR-55 methodology. Arc Hydro tools, in conjunction with the USACE HEC-GeoHMS software, were used to combine land use data with corresponding soil types and develop a weighted RCN for the entire watershed.

The projected future land use conditions RCN was developed based on the Future Land Use Map provided in the 2005 Tioga County Comprehensive Plan.

**Time of Concentration.** The Time of Concentration (T<sub>c</sub>) was developed using the segmental/velocity approach, described in TR-55, and the USACE HEC-GeoHMS software. An automated tool in HEC-GeoHMS uses the terrain to determine the paths with minimal slope for shallow concentrated flow, sheet flow, and open channel flow. The HEC-GeoHMS tool develops a preliminary longest flow path using the DEM, which can be adjusted as needed. The adjustments include identifying the locations of flow-type transitions from sheet flow to shallow concentrated flow, and from shallow concentrated flow to channel flow.

**Precipitation Data.** Precipitation data for the Hamilton Dam watershed was derived using the following sources:

- Hydrometeorological Report 51 – Probable Maximum Precipitation (PMP) Estimates, United States East of the 105th Meridian, which provides PMP values for various storm durations; and
- NOAA Atlas 14, Volume 2 (Ohio River Basin and Surrounding States) – Provides rainfall depth-duration-frequency data for 13 Mid-Atlantic and central states. The data can be accessed online at <http://hdsc.nws.noaa.gov/hdsc/pfds/>

Rainfall depth from the above-mentioned sources was used to develop design hydrographs and evaluate the principal spillway capacity; stability and integrity of auxiliary spillway; and dam capacity (top of dam elevation).

Technical Release 60 (TR-60) design criteria require that the principal spillway capacity be evaluated by routing the Principal Spillway Hydrograph (PSH) with a combined 1-day/10-day 100-year return period rainfall. Two methods for estimating runoff volumes were considered: (1) the runoff curve number procedure and (2) runoff volumes based on stream gage studies (TR-60, Figures 2-1(a) and 2-1(b)). The procedure that results in the higher auxiliary spillway crest elevation, when the PSH is routed through the structure, will be used for earth auxiliary spillways.

The top of dam elevation and integrity of the auxiliary spillway (e.g., head-cutting and breaching) were evaluated by routing the Freeboard Hydrograph (FBH). For “High Hazard” potential dams, such as the Hamilton Dam, the FBH is generated by a PMP storm. A short duration (6-hour) and a long duration (24-hour) storms were analyzed and the most critical result used. The stability of the auxiliary spillway e.g., erosion and scour along the exit channel) was evaluated by routing the Stability Design Hydrograph (SDH), which was generated by using rainfall depth computed from the following method:

Per TR-60, the rainfall depths are temporally distributed using the standard NRCS 6-hour storm distribution (for the SDH and 6-hour FBH), the NRCS 5-point rainfall curve (for the 24-hour FBH), and the NRCS 1-day/10-day distribution (for the PSH). The 1-day/10-day and 6-hour distributions are applied by SITES directly. The 5-point rainfall curve is a critically stacked distribution, which is developed using PMP data for 6-, 12-, and 24-hour PMP storms. The 6-hour PMP is applied uniformly in the second increment of the stacked distribution. Each of the remaining incremental rainfalls is applied uniformly in adjoining 6-hour increments. A site-specific 5-point rainfall curve for Hamilton Dam was developed using a guidance document/spreadsheet (“5-point 24-hour NRCS Dimensionless Rainfall Distribution & TR-60 SDH/FBH Hydrologic Criteria”) provided by NRCS.



In addition, the Pennsylvania Department of Environmental Protection (PADEP) commonly requires the temporal distribution of the PMP to follow the Hydrometeorological Report 51/52 critically stacked distribution or, for drainage areas less than 10 square miles, a distribution based on USACE EM 1110-2-1411. For Hamilton Dam, the Project Team developed a HEC-1 model using the hydrologic inputs for the SITES model (RCN and Tc) to apply the EM 1110-2-1411 distribution.

**Sediment Volume.** A field survey and a sediment survey evaluation were conducted by the Project Team in May 2016. The sediment survey consisted of physical measurements of existing aerated and submerged sediment depth. Sampling occurred on a 100-foot by 200-foot grid in the permanent pool. Extra measurements were taken to identify the sediment depths in the old stream channel. In the flood pool above the elevation of the permanent pool, evidence of aerated sediment was verified.

The sediment depths were measured at 92 locations. Due to the deep waters in the reservoir, the Project Team developed a 2-inch diameter by 4-foot-long coated steel spud bar that was attached to a rope. The spud bar was then dropped under the influence of the heavy steel density which was enough to drive the spud bar through the sediment layer. Thickness readings were then taken by measuring the loose sediments retained by the granular surface of the spud bar, which was raised up through the water prior to each reading. The weight of the spud bar was sufficient enough to penetrate the submerged sediment, but not so much so that it penetrated the base, making it difficult to pull back up through the water. Location of each reading was collected by a GPS unit. Bottom of sediment elevations were collected by subtracting the wet rope length from the normal pool elevation at each location. Top of sediment elevations were calculated by adding the measured thickness to the bottom elevation at each location.

The areas surrounding the impoundment are vegetated and well maintained (mostly recreational grass areas except for the South and Southwest side of the impoundment where trees are present). An estimation of the existing aerated sediments volume was made by the Project Team visiting the site to look for aerated sediment deposits. Based on field observations and a comparison of the 2016 topographic survey to the original ground shown in the 1967 as-built plans, an estimated aerated sediment volume of 3.82 acre-feet was calculated within the flood pool above the elevation of the permanent pool. Most aerated sediment deposits were found in gravel fan deposits, near the mouth of the tributary upstream of Hamilton Lake, and along the flood pool area adjacent to the lake. The current aerated sedimentation rate (since the dam was built) is approximately 0.08 acre-ft/year. However, based on the predicted future changes in land use, the aerated sedimentation rate is anticipated to decrease to approximately 0.06 acre-feet /year in accordance with SCS-ENG-309.

The 2008 LiDAR survey data from the PA DCNR obtained through the Pennsylvania Spatial Data Access (PASDA) was converted to the as-built plans reference vertical datum and was used to derive the storage values above elevation 1427.50 feet (normal pool). The available LiDAR in the vicinity of the Hamilton Dam reservoir is of high quality and has an acceptable accuracy according to qualitative acceptance report published by PASDA for Tioga County. The Project Team considers the data as the best publicly available supplement to the field survey and meets the need to calculate an accurate storage volume.

The total stage-storage curve (bottom of pool to top of dam) for current conditions was developed using the Surface-Volume tool in ArcGIS, which calculates the area and storage volume of a Digital Elevation Model (DEM) surface above or below a given reference plane.

The current and future yearly reservoir sedimentation rates were evaluated and compared to the original design, using existing and future (build-out) land use conditions, in accordance with NEH Section 3, Chapter 8 and SCS-ENG-309. The soil loss rates for different land use conditions were based on the Hamilton Dam Design Report and were assigned to the current land use types. The planning level evaluation estimated an anticipated submerged sedimentation rate of 0.64 acre-feet/year and an anticipated aerated sedimentation rate of 0.06 acre-ft/year.

The total existing storage volume reserved for water supply is 455.92 acre-feet (333.92 acre-feet allotted for water supply and 122 acre-feet for evaporation and seepage from the original design report.) With a measured storage volume of 534.07 acre-feet at permanent pool elevation 1427.5, the current remaining capacity of available for sediment storage is 78.15 acre-feet in the reservoir. Therefore, based on the 2016 sediment survey and estimated submerged sedimentation rate, the remaining life of the existing

sediment pool would extend to the year 2138. The estimated corresponding additional aerated sediment capacity of 6.0 acre-feet over that same 100-year period can be accommodated by the available floodwater retarding storage capacity (1,945.84 acre-feet).

**Water Supply.** The Borough of Wellsboro explored additional sources of water supply from wells and surface water with an Alternative Water Supply Proposal completed in 2004. Information from this proposal was used to develop costs for maintaining adequate water supply for Wellsboro.

A reliable yield assessment was completed to evaluate Hamilton Dam watershed with respect to supply and evaluate water supply storage. The Borough of Wellsboro utilizes several sources of water supply. Sources include six groundwater wells, three surface water intakes and an intake at Hamilton Lake.

The water supply analysis methodology chosen for Hamilton Lake was limited by the amount of available inputs data. A spreadsheet analysis was developed to describe the current water demand and the benefits of the alternatives chosen to increase water supply storage in Hamilton Lake.

Data was collected from the Sponsor and nationally recognized climate data sources as inputs into the spreadsheet model. Daily reservoir withdrawals were collected and totaled for the years 2005-2015. Wellsboro does not purchase any additional water from neighboring utilities. Precipitation and evapotranspiration data was collected from the Daymet climate data and Prism Climate Group. The reservoir storage-elevation data developed during this study was utilized and population projections were gathered.

Low flow from Hamilton Dam of 1.24 cfs (800,000 gallons per day) is required by Water Allocation Permit 326A, dated 1984. This is a revised permit from the original issued in 1951. There is currently no low-flow augmentation device on the dam, as the original withdrawal permit would not have required it. The Borough of Wellsboro currently maintains low flow using a pond drain.

The water supply intake elevation was surveyed on November 6, 2016 and found to have an invert of 1407.8 feet and a crown elevation of 1409.13 feet. Seepage and evaporation (122 acre-ft) was subtracted from the storage volume calculated above the water supply inlet. The available storage was then calculated for three scenarios as the reported available storage for municipal water supply storage of 333.92 acre-feet and additional storage created by raising the principal spillway elevation incrementally.

The average daily withdrawal was calculated for each month of data available. A maximum yearly average daily withdrawal of 642,890 gallons per day was used as the estimate of average daily demand to the system. An additional value was added to daily demand to account for required stream discharge from the dam of 1.24 cfs, an equivalent of 800,000 gallons per day (per Wellsboro Water Allocation Permit) for a total of 1,442,890 gallons per day withdrawn from the reservoir. Also referenced in the water allocation permit was a limitation of “daily withdrawal of 1.15 MGD unless a new treatment plant capable of treating up to 2.0 MGD has been completed; then the allocation shall be for an annual average withdrawal of 1.5 MGD and a maximum day withdrawal of 2.0 MGD.”

Monthly precipitation and evapotranspiration data from 1980 to 2015 were utilized for the model. Evapotranspiration was estimated using the Penman-Monteith equation and subtracted from precipitation for each month to obtain a net depth of water. The net depth of water was distributed over the Hamilton Lake watershed to simulate monthly inflow volume supplied.

The spreadsheet model was set up to simulate a water balance based on the supply and demand on a monthly basis. If, after demand was subtracted from available runoff, water remained at the end of the month, the surplus amount was added to the previous month's storage volume. Conversely, if insufficient runoff was available to satisfy demands, the deficiency was subtracted from the previous month's storage volume. If the total capacity of the reservoir was exceeded at the end of a month, storage was set equal to total reservoir capacity.

This simulation was performed for 6 scenarios, Current, Current +1 foot of added storage, Current +2 feet of storage, Current +3 feet of storage, Current +4 feet of storage, and Current +5 feet of storage. Each scenario was run in the spreadsheet model over the time period from 1980 to 2015 (432 months). The scenarios were run for each level of increase in the storage for Hamilton Lake. The total number of

months the reservoirs had 10% or less available volume was calculated for each scenario and results were applied to alternative formulation and evaluation in consultation with the Borough of Wellsboro.

**Site Walk.** The Project Team conducted a site visit to document the current conditions of Hamilton Dam, located in Tioga County, Pennsylvania on June 15, 2016. The site visit included a visual review and photographic documentation of the exposed areas of the dam and associated structures.

**Principal Spillway Video Inspection.** The Project Team performed a TV inspection of the Hamilton Dam principal spillway on July 20, 2016. The objectives of the inspection were to document the current condition of the principal spillway outlet pipe and riser structure, measure the joint gap at each pipe segment, and identify any potential issues.

The Project Team technicians used a remotely operated vehicle (ROV) mounted with a camera, to perform the principal spillway pipe inspection. The camera was inserted at the outlet structure, and directed to crawl the length of the spillway to the riser. The spillway was inspected to identify any deformities, sags, cracks, or other items of note. In addition to collecting photo-video data of the pipe, the technicians also mounted a laser scope on the crawler, which collected a 360-degree laser indexed measurement to assess the roundness of the pipe, for any signs of sagging or creep.

The Project Team also used this laser capture to estimate the joint width measurements, in postproduction. Photos of the joint gap spaces and condition were taken with the ROV facing upstream at each joint in the outlet pipe at four positions: 9 o'clock, 12 o'clock, 3 o'clock, and 6 o'clock. The camera on the ROV is steerable and was rotated and turned to take picture approximately normal to the interior pipe surface at each joint. A video inspection of the entire pipe section was also performed and recorded to provide additional observations.

**Toe Drain Video Inspection.** The Project Team performed a TV inspection of the Hamilton Dam toe drains on July 20, 2016. The objective of the inspection was to document the current condition and identify any potential issues of the embankment drains. Due to the complex configuration with multiple 90-degree bends of the toe drains, The Project Team opted to use a "pushcam" apparatus to perform the inspection. This equipment provided video inspection by manually pushing the camera through the 6-inch diameter corrugated metal drain pipe.

TV inspection of the toe drains was limited due to difficulty in navigating the 90-degree bends. The west toe drain pipe was observed that the pipe was more than 50% submerged with water. The line appeared to be sloping downwards and the further the camera was pushed it, the more it kept getting submerged under the debris filled water. The camera was pushed along and on the first 90-degree bend, 2 feet into the pipe, but the camera kept snaking downwards and into the debris. On further attempts to shake away the debris and push through the bend, the camera head was stuck and wouldn't go any further past the first bend.

The east toe drain presented similar conditions – pipe full of water and debris making it difficult to video the line. Only about 2 feet of pipe was videoed in this segment.

**Slope Stability.** The Project Team estimated the slope stability of the existing dam by numerically modeling a two-dimensional section through the embankment and subgrade using Geo-Slope International's Geo-Studio 2012 software entitled SLOPE/W and SEEP/W. The Project Team used the section from the as-built plans as a template for the analysis cross-section. The soil properties and material zones for the analyses were based on soil properties from the original design documents and comparison to the result of the 2016 geology investigation and testing.

The Project Team considered four general Conditions to evaluate the stability of the dam:

- Condition 1 – The low pool stage at the invert of the inlet pipe to evaluate end-of-construction conditions (Not evaluated due to the age of the dam).
- Condition 2 – Sudden drawdown from the permanent pool to the lowest ungated stage.
- Condition 3 – The flood stage pool at the maximum design elevation.
- Condition 4 – Pseudo-Static Seismic analysis at permanent pool stage, downstream face using horizontal seismic acceleration of PGAM = 0.189g for the site.

For each stability analysis, we use optimized failure surfaces. The stability analysis results indicate that the factors of safety exceed the Draft TR-60 (2016), Table 5-2 requirement for Cases T2 and T3, and Table 5-2, TR-60 (2005) for Case T4. Graphic outputs were provided for each stability case as well as the graphic output for the simplified seepage analysis.

Additionally, for the Pennsylvania Code, 25 PA Code § 105.97 criteria analyses, the Project Team analyzed the following four general cases to evaluate the stability of the dam.

- Case P1: Normal pool, Elevation 1427.5 feet, with steady-state seepage conditions
- Case P2: Maximum pool (crest of dam) (Elevation 1462.2 feet per as-built plans)
- Case P3: Sudden Drawdown from permanent pool to lowest ungated discharge, Elevation 1427.5 feet to Elevation 1391 feet (upstream slope).
- Case P4: Pseudo-static Seismic analysis at permanent pool stage, Elevation 1427.5 feet, downstream face using MCE horizontal seismic acceleration of  $PGA_m = 0.079g$  for the site.

Because NRCS completed construction of Hamilton Dam 51 years ago, the end-of-construction, Case P5 was not evaluated.

Based upon the original design soil parameters, current studies and conservative assumed conditions, it is the Project Team's opinion that the seepage/stability analyses indicate that the dam meets the current (2005) and draft (2016) NRCS TR-60 slope stability requirements. The dam also meets the current 25 PA Code § 105.97 standard for static and earthquake stability at normal pool as well as for the flood case and for sudden drawdown.

**Downstream Effects.** A hydrologic evaluation of the entire Marsh Creek watershed was completed for three scenarios: the existing conditions (with Hamilton Dam in-place), with Hamilton Dam rehabilitated and the FWOP scenario with Hamilton Dam removed. Hydrologic models of the watershed were developed to determine the peak discharges downstream of the dam for 100-year and 500-year, 24-hour storm events.

A HEC-HMS model was developed for the 7 uncontrolled subareas and the 3 subareas controlled by existing structures. The stage-storage-discharge relationships for the PA-600 and PA-601 dams were taken from the original design documentation and as-built drawings for the dams. The stage-storage-discharge relationships for Hamilton Dam were taken from the SITES routing results.

The USACE HEC-RAS version 5.03 hydraulic computer model was used to analyze the study reaches within the Marsh Creek Watershed. Specific interest was in two reaches: (1) Downstream from Hamilton Dam to the confluence of Charleston Creek with Marsh Creek and (2) Along Marsh Creek to the confluence with Wolf Run, corresponding with the downstream benefit area.

The developed HEC-RAS model considered three scenarios for the 100-year and 500-year storm events: (1) Hamilton Dam as it exists today, (2) a FWOP scenario with Hamilton Dam removed, and (3) Hamilton Dam for the rehabilitation alternative. Cross sections for the HEC-RAS models were developed in ESRI ArcMap using Pennsylvania 1-meter DEM LiDAR elevation data. Stream centerlines were digitized from the available aerial photography. Manning's  $n$  values were estimated from aerial photography along with HEC-RAS User's Manual. Bank stations were set based on LiDAR data. HEC-RAS results for the 100-year and 500-year flood events were mapped based on the elevation data from the LiDAR 1-meter DEM.

The results of hydraulic study mapping show the increased flooding with the Hamilton Dam removed. Removal of the Hamilton Dam for decommissioning or FWOP would result in increased downstream flooding depths and damages. Without the Hamilton Dam, an additional 7 residential properties and 14 commercial properties would experience flooding and during the 100-year event; flood depths would increase 1.3 to 6.1 feet along Charleston Creek and 0.4 to 1.3 feet along Marsh Creek for 99 residential and 32 commercial properties if the dam were removed.

The peak discharges for the existing and rehabilitated Hamilton Dam scenarios were nearly the same (less than 1 percent difference) at all locations for the 100-year event, so there is no discernable difference with the mapping. For the 500-year event, the peak discharge increases from approximately 1,100 cfs to 2,100 cfs for the rehabilitated auxiliary spillway versus existing auxiliary spillway. For the 500-year event there is increased



flooding depth for approximately 1,800 of stream length directly downstream of the dam; Areas impacted by the increased 500-year water level consist of the stream corridor and a paved lot.

One government housing property for elderly, handicapped and disabled persons was identified within the 500-year floodplain approximately two miles downstream from the existing Hamilton Dam. A second government housing property for elderly, handicapped and disabled persons would be within the 500-year floodplain with Hamilton Dam removed. It was checked to see if increasing the level of flood protection at Hamilton Dam could lower the 500-year floodplain below the property in the existing 500-year floodplain, but it was determined to not be possible due to the effects of uncontrolled drainage downstream from the dam.

***Alternative Formulation.*** The Project Team completed a conceptual/preliminary engineering analysis to determine the alternatives to be evaluated in detail. The alternatives considered included the following:

Future Without Federal Project (FWOP) (No Action) – The FWOP Alternative was identified in coordination with NRCS and the Sponsor and is also known as the No Action Alternative. The FWOP Alternative is a minimum level Sponsor breach of the dam, as directed by PADEP. According to the National Watershed Program Handbook, FWOP is based on the course of action that the Sponsor is most likely to take in the event that no federally-financed rehabilitation works were to be undertaken.

The FWOP Alternative would consist of removing the dam to essentially restore the stream to its natural, free-flowing state through the impoundment and dam footprint based on the approval requirements of PADEP for dam removals.

Rehabilitation to Current High Hazard Potential Dam Standards – Multiple rehabilitation options were considered during the engineering analysis and eliminated from detailed evaluation in consultation with the Sponsor. Rehabilitation options considered modifications to the auxiliary spillway, dam crest and/or principal spillway to upgrade the dam to Current NRCS High Hazard Potential criteria. Changes included widening and raising the auxiliary spillway, raising the crest elevation, modifying the principal spillway, armoring the spillway and combinations thereof. All the rehabilitation options include extending the design life of the project an additional 100 years and upgrading the internal drainage controls in the dam. The preferred rehabilitation option, for detailed evaluation, was selected based on effectiveness, efficiency, constructability, and compatibility with the purpose and need for the project.

The preferred alternative to rehabilitate Hamilton Dam would require construction and modifications in four locations of the dam: (1) the auxiliary spillway, (2) the principal spillway, (3) the downstream toe, and (4) the upstream face of the dam. This alternative is detailed in Option 3, below.

The Project Team formulated a matrix of dam features, deficiencies and potential solutions to explore options for dam rehabilitation. Options were evaluated in consultation with the Borough of Wellsboro. Rehabilitation options considered and either selected or dismissed from further evaluation included the following:

1. Construct a new RCC armored spillway within the dam embankment with a 280-foot-wide crest at Elevation 1452.6. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Close existing auxiliary spillway. Maintain settled dam crest at Elevation 1462.4 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct the impact basin at the outlet. Dismissed from further evaluation due to higher cost.
2. Install labyrinth weir structure with crest at Elevation 1452.6 in 175-foot auxiliary spillway and regrade channel. Armor auxiliary spillway crest and exit channel with RCC to valley floor. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Maintain settled dam crest at Elevation 1462.4 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct an impact basin at the outlet. Dismissed from further evaluation due to higher cost.
3. Install labyrinth weir structure with crest at Elevation 1452.6 in 175-foot auxiliary spillway and regrade channel. Armor auxiliary spillway crest and exit channel with RCC to 10 feet above valley

floor and outlet to vegetated channel to valley floor. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Maintain settled dam crest at Elevation 1462.4 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct an impact basin at the outlet. Selected for further evaluation due to being an option that provides redundancy with the principal spillway and auxiliary spillway at separate locations on dam and low cost (within 2.5% of lowest option.)

4. Construct a new labyrinth weir spillway with crest at Elevation 1452.6 within the dam embankment with a 150-foot width and RCC armored spillway. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Close existing auxiliary spillway. Maintain settled dam crest at Elevation 1462.4 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct the impact basin at the outlet. Dismissed from further evaluation due to acceptability to Sponsor.
5. Install labyrinth weir structure with crest at Elevation 1457.9 to increase flood protection to 500-year level; maintain 175-foot auxiliary spillway width and regrade channel. Armor auxiliary spillway crest and exit channel with RCC to valley floor. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Raise dam crest 4.7 feet to Elevation 1467.1 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct an impact basin at the outlet. Dismissed from further evaluation due to higher cost, social disruption from upstream land acquisition requirements and lack of significant benefits gained in providing 500-year protection.
6. Construct a RCC armored spillway with crest at Elevation 1453.6 to maintain current level of activation for the auxiliary spillway; keep existing 175-foot auxiliary spillway width and regrade channel. Armor auxiliary spillway crest and exit channel with RCC to valley floor. Modify riser to raise orifice crest 2.0 feet to Elevation 1429.5 for increased water supply. Raise dam crest 3.4 feet to Elevation 1465.8 and flatten downstream slope of dam to 3:1. Extend principal spillway conduit and re-construct an impact basin at the outlet. Dismissed from further evaluation due to higher cost and social disruption from upstream land acquisition requirements.

Dam Decommissioning with Nonstructural and Other Measures – The Decommissioning Alternative was formulated to restore the stream by reconnecting the upstream and downstream channel in a non-erosive manner and restoring the stream/river. The dam embankment would be excavated to allow normal flows and up to 100-year flood flows through the site in a non-erosive manner. Accumulated sediment would not be removed. The Decommission Alternative was developed in consideration of guidance in NRCS National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes, and Practices.

The Decommissioning Alternative would eliminate flood storage and protection provided by the dam, which could possibly expose downstream properties to an increased risk of flooding, property damage, and loss of human life. As a result, the Decommissioning Alternative alone would not meet the objective to maintain the downstream flood damage reductions provided by the existing project. To meet this objective, the Decommissioning Alternative would have to be supplemented by other measures such as floodproofing or relocation of structures located within the 100-year floodplain.

A government property providing housing for elderly, handicapped and disabled persons would be within the 500-year flood area if Hamilton Dam were removed.

Also, to meet the Sponsor's purpose and need, the water supply and incidental recreation aspects of Hamilton Lake would need to be relocated or replaced. Estimated costs of the Nonstructural and Other Measures consider relocation, property acquisition, demolition, and site stabilization/restoration along with decommissioning utilities, septic structures, wells and similar facilities.

Acquisition/Relocation of At-Risk Structures and Other Nonstructural Measures (Floodproofing in the Inundation Areas) – These alternatives were formulated to remove the downstream hazard and allows the Hamilton Dam to be reclassified as a Significant Hazard potential dam. Land use restrictions were considered to prevent future upgrades to High Hazard potential dam due to downstream development within the breach inundation area. The threat to human life from sudden dam failure would be reduced by relocating the residential and commercial structures and raising and/or relocating the roadways within the potential breach inundation.

**Cost Estimates.** The Project Team prepared predictions of probable costs for all alternatives. The predictions of probable costs are intended for comparing the alternatives. Unless otherwise noted predictions of probable costs were prepared using the RS Means method for engineering cost estimation. Comparison of costs to the rehabilitation option selected for detailed study is shown in the table below.

**Table D-4 – Rehabilitation Option Comparisons**

| Feature                                  | Option 1    | Option 2    | Option 3    | Option 4    | Option 5    | Option 6    |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Opinion of Probable Costs for Comparison | \$7,193,000 | \$7,258,000 | \$6,634,000 | \$6,464,000 | \$9,183,000 | \$7,610,000 |
| Cost Relative to Lowest Cost Alternative | 111%        | 112%        | 103%        | 100%        | 142%        | 118%        |

Rehabilitation Alternative Option 4 was the most cost-effective alternative, but Options 1, 2 and 3 were within the contingency values of the planning cost estimates. With the comparable costs, additional environmental and social effects, and operation during passage of the design floods were compared. Consequently, Rehabilitation Alternative Option 3, was considered for detailed evaluation in consultation with the Sponsor.

## **Appendix E**

### **PROJECT DATA**



| <b>Public Law 83-566 Project Information</b><br><b>Marsh Creek Watershed Supplemental Watershed Plan/EE</b><br><b>Hamilton Dam (PA-602)</b><br><b>Charleston Township, Tioga County, PA</b> |                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| <b>Rehab General Description Data</b>                                                                                                                                                       |                                                   |
| Project Number                                                                                                                                                                              | 422016                                            |
| Hydrologic Unit Area:                                                                                                                                                                       | 020502050301                                      |
| Longitude (decimal format):                                                                                                                                                                 | -77.26481                                         |
| Latitude (decimal format):                                                                                                                                                                  | 41.73967                                          |
| Area of Project (acres):                                                                                                                                                                    | 5,408                                             |
| Project Evaluation Life:                                                                                                                                                                    | 103 Years                                         |
| Project Discount Rate:                                                                                                                                                                      | 3.00%                                             |
| Price Base:                                                                                                                                                                                 | 2019                                              |
| B/C Ratio:                                                                                                                                                                                  | 6.25 to 1.0                                       |
| Total Cost (Table 1):                                                                                                                                                                       | \$6,634,000                                       |
| Total Public Law 83-566 Cost:                                                                                                                                                               | \$4,836,000                                       |
| Dam Number                                                                                                                                                                                  | PA-602                                            |
| National Inventory of Dams (NID):                                                                                                                                                           | PA00033                                           |
| Congressional District of dam:                                                                                                                                                              | 10-PA                                             |
| FIPS Code of dam:                                                                                                                                                                           | 42117                                             |
| # Single-Purpose Floodwater Retarding Structures Planned:                                                                                                                                   | 0                                                 |
| # Multi-Purpose Structures Planned:                                                                                                                                                         | 1                                                 |
| Rehab Project Purposes:                                                                                                                                                                     | Flood Damage Reduction,<br>Municipal Water Supply |

|                                                                                                                                                                                             |                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| <b>Public Law 83-566 Project Information</b><br><b>Marsh Creek Watershed Supplemental Watershed Plan/EE</b><br><b>Hamilton Dam (PA-602)</b><br><b>Charleston Township, Tioga County, PA</b> |                                       |
| <b>Sponsor Data</b>                                                                                                                                                                         |                                       |
| Organization:                                                                                                                                                                               | Wellsboro Borough Municipal Authority |
| Sponsor Representative (optional):                                                                                                                                                          | Scot F. Boyce, Jr.                    |
| Sponsor Title:                                                                                                                                                                              | Borough Manager                       |
| Sponsor Type:                                                                                                                                                                               | Borough                               |
| Address:                                                                                                                                                                                    | 14 Crafton Street                     |
| City:                                                                                                                                                                                       | Wellsboro                             |
| State:                                                                                                                                                                                      | Pennsylvania                          |
| Zip:                                                                                                                                                                                        | 16901                                 |
| Phone:                                                                                                                                                                                      | 570.724.3186                          |
| Email:                                                                                                                                                                                      | Wellsboromanager@ptd.net              |
| O&M Responsibility (Yes/No):                                                                                                                                                                | Yes                                   |

| <b>Public Law 83-566 Project Information</b><br><b>Marsh Creek Watershed Supplemental Watershed Plan/EE</b><br><b>Hamilton Dam (PA-602)</b><br><b>Charleston Township, Tioga County, PA</b> |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Rehab Budget Request Data</b>                                                                                                                                                            |             |
| Failure Index:                                                                                                                                                                              | 117         |
| Population at Risk:                                                                                                                                                                         | 1,650       |
| Price Base:                                                                                                                                                                                 | 2019        |
| Estimated Installation Cost (Watershed Agreement):                                                                                                                                          | \$6,634,000 |
| Priority - State Dam Safety Agency:                                                                                                                                                         | Low         |
| Number of Municipal Water Supply Users:                                                                                                                                                     | 4,000       |

| <b>Public Law 83-566 Project Information</b><br><b>Marsh Creek Watershed Supplemental Watershed Plan/EE</b><br><b>Hamilton Dam (PA-602)</b><br><b>Charleston Township, Tioga County, PA</b> |                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| <b>Rehab Subset of Benefits Data</b>                                                                                                                                                        |                         |
| Price Base:                                                                                                                                                                                 | 2019                    |
| Total Funds Needed (FA/TA) (Table 1): Public Law-83-566 NRCS                                                                                                                                | \$4,836,000/\$1,500,000 |
| Other Than Public Law-83-566:                                                                                                                                                               | \$1,798,000             |
| Agricultural Related Flood Damage Reduction Benefits (Average Annual):                                                                                                                      | \$ 533,000              |
| Other Benefits – Cost Avoidance (Average Annual):                                                                                                                                           | \$ 229,000              |
| Other Benefits – Water Supply (Average Annual):                                                                                                                                             | \$ 75,000               |
| Other Benefits - Recreation (Average Annual):                                                                                                                                               | \$ 556,000              |
| Beneficiaries (No.):                                                                                                                                                                        | 41,981                  |
| Visitor Days (Optional):                                                                                                                                                                    | --                      |
| Farms and Ranches Benefited (No.):                                                                                                                                                          | Not Evaluated           |
| Bridges Benefited (No.):                                                                                                                                                                    | 10                      |
| Public Facilities Benefited (No.):                                                                                                                                                          | 0                       |
| Businesses Benefited (No.):                                                                                                                                                                 | 64                      |
| Homes Benefited (No.):                                                                                                                                                                      | 98                      |
| Reduced Erosion (Tons/Yr.):                                                                                                                                                                 | 0                       |
| Reduced Sedimentation (Tons/Yr.):                                                                                                                                                           | 1,098                   |
| Streams/Corridors Enhanced/Protected (Miles):                                                                                                                                               | 12                      |
| Lakes/Reservoirs Enhanced/Projected (Surface Acres):                                                                                                                                        | 41.8                    |
| Domestic Water Supplies Benefited (No.):                                                                                                                                                    | 1                       |
| Incidental Recreation Benefited (No. of Water Bodies/Stream Segments):                                                                                                                      | 1                       |
| Groundwater Recharge (Acre-Feet):                                                                                                                                                           | 0                       |
| Wetlands Created, Enhanced, or Restored (Acres):                                                                                                                                            | 0                       |
| Upland/Riparian Habitat Created/Enhanced (Acres):                                                                                                                                           | 0                       |
| Threatened and Endangered Species Benefited:                                                                                                                                                | 0                       |
| Population with Reduced Risk:                                                                                                                                                               | 1,650                   |