FINDING OF NO SIGNIFICANT IMPACT

Integrated Detailed Project Report
and Environmental Assessment
Seneca Nation of Indians Territory Ecosystem Restoration Project
Cattaraugus County, New York

In accordance with the National Environmental Policy Act and its implementing regulations, an Environmental Assessment (EA) has been integrated into the Detailed Project Report for the Seneca Nation of Indians Ecosystem Restoration Project, proposed under Section 1135, located along the Allegheny River in Cattaraugus County, New York. This project is located within the Allegheny Reservoir, upstream of the Kinzua Dam. The report analyzed five alternatives in detail to restore aquatic and floodplain habitat within the Study Area including a "No Action" alternative (Alternative 1), an alternative that combined measures for Harmful Algal Bloom (HAB) improvement with sediment removal, mechanical aeration, native species planting, invasive species removal and bank stabilization with installation of a rock berm (Alternative 2), an alternative that combined sediment removal, mechanical aeration, native species planting, invasive species removal and bank stabilization with installation of rip rap (Alternative 3), an alternative without aeration that combined sediment removal, native species planting, invasive species removal and bank stabilization with installation of a rock berm (Alternative 4) and an alternative without aeration that combined sediment removal, native species planting, invasive species removal and bank stabilization with installation of rip rap (Alternative 5). Alternative 5 was selected as the preferred alternative. This alternative includes the restoration of aquatic habitat through the removal of sediment and seasonal planting of native aquatic plants to improve HABs, invasive species removal and treatment, native species planting and the installation of rip rap for bank stabilization. Seasonal plantings are proposed at six locations, for a total over 240 acres. Excavation is proposed over 10 acres with onsite disposal approximated at 5 acres. The rip rap blanket footprint was estimated at 3.3 acres.

The EA determined that the proposed action will not result in significant impacts to the natural or human environment. The proposed action does not require the preparation of an Environmental Impact Statement (EIS). All environmental, social, and economic factors that are relevant to the proposal were considered in this assessment. These include, but are not limited to, water quality, air quality, noise, wetlands, wildlife, threatened and endangered species, and cultural resources. The primary benefit of the proposed project would be the restoration of aquatic and riparian habitat. Adverse effects would be temporary in nature and include temporary noise, dust, air quality, and water quality impacts. Best management practices would be employed to minimize these temporary effects. These effects were deemed to be non-significant.

A 45-day public comment period on the draft EA occurred from June 17, 2019 to August 1, 2019. Additionally, a public meeting was held at the Seneca Nation of Indians headquarters located in Salamanca, New York, on June 24, 2019. A total of five comment letters were received and have been included in the final EA.

Based on the EA, the proposed Federal activity will not have any significant adverse impacts on the environment and the proposed project will not constitute a major federal action significantly

affecting the quality of the human environment. Therefore, an EIS is not required and will not be prepared.

Jonathan E. Klink Digitally signed by Jonathan E. Klink
Date: 2020.03.28 10:44:36 -04'00'

Jonathan E. Klink, PMP
Lieutenant Colonel, Corps of Engineers
Pittsburgh District Commander

28-March-2020
Date

US Army Corps
of Engineers ®
Pittsburgh District

Integrated Detailed Project Report and Environmental Assessment

Seneca Nation of Indians Territory Ecosystem Restoration Project Cattaraugus County, New York

Conducted Pursuant to Water Resources Development Act 1986, Section 1135, as amended

Harmful Algal Bloom, Allegheny Reservoir August 8, 2017

March 2020

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1.0.0 **INTRODUCTION**

The Seneca Nation of Indians Ecosystem Restoration Project is a feasibility planning study conducted under Section 1135 of the Water Resources Development Act (WRDA) of 1986. This project is a cost-shared partnership between the Seneca Nation of Indians and the U.S. Army Corps of Engineers (Corps). The Seneca Nation of Indians, a federally recognized Indian tribe, is listed in the January 17, 2017 Federal Register Notice published by the Bureau of Indian Affairs, U.S. Department of the Interior, of tribal entities recognized and eligible for funding and services by virtue of their status as Indian Tribes. The Seneca Nation of Indians functions as an autonomous and sovereign nation, which provides a wide range of services and opportunities to their members and their communities.

Seneca Nation territories are on their ancestral lands; the Allegheny Mountains and Allegheny River have been home to many generations and will remain for numerous generations to come. The Seneca people traditionally lived in New York between the Genesee River and Canandaigua Lake and as far south as northwestern Pennsylvania; however, currently the Seneca Nation territories are located strictly in Western New York State. The Seneca Nation consists of five territories. These territories are adjacent to the counties of Allegany, Cattaraugus, Chautauqua, Erie and Niagara in Western New York, an area of the state where communities are primarily rural in geographic location. The territories are not contiguous and each parcel is unique in its economic, social, and environmental profile. The Seneca Nation Allegany Territory is located along the Allegheny River in Cattaraugus County, New York and includes the City of Salamanca, as shown in Figure 1.

Figure 1 - Seneca Nation Allegany Territory

The Allegheny River is in the most current natural state during the winter, when the Kinzua Dam gates are open and only are utilized as flood control structures. The gates close in the spring and the Allegheny River becomes a lake system forming the Allegheny Reservoir. The impoundment area is typically inundated during most of the summer and covers one-third of the Seneca Nation Allegany Territory. The Seneca people call the Allegheny River - Ohi:yo', which translates to the good river or beautiful river. Whether the system is a river during the winter or a lake during the summer, to the Seneca people the Allegheny River or Allegheny Reservoir is always Ohi:yo' and will be referred to as such in this report.

This Detailed Project Report/Environmental Assessment (DPR/EA) documents the feasibility phase of the planning process for environmental restoration within the Study Area, defined below, to demonstrate consistency with both the applicable Congressional authorization and Corps planning policy. In addition, this DPR/EA demonstrates consistency, compliance, and consideration of potential environmental effects in accordance with the National Environmental Policy Act (NEPA).

Opportunities will be presented for the public to provide comments on potentially affected resources, environmental issues to be considered, and the Corps' approach to the analysis.

The feasibility study and each alternative explored includes: consideration of monitoring, adaptive management, and operations and maintenance requirements. During the feasibility phase, the federal government is responsible for the first $100,000 in costs. Beyond that, the Seneca Nation is responsible for providing 50% of the feasibility study costs. The design and implementation phase for any project that is recommended for implementation coming out of this study would have a different cost share. The Federal share of planning, design, and construction cannot exceed $10,000,000 per project. The Seneca Nation is entitled to a waiver in the design and construction phase of the project, up to an amount of $766,250 as outlined in Section 1156 of WRDA 2018 and the Economic Guidance Memorandum 19-06, dated September 2019. Beyond this initial $766,250, the Seneca Nation would be responsible for 25% of the cost.

1.1.0 STUDY PURPOSE AND SCOPE

As stated in 33 USC 2309a(c)(1), if the Secretary determines that construction of a water resources project by the Secretary or operation of a water resources project constructed by the Secretary has contributed to the degradation of the quality of the environment, the Secretary may undertake measures for restoration of environmental quality and measures for enhancement of environmental quality that are associated with the restoration, through modifications either at the project site or at other locations that have been affected by the construction or operation of the project, if such measures do not conflict with the authorized project purposes.

The purpose of this study is to formulate and analyze a series of ecosystem restoration alternatives to restore ecosystem function, structure, and dynamic processes to Ohi:yo,' where the construction and operation of an existing Corps project (Kinzua Dam) has directly contributed to the degradation of the quality of the environment. The historical conversion of the

free-flowing river to a fluctuating reservoir environment has resulted in ecosystem degradation throughout the Study Area. There are multiple processes impacting the environment adjacent and upstream from the Kinzua Dam. The operation of the dam is dictated by two factors: flood protection and downstream water quality control. Regulation of the pool to meet these authorized purposes creates drastic changes in the water level, shown in Figure 2. Additionally, the operation of the non-Federal hydroelectric facility alters water levels throughout the Study Area daily. As appropriate, the study will recommend a National Ecosystem Restoration (NER) plan for implementation under the Section 1135 program.

Figure 2 - From northern end of Bear Claw looking downstream 10-24-2017(left) and 6-21-2017 (right)

The study scope addresses a number of impacts upon the ecosystem. The Seneca Nation's primary concerns include the proliferation of harmful algal blooms (HABs), riparian zone degradation, invasive plant species, and degraded fish habitat. The occurrence and severity of HABs in Ohi:yo' have increased over the last five years. A decline and/or loss of available fish habitat have caused a decrease in the number and diversity of fish as well as other aquatic species over time. Spawning and rearing habitat for target aquatic species such as paddlefish and walleye are limited in the Study Area. The Seneca Nation was recently successful in establishing a stocking program, including a walleye hatchery, which appears to have enhanced the fishery. Erosion throughout the impoundment area increased the turbidity while increasing the amount of lost land and vegetation, shown in Figure 3.

1.2.0 LOCATION

Figure 3 - Erosion on the upper bank

The Study Area, shown in Figure 4, spans the border between Pennsylvania and New York. Within Pennsylvania, the reservoir is surrounded by the Allegheny National Forest. In New York, the reservoir is bounded by the Allegheny State Park and the Seneca Nation Allegany Territory. The reservoir is managed to provide flood risk reduction and flow augmentation for downstream water quality. A collection of Seneca and local community members still use Ohi:yo' for sustenance. There are numerous Seneca Nation and public recreational features within or adjacent to the Study Area, including marinas, state and local parks, campgrounds, hiking trails, and boat launches. Highbanks Campground is owned and operated by the Seneca Nation. The campground includes over 89 camping sites plus 36 cabins. Poor summer water quality and continued erosion threaten the viability of this campsite.

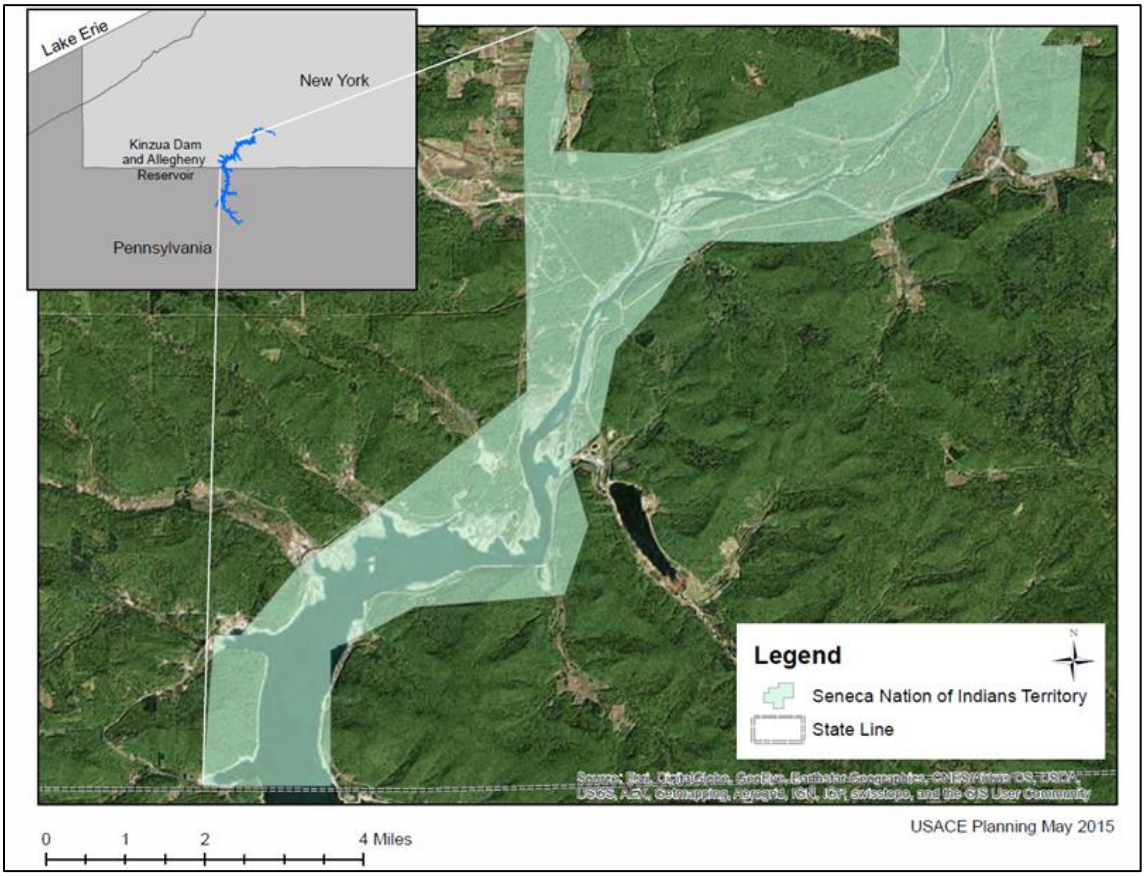

Figure 4 - Boundaries of the Seneca Nation Territory in the vicinity of the Section 1135 Project

1.2.1 Study Area

This project will focus on specific areas associated with the Ohi:yo' impoundment formed by the Kinzua Dam as shown in Figure 5 Study Area. The Study Area is defined by the purple boundary and all considered measures will fall within the limits of this boundary in Figure 5. Completion of the multipurpose Kinzua Dam near Warren, Pennsylvania, in 1965 impounded Ohi:yo', creating a reservoir that occupies portions of NW Pennsylvania and SW New York. The total surface area of the 24-mile long reservoir is 21,180 acres and the maximum storage pool is 1,180,000 acre-feet. The drainage area of the Allegheny River above the dam is 2,180 square miles (1.4 million acres).

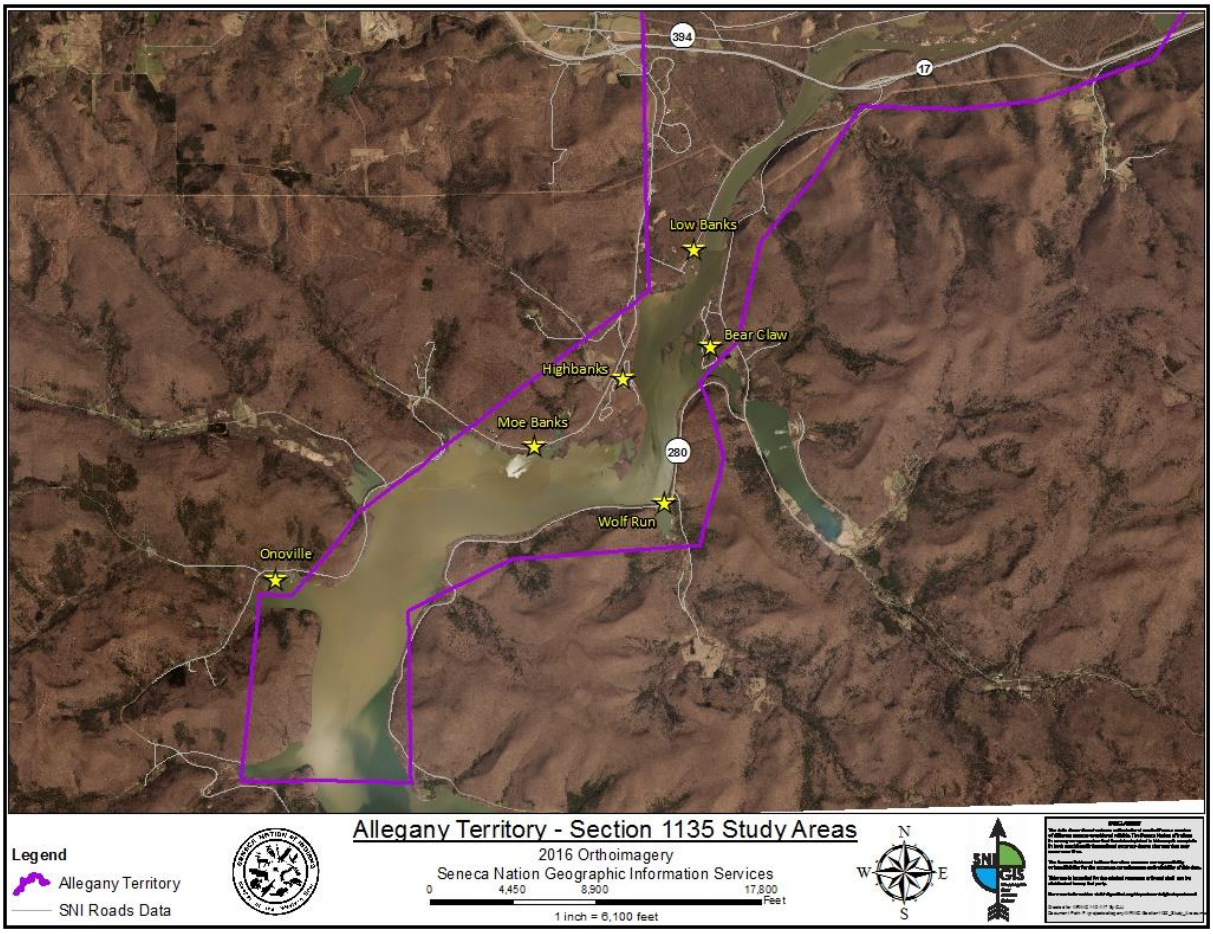

Figure 5 – Study and Project Area

The multiple species of fish and other resources in the reservoir have always been an integral component of Seneca Nation culture and physical sustenance. Restoration of water quality and fisheries habitat within the reservoir is a priority for the Seneca Nation. Since 2012, HABs have occurred annually and in recent years the blooms have required human health notifications (warnings) from July through October. The Seneca Nation utilizes the U.S. Army Corps of Engineers (USACE) Pittsburgh HAB response plan, in accordance with World Health Organization (WHO) guidelines, to respond to summer HAB events to track the location and severity of blooms.

1.2.2 Project Area: Kinzua Dam and Ohi:yo'

Kinzua Dam provides flood risk management and flow augmentation for downstream water quality, as authorized by the Flood Control Acts of 1936, 1938, and 1941. Since the completion of the dam, it is estimated to have prevented $1.2 billion in flood damages. The dam also supports hydroelectric power generation. The Seneca Pumped Storage Generating Station is located south of the dam and generates approximately 450 megawatts of electricity every year. It was originally owned and operated by FirstEnergy Corporation but was sold to LS Power of New York City in 2013. Both the Seneca Pumped Storage Project and Kinzua Dam operations cause fluctuations to Ohi:yo' water surface elevations, which affect Seneca Nation land, water, and aquatic resources. Impacts from fluctuating water levels include potentially trapping fish in backwaters, desiccating littoral habitat vital for fishes, amphibians, and invertebrates, as well as causing erosion and sedimentation in the Allegany Territory.

The project area is located within the same area as the study area (Figure 5) and includes multiple areas of proposed work further described in Section 3.6.0 and shown in Figure 35.

1.3.0 STUDY AUTHORITY

This DPR/EA is prepared under the authority of Section 1135 of the Water Resources and Development Act of 1986, as amended. Section 1135 provides the Corps the authority to evaluate potential modifications to existing Corps' water resource projects for the purpose of improving the environment in the public interest. The Pittsburgh District, in collaboration with the Seneca Nation, analyzed problems and opportunities in the Study Area and developed a Federal Interest Determination that was approved by the USACE Great Lakes and Ohio River Division on July 17, 2015. The project Feasibility Study Cost Share Agreement was executed on August 17, 2016. In December 2016, the Pittsburgh District received the initial portion of federal cost-share funds to initiate the feasibility study and at that time also requested the Seneca Nation cost share portion. The feasibility cost share proportion is 50/50, with the Seneca Nation providing both funds and work-in-kind (WIK) value for their proportion.

1.4.0 RELEVANT PRIOR STUDIES AND REPORTS

Seneca Nation has applied for and received several grants to improve fisheries in the reservoir and other territorial waters. In 2010, the U.S. Fish & Wildlife Service (USFWS) provided funding to construct a Walleye Fish Hatchery (Seneca Nation 2017a). The Seneca Nation matched the funds with lands, manpower, machinery, and cash. Construction was completed in 2012. The Seneca Nation Fish and Wildlife Department's goal with the hatchery was to produce 2.5 million fry, between 15,000-25,000 walleye fingerlings and 1,000-1,500 juveniles for release into the Ohi:yo' annually (Seneca Nation 2017a). Walleye, a popular sport fish, has great cultural importance to the Seneca Nation and provides an important food source for the Nation (WGRZ 2014).

In 2014, Seneca Nation applied for and received $350,000 in grant funding (with $250,000 matching funds) from the National Fish and Wildlife Foundation to reconnect and restore the Ohi:yo' (National Fish and Wildlife Foundation 2017). Goals of this effort include riparian

buffer restoration and reconnection of ten land-locked areas near the reservoir. Additionally, the Seneca Nation places Christmas trees within the reservoir and constructs/places artificial habitat structures to benefit fish habitat within the Study Area (WGRZ 2015).

The New York State Department of Environmental Conservation (NYSDEC) initiated a paddlefish recovery program in 1998 within Ohi:yo'. Paddlefish spend their summers in the upper reservoir and overwinter in the deeper Pennsylvania portion of the reservoir (NYSDEC 2016b). NYSDEC continues to stock and monitor the population. Paddlefish restoration is being conducted to restore a historic fishery and set the basis for a future sport fishery. As discussed above, the ability of paddlefish to move freely between spawning and non-spawning habitats is critical for their population recovery. HABs have the potential to strand paddlefish in less productive waters during the summer and fall. This may restrict their access to food supplies and limit growth rates and could result in death for any juvenile paddlefish that enter the anoxic environment created by HABs.

The 2014 Annual Report of New York Parks (New York State, 2014) reported 1.6 million visitors visited the four parks in the Allegheny Region. The Quaker Area of the Allegheny State Park is known for its lakes and camping opportunities. It offers a sandy beach, two fishing piers, and boating access points. A total of 189 campsites and 230 cabins are available. Though these largely center on Quaker Lake and Quaker Run, which are outside the Study Area, the State Park reaches down to Ohi:yo'. The Friends Boat Launch, within the Quaker Area of the State Park, provides access to the reservoir for recreationalists in the area. This boat launch has parking for 35 vehicles with trailers. Use of this launch and associated tourism are impacted by HABs.

The following existing studies and reports helped inform the development of this document. There are other studies specifically referenced throughout this report where applicable.

- Allegheny National Forest Land and Resource Management Plan (USDA, 2007)
- Allegheny State Park Master Plan (NYPRH, 2010)
- Environmental Assessment, Operation and Maintenance of Kinzua Dam and Allegheny Reservoir (USACE, 1986)
- Allegheny River Reservoir Regulation Manual, Pittsburgh District, USACE, 1977 [Change 2 – 29 March 2011].

2.0.0 AFFECTED ENVIRONMENT

2.1.0 CLIMATE

The climate in Salamanca, New York is temperate with an appreciable variation in temperature. The average daily high temperature ranges from 33°F in January to 81°F in July, whereas the average daily low temperature ranges from 12°F in January to 54°F in July (shown in Figure 6). The mean annual air temperature in the Study Area is 45 to 50 degrees F. The mean annual precipitation is 39 to 48 inches and winds are primarily westerly. The frost-free period is at least 105 days and the average annual snowfall is 95 inches.

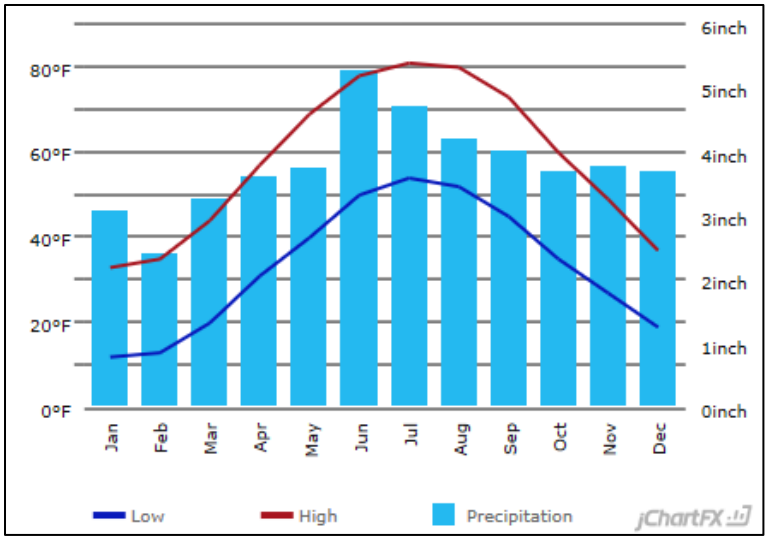

Figure 6 - Salamanca Climate Graph (www.usclimatedata.com)

Climate change impacts are already occurring in New York. Average annual temperatures statewide have risen about 2.4 °F since 1970, and precipitation has increased and become more concentrated to the winter months. Between 1958 and 2012, the Northeast saw more than a 70% increase in the amount of rainfall measured during heavy rain events (NYSDEC, 2017). Visser et al. (2016) have shown that the expected future changes, including increased temperatures, and increased atmospheric carbon dioxide, are likely to exacerbate harmful algal blooms. For Ohi:yo', the expected climate changes over the next 50 years would increase the intensity of harmful algal blooms.

Corps policy as stated in Engineering and Construction Bulletin 2016-25, "Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects," requires consideration of climate change in current and future studies to reduce vulnerabilities and enhance the resilience of our water resources infrastructure. A qualitative analysis of the Allegheny River Basin conducted by USACE (found in Appendix E), did not indicate what definitive impacts climate change will hold for river hydrology. The recommendation is to treat the potential effects of climate change as occurring within the uncertainty range calculated for the current hydrologic analysis.

2.2.0 SOILS AND GEOLOGY

2.2.1 Geology and Physiography

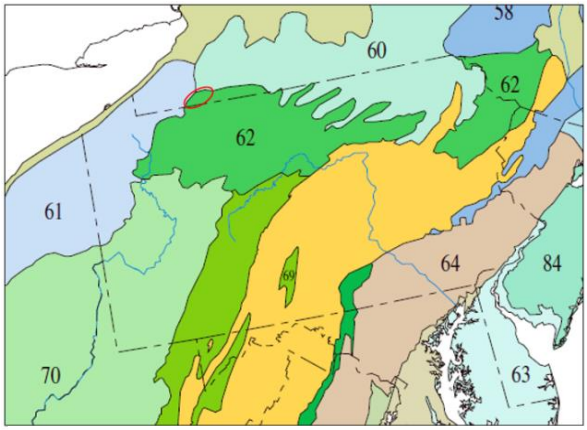

Figure 7 - Unglaciated High Appalachian Plateau ecoregion boundary in the Study Area

The Study Area lies at the northwestern extent of the North Central Appalachians ecoregion (62), contiguous with the Erie Drift Plain (61) and with Northern Appalachian Plateau and Uplands (60; EPA 2013). The North Central Appalachians ecoregion is a vast, elevated plateau composed of horizontally bedded sandstone, shale, siltstone, conglomerate, and coal. Its highly dissected hills and low mountains were only partly glaciated, shown in Figure 7. The region reaches its highest elevations in south central New York on erosion-resistant sandstones. Soils, derived from residuum, colluvium, and till, often have a frigid temperature regime; they are low in nutrients and support extensive northern hardwood and Appalachian oak forests, with isolated highland pockets of spruce and fir.

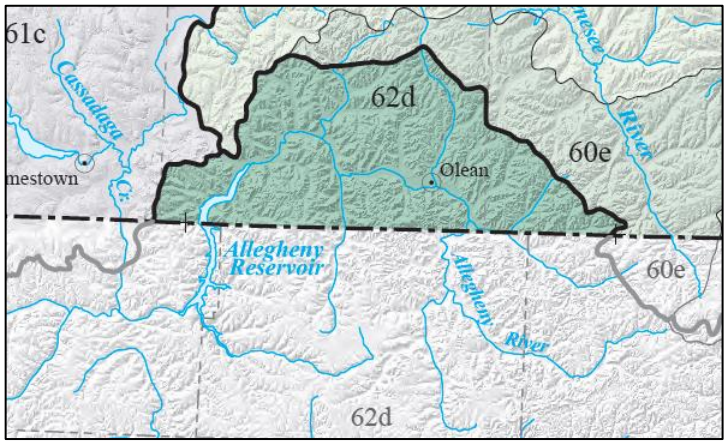

Figure 8 - Level III Ecoregions in Study Area region

In this ecoregion (shown in Figure 8), the Study Area is confined within the Unglaciated High Allegheny Plateau (62d, Level IV ecoregion). This area generally follows the course of Ohi:yo', and is characterized as a deeply dissected highland composed of eroded plateau remnants, steep hills, and narrow valleys. It is the most northerly region of unglaciated landscapes in eastern North America. Soils tend to be nutrient poor and the area is heavily forested. Pre-settlement forests contained a high percentage of both hemlock and beech, which species are scarce today (Bryce et al. 2010). Elevation in the area ranges from 1,284 feet where Ohi:yo' enters Pennsylvania to about 2,400 feet at the plateau top.

2.2.2 Soil Associations

Soils were formed in colluvial and residual material derived dominantly from Mississippian and Pennsylvanian bedrock consisting of acid shale, siltstone, and sandstone (shown in Figure 9). Selected area of interest covers approximately 9,520 acres with 32% water with prominent soils outlined in Table 1.

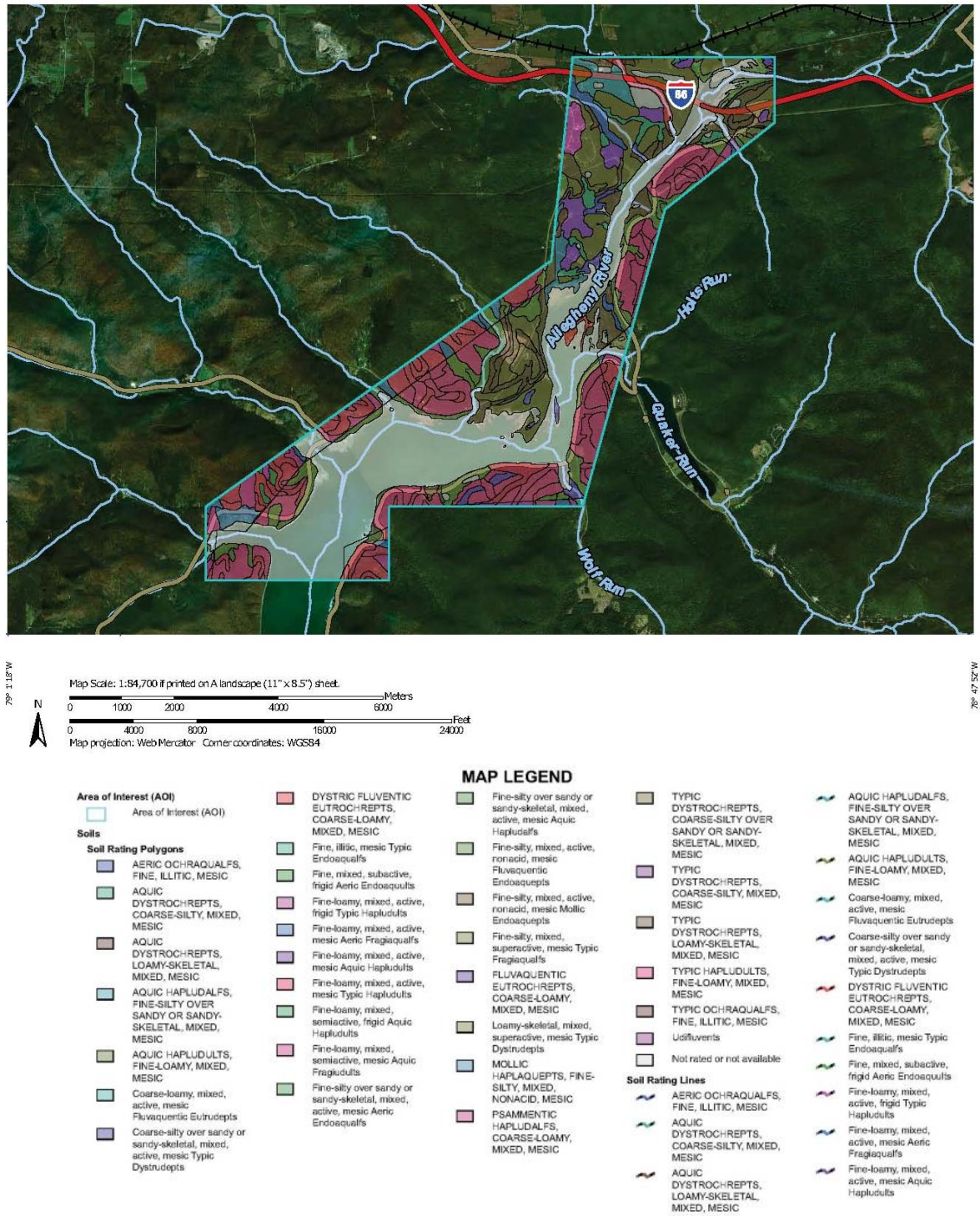

Figure 9 - Map displaying Web Soil Survey results showing soils in Study Area

Table 1 - Web Soil Survey results showing soils in Study Area

Soil	Percent of AOI	Parent material	Typical profile	Hydrologic Soil Group
Allard silt loam, 0 to 3 percent slopes	10%	Silty eolian, glaciolacustrine, or old alluvial deposits over sandy and gravelly glaciofluvial deposits	• H1 - 0 to 9": silt loam • H2 - 9 to 27": silt loam • H3 - 27 to 60": stratified very gravelly loamy san	B
Allard silt loam, 3 to 8 percent slopes	1.5%	Silty eolian, glaciolacustrine, or old alluvial deposits over sandy and gravelly glaciofluvial deposits	• H1 - 0 to 9": silt loam • H2 - 9 to 27": silt loam • H3 - 27 to 60": stratified very gravelly loamy san	B
Allard variant silt loam, 0 to 3 percent slopes	1.2%	Silty eolian, glaciolacustrine, or old alluvial deposits over sandy and gravelly glaciofluvial deposits	• H1 - 0 to 9": silt loam • H2 - 9 to 23": silt loam • H3 - 23 to 36": silty clay loam • H4 - 36 to 60": very gravelly loamy sand	C
Brinkerton variant silt loam	2%	Loamy colluvium derived from acid shale and siltstone	• H1 - 0 to 3": silt loam • H2 - 3 to 15": silt loam • H3 - 15 to 38": channery silt loam • H4 - 38 to 45": channery loam	C/D
Chenango gravelly loam, 0 to 3 percent slopes	2.1%	Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone	• H1 - 0 to 8": gravelly loam • H2 - 8 to 30": very gravelly loam • H3 - 30 to 60": very gravelly loamy sand	A
Chenango gravelly loam, 3 to 8 percent slopes	1.2%	Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone	• H1 - 0 to 8": gravelly loam • H2 - 8 to 30": very gravelly loam • H3 - 30 to 60": very gravelly loamy sand	A

Soil	Percent of AOI	Parent material	Typical profile	Hydrologic Soil Group
Ernest variant silt loam, 15 to 25 percent slopes	2.1%	Acid loamy colluvium derived from shale, siltstone, and sandstone	• H1 - 0 to 2": silt loam • H2 - 2 to 20": silt loam • H3 - 20 to 46": channery clay loam • H4 - 46 to 60": channery silty clay loam	C
Gilpin channery silt loam, 35 to 65 percent slopes	1.3%	Acid fine-loamy residuum weathered from shale and siltstone and/or fine-grained sandstone	• Oi - 0 to 2": slightly decomposed plant material • A - 2 to 3": channery silt loam • E - 3 to 7": silt loam • Bt - 7 to 24": channery silt loam • C - 24 to 31": extremely channery silt loam • R - 31 to 41": bedrock	C
Middlebury silt loam	1%	Loamy alluvium predominantly from areas of shale and sandstone with some lime-bearing material	• H1 - 0 to 9": silt loam • H2 - 9 to 37": silt loam • H3 - 37 to 60": stratified sand to fine sand to silt loam	B/D
Pits, gravel	1.2%		• H1 - 0 to 6": very gravelly sand • H2 - 6 to 72": very gravelly coarse sand	
Rayne channery silt loam, 15 to 25 percent slopes	2.4%	Loamy residuum weathered from interbedded shale, siltstone, and sandstone	• H1 - 0 to 7": channery silt loam • H2 - 7 to 20": channery silt loam • H3 - 20 to 60": channery silt loam	B
Rayne channery silt loam, 25 to 35 percent slopes	7.8%	Loamy residuum weathered from interbedded shale, siltstone, and sandstone	• H1 - 0 to 7": channery silt loam • H2 - 7 to 20": channery silt loam • H3 - 20 to 60": channery silt loam	B

Soil	Percent of AOI	Parent material	Typical profile	Hydrologic Soil Group
Rayne channery silt loam, 35 to 65 percent slopes	3.1%	Loamy residuum weathered from interbedded shale, siltstone, and sandstone	• H1 - 0 to 7": channery silt loam • H2 - 7 to 20": channery silt loam • H3 - 20 to 60": channery silt loam	B
Scio silt loam	1.4%	Glaciolacustrine deposits, eolian deposits, or old alluvium, comprised mainly of silt and very fine sand	• H1 - 0 to 10": silt loam • H2 - 10 to 34": silt loam • H3 - 34 to 42": silt loam • H4 - 42 to 60": stratified very gravelly loamy sand to sandy loam	B/D
Unadilla silt loam	2%	Glaciolacustrine deposits, eolian deposits, or old alluvium, comprised mainly of silt and very fine sand	• H1 - 0 to 9": silt loam • H2 - 9 to 38": very fine sandy loam • H3 - 38 to 60": fine sandy loam	B
Wayland soils complex, 0 to 3 percent slopes, frequently flooded	1.3%	Silty and clayey alluvium derived from interbedded sedimentary rock	• A - 0 to 6": silt loam • Bg1 - 6 to 12": silt loam • Bg2 - 12 to 18": silt loam • C1 - 18 to 46": silt loam • C2 - 46 to 72": silty clay loam	B/D

2.2.3 Hydric Soils

The Study Area contains both hydric and non-hydric soils, shown in Figure 10.

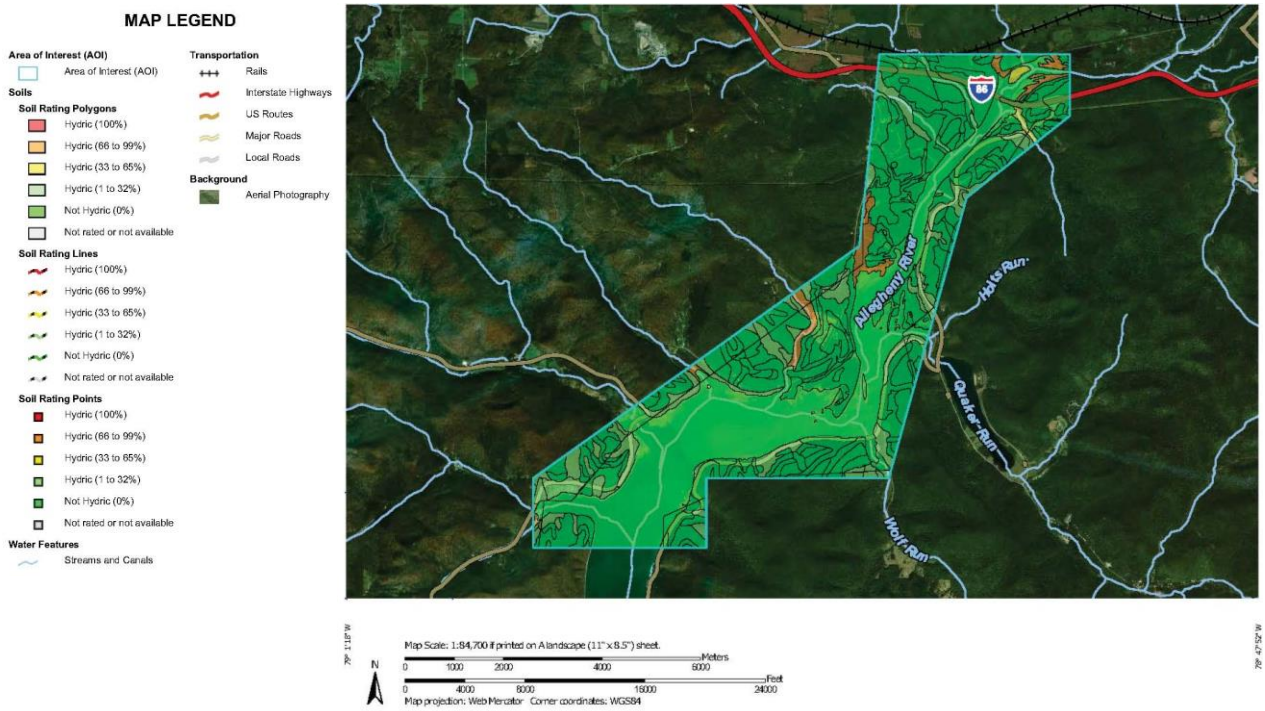

Figure 10 - Map showing soil properties

2.2.4 Harmful Algal Blooms

The intent of the proposed action is to substantially reduce or eliminate HABs in the Study Area. By eliminating HABs, the presence of the associated toxin is also expected to be eliminated. Microcystin, one of the toxins produced by cyanobacteria can be present in lake sediments (Song et al 2015). In addition, cyanotoxins have been found in crops and soils from contaminated irrigation waters, with microcystin found at and several centimeters below the surface (EPA 2015d). Chen et al. (2006) looked at the impacts of contaminated waters on crops and found that microcystin in soils had a half-life of 7 to 18 days. They note a concern, particularly during rainy season that use of contaminated waters on agricultural lands may allow for the leaching of these persistent toxins into groundwater. Drobac et al (2013) note the inhalation is a potential exposure route for humans. They also found that sediment samples from dry river beds in the desert of Qatar had levels of microcystin such that the amount of dust inhaled by a person could surpass the tolerable daily intake recommended by the World Health Organization. Yang et al (2016) note that human exposure to microcystin toxins contained within dredged sediment is possible through plant uptake or by leaching to groundwater.

2.3.0 SURFACE WATER AND OTHER AQUATIC RESOURCES

2.3.1 Surface Water

Prior to the construction of the Kinzua Dam (shown in Figure 11), the Ohi:yo was a free flowing river and when the gates at the Kinzua Dam are opened, Ohi:yo is returned to a natural river state with an elevation of approximately 1,324 feet. In 1966 the Kinzua Dam became operational and creates a lake system when the dam is utilized for downstream flood protection while reducing pollution and improving the quality and quantity of water for domestic, industrial and recreation downstream use. The approximate elevation of Ohi:yo' when the gates at the Kinzua Dam are closed is 1,348 feet with a maximum storage at the 1,365-foot elevation level, water elevation shown in Figure 12.

Figure 11 - Kinzua Dam

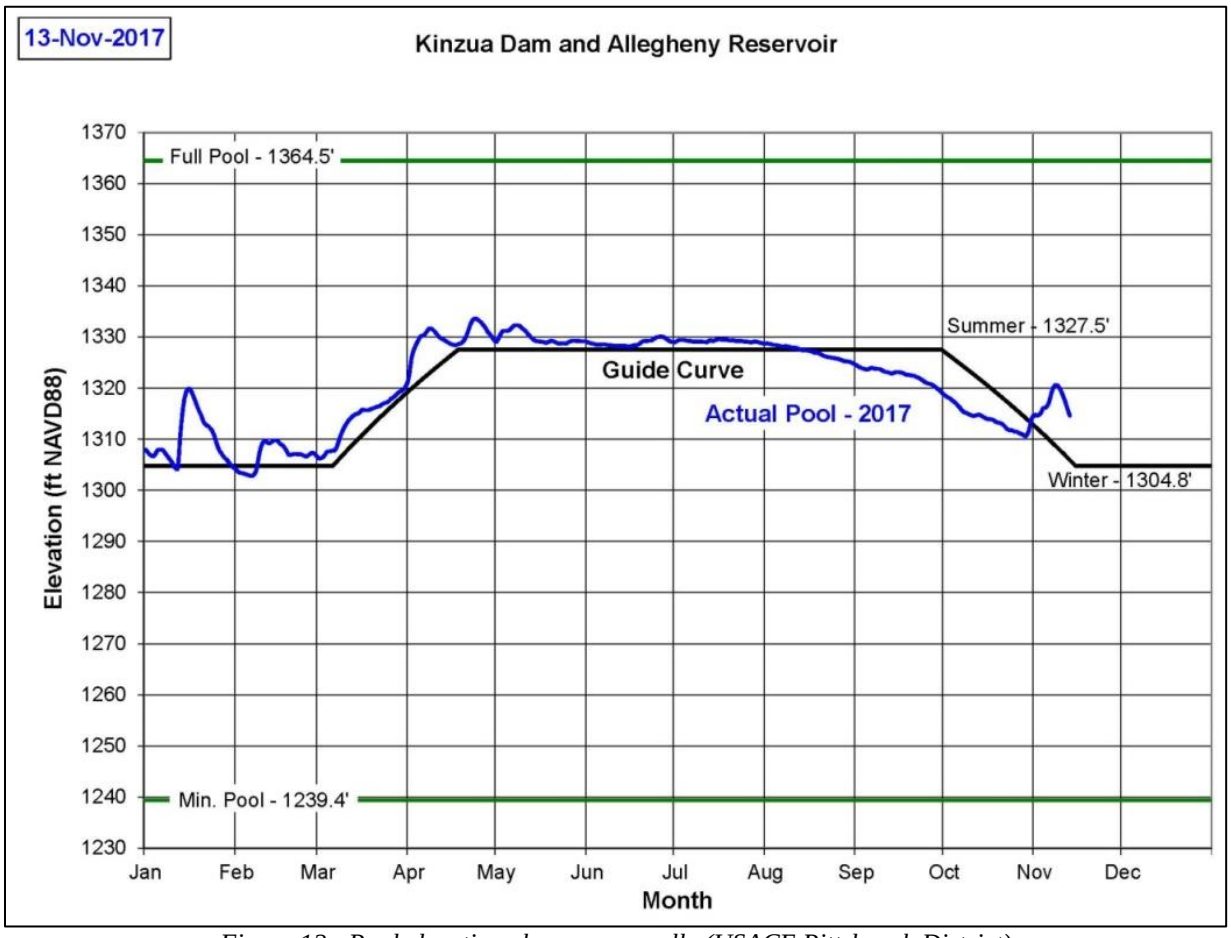

Figure 12 - Pool elevation changes annually (USACE Pittsburgh District)

The changes in pool elevation measured at the Kinzua Dam (shown in Figure 13) are not reflective of the upstream impacts. The U.S. Geological Survey (USGS) station at the control house at Kinzua Dam on Allegheny River, 3 miles upstream from Hemlock Run, and 7 miles east of Warren (Lat 41`50'17", long 79`00'15", Warren County, Hydrologic Unit 05010001, in Allegheny National Forest) indicates only minor changes when much more drastic variations occur throughout the reservoir, shown in Figure 14.

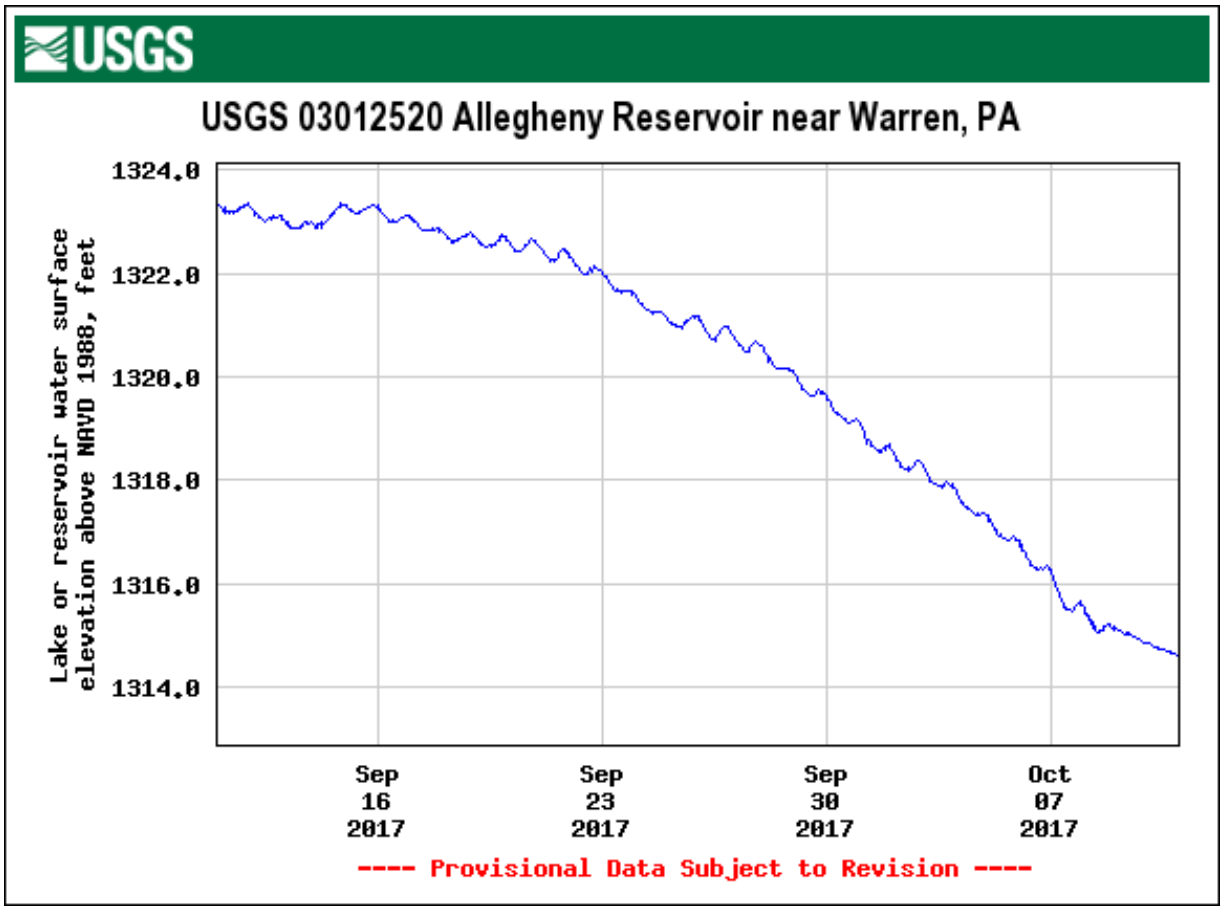

Figure 13 - USGS gage station at Kinzua Dam from September 9, 2017 to October 10, 2017

Figure 14 - Bear Claw (Quaker Bay) September 11, 2017 (left) versus October 10, 2017 (right)

Water quality conditions in Ohi:yo' have been monitored by USACE Pittsburgh District in conjunction with the Seneca Nation. A database is underway on a user friendly format at the Seneca Nation GIS website (https://gis.sni.org/wrwg/). Measured nutrient levels, both Nitrogen (N) and Phosphorus (P) are lower now than levels recorded in the early 1970s, although Ohi:yo' is included in the PROPOSED FINAL New York State 2016 Section 303(d) List of Impaired/TMDL Waters.

Historically, P levels would have resulted in the reservoir being classified as hyper-eutrophic. The current P level indicates that the trophic state of Ohi:yo' is eutrophic. As a eutrophic system, it is expected that high levels of algae would be found periodically in the water body. Algae remove nutrients from the water column for growth, generate oxygen through photosynthesis during daylight, and take up oxygen via respiration during darkness. Phosphorus is typically the nutrient whose availability limits algal growth, so a reduction in available P typically translates into reduced algal growth levels in a water body.

Reservoir outflow data for other water quality parameters such as Total Acidity, Total Iron, Manganese, and Aluminum, Specific Conductivity, and Total Hardness all indicate that their respective levels have decreased since the late 1960s. The degree to which these reductions are reflective of decreases in external loadings or the maturity of the reservoir itself is unknown. Sediment sampling completed in 2015 and 2017 indicate that the primary issue within the reservoir is nutrient loading, whereas no priority pollutants, heavy metals or pesticides were identified in any of the samples.

2.3.2 Groundwater

The groundwater migration through the soil varies throughout the Study Area. The terrain along Ohi:yo' is comprised of mud flats in some areas with rocky banks on steep slopes in other areas. Therefore, as the movement of groundwater varies by soil type, certain areas are dominated by soils that are highly conductive, but there are also areas with poorly draining soils that experience frequent flooding, shown in Table 2 and Figure 15.

Table 2 - Soil properties vary throughout the Study Area

Soil	**Natural drainage class**	**Capacity of the most limiting layer to transmit water (Ksat)**	**Depth to water table (inches)**
Allard silt loam	Well drained	Moderately high to high (0.57 to 1.98 in/hr.)	More than 80
Allard variant silt loam	Moderately well drained	Moderately high to high (0.20 to 1.98 in/hr.)	About 24 to 36
Brinkerton variant silt loam	Somewhat poorly drained	Moderately low to moderately high (0.06 to 0.57 in/hr.)	About 6 to 18
Chenango gravelly loam	Well drained	Moderately high to high (0.57 to 5.95 in/hr.)	More than 80
Ernest Variant silt loam	Moderately well drained	Moderately low to moderately high (0.06 to 0.57 in/hr.)	About 18 to 36
Gilpin channery silt loam	Well drained	Moderately low to high (0.06 to 2.00 in/hr.)	More than 80
Middlebury silt loam	Moderately well drained	Moderately high to high (0.57 to 1.98 in/hr.)	About 6 to 24
Rayne Channery silt loam	Well drained	Moderately high to high (0.57 to 1.98 in/hr.)	More than 80
Scio silt loam	Moderately well drained	Moderately high to high (0.57 to 1.98 in/hr.)	About 18 to 24
Unadilla silt loam	Well drained	Moderately high to high (0.57 to 1.98 in/hr.)	More than 80
Wayland soils complex	Poorly drained, frequently flooded	Moderately low to high (0.14 to 14.17 in/hr.)	About 0 to 6

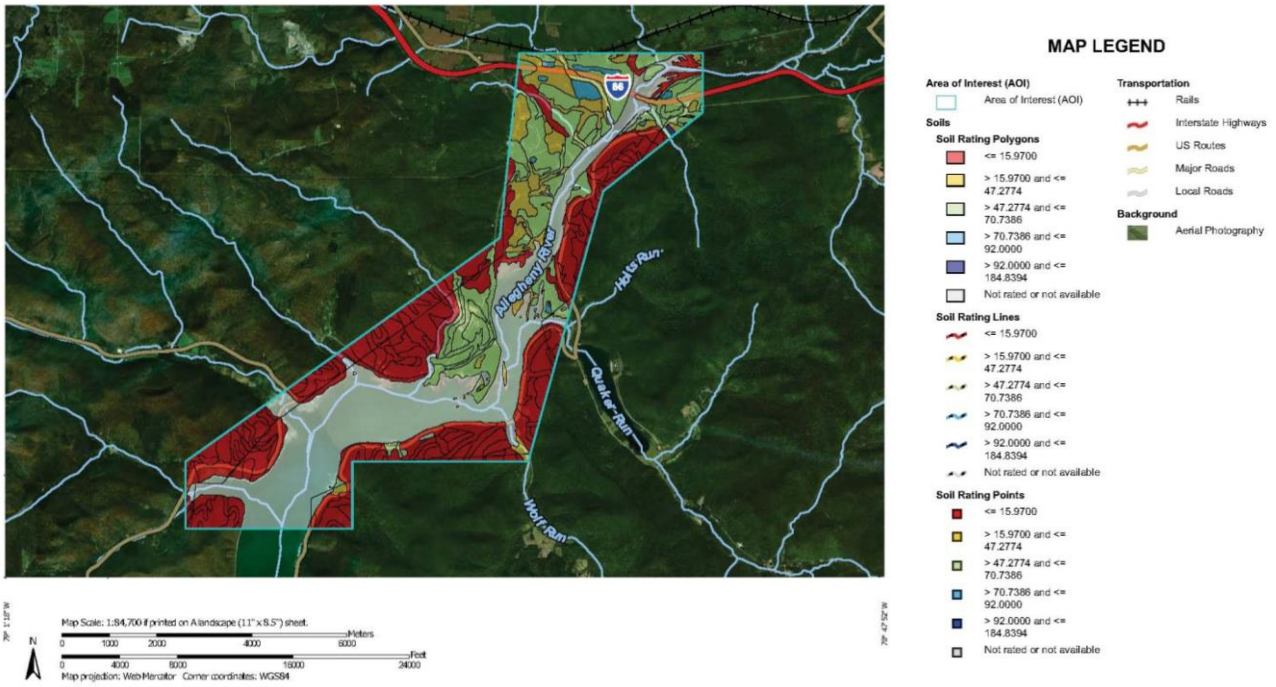

Figure 15 - Rating from 15 μm/s (red) to 71 μm/s (blue)

2.3.3 Floodplains

The entire Study Area is located within the floodplain (shown in Figure 16) as the project boundary is the 1,365 foot inundation elevation. The inundation is due to the water storage during half of the year; the majority of the land cannot be utilized for development. There are a few temporary camps along the banks with housing only placed on higher ground, farther back from the summer shoreline. The Seneca Nation community that originally occupied the land adjacent to Ohi:yo were moved to a higher elevation in Steamburg, although the small residential area is still within the floodplain in the Study Area.

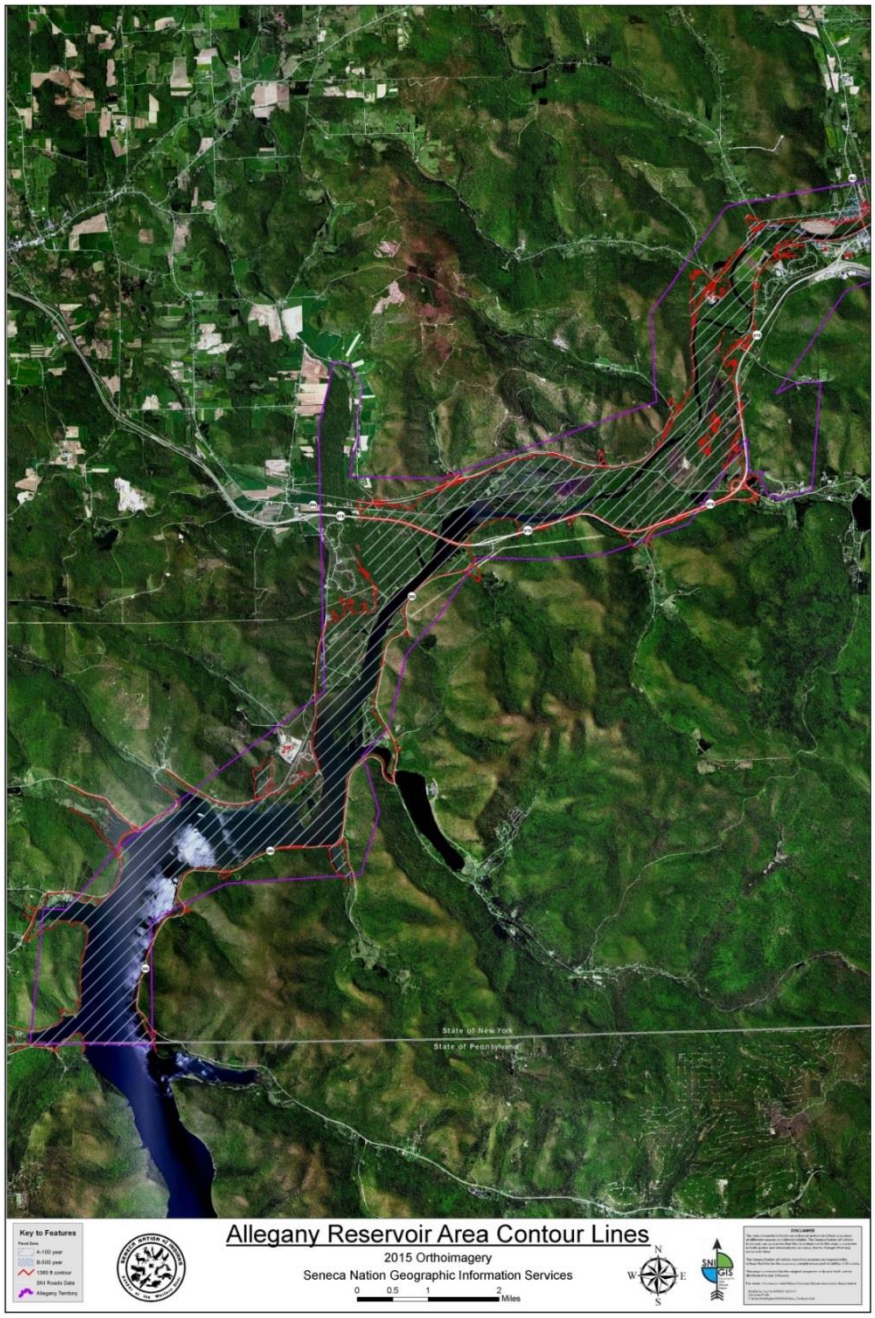

Figure 16 - Contour lines

2.3.4 Wetlands

According to the National Wetlands Inventory (NWI), there are areas of wetlands within the Study Area. In the Allegheny Basin, 1.68% of land cover is considered woody wetlands and 0.05% is considered emergent wetlands. It is unlikely that there were historical wetlands at this location before human development of a dam. No wetlands have been field identified within the Study Area; however, prior to construction a wetland delineation will be conducted.

Description for code L1UBHh:

- L System LACUSTRINE: The Lacustrine System includes wetlands and deep water habitats with all of the following characteristics: 1. situated in a topographic depression or a dammed river channel; 2. lacking trees, shrubs, persistent emergent, emergent mosses or lichens with greater than 30% areal coverage; 3. total area exceeds 8 hectares (20 acres).
- 1 Subsystem LIMNETIC: Extends outward from Littoral boundary and includes all deep-water habitats within the Lacustrine System.
- UB Class UNCONSOLIDATED BOTTOM: Includes all wetlands and deep water habitats with at least 25% cover of particles smaller than stones (less than 6-7 cm), and a vegetative cover less than 30%.

Modifier(s):

- H WATER REGIME Permanently Flooded: Water covers the land surface throughout the year in all years.
- h SPECIAL MODIFIER Diked/Impounded: These wetlands have been created or modified by a man-made barrier or dam which obstructs the inflow or outflow of water. The descriptors 'diked' and 'impounded' have been combined into a single modifier since the observed effect on wetlands is similar. They have been combined here due to image interpretation limitations. For clarification of the extent of impoundment see discussion of Lacustrine System limits.

2.4.0 FISH AND WILDLIFE HABITATS

2.4.1 Terrestrial and Aquatic Vegetation

Ohi:yo' is situated within the Allegheny Forest; the Allegheny Plateau was mostly clear due to logging so the forest is dominated by secondary growth. This ecoregion is characterized by temperate broadleaf and mixed forests. Within the Study Area, existing vegetation is typical of the Upper Allegheny River and includes a variety of native tree species such as dogwoods, maples, willows, American sycamore, green ash, eastern cottonwood, slippery elm, yellow birch, assorted Hemlock, and American basswood. It also includes a wide variety of native grasses, forbs, and shrubs. The existing community also includes large stands of non-native species including Japanese knotweed, purple loosestrife, reed canary grass, numerous thistles, water-willow, and several species of smartweed.

2.4.2 Fauna

The Allegheny region has undergone changes over time due to deforestation for lumber, paper, wood pulp products and wood chemical plants followed by forest conservation and wildlife conservation efforts. Currently the region harbors numerous fish and wildlife including rare (not threatened or endangered) animal species. Many of the species within the Study Area are common. Common mammal species likely to occur include: white tailed deer, opossum, shrews, moles, bats, rabbits, beaver, black bear, mice, voles, squirrels, chipmunk, woodchuck, skunk, weasels, mink, fishers, muskrat, raccoons, porcupines, and coyotes. Bird species within the Study Area include cardinal, crow, robin, blue jay, sparrows, mourning dove, woodpeckers, wrens, starlings, black-capped chickadee, finches, gulls, red-winged blackbird, grackle, Canada

goose, mallard, common merganser, wood duck, green-winged teal, great blue heron, green heron, bluebirds, swallows, wild turkey, turkey vulture, osprey, bald eagle, golden eagle, double crested cormorant, bard owl, killdeer and red-tailed hawk.

A recent fisheries survey in the Study Area noted the occurrence of smallmouth bass, white bass, sauger, smallmouth bass, rock bass, largemouth bass, several sucker species, muskellunge, northern pike, white crappie, black crappie, sunfish, bluegill, channel catfish, yellow bullhead, walleye, yellow perch, common carp, mirror carp, paddlefish, white perch, spottail shiner, golden shiner, emerald shiner, Quillback. Mussel species within the Study Area are unlikely but the possibility exists to include Wabash pigtoe, wavy rayed lampmussel, rainbow, black sandshell, rayed bean (e), dwarf wedge mussel (e), northern riffleshell (e) and clubshell (e). A number of reptiles can also be found in the region, such as spiny soft-shelled turtle, smooth green snake, and hellbender salamander.

2.4.3 Existing Terrestrial and Aquatic Habitats

Ohi:yo' in the Study Area is approximately 1,000 feet wide during full summer pool with an average depth of approximately 20 feet and a maximum depth of approximately 37 feet, which includes the near shore area of the Highbanks Campground. The aquatic habitats currently contain backwaters, gravel and sand bars, floodplain connectivity, and wetland areas. The existing vegetation is all-encompassing. The reservoir system experiences dramatic water level fluctuations throughout the year. The most dramatic fluctuation occurs during the fall and winter time when the reservoir is drawn down. This occurs because the reservoir reverts to a riverine environment with the drawdown. The maximum depth at winter pool near the Study Area is approximately 8 feet.

Two plant surveys were completed during the summer of 2017 with an initial survey done in June and follow-up survey performed in August. The results indicated a broad array of mosses, grasses, shrubs, and woody vegetation along the river corridor, shown in Table 3. Only a summer survey was completed so the list does not contain every species that can be found in the Study Area. In order to create an all-inclusive list, multiple plant surveys would need to be completed during all seasons. The data will be further evaluated in Section 3.1.3.

Table 3 - Plant species observed during 2017 plant survey

Note: P = not recorded but likely present

Native Y or N	**Scientific Name**	**Common Name**
Y	Acalypha Rhomboidea	Three Seeded Mercury
Y	Acer Rubrum	Red Maple
Y	Acer Saccharinum	Silver Maple
N	Achillea Millefolium (P)	Common Yarrow
Y	Agrostis Perennans	Autumn Bent, Agrostis grass
Y	Ambrosia Artemisiifolia	Common Ragweed
Y	Apios Americana	Hog peanut, hogweed, ground nut
Y	Apocynum Cannabinum	Dogbane, Indian Hemp
N	Arabidopsis Thaliana	Duckweed

Native Y or N	Scientific Name	Common Name
Y	Aralia Nudicaulis	Wild Sarsaparilla
N	Artemisia Vulgaris	Common Wormwood, Common Mugwort
Y	Asclepias Incarnata	Aquatic Milkweed
Y	Asclepias Syriaca (P)	Common Milkweed
Y	Aster Lateriflorus (P)	Calico Aster, Starved Aster
N	Aster Tartaricus	N Aster
N	Bellis Perennis	Daisy
Y	Bidens Frondosa	Beggar ticks, stick-tights
Y	Boehmeria Clyindrica	False Nettle, Bog hemp
Y	Bryophyta (P)	Moss
Y	Carex grayi	Sedge
Y	Carex Lurida	Turf Sedge
Y	Carex Scoparia	Broom Sedge
Y	Carex Squarrosa	Sedge
Y	Carex Vulpinoidea	Foxtail Sedge
Y	Carya Laciniosa	Shellbark hickory
Y	Cephalanthus Occidentalis	Buttonbush
Y	Chelone Glabra	Turtle Head
N	Chrystanthemum Leucanthemum (P)	Ox-eye Daisy
N	Cichorium Intybus	Chicory, Blue Sailors
Y	Clematis Virginiana	Virgins bower, old man's beard, wild clematis
Y	Cornus Amomum	Silky dogwood, red-willow
Y	Cornus Racemosa	Panicled dogwood, swamp dogwood
N	Coronilla Varia (P)	Crown Vetch
Y	Cyperus Strigosus	Galingale, False nutsedge
N	Cyperus (P)	Umbrella Sedge
N	Dactylis glomerata (P)	Orchard Grass
N	Daucus Carota	Wild carrot, Queen-Anne's Lace
Y	Desmondium Canadense	Wild pea, shown tick-trefoil
Y	Dichanthelium Acuminatum	Panic Grass
Y	Dichanthelium Clandestinum	Deer-tongue grass, Broad leaved panic grass
N	Digitaria Ischaemum	Smooth crabgrass
Y	Eleocharic Acicularis	Needle spike-rush
Y	Elymus Virginicus	Virginia wild-rye, wild oats
N	Eragrostis Pectinacea	Carolina lovegrass, agrostis grass
Y	Erigeron Annus	Daisy Fleabane, White-Top
Y	Eupatorium Fistulosum (Purpureum)	Common joe pye weed
Y	Eupatorium Perfoliatum	Boneset
N	Eupatorium Rugosom (P)	White snakeroot
Y	Euphorbia Corollata	Flowering Spruge
N	Fallopia Japonica	Japanese Knotweed
Y	Fraxinus Americana	White Ash, American Ash
Y	Galium aparine	Bedstraw, cleavers, goosegrass

Native Y or N	Scientific Name	Common Name
Y	Galium tinctorium	Bedstraw
Y	Geranium Maculatum	Wild Geranium, wood geranium
Y	Geum Canadense	White Avens, Rose Family
N	Glechoma Hederacea	Gill over the ground, ground ivy
N	Gnaphalium Ulginosum	Low cudweed
Y	Hamamelis Virginiana (P)	Witch Hazel
N	Helianthus Annus	Wild Sunflower
N	Hypercum Peroratum	Common St. John's Wort
Y	Hypercum Ellipticum	Pale St. John's Wort
N	Hypercum mutilum	Dwarf St. John's Wort
Y	Impatiens Capensis	Jewel Weed
N	Iris Pseudoacorus	Yellow Iris
Y	Juncus tenuis	Yard Rush, Path Rush
Y	Lactuca Canadense	Wild Lettuce
N	Leucanthemum Vulgare	Ox-eye Daisy
N	Linara Vulgaris	Butter and Eggs
Y	Lindera Benzoin (P)	Spicebush
Y	Lobelia Cardinalis	Cardinal flower
Y	Lobelia Inflata	Indian Tobacco, Bladder Flower
Y	Lycopus Americanus	Water Horehound
Y	Lycopus Virginicus	Bugleweed, water horehound
Y	Lysimachia Ciliata	Fringed Loosestrife
N	Lysimachia Nummularia	Creeping Charlie, Moneywort
N	Lysimachia vulgaris	Garden Loosestrife
N	Marrubium vulgare	Horehound
Y	Mentha Arvenis	Field Mint, mint
N	Mentha Pulegium (P)	Penny Royal
N	Mentha Spicata	Spearmint
N	Mentha x piperata	Peppermint
Y	Mimulus ringens	Common monkey flower
N	Myosotis Scorpioides	Forget-me-not
N	Nicotina Tabacum	Nicotina
Y	Onoclea Sensibilis	Sensitive Fern
Y	Oxalis Stricta	Sourweed
Y	Pancium Acuminatum	Panic grass
Y	Pancium Clandestinum	Deer-tongue grass, Brad leaved panic grass
Y	Parthenocissus Quinquefolia	Virginia creeper
Y	Penthorum sedoides	Ditch stonecrop
Y	Phalaris Arundinacea	Reed Canary Grass
Y	Phryma Leptostachya	Lopseed
N	Plantago Lanceolata	Narrow leaved plantain
N	Plantago Major	Broad leaved Plantain
Y	Platanus Occidentails	Sycamore, buttonwood

Native Y or N	Scientific Name	Common Name
Y	Polygonum Pensylvanicum	Pennsylvania smartweed, wild buckwheat
N	Polygonum persicaria	Lady's thumb, smartweed, wild buckwheat
N	Polystichum tsus-simense	Korean rock fern
Y	Populus Deltoides	Cottonwood
Y	Populus tremuloides	Quaking Aspens
Y	Potentilla simplex	Old field cinquefoil, cinquefoil
N	Prunella vulgaris	Heal-all, self-heal
Y	Prunus serotine (P)	Wild Black Cherry
N	Ranunculus Acris	Buttercup
N	Ranunculus repens	Creeping buttercup
Y	Rhus Typhina	Staghorn Sumac
Y	Robina pseudo-acacia	Black Locust
Y	Rorippa Islandica	Marsh Yellow cress
N	Rose Multiflora	Multiflora rose
Y	Rubus Allegheniensis	Common blackberry
Y	Rubus flagellaris	Ground blackberry
Y	Rubus Occidentalis	Black cap, black raspberry
Y	Rudbeckia Laciniata (P)	Tall or cutleaf coneflower
N	Rumex Acetosella	Field sorrel, sheep sorrel
N	Rumex crispus	Curly leaved dock
N	Rumex Obtusifolius (P)	Broad leaf dock, bitter dock
Y	Rumex verticillatus	Swamp dock, aquatic dock
Y	Salix Interior	Sandbar willow
Y	Salix Nigra	Black willow
N	Salix sp. (alba)	Willow
Y	Sambucus Canadensis	Common elder, American elder
N	Sambucus Nigra	Elderberry
Y	Sassafras Albidum	Sassafras
Y	Scutellaria lateriflora	Small blue lobelia, mad dog skullcap
Y	Similax herbacea, (ioscorea Villosa)	Wild yam root, green briar, carrion flower
Y	Sisyrinchium angustifloium	Narrow leaf grass
N	Solanum Dulcamara	Snake berry
Y	Solanum Trilobatum	Pea Eggplant
Y	Solidago Adodra	Sweet golden rod
Y	Solidago Altissima	Canada goldenrod, tall goldenrod
Y	Sorghastrum Nutans	Indian Grass
Y	Sphagnum sp.	Sphagnum moss
N	Stellaria Media	Chickweed
N	Taraxacum Officinale	Common Dandelion
Y	Teucrium Canadense	American germander, wood sage
Y	Toxicodendron (rhus) radicans	Eastern poison-Ivy
N	Trifolium Pratenses	Red Clover
N	Trifolium repens	White clover

Native Y or N	Scientific Name	Common Name
Y	Trillium erectum	Purple eggplant
Y	Ulmus rubra	Slippery Elm, red elm
N	Urtica Dioica	Wetland Nettle
Y	Verbasina Alternifolia	Wingstem
Y	Verbena urticifolia	White Vervain
Y	Veronica Americana	American brooklime, speedwell
Y	Viola sororia	Common blue violet
Y	Vitis riparia	River-bank grape, wild grape
N	Vitis Vinifera	Wild grape
Y	Vitus Aestivalis	Summer grape

2.5.0 THREATENED AND ENDANGERED SPECIES

2.5.1 Federal

In accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed and proposed threatened or endangered species. The species in Table 4 are listed as threatened and may be found on the Seneca Nation Allegany Territory.

Table 4 - Threatened and endangered species

Species	Listed Status	Critical Habitat
Clubshell Mussel (*Pleurobema clava)*	Endangered	Not Designated
Rayed Bean *(Villosa fabalis)*	Endangered	Not Designated
Northern Long-eared Bat (*Myotis septentrionalis)*	Threatened	Not Designated
Northern riffleshell	Endangered	Not Designated
Snuffbox	Endangered	Not Designated
Rabbitsfoot	Threatened	Not Designated

The potential federally-listed mussel species to occur within the Study Area are: northern riffleshell (endangered), clubshell (endangered), rayed bean (endangered), snuffbox (endangered), and rabbitsfoot (threatened). All five of these species' are generally found utilizing gravel and sand substrate. It is unlikely that these species would occur within the Study Area, but they do have the potential to occur.

The clubshell is a freshwater mussel that prefers clean, loose sand and gravel in medium to small rivers and streams (USFWS, 1993). This species' decline is principally due to reduced water quality from agricultural runoff and industrial wastes, as well as impoundments of rivers for navigation (USFWS, 1993). A new threat to the species is the invasive zebra mussel (*Dreissena polymorpha*). This prolific species covers and suffocates native mussels. This species was historically widespread in the Ohio River Basin and in western Lake Erie.

The northern long-eared bat (Myotis septentrionalis) is federally listed as "Threatened." This small bat species hibernates during the winter in caves and abandoned mines. They require

humid caves with stable temperatures between for hibernation. They utilize trees for roosting and foraging sites during the summer months.

The American paddlefish (Polyodon spathula) also inhabits the Study Area. A joint project between the Army Corps, Pennsylvania Fish and Boat, New York DEC and the Seneca Nation to reintroduce this species is ongoing. The paddlefish had been deemed extirpated and from the watershed since the construction of the dam. To date, in excess of 1,700 young of year paddlefish have been released within the Study Area and their status continues to be monitored. Paddlefish are federally listed as a "vulnerable" species. The Eastern Hellbender, also known as the Allegany Hellbender, (Cryptobranchus alleganiensis) is also a species that lives within the Study Area and is a New York State species of Special Concern. The Blanding's Turtle (Emys blandingii or Emydoidea blandingii) is also listed as endangered by the Federal government and has been newly discovered in the area.

2.5.2 Seneca Nation

Within the Study Area, the Seneca Nation also designates species protective status within the Seneca Nation Territory. The Seneca Nation Fish and Wildlife Department (SN FWD) currently has projects meant to aid in the repopulation of a number of species by means of rearing facilities and/or relocation projects.

- Northern Long-Eared Bat (Myotis septentrionalis) – The SN FWD has deployed in excess of 75 bat houses in various locations to aid in providing adequate housing and protection. A relocation project in conjunction with the Pennsylvania Fish & Boat Commission and USFWS is currently underway with the placement of endangered clubshell and riffleshell mussels. Although the relocation project is not directly within the Study Area, there is potential for these species to exist within the Study Area.
- Allegany Hellbender (Cryptobranchus alleganiensis) – The SN FWD is in their seventh year of rearing hellbenders from eggs (collected by the department in the upper Allegany River) for release into unpopulated areas that have adequate habitat.
- Blanding's Turtles (Emys blandingii or Emydoidea blandingii) – The SN FWD is currently in their third year of a rearing and release project where the department has three females with telemetry markers on them. The females are collected yearly and eggs are collected for rearing and release purposes. The project is worked on in conjunction with the Buffalo (New York) Zoo. There are many wetland areas within the Study Area that could harbor this species.
- Walleye (Sander vitreus) – Although not state or federally listed, the Seneca Nation deems the walleye to be a species of concern due to the drastic decline in numbers through the years. The cause is directly related to the conditions in the reservoir system. Water quality, habitat erosion, excessive silt and sedimentation all contribute to the decline in populations. The Seneca Nation considers the walleye an integral part of their customs, traditions and heritage. Tribal members to this day still depend on the annual walleye harvest for sustenance. The SN FWD has been operating a walleye hatchery for eight years now and has begun an aggressive campaign to reintroduce habitat and reclaim lost structure.

2.5.3 Critical Habitat

There is no designated critical habitat within the Study Area.

2.6.0 RECREATIONAL, SCENIC, AND AESTHETIC RESOURCES

2.6.1 Local Resources

During the summer months, in the Study Area, there are several campgrounds located along Ohi:yo'. On the east side of the river in the Bear Claw (BC) area are several camping sites with individual boat docks and child playground areas. The camp sites have well-manicured lawns and wooded areas. The Allegheny State Park contains a boat launch area that has both well-manicured and wooded areas around it and well-maintained hiking paths. On the west side is Low Banks campgrounds with individual boat docks, manicured lawns, and wooded areas. Highbanks Campground has boat docks with well-manicured lawn and wooded areas. Further downstream are Moe Banks camping areas with individual boat launches and wooded areas. River-based recreational activities include fishing, hiking and recreational boating.

2.6.2 Regional Resources

Several walleye tournaments are hosted on Ohi:yo' each year. In 2014, the Master's Walleye Circuit fishing tournament was held on the reservoir attracting premier walleye anglers throughout the country to the region. The Ohi:yo' not only draws fisherman to the area but it has also become a popular location for many recreational campers, boaters, birders, and hikers. The Highbanks Campground is open year round and has become a popular attraction for families across the region.

2.7.0 CULTURAL RESOURCES

2.7.1 Cultural History

The Seneca Nation, one of the largest tribes of the Six Nations of the Haudenosaunee Confederacy in New York State, reorganized its tribal governmental structure in 1848 with the adoption of a formal written constitution that provides leadership by elected officials in a democratic process. The enrolled membership of the Seneca continues to grow and currently stands at 8,337 members, based on matriarchal lineage and enrollment. Among the Seneca Nation's territories, 4,328 enrolled members live on territorial lands, with a substantial portion of the remaining membership either living in proximity to the territories or within the Western New York State Region (Seneca Nation Tribal Enrollment, October 2017). With 53,884 acres, the Seneca Nation controls and holds an important land base in Western New York. The Allegany Territory has 110 miles of Ohi:yo' shoreline; in addition to that, there is another 116 miles of streams/creeks running through that territory.

The Seneca Nation Tribal Historic Preservation Office (THPO) will require a shoreline cultural survey prior to project implementation. There are many sites located along the shore that are

eroding, as well as sites that are inundated by water during summer pool. Additionally, any construction activity or placement of materials will require a THPO review.

2.7.2 Previous Investigations

The U.S. Department of Agriculture (USDA) has developed an inventory of culturally-important plants. Fact Sheets & Plant Guides is a partnership of the National Plant Data Team and the Plant Materials Program. A number of these plants can be found in the Study Area, outlined in Table 5. The Seneca Nation has also identified numerous plants within the Study Area that are utilized as a cultural resources, but that information is not publicly available.

Table 5 – Culturally-important plants and their ethnobotanic uses

Scientific Name	**Common Name**	**Ethnobotanic uses**
Achillea Millefolium	Common Yarrow	The plant is used for treatment of pain relief, headaches, to reduce fever and aid in restful sleep.
Apios Americana	Hog peanut, hogweed, ground nut	Food source.
Apocynum Cannabinum	Dogbane, Indian Hemp	Threads, rope, basket weaving, the root used as a tea to treat headache, nervousness, dizziness, worms and insanity.
Asclepias Syriaca	Common Milkweed	Food source, fiber. Threads, clothing.
Fraxinus Americana	White Ash, American Ash	Laxative, diuretic, basket weaving, furniture, hand tools.
Helianthus Annus	Wild Sunflower	Food source.
Lobelia Cardinalis	Cardinal flower	Treat fevers sores, typhoid.
Lobelia Inflata	Indian Tobacco, Bladder Flower	Venereal diseases, ulcers, leg sores.
Platanus Occidentails	Sycamore, buttonwood	Cold and cough remedies, dietary, dermatological, respiratory and gastrointestinal aids.
Populus tremuloides	Quaking Aspens	Food source.
Sambucus Canadensis	Common elder, American elder	Medicine, dyes for basketry. Arrow shafts, flutes,
Sassafras Albidum	Sassafras	Fevers, diarrhea, rheumatism, measles, scarlet fever.
Ulmus rubra	Slippery Elm, red elm	Ropes and cords, threads, baskets, sore throats.

2.8.0 AIR QUALITY

The Air Quality Index (AQI) characterizes the quality of air in a particular location, with higher numbers indicating a larger percentage of the population may experience adverse health effects. The index is grouped into 6 levels. The first level is the Good range, Green color with a range of 0 to 50. The second level is the Moderate range, Yellow color with a scale of 51 to 100. The

third level is the Unhealthy for Sensitive Groups, Orange color with a range of 101 to 150. The fourth level is the Unhealthy, Red color with a range of 151 to 200. The fifth level is the Very Unhealthy, Purple color with a range of 200 to 300. The sixth level is the Hazardous, Maroon color with a range of 301 to 500.

It is this scale that informs us of how polluted the air we breathe is. EPA calculates the AQI for the 5 major air pollutants regulated by the Clean Air Act: Ground-level Ozone, Particle Pollution (Particulate Matter), Carbon Monoxide, Sulfur Dioxide and Nitrogen. (EPA AirNow.Gov). For the past year the air quality for the Study Area has been listed as good to moderate, with one or two days of Unhealthy for Sensitive Groups (USA.com 2017). In general, the AQI of Cattaraugus County has been improving over the last ten years. AQI of the county is slightly higher (worse) than the state, but slightly lower (better) than the country as a whole. Readings for the closest air quality monitoring site is shown in Table 6. The proposed Study Area is within an area of attainment (EPA 2018).

Table 6 - Air Quality Pollutants Summary on 10/25/17 (Information taken from USA.COM)

State	**Closest Air Monitor**	**County**
New York	Steamburg	Cattaraugus
2009 8-hour O3 reading was 0.0475 ppm		
2009 PM2.5 was 10 g/m3		
2009 Carbon Monoxide was 0.28 ppm		
2009 Sulfur Dioxide (SO2) was 0.0025 ppm		
2009 Nitrogen Dioxide (NO2) was 0.0075 ppm		

2.9.0 NOISE

The Study Area is in a developed rural community within the Seneca Nation Territory. Noise levels are typically low due to the lower population density. Sources of noise pollution in the Study Area would include campers, residents, and boaters. Lawn maintenance, motor boats, and traffic noise are common in the area.

2.10.0 HAZARDOUS AND TOXIC SUBSTANCES

A Phase 1 Environmental Site Assessment (PH 1 ESA) was prepared by the Environmental Protection Department of the Seneca Nation of Indians in October 2018, to determine the potential presence of materials regulated under CERCLA. Guidelines under the American Society for Testing and Materials (ASTM) Standard E1527-05: Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Assessment Process was followed. Although not required by the rule, yet, in compliance with the ASTM, an analysis of the topography, geology, hydrogeology, and hydrology may be found in section 2.0 of this document. The PH 1 ESA concluded that the potential for the presence of contaminants at the subject site is minimal and would only occur through sediment transported from upstream activities. Results of the representational sediment sampling program do not indicate sediment contamination at the project site. The lack of legacy pollutants at the project site reduces

cognizable risk of potential contamination at the site and ensures the health and safety of workers, while allowing for the best beneficial use of excavated material.

Prior to the inundation of the Study Area by water via the Kinzua Dam, portions of the Study Area were considered residential. Through research of historic tribal records, there is no indication that the Study Area contained activity regarding hazardous or toxic substances. No historic tribal records, to include aerial photographs, indicate any activities or substances present that would invoke requirements under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the Resource Conservation and Recovery Act (RCRA).

The closest National Priority List (NPL) site is located in Little Valley, NY. The Little Valley Superfund site is comprised of a trichloroethylene (TCE)-contaminated groundwater plume that extends approximately eight miles southeastward from the village of Little Valley to the northern edge of the City of Salamanca, which is part of the Seneca Nation of Indian lands. Little Valley Superfund site is approximately 25 miles from the Study Area. The TCE contamination was attributed to a manufacturing facility on Route 353 near Little Valley. Following the installation of treatment systems on private water wells, the Environmental Protection Agency (EPA) put the site's long-term remedy in place, which consisted of soil remediation, a long-term groundwater monitoring program, institutional controls, and an evaluation of the potential for soil vapor intrusion into structures within the immediate area of Little Valley. The Little Valley NPL site is not anticipated to have any impacts on this project. No sites within the Study Area were used for commercial or industrial purposes. There is a gas station adjacent to the Study Area, approximately 0.73 miles west of the reservoir, located at 1972 W. Perimeter Rd., Steamburg NY. The gas station is called the Turtle Pit and has one 12,000-gallon capacity above-ground gasoline storage tank, and one 12,000-gallon capacity diesel fuel underground storage tank. There has been no reported release(s) of petroleum from the gas station.

2.11.0 SOCIOECONOMIC AND ENVIRONMENTAL JUSTICE

2.11.1 EO 12898 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, provides that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." The Executive Order (EO) makes clear that its provisions apply fully to programs involving Native Americans.

The Council on Environmental Quality (CEQ) has oversight of the Federal government's compliance with EO 12898 and the NEPA. CEQ, in consultation with the EPA and other affected agencies, developed NEPA guidance for addressing requirements of the EO. This guidance was developed to further assist Federal agencies with their NEPA procedures so that environmental justice (EJ) concerns are effectively identified and addressed.

The CEQ has also identified six general principles for consideration in identifying and addressing EJ in the NEPA process which include: (1) area composition (demographics); (2) data

(concerning cumulative exposure to human health or environmental hazards); (3) interrelated factors (recognize the interrelated cultural, social, occupational, or economic factors); (4) public participation; (5) community representation; and (6) tribal representation.

The Study Area is entirely within Seneca Nation Territory. While the Project, if implemented, will have disproportionately high effects on a population subject to environmental justice review pursuant to Executive Order 12898, those effects are expected to beneficial and not adverse. The Project's purpose is to restore ecosystem function, structure, and dynamic processes to Ohi:yo,' where the construction and operation of an existing Corps project (Kinzua Dam) has directly contributed to the degradation of the quality of the environment. The affected population is the Project's partner, the Seneca Nation, who proposed the Project via submission of a letter to the Corps dated June 3, 2014. USACE and the Seneca Nation worked collaboratively to assess the Project to ensure that it addresses the needs of affected population by decreasing environmental burdens and increasing environmental benefits. The fundamental purpose behind a Section 1135 ecosystem restoration project is to decrease environmental burdens and increase environmental benefits. As this Project will benefit the Seneca Nation, no adverse impacts to an environmental justice population are anticipated.

2.11.2 EO 13045 Protection of Children

Executive Order 13045 concerns the environmental health and safety risks that may disproportionately affect children. HABs occur throughout the reservoir, typically from July through November. The reservoir is highly utilized by many people throughout this time, from fishing and swimming along the shore to boating many miles within. There are a few people that still live along the Ohi:yo' as well as many people that camp frequently at various camping areas. Children have increased hand to mouth contact while they are also less likely to practice frequent hand washing. The potential health impacts to children by HABs are greater due to their body mass, increased water activity and lack of awareness. The lack of awareness of potential health impacts due to cyanobacteria is dangerous when coupled with children's intrigue of HABs (shown in Figure 17).

Figure 17 - Children are attracted to blooms and do not understand risk

3.0.0 PLAN FORMULATION

3.1.0 PROBLEMS AND OPPORTUNITIES

The historical conversion of the free-flowing Ohi:yo' by the Kinzua Dam to a fluctuating reservoir environment has resulted in ecosystem degradation throughout the Study Area. In New York, the reservoir occupies Seneca Nation lands outlined by the Treaty of 1794. Of the 30,189 acres in the Allegany Territory, 3,520 acres were acquired outright for inundation and flowage easements acquired over another 5,557 acres. The purpose of this project is to improve ecosystem function, structure, and dynamic processes to Ohi:yo' to the extent consistent with the authorized purposes of Kinzua Dam. The Seneca Nation has identified and prioritized the ecosystem resources of concern in the following order – proliferation of HABs, shoreline erosion/reservoir sedimentation, proliferation of nuisance invasive plants, and degradation of fish habitat. These problems are further described below. Opportunities exist to improve water quality by reducing HABs and erosion-related sedimentation, improving the diversity and health of the riparian zone, and improving habitat for native fisheries. In addition, this project provides an important opportunity to strengthen the relationship between the Corps and the Seneca Nation.

3.1.1 Harmful Algal Blooms

Algae are simple organisms, the chlorophyll containing plants range from microscopic to macroscopic and are an important part of the food web (NYSDEC 2016a). Blooms of algae species that produce - or have the potential to produce - toxins are referred to as harmful algal blooms. Cyanobacteria are microscopic blue-green algae (BGA), under suitable conditions they can grow quickly and form concentrated blooms, shown in Figure 18. These blooms which may cover all or portions of a lake and are typically associated with warm temperatures and eutrophic lake conditions.

HABs, with or without toxin production can have negative ecological, biogeochemical, and health impacts, and are becoming an increasing worldwide problem. HABs were first documented in Ohi:yo' in 1972 with algal counts as high as 616,000 cells/ml. Less severe HABs were repeated in 1978, 1982, and 2005.

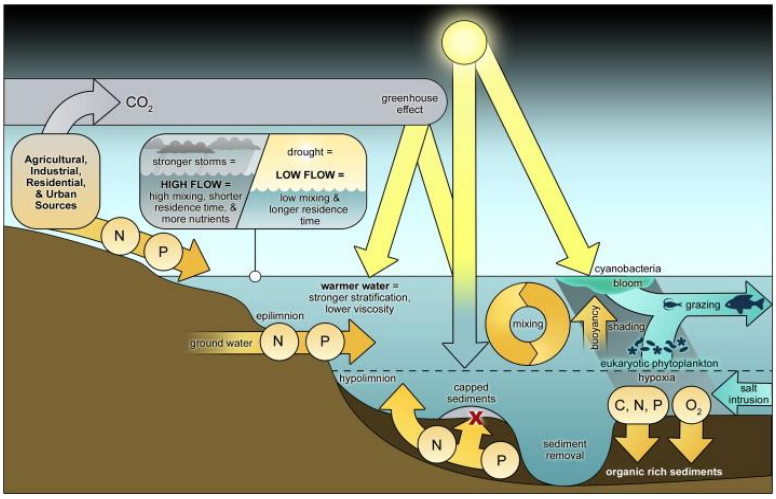

Figure 18 - Processes that control HAB formation (Paerl et. al., 2011)

During the 2012 event, HABs were reported in a 10-mile long reach of the reservoir located from Willow Bay upstream to Cold Spring Creek (approximately 6,400 acres) with blue-green algae counts of 52 million cells/ml. Since 2013, the Seneca Nation Allegany Territory has experienced severe impacts due to HABs throughout Ohi:yo' impoundment area (2014 HAB extent shown in Figure 19). Densities of 20,000 cells/ml are considered a moderate probability for adverse health effects and 10,000,000 cells/ml are considered a very high probability of adverse health effects in recreational waters, according to the World Health Organization's guidelines for safe practice in managing recreational waters.

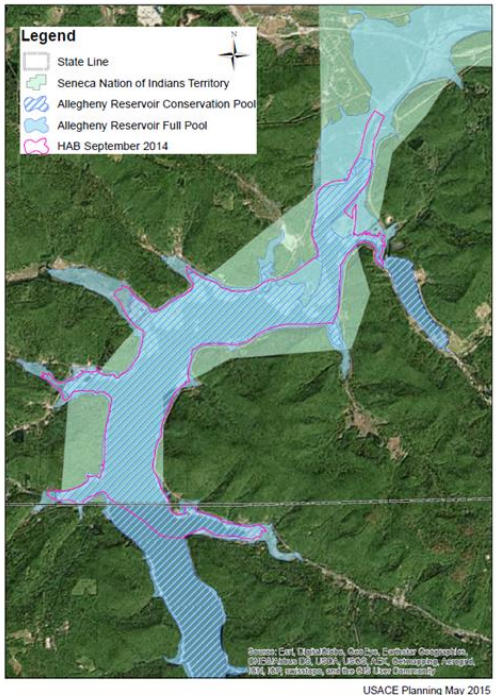

Figure 19 - Estimated Extent of 2014 Ohi:yo' harmful algal bloom.

The primary species that have been found to be causing the harmful algal blooms (shown in Figure 20) are *Microcystis aeruginosa*, *Anabaena Planctonica*, and *Aphanizomenon Flos-aquae*. *Aphanizomenon Flos-aquae* can create toxins called cylindrospermopsin during blooms. Human exposure by inhalation and dermal contact during recreational activities in water bodies

containing the toxins requires bathing or showering to minimize risk (EPA 2015). Symptoms of exposure can be as minor as skin irritation but also include fever, headache, vomiting, bloody diarrhea, enlarged liver, and kidney damage as outlined in Table 7.

Figure 20 - Harmful algal bloom at Low Banks on August 21, 2017

Table 7 - Cyanobacteria health and human impacts (EPA 2015)

	Microsystis Aeruginosa	***Anabaena Planctonica***	***Aphanizomenon Flos-aquae***
Toxins produced	Heptotoxins called microsystins which exist in cyanobacteria.	Neurotoxic alkaloids such as anatoxin-a, anatoxin -a(S) or saxitoxin.	BMAA, Endotoxins, cylindrospermopsin
Toxicity	Linked to hepatocellular carcinoma in humans.	Nerve synapse, nerve axons, and respiratory paralysis.	Hepatic and neuroendotoxins
Health Impacts	Minor skin irritation or allergic reaction, eye irritation and blistering of the lips. Damage to the liver. In animals it can cause swelling of the organs.	In fish there is damage to the liver, heart, kidney, gills, skin and spleen. In humans nausea, vomiting, and diarrhea.	Damage to the liver, kidney and nerve tissue
Symptoms of exposure	Abdominal cramps, nausea, vomiting, diarrhea, fever, sore throat or hay fever like symptoms. Conjunctivitis. High fever and hypothermia in animals.	Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis leading to death.	Fever, headache, vomiting, bloody diarrhea

The Seneca Nation has conducted blue-green algae monitoring and sampling in conjunction with USACE Pittsburgh District. This work was in response to BGA persisting on Ohi:yo' and was initiated in 2014. Sample collection in 2015, 2016, and 2017 occurred weekly after the onset of a harmful algal bloom. HABs in the reservoir have required human health notifications (warnings) for 13-15 weeks. The recurrent HABs are likely caused by a combination of nutrient pollution from the drainage basin upstream of the reservoir and the contribution of nutrients from sediment and algal detritus that has deposited in the reservoir since impoundment.

Sediment data was collected at multiple points (shown in Figure 21) while examining depth of sediment deposited over time. A change in the nitrogen to phosphorus ratio (N:P) in conjunction with sediment deposit over time in Ohi:yo' provides BGA access to nutrients. This type of change has the potential to alter the predominant species of algae towards those best suited to deal with available levels of nutrients. Cyanobacteria are very advantageous organisms; they have the ability to alter buoyancy to move throughout the water column based on environmental conditions. Unlike other algae, cyanobacteria have the ability to use atmospheric Nitrogen, and therefore, these algae thrive and bloom in low-Nitrogen waters. During the summer of 2017, the dominant species of cyanobacteria varied throughout the reservoir.

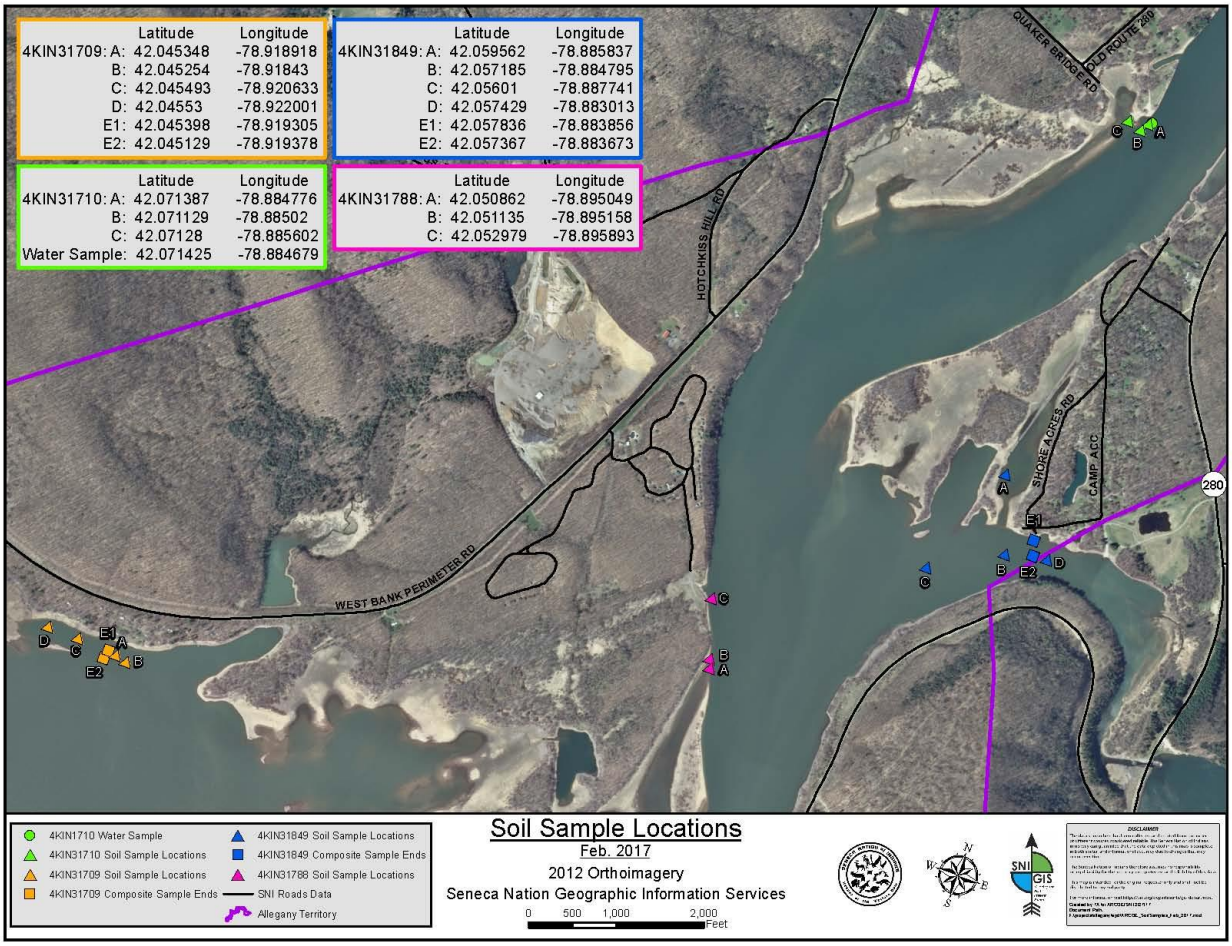

Figure 21 - Sediment survey results

Upper portions of Ohi:yo' on Seneca Nation Allegany Territory seem most impacted by the HAB with the blooms becoming more prevalent in bay areas. The inflows into these areas have been sampled to determine impact on nutrient loading and are not likely to provide nutrient sources. Because these areas are shallower and warmer than the main channel, algae are in closer proximity to the sediments and are better able to capture sediment nutrient releases. These off-channel inlets are also more sheltered so that algae in these areas are less likely to be dispersed in the reservoir through natural circulation processes. As algae levels increase, toxin production increases. Within these sheltered areas, the toxins are not easily dispersed unless large flushing events occur. During storm events and strong winds, the bloom gets dispersed throughout the reservoir.

Worker safety should be considered as workers could become exposed to cyanotoxins during construction activities. Further study and analysis of possible exposure routes and implementation of protective measures for workers should be considered during the design and implementation phase.

3.1.2 Shoreline Bank Erosion

The Highbanks Campground area is situated on the outer bank of a large bend in the river, opposite from the mouth of Quaker Run. Loss of bank has been observed since creation of the reservoir (shown in Figure 22), likely attributable to a combination of reservoir pool fluctuations, stream velocities and direction, wave action, and geological conditions. The river channel is adjacent to the Highbanks boat launch and the water level depth is controlled by the operation of the Kinzua Dam; at times of water storage the water depth of the river channel is approximately 26 feet and drops to as low as 6 to 8 feet during winter months.

Two nesting trees used by Bald Eagles have been lost due to bank retreat, and nesting activity has ceased in the Highbanks shoreline area. Erosion also contributes to reservoir sedimentation and degradation of fish spawning habitat. Highbanks Campground is a Seneca Nation operated facility that provides public recreation opportunities and generates revenue for the Nation. HABs concentrate at the Highbanks Campground boat launch increasing risk to anyone utilizing the area.

Figure 22 - Looking upstream from Highbanks boat launch on October 10, 2017

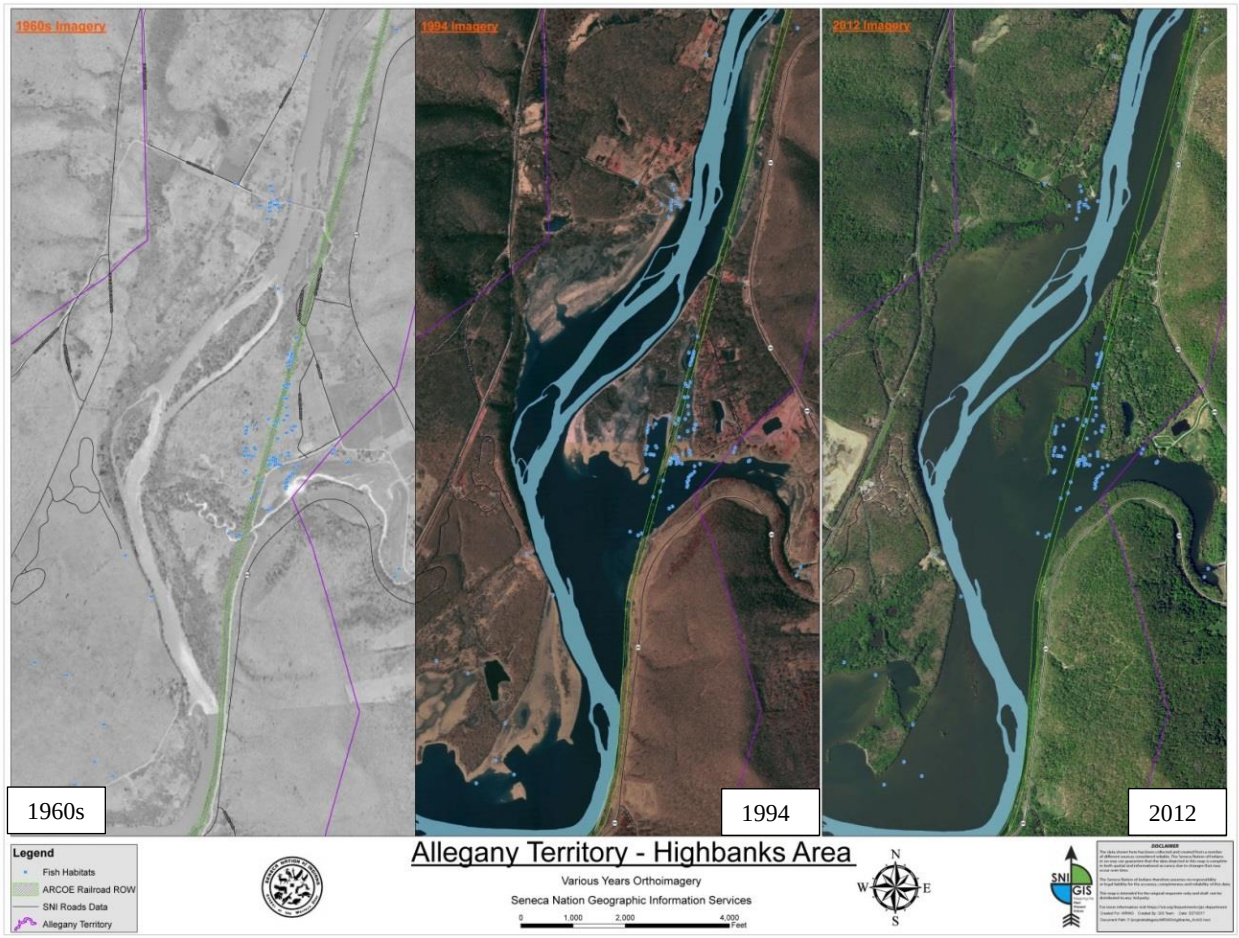

Figure 23 – Highbanks/Quaker Bay progression through time

3.1.3 Invasive Species

Invasive plant species are prevalent along the shorelines of many rivers throughout the Allegheny region, particularly Japanese knotweed (*Fallopia japonica*) and the closely related giant knotweed (*Fallopia sachalinense*). These species out-compete native riparian plants, shading out successional understory plants and using allelopathy mechanisms to further restrict the growth potential of native plants, shown in Figure 24. The plant has a bamboo like stem and can grow from three to fifteen feet tall while having the ability to withstand drought. Japanese knotweed has a rhizoid root structure, which in an erosive riparian environment provides little soil-holding capability compared to native riparian plants even though it was originally used for erosion control. Stem fragments may spread the plant while the system of rhizomes may also sprout shoots in addition to spreading by seed so Japanese Knotweed spreads quickly producing dense thickets that crowd out native vegetation.

Figure 24 - Japanese knotweed

Of particular concern in the Study Area is a Japanese knotweed infestation on islands and along the bank of the reservoir. The upper reaches of the Study Area are littered with knotweed along the banks. A visual assessment of the banks was completed to assess the reach of knotweed, shown in Figure 25. Additionally, an attempt to locate areas that the knotweed had just begun encroaching upon was determined so efforts could be focused on preserving native plant species.

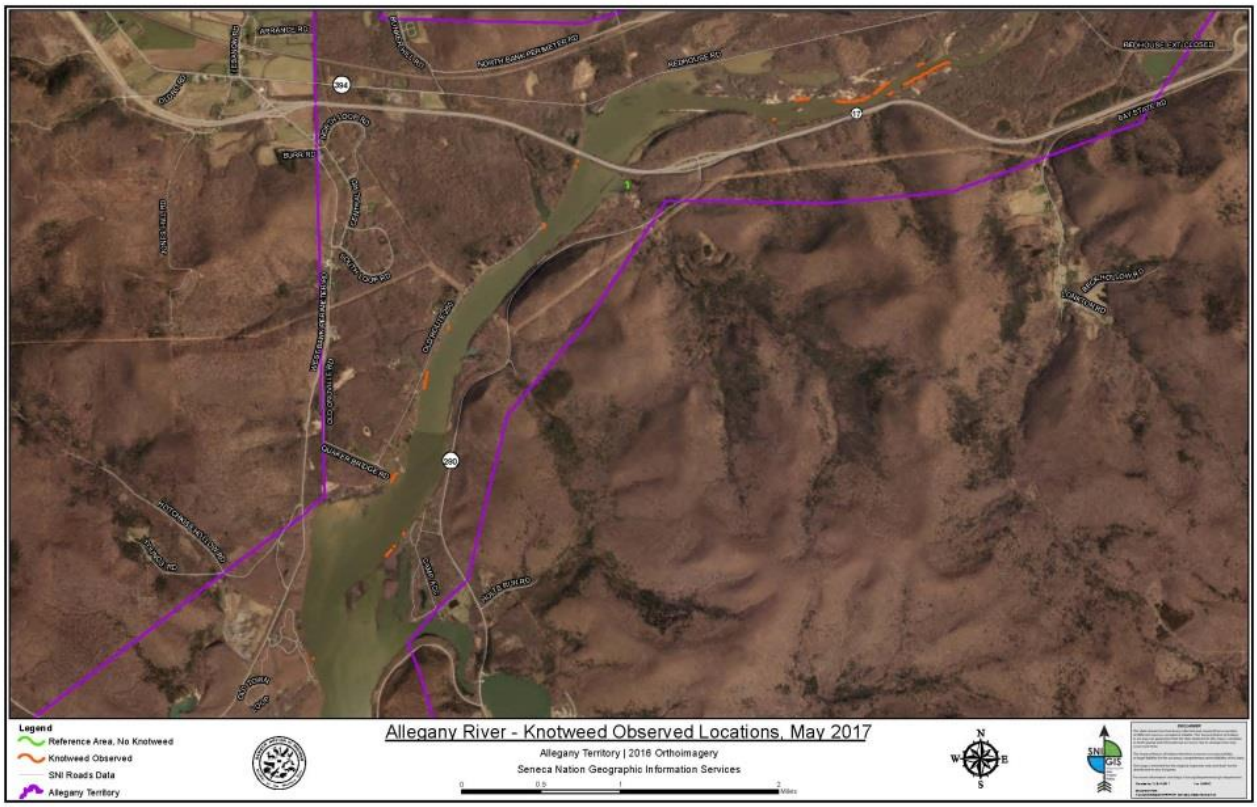

Figure 25 - Shoreline knotweed established in upper reaches of Study Area

The plant inventory was taken for 4 specific areas (shown in Figure 26 and Figure 27) to assess the biodiversity and impact of invasive species with the full list of plants identified listed in Section 2.4. The selected areas were chosen because the upstream river corridor has been overcome with Knotweed and these given areas represented zones that Knotweed was encroaching upon native plant life. The results are presented below with model input and output provided in Appendix B.

A floristic quality assessment was completed courtesy of the Penn State (ww.riparia.psu.edu) floristic quality assessment bio-monitoring tool. For riparian and floodplain habitats, the Floristic Quality Assessment (FQA) Model for the Mid-Atlantic Region (MAR) was used to assess the quality of habitats. This is a regional version of the FQA Coefficients of Conservatism for the Chicago Region which is approved for regional use by the Ecosystem Restoration Planning Center of Expertise (ECO PCX). The process for adapting the MAR FQA is discussed in "Developing coefficients of conservatism to advance floristic quality assessment in the Mid-Atlantic region." (Chamberlain and Ingram 2012). The tool was accessed online at: http://apps.cei.psu.edu/fqacalc/.

The MAR FQA was selected as it is applicable to the region in which the project occurs and provides a general index for riparian and wetland habitat quality. The model calculates both a mean "Coefficient of Conservatism" (CoC) and a "Floristic Quality Index" (FQI) for a given species. These are methods of assessing the habitat nativity and resource condition of a plant

community given a recorded or projected species list. CoC is assigned based on the degree of tolerance to which plants are adapted.

The adjusted FQI, which is defined in Miller and Wardrop (2006) and shown in Table 8, is dependent on coefficient of conservatism (C), number of native species (N), and total species richness (S). The Total Mean C, FQI, and adjusted FQI were determined for each plant management area with results shown in Table 9.

Table 8 - Floristic Quality Index determination (Wilson et al. 2013)

Metric	**Description**	**Notes**
FQI	$I = \bar{C}x\sqrt{N}$	Uses only native species
Adjusted FQI	$I' = \left(\frac{\bar{C}x\sqrt{N}}{10x\sqrt{N+A}}\right)x100$	Includes non-native species (A)
Total Mean C	Average (C_{Native} and $C_{Non\text{-}Native}$)	Mean coefficient value for native and non-native species
Total N	Native + Non-native species	Total number of species present

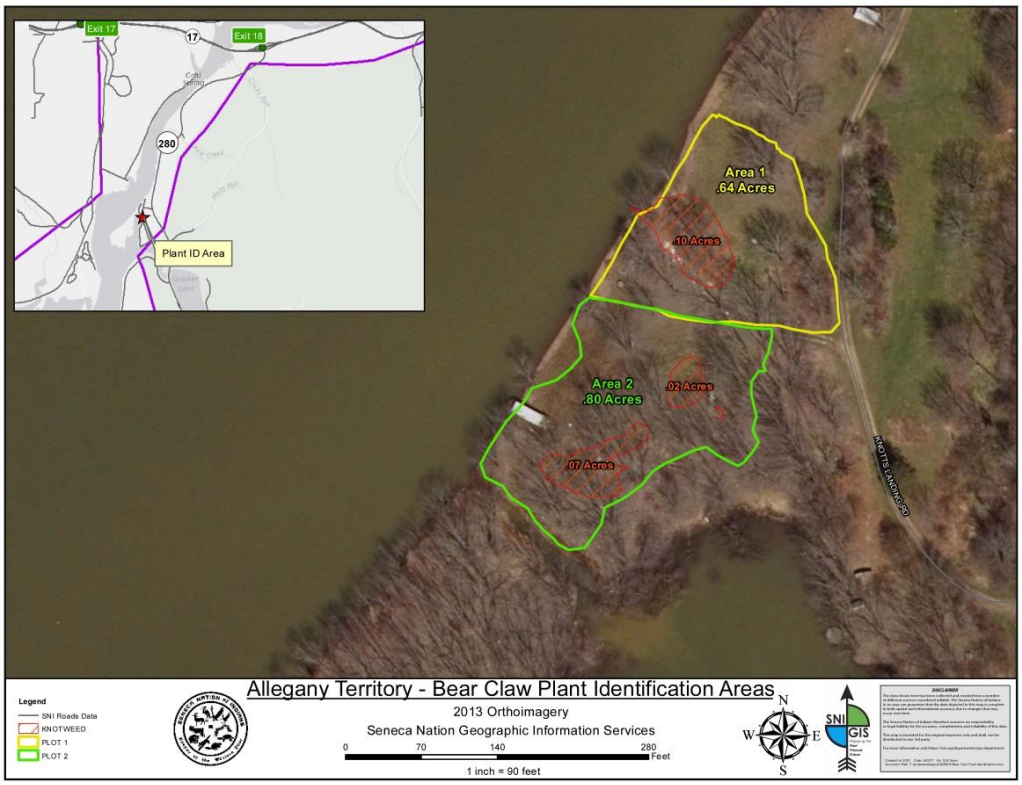

Figure 26 – Bear Claw plant survey area 1 and 2

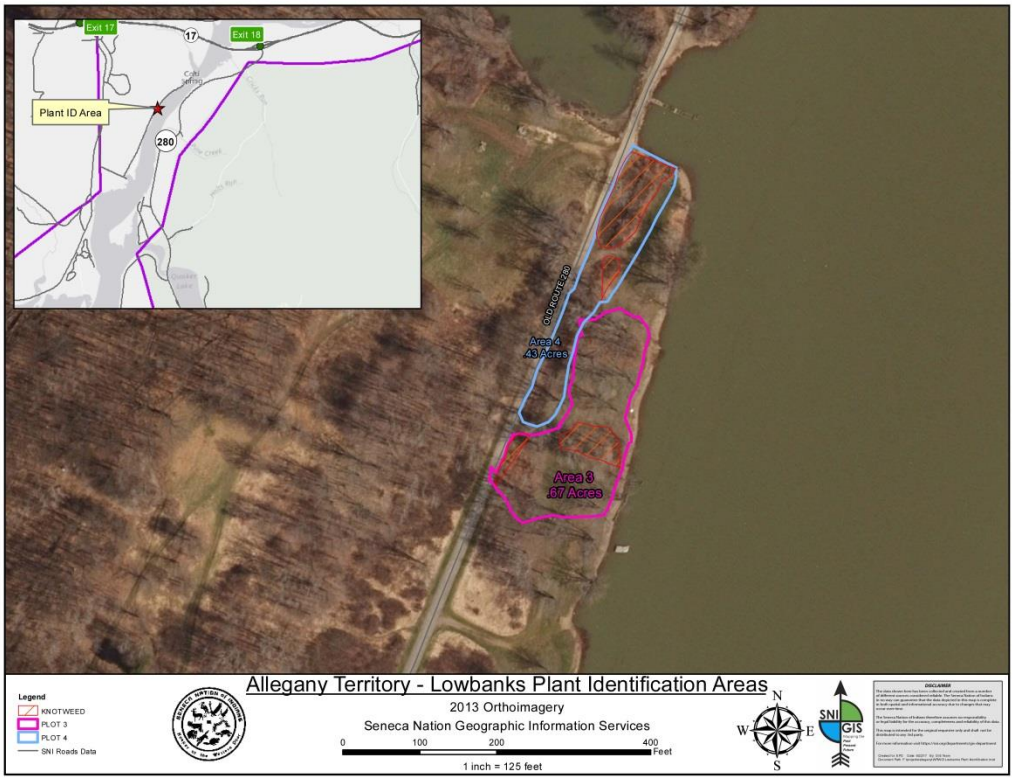

Figure 27 – Low Banks plant survey area 3 and 4

According to Wilhelm and Masters (1995), a Total Mean C greater than 5 represents a system that is high in natural quality. For the 4 areas considered, the Total Mean C is similar but the FQI and adjusted FQI differ. The calculation of these numbers will establish a baseline of the floristic quality of the area. It will also facilitate the comparison among the different sites which will allow for the monitoring and adaptive management strategies to maximize success of habitat restoration.

Table 9 - Results from Floristic Quality Assessment produces a measuring index

Area	Species Count	Native Plant Ratio	Total Mean C	FQI	Adjusted FQI
1	16	3.9	2.1	21.3	22.3
2	73	3.6	2.5	25.9	21.2
3	62	3.4	2.1	21.3	17.0
4	60	3.2	2.2	20.8	18.3

3.1.4 Fish Habitat

Paddlefish (*Polyodon spathula)* were extirpated from the Ohio River Basin by the early 20th century, attributable to a reduction of habitat, poor water quality, and migration routes blocked by dams. While the new paddlefish population in the lake appears to be thriving, there was no evidence of natural reproduction as of 2013 (PFBC 2013). This species moves upstream in the spring when water temperatures near 60 degrees to spawn in large rivers (such as Ohi:yo') on clean gravel bars and then spends the summers and winters in slack waters such as backwaters of

large rivers and river lakes. Temperatures typically reach 60 degrees on Ohi:yo' near Salamanca between the beginning and the end of May. Paddlefish collection efforts from during early May – late June 2008-2011 found that the majority of captured paddlefish were concentrated in the upper reservoir indicating that this is likely their preferred habitat during this time period (Budnik et al. 2014).

The fishery of Ohi:yo' is a regional resource of importance to Pennsylvania, New York, and the Seneca Nation. Walleye (*Stizostedion vitreum*) is considered to be the primary game fish in the reservoir, and is a species of particularly significant cultural importance to the Seneca Nation (shown in Figure 28). The lake supports healthy populations of walleye and other native fish species, however, growth rates are poor and fisheries must be supported through stocking efforts by the Seneca Nation, Pennsylvania Fish and Boat Commission (PFBC), and NYSDEC to maintain populations. The Seneca Nation Fish and Wildlife Department have operated a Walleye hatchery since 2012.

Ohi:yo' fish habitat is negatively affected by the magnitude of reservoir fluctuations, sedimentation, and HABs. Sedimentation in the upstream reach of the reservoir has reduced the availability of spawning areas for native fish species. Gravel beds, important for spawning of walleye, paddlefish and other native fish species, were more abundant historically than they are now. Not only has this gravel habitat been covered by sediment deposited over the past 50 years since Kinzua Dam was constructed, but also the pool created by the Dam inundated approximately 24 miles of Ohi:yo', converting free-flowing habitat to lacustrine habitat.

Figure 28 - Walleye (left) and Northern Pike (right)

The availability of shelter, spawning, rearing, and feeding habitat for fish in Ohi:yo' has diminished greatly over time. Submerged aquatic vegetation cannot be supported in the shallow zones of the reservoir as those lose water coverage for almost half the year. Therefore, plant structure important to juvenile fish for shelter and forage areas are unable to properly develop. To compensate for this lack of important life-stage habitat, the Seneca Nation, Pennsylvania Fish and Boat Commission, Kinzua Fish & Wildlife Association, and Allegheny National Forest have been constructing artificial habitat in Ohi:yo'. These efforts are limited in extent and are semi-permanent.

3.2.0 OBJECTIVES AND CONSTRAINTS

3.2.1 Planning Objectives

The following planning objectives summarize the future conditions that the alternatives for this study are seeking to achieve within the Ohi:yo' ecosystem based on the identified problems and opportunities.

- Improve aquatic habitat in the Study Area including reduction of HAB-related impacts through 2068.
- Improve the quality and connectivity of aquatic habitats in the Seneca Nation portion of Ohi:yo' through 2068.
- Restore natural riparian areas along reservoir shorelines within the Seneca Nation portion of Ohi:yo' through 2068.
- Reduce shoreline erosion and nutrient inputs within the Seneca Nation portion of Ohi:yo' through 2068.

3.2.2 Planning Constraints

- Do not negatively impact fisheries.
- Do not negatively impact species that have significance to the Seneca Nation.
- No loss of flood protection, water quality or hydroelectric power from existing projects, to include working with the annual and daily water level fluctuations dictated by these purposes.
- Do not select an alternative that the Seneca Nation of Indians considers cost-prohibitive or too burdensome to maintain.

3.3.0 MOST PROBABLE FUTURE WITHOUT PROJECT CONDITIONS

There are 3 primary factors that are largely responsible for the continued degradation to the environment upstream from the Kinzua Dam. The first factor is the utilization of the dam for flood control inundates a great deal of land quickly, especially when operated during the winter as shown in Figure 29. Future flooding is unlikely because this is a regulated section of the river where water is released to meet downstream flow requirements and is also released to prevent flooding. The second factor is the difference between summer pool elevation stored for downstream water quality and the winter pool. The minimum pool elevation is 1,240 feet with average winter low-water pool elevation at 1,292 feet (capacity, 239,780 acre-feet) filling up to summer low-water pool elevation of 1,328 feet (capacity, 572,610 acre-feet). Storage to summer pool normally occurs during period April to May with draw down to winter pool occurring during October to November. Lastly, the hydro-electric facility creates water level fluctuations on a daily basis, sometimes multiple times a day, which causes varying levels of impacts based on shoreline topography. Current pump storage size does not allow for increased hydropower capacity so it is highly unlikely that there will be increasing demands for hydropower.

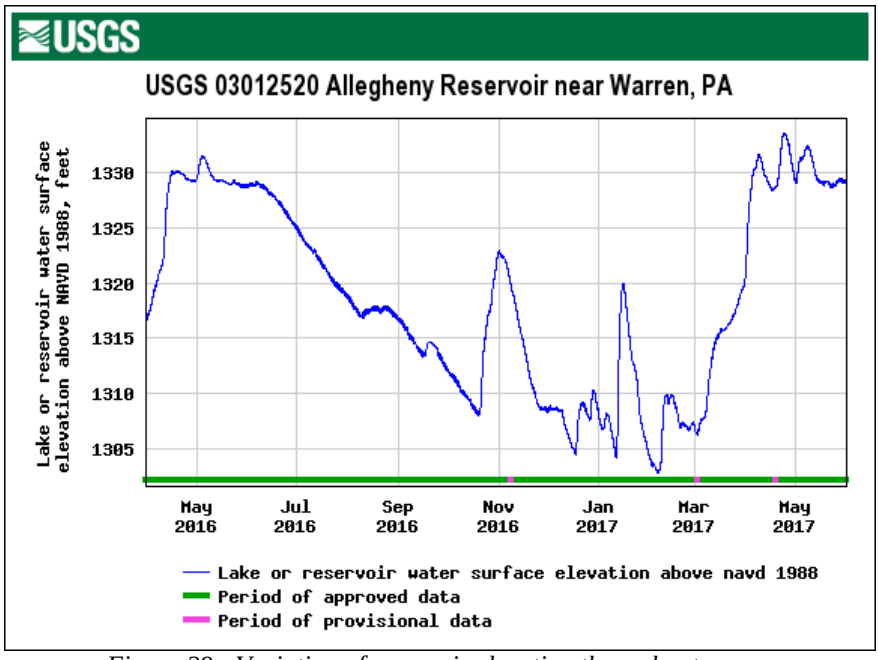

Figure 29 - Variation of reservoir elevation throughout a year

With the current conditions placed on Ohi:yo', the environmental degradation upon the area between summer and winter pool as well as the near-shore area will continue. A loss of land and loss of vegetation will persist which will thereby cause more land to be lost even with the continued efforts of the Seneca Nation to plant trees and create artificial habitat. The vicious erosion cycle thrives under the current operating conditions which also creates water quality issues as the eroded shorelines input an increased amount of sediment into the system. As vegetation is lost, invasive species are able to take hold in the disturbed areas while encroaching upon native plants. The rich biodiversity of the Study Area has declined over time and will remain on that course if no action is taken.

Visser et al. (2016) have shown that expected future changes, including increased temperatures, and increased atmospheric carbon dioxide, are likely to exacerbate HABs. However, a qualitative analysis of the Allegheny River Basin conducted by USACE (Appendix E), found no compelling evidence to alter the execution of the project as a result of climate change. The HABs impacting the reservoir have become more severe and long-lasting over the past five years. Not only are the HABs encompassing an area approximately 7 miles in length along the reservoir (from Willow Creek Bay to Lowbanks) but they also reach well beyond the near-shore area. The HABs persist due to the flux of nutrients into the system and the nutrients stored in the sediment so as more nutrient laden sediment fills the reservoir, the potential for extensive and prolonged HABs events will also increase. As the concentration of cyanobacteria increase, the formation of cyanotoxins becomes more prevalent thereby escalating the risk to recreational and downstream users. Fish populations have been able to move throughout the Study Area as HABs migrate throughout the reservoir but this ability becomes diminished as the HABs become more widespread. HABs can cause low dissolved oxygen and can interrupt the food web (USGS, 2018).

3.4.0 MEASURES TO ACHIEVE PLANNING OBJECTIVES

3.4.1 Preliminary Measures

A total of 37 measures were considered, these included 14 measures for HABs (with several internal variants or sub-measures), 6 measures for invasive species management, 14 measures for erosion control, and 3 measures for fisheries habitat.

3.4.1.1 HAB Measures

Five objectives for ways to address HABs were considered, with a total of 14 measures and several sub-measures (shown in Table 10). Measures range from treatment of the cause of the HABs to treating the effects of the HABs in small areas for local benefits to the Study Area.

Table 10 - HAB measures considered

Note: as the development process was iterative, measure designations are not always sequential. Measures that moved forward for further evaluation are marked with an asterisk (*).

POTENTIAL OUTCOMES	MEASURES	SCREENING NOTES
Reduce availability of Nitrogen and Phosphorus that aids in HAB formation	H1. Chemical treatment (flocculation)	Chemical treatment can be expensive and can negatively impact aquatic life, sediment quality, and habitat.
	H2. Capping of nutrient laden sediments	Capping has not been proven to be successful on scales of this magnitude, also expensive.
	H3. Large scale sediment removal/excavation for reduction of nutrients in the system	Dredging/excavation have not been proven to be successful on scales of this magnitude. Also, the impact and cost of dredging on this scale is prohibitive. Removal of in situ nutrients does not address incoming water-borne nutrients.
	H4. Reduction of N and P from point and nonpoint sources (increased regulatory control of pollution, treatment wetlands, watershed nutrient management plan)	Outside the scope/authority of the 1135. However, engaging stakeholders to develop a nutrient watershed plan would be a long-term effort and solution to inflow nutrient loads.
	H5a. Small scale sediment removal/excavation for local benefit - deep channel through Bear Claw (BC)	A deep channel connecting to the river thalweg through Bear Claw may increase flow in Quaker Bay and remove nutrient rich sediments; however, the amount of dredging/excavation would be expensive, the channel would require extensive armoring, and there are concerns with causing downstream erosion (particularly at Wolf Run).

POTENTIAL OUTCOMES	MEASURES	SCREENING NOTES
Reduce availability of Nitrogen and Phosphorus that aids in HAB formation	*H5b. Small scale sediment removal/excavation - shallow channel through BC (6"; Off-Site Deposit; Area C)	Excavate a small channel through the Bear Claw area to remove nutrient laden sediments and increase flow in the area during high pool. Excavation of smaller protected bays or coves (i.e. Quaker Bay or Moe Banks) may be locally beneficial. See Figure 31 for explanation of Area C.
	*H5c. Small scale sediment removal/excavation - shallow excavation on south side of BC (no thru- channel) (6"; Off-Site Deposit; Area A)	Excavate south end of Bear Claw, with no through channel, to remove nutrient laden sediments. Excavation of smaller protected bays (i.e. Quaker Bay or Moe Banks) may be locally beneficial. See Figure 31 for explanation of Area A.
	*H5d. Small scale sediment removal/excavation - shallow channel through BC (6"; Local Deposit; Area C)	Excavate a small channel through the Bear Claw area to remove nutrient laden sediments and increase flow in the area during high pool. Excavation of smaller protected bays (i.e. Quaker Bay or Moe Banks) may be locally beneficial. See Figure 31 for explanation of Area C.
	*H5e. Small scale sediment removal/excavation - shallow excavation on south side of BC (no thru- channel) (6"; Local Deposit; Area A)	Excavate south end of Bear Claw, with no through channel, to remove nutrient laden sediments. Excavation of smaller protected bays (i.e. Quaker Bay or Moe Banks) may be locally beneficial. See Figure 31 for explanation of Area A.
	*H5f. Sediment removal/excavation - shallow excavation of a shallow channel through BC (Local Deposit; Area A - 12" and Area C - 6")	Excavate a small channel through the Bear Claw area (Area C) at a depth of 6". In addition, excavate the south end of Bear Claw (Area A) at a depth of 12". Excavate in order to remove nutrient laden sediments and increase flow in the area during high pool. Excavation of smaller protected bays (i.e. Quaker Bay or Moe Banks) may be locally beneficial. See Figure 31 for explanation of Area C.
	H6. Changes to land use management in the watershed	Outside the scope/authority of the 1135. However, engaging stakeholders to identify a way forward could be the first steps toward development of a watershed nutrient management plan/modeling, etc.

POTENTIAL OUTCOMES	MEASURES	SCREENING NOTES
	*H14. Seasonal planting during exposure	Seasonal planting of barren lands (at elevations between high and low pool) to uptake the nutrients from the sediments, minimize erosion, and increase food source for the fish and wildlife. These plantings will occur annually when the water recedes to winter pool. Planting would need to occur every year; no harvest necessary; no need for fertilization or seed collection.
Increase vertical mixing to reduce conditions that aid in HAB formation	H7a. Mechanical mixers	Mechanical mixers have not been proven to be successful on scales of this magnitude, also expensive (equipment and O&M). Solar bees have had controversial results.
	*H7b. Aeration/ hypolimnetic oxygenation	Provide a local benefit (Quaker Bay or Moe Banks) by eliminating anoxic periods for fish and disrupting the HAB cycle. Does not address the cause of the HABs, but does address the impacts of the HABs. Limited sustainability as it requires perpetual running and O&M to see the benefit. Use of pure oxygen injection into the hypolimnetic waters was rejected due to cost and safety concerns. Use of air to increase mixing may be viable.
Modify reservoir operations to reduce reservoir retention times, decrease stratification & anoxia, & increase discharge of N & P, which contributes to HAB formation (horizontal & vertical flushing)	H8. Increase reservoir bottom discharges	Outside the scope/authority of the 1135. Does not require a reallocation study. District currently testing effects of bottom discharges from the dam (water temperature limited). By releasing water from lower in the reservoir earlier in the year, it may reduce stratification, remove nutrients, and reduce HABs.
	H9. Reservoir operational changes	Outside the scope/authority of the 1135. This action would require a reallocation study.
Use chemical, biological, or physical controls to reduce the severity of HABs (remedial; prevent proliferation & treat	H10. Chemical: algaecides, clay, barley straw	Chemical treatments expensive and can negatively impact aquatic life, sediment quality, & habitat. Also, nutrient reduction methods and other chemical methods have not been proven to be successful on scales of this magnitude.

POTENTIAL OUTCOMES	MEASURES	SCREENING NOTES
HABs once they have occurred)	*H11. Physical: Surface skimming	Physical skimming of floating algae likely not successful on scales of this magnitude. Some blue green algae and toxins will remain after algae removal so risks to aquatic life and the public are reduced but not eliminated. Skimming is possible only when buoyant algae float to the surface. Also, skimming would be too labor intensive at an algae harvest rate of 2 acre/hour.
	*H12. Biological: floating Islands, native algae seeding	Seeding of native algae species not likely to be effective on this scale. Floating islands provide local benefit (nutrient uptake and fish cover) but tend to attract waterfowl, increasing nutrient input.
Deploy HAB real-time continuously recording monitors to be used as an early HAB warning system	H13. Deploy continuous water quality monitors in the upper reservoir to track nutrient, algae, and sediment loads to the reservoir	Outside the authority of the 1135. This effort would provide data for human health and safety, and for reservoir nutrient load modeling.

3.4.1.2 Shoreline Protection Measures

Stabilization of eroding shorelines would reduce the loss of riparian and upland habitat and reservoir sedimentation that negatively impacts fish habitat. In addition to preventing habitat value loss, alternative methods of stabilization would furnish positive habitat benefits, such as stone providing fish habitat benefits and natural vegetation providing riparian habitat benefits. Fourteen measures for erosion reduction were considered, shown in Table 11. These were divided into two categories: stabilizing the entire over steepened bank or concentrating on the toe of the bank.

Table 11 - Shoreline protection measures considered

Note: as the development process was iterative, measure designations are not always sequential. Measures that moved forward for further evaluation are marked with an asterisk (*).

POTENTIAL OUTCOMES	MEASURES	SCREENING NOTES
Strengthen bank hard (full bank height)	E1. Structural Walls	Walls are unacceptable to Sponsor
	E2. Rip Rap	E2 & E3. Denuding and rock lining the entire bank may cause additional stabilization issues instead of helping control erosion, the bank is a diverse native forest and this impact may be significant.
	E3. Gabion Baskets	

POTENTIAL OUTCOMES	MEASURES	SCREENING NOTES
Strengthen bank soft (full bank height)	E4. Cellular confinement with soil infill – vegetated	Denuding and rock lining the entire bank, may cause additional stabilization issues instead of helping control erosion, the bank is a diverse native forest and this impact may be significant.
	E5. Re-grading of slope – vegetated	Insufficient room at Highbanks to re-grade (campground at top and deep thalweg off shore)
Reduce hydro-dynamic forces (full bank height)	E6. Rock Dike / Weirs	Does not address likely cause of erosion at the site
Toe protection	*E7./E9. Hard - Rip Rap	Band of 12-18 inch diameter rock with rock filter, stretching from winter pool to summer pool elevation. This alternative would provide spaces for a food base to feed the fish populations.
	E8. Soft - Natural stream bank protection measures (root wads, engineered log jam)	Not likely to be effective erosion control methods due to amount of drawdown.
	*E10. Dave Derrick's 4 pocket cove design	Xs of rock and large woody debris to act as speed bump at toe while providing diverse habitat at various water levels, use in conjunction with narrow rip rap band near summer high pool for continuous erosion protection. Ecological improvement would be even greater, fish habitat improvement than E7/9.
	E11. Rock Dike	Could trap HAB at bank, would be expensive, huge rock structure needed, highly visible at low pool.
	*E12. Rock Berm/Flood Bench	Could bolster upper bank, could be built discontinuous (reduce cost, increase bank diversity). Would also put plantings behind the rock berm.
Reduce hydrodynamic forces (toe only)	E13. Bendway weir, J-Hook, etc.	Does not address likely cause of erosion at the site.
Reduce hydrodynamic forces (toe only) with soft methods	E14. Vegetation/native planting	Eliminated as a standalone measure as unlikely to be effective, but to be kept as an "add on" impact reduction measure for multiple measures/alternatives.

3.4.1.3 Invasive Species Management Measures

Removal of invasive species, particularly Japanese knotweed, in combination with replanting of suitable native species is another potential opportunity to increase the adjusted FQI. Benefits

would include improvement of riparian habitat values for upland wildlife species, improvement of aquatic habitat through reduced sedimentation and siltation, and restoration of native plants having cultural importance to the Seneca Nation. Six measures to reduce invasive species were considered, shown in Table 12. These were concentrated at areas where colonization of invasive plants is threatening existing diverse, native habitats.

Table 12 - Invasive Species Management Measures

Note: as the development process was iterative, measure designations are not always sequential. Measures that moved forward for further evaluation are marked with an asterisk (*).

MEASURES	SCREENING NOTES
*P1. Chemical treatment (Rodeo)	Due to Seneca Nation concerns re: safety of nearby native vegetation and impacts to the aquatic system, we will use application methods that reduce drift (such as wiping or injecting the herbicide following a mechanical cutting). Chemical treatment done in August. The effectiveness goes up over 3 year period with decline of population of invasive plants resulting in less use of chemical over time. This alternative completed in combination with planting.
P2. Burn	Not appropriate method for knotweed (which is the largest concern).
*P3. Mechanical	Removal alone requires diligent maintenance for several years. Can be done through cutting or grazing (goats). Mechanical removal, in possible combination with goats on steep or inaccessible terrain, would occur in June.
*P4. Native vegetation planting	Would be used in conjunction with all other methods to minimize re-infestation. Possible use of allelopathic plants or plant materials to reduce regrowth of non-natives. Black walnut, for instance. Knotweed has been witnessed growing beneath mature black walnut trees, though perhaps a dense planting of the species might work. Could try a test plot. Plant stock could be seed or stock, depending on what types of plants are chosen (grasses, shrubs, and tree species - all native seed mixes). Another way in which to propagate native plants is to use sources of plants in the area.
P5. Solar blankets	May be insufficient sun to produce enough heat to kill the roots. Could try a test plot.
*P6. Essential oils	Effectiveness unknown. Could try a test plot. Kill rate is marginal compared to chemical and application would be weather dependent; however, this approach is more natural and accepted by community.

3.4.1.4 Fish Habitat Improvement Measures

Restoring quality spawning habitat, increasing structural habitat for juvenile fish shelter, and improving riverine connectivity are all potential opportunities to restore ecosystem processes and functions impeded by reservoir operations. Potential alternatives addressing HABs and shoreline erosion will also have direct or incidental benefits to the reservoir fishery, and need to be assessed as having these multiplied benefits. While habitat improvement is integral to all measures, three measures solely for aquatic habitat improvement were considered (shown in Table 13).

Table 13 - Fish habitat measures considered

Note: as the development process was iterative, measure designations are not always sequential. Measures that moved forward for further evaluation are marked with an asterisk (*).

MEASURES	SCREENING NOTES
F1. Engineered log jam	Concern that the pool fluctuation would cause rapid degradation of any woody structure.
F2. Restore/rebuild island formation	Measure unacceptable to Sponsor. Historic islands are gone because of changes to the system.
F3. Build shallow dikes near the mouth(s) of reservoir embayment(s)	Create fish habitat during the fall/winter drawdown period and create wetlands by stabilizing water level. Measure is likely to create migration barriers for spring spawners.

3.4.2 Measures Excluded from Detailed Consideration

Several of the above measures were initially proposed but were eliminated for various reasons. The Screening Notes in the above tables provide information from the initial discussions regarding cost, effectiveness and acceptability. Of note are several measures that were considered, but which are outside of the scope or authority of this 1135 project, including consideration of a watershed study (H4), land use management changes (H6), and reservoir management changes (H8 and H9). Although these are unable to be implemented under this project, these are viable measures that will continue to be discussed for possible future action. Particularly, H4 and H6 represent the best long-term strategies to address the cause of the HABs but require a large, coordinated effort to analyze and address pollutant inputs in the watershed.

3.5.0 ALTERNATIVE SOLUTION SETS

3.5.1 Formation of Alternatives

As noted in section 3.4, team discussions of cost, effectiveness and acceptability were used for the first screening. From the array of initial 37 measures and 6 sub-measures or variants, 16 measures/sub-measures moved forward. The Seneca Nation and Corps project team rated these 16 measures/sub-measures based on initial cost, operations and maintenance cost, durability/life span, effectiveness, and feasibility/acceptability. Rankings were Red, Amber, and Green based on initial analyses and best professional judgment. Costs were based on a preliminary analysis of known or expected features. Durability (including Operation and Maintenance) was related to the project life of 50 years, with 50 years being green, 20 to 50 being amber, and less than 20 as red. Effectiveness was ranked as green showing an expected benefit, amber being limited or unlikely benefit, and red being little improvement expected. Feasibility was a ranking of how easily the measure would be to implement, including acceptability by the sponsor. For Feasibility, a green showed a definite ability to implement, amber was potentially implementable, and red was unlikely to be able to implement. Based on the ratings as well as the risks discussed during initial screening (see Section 3.4.1) and anticipated relative level of effectiveness (particularly for the sub-measures), 8 measures were moved forward to establish the alternatives that are shown in Table 14.

Table 14 - Measure ratings by screening criteria

Note: as the development process was iterative, measure designations are not always sequential. Measures that moved forward for further evaluation are marked with an asterisk (*).

	Screening criteria				
Measure	**Initial Cost**	**O + M Cost**	**Durability / Lifespan**	**Effectiveness**	**Feasibility**
H5b. Small scale sediment removal/excavation - shallow channel through BC (6"; Off-Site Deposit; Area C)	**R**	**G**	**R**	**R**	**G**
H5c. Small scale sediment removal/excavation - shallow excavation on south side of BC (no thru- channel) (6"; Off-Site Deposit; Area A)	**A**	**G**	**R**	**R**	**G**
*H5d. Small scale sediment removal/excavation - shallow channel through BC (6"; Local Deposit; Area C)	**A**	**G**	**R**	**G**	**G**
H5e. Small scale sediment removal/excavation - shallow excavation on south side of BC (no thru- channel) (6"; Local Deposit; Area A)	**G**	**G**	**R**	**G**	**G**
*H5f. Sediment removal/excavation - shallow excavation channel through BC (Local Deposit; Area A - 12" and Area C - 6")	**A**	**G**	**R**	**G**	**G**
*H7b. Aeration/hypolimnetic oxygenation	**A**	**A**	**A**	**G**	**G**
H11. Physical: surface skimming	**G**	**G**	**G**	**A**	**G**
H12. Biological: floating islands, native algae seeding	**G**	**G**	**A**	**G**	**G**
*H14. Seasonal planting of native aquatic plants during exposure (i.e. winter wheat & aquatic plants)	**G**	**G**	**R**	**G**	**A**
*P1. Chemical treatment (Rodeo) (includes mechanical)	**G**	**G**	**A**	**G**	**G**
P3. Mechanical	**G**	**A**	**R**	**G**	**G**
*P4. Native vegetation planting	**G**	**G**	**A**	**G**	**G**
P6. Essential oils	**G**	**A**	**A**	**G**	**A**
*E7./E9. Hard - rip rap	**R**	**G**	**G**	**G**	**G**
E10. Dave's 4 pocket cove design	**R**	**G**	**A**	**G**	**A**
*E12. Rock berm/flood bench	**R**	**G**	**G**	**G**	**G**

3.5.2 Alternative Plan Descriptions

Alternatives were formulated by combining the remaining eight measures to establish alternatives that benefitted each objective of the project: HAB reduction, bank stability, fish habitat and reduction of invasive plants in key areas. This plan formulation strategy was used to develop distinguishable alternatives that met the identified planning objectives. The following sections describe the alternative plans considered for this study.

3.5.2.1 Alternative 1: No Action

For all projects, the Corps is required to consider a "No Action" alternative. Under this alternative, the Corps would take no additional actions targeted at ecosystem restoration within the Study Area. However, other actions that can reasonably be expected to take place are considered within this alternative, such as continued action taken by the Seneca Nation to improve conditions and protect their natural resources by planting vegetation and creating artificial habitat. Existing trends in resource conditions will be used to estimate the changes in existing conditions from No Action over the planning horizon (50 years). This alternative will form the basis of comparison for the other alternative plans. See Section 3.3.0 for a description of the "Most Likely Future Without Project Condition" that would occur under this No Action alternative.

3.5.2.2 Alternative 2

Alternative 2 includes three measures for HAB improvement (H5f, H7b, and H14), two measures for invasive species removal (P1 and P4) and one measure for bank stabilization (E12). These are detailed below.

<u>H5f. Sediment removal/excavation - shallow excavation on south side of Bear Claw (Local Deposit; Area A - 12" and Area C - 6")</u>
Initial algae blooms in the reservoir are largely caused by nutrients in the water column. These initial blooms can cause anoxic conditions in the deeper, stratified waters. These anoxic conditions then release nutrients that are otherwise bound to the sediments. These nutrients then become available to the algae causing increased duration and intensity of the blooms. Sediment testing was conducted in various locations around the Study Area (see Figure 30). Testing results show that the upper 6 inches of the soil contain increased levels of P and N.

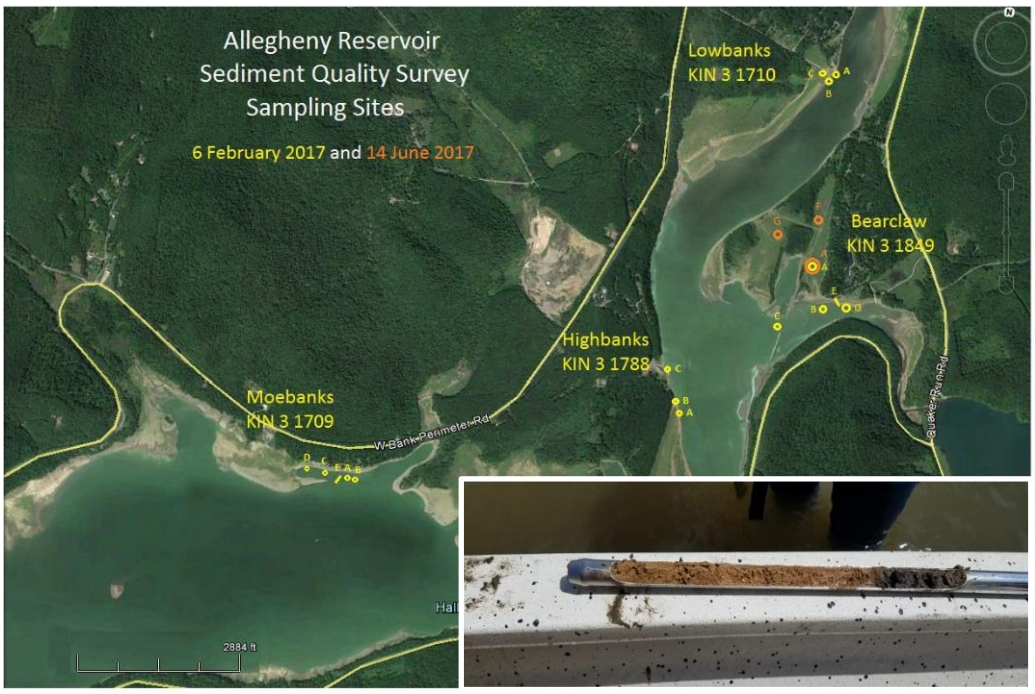

Figure 30 - Sediment quality survey sampling sites
(Includes image showing soil quality difference between top layers and bottom (deeper) layers of sediment at Sample Site G in the Bear Claw area.)

Sediment removal would involve excavation during winter low pool to remove sediment from an area where HABs tend to persist. Approximately 6 inches depth of sediment would be removed from 5 acres of land (Area C) and 12 inches depth would be removed from an additional 5 acres (Area A; see Figure 31). This will remove nutrient laden sediments from 10 acres, and expose larger grain sediments that are preferred by fish. Additionally, the shallow excavation through Bear Claw will improve connectivity to the upstream (north) side of the peninsula during summer pool. At high pool, water overflows this area already. The shallow, 6-inch excavation on the north side of Bear Claw is intended to better capture the low velocity (inside bend) flows for slightly increased (non-erosive) flows within the Study Area. The deeper 12-inch depth excavation on the south side of Bear Claw is added to improve local drainage and reduce risk of fish stranding as the lake level drops. Further hydrologic and hydraulic modelling will be done during the next phase of the design to ensure that the risk for capturing erosive flows is limited.

By limiting excavation to the winter, the work can be done in the dry, reducing the cost and the environmental impacts of the construction. Local deposition of the sediment also reduces cost and duration of the work and allows beneficial on-site use of the material. The disposal site for this alternative is estimated to be 5 acres in size. Placed materials will be protected with rip rap to reduce risk of erosion and will be capped with appropriate quality soils to allow for planting. Capping the nutrient-laden sediments and planting will limit the reactivation of the nutrients during periods of inundation. These areas will augment existing native forested areas that become islands during the summer high pool and protect a nearby eroding shoreline. The addition of rock and native vegetation will improve available shoreline diversity and quality for fish and wildlife.

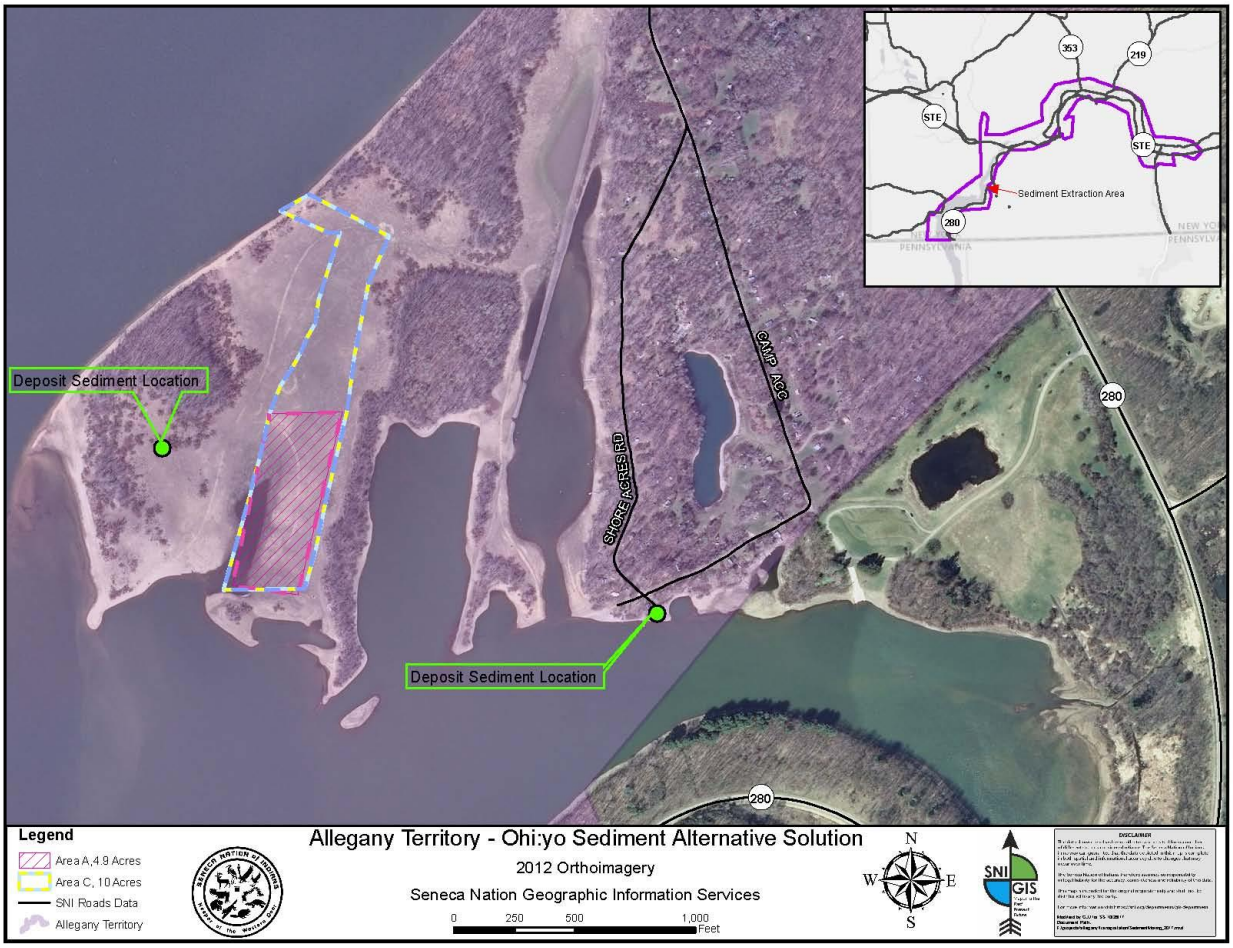

Figure 31 - Sediment removal at Bear Claw

H7b. Aeration

This measure uses aerators to pump air through diffusers near the lake bottom. This air rises to the surface and creates a vertical circulation cell to disrupt the stratification of the lake and eliminate the anoxic conditions (EPA 2015a). Proposed length of the deployed line is approximately 1700 feet (see Figure 32). This measure is expected to directly benefit approximately 80 acres and indirectly benefit the entire Study Area and potentially beyond. Reduction or elimination of HABs in this area not only benefit the immediate area but can lead to a reduction in the feedback loop and potentially influence a greater area beyond the immediate Study Area. The measure will likely increase the water temperatures at depth by increasing mixing with the surface waters. This has been noted as a detriment of the measure because it reduces available cold water refuge for fish; however, the deep waters in the Study Area do not provide cold water refuge because they currently become completely anoxic during the summer.

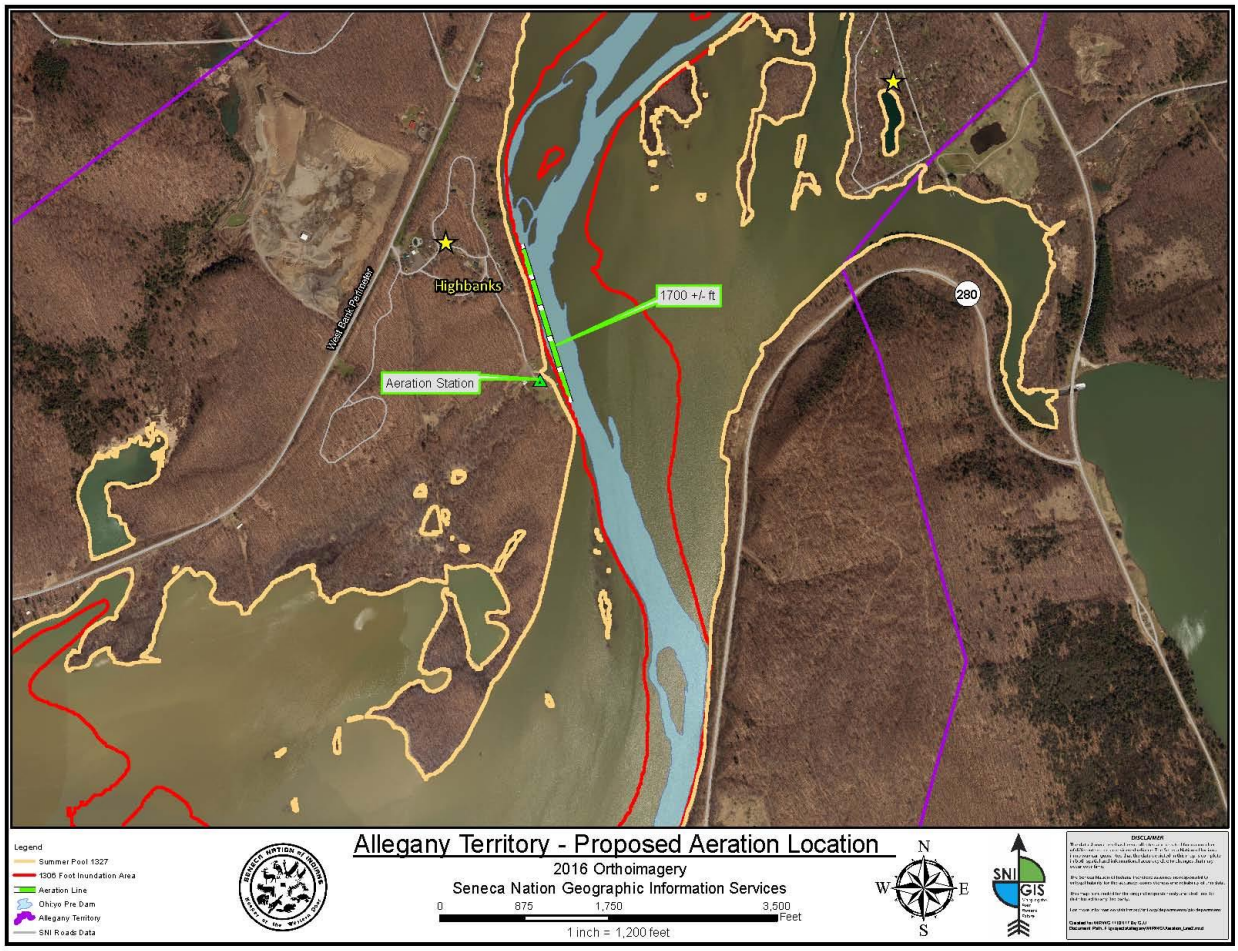

Figure 32 - Aeration line map

H14. Seasonal Plantings

This measure employs seasonal plantings on the large tracts of land that become exposed when summer pool is drawn down to winter pool (October to November). As lands become exposed due to the lowered pool, barren mudflats become visible throughout the near shore area. The mudflat areas would benefit from seasonal plantings as plants would increase erosion protection, provide habitat complexity, and provide refuge and food sources for wildlife during low winter pool and for fish post-inundation. Additionally, seasonal plantings may uptake nutrients from the soil to reduce the duration and intensity of HABs in the area. As shown in Appendix B, benefit calculations for this measure were limited to the improvement of fish cover habitat due to the certainty of this being actualized by implementation. The lack of certainty on the intensity of actualized change in water quality from this measure alone lead to this being an uncaptured benefit in the model.

Plants chosen for the seeding areas germinate quickly, establish easily, and are cold tolerant. Proposed planting species are: winter rape (*Brassica napus L.*), winter pea (*Pisum sativum*), winter wheat (*Triticum aestivum*), and Marshall Ryegrass. Some mudflat species would be available as seed that may be broadcast late summer in the back bay areas as the pool begins to

drop. For cool season grasses, the fall is the best planting. These plants are not invasive in this region and are known to provide good erosion control and weed suppression. Nutrient uptake in the fall can be slow, but increases in late winter and early spring (SARE 2014). Six locations within the Study Area have been identified for seasonal plantings (Figure 33) that total over 240 acres.

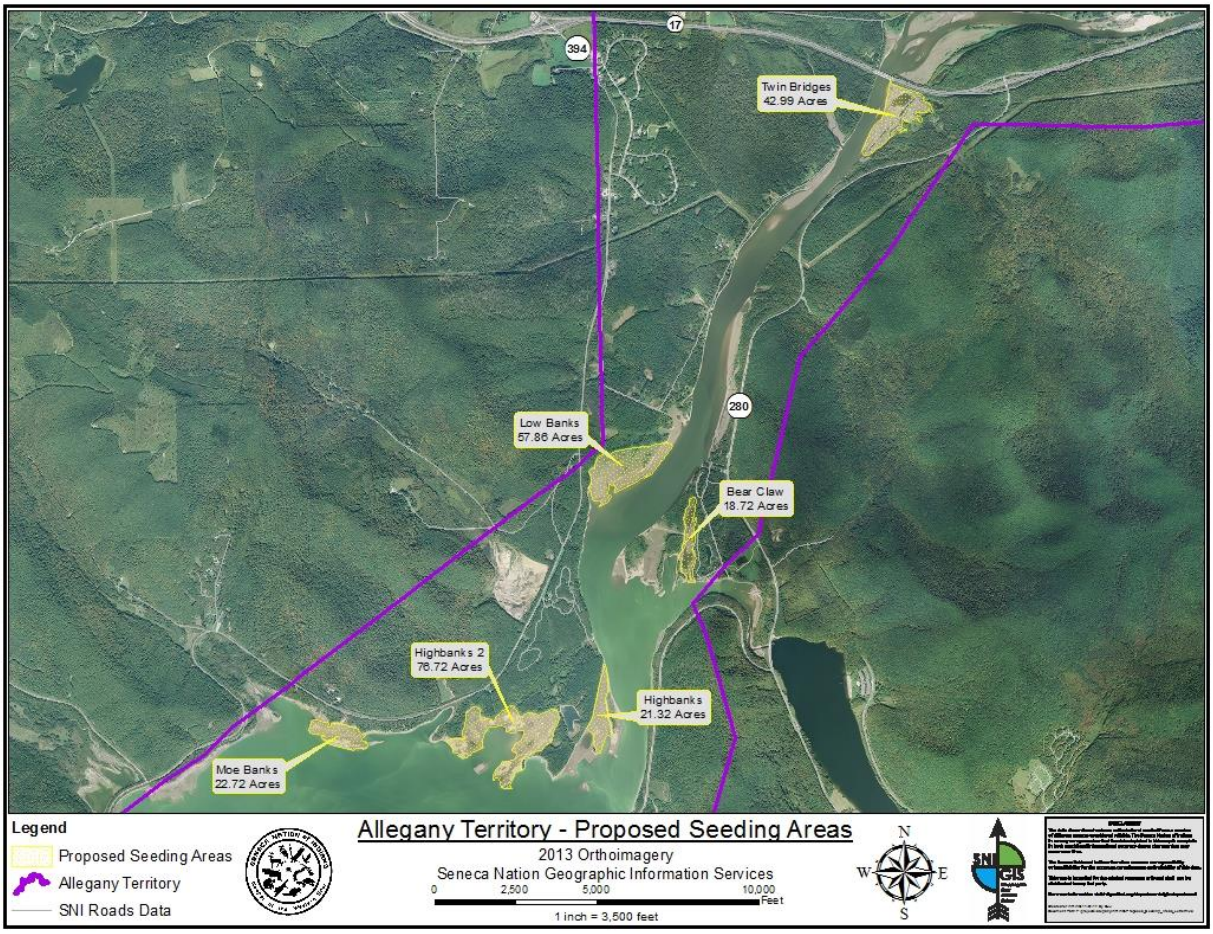

Figure 33 - Proposed seasonal planting locations

<u>P1. Chemical treatment of invasive plants & P4. Native plantings</u>

These two measures will work in tandem to provide management of invasive species in the Study Area. Rodeo is a glyphosate that is labeled for use near water bodies (NRCS 2007), as the use of this product reduces the risk to aquatic species. Additionally, methods that reduce drift will be used. These methods include wiping or injecting the herbicide on individual stems following mechanical cutting. Mechanical cutting would occur in June/July, with chemical treatment in August. Treatment is most effective if conducted annually for three years.

Planting of native vegetation following treatment is important to minimize regrowth of undesired species. Plantings would include a variety of woody and herbaceous native plants as Japanese Knotweed has inhibited the development of the secondary, understory growth. Tree plantings would include Silver Maple, Cottonwood, Swamp White Oak, Tulip Poplar, White Pine,

Slippery Elm and Boxelder. A number of shrubs would be beneficial to the area such as: Silky Dogwood, Speckled Alder, Ninebark, Silky Willow, Sandbar Willow, Buttonbush, Gray Dogwood and Black Chokeberry. The varying soil types and degrees of wetness will dictate native plant species sourced for each area. Use of native species such as black walnut which are known to have an allelopathic effect on other plants may also be used to suppress regrowth within some test areas. Adaptive management of plantings for several years would be required in order to ensure planting success and continued ability of the newly establishing vegetation to outcompete and suppress non-native species.

For this project, we used the mean CoC as a metric of habitat quality. Since the mean CoC ranges from 0 to 10, dividing this number by 10 provides a habitat quality index that can be multiplied by a given acreage in order to obtain "habitat units" (HUs) that measure both the quantity and quality of habitat to be restored. The more acres restored and the higher the habitat quality of those acres (represented by the habitat quality index) will result in greater habitat units to be restored. Maximizing habitat units is desirable from an ecological perspective. The floristic quality is not a true ecosystem property, it may be used to compare impacts of plant populations and indicate that the replacement of the invasive plants with native species would provide an ecological lift. The FQI score takes the mean CoC for a plant community and factors in the number of native plant species in the area to measure the "naturalness" of the site. In order to determine the impact due to replacement of invasive plants with native plants, the FQI model was used. The original data set was used to calculate the improvement to the selected areas; the Fallopia Japonica (Japanese Knotweed) was removed and replaced with desired native plant species. As shown in Table 15, the areas will increase in biodiversity while making the soils more stable and withstand erosion (model input and output provided in Appendix B).

Table 15 - Floristic Quality Assessment to determine effect of restoration activities

Area	Current Native Plant Ratio	Native Plant Ratio post-planting	Total Means C post-planting	FQI post-planting	Adjusted FQI post-planting	Δ Total Means C	Δ FQI	Δ Adjusted FQI
1	3.9	4.8	3.9	22.9	35.6	1.8	1.6	13.3
2	3.6	3.9	2.9	30.7	25.2	0.4	4.8	4
3	3.4	3.9	2.7	27.3	22.3	0.6	6	5.3
4	3.2	3.7	2.7	26.2	23.3	0.5	5.4	5

E12. Rock Berm/Flood Bench

This measure, also sometimes known as a longitudinal peak stone toe protection, involves construction of a rock berm waterward of and parallel to the eroding toe. The base of the berm would be placed at or near the winter pool elevation and the height would reach just above the summer pool elevation. The space behind the berm would be filled with soil, possibly to include excavated material from the Bear Claw area. This filled area would then be planted with native plants. The plantings are expected to be mostly herbaceous to ensure the ability to inspect the

structure and minimize concern of root intrusion/displacement within the rock structure. See Appendix A for typical detail plans.

Benefits of this measure include the stabilization of the high bank at the site. This will reduce local sedimentation and protect the existing high quality upland forested habitat on the bank. The plantings and the interstitial spaces in the berm will provide valuable fish and wildlife habitat.

3.5.2.3 Alternative 3

Alternative 3 includes three measures for HAB improvement (H5d, H7b, and H14), two measures for invasive species removal (P1 and P4) and one measure for bank stabilization (E7/E9). Changes from Alternative 2 are described below.

H5d. Small scale sediment removal/excavation - shallow excavation on south side of Bear Claw (Local Deposit; Area C - 6")

This measure is similar to Measure H5f described above except that excavation through the entire area (10 acres) would be to a depth of 6 inches. This slightly reduces the overall drainage improvement for the area and reduces the amount of material available for reuse to augment the existing vegetated areas. The disposal site for this alternative is estimated to be 4 acres in size. Other benefits are expected to be similar to Measure H5f.

E7/E9. Rip Rap blanket

This erosion control measure places a filtering stone material overlaid by larger armor rock onto the existing slope between the winter and summer pool elevations. This method does not create area for native plantings but does reduce sedimentation, protect the high quality existing forested habitat, and provide valuable bank diversity for fisheries. See Appendix A for typical detail plans.

3.5.2.4 Alternative 4

Alternative 4 includes two measures for HAB improvement (H5f and H14), two measures for invasive species removal (P1 and P4) and one measure for bank stabilization (E12). This alternative is similar to Alternative 2 described above except for the removal of the aeration measure.

3.5.2.5 Alternative 5

Alternative 5 includes two measures for HAB improvement (H5f and H14), two measures for invasive species removal (P1 and P4) and one measure for bank stabilization (E7/E9). This alternative is similar to Alternative 4 described above except for the removal of the rock berm/flood bench (E12) and the addition of the rip rap blanket (E7/E9) described in Alternative 3.

3.5.3 Comparison of Alternative Plans

A summary of alternatives and the anticipated work areas are summarized in Table 16 and Figure 34.

Table 16 - Alternatives summary

Alternative 1
NO ACTION
Alternative 2
H5f. Sediment removal/excavation - shallow channel through Bear Claw (Local Deposit; Area A - 12" and Area C - 6")
H7b. Aeration/ hypolimnetic oxygenation
H14. Seasonal Planting of Native Aquatic Plants during Exposure (i.e. Winter Wheat & Aquatic Plants)
P1. Chemical treatment (Rodeo)
P4. Native vegetation planting
E12. Rock Berm/Flood Bench
Alternative 3
H5d. Small scale sediment removal/excavation - shallow channel through BC (6"; Local Deposit; Area C)
H7b. Aeration/ hypolimnetic oxygenation
H14. Seasonal Planting of Native Aquatic Plants during Exposure (i.e. Winter Wheat & Aquatic Plants)
P1. Chemical treatment (Rodeo)
P4. Native vegetation planting
E7./E9. Hard - Rip Rap
Alternative 4
H5f. Sediment removal/excavation - shallow channel through Bear Claw (Local Deposit; Area A - 12" and Area C - 6")
H14. Seasonal Planting of Native Aquatic Plants during Exposure (i.e. Winter Wheat & Aquatic Plants)
P1. Chemical treatment (Rodeo)
P4. Native vegetation planting
E12. Rock Berm/Flood Bench
Alternative 5
H5f. Sediment removal/excavation - shallow channel through Bear Claw (Local Deposit; Area A - 12" and Area C - 6")
H14. Seasonal Planting of Native Aquatic Plants during Exposure (i.e. Winter Wheat & Aquatic Plants)
P1. Chemical treatment (Rodeo)
P4. Native vegetation planting
E7./E9. Hard - Rip Rap

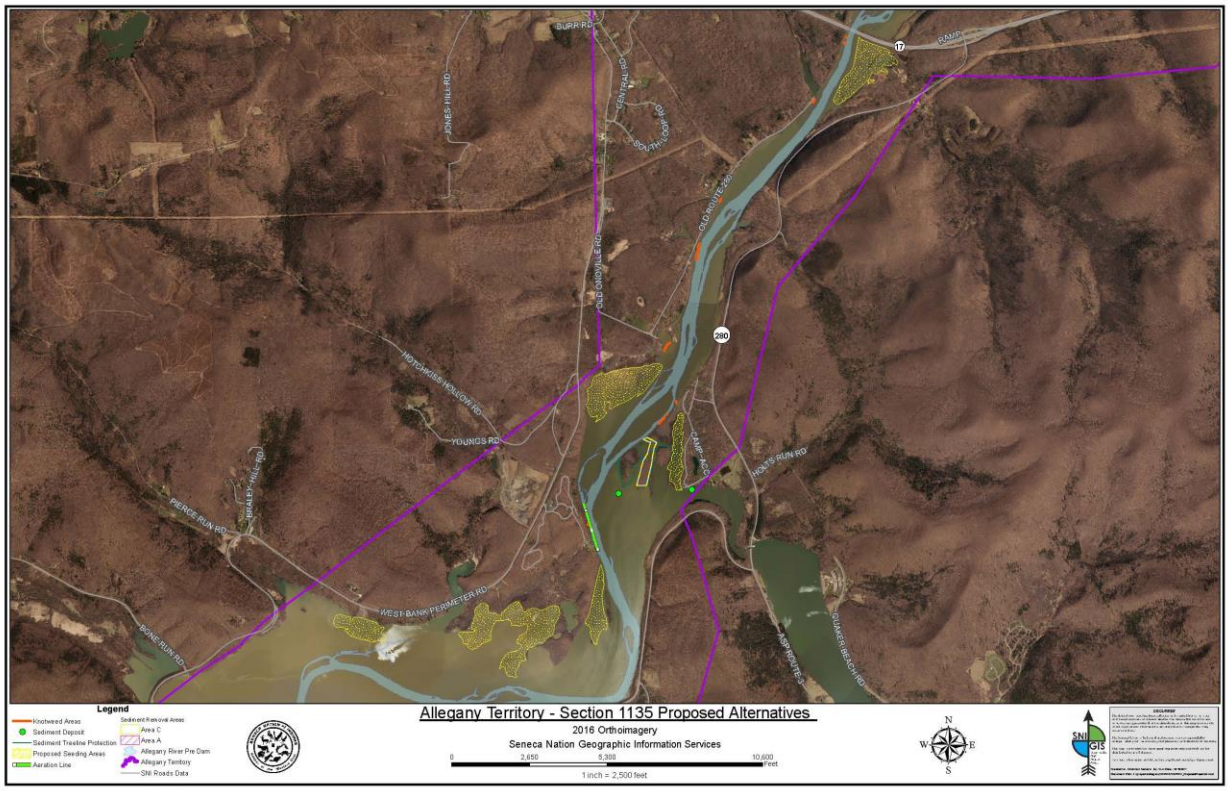

Figure 34 - Alternative project work areas

In order to assess the relative benefits of the alternative plans, two planning models were applied to the alternatives. The action alternatives were then compared to the No Action Alternative in order to assess anticipated increase in the quantity and quality of habitat.

The Smallmouth Bass Habitat Suitability Index (HSI) model was used to measure the benefits of aquatic habitat restoration measures (Edwards et. al., 1983). This model was selected because the life requisites of bass and habitat characteristics reflected in the model (such as water quality, gravel substrates, and habitat structure) are important to a number of target species including walleye and paddlefish. The Floristic Quality Assessment (FQA) model was used to determine riparian habitat benefits, as described above in Section 3.1.3. Additionally, the model was previously certified by the ECO PCX. Additional details on modeling efforts are contained in Appendix B.

The benefits and cost effectiveness analysis for the three action alternatives are summarized using the screening level cost estimates developed for the alternatives. The Corps' Institute for Water Resources (IWR) developed a decision support tool, the IWR Planning Suite II, for the formulation and evaluation of ecosystem restoration alternative plans. It allows for the evaluation of actions involving monetary and non-monetary costs and benefits. The IWR Planning Suite II was used to conduct the cost effectiveness/incremental cost analysis for this project. The No Action Alternative (Alternative 1) would have no costs and no benefits above and beyond the future without project condition. For the purposes of this evaluation and comparison both aquatic and riparian habitats were given equal weighting. Habitat units were developed from both the quantity and quality of both habitat types and compared equally across

all alternatives. In Appendix B, average annual habitat units (AAHU), and cumulative habitat units (CHU) are reported. In Table 17, average annual cost and AAHU is reported. A Cost Effective/Incremental Cost Analysis (CE/ICA) was conducted to determine the cost effectiveness of each alternative. The average annual cost is compared to AAHU in the IWR Planning Suite II; the CE/ICA results are located below in Table 17.

Table 17 – Summary of the habitat benefits anticipated for the alternatives and the associated costs

Alternative	Net Benefits (AAHU)	Average Annual Cost	Cost effectiveness
Alternative 1: No Action	0	$0	
Alternative 2: Rock Berm with Aeration	275.31	$383,119	Not Cost Effective
Alternative 3: Rip Rap with Aeration	275.31	$236,375	Best Buy
Alternative 4: Rock Berm without Aeration	96.13	$345,368	Not Cost Effective
Alternative 5: Rip Rap without Aeration	96.13	$194,138	Cost Effective

Plans were then compared based on the extent to which they addressed the planning objectives and did not violate the constraints (Table 18). A relative comparison of High, Medium, Low, and None was made as to the extent to which each of the planning objectives was achieved by the alternatives and the extent to which each of the planning constraints was avoided by the alternatives. The No Action alternative did not meet any of the objectives. Alternatives 2 and 3 were very effective at meeting all of the objectives. Alternatives 3 and 5 were moderately effective at meeting Objective 1, but were highly effective at meeting all other planning objectives.

The No Action alternative was successful at avoiding all of the planning constraints. Alternatives 2 and 3 were highly effective at avoiding potential impacts to fish and other species, and would not degrade flood protection, water quality, or hydropower. Alternatives 2 and 3 were rated as Low for the fourth constraint, due to the large operation and maintenance burden of the aeration system. Alternatives 3 and 4 successfully avoid all of the planning constraints.

Table 18 - Alternatives Comparison against the Planning Objectives and Constraints

Objectives				
	reduction of HAB-related impacts	Improve aquatic habitats	Restore natural riparian areas	Reduce shoreline erosion and nutrient inputs
1. No Action	None	None	None	None
Alt 2	High	High	High	High
Alt 3	High	High	High	High
Alt 4	Medium	Medium	High	High
Alt 5	Medium	Medium	High	High
Constraints				
	Do not negatively impact fisheries	Do not negatively impact species of significance to the Seneca Nation	No loss of flood protection, water quality or hydroelectric power	Do not select a cost-prohibitive or too burdensome alternative
1. No Action	High	High	High	High
Alt 2	High	High	High	Low
Alt 3	High	High	High	Low
Alt 4	High	High	High	High
Alt 5	High	High	High	High

The alternatives were also compared based on the extent to which they met the four criteria identified in the 1983 "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies." These criteria are described below along with the specific metrics used to assess the performance of each alternative against these criteria and the scores used to rank their performance.

Completeness: 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. For this study, completeness was determined based on the inherent risk involved in the long-term sustainability of the project, considering both the durability and the cost burden of any maintenance or repairs. Alternatives 3 and 5 were considered to be complete as they had minimal risks and costs associated with the long-term implementation and actualization of the benefits. They were awarded a score of 9. Alternatives 2 and 3 had elevated risk of damage to the aeration system from ice and debris during winter low flows and is likely to need significant, costly repairs or replacements over the 50 years in order to actualize the benefits. Determining the frequency and amount of damage to aeration lines is highly uncertain. Based on these risks, these alternatives were awarded a score of 1.

Effectiveness: The extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities. The performance against the planning objectives was used to assess effectiveness of alternatives for this study. A score of 10 was awarded if it performed highly at meeting all four planning objectives down to a score of zero if it met no planning objectives. Scores in between were awarded based on the extent to which they met each of the objectives using the High, Medium, and Low rankings from the table above to award fractional points when applicable.

Efficiency: The extent to which an alternative plan is the most cost effective means of alleviating the specified problems and opportunities. The results of the cost effectiveness and incremental cost analysis were used to assess efficiency for this study. A score of 10 was awarded for Best Buy plans (Alternative 3), a score of 5 was awarded for cost effective plan (alternative 5), and a score of zero was awarded to plans that are not cost-effective (Alternatives 2 and 4).

Acceptability: 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. The extent to which alternatives avoided potential constraints was used to assess acceptability for this study. A score of 10 was awarded if it performed highly at avoiding all five planning constraints down to a score of zero if it completely violated all constraints. Scores in between were awarded based on the extent to which they performed against the constraints using the High, Medium, and Low rankings from the table above to award fractional points when applicable.

The performance of the alternatives against these four criteria is illustrated in the Table 19 below. Of the action alternatives, Alternative 5 performed best, Alternative 3 was second, and Alternative 2 performed the worst.

Table 19 - Performance of Alternatives against the Principles and Guidelines Criteria

	Completeness	Effectiveness	Efficiency	Acceptability	Total
1. No Action	10	0	10	10	30
Alt 2	1	10	0	8.3	19.3
Alt 3	1	10	10	8.3	29.3
Alt 4	9	8.2	0	10	27.2
Alt 5	9	8.2	5	10	32.2

3.5.4 Risk and Uncertainty

This study was undertaken using Risk Informed Decision Making to ensure that study, implementation, and project outcome risks were taken into account when formulating plans, selecting a plan for implementation, and during feasibility-level design efforts. A discussion of risk and uncertainty allows the Project Design Team (PDT) and Project Sponsor (Sponsor) to assess risks likely to be encountered as well as the consequences that could result from actions taken (or not taken) and items considered (or not considered) during each stage of the project.

Habitat modelling risk for the project is considered low. Existing robust datasets were used to establish the current condition. Over the 50 year period of analysis, the only anticipated change in modelled variables from the current condition to the future without project condition is water temperature due to climate change. This has the potential to alter scores for several variables in the habitat suitability model that was used for smallmouth bass (Appendix B). However, in order to change the score for these variables, the water temperature would have to change by more than 10 degrees, which is highly unlikely to occur. While conditions may change slightly between the current condition and the future without project forecast, the model used is not sensitive enough to these small changes that it would affect the habitat score. There is also risk that our projected benefits for the future with project conditions could be incorrect. But to mitigate this risk, conservative assumptions were made. By altering the substrate, completing the

plantings, and conducting adaptive management and monitoring, we can be fairly certain that these benefits are achieved (See Section 6.3.1).

There is risk that influences outside of the project area could continue to exacerbate HABs and there is associated reputational risk that the public would then mischaracterize the project as a failure. HABs in the reservoir are closely tied to the quality of the water that enters the reservoir. A watershed scale study is needed to guide a reservoir-wide reduction or elimination of the primary pollutant inputs that cause the algal blooms. As stated in Section 3.2.1, the objective of this project is to reduce HAB-related impacts to the area. The proposed action is expected to meet this objective by reducing the nutrient availability within reservoir sediments. That reduced nutrient availability will reduce the duration and intensity of HAB. However, if incoming water quality worsens, HABs could also worsen. The reduced nutrient availability would still minimize the feedback mechanisms that sustain HAB, but that reduction may be largely invisible to the public. Reputational risk can be mitigated by careful outreach to the public and stakeholders before, during, and after implementation.

There is also an engineering risk. The proposed actions and the associated cost estimates have been developed with limited engineering data (bathymetric survey, geotechnical study, hydraulic modelling). To reduce study cost and schedule, limited data collection was conducted. Assumptions have been made based on available data and best professional judgment. Incorrect assumptions would be unlikely to change the expected effectiveness of the chosen alternatives, but may impact the overall design and construction costs.

3.6.0 RECOMMENDED PLAN

While Alternative 3 was identified through the CE/ICA as the Best Buy, Alternative 5 was identified as the preferred alternative and as the National Ecosystem Restoration (NER) Plan as it is the plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objectives and the Principles and Guidelines Criteria. As defined in ER 1105-2-100, the selected plan must be shown to be cost effective and justified to achieve the desired level of output. This plan shall be identified as the NER Plan.

Alternative 3 creates the highest habitat benefit within the HSI model because the aeration measure produces an instantaneous water quality benefit by eliminating stratification. However, actualizing the water quality benefit of this measure requires costly long-term operation and maintenance of the aeration system. The team had concerns over this alternative not meeting the fourth planning constraint and the alternative's associated lack of completeness.

Alternative 5 provides measures for HAB improvement, invasive species removal and bank stabilization. It provides environmental benefits and is a cost effective alternative. Alternative 5 includes sediment removal/excavation and seasonal planting of native aquatic plants for HAB improvement, mechanical removal of invasive species followed by targeted chemical treatment (Rodeo) and subsequent planting of native vegetation, and bank stabilization utilizing hard - rip rap (shown in Figure 35). Refer to cost Appendix C for a full comparison of the alternatives.

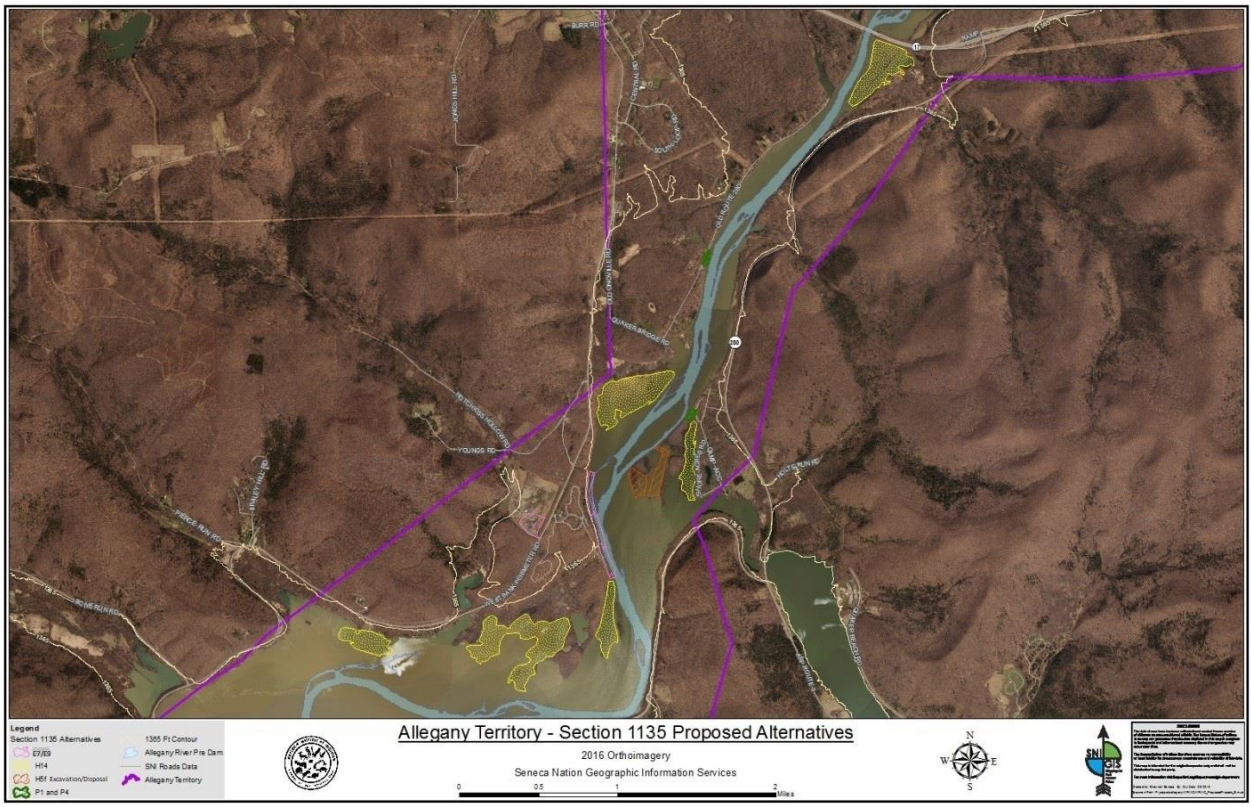

Figure 35 - Proposed project work areas

3.6.1 Recommended Plan Description

Alternative 5:

- H5f. Shallow excavation (Area A - 12" and Area C - 6") through Bear Claw with targeted local deposit
- H14. Seeding of exposed mudflats
- P1. & P4. Mechanical removal of invasive plants with chemical treatment (Rodeo) & Native vegetation planting
- E7/E9. Hard - Rip Rap

Sediment removal involves excavation during winter low pool from an area where nutrient laden sediment has accumulated. Approximately 6 to 12 inches of sediment would be removed from about 10 acres and expose larger grain sediments that are preferred by fish. By limiting excavation to the winter, the work can be completed with minimal environmental impacts during construction. Local deposition of the sediment allows beneficial on-site use of the material. Placed materials will be protected with rip rap to reduce risk of erosion and will be capped with appropriate quality soils to allow for planting. Capping the nutrient-laden sediments and planting will limit the reactivation of the nutrients during periods of inundation. These areas will augment existing native forested areas that become islands during the summer high pool and protect a nearby eroding shoreline. The addition of rock and native vegetation will improve available shoreline diversity and quality for fish and wildlife. Excavated sediment will not be disposed of over vegetated areas.

Six locations (240 acres total) within the Study Area have been identified for seasonal plantings on the large tracts of land that become exposed when summer pool is drawn down to winter pool (October to November). Plants chosen for the seeding areas germinate quickly, establish easily, and are cold tolerant. Proposed planting species are: winter rape (*Brassica napus L.*), winter pea (*Pisum sativum*), winter wheat (*Triticum aestivum*), and Marshall Ryegrass. These plants are not invasive in this region and are known to provide good erosion control and weed suppression. Planting can begin late summer in the back bay areas as the pool begins to drop. For cool season grasses, the fall is the best planting. The mudflats areas may benefit from seasonal plantings as plants would uptake nutrients from the soil, increase erosion protection, and provide habitat diversity, refuge, and food sources for wildlife through the winter and fish post-inundation in the spring.

The management of invasive species is complex and would be futile in established stands along the shorelines. Two 1-acre areas were selected to halt the encroachment of Japanese Knotweed in particularly diverse areas (Low Banks and Bear Claw). Mechanical cutting would occur in June/July, with chemical treatment in August. Rodeo applied with methods that reduce drift will be used. These methods include wiping or injecting the herbicide on individual stems following mechanical cutting. Treatment is most effective if conducted annually for three years. Planting of native vegetation following treatment is important to minimize regrowth of undesired species. Plantings would include a variety of woody and herbaceous native plants as Japanese Knotweed has inhibited the development of the secondary, understory growth. Tree plantings would include Silver Maple, Cottonwood, Swamp White Oak, Tulip Poplar, White Pine, Slippery Elm and Boxelder. A number of shrubs will also be used such as: Silky Dogwood, Speckled Alder, Ninebark, Silky Willow, Sandbar Willow, buttonbush, Gray Dogwood and Black Chokeberry. The varying soil types and degrees of wetness will dictate native plant species sourced for each area. Adaptive management of plantings for several years would be required in order to ensure planting success and continued ability of the newly establishing vegetation to outcompete and suppress non-native species.

The erosion control rip rap blanket places a filtering stone material overlaid by larger armor rock onto the existing slope between the winter and summer pool elevations. This method does not create area for native plantings but does protect the high quality existing forested habitat.

3.6.2 Estimated Project Costs and Schedule

Parametric cost estimates were used to select the recommended alternative. A detailed cost estimate was then developed for the recommended alternative as shown in Table 20. For further discussion of parametric costs, see Appendix C.

Table 20 - Recommended Plan Cost Estimate Summary

	FY2017 and back	FY2018	FY2019	FY2020	FY2021	FY2022*	Total**
Feasibility Study Costs							
FED Share	$ 187,363.09	$ 34,221.53	$ 2,818.79	$ -	$ -	$ -	$ 224,403.41
non-FED Cash	$ 15,227.17	$ 23,534.85	$ 8,475.31	$ -	$ -	$ -	$ 47,237.33
non-FED WIK	$ 26,199.26	$ 53,202.74	$ -	$ -	$ -	$ -	$ 79,402.00
Total Feasibility Cost	$ 228,789.52	$ 110,959.12	$ 11,294.10	$ -	$ -	$ -	$ 351,042.74
Design and Implementation Costs							
Design, Analysis, Plans, & Specs	$ -	$ -	$ -	$ 232,000.00	$ 550,000.00	$ -	$ 782,000.00
Construction	$ -	$ -	$ -	$ -	$ -	$ 5,040,000.00	$ 5,040,000.00
Construction Management	$ -	$ -	$ -	$ -	$ -	$ 403,000.00	$ 403,000.00
LERRDs	$ -	$ -	$ -	$ -	$ 227,000.00	$ -	$ 227,000.00
Total Project Cost	$ -	$ -	$ -	$ 232,000.00	$ 777,000.00	$ 5,443,000.00	$ 6,452,000.00
FED Share of Total Project Cost	$ -	$ -	$ -	$ 174,000.00	$ 582,750.00	$ 4,566,250.00	$ 5,605,250.00
non-FED Share of Total Project Cost	$ -	$ -	$ -	$ 58,000.00	$ 194,250.00	$ 876,750.00	$ 846,750.00

*Note: Design and Implementation Costs in FY2022 include a $484,000 credit to the Seneca Nation as outlined in Section 1156 of WRDA 2018.

**Note: The total non-federal share of design and implementation costs also includes an additional 25% cost reduction ($282,250) based on procedures outlined in Economic Guidance Memorandum 19-06 dated 18 Sept 2019.

The Total Project Cost estimate above includes a risk-informed contingency of 27% based on the Abbreviated Risk Analysis included in the Cost Appendix. This 27% contingency corresponds to an 80% confidence level. The Abbreviated Risk Analysis also produces a 50% confidence level contingency, which corresponds to approximately 16% contingency. The Fully Funded Total Project Cost without contingency is estimated at $5,080,000. The 50% confidence level contingency (16%) corresponds to a Total Project Cost of $5,893,000. The 80% confidence level contingency (27%), as presented throughout this document and the Certified Total Project Cost estimate is $6,452,000.

Table 21 - Implementation Schedule

Milestone	*Schedule*	*Actual*
Initiate Feasibility Phase	*02 January 2015*	*02 January 2015*
Submit Federal Interest Determination Report	*08 June 2015*	*08 June 2015*
MSC Approved FID Report	*17 July 2015*	*17 July 2015*
Execute Feasibility Cost Share Agreement	*17 August 2016*	*17 August 2016*
Submit MSC Decision Milestone Draft DPR	*11 June 2018*	*03 December 2018*
MSC Approved Decision Document	*13 February 2020*	
Project Approval – Initiate D&I Phase	*12 March 2020*	
Fully Executed PPA	*10 July 2020*	
RE Certification	*09 November 2020*	
ATR Certified Construction Plans & Specifications	*03 May 2021*	
Construction Contract Award	*05 November 2021*	
Construction Complete	*19 August 2022*	
Project Closeout	*09 September 2022*	

3.6.3 Seneca Nation Responsibilities

The Seneca Nation played an integral role in the development of the selected alternatives as well as the organization of the final alternative array. The recommended alternative was based on predicted success of the implementation phase of the Section 1135.

The Corps conducts a feasibility study beginning at Federal expense. Study costs in excess of $100,000 are shared 50/50 with the Seneca Nation of Indians. This section describes the primary non-federal Sponsor responsibilities in conjunction with the Federal Government to implement the recommended plan.

The Feasibility Study and plans and specifications costs shall be included as part of the total project costs to be shared 50 percent Federal and 50 percent non-Federal after the initial $100,000 federal expense to begin the study. The non-federal Sponsor shall:

• Provide all lands, easements, rights-of-way, relocations, and disposal areas (LERRDs) necessary for construction, operation and maintenance of the project.

• Provide, during construction, any additional costs as necessary to make the total non-Federal contributions equal to 25 percent of the total project costs. The non-federal sponsor will provide cash and/or work in kind during final design and construction as well as providing the post-construction monitoring. The scope of non-federal sponsor contributions will be further defined during preparation of the Project Partnership Agreement (PPA). The non-Federal share is estimated at $846,750. The value of the LERRDs needed for the project will be deducted from this amount.

• Operate, maintain, repair, replace, and rehabilitate the completed project or functional portion of the completed project at no cost to the Federal Government, in accordance with the applicable Federal and State laws and any specific directions prescribed by the Federal Government for so long as the project is authorized.

• Hold and save the Federal Government harmless from damages due to the construction and operation and maintenance of the project, except where such damages are due to the fault or negligence of the Federal Government or its contractors.

• Grant the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-federal Sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purposes of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

• Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs for a minimum of three years after completion of the project construction for which such books, records, documents, and other evidence are required.

• Perform, or cause to be performed, any investigations for hazardous substances regulated under the CERCLA, 42 USC 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way necessary for construction, operation, and maintenance of the project; except that the non-federal Sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Federal Government determines to be subject to the navigation servitude without prior specific written direction by the Federal Government.

• Assume complete financial and regulatory responsibility and provide all necessary cleanup and response costs associated with any CERCLA-regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines are necessary for construction, operation, and maintenance of the project.

• Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the aquatic ecosystem restoration, hinder its operation and maintenance, or interfere with the proper function such as any new development on project lands or the addition of facilities that would degrade the benefits of the project.

• Not use Federal funds to meet the non-federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

4.0.0 ENVIRONMENTAL EFFECTS OF ALTERNATIVES

This section identifies the most important potential impacts upon the current conditions presented in Section 2 associated with implementation of a viable solution and presents detailed evaluation of the impacts of the alternative plans. An estimate of all unavoidable impacts to aquatic and terrestrial habitats and the human environment caused by project implementation is provided.

4.1.0 SOILS

4.1.1 Alternative 1: No Action

Under the no action alternative, increased accumulations of nutrient rich sediment will intensify the levels and longevity of blue green algae, now and for the foreseeable future.

4.1.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

Sediment removal/excavation is a measure put in place to eliminate one of the sources of nutrients that aid proliferation of cyanobacteria. This alternative is focused on combatting the HABs until watershed measures can be taken to reduce incoming nutrients. With this alternative, the sediment removal/excavation will be completed upon dry land, therefore it will have minimal impacts during construction but will have a positive impact on the system by reducing the nutrients available for HABs. The emplacement of the aeration system must be done with a barge and crane in open water. The laying of the line and diffusers will create river bottom disturbances during construction and for a short time after. The aeration/hypolimnetic

oxygenation will have minimal impact on the river sediment. Seasonal planting of exposed mudflats with native species will have no significant effects, but will be beneficial in reducing erosion during storm events. Chemical treatment used to eradicate invasive plants will have brief negative impacts on the soil but Rodeo is short-lived with targeted application. Installation of the rock berm/flood bench will create sediment disturbances during construction but will greatly reduce the river bank erosion and increase the riparian corridor. No significant direct or indirect impacts to soils are anticipated from the implementation of this alternative.

4.1.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

Sediment removal/excavation is a measure put in place to eliminate one of the sources of nutrient that aid proliferation of cyanobacteria. This alternative is focused on combatting the HABs until watershed measures can be taken to reduce incoming nutrients. With this alternative, the sediment removal/excavation will be completed upon dry land, therefore it will have minimal impacts during construction but will have a positive impact on the system by reducing the nutrients available for HABs. The emplacement of the aeration system must be done with a barge and crane in open water. The laying of the line and diffusers will create river bottom disturbances during construction and for a short time after. The aeration/hypolimnetic oxygenation will have minimal impact on the river sediment. Seasonal planting of exposed mudflats with native species will have no significant effects, but will be rather beneficial in reducing erosion during storm events. Chemical treatment used to eradicate invasive plants will have brief negative impacts on the soil but Rodeo is short-lived with targeted application. Installation of the hard-rip rap will create sediment disturbances during construction but will greatly reduce the river bank erosion. No significant direct or indirect impacts to soils are anticipated from the implementation of this alternative.

4.1.4 Alternative 4: H5f, H14, P1, P4, E12

Sediment removal/excavation is a measure put in place to eliminate one of the sources of nutrient that aid proliferation of cyanobacteria. This alternative is focused on combatting the HABs until watershed measures can be taken to reduce incoming nutrients. With this alternative, the sediment removal/excavation will be completed upon dry land, therefore it will have minimal impacts during construction but will have a positive impact on the system by reducing the nutrients available for HABs. Seasonal planting of exposed mudflats with native species will have no adverse effects, but will be rather beneficial in reducing erosion during storm events. Chemical treatment used to eradicate invasive plants will have brief negative impacts on the soil but Rodeo is short-lived with targeted application. Installation of the rock berm/flood bench will create sediment disturbances during construction but will greatly reduce the river bank erosion and increase the riparian corridor. No significant direct or indirect impacts to soils are anticipated from the implementation of this alternative.

4.1.5 Alternative 5: H5f, H14, P1, P4, E7/E9

Sediment removal/excavation is a measure put in place to eliminate one of the sources of nutrient that aid proliferation of cyanobacteria. This alternative is focused on combatting the HABs until watershed measures can be taken to reduce incoming nutrients. With this alternative, the sediment removal/excavation will be completed upon dry land, therefore it will have minimal

impacts during construction but will have a positive impact on the system by reducing the nutrients available for HABs. Seasonal planting of exposed mudflats with native species will have no significant effects, but will be rather beneficial in reducing erosion during storm events. Chemical treatment used to eradicate invasive plants will have brief negative impacts on the soil but Rodeo is short-lived with targeted application. Installation of the rip rap will create sediment disturbances during construction but will greatly reduce the river bank erosion and increase the riparian corridor. No significant direct or indirect impacts to soils are anticipated from the implementation of this alternative.

4.2.0 SURFACE WATERS AND OTHER AQUATIC RESOURCES

4.2.1 Surface Water

4.2.1.1 Alternative 1: No Action

If no remedial action is taken, the HABs will continue to persist throughout the reservoir increasing in duration and area impacted. As erosion of mudflats and shoreline continues, the amount of sediment will also increase thereby reducing water quality while accumulating more sediment in other areas of the reservoir.

4.2.1.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

Environmental impacts upon the surface water will be primarily positive aside from short-term, localized impacts during construction. With this alternative, the sediment removal/excavation will be completed upon dry land, therefore it will have minimal impacts during construction but will have a positive impact on the system by reducing the nutrients available for HABs. The slight increase of local flows from improved connectivity on the north side of Bear Claw would slightly improve flushing of the Bear Claw area. Seasonal planting will reduce exposed sediment, creating a condition that is more stable with less erosion occurring. The emplacement of the aeration system must be done with a barge and crane in open water. The laying of the line and diffusers will create bottom disturbances. When aeration/hypolimnetic oxygenation is introduced to the water, the water column becomes mixed and reduces stratification. The largest impact the aeration system has on the surface water quality is the increase in dissolved oxygen available for other species of algae and fish. Chemical treatment using Rodeo used to eradicate Japanese knotweed must occur at least 5 feet from the shoreline to reduce negative impacts on aquatic organisms. Installation of the rock berm/flood bench will greatly reduce the river bank erosion and increase the riparian corridor. As the rock berm/flood bench is built, it is likely that local turbidity would increase. However, the Ohi:yo' experiences periods of high turbidity at times (greater than 50 NTUs) during heavy rains and melting snow events. This temporary increase in turbidity is not out of the ordinary in this area and would not represent a significant impact. Under this alternative, no significant direct or indirect impacts to surface waters are anticipated.

4.2.1.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

Small scale sediment removal/excavation reduces the availability of nutrients while increasing the depth of water and exposing a rockier substrate. This alternative also includes increasing the

width and depth of the small flow through channel to allow increased flow of water into the back-bay area. The seasonal planting and hypolimnetic oxygenation will provide the same impacts as described above in Alternative 2. Chemical treatment using Rodeo used to eradicate Japanese knotweed must occur at least 5 feet from the shoreline to reduce negative impacts on aquatic organisms. The use of hard – rip rap would reduce sedimentation, protect the high quality existing forested habitat, and provide valuable bank diversity for fisheries. Under this alternative, no significant direct or indirect impacts to surface waters are anticipated.

4.2.1.4 Alternative 4: H5f, H14, P1, P4, E12

With this alternative, the sediment removal/excavation will be completed upon dry land, therefore it will have minimal impacts during construction but will have a positive impact on the system by reducing the nutrients available for HABs. The slight increase of local flows from improved connectivity on the north side of Bear Claw would slightly improve flushing of the Bear Claw area. Seasonal planting when allowed to grow will make the exposed sediment to be more stable and less erosion will occur. The seasonal planting and hypolimnetic oxygenation will provide the same impacts as described above in Alternative 2. Chemical treatment using Rodeo used to eradicate Japanese knotweed must occur at least 5 feet from the shoreline to reduce negative impacts on aquatic organisms. The positive impacts of this measure include the stabilization of the high bank at the site. This will reduce local sedimentation and protect the existing high quality upland forested habitat along the shoreline. The plantings and the interstitial spaces in the berm will provide valuable fish and wildlife habitat. Under this alternative, no significant direct or indirect impacts to surface waters are anticipated.

4.2.1.5 Alternative 5: H5f, H14, P1, P4, E7/E9

With this alternative, the sediment removal/excavation will be completed upon dry land, therefore it will have minimal impacts during construction but will have a positive impact on the system by reducing the nutrients available for HABs. The slight increase of local flows from improved connectivity on the north side of Bear Claw would slightly improve flushing of the Bear Claw area. Seasonal planting when allowed to grow will make the exposed sediment to be more stable and less erosion will occur. The seasonal planting and hypolimnetic oxygenation will provide the same impacts as described above in Alternative 2. Chemical treatment using Rodeo used to eradicate Japanese knotweed must occur at least 5 feet from the shoreline to reduce negative impacts on aquatic organisms. The bank stabilization will provide a diverse landscape while reducing sedimentation and offering habitat. Under this alternative, no significant direct or indirect impacts to surface waters are anticipated.

4.2.2 Groundwater

4.2.2.1 Alternative 1: No Action

The groundwater in the Study Area is based on conditions of the Ohi:yo’ and is not negatively impacted by current state of system.

4.2.2.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

Under this alternative, the area of natural, pervious surfaces would be increased through the restoration of riparian shelf and reshaping of existing banks. The measures are expected to provide a small increase in groundwater recharge within the specific Study Area and are not expected to have any negative impacts on ground water resources. No significant direct or indirect impact to groundwater resources is anticipated.

4.2.2.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

Under this alternative, the area of natural, pervious surfaces would be increased through the restoration of riparian shelf and reshaping of existing banks. The measures are expected to provide a small increase in groundwater recharge within the specific Study Area and are not expected to have any negative impacts on ground water resources. No significant direct or indirect impact to groundwater resources is anticipated.

4.2.2.4 Alternative 4: H5f, H14, P1, P4, E12

Under this alternative, the area of natural, pervious surfaces would be increased through the restoration of riparian shelf and reshaping of existing banks. The measures are expected to provide a small increase in groundwater recharge within the specific Study Area and are not expected to have any negative impacts on ground water resources. No significant direct or indirect impact to groundwater resources is anticipated.

4.2.2.5 Alternative 5: H5f, H14, P1, P4, E7/E9

Under Alternative 5, the area of natural, pervious surfaces would be increased through the restoration of riparian shelf and reshaping of existing banks. The measures are expected to provide a small increase in groundwater recharge within the specific Study Area and are not expected to have any negative impacts on ground water resources. No significant direct or indirect impact to groundwater resources is anticipated.

4.2.3 Floodplains

4.2.3.1 Alternative 1: No Action

The no action alternative maintains the status quo. No change to floodplains would occur.

4.2.3.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

The entire project work area is below the 1365-foot flowage easement and has potential for seasonal flooding. The utilization of Rodeo for control of invasive plants needs to occur during a time that the land is dry and little to no precipitation is anticipated to minimize adverse effects. Disposal areas within Bear Claw will raise the elevation of currently unvegetated lands to allow floodplain forest expansion. Overall no significant direct or indirect impact to floodplain resources is anticipated with this alternative.

4.2.3.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

Impacts of this alternative are the same as those discussed for Alternative 2. Overall no significant direct or indirect impact to floodplain resources is anticipated with this alternative.

4.2.3.4 Alternative 4: H5f, H14, P1, P4, E12

Impacts of this alternative are the same as those discussed for Alternative 2. Overall no significant direct or indirect impact to floodplain resources is anticipated with this alternative.

4.2.3.5 Alternative 5: H5f, H14, P1, P4, E7/E9

Impacts of this alternative are the same as those discussed for Alternative 2. Overall no significant direct or indirect impact to floodplain resources is anticipated with this alternative.

4.2.4 Wetlands

4.2.4.1 Alternative 1: No Action

No wetlands have been identified within the Study Area and no wetland impacts are proposed. After project design plans have been finalized and prior to construction a wetland delineation will be conducted to confirm that wetlands will not be impacted.

4.2.4.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

No wetlands have been identified within the Study Area and no wetland impacts are proposed. After project design plans have been finalized and prior to construction a wetland delineation will be conducted to confirm that wetlands will not be impacted.

4.2.4.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

No wetlands have been identified within the Study Area and no wetland impacts are proposed. After project design plans have been finalized and prior to construction a wetland delineation will be conducted to confirm that wetlands will not be impacted.

4.2.4.4 Alternative 4: H5f, H14, P1, P4, E12

No wetlands have been identified within the Study Area and no wetland impacts are proposed. After project design plans have been finalized and prior to construction a wetland delineation will be conducted to confirm that wetlands will not be impacted.

4.2.4.5 Alternative 5: H5f, H14, P1, P4, E7/E9

No wetlands have been identified within the Study Area and no wetland impacts are proposed. After project design plans have been finalized and prior to construction a wetland delineation will be conducted to confirm that wetlands will not be impacted.

4.3.0 WILDLIFE HABITATS

4.3.1 Terrestrial and Aquatic Vegetation

4.3.1.1 Alternative 1: No Action

A significant impact is anticipated if action is not taken. Under the no action alternative it is anticipated that riparian vegetation will continue to be depleted due to bank erosion with continued intrusion of invasive species within the Study Area. Native aquatic vegetation is likely to decrease with the increased populations of invasive species. With the increase of invasive plants, coupled with the current erosion issues, the severity and interval of shoreline erosion will be expedited significantly. Populations of natural aquatic and riparian plants within the Study Area will decrease and will likely be replaced by invasive plants. A significant number of these plants are used for traditional medicine and are a cultural resource to the community. Continued erosion would increase loss of native plant species, including culturally-important plants.

4.3.1.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

Under Alternative 2, the removal of nutrient rich sediment in shallow water bays, inlets and coves by excavation will benefit the Study Area in many ways. By removing sediment and exposing the natural gravel/rocky lake bottom, spawning areas for a number of fish species will be increased as well as for both macro and micro invertebrates. Phosphorous is a limiting nutrient for BGA, therefore reducing available phosphorous will reduce HABs and raise water quality. Planting vegetation within the Study Areas (during lake bottom exposure), will benefit the environment on three levels. The vegetation will remove nutrients from the soil naturally, decrease the amount of erosion on the lake bottom and provide sustenance for wildlife during the fall and throughout the winter. Aeration will provide localized area (main river channel) with oxygenated water decreasing the severity and longevity of BGA. Additionally, native riparian vegetation would benefit with the removal of invasive plants and the planting of native species. The protection and planting of native species will increase the biodiversity as well as restore culturally significant plants. The flood bench will have short term negative impacts during construction but much greater positive long-term impacts as it will serve as an erosion measure and provide habitat for a number of plant, aquatic and wildlife species. No significant direct or indirect effects are anticipated.

4.3.1.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/E9

The removal of nutrient rich sediment in shallow water bays, inlets and coves by excavation will benefit the Study Area in many ways. With the addition of shallow channels in those areas (shallow bays, inlets and coves), water flow will be increased. The increase of flow will decrease stagnation and the severity of BGA in those areas. By removing sediment and exposing the natural gravel/rocky lake bottom, spawning areas for a number of fish species will be increased as well as for both macro and micro invertebrates. Phosphorous is a limiting nutrient for BGA, therefore reducing available phosphorous will reduce HABs and raise water quality. Planting vegetation within the Study Area in the fall (exposed lake bottom) will benefit the environment on three levels. The vegetation will remove nutrients from the soil naturally, decrease the amount

of erosion on the lake bottom and provide sustenance for many wildlife species during the fall and throughout the winter season. Aeration will provide localized area (main river channel) with oxygenated water decreasing the severity and longevity of BGA. Under Alternative 3, native riparian vegetation would be unaffected with the removal of invasive plants and the planting of native species. The protection and planting of native species will increase the biodiversity as well as restore culturally-important plants. Rip rap will serve as an erosion measure with limited benefits outside of an erosion measure. No significant direct or indirect effects to the environment are anticipated.

4.3.1.4 Alternative 4: H5f, H14, P1, P4, E12

Under Alternative 4, the removal of nutrient rich sediment in shallow water bays, inlets and coves by excavation will benefit the Study Area in many ways. With the addition of shallow channels in those areas (shallow bays, inlets and coves), we will be increasing water flow. The increase of flow will decrease stagnation and the severity of BGA in those areas. By removing sediment and exposing the natural gravel/rocky lake bottom, we will be increasing spawning areas for a number of fish species as well as both macro and micro invertebrates. By removing sediment and exposing the natural gravel/rocky lake bottom, spawning areas for a number of fish species will be increased as well as for both macro and micro invertebrates. Phosphorous is a limiting nutrient for BGA, therefore reducing available phosphorous will reduce HABs and raise water quality. Planting vegetation within the Study Area in the fall (exposed lake bottom) will benefit the environment on three levels. The vegetation will remove nutrients from the soil naturally, decrease the amount of erosion on the lake bottom and provide sustenance for many wildlife species during the fall and throughout the winter season. Under this alternative, native riparian vegetation would be unaffected with the removal of invasive plants and the planting of native species. The protection and planting of native species will increase the biodiversity as well as restore culturally-important plants. Rip rap will serve as an erosion measure with limited benefits outside of an erosion measure. No significant direct or indirect effects to the environment are anticipated.

4.3.1.5 Alternative 5: H5f, H14, P1, P4, E7/E9

Under this alternative, the removal of nutrient rich sediment in shallow water bays, inlets and coves by excavation will benefit the Study Area in many ways. With the addition of shallow channels in those areas (shallow bays, inlets and coves), we will be increasing water flow. The increase of flow will decrease stagnation and the severity of BGA in those areas. By removing sediment and exposing the natural gravel/rocky lake bottom, spawning areas for a number of fish species will be increased as well as for both macro and micro invertebrates. Phosphorous is a limiting nutrient for BGA, therefore reducing available phosphorous will reduce HABs and raise water quality. Planting vegetation within the Study Area in the fall (exposed lake bottom) will benefit the environment on three levels. The vegetation will remove nutrients from the soil naturally, decrease the amount of erosion on the lake bottom and provide sustenance for many wildlife species during the fall and throughout the winter season. Under this alternative, native riparian vegetation would be unaffected with the removal of invasive plants and the planting of native species. The protection and planting of native species will increase the biodiversity as well as restore culturally-important plants. Rip rap will serve as an erosion measure with limited

benefits outside of an erosion measure. No significant direct or indirect effects to the environment are anticipated.

4.3.2 Fauna

4.3.2.1 Alternative 1: No Action

Under the no action alternative, populations of natural aquatic and riparian fauna within the Study Area will decrease and be replaced by invasive plants. A major impact upon the environment is anticipated if no action is taken. Continued erosion increases loss of native plant species, including culturally-important plants is anticipated.

4.3.2.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

As part of the sediment removal, the excavated material will be utilized to bolster island structures thereby protecting remaining vegetation. Additionally, rock and planting of native plants will be used to confine excavated sediment which will result in the enhancement of biodiversity in the Study Area. Planting vegetation within the project work areas when the lake bottom is exposed will benefit the environment on three levels. The vegetation will remove nutrients from the soil naturally, decrease the amount of erosion on the lake bottom and provide sustenance for wildlife during the fall and throughout the winter season. Native riparian vegetation would be unaffected with the removal of invasive plants and the planting of native species will increase the biodiversity. No significant direct or indirect impact to aquatic life is anticipated. The rock berm/flood bench will serve as an erosion measure, expand the riparian corridor as well provide habitat for a number of plant, aquatic and wildlife species.

4.3.2.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

Planting vegetation within the project work areas when the lake bottom is exposed will benefit the environment on three levels. The vegetation will remove nutrients from the soil naturally, decrease the amount of erosion on the lake bottom and provide sustenance for wildlife during the fall and throughout the winter season. Native riparian vegetation would be unaffected with the removal of invasive plants and the planting of native species will increase the biodiversity. Rip rap will serve as an erosion measure with limited benefits outside of an erosion measure. No significant direct or indirect effects to the environment are anticipated.

4.3.2.4 Alternative 4: H5f, H14, P1, P4, E12

As part of the sediment removal, the excavated material will be utilized to bolster island structures thereby protecting remaining vegetation. Additionally, rock and planting of native plants will be used to confine excavated sediment which will result in the enhancement of biodiversity in the Study Area. Planting vegetation within the project work areas when the lake bottom is exposed will benefit the environment on three levels. The vegetation will remove nutrients from the soil naturally, decrease the amount of erosion on the lake bottom and provide sustenance for wildlife during the fall and throughout the winter season. Native riparian vegetation would be unaffected with the removal of invasive plants and the planting of native

species will increase the biodiversity. No significant direct or indirect impact to aquatic life is anticipated. The rock berm/flood bench will serve as an erosion measure, expand the riparian corridor as well provide habitat for a number of plant, aquatic and wildlife species.

4.3.2.5 Alternative 5: H5f, H14, P1, P4, E7/E9

As part of the sediment removal, the excavated material will be utilized to bolster island structures thereby protecting remaining vegetation. Additionally, rock and planting of native plants will be used to confine excavated sediment which will result in the enhancement of biodiversity in the Study Area. Planting vegetation within the project work areas when the lake bottom is exposed will benefit the environment on three levels. The vegetation will remove nutrients from the soil naturally, decrease the amount of erosion on the lake bottom and provide sustenance for wildlife during the fall and throughout the winter season. Native riparian vegetation would be unaffected with the removal of invasive plants and the planting of native species will increase the biodiversity. No significant direct or indirect impact to aquatic life is anticipated. The rip rap will serve as an erosion measure, expand the riparian corridor as well provide habitat for a number of plant, aquatic and wildlife species.

4.3.3 Existing Terrestrial and Aquatic Habitats

4.3.3.1 Alternative 1: No Action

Under the no action alternative, degraded riparian and aquatic habitats are likely to persist within the Study Area. Riparian habitats are likely to further degrade due to the increased spread of invasive species. An increased negative impact to the environment is anticipated.

4.3.3.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

Aquatic habitats will be improved by adding larger diameter rock to the area. Rock will provide added habitat and structure. Removal of sediment laden with high nutrients will open up spawning habitat for fish, macro and micro invertebrates. No significant direct or indirect impacts are anticipated as a result of these improvements.

4.3.3.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

Aquatic habitats would be improved by adding larger diameter rock to the area. Rock will provide added habitat and structure. Removal of sediment laden with high nutrients will open up spawning habitat for fish, macro and micro invertebrates. No significant direct or indirect impacts are anticipated as a result of these improvements.

4.3.3.4 Alternative 4: H5f, H14, P1, P4, E12

Aquatic habitats would be improved by adding larger diameter rock to the area. Rock will provide added habitat and structure. Removal of sediment laden with high nutrients will open up spawning habitat for fish, macro and micro invertebrates. No significant direct or indirect impacts are anticipated as a result of these improvements.

4.3.3.5 Alternative 5: H5f, H14, P1, P4, E7/E9

Aquatic habitats would be improved by adding larger diameter rock to the area. Rock will provide added habitat and structure. Removal of sediment laden with high nutrients will open up spawning habitat for fish, macro and micro invertebrates. No significant direct or indirect impacts are anticipated as a result of these improvements.

4.4.0 ENDANGERED AND THREATENED SPECIES

4.4.1 Federal

4.4.1.1 Alternative 1: No Action

Under the No-Action alternative, no work would be undertaken. Therefore, no effects to federally-listed species would occur.

4.4.1.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effects to federally-listed species are anticipated. If tree removal is proposed, the Corps may need to initiate Section 7 consultation with the USFWS.

4.4.1.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effects to federally-listed species are anticipated. If tree removal is proposed, the Corps may need to initiate Section 7 consultation with the USFWS.

4.4.1.4 Alternative 4: H5f, H14, P1, P4, E12

The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effects to federally-listed species are anticipated. If tree removal is proposed, the Corps may need to initiate Section 7 consultation with the USFWS.

4.4.1.5 Alternative 5: H5f, H14, P1, P4, E7/E9

The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effects to federally-listed species are anticipated. If tree removal is proposed, the Corps may need to initiate Section 7 consultation with the USFWS.

4.4.2 Seneca Nation

4.4.2.1 Alternative 1: No Action

There are a number of other species within the river/reservoir system that depend on good water quality. Further degradation of water quality could impact many species including Paddlefish, Hellbenders and Bald Eagles. There is an increased likelihood that these species may not be able to tolerate such water quality issues. An increased negative impact to the environment is anticipated to also adversely impact many species.

The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effect is expected.

4.4.2.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effect is expected.

4.4.2.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

There are not any Seneca Nation listed species within the work area, therefore no effects are expected. The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effect is expected.

4.4.2.4 Alternative 4: H5f, H14, P1, P4, E12

The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effect is expected.

4.4.2.5 Alternative 5: H5f, H14, P1, P4, E7/E9

The Study Area does not contain any listed species during the season that the work will be completed. The back bays are void of water, therefore any species of concern will not inhabit these areas. Due to the known and assumed preferred habitat types of these species, it is unlikely that they would exist within the Study Area. No effect is expected.

4.4.3 Critical Habitat

There is no designated critical habitat within the project work area. Therefore, no alternatives would impact this resource.

4.5.0 RECREATIONAL, SCENIC, AND AESTHETIC RESOURCES

4.5.1 ALTERNATIVE 1: NO ACTION

The No Action alternative maintains the existing degraded habitat. During prime summer recreation months, the Study Area experiences annual HABs that significantly impact the ability to recreate in the reservoir and degrade the scenic and aesthetic appeal of the area. With the anticipated water temperature increases caused by climate change, HABs are expected to continue to worsen. Additionally, without the implementation of the proposed invasive species management, the aesthetic and scenic quality of the uplands would also be expected to degrade.

4.5.2 ALTERNATIVE 2: H5F, H7B, H14, P1, P4, E12

This alternative is designed to improve the aquatic and terrestrial habitats of the Study Area. While the presence of armor rock will change the aesthetic quality of the bank in those areas, the armor protects existing recreational facilities (campgrounds and boat launch) as well as high-quality forest communities. Additionally, the presence of the above ground facilities to support the aeration will also impact the aesthetics of the immediate area, but will have a large benefit on the surrounding aquatic environment to improve the safety and quality of recreation in the area. Overall a net benefit to recreational, scenic and aesthetic resources is anticipated and no significant direct or indirect impacts are anticipated.

4.5.3 ALTERNATIVE 3: H5D, H7B, H14, P1, P4, E7/ E9

This alternative is designed to improve the aquatic and terrestrial habitats of the Study Area. While the presence of armor rock will change the aesthetic quality of the bank in those areas, the armor protects existing recreational facilities (campgrounds and boat launch) as well as high-quality forest communities. Additionally, the presence of the above ground facilities to support the aeration will also impact the aesthetics of the immediate area, but will have a large benefit on the surrounding aquatic environment to improve the safety and quality of recreation in the area. Overall a net benefit to recreational, scenic and aesthetic resources is anticipated and no significant direct or indirect impacts are anticipated.

4.5.4 ALTERNATIVE 4: H5F, H14, P1, P4, E12

This alternative is designed to improve the aquatic and terrestrial habitats of the Study Area. While the presence of armor rock will change the aesthetic quality of the bank in those areas, the armor protects existing recreational facilities (campgrounds and boat launch) as well as high-quality forest communities. Overall a net benefit to recreational, scenic and aesthetic resources is anticipated and no significant direct or indirect impacts are anticipated.

4.5.5 ALTERNATIVE 5: H5F, H14, P1, P4, E7/E9

This alternative is designed to improve the aquatic and terrestrial habitats of the Study Area. While the presence of armor rock will change the aesthetic quality of the bank in those areas, the armor protects existing recreational facilities (campgrounds and boat launch) as well as high-quality forest communities. Overall a net benefit to recreational, scenic and aesthetic resources is anticipated and no significant direct or indirect impacts are anticipated.

4.6.0 CULTURAL RESOURCES

4.6.1 Alternative 1: No Action

Under the no action alternative, continued erosion may cause the elimination of deeply buried cultural resources. No historic (above ground) buildings exist within the project area although prehistoric sites still need to be surveyed for.

4.6.2 Alternative 2: H5f, H7b, H14, P1, P4, E12

No above ground historical buildings exist in the work area. Archaeological resources may exist within the project area. An archaeological survey will be conducted by THPO at the start of the construction and implementation phase. Buried cultural resources would need to be identified but any actions that reduce shoreline erosion will stop the loss of the sites. Overall a net benefit with no significant adverse impact is anticipated.

4.6.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/ E9

No above ground historical buildings exist in the work area. Archaeological resources may exist within the project area. An archaeological survey will be conducted by THPO at the start of the construction and implementation phase. Buried cultural resources would need to be identified but any actions that reduce shoreline erosion will stop the loss of the sites. Overall a net benefit with no significant impact is anticipated.

4.6.4 Alternative 4: H5f, H14, P1, P4, E12

No above ground historical buildings exist in the work area. Archaeological resources may exist within the project area. An archaeological survey will be conducted by THPO at the start of the construction and implementation phase. Buried cultural resources would need to be identified but any actions that reduce shoreline erosion will stop the loss of the sites. Overall a net benefit with no significant impact is anticipated.

4.6.5 Alternative 5: H5f, H14, P1, P4, E7/E9

No above ground historical buildings exist in the work area. Archaeological resources may exist within the project area. An archaeological survey will be conducted by THPO at the start of the construction and implementation phase. Buried cultural resources would need to be identified but any actions that reduce shoreline erosion will stop the loss of the sites. Overall a net benefit with no significant impact is anticipated.

4.7.0 AIR QUALITY

4.7.1 Alternative 1: No Action

The No Action alternative would have no impact to air quality in the region.

4.7.2 Alternatives 2: H5f, H7b, H14, P1, P4, E12

Impacts to air quality from the proposed actions of Alternatives 2 include the short-term emissions generated during construction, such as the excavation and movement of materials at Bear Claw, the placement of the materials in the disposal areas, and the importing of material such as armor rock and topsoil for planting. Additionally, annual long-term emissions would include the power generation needed to run the aerator and the emissions for seasonal plantings.

The air quality of the Study Area is good to moderate and no applicable state implementation plans exist. Federal agencies are not required to undertake a general conformity analysis for a federal action that is undertaken in an attainment or unclassified area (EPA 2010).

Overall, construction would be expected to negatively impact local air quality during the activity. The seasonal plantings and running of the aerator would create minor long-term emissions outputs. These are not expected to be sufficient to cause degradation of the regional air quality. No significant impact is expected.

4.7.3 Alternatives 3: H5d, H7b, H14, P1, P4, E7/ E9

Impacts to air quality from the proposed actions of Alternatives 2 include the short-term emissions generated during construction, such as the excavation and movement of materials at Bear Claw, the placement of the materials in the disposal areas, and the importing of material such as armor rock and topsoil for planting. Additionally, annual long-term emissions would include the power generation needed to run the aerator and the emissions for seasonal plantings.

The air quality of the Study Area is good to moderate and no applicable state implementation plans exist. Federal agencies are not required to undertake a general conformity analysis for a federal action that is undertaken in an attainment or unclassified area (EPA 2010).

Overall, construction would be expected to negatively impact local air quality during the activity. The seasonal plantings and running of the aerator would create minor long-term emissions

outputs. These are not expected to be sufficient to cause degradation of the regional air quality. No significant impact is expected.

4.7.4 Alternative 4: H5f, H14, P1, P4, E12

Alternative 4 is similar to Alternatives 2 and 3, but does not include the aeration measure. This would reduce the annual emissions by eliminating the power generation needed to run the diffusers.

Overall, construction would be expected to negatively impact local air quality during the activity. The seasonal plantings would create minor long-term emissions outputs. These are not expected to be sufficient to cause degradation of the regional air quality. No significant impact is expected.

4.7.5 Alternative 5: H5f, H14, P1, P4, E7/E9

Alternative 5 is similar to Alternatives 2 and 3, but does not include the aeration measure. This would reduce the annual emissions by eliminating the power generation needed to run the diffusers.

Overall, construction would be expected to negatively impact local air quality during the activity. Transport of fill to offsite areas would be expected to cause an increase in emissions during construction activities. The seasonal plantings would create minor long-term emissions outputs. These are not expected to be sufficient to cause degradation of the regional air quality. No significant impact is expected.

4.8.0 NOISE

4.8.1 Alternative 1: No Action

The No Action alternative would have no impact to noise in the region.

4.8.2 Alternatives 2: H5f, H7b, H14, P1, P4, E12

Impacts to noise from the proposed actions of Alternatives 2 include the short-term noise generated during construction, such as the excavation and movement of materials at Bear Claw, the placement of the materials in the disposal areas, and the importing of material such as armor rock and topsoil for planting. Additionally, long-term, local noise increase would occur from running the aerator and from the running of farm equipment for seasonal plantings.

Overall, construction would be expected to negatively impact local noise levels during the activity. Noise reduction measures such as limiting work hours to normal daylight hours would reduce impacts to nearby receptors. Seasonal plantings would create annual, short duration noise during planting activities. Running the aerator machinery will cause continued noise outputs. The machinery will be placed to minimize disturbance to any sensitive receptors, to include campgrounds and homes. In addition, noise outputs will be taken into consideration in the

design of the buildings that will house the aeration equipment. If needed, sound deadening materials and other best management practices can be incorporated into the facility to minimize effects. No significant direct or indirect impact is expected.

4.8.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/E9

Impacts to noise from the proposed actions of Alternatives 2 include the short-term noise generated during construction, such as the excavation and movement of materials at Bear Claw, the placement of the materials in the disposal areas, and the importing of material such as armor rock and topsoil for planting. Additionally, long-term, local noise increase would occur from running the aerator and from the running of farm equipment for seasonal plantings.

Overall, construction would be expected to negatively impact local noise levels during the activity. Noise reduction measures such as limiting work hours to normal daylight hours would reduce impacts to nearby receptors. Seasonal plantings would create annual, short duration noise during planting activities. Running the aerator machinery will cause continued noise outputs. The machinery will be placed to minimize disturbance to any sensitive receptors, to include campgrounds and homes. In addition, noise outputs will be taken into consideration in the design of the buildings that will house the aeration equipment. If needed, sound deadening materials and other best management practices can be incorporated into the facility to minimize effects. No significant direct or indirect impact is expected.

4.8.4 Alternative 4: H5f, H14, P1, P4, E12

Alternative 4 is similar to Alternatives 2 and 3, but does not include the aeration measure. This would reduce the long-term noise effects of the proposed project.

Overall, construction would be expected to negatively impact local noise levels during the activity. Noise reduction measures such as limiting work hours to normal daylight hours would reduce impacts to nearby receptors. Seasonal plantings would create annual, short duration noise during planting activities. No direct or indirect significant impact is expected.

4.8.5 Alternative 5: H5f, H14, P1, P4, E7/E9

Alternative 5 is similar to Alternatives 2 and 3, but does not include the aeration measure. This would reduce the long-term noise effects of the proposed project.

Overall, construction and transport and placement of fill at the offsite location would be expected to negatively impact local noise levels during the activity. Noise reduction measures such as limiting work hours to normal daylight hours would reduce impacts to nearby receptors. Seasonal plantings would create annual, short duration noise during planting activities. No significant direct or indirect impact is expected.

4.9.0 HAZARDOUS AND TOXIC SUBSTANCES

4.9.1 Alternative 1: No Action

No hazardous or toxic substances are known in the Study Area.

4.9.2 Alternatives 2: H5f, H7b, H14, P1, P4, E12

No known hazardous or toxic substances are known in the Study Area.

4.9.3 Alternatives 3: H5d, H7b, H14, P1, P4, E7/ E9

No hazardous or toxic substances are known in the Study Area.

4.9.4 Alternative 4: H5f, H14, P1, P4, E12

No hazardous or toxic substances are known in the Study Area.

4.9.5 Alternative 5: H5f, H14, P1, P4, E7/E9

No hazardous or toxic substances are known in the Study Area.

4.10.0 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

4.10.1 Alternative 1: No Action

The No Action alternative would maintain the status quo. If the status quo is maintained, it is expected that the degraded condition of the area will persist. The impacts of degradation on the socioeconomics of the region, for the Seneca Nation in particular, would continue. Subsistence fishing is a large part of the culture of the Seneca Nation and tourism/recreation are an important economic draw for the area. The annual HABs create a health hazard and hardship for the Seneca Nation, an environmental justice population recognized by EO 12898. Dam operations contribute to the degraded aquatic habitat in the Study Area. Taking no action disproportionately, negatively affects an environmental justice population.

4.10.2 Alternatives 2: H5f, H7b, H14, P1, P4, E12

The purpose of the Project is to improve existing degraded conditions caused, in part, by the presence and/or operation of Kinzua Dam. Each of the proposed action alternatives are expected to improve existing conditions for the Seneca Nation. This alternative would provide a beneficial impact to an environmental justice population. No adverse impacts to socioeconomics and environmental justice are anticipated.

4.10.3 Alternative 3: H5d, H7b, H14, P1, P4, E7/E9

The purpose of the Project is to improve existing degraded conditions caused, in part, by the presence and/or operation of Kinzua Dam. Each of the proposed action alternatives are expected to improve existing conditions for the Seneca Nation. This alternative would provide a beneficial impact to an environmental justice population. No adverse impacts to socioeconomics and environmental justice are anticipated.

4.10.4 Alternative 4: H5f, H14, P1, P4, E12

The purpose of the Project is to improve existing degraded conditions caused, in part, by the presence and/or operation of Kinzua Dam. Each of the proposed action alternatives are expected to improve existing conditions for the Seneca Nation. This alternative would provide a beneficial impact to an environmental justice population. No adverse impacts to socioeconomics and environmental justice are anticipated.

4.10.5 Alternative 5: H5f, H14, P1, P4, E7/E9

The purpose of the Project is to improve existing degraded conditions caused, in part, by the presence and/or operation of Kinzua Dam. Each of the proposed action alternatives are expected to improve existing conditions for the Seneca Nation. This alternative would provide a beneficial impact to an environmental justice population. No adverse impacts to socioeconomics and environmental justice are anticipated.

4.11.0 CUMULATIVE EFFECTS

Pursuant to 40 CFR 1508.7, cumulative impacts are the impacts on the environment which results from "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." The Study Area is entirely within Seneca Nation Territory. These lands are impacted by the operation of the dam and any structural development of the land is prohibited. As noted previously, the Seneca Nation has been working to install fish habitat structures in the study area, and the Nation is expected to continue to conduct small scale habitat improvement projects. No future development of the area is anticipated.

The preferred alternative is intended to improve the quality and quantity of existing habitats within the study area and is not expected to have any long-term negative impacts. Therefore, in the context of the historical, current, and reasonably foreseeable future actions that have impacted and may impact the Study Area, no significant cumulative effects are anticipated with the preferred alternative, and any reasonably foreseeable future actions are expected to cumulatively benefit the Study Area.

5.0.0 MITIGATION OF ADVERSE EFFECTS

As this is an ecosystem restoration project, it has been formulated to provide an overall benefit to native species and their habitats. No wetland impacts are proposed. No mitigation measures are necessary or proposed as part of the recommended plan.

6.0.0 IMPLEMENTATION REQUIREMENTS

6.1.0 PROJECT PARTNERSHIP AGREEMENT

The non-federal sponsor is prepared to execute a PPA for the alternatives recommended in this feasibility report. A letter of intent to accomplish this project was received on June 3, 2014 (Appendix G). The roles and responsibilities of the non-federal sponsor are listed in Section 3.6.3 of this document. Design and Implementation funds will not be requested until a PPA has been executed between USACE and the Seneca Nation of Indians.

6.2.0 LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS AND DISPOSAL AREAS

There are approximately 286.87 acres required for this project. There are no areas needed for disposal since the material will be reused for the project. The lands needed for this project are on the Seneca Nation lands. The Study Area limits are located in lands owned by the Seneca Nation in Restricted Fee with land agreements issued to certain tribal members to occupy and use the land and the Corps has flowage easements over this property. Restricted Fee is legal title to land but with legal restrictions against alienation or encumbrances with the land agreements to Seneca Nation members that allow members to access and use certain parcels and the flowage easements allow flooding to the 1,365' elevation by the Corp. For LERRDS purposes, the acreage breakdown is as follows.

a. A total of 286.87 acres will be required for the Study Area that the Seneca Nations owns in restricted fee.

b. Subordination agreements and/or access agreements are required from the Seneca Nation members who have use and occupancy rights for access, construction and O&M for the project.

c. A consent to easement from the Corps will be needed for the flowage easements that are encumbered by the property.

d. Access to the property will be from public streets.

Six locations within the Study Area will include seasonal plantings in October to November. In addition, two 1 acre areas in Bear Claw and Low Banks will be used to control Japanese Knotweed. Mechanical cutting will occur in the June-July time frame.

There are no disposal areas on site or off site and if there are any materials that will be disposed of it will be taken to a properly-permitted commercial disposal facility. The current plan involves some dredging and reusing the material at the same site at Bear Claw.

There will not be any acquisition of additional lands based on the current plan. Based on the current plan, the recommended alternative will be constructed during a three-year period.

6.3.0 MONITORING AND ADAPTIVE MANAGEMENT

In order to determine whether or not the project has achieved its ecological success in meeting the restoration objectives, the following monitoring and adaptive management plan would be implemented following project construction. This plan lays out the strategy for assessing project success based on clearly defined objectives, and potential adaptive management actions that could be implemented if the project fails to meet these objectives.

6.3.1 UNCERTAINTIES

The degree of uncertainty surrounding whether or not the project benefits will be achieved is key for scaling the monitoring and adaptive management strategy. For this particular project, the habitat quantity benefits are captured as acreages of improved habitats and habitat quality benefits are primarily derived from two analyses: the MAR FQA for riparian habitats and the smallmouth bass HSI for aquatic habitats.

The MAR FQA measures its benefits from the mean coefficient of conservation for the species forecasted to be within the project area. These benefits derived are primarily related to the hardiness of the species and the diversity of the species within the project area. As the plantings will be installed by the local sponsor or by a contractor at the direction of the Corps, there is little risk that this will not be achieved. There is risk however that species could die over time or be out-competed by aggressive or invasive species. As such, the monitoring plan will focus primarily on this risk for riparian habitat benefits.

The smallmouth bass HSI model uses a multitude of habitat factors in order to assess suitability. In the analysis conducted for this project, two habitat conditions drove the benefits for the proposed alternative when compared to the No Action condition: improved cover habitat and dominant substrate type. By altering the substrate and by conducting the seasonal plantings, we can be fairly certain that these conditions are achieved. Placement of the rip rap with an engineering analysis completed to properly size the material based on expected conditions, minimizes this risk. No monitoring for rip rap is recommended. There is uncertainty related to the seasonal plantings of barren land, due to the reliance on sufficient duration of exposure during seasonal lowering of the lake and its allowance for growth of plants. This uncertainty is relatively low. Quick growing varietals would be used and the plants need not reach maturity in order to provide habitat benefit once inundated. The monitoring plan will focus primarily on this risk for cover habitat benefits.

The HSI model captured benefits to fisheries based on the exposure of larger grained sediments at Bear Claw. As the sediment removal would be conducted by the Corps, there is little risk that

this will not be achieved. There is risk that sedimentation in Bear Claw could reoccur faster than anticipated. Monitoring sedimentation ensures the realization of this benefit. This uncertainty is relatively low, but the monitoring plan will focus primarily on this risk.

The analysis conducted was conservative in regards to anoxic conditions and HABs. The assumption used in the smallmouth bass model for the chosen alternative is that anoxic conditions would occur. Because of this assumption, there is no risk related to HABs that the chosen alternative would not meet the modelled habitat improvements.

6.3.2 PROJECT OBJECTIVES

Clear articulation of the project objectives is the foundation of adaptive management; a process that iteratively compares management outcomes against the objectives and adjusts management actions or the objectives themselves based on learning over time. An effective adaptive management strategy requires specific success metrics and a time horizon to guide and improve decision making that facilitates progress toward the goal. For this particular project, four objectives have been identified.

- Monitoring Objective 1: Greater than 75% plant coverage within seasonal planting areas (i.e. HAB measure H14) annually for 3 years after construction completion.

This objective addresses uncertainties related to seasonal planting benefits for habitat and cover as measured by the smallmouth bass HSI.

- Monitoring Objective 2: Greater than 75% plant species survival within invasive species management areas (i.e. invasive species management measures P1/P4) annually for 5 years after construction completion.

This objective addresses uncertainties related to species survival and benefits associated with improvements measured by the MAR FQA model.

- Monitoring Objective 3: No spread of invasive species within the P1/P4 invasive species management areas within 5 years of construction completion.

This objective addresses uncertainties with continued survival of native species within the planting areas due to invasive species and addresses benefits associated with invasive species removal from existing areas measured with the MAR FQA model.

- Monitoring Objective 4: Less than 4 inches of sediment deposition with a grain size less than 62 microns over less than 25% of the excavation area (i.e. HAB measure H5F).

This objective addresses uncertainties about the reduction of nutrient availability in sediments and the exposure of larger grained sediments associated with improvements measured by the HSI model.

6.4.0 MONITORING

In order to ensure the stated objectives are met, the following monitoring is recommended:

Table 22 - Proposed Monitoring Activities

Performance Metric	**Data Gathered**	**Methodology**	**Collection Time**	**Cost per Monitoring Event**	**Time Frame**
Native Species Cover	Plant Species Composition	Field Observations	Late July	$1,000	Every Year for 5 Years
Seasonal Planting success	Plant growth presence / absence	Field Observations	Late Summer	$1,000	Every Year for 3 Years
Sediment deposition and composition	Sediment thickness and grain size	Field Measurements and Grab Samples	Winter	$5,000	Years 5 and 10 following construction

Annual monitoring will be conducted at the planting sites to determine species composition and success. An observer would perform site visits at least once during the active growing season (preferably in late July) to examine the native and seasonal planting sites. The total cost of this effort for monitoring objectives 1, 2, and 3 is estimated at $8,000.

During low water in years 5 and 10 following construction, sediment thickness would be measured and grab samples would be collected from 10 locations and analyzed to determine grain size. Additionally, sediment measuring greater than 62 microns in size would not likely be contaminated with N and P nutrients (Thomas, 1977). While HAB-reduction benefits were not captured in the HSI model, the secondary benefit of the reduced nutrient availability is an important aspect of this project. Therefore, accumulation of sediment with a grain size smaller than 62 microns, at a vertical thickness greater than 4 inches, could trigger adaptive management. The total cost for this effort is estimated at $10,000.

Total monitoring costs over the 10-year time frame are estimated at $18,000. Analysis and results of these efforts would be documented in an annual monitoring report.

6.5.0 ADAPTIVE MANAGEMENT

In the event that a restoration measure fails to achieve the stated objective, subsequent action may be necessary to ensure that the project is successful. In years 1-5 of monitoring, removal of non-native plant species from the restored area may be warranted. Methods may need to be altered in order to address invasive plant communities that continue to survive. For example, other herbicides may need to be used or other application methods may be needed. It is anticipated that over the first 5 years, up to 15% of the original area targeted for invasive species removal would need to be retreated. This work could also involve re-planting of desired native species. Based on the survival of species observed during the monitoring period, species composition may need to be altered to avoid species that failed during the 5-year monitoring

period, and replaced with species that have a higher likelihood of survival based on monitoring results. The anticipated cost in year 5 for replanting is estimated to be 10% of the initial planting costs.

For the seasonal plantings, the ability to adaptively manage annually exists with no associated cost. If one species is shown to not succeed, another species can be planted the following year. The three years of monitoring is expected to be sufficient to find successful species and planting methods.

If following monitoring years 5 and/or 10, more than 4 inches of sediment smaller than 62 microns accumulates, some additional sediment removal may be needed along with consideration of more frequent maintenance dredging/excavation through the project life. This is highly unlikely to occur as the site has not historically shown high rates of deposition. For the purposes of this adaptive management plan, it is assumed that a portion of the site may need maintenance excavation. This cost was estimated to be up to 10% of the original sediment removal cost. The costs for monitoring and adaptive management are estimated below.

Table 23 - Estimated Monitoring and Adaptive Management Costs Over Time

	Monitoring	**Invasive Removal**	**Replanting**	**Sediment Removal**	**Total**
Year 1	$2,000	$2,000			$4,000
Year 2	$2,000	$2,000			$4,000
Year 3	$2,000	$2,000			$4,000
Year 4	$1,000	$2,000			$3,000
Year 5	$6,000	$2,000	$35,000		$43,000
Year 10	$5,000				$5,000
Year 11				$110,000	$110,000
Total	$18,000	$10,000	$35,000	$110,000	$173,000

The Corps will be responsible for conducting monitoring and adaptive management for the first ten years following implementation. Costs for these efforts will be shared as described in Section 3.6.3 above. If the full amount of funds ($173,000) is needed, the costs of implementing the monitoring and adaptive management plan would be $129,750 federal and $43,250 sponsor funds. Following the period of monitoring and adaptive management, the project will be operated and maintained by the non-federal sponsor to ensure the features sustain their intended benefits for the life of the project.

6.6.0 OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION

Costs and activities relative to the operation, maintenance, repair, replacement and rehabilitation (OMRR&R) of the finished project will be the responsibility of the Non-Federal Sponsor. These are activities other than monitoring or adaptive management and are described briefly below:

- Operation is the control of the constructed features whose regulation or other manipulation is intended or necessary to ensure the Project's performance.

- Maintenance includes those activities of a routine nature that hold the project in a well-kept condition, to keep it functioning as intended and to deter more damaging or more costly repair or replacement needs.
- Repair is the resolution of unexpected failures and problems as they arise.
- Replacement covers those activities necessary to bring a deteriorated project or condition back to its original condition. These actions would conform to the project's "as-built" plans and specifications unless other arrangements are made.

When the USACE determines that the entire project is complete (except for monitoring), the Non-Federal Sponsor will be notified and will be furnished with an OMRR&R Manual including "As-Built" drawings. From that time, the Non-Federal Sponsor will be required to operate, maintain, repair, rehabilitate and replace the project in accordance with the PPA.
As with all ecologically-based projects, long term success requires continued operation and maintenance of the selected and implemented restoration measures of the recommended alternative. Operation and maintenance for this project is likely to involve some periodic maintenance of restoration plantings, control of invasive species populations, and maintenance of rock protection.

Specific annual costs for each OMRR&R line item are built into the unit costs as shown in Appendix C.

6.7.0 COMPLIANCE WITH ENVIRONMENTAL STATUTES

This chapter provides documentation of how the recommended plan (agency preferred alternative) complies with all applicable Federal environmental laws, statutes, and executive orders.

Table 24 - Legal Compliance

Laws and Executive Orders	**Compliance Status**
Archaeological and Historic Preservation Act, 16 U.S.C. 469, et seq.	Consultation with the Seneca Nation Tribal Historic Preservation Office (THPO) was initiated on 07 February 2017 and is ongoing.
Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C.	Elements of a Phase I Environmental Site Assessment (PH 1 ESA) was conducted for the site to determine the potential presence of hazardous substances. Discussion of findings of the PH 1 ESA may be found in section 2.10.0.
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Construction activities associated with the proposal will create short-term air emissions, but the emissions are expected to be minimal.
Clean Water Act, 33 U.S.C. 1251, et seq.	The Corps will determine whether or not a National Pollutant Discharge Elimination System (NPDES) permit is required under Section 402 of the CWA prior to construction. The Corps has evaluated potential project impacts under Section 404 of the CWA and

Laws and Executive Orders	Compliance Status
	determined that they are consistent with applicable Nationwide permits, demonstrating substantive compliance with the Clean Water Act. Final design plans will be reviewed to ensure compliance with the Clean Water Act, and the necessary Section 401 water quality certifications will be obtained.
Endangered Species Act, 16 U.S.C. 1531, et seq.	Six listed species may be found in the Study Area: Clubshell Mussel, Rayed Bean, Northern riffleshell, Snuffbox, Rabbitsfoot, and Northern Long-eared Bat. The freshwater mussels are unlikely to be within the reservoir within the Study Area due to the recurrent HABs. Host fish however could travel through the Study Area. No tree clearing is currently proposed; however, if tree clearing is proposed in final design then USFWS consultation will be initiated.
Bald and Golden Eagle Protection Act, 16 U.S.C. 668, et seq.	Bald eagles were known to nest in the Highbanks Campground area; however, the nest tree was lost due to erosion of the bank. No known nests exist in the area and no negative impacts to eagles are anticipated. Water quality improvements due to HAB decreases could improve forage conditions for eagles within the Study Area and stabilization of the bank would protect the other potential nesting trees in the area.
Farmland Protection Policy Act, 7 U.S.C. 658, et seq.	As the proposed work is occurring below ordinary high water, no impact to prime and unique farmland is expected. Chenango (CkA) and Tioga silt loam (To) soils at Bear Claw are rated as prime farmland. No negative impacts to these areas are expected.
Fish and Wildlife Coordination Act, 16 U.S.C. 601, et seq.	Comments were sought with regard to this act from the US Fish and Wildlife Service (USFWS) in a letter dated 23 November 2016. The USFWS responded on 12 April 2017 with initial information regarding the Endangered Species Act, but did not address FWCA. The draft EA will be sent to the USFWS for comment. Coordination with the Seneca Nation of Indians' Fish and Wildlife Department is ongoing.
National Environmental Policy Act, 42 U.S.C. 4321, et seq.	This integrated Environmental Assessment and the result Finding of No Significant Impact was developed to ensure compliance with this act.

Laws and Executive Orders	Compliance Status
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	No historic properties will be affected by the proposed action. The Corps has consulted with the Seneca Nation Tribal Historic Preservation Office (THPO) and has confirmed no historic buildings exist within the Study Area.
Migratory Bird Treaty Act, 16 U.S.C. 703, et seq.	Construction activities will seek to avoid nesting periods of migratory birds and a survey for nesting activities will be conducted prior to clearing and grubbing to ensure compliance with this act. The Corps will confer with the USFWS on this determination during the public review of the draft document.
Floodplain Management (EO11988)	Engineering analysis of project alternatives was conducted to develop design considerations that would ensure that no increase in flood risk would arise as part of the alternatives considered. As this is a reservoir ecosystem restoration project, there is no practicable alternative to siting this project in the floodplain.
Protection of Wetlands (EO11990)	The Corps will coordinate with its regulatory section to ensure compliance with this executive order.
Environmental Justice in Minority Populations and Low-Income Populations (EO12898)	The proposed action is intended to improve conditions for a protected population. The project is in compliance with this EO.
Invasive Species (EO13112)	The preferred alternative will seek to eradicate invasive species within the Study Area.
Consultation and Coordination with Indian Tribal Governments (EO 13175)	As the Seneca Nation is the local sponsor for this project, they have been regularly involved in decision making for the project. The Corps has engaged in regular and meaningful consultation and collaboration with the Seneca Nation throughout the course of the study.

7.0.0 **PUBLIC INVOLVEMENT**

7.1.0 PUBLIC VIEWS AND COMMENTS

The introduction of the ecosystem restoration feasibility study to Seneca Nation members and concerned public agencies was completed on November 14th and 15th of 2016. The meeting discussion notes were organized by concern and associated proposed solutions and are provided below.

7.1.1 Open articulated concerns and proposed solutions

Articulated concerns:

1. Human health and safety, most importantly including children and family pets, from exposure to the blooms/toxins; restricted use of shoreline area during blooms.
2. Effects of HABs on wildlife and fisheries as well as fishing success.
3. HABs are a watershed-scale problem that accumulates and persists; it quickly becomes problematic throughout the reservoir.

Proposed solutions:

- Attack this problem using multiple methods, not just one.
- Create **Seneca Nation Water Quality Standards utilizing aquatic life criteria** and put into law. Utilize the recent determination for "Treatment in a similar manner as a State" under the federal Clean Water Act Impaired Waters (Section 303d) to set Total Maximum Daily Load (TMDL) levels.
    - Consideration:
        - Whatever standards are set, the Seneca Nation will need to ensure that they can also meet the water quality standards they set.
- **Mechanical mixers**
    - Considerations:
        - The intent is to prevent warm season reservoir stratification and anoxic conditions that lead to release of nutrients from the sediments, making them available to feed blooms. This could reduce the likelihood or extent of HABs occurring and allow folks to safely recreate on the Reservoir, there are many potential problems associated with this technology.
        - The utilization of mechanical mixers doesn't address the continuation of inflow nutrient loading, or removal of existing sediment contaminants, so in essence would treat only the symptoms, not the causes of HABs, (i.e., act as a Band-Aid).
        - Known mechanical mixers used to treat HABs on small ponds may be ineffective in an environment such as Allegheny Reservoir, much larger in size and subject to fluctuating levels on a DAILY basis.
        - There are high operations and maintenance costs associated with this management measure, and this cost would fall completely on the Seneca Nation. Also, mixers would need to be taken in and out of the reservoir seasonally, for maintenance or possibly in response to extreme water level fluctuations and the Seneca Nation would require the capability to do so as well as a place to store the large equipment
        - Deployment of a large number of floating mixer units would minimally interfere with recreational use of the Reservoir as boats channels are marked necessarily due to the bathymetry of the Reservoir.
- **Skim the water** to collect the HAB on the surface of the water.
    - Considerations:
        - Need to be done when HAB are not dispersed throughout the water column.
        - The algae of concern, blue- green algae (actually a form of bacterium having chlorophyll) are naturally occurring in watersheds, and cannot be totally eradicated. They only become problematic when nutrient and temperature

conditions are ideal for growth. They will continue to recur as long as conditions are favorable. Therefore, when conditions are ideal, blue-green algae will likely grow back if removed.

- **Sediment Removal**
  - Considerations:
    - Would be easier to do during the winter months, when water levels in reservoir are reduced and sediment is uncovered in many of the bay areas.
    - Sediment disposal would be challenging and expensive if disposed of off territory. Consider approaching owners of gravel pit near Highbanks Campground for use as a sediment disposal site, or look at feasibility of re -using sediment for contouring banks or creating other in-lake habitat.
    - Focused sediment removal could minimize cost, particularly in the bays that the HABs are most present. The first mile or two of the reservoir, where the water velocity slows and some sediments settle should also be investigated.
    - Dredging of the reservoir would be a monumental task, but could be conducted piecemeal or targeted in specific areas based on sediment survey results.
    - Removal of nutrient-laden sediment would be effective to mitigate the nutrient availability but as long as the levels of nutrients in the watershed are not reduced the HABs will remain an issue.
- **Improve Dissolved Oxygen levels** in the water to lessen the amount of nutrients in solution and encourage the growth algae species that are not harmful.
  - Considerations:
    - The nutrient availability would not change and this does not target limiting nutrient.
    - The likeliness of bloom reduction as cyanobacteria tends to outcompete.
- **Watershed Nutrient Management** in order to control the level of nutrients coming into the Reservoir.
  - Considerations:
    - This is beyond the scope of this study.
- **Research Best Management Practices** to see how nutrient pollution or chronic HAB problems have been managed in other places.
  - Consideration:
    - Places to investigate include:
      - Miami
      - Chesapeake Bay
      - Onondaga Lake – Required Phosphorus Standards
      - NYS
      - Great Lakes Region
- Add "**Nutrient Logs**" to the Reservoir to collect nutrients +
- **Engage with PA and NY** to consider how the existence and/or creation of state **HAB plans** could be used to collaborate with the Seneca Nation and amend incoming nutrients generating from their states in the Reservoir.
- Reach out to entities (states, counties, agencies) to gather their watershed data. Create **a database** of water quality data for the Allegany Reservoir. Create Allegany Watershed Alliance to tackle issues plaguing the Reservoir.

- Conduct studies to **identify the point and non-point sources of nutrients** in the Reservoir. (e.g. old dumps, wastewater treatment plant discharges, failing septic systems, combined sewer overflows, industrial discharges, erosion and sedimentation, agricultural and urban runoff, etc.)
- Conduct a larger **watershed study** in order to address the incoming nutrient problems from upstream of the reservoir.
    - Consideration:
        - The Scope of the Section 1135 may not be able to address many of the sources contributing to the nutrient management issues, outside of the Allegheny Reservoir.
        - If this Section 1135 study identifies the origin of nutrients coming from outside of the Reservoir, may need to use this data to approach others and consider another, larger study of the watershed.
- Study the **interaction between the binding of iron and phosphorus**, linked to internal eutrophication.
- **Stream assessment for PA reaches** for the Allegheny River would be useful to inform this study.
- **Sediment Rate Survey and Sediment Quality Survey** to document the quantity, rate of deposition, and quality of the sediment in the Reservoir. Utilize **NY DEC's upcoming monitoring data**. Will be conducted in FY17 on the Allegheny River.
- **Boat Washing**
    - Considerations:
        - Enforcement would be difficult. Easiest enforcement would occur at monitored boat docks/slips.
        - The management issue is nutrient levels rather than the presence of HABs, which are naturally occurring organisms in our watersheds.
- **Oil-Spill Clean-Up Techniques**/Lessons Learned.
    - Considerations:
        - Algae are harder to contain and has different clumping characteristics than oil.
- Kill with **Copper Sulfate**
    - Consideration:
        - When you kill off the algae, the algae will still release the toxins into the water which may cause a larger problem.
- **Cryogenically freeze** the Algae

Other General Concerns/Suggestions:
- Partner with other entities impacting the nutrients flowing into the Allegheny Reservoir (e.g. State Park, Counties, etc.). Should consider partnering and cost sharing if they are contributing to the nutrient problem.
- Could pursue other studies, either a watershed study or study looking at the reallocation of the storage for other uses such as recreation or fish and wildlife enhancement.

7.1.2 Identified Issue: Erosion & Lack of Shoreline Vegetation

Articulated concerns:

1. The reservoir operations inhibit the growth of vegetation along the shoreline inundated during the growing season but exposed with winter drawdown. Fluctuations due to the operation of the Kinzua Dam and daily pool fluctuations to/from pumped storage affects vegetation establishment and would have to be considered when determining plant species used in restoration efforts.
2. The riverbank inundated during raised summer pool and exposed during winter drawdown for flood storage remains unvegetated and exposed to erosion.
    a. Considerations:
        i. If the water levels were able to stay at a little bit higher of a level over the winter, might be able to establish habitat in the Reservoir.
        ii. The shoreline elevations in some locations are steep and enhance impacts due to water level changes, shoreline modifications and establishment of riparian zone could reduce impacts.
3. Carp, recently increasing in population, spawning in the shallows leads to lack of vegetation and adds to the turbidity in the water.
4. Erosion at Highbanks Campground has been documented since the 80's. Top of bank erosion has been noticed landward of the 1365 elevation. USACE commitment to addressing erosion has fluctuated over the years. Can the study extend beyond the 1365 elevation boundary? The possibility of a mass failure needs to be explored and amended.
5. Seneca Nation members' question why the Seneca Nation should pay for a problem they didn't cause. In Part 1 of this study, it was determined that the HAB issues stemmed from the Kinzua Dam reducing flows and allowing the accumulation of nutrients (both aqueous and sediment). Additionally, most erosion issues stem from water fluctuations driven by the operation of the Dam and Hydropower Facility. AND, at least 50% of the incoming nutrients stem from regulated point sources in NY and PA.

Proposed long-term solutions:

- **Stabilize the pool elevation**
    - **Raise water elevation during winter months** to establish vegetation
    - Investigate reservoir authorized purposes for reallocation of storage/operations based on current conditions, including reducing the elevation of our maximum pool take line.
    - Investigate avenues through which to work with FERC to **reduce the daily fluctuations in water levels** due to Hydropower generation.
- Explore **opportunities for grants** or other ways mitigate issues on Reservoir that reach beyond scope of this study.
    - Procure vegetation source materials (e.g. NY DEC's Free Tree Program), although NY DEC Free Tree Program may only be for reforesting

7.1.3 Identified Issue: Invasive Species

Articulated concerns:

1. Japanese Knotweed is the biggest threat along with Spiny Water Flea (which the Walleye do not like).
2. Even if removed, will still come down from upstream and repopulate in a year or two.

3. If the riparian invasive species are removed, appropriate replacement plantings will be necessary to secure banks from erosion by contributing important root structure and habitat.
4. Invasive species out-compete native plants and are a threat to Seneca Nation's reliance on native plants important for food and traditional medicinal purposes.

Proposed solutions:
- **Concentrate removal efforts** to areas of key concern (e.g. medicinal plant areas)
- **Re-establish riparian corridor**
- **Herbicide Spraying**
  - Considerations:
    - Have already tried to spray, but the plants returned.
- **Tarping**
  - Considerations:
    - Since the invasive species are along most of the banks, it is more detrimental to weaken root bases holding banks together.

7.1.4 Identified Issue: Fish Habitat

Articulated concerns:
1. Failing culverts. Many culverts of tributary streams in need of repair, causing stream connectivity issues.
2. Ponded stranding of fish during reservoir drawdown.
3. Lack of structure in reservoir for spawning and shelter.
4. HABs can cause fish to move to non-affected areas, and can block fish passage through affected areas. In other lakes/reservoirs, HABs have caused fish dye-offs.

Proposed solutions:
- Do NOT draw down the reservoir so rapidly.
- **Replace road culverts** with the goal to decrease fish passage barriers from the tributaries into the reservoir.
- Continue to **dig trenches** from ponding areas back to the natural river in order to allow fish passage. Use maps showing areas in need of trenching to guide efforts.
- Put **donated materials** into valuable fish habitat locations.
- Seneca Nation could provide materials (such as small seine nets) to allow **community volunteers to capture and relocate trapped fish.**

7.1.5 Additional questions and provided answers

Who is doing the work for this study?
Answer: Seneca Nations Watershed Resources Working Group and the US Army Corps of Engineers Pittsburgh District.

What is the dam designed for?
Answer: Kinzua Dam and Allegheny Reservoir was authorized by the Flood Control Acts of 1936 and 1938. It protects the downstream Allegheny River and upper Ohio River Valleys and it

is one of 16 flood control projects in the USACE Pittsburgh District. The reservoir also provides water to reduce pollution and improve the quality and quantity of water downstream for domestic, industrial and recreation uses.

How do you clean up HAB?
Answer: The best way to clean up HABs is to manage the nutrient loads.

What has made the frequency and size of the HAB increase recently?
Answer: Many reasons which could include: increasing reservoir stratification and anoxia, elevated concentrations of nutrients in the lake sediment coupled with incoming nutrients from upstream (both point and non-point sources), increasing frequency and magnitude of extreme run off events, increasing number of sunny days (greater light penetration), and warmer seasonal water temperatures.

Are the toxin/algae on land?
Answer: Blue-green algae scum that dries on the reservoir shorelines may contain algae toxins for as long as several months after the algae have died.

What harm does this HAB cause?
Answer: Exposure to blue-green algae toxins through recreational contact, ingestion, or inhalation may cause symptoms such as skin rashes, gastrointestinal distress, muscle and joint pain, respiratory distress, kidney and liver toxicity, and neurological symptoms and in some rare cases, death - particularly in pets and young children. Even if not producing toxins, HABs can alter food webs, cause anoxia, and degrade ecosystems.

What has the extent of bloom been in recent years?
Answer: In September 2016, the HAB extended from the head of the reservoir on SNI Territory downstream to the Wolf Run Marina in PA. The harmful algal blooms typically occur during mid-summer and persist in the Reservoir well into the fall, last year the HABs lasted until November. The concentrations of blue-green algae and toxins increased throughout the year.

What is limiting nutrient to the HAB?
Answer: While the HAB rely on both Nitrogen and Phosphorus as their food source, Phosphorus appears to be the limiting nutrient in this system but the limiting nutrient must be determined. Phosphorus is necessary for plants to grow but the addition of an excess amount can cause an explosive growth of algae.

Does the HAB reduce plant life?
Answer: No, plants would grow in these areas if they were able – regardless of HAB presence because the upper reach of Allegheny Reservoir is dewatered in the winter so any plants that grow during the summer usually die. If plants could grow, the bloom would likely kill them since it would block the sunlight necessary for the plants to photosynthesize.

Are there target nutrient levels?

Answer: The State of NY is working on their TMDL requirements. PA hasn't listed any TMDLs in the area. The Seneca Nation is also working to seek TMDL requirements under the Clean Water Act Impaired Waters.

Does the Corps have power to control the ways in which the hydropower facility draws the water from the reservoir?
Answer: USACE has a Memorandum of Agreement with the hydropower plant operator, required by the project's Federal Energy and Regulatory Commission (FERC) license, regulating reservoir withdrawal for pump storage and energy generation, and release back into the reservoir or downriver depending on USACE reservoir release schedule. These mandates have not changed since the dam was built in 1965.

What steps are already being taken to address this problem?
Answer: The Seneca Nation has minimal nutrient inputs into the Reservoir and is investigating any possible sources that may generate on territory. The state of New York is tightening up their regulation of point sources nutrient pollution, which will improve the quality of the water entering Allegheny Reservoir. For example, the City of Olean NY is currently upgrading their waste water treatment plant and NY now requires Concentrated Animal Feeding Operations (CAFO) permits.

What do we hope to accomplish in 2017?
Answer: Will be using the 50/50 cost share, with work in-kind from the Seneca Nation to gather data and follow the feasibility study work plan created by USACE and the Seneca Nation. We hope to produce a report with definite recommendations by August 2017, which will go through a series of reviews into 2018 before any decision on implementing a project will be made.

The draft integrated report and EA will be circulated for public review and comment during the 2nd quarter of 2019.

All relevant comments will be addressed in the final integrated report and EA. Agency letters and responses will be located in the Appendix.

7.2.0 STAKEHOLDER AGENCY COORDINATION

The public meeting held on November 14th and 15th of 2016, was attended by representatives of the following agencies:

- Seneca Nation Department of Transportation
- Seneca Nation Environmental Health
- Seneca Nation Fish and Wildlife
- Seneca Nation GIS
- Seneca Nation Health
- Seneca Nation Planning
- Cattaraugus County Department of Health
- New York Parks, Recreation and Historic Preservation
- New York State Department of Environmental Conservation, Fisheries

- New York State Parks (Allegany State Park)
- U.S. Army Corps of Engineers
- U.S. Forest Service

Project information was also provided to the U.S. Fish and Wildlife Service by letter dated November 23, 2016.

7.3.0 PUBLIC REVIEW AND COMMENT PERIOD

The draft DPR/EA was circulated for public review and comment from June 17, 2019 to August 1, 2019 (45 days). In addition, a public meeting was held on June 24, 2019, from 5:00 – 7:00pm at the Seneca Nation of Indians headquarters in Salamanca, New York, to provide information on the project and solicit public comment. Five comments were received and are contained in Appendix F. The comments can be categorized into two general themes:

- Concerns over the use of herbicide to treat invasive plant species
- Request to utilize public volunteers for project construction activities

The draft DPR/EA was shared with the following agencies/outlets during the 2019 public review and comment period:

- U.S. Fish and Wildlife Service
- U.S. Forest Service
- U.S. Environmental Protection Agency
- U.S. Natural Resource Conservation Service
- New York Department of Environmental Conservation
- New York State Parks, Allegany State Park
- Pennsylvania Game Commission
- Pennsylvania Fish & Boat Commission
- Local Newspaper Announcements of Availability

No changes were made to the DPR/EA based on the comments received. The final DPR/EA will be published on the Corps website upon approval.

8.0.0 RECOMMENDATION

The District has concluded that the Seneca Nation of Indians is capable of meeting their financial obligations and that the total public interest would be served by the implementation of the recommended alternative. This study has included an examination of all potential and practicable alternatives for meeting the study objectives of reducing the severity of harmful algal blooms, reducing shoreline bank erosion, restoring natural riparian areas, controlling invasive species and improving aquatic habitat. The recommended alternative provides environmental benefits and meets the sponsor and public needs. The recommended alternative provides important fish, wildlife, habitat and public health benefits at a reasonable construction and O&M cost. The plan has negligible impact on flood water surface elevations. The plan is consistent

with national policy, statutes and administrative directives. The plan has been reviewed in light of overall public interest, which includes the views of the sponsor and interested agencies.

The recommended alternative would include restoration of fish and wildlife habitat within the Allegheny Reservoir, as generally described in this report, with such modifications by the Chief of Engineers as may be advisable to meet provision of Section 1135 of the 1996 Water Resources Development Act, as amended. Authorization is subject to cost sharing and financing arrangements with the non-Federal sponsor, the Seneca Nation of Indians, and is based on the cost sharing and financing requirements of the Section 1135 program. Prior to construction, and during the Plans and Specifications phase, the non-Federal sponsor will: (1) provide all lands, easements, and rights of way necessary for project construction and operation and maintenance; and (2) hold and save harmless the United States from damages due to the construction or operation and maintenance of the project. The non-Federal sponsor will also operate and maintain the project after construction for the life of the project (50 years).

This recommendation reflects information available at this time and current policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the entire Executive Branch. Consequently, the recommendations may be modified before they are approved for implementation.

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APPENDIX A

ENGINEERING

Seneca Nation of Indians Ecosystem Restoration
Engineering Appendix

Table of Contents

Figures

Tables

1 STUDY AREA - EXISTING CONDITIONS

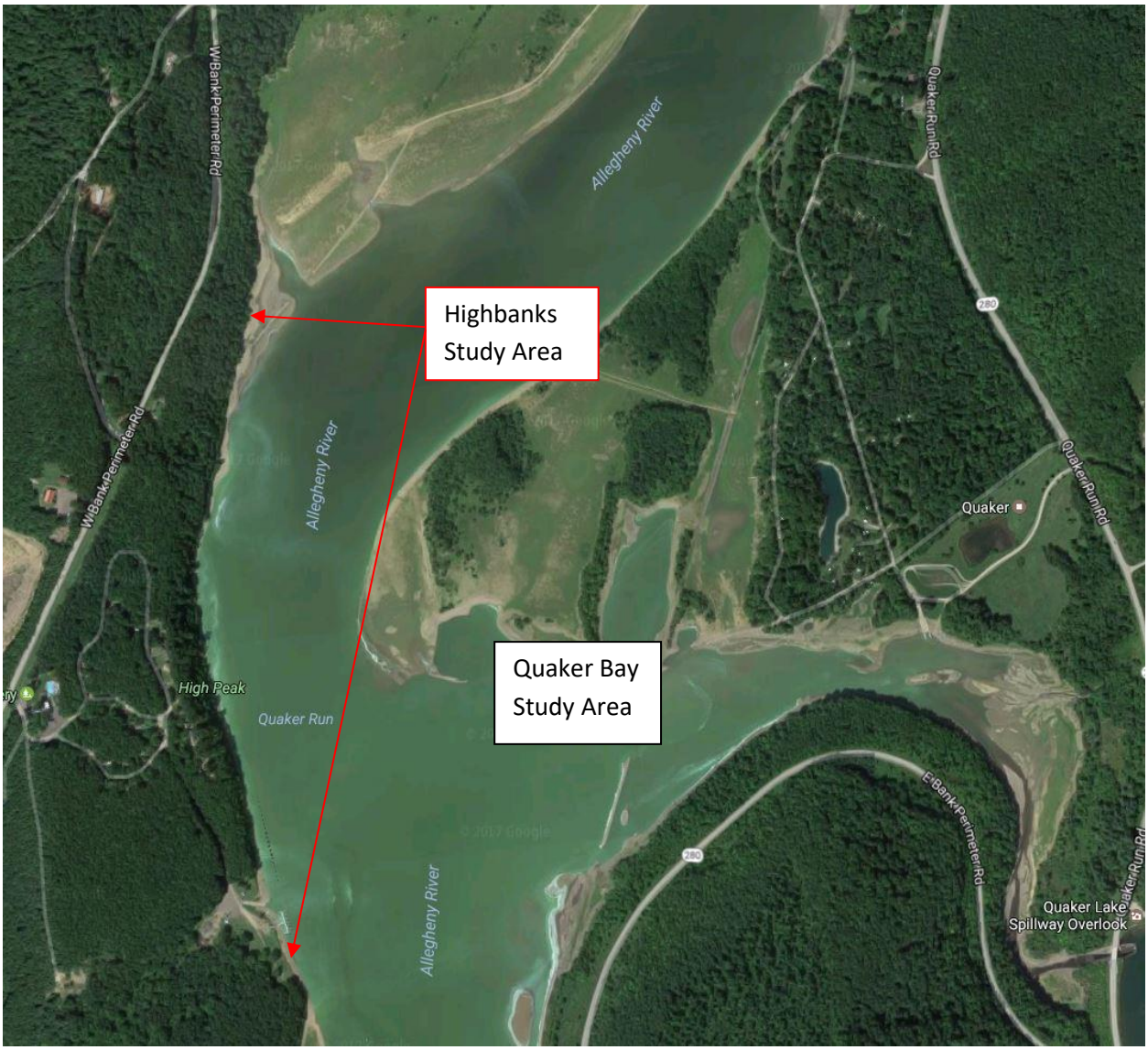

Figure 1: Aerial View of Study Area (Source: Google Earth, 2017)

The Study Area (shown in Figure 1) Existing Conditions are described in the various Sections of this Appendix.

1.1 SOILS AND GEOLOGY

1.1.1 Geology and Physiography

1.1.1.1 Site Description and Observations

The project is comprised of a shoreline zone extending about 3,000 feet along the right bank (western shoreline) of the Allegheny Reservoir opposite of Quaker Bay, about 3.5 miles south of Steamburg, Cattaraugus County, New York. The downstream extent of the project area begins about 750 feet south of the boat loading ramp, then continues north for another approximately 2,250 feet. The extent of shoreline revetment may be revised based on further hydraulic and hydrologic study.

The project area abuts the Highbanks Campground, a year-around campground facility owned and operated by the Seneca Nation of Indians. The campground is situated on a bluff which rises about 120 feet above the summer pool elevation (El.) of 1328 and tapers down to approximately 1323 feet near the boat launch. The campground is heavily wooded with trees which is broken only by the individual cabin sites and connecting roads. The trees and woody vegetation continue to the edge of the slope. Woody vegetation exists on the slope down to the top of the shoreline (corresponding to about El. 1328).

The shoreline along the project area is characterized by slopes ranging roughly between 1Vertical:3Horizontal to nearly vertical embankments. The shoreline is covered with rounded gravels and cobbles, ranging up to about 8 inches, and generally evenly distributed across the surface. The gravels and cobbles were primarily sandstone, with lesser amounts of shales and some quartz. Colors were varied and included white, light-to-dark gray, black, brown, orange and red. The larger rocks were predominately well-rounded with high sphericity and the smaller cobbles and gravels ranged from well-rounded to sub-rounded, also exhibiting high-sphericity.

1.1.1.2 Site Geology

No soil or rock borings were available for the study. Geomaterial classification is limited to published soil surveys and geologic references. Using the Natural Resources Conservation Service, a custom soil resource report (Web Soil Survey – Appendix 4.2.) was generated for the project area located in Cattaraugus County, New York. It is important to note that soil survey provides information which is generalized over large areas and may not accurately represent specific soils local to the immediate project area. Onsite soil and rock borings should be performed if accurate, detailed characterization of geotechnical parameters is required for final design.

The project area lies in the southwestern corner of Cattaraugus County. Cattaruagus County includes both glaciated and unglaciated land areas. The project is situated in the unglaciated Allegheny Plateau province which generally follows the alignment of the Allegheny River. This area escaped glaciation and is characterized by rugged topography, long and steep slopes with deeply incised V-shaped valleys (Puglia, 2002).

Bedrock in the region dates back 300-400 million years to the Devonian, Mississippian, and Pennsylvanian periods. Lower elevations are comprised of Devonian-age formations while the higher elevations are typically Pennsylvanian formations. The bedrock is generally horizontal but is dipped slightly to the south or south-west.

The makeup of colluvial boulders observed along the shoreline in the project area suggest they originate from the Olean Conglomerate. Olean Conglomerate consists of cemented, rounded gravel to coarse sandstone masses with few gravel particles. The rounded gravel indicates an alluvial or stream environment origin.

1.1.1.3 Site Soils

The soils at the site are likely formed from the residuum of the Mississippian and Pennsylvanian bedrock. Primary constituents of these soils are weathered sandstone or siltstone. According to Web Soil Survey (WSS) for the site (Puglia, 2007), the slopes at the study site are classified as Chenango gravelly loam. The Cattaruagus NY Soil Survey (NY Soil Survey), (reference) describes these soils as "gently to strongly sloping, very deep, well drained to moderately well drained, medium and moderately coarse textured soils that have a low content of lime; on moraines and outwash plains in valleys."

Chenango soils generally have a high content of sand and gravel. As a result of the medium-coarse texture of the subsoil, they are typically well-drained. The subsoil is commonly stratified and ranges from nearly level to sloping where they occur along beach ridges. The water table underlying Chenango soils is usually found at depths greater than 6 feet.

According to the NY Soil Survey, the surface layer ranges between 0 and 9 inches deep and consists of dark grayish brown gravelly silt loam. Gravel makes up 20 percent of the in-situ soil volume. The subsoil beneath the surface layer is predominately friable gravelly silt loam with increasing constituent volumes of gravel with depth. The substratum of grayish brown loose, stratified very gravelly sand is found 35 to 72 inches below the ground surface with 55 percent gravel by volume.

High permeability can be expected in coarse soils with high gravel contents. Permeability is characterized by the Soil Survey (2007) as moderate or moderately rapid in the surface layer and rapid in the substratum.

1.1.2 Hydric Soils

Based on the information obtained from the NRCS Web Soil Survey (Web Soil Survey), the soils in the project vicinity are not hydric soils.

1.2 STRUCTURAL

1.2.1 Buildings or Permanent Structures in Study Area

A number of various "structures" are located along the Study Area alignment. A boat ramp and boat docks are located within the Highbanks study area. The boat ramp is approximately 140 feet long by 20 feet wide and the dock is approximately 140 feet long by 45 feet wide. Cabins belonging to the Seneca Nation's Highbanks Campgrounds are located at the top of the slope above the Highbanks study area but do not interfere with the study or alternatives.

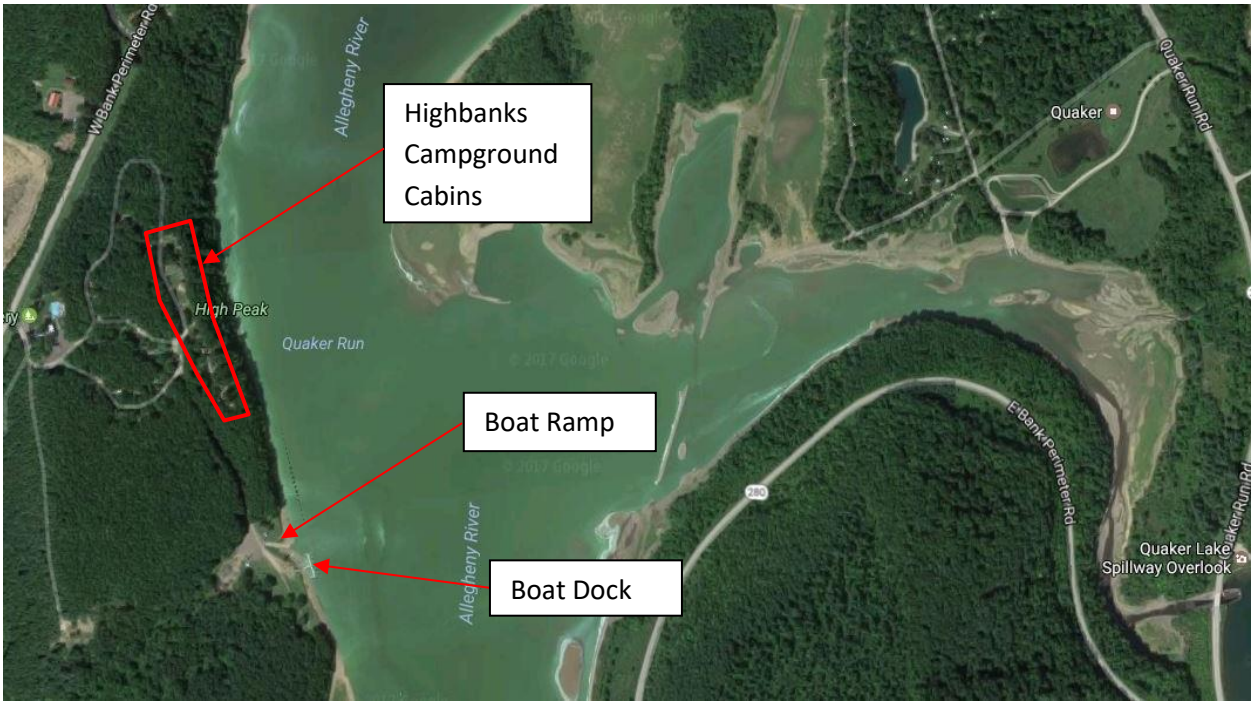

Figure 2: Structure Locations within Study Area

1.2.2 Below Ground Structures

Subsurface utilities are not known to exist in the Study Area. No permanent structures other than the storm sewer outfalls and those identified above appear to exist within the Study Area.

1.3 WATER RESOURCES

1.3.1 Surface Water

The Study Area is located in the Allegheny Reservoir, adjacent to the Highbanks campground and Quaker Bay. It is located within the reservoir created by the Kinzua Dam, which is situated approximately 19 miles downstream of the study area. Kinzua Dam is operated to maintain a reservoir summer pool elevation of 1327.5 feet NAVD88 and a winter pool elevation of 1304.8

feet NAVD88. Water surface elevations near the study area are within ±1 foot of these elevations 90% of the year. Significant flood events can affect the study area as a result of elevated flows on the Allegheny River.

The Allegheny Reservoir is US Geological Survey (USGS) Hydrologic Unit Code 05010001 (HUC-8). The Study Area is within three different HUC-12s: 050100010805, 050100011202 and 050100011201.

The drainage area of the Allegheny River upstream of the Kinzua Dam is approximately 2180 square miles, including parts of Pennsylvania and New York.

The river channel in the reservoir area is from 200 to 400 feet wide, and valleys ranging in width from a few hundred feet to as much as 2000 feet adjoin the channel on one or both sides.

1.3.2 Flood Plains

Most of the Study Area is within the 100-year floodplain.

Figure 3: Flood Plain Map of Study Area (Source: FEMA)

1.3.3 Wetlands

No wetlands have been field identified within the project area; however prior to construction a wetland delineation will be conducted.

2 ENGINEERING CONSIDERATIONS RELATED TO MANAGEMENT MEASURES

2.1 GENERAL DISCUSSION

2.1.1 Determination of Project Area Limits

The future project area within the Study Area is limited by several factors, including topography, hydraulic and hydrologic limitations, and geostructural capacity of soil and rock. The future project limits are primarily restricted in plan-view, however cross sections were also developed as part of the Feasibility Study and provide an alternative view of the plans.

2.2 GEOTECHNICAL CONSIDERATIONS

2.2.1 Slope and Soil Strength

Slope stability along shoreline banks often involve both geotechnical and hydraulic factors. In the case of the Allegheny reservoir, annual, cyclical gate operations of the Kinzua dam cause seasonal changes in the elevations of the reservoir. This may introduce draw-down resulting in elevated pore pressures which reduce the effective stress of the soil. Hydraulic scour at the toe may result from wind/wave action, particularly during periods of high pool. Scour of the toe can ultimately lead to a geotechnical failure of the slope.

The slope of material associated with any restoration measure and the design configuration depends, in large part, on the strength characteristics of the geomaterials. The strength properties of in-situ soils and engineered geomaterials should be considered to provide a framework from which cross-section geometries can be developed. Soils with higher shear strengths generally allow for construction of steeper slopes which are sufficiently stable. Cohesive soils are generally assessed according to the undrained shear strength to assess the slope stability. The shear strength of granular, cohesionless soils are usually represented by the internal friction angle and sometimes allow steeper, stable unreinforced slopes. Riprap or other engineered materials can provide stability at even steeper slopes while earth retaining structures (e.g. walls) can provide support for vertical geometries. It is important to understand that other factors, particularly pore water pressures, can significantly affect the effective strength of soil and should be considered in the final design.

2.2.2 Soil Classification

As noted in Section 1.1.1.3 Soils, the Web Soil Survey delineates the site area as Chenango silt loam. It is expected that the site soils contain a 20% constituency by volume of gravel and is otherwise comprised of silts and sands. As a result of the medium-coarse texture of the subsoil, they are typically well-drained. Based on the information referenced in this report, the soils are likely classified under the Unified Soil Classification System (USCS) as silt (ML) or lean clay (CL) with gravel, however, only field and/or laboratory soil index testing should be used for final classification.

Characterization of the site soils should be part of an appropriately-detailed subsurface exploration program consisting of test pits and/or soil/rock borings and is outside the scope of this report. The soil strength, as represented by the internal friction angle or undrained shear strength, should be used in the assessment of the final slope configuration. While a limit-equilibrium slope stability analyses is often relied upon for preliminary and final designs, analytical tools should be appropriate for the anticipated forms of instability. Consideration for and applicable factor of safety should also be included in the design process.

2.2.3 Revetment

Slope revetment can provide resistance to the erosive forces of moving water, allowing a shoreline slope to remain stable. Geomaterials can differ significantly in their resistance to erosion. Considering allowable velocity, coarse sands may provide resistance to mean channel velocities up to 4.0 feet per second (fps), while a soft sandstone may be expected to resist velocities of 8.0 fps. From the United States Army Corps of Engineers (USACE) Engineering Manual (EM) 1110-2-1601 Channel Stability Assessment for Flood Control Projects (USACE, 1994), the following figure lists common channel materials and the mean allowable channel velocity.

Example of Simple Allowable Velocity Data (From EM 1110-2-1601)

Channel Material	Mean Channel Velocity, fps
Fine Sand	2.0
Coarse Sand	4.0
Fine Gravel	6.0
Earth	
Sandy Silt	2.0
Silt Clay	3.5
Clay	6.0
Grass-lined Earth (slopes less than 5%)	
Bermuda Grass	
Sandy Silt	6.0
Silt Clay	8.0
Kentucky Blue Grass	
Sandy Silt	5.0
Silt Clay	7.0
Poor Rock (usually sedimentary)	10.0
Soft Sandstone	8.0
Soft Shale	3.5
Good Rock (usually igneous or hard metamorphic)	20.0

Table 1: Example of Simple Allowable Velocity Data

Boundary shear stress, or tractive force, can also be used in selection of revetment material.

Riprap has the ability to provide slope protection from the erosive forces of flowing water. Factors that affect the level of protection include; stone shape, size, weight and durability. Riprap gradation and layer thickness also influences the resistance to hydraulic forces. Design of toe protection should account for bed material and local scour characteristics. Groundwater conditions and bank material need to be considered for filters between the riprap and underlying material. Practical riprap design guidance can be found in EM 1110-2-1601 Hydraulic Design of Flood Control Channels (USACE, EM 1110-2-1601 Hydraulic Design of Flood Control Channels, 1994).

2.3 WATER RESOURCE CONSIDERATIONS

Basin Characteristics - The area tributary to Allegheny River Reservoir lies in northwestern Pennsylvania and southwestern New York between the approximate limits of 41° 40' to 42° 25' North Latitude, and 77° 50' to 79° 00' West Longitude. The stream pattern of the river system is dendritic with well-defined valleys. The watershed area of 2,180 square miles is roughly rectangular in shape with the long axis (about 60 miles) running in a southeast-northwest direction. The average width is about 36 miles. Due to the elongated shape of the drainage basin, the area above Eldred, PA, does not contribute materially to the peak natural flow at the damsite. With uniform rainfall over the reservoir watershed, the routing time for Eldred peak flows to reach the reservoir is about three days. The natural crest of runoff occurs about one day after the end of rainfall excess, with the area between Eldred and Salamanca, and the local area between Salamanca and the dam, contributing in proportion to their respective drainage areas. The peak inflow with the dam in place occurs two hours after the end of rainfall excess. The relatively large perimeter area of 452 square miles peaks one hour after the end of rainfall excess and accounts for 80 percent of the peak inflow. The stream density of the Allegheny River above the damsite is about 0.19 mile of stream length (principal and tributary streams included) per square mile of drainage area.

2.3.1 Discharge Frequency Analysis

The effective Federal Emergency Management Agency (FEMA) *Flood Insurance Study for the City of Salamanca, New York* (FEMA, 1977) provides a source of discharge frequency values for the Allegheny River upstream of the Kinzua Reservoir. These values were generated by the New York State Department of Environmental Conservation in 1976.

A preliminary discharge frequency analysis based on Bulletin 17B, *USGS Guidelines for Determining Flood Flow Frequency* (USGS, 1981) procedures using the HEC-SSP software program (USACE HEC, October 2010) was developed for this effort. Data was taken from the Allegheny River at Salamanca, NY gage (USGS, 2017), which provides peak discharge values for water years 1904-2016. Both the FEMA FIS and HEC-SSP values are summarized in the table below; the SSP values are shown on the plot below.

Table 2: Discharge Frequency Data for the Allegheny River at Salamanca, NY

Frequency (years)	Frequency (ACE)[1]	Frequency (%)	Discharge (cfs)	
			FEMA FIS (1977)	HEC-SSP (1904-2016)
1	1.0	99	n/a	11500
2	0.5	50	n/a	22600
5	0.2	20	n/a	30500
10	0.1	10	37000	36100
50	0.02	2	55000	49400
100	0.01	1	64000	55600
500	0.002	0.2	91000	71200

[1] ACE = Annual Chance Exceedance

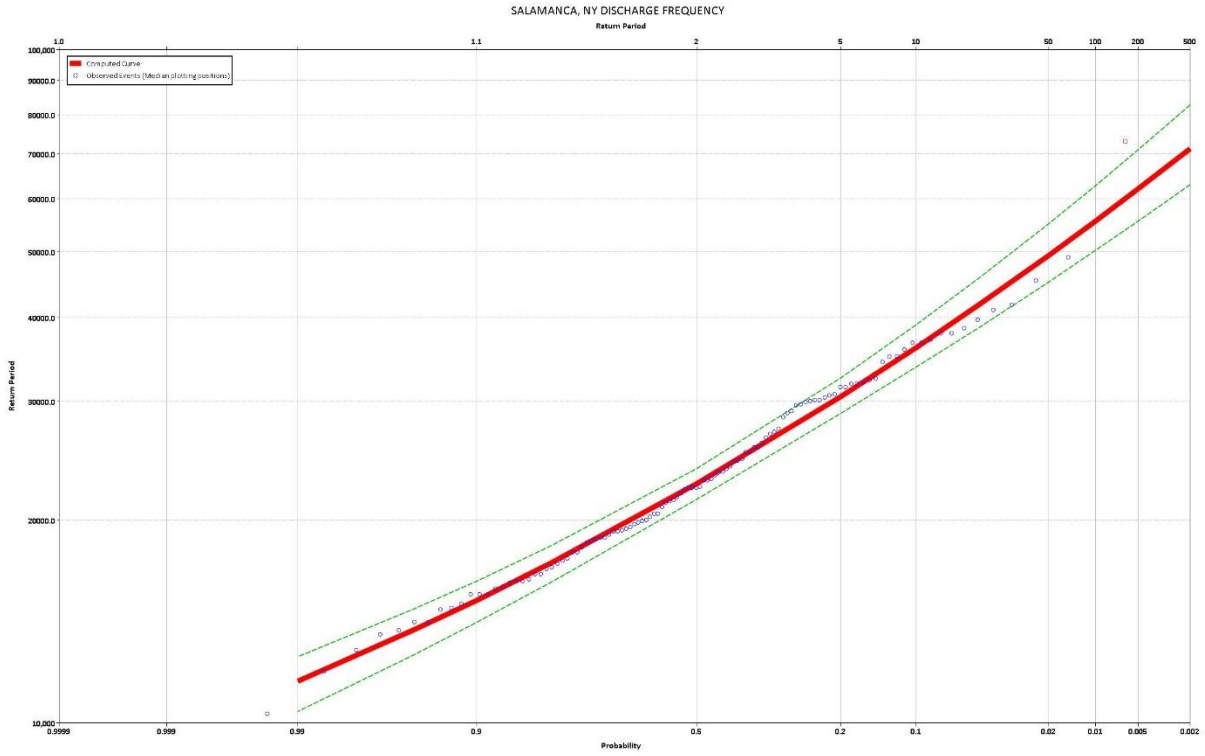

Figure 4: Discharge Frequency Plot for the Allegheny River at Salamanca

Kinzua Dam is operated to follow an elevation guide curve throughout the year. The guide curve tarts at a winter pool elevation of 1304.8 from mid-November through early March, rises to the summer pool of 1327.5 between mid-April and the beginning of September, then returns to winter pool elevation by mid-November. This guide curve provides for flood control storage during the spring, fills to summer pool to provide water for downstream water quality control

during the summer, then draws down to winter pool during the fall. The guide curve and actual pool elevation curves for 2017 are shown below.

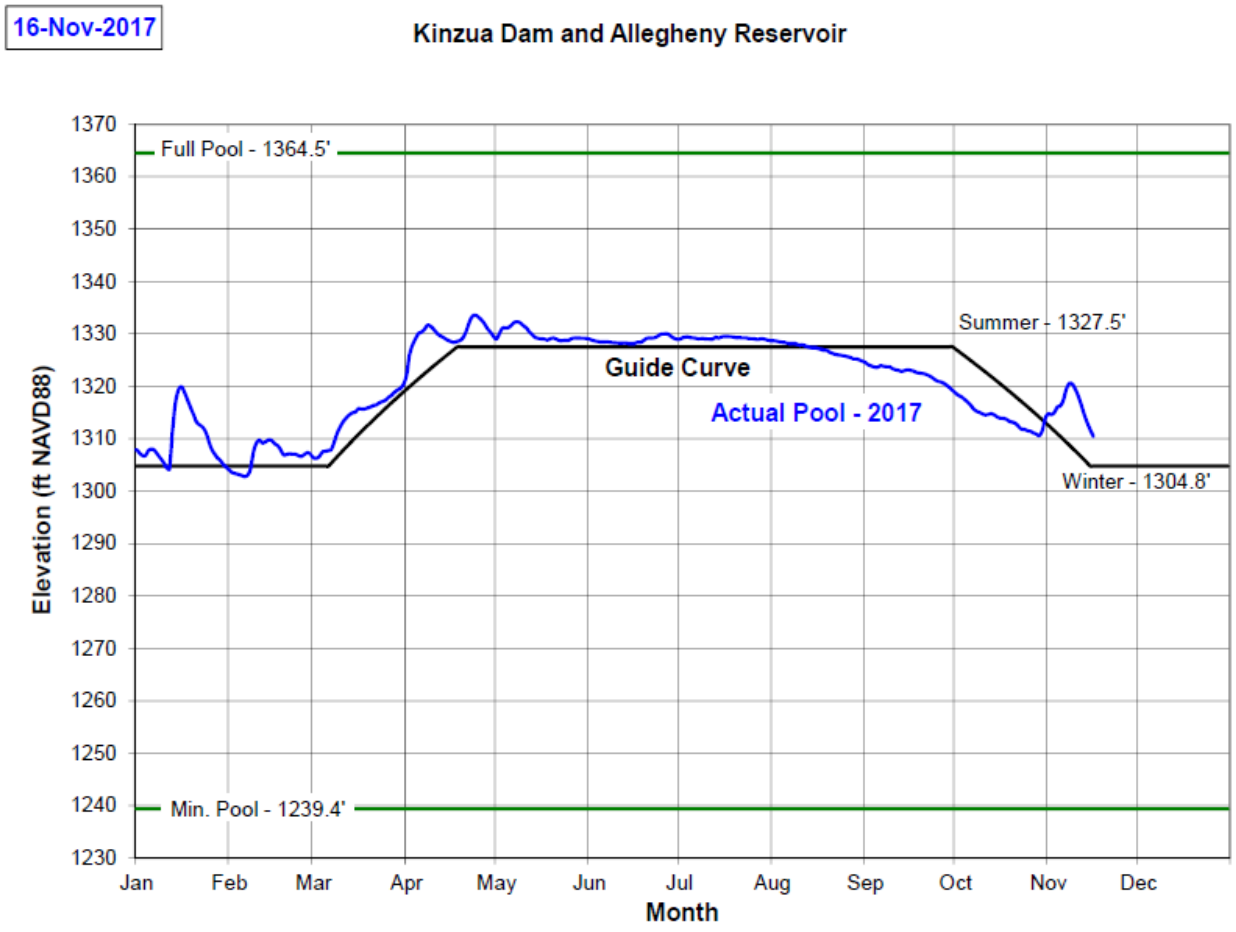

Figure 5: Guide Curve and Pool Elevation Curve at Kinzua Dam and Allegheny Reservoir

2.3.2 Elevation Frequency Analysis

Elevation frequency values are available for the Study Area, based on USACE daily pool elevations for the Kinzua Dam. A preliminary elevation frequency analysis using the HEC-SSP software program (USACE HEC, October 2010) was developed for this effort. Data was taken from the USACE records of daily pool elevations at the Kinzua Dam. Only values from water years 1967-2013 were used in the analysis, since the Kinzua Dam was put into operation in January 1966. The HEC-SSP values are summarized in the table and figure below.

Table 3: Elevation Frequency Data for Kinzua Reservoir

Frequency (years)	Frequency (ACE)[1]	Frequency (%)	Elevation (ft NAVD88) HEC-SSP (1967-2013)
1	1.0	99	1330.0
2	0.5	50	1335.5
5	0.2	20	1342.9
10	0.1	10	1348.5
50	0.02	2	1361.6
100	0.01	1	1367.3

[1] ACE = Annual Chance Exceedance

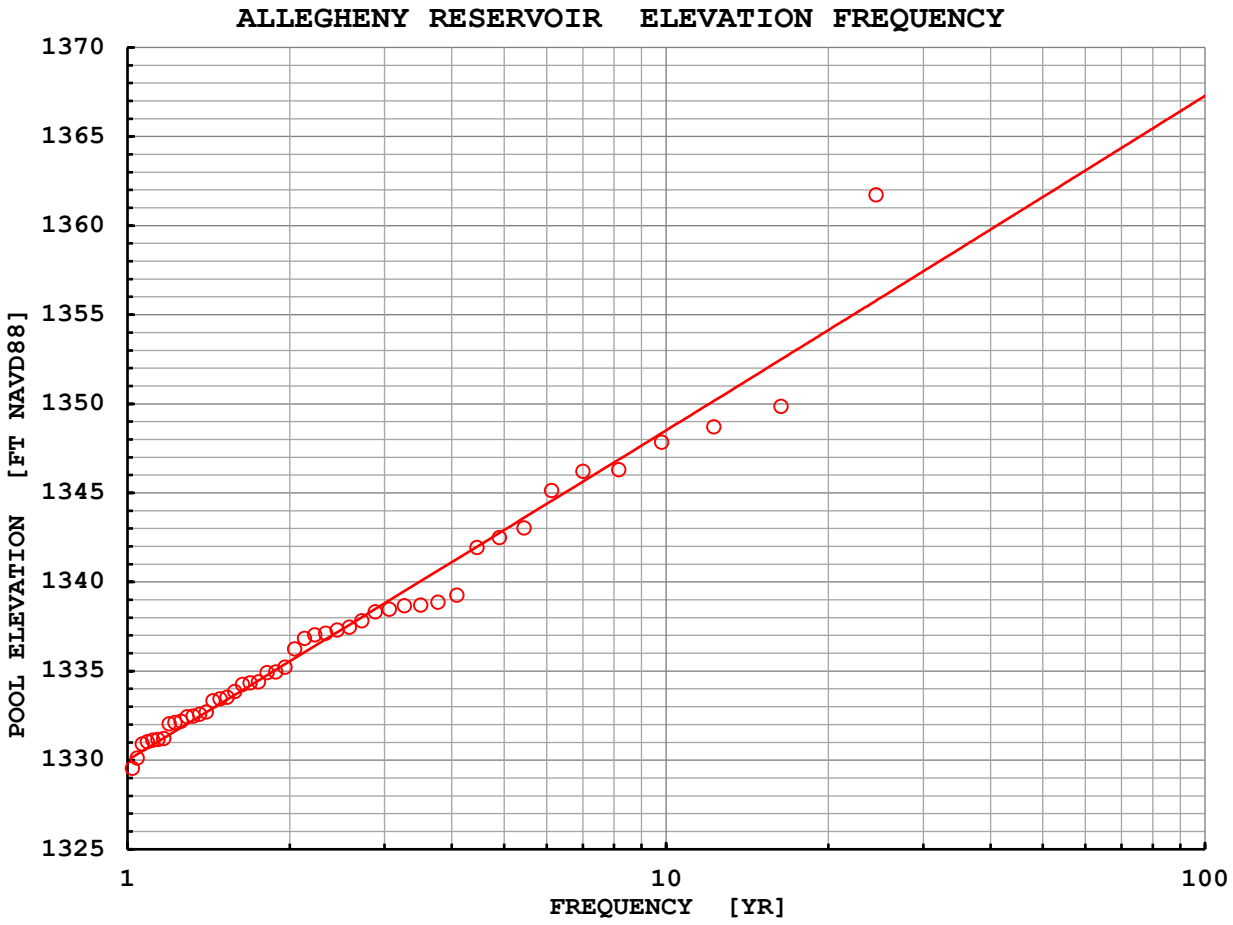

Figure 6: Elevation Frequency Plot for the Allegheny Reservoir

2.3.3 Elevation Duration Analysis

A preliminary elevation duration analysis was completed for this effort using the software program HEC-DSSVue (USACE HEC, January 2015). Daily pool elevation data for the Kinzua

Reservoir from 1 January 1986 through 1 January 2013 was used in the analysis. A plot of results is provided below.

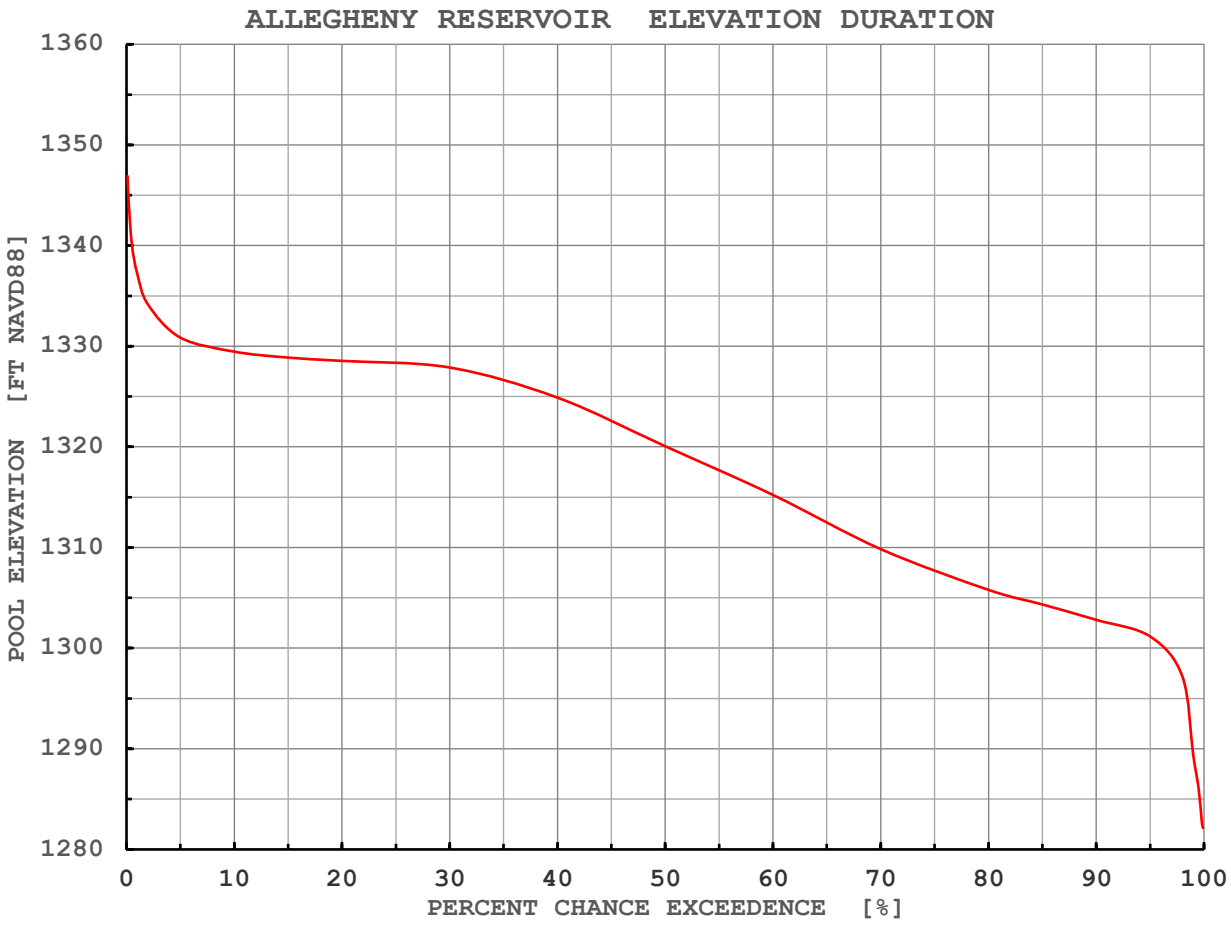

Figure 7: Elevation Duration Plot for the Allegheny Reservoir

2.4 ENGINEERING RECOMMENDATIONS

The general engineering, geotechnical and water resources analysis presented above results in the following engineering recommendations for the alternatives analysis:

- After analyzing the available engineering data and consulting with the members of the PDT and Seneca Nation, two engineering measures were recommended and picked to move forward into the Alternative Formulation process. These two measures are a riprap berm with native plantings and a riprap blanket. Both measures are included in the alternatives as a way to protect the Highbanks area and reduce erosion. Conceptual cross sections of the two measures can be found in Appendix 4.1. Alternate 5 was ultimately selected.
- A geotechnical site investigation is recommended during the Engineering and Design phase.

- A bathymetric survey is recommended during the Engineering and Design phase in order to more accurately determine design cross sections of the selected alternatives and material quantities.
- A two-dimensional unsteady flow HEC-RAS model, using actual location and dimensions of obstructions proposed, should be performed during the design phase of the Project to evaluate the localized effects of the selected project features (measures).
- A wetland delineation is recommended prior to the development of final design. Additionally, existing vegetation limits are recommended to be identified: Seeding areas and excavated sediment placement location(s) will be finalized based on the wetland delineation and existing vegetation locations.

2.5 STRUCTURAL CONSIDERATIONS

2.5.1 General

Currently, only one permanent "structure" exists within the Study Area planned for restoration activities or improvement. This structure is a boat ramp located downstream of Highbanks Campground within the Study Area.

3 REFERENCES

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(Seneca Nation of Indians, 2017) Seneca Nation of Indians. Public GIS Application. https://gisportal.sni.org/portal/apps/webappviewer/index.html?id=b7bc4411c5f54195bc31c5447e9c7dcb

(USACE, 2015) U.S. Army Corps of Engineers. CAP Section 1135 Ecosystem Restoration Seneca Nation of Indians Territory: Federal Interest Determination. USACE, Pittsburgh District, Pittsburgh, PA, USA. June 2015.

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(USACE, 1994) U.S. Army Corps of Engineers. EM 1110-2-1601 Hydraulic Design of Flood Control Channels. 1994.

(USACE, June 1994), US Army Corps of Engineers. Engineer Manual 1110-2-1601. Hydraulic Design of Flood Control Channels. Revised June 30, 1994.

(USGS, 2017) US Geological Survey. USGS Water Data for Allegheny River. USGS 03011020 Allegheny River at Salamanca, NY, https://waterdata.usgs.gov/ny/nwis/uv?site_no=03011020

(USGS, 2017) US Geological Survey. USGS Water Data for Kinzua Dam. USGS 03012550 Allegheny River at Kinzua Dam, PA, https://waterdata.usgs.gov/pa/nwis/uv?site_no=03012550

4 ATTACHMENTS

4.1 Recommended Engineering Measures

H4TSDBAC IP_PWP:dms57611\SK-2.dgn

US ARMY CORPS OF ENGINEERS
PITTSBURGH DISTRICT

SECTION 1135 ECOSYSTEM RESTORATION PROJECT
SENECA NATION OF INDIANS

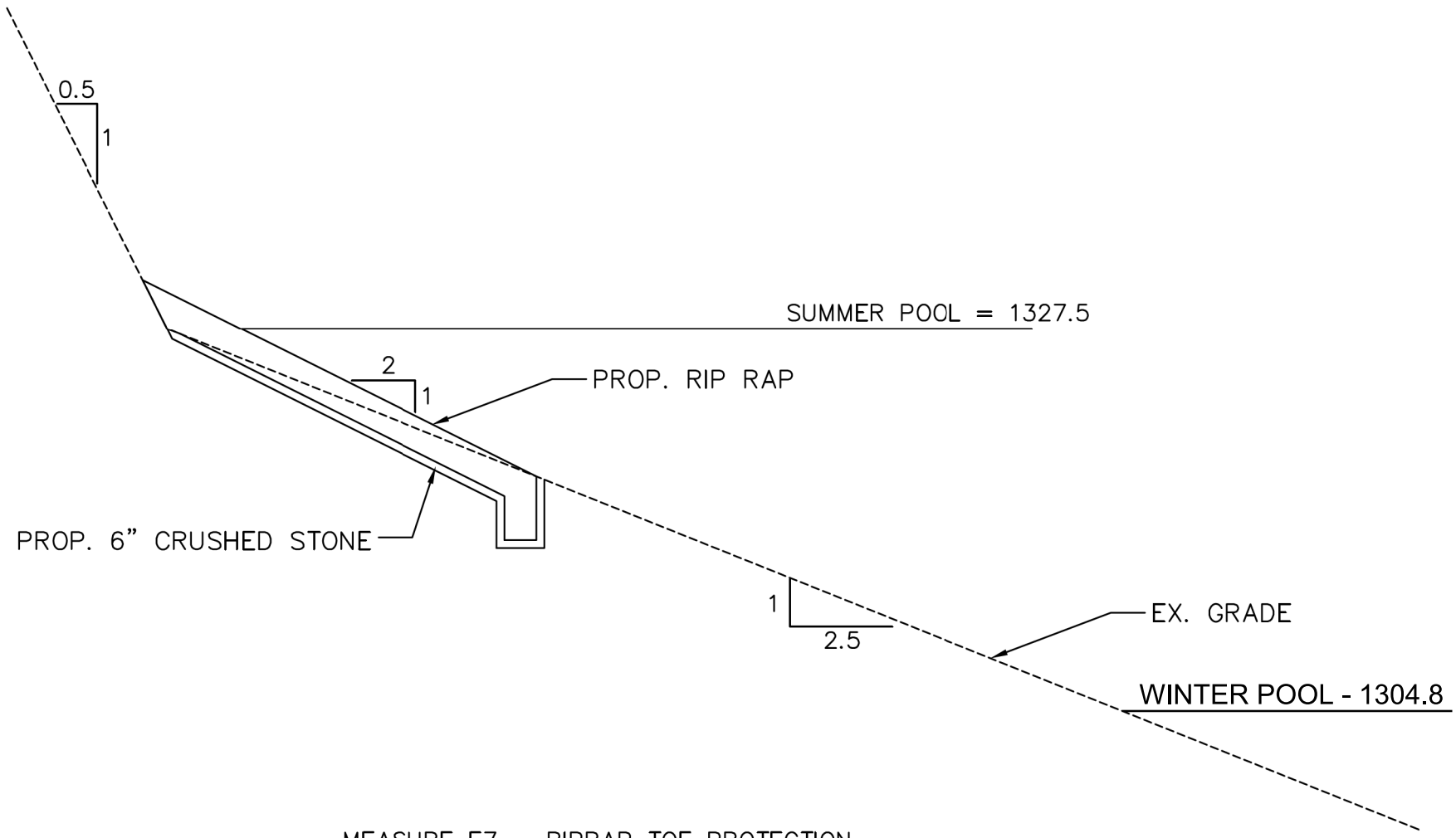
MEASURE E7
RIPRAP TOE PROTECTION

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
PITTSBURGH, PA

DESIGNED BY:
DRAWN BY: B. CRATTY
CHECKED BY:
SUBMITTED BY:
DATE:
SOLICITATION NO.:
CONTRACT NO.:

MARK	DESCRIPTION	DATE	APPR

SHEET IDENTIFICATION NUMBER
SK-2



MEASURE E7 – RIPRAP TOE PROTECTION

R5: 58 SF
Cut: 30 SF
Crushed Stone: 16 SF

1"=10'

H4TSDBAC IP_PWP:dms57611\SK-1.dgn

US ARMY CORPS OF ENGINEERS
PITTSBURGH DISTRICT

SECTION 1135 ECOSYSTEM RESTORATION PROJECT
SENECA NATION OF INDIANS

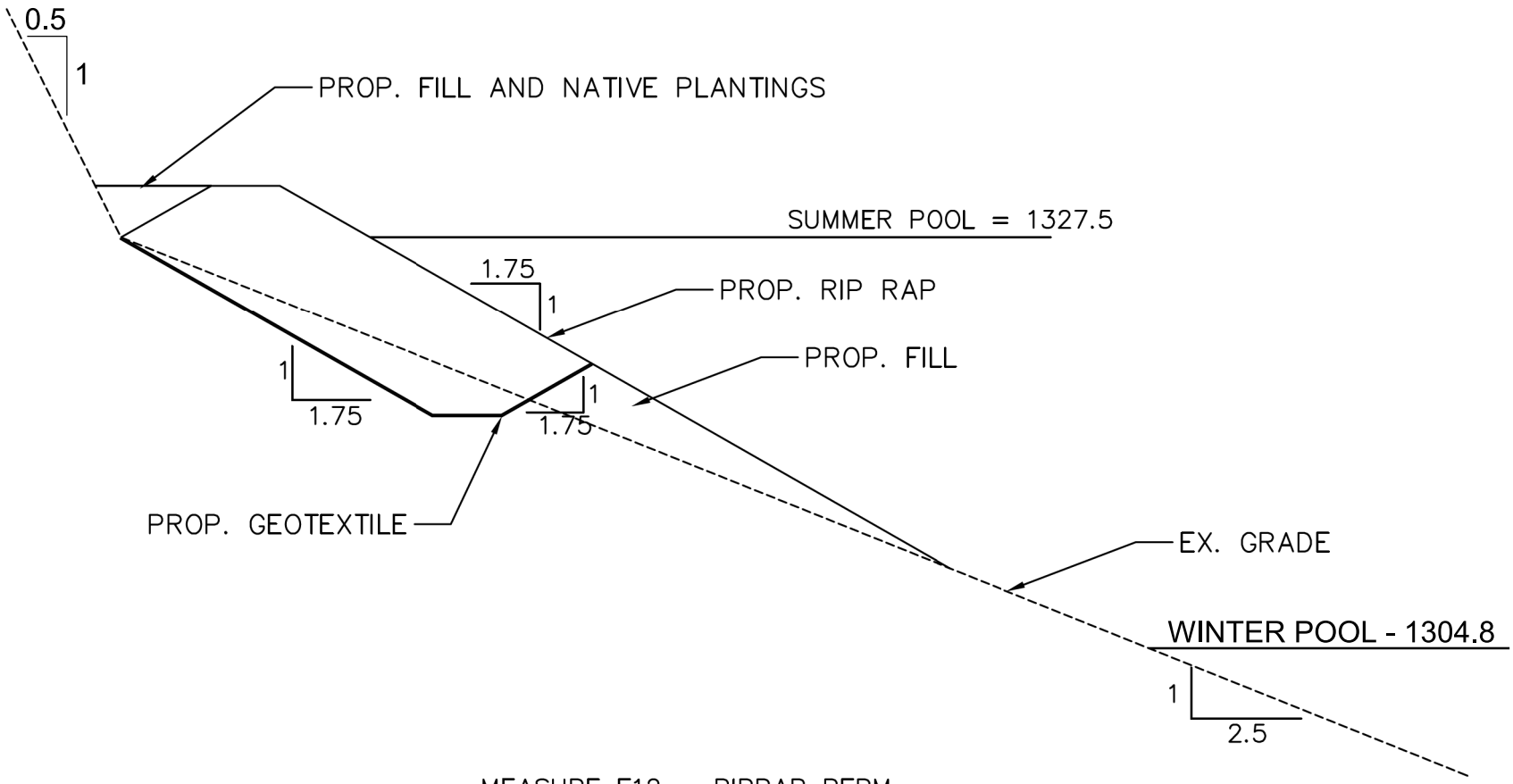
MEASURE E12
RIPRAP BERM

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
PITTSBURGH, PA

DESIGNED BY:
DRAWN BY: B. CRATTY
CHECKED BY:
SUBMITTED BY:
DATE:
SOLICITATION NO.:
CONTRACT NO.:

MARK	DESCRIPTION	DATE	APPR

SHEET IDENTIFICATION NUMBER
SK-1



MEASURE E12 – RIPRAP BERM

R5: 163 SF
Fill: 54 SF
Cut: 38 SF
Geotextile: 31 LF
*Reuse cut for fill so Total Fill=16 SF

1"=10'

4.2 Web Soil Survey

United States Department of Agriculture

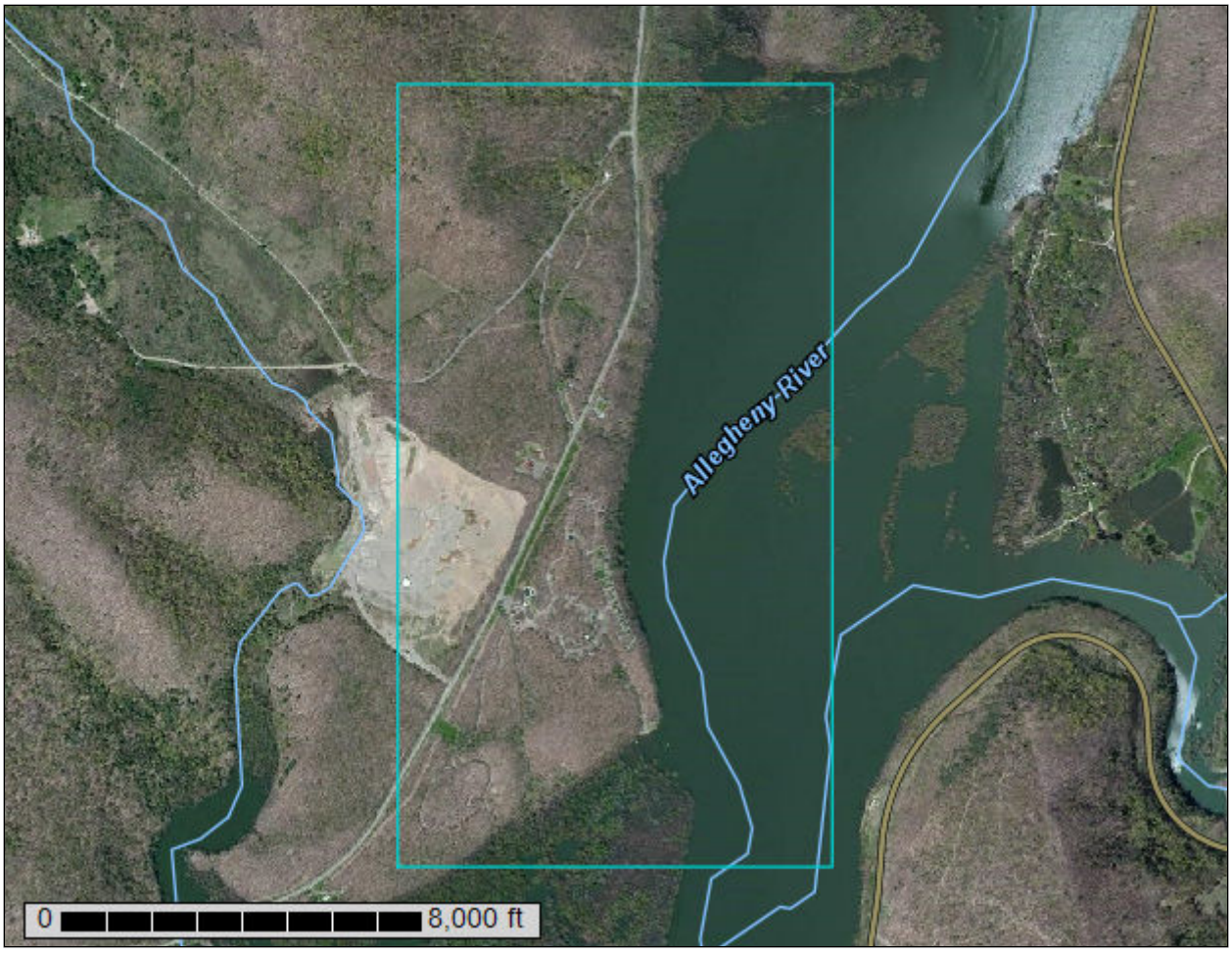
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Cattaraugus County, New York, and Seneca Nation of Indians, New York

Highbanks Campground



April 20, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

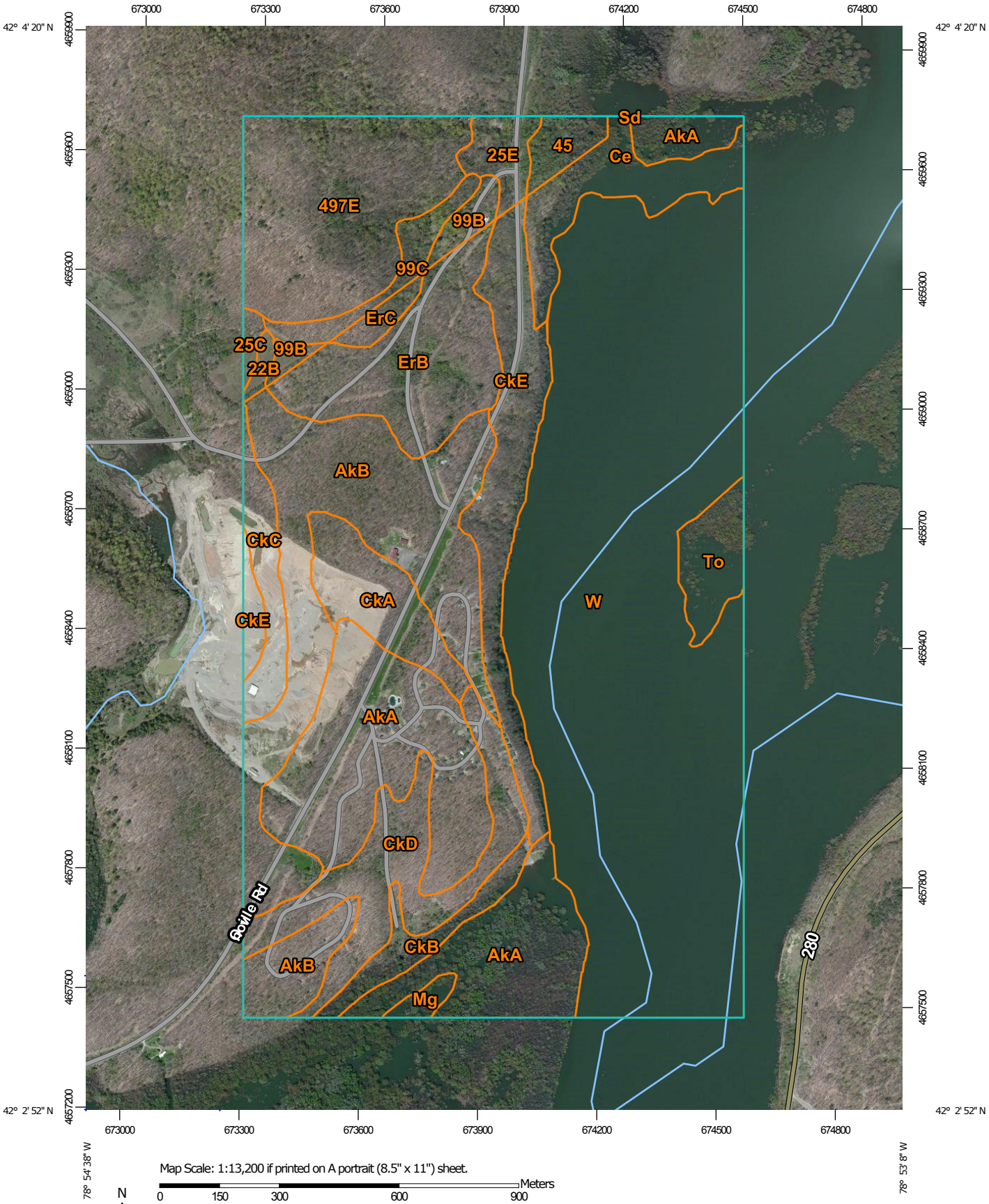
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cattaraugus County, New York
Survey Area Data: Version 17, Sep 23, 2016

Soil Survey Area: Seneca Nation of Indians, New York
Survey Area Data: Version 12, Sep 24, 2016

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 15, 2011—Jul 1, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Cattaraugus County, New York (NY009)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
22B	Allard silt loam, 3 to 8 percent slopes	1.6	0.2%
25C	Chenango gravelly silt loam, 8 to 15 percent slopes	1.7	0.2%
25E	Chenango gravelly silt loam, 25 to 35 percent slopes	7.6	1.1%
45	Canandaigua silt loam, acid substratum	5.8	0.8%
99B	Buchanan silt loam, 3 to 8 percent slopes	5.9	0.8%
99C	Buchanan silt loam, 8 to 15 percent slopes	8.5	1.2%
497E	Rayne channery silt loam, 25 to 35 percent slopes	56.8	8.1%
Subtotals for Soil Survey Area		**88.1**	**12.5%**
Totals for Area of Interest		**705.6**	**100.0%**

Seneca Nation of Indians, New York (NY605)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AkA	Allard silt loam, 0 to 3 percent slopes	91.7	13.0%
AkB	Allard silt loam, 3 to 8 percent slopes	87.1	12.3%
Ce	Canandaigua silt loam, acid substratum	20.9	3.0%
CkA	Chenango gravelly loam, 0 to 3 percent slopes	19.0	2.7%
CkB	Chenango gravelly loam, 3 to 8 percent slopes	9.9	1.4%
CkC	Chenango gravelly loam, 8 to 15 percent slopes	12.0	1.7%
CkD	Chenango gravelly loam, 15 to 25 percent slopes	35.8	5.1%
CkE	Chenango gravelly loam, 25 to 40 percent slopes	38.5	5.5%
ErB	Ernest variant silt loam, 3 to 8 percent slopes	38.6	5.5%
ErC	Ernest variant silt loam, 8 to 15 percent slopes	3.5	0.5%
Mg	Middlebury silt loam	2.4	0.3%
Sd	Scio silt loam	0.0	0.0%
To	Tioga silt loam	11.5	1.6%

Seneca Nation of Indians, New York (NY605)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
W	Water	246.6	34.9%
Subtotals for Soil Survey Area		**617.5**	**87.5%**
Totals for Area of Interest		**705.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Cattaraugus County, New York

22B—Allard silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9q9r
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 105 to 140 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Allard and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Allard

Setting

Landform: Alluvial fans, outwash plains, terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Silty eolian, glaciolacustrine, or old alluvial deposits over sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 34 inches: silt loam
H3 - 34 to 72 inches: stratified very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 4 percent
Hydric soil rating: No

Chenango
Percent of map unit: 4 percent
Hydric soil rating: No

Olean
Percent of map unit: 4 percent
Hydric soil rating: No

Scio
Percent of map unit: 3 percent
Hydric soil rating: No

25C—Chenango gravelly silt loam, 8 to 15 percent slopes

Map Unit Setting
National map unit symbol: 9q9v
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 105 to 140 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Chenango and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango

Setting
Landform: Valley trains, terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile
H1 - 0 to 9 inches: gravelly silt loam
H2 - 9 to 30 inches: very gravelly silt loam
H3 - 30 to 72 inches: stratified very gravelly sand

Properties and qualities
Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Castile

Percent of map unit: 4 percent
Hydric soil rating: No

Valois

Percent of map unit: 4 percent
Hydric soil rating: No

Allard

Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 3 percent
Hydric soil rating: No

25E—Chenango gravelly silt loam, 25 to 35 percent slopes

Map Unit Setting

National map unit symbol: 9q9x
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 105 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Chenango and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango

Setting

Landform: Valley trains, terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Convex

Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile

H1 - 0 to 9 inches: gravelly silt loam
H2 - 9 to 30 inches: very gravelly silt loam
H3 - 30 to 72 inches: stratified very gravelly sand

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Valois

Percent of map unit: 12 percent
Hydric soil rating: No

Udifluvents

Percent of map unit: 4 percent
Hydric soil rating: No

Chadakoin

Percent of map unit: 4 percent
Hydric soil rating: No

45—Canandaigua silt loam, acid substratum

Map Unit Setting

National map unit symbol: 9qc5
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 105 to 140 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Canandaigua, acid substratum, and similar soils: 80 percent

Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canandaigua, Acid Substratum

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Silty and clayey glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 32 inches: silty clay loam
H3 - 32 to 72 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Canadice

Percent of map unit: 6 percent
Landform: Depressions
Hydric soil rating: Yes

Canandaigua, very poorly drained

Percent of map unit: 4 percent
Landform: Depressions
Hydric soil rating: Yes

Getzville

Percent of map unit: 4 percent
Landform: Depressions
Hydric soil rating: Yes

Niagara

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: No

Lamson

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

99B—Buchanan silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2sgr4
Elevation: 920 to 2,320 feet
Mean annual precipitation: 38 to 50 inches
Mean annual air temperature: 45 to 49 degrees F
Frost-free period: 126 to 165 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Buchanan and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buchanan

Setting

Landform: Hillslopes
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave, linear
Parent material: Acid fine-loamy colluvium derived from sandstone and siltstone

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: silt loam
E - 3 to 5 inches: silt loam
BE - 5 to 12 inches: silt loam
Bt - 12 to 28 inches: channery loam
Btx - 28 to 59 inches: very channery loam
C - 59 to 80 inches: very channery loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 21 to 33 inches to fragipan
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 16 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Portville

Percent of map unit: 4 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave, linear
Hydric soil rating: No

Brinkerton, wooded

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Philo

Percent of map unit: 3 percent
Landform: Flood plains, mountain valleys
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: No

99C—Buchanan silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2sgr5
Elevation: 860 to 2,330 feet
Mean annual precipitation: 38 to 50 inches
Mean annual air temperature: 45 to 49 degrees F
Frost-free period: 126 to 165 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Buchanan and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buchanan

Setting

Landform: Hillslopes
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave, linear
Parent material: Loamy colluvium derived from sandstone and shale

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: silt loam
E - 3 to 5 inches: silt loam
BE - 5 to 12 inches: silt loam
Bt - 12 to 28 inches: channery loam
Btx - 28 to 59 inches: very channery loam
C - 59 to 80 inches: very channery loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 21 to 33 inches to fragipan
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 16 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Portville

Percent of map unit: 4 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave, linear
Hydric soil rating: No

Philo

Percent of map unit: 3 percent
Landform: Flood plains, mountain valleys
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Hydric soil rating: No

Brinkerton, wooded

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

497E—Rayne channery silt loam, 25 to 35 percent slopes

Map Unit Setting

National map unit symbol: 9qcl
Elevation: 1,250 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 54 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Rayne and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rayne

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy residuum weathered from interbedded shale, siltstone, and sandstone

Typical profile

H1 - 0 to 4 inches: channery silt loam
H2 - 4 to 38 inches: channery silt loam
H3 - 38 to 72 inches: channery silt loam

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Hartleton

Percent of map unit: 8 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 8 percent
Hydric soil rating: No

Gilpin

Percent of map unit: 4 percent
Hydric soil rating: No

Seneca Nation of Indians, New York

AkA—Allard silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9pyq
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Allard and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Allard

Setting

Landform: Alluvial fans, outwash plains, terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Silty eolian, glaciolacustrine, or old alluvial deposits over sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 27 inches: silt loam
H3 - 27 to 60 inches: stratified very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Olean

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

Scio

Percent of map unit: 5 percent
Hydric soil rating: No

Unadilla

Percent of map unit: 5 percent
Hydric soil rating: No

AkB—Allard silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9pyr
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Allard and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Allard

Setting

Landform: Alluvial fans, outwash plains, terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Silty eolian, glaciolacustrine, or old alluvial deposits over sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 27 inches: silt loam
H3 - 27 to 60 inches: stratified very gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Unadilla

Percent of map unit: 5 percent
Hydric soil rating: No

Olean

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Scio

Percent of map unit: 5 percent
Hydric soil rating: No

Chenango

Percent of map unit: 5 percent
Hydric soil rating: No

Ce—Canandaigua silt loam, acid substratum

Map Unit Setting

National map unit symbol: 9pzc
Elevation: 100 to 1,000 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Canandaigua, acid substratum, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canandaigua, Acid Substratum

Setting

Landform: Lake plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Silty and clayey glaciolacustrine deposits

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 37 inches: silty clay loam
H3 - 37 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Unnamed soils

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Canadice

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Niagara

Percent of map unit: 5 percent
Hydric soil rating: No

Halsey

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

CkA—Chenango gravelly loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9pzj
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chenango and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango

Setting

Landform: Terraces, valley trains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile

H1 - 0 to 8 inches: gravelly loam
H2 - 8 to 30 inches: very gravelly loam
H3 - 30 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Castile
Percent of map unit: 5 percent
Hydric soil rating: No

Olean
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils
Percent of map unit: 5 percent
Hydric soil rating: No

Allard
Percent of map unit: 5 percent
Hydric soil rating: No

CkB—Chenango gravelly loam, 3 to 8 percent slopes

Map Unit Setting
National map unit symbol: 9pzk
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Chenango and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango

Setting
Landform: Terraces, valley trains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile
H1 - 0 to 8 inches: gravelly loam
H2 - 8 to 30 inches: very gravelly loam
H3 - 30 to 60 inches: very gravelly loamy sand

Properties and qualities
Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Allard

Percent of map unit: 5 percent
Hydric soil rating: No

Castile

Percent of map unit: 5 percent
Hydric soil rating: No

Alton

Percent of map unit: 5 percent
Hydric soil rating: No

CkC—Chenango gravelly loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9pzl
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chenango and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango

Setting

Landform: Terraces, valley trains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile

H1 - 0 to 8 inches: gravelly loam
H2 - 8 to 30 inches: very gravelly loam
H3 - 30 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Alton

Percent of map unit: 5 percent
Hydric soil rating: No

Castile

Percent of map unit: 5 percent
Hydric soil rating: No

Allard

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

CkD—Chenango gravelly loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 9pzm
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Chenango and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango

Setting

Landform: Terraces, valley trains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile

H1 - 0 to 8 inches: gravelly loam
H2 - 8 to 30 inches: very gravelly loam
H3 - 30 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed soils
Percent of map unit: 5 percent
Hydric soil rating: No

Allard
Percent of map unit: 5 percent
Hydric soil rating: No

Alton
Percent of map unit: 5 percent
Hydric soil rating: No

Castile
Percent of map unit: 5 percent
Hydric soil rating: No

CkE—Chenango gravelly loam, 25 to 40 percent slopes

Map Unit Setting
National map unit symbol: 9pzn
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition
Chenango and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chenango

Setting
Landform: Terraces, valley trains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly loamy glaciofluvial deposits over sandy and gravelly glaciofluvial deposits, derived mainly from sandstone, shale, and siltstone

Typical profile
H1 - 0 to 8 inches: gravelly loam
H2 - 8 to 30 inches: very gravelly loam
H3 - 30 to 60 inches: very gravelly loamy sand

Properties and qualities
Slope: 25 to 40 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Arkport

Percent of map unit: 5 percent
Hydric soil rating: No

Allard

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Alton

Percent of map unit: 5 percent
Hydric soil rating: No

ErB—Ernest variant silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9q06
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Ernest variant and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ernest Variant

Setting

Landform: Hills

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Acid loamy colluvium derived from shale, siltstone, and sandstone

Typical profile

H1 - 0 to 2 inches: silt loam
H2 - 2 to 20 inches: silt loam
H3 - 20 to 46 inches: channery clay loam
H4 - 46 to 60 inches: channery silty clay loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Brinkerton, variant

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Scio

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Caneadea

Percent of map unit: 5 percent
Hydric soil rating: No

ErC—Ernest variant silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9q07
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Ernest variant and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ernest Variant

Setting

Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Acid loamy colluvium derived from shale, siltstone, and sandstone

Typical profile

H1 - 0 to 2 inches: silt loam
H2 - 2 to 20 inches: silt loam
H3 - 20 to 46 inches: channery clay loam
H4 - 46 to 60 inches: channery silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Unnamed soils
Percent of map unit: 5 percent
Hydric soil rating: No

Brinkerton, variant
Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Rayne
Percent of map unit: 5 percent
Hydric soil rating: No

Wharton
Percent of map unit: 5 percent
Hydric soil rating: No

Scio
Percent of map unit: 5 percent
Hydric soil rating: No

Mg—Middlebury silt loam

Map Unit Setting
National map unit symbol: 9q17
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Middlebury and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Middlebury

Setting
Landform: Flood plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy alluvium predominantly from areas of shale and sandstone with some lime-bearing material

Typical profile
H1 - 0 to 9 inches: silt loam
H2 - 9 to 37 inches: silt loam

H3 - 37 to 60 inches: stratified sand to fine sand to silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Udifluvents

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Tioga

Percent of map unit: 5 percent
Hydric soil rating: No

Scio

Percent of map unit: 5 percent
Hydric soil rating: No

Sd—Scio silt loam

Map Unit Setting

National map unit symbol: 9q25
Elevation: 100 to 1,000 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Scio and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scio

Setting

Landform: Lake plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Glaciolacustrine deposits, eolian deposits, or old alluvium, comprised mainly of silt and very fine sand

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 34 inches: silt loam
H3 - 34 to 42 inches: silt loam
H4 - 42 to 60 inches: stratified very gravelly loamy sand to sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Allard

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Unadilla

Percent of map unit: 5 percent
Hydric soil rating: No

Collamer

Percent of map unit: 5 percent
Hydric soil rating: No

Raynham

Percent of map unit: 5 percent
Hydric soil rating: No

To—Tioga silt loam

Map Unit Setting

National map unit symbol: 9q26
Elevation: 600 to 1,800 feet
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Tioga and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tioga

Setting

Landform: Flood plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy alluvium

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 51 inches: silt loam
H3 - 51 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unadilla
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed soils
Percent of map unit: 5 percent
Hydric soil rating: No

Middlebury
Percent of map unit: 5 percent
Hydric soil rating: No

Chenango
Percent of map unit: 5 percent
Hydric soil rating: No

W—Water

Map Unit Setting
National map unit symbol: 9q2d
Mean annual precipitation: 39 to 48 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 105 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition
Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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Appendix B
ENVIRONMENTAL

1 Model Results

When conducting the habitat modeling for this study, the project development team (PDT) considered the timing of when benefits would be achieved, and how those benefits could potentially change over the period of analysis (50 years), with particular regard to the sensitivity of the models being used to assess these changes. With regard to the Smallmouth Bass Habitat Suitability Index (HSI), the only anticipated changes from the current condition to the future without project condition over the 50 year period of analysis are to water temperatures due to climate change. This has the potential to alter scores for variables 10, 11, 12, and 13. However, in order to change the score for these variables in the HSI, the water temperature would have to change by more than 10 degrees, which is highly unlikely to occur. While conditions may change slightly between the current condition and the future without project forecast, the model used is not sensitive enough to these small changes that it would affect the habitat score.

When estimating the future with project conditions, there are three variables driving the benefits being achieved by the alternatives: dominant substrate type, percent cover, and minimum dissolved oxygen. Excavation and erosion control efforts are expected to change substrate types. Placement and planting of excavated material, as well as placement of riprap, will increase cover habitat. Aeration efforts would improve minimum dissolved oxygen levels. All of these changes will be experienced immediately following construction. Substrate was sized according to engineering analyses to remain in place throughout the 50 year period of analysis and will be monitored with the potential to implement Adaptive Management in the five years following construction to add additional structural elements if subsidence or flows are higher than anticipated and substrate is being lost. Although the excavation measures would slightly change the local summer water depth by 6 to 12 inches, this variable is an average of a large area and this small change is not measurably different at this scale.

For the Floristic Quality Assessment (FQA) used to determine riparian habitat benefits, this method relies on a species assemblage to assess benefits. For the future without project condition, it was assumed that the area of invasive species would increase while the area of native species would continue to decrease. However, it was assumed that the species composition would stay the same. In the FQA model, the result of this is that habitat score remains unchanged between the current condition and the future without project (FWOP) condition. Similarly, for the action alternatives involving changes to the riparian habitats, while the proliferation of various species may change over time, the overall species composition is anticipated to remain fairly consistent over the period of analysis with the sponsor conducting routine maintenance to remove invasive species and re-plant native species as needed.

Because of these considerations with the model, only two time steps were used for the annualization of benefits (Year 0 and Year 50) and both time steps have the same value. The result is that the annualized benefits are equivalent to the benefits in Year 0, immediately following construction.

1.1 Area of Habitat Restored

For riparian habitats restored, the determination of locations to be restored was based on the Seneca Nations knowledge of areas where the infestation of knotweed, *Fallopia Japonica,* was relatively small now, but expected increases would greatly impact native plant stands. Four sites were chosen with a total of about 2.5 acres. For acres of aquatic habitat restored, the aquatic project area was measured using geographic information system (GIS) based on the area where hazardous algal blooms (HABs) occur annually and are the greatest intensity. Seasonal plantings are proposed at six locations, for a

total over 240 acres. Excavation is proposed over 10 acres with onsite disposal approximated at 4 (for Alternative 3) or 5 acres (for Alternatives 2, 4, and 5). The riprap blanket footprint was estimated at 3.3 acres and the rock berm was estimated at 6.4 acres. The aeration footprint is relatively small (Alternatives 2 & 3), but the benefits are anticipated to be felt throughout the full Quaker Bay/Highbanks area (436 acres). These acreages were used for HSI variables that required acreage assessments (percent cover). When comparing to the FWOP, the acreage of existing shoreline and flooded vegetation (at summer pool) was expected to be the same. Alternative 5 has been selected by the Seneca Nation of Indians (SNI) and the Pittsburgh District, U.S. Army Corps of Engineers as the preferred option for this study.

1.2 Aquatic Habitat Benefits - Habitat Suitability Index

The HSI model was used to measure the benefits of aquatic habitat restoration measures (Edwards et. al., 1983). This model was selected because the life requisites of bass and habitat characteristics reflected in the model (such as substrates and habitat structure) are important to other target species including walleye and paddlefish as well as to important forage species. There are 12 variables that are used to calculate the overall HSI score (see Table B-1). The below table includes both the value for each variable and the resulting suitability index calculated based on that value for each variable. Five different HSI scores were calculated. Alternative 1 was calculated primarily based on existing conditions that were assumed to continue as part of the no action alternative / future without project condition. The four action alternatives were calculated based on the formulated or estimated changes expected.

The Corps has collected water quality data throughout the Allegheny Reservoir since the 1970s. For this study, water quality data collected in the upper reservoir since 2012 was used. Occurrence of annual Harmful Algal Blooms (HABs) since 2012 has changed the summer water quality in the project area and therefor data from this time period is most applicable to the current conditions. Additionally, occurrence of HABs has spurred much more robust and frequent sampling events, providing additional data that could be used for the analysis.

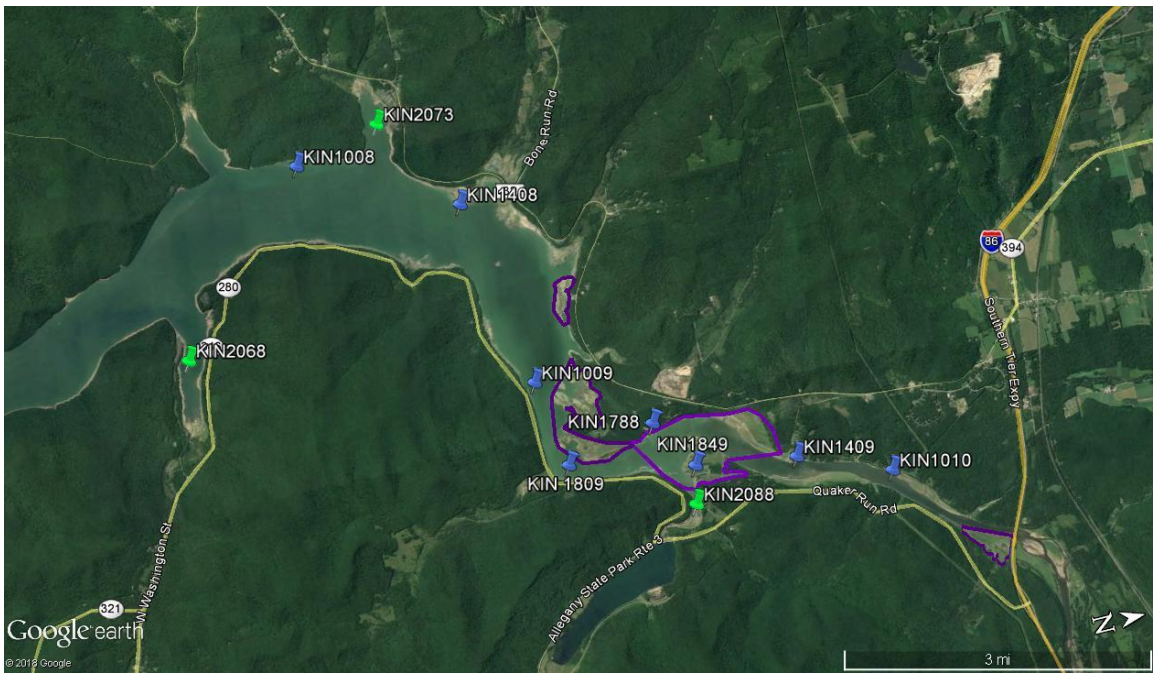


Figure B-1. Water quality sampling site locations. Project focus area is shown in purple. Samples labeled as "lake" have a blue icon, samples labeled as "tributary" have a green icon. See Appendix D, page 18 for project site map orientation.

Following is a discussion of the assumptions and sources that were used to calculate the HSI variables. The proposed action is within the Allegheny Reservoir. Although the reservoir has riverine properties in the project area during portions of the year, the lacustrine model was used. Summer water conditions, when the reservoir water levels are high and the project area is functioning as a lake, are the driver of habitat function in the area.

Variable 1: Dominant substrate type – Existing conditions were based on sediment samples completed by the Corps. Sediment samples showed the project area to be predominantly silt/sand. For the action alternatives, placement of riprap within the project area, as seen with several alternatives, would improve the substrate along the shoreline.

Variable 2: Percent Pools – This is a riverine variable and was therefore not used in the calculations.

Variable 3: Average depth of lake or reservoir during midsummer – The reservoir's summer pool elevation is 1,327.5 ft. Existing bathymetric data was used to estimate average water depths in the two project locations (Quaker Bay/Bear Claw and High Banks) at summer pool.

Variable 4: Average Depth of Pools Mid-Summer – This is a riverine variable and was therefore not used in the calculations.

Variable 5: Percent Cover – Percent cover in the model is defined as those areas that are protected by stumps, trees and boulders. Under the existing condition, it is assumed that vegetated shorelines provide a narrow band of cover, along with any vegetated areas that are inundated by the summer pool. Under the action alternatives, placement of riprap and other materials (as with the 4-cove design) would create cover habitat. Placement of dredge material on site, likely with a riprap containment area, would also increase cover habitat due to the rocky material used to contain the placed material as well as plantings that would occur on the placed dredge material.

Variable 6: Average pH level – Defined as the average during the year, this variable assesses the pH level within the project area. Average pH level for the lake and tributary samples in the project vicinity for the years 2012 to 2016 was 7.69. This was assumed to be unchanged under the No Action and Action Alternatives.

Variable 8: Minimum Dissolved Oxygen – This variable looks at the minimum dissolved oxygen (DO) throughout the calendar year in the project area. HABs cause anoxic conditions in the project area during the summer. Although several of the measures are designed to reduce HABs, such as the excavation of nutrient-laden sediments, the initial pulse of HABs is caused by incoming nutrient-laden waters. Any nutrients in the sediments are not engaged until anoxic conditions occur, at which point these nutrients, if available, would increase the duration and severity of HABs. Because the incoming water quality is unchanged by this project, the initial HAB is still likely to occur and is anticipated to continue to cause hypoxic/anoxic conditions. The only measure that would guarantee that DO is maintained within the optimal zone is the aeration measure.

One note, the data show that the epilimnion (approximately the upper 9 feet of water in the lake samples and the upper 3 feet within the tributary samples) has much better DO levels than the deeper waters. Of the 214 epilimnion samples analyzed, only 3 are below 6.0 mg/L (1.95 mg/L, 5.27 mg/L, and 5.46 mg/L). Of the 263 deeper samples, 80 are below 6.0 mg/L (with 55 of the 80 showing values below 5.0 mg/L). The HSI model focuses on the minimum DO level, regardless of depth, and certainly reflects

that DO in the project area is the limiting factor for habitat in the project area. However this further description of the data provides valuable understanding of how fish likely use the project area.

Variable 9: Average Maximum Turbidity – This variable is defined as the maximum monthly average turbidity "during the summer". Monthly averages were calculated for May through September, with the highest monthly average occurring in September (10.39 NTU). Turbidity in the model is in Jackson Turbidity Units (JTU) but the only available information was in Nephelometric Turbidity Units (NTU); however these units are roughly equivalent. Although the proposed erosion control measures will reduce local turbidity, the average scores show that the overall turbidity of the project area is low and results in an HSI score of 1.0.

Variable 10: Water Temperature during Growing Season – This variable assesses water temperatures affecting Smallmouth Bass adults during the growing season. Adults will use depths up to 40 ft deep (12 m). To calculate the water temperatures, lake and tributary samples taken from May to October from 0 to 40 feet in depth were used. No change between the No Action Alternative and the Action Alternatives is anticipated.

Variable 11: Water Temperature in Spawning Habitat – This variable assesses water temperatures affecting embryos in selected [spawning] habitat for 45 days following spawning. Spawning for Smallmouth Bass is initiated when water temperatures reach 15 degrees Celsius which is around mid-May in the project area. Spawning typically occurs in protected bays or shoals in lakes. To calculate the water temperatures for this variable, May and June tributary samples from 0 to 3 feet in depth were used. No change between the No Action Alternative and the Action Alternatives is anticipated.

Variable 12: Water Temperature during Growing Season – This variable assesses water temperature affecting fry during the growing season. Fry typically remain in shallower (<20 ft [6m]), protected waters with reduced water velocities. To calculate the water temperatures for this variable, May to October tributary samples from 0 to 20 feet in depth were used. No change between the No Action Alternative and the Action Alternatives is anticipated.

Variable 13: Water Temperature during Growing Season – This variable assesses water temperatures affecting juveniles during the growing season. Juveniles typically use shallower waters than adults. To calculate the water temperatures, lake and tributary samples taken from May to October from 0 to 20 feet in depth were used. No change between the No Action Alternative and the Action Alternatives is anticipated.

Variable 14: Water Level Fluctuations – Defined as water level fluctuations during spawning and for 45 days after spawning. Although the water levels in the reservoir vary significantly from winter to summer pool, during May and June the pool is typically fairly stable. Data for 6 years (2012 to 2017) were reviewed and the maximum one day change from May through June was 1.8 ft (0.6 m) with an average change of 0.6 ft (0.2 m). Of the 366 data points, only 13 show a change of greater than 1 ft in a single day. This level of fluctuation, falls within the range of "stable" for this variable.

Variable 15: Stream Gradient – This is a riverine variable and was therefore not used in the calculations.

The HSI model combines the above variables to calculate suitability for five life requisites: food, cover, water quality, reproduction, and other. A final equation combines each of these life requisites for an overall score, however if the water quality or the reproduction score is low (less than 0.6) than that life requisite score is the limiting factor and is used as the overall score as highlighted in yellow in Table B-1.

As shown in Table B-1, the reproduction score is heavily impacted by Variable 8 (minimum DO) and is often below this threshold. Therefore, the reproduction score is often the final HSI score.

Figure B-2: Cover Calculation Maps Note: SNI – Seneca Nation of Indians

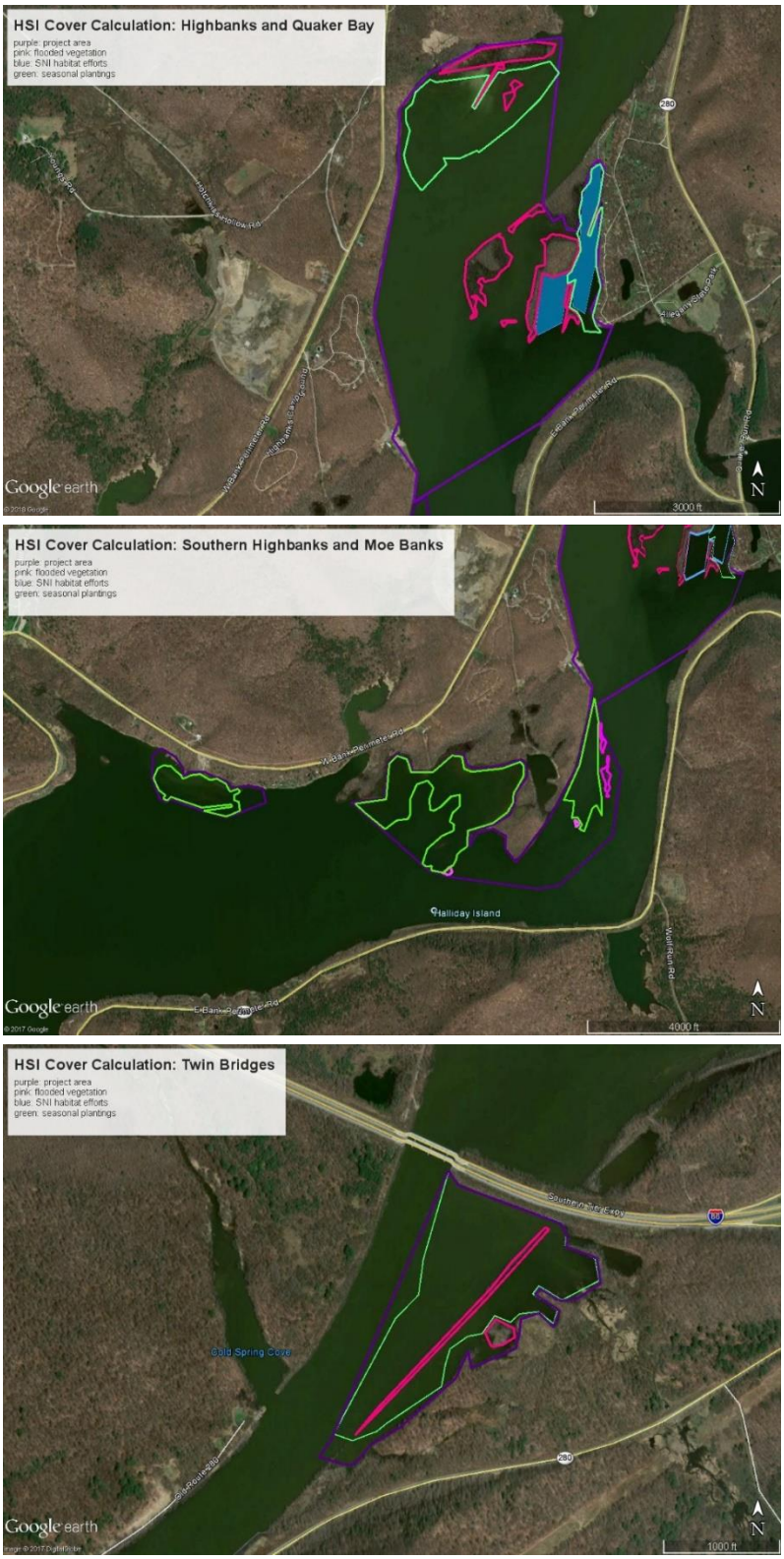


Table B-1: Summary of HSI Model Results

		Alt 1 No action		Alt 2 - H5f, H7b, H14, E12		Alt 3-H5d, H7b, H14, E7/9		Alt 4 - H5f, H14, E12		Alt 5 - H5f, H14, E7/9		twin bridge-existing		H14- twin bridge		Lower HB existing		H14-Lower HB		Moe Banks-existing		H14 - Moe Banks	
Variable		Value	SI	Value	SI	Value	SI	Value	SI	Value	SI	Value	SI	Value	SI	Value	SI	Value	SI	Value	SI	Value	SI
V1	Dominant Substrate in shoal	sand/silt	0.2	riprap/silt/sand	0.6	riprap/silt/sand	0.6	riprap/silt/sand	0.6	riprap/silt/sand	0.6	sand/silt	0.2	sand/silt	0.2	sand/silt	0.2	sand/silt	0.2	sand/silt	0.2	sand/silt	0.2
V2	NA																						
V3	Average depth of lake or reservoir during midsummer	6	0.67	6	0.67	6	0.67	6	0.67	6	0.67	6	0.67	6	0.67	6	0.67	6	0.67	6	0.67	6	0.67
V4	NA																						
V5	Percent cover (boulders, vegetation)	0.09	0.35	0.28	1.00	0.28	1.00	0.05	1.00	0.28	1.00	0.05	0.21	0.82	0.70	0.01	0.06	0.45	1.00	0.00	0.01	0.61	0.90
V6	Average pH during the year	7.70	0.90	7.70	0.90	7.70	0.90	7.70	0.90	7.70	0.90	7.70	0.90	7.70	0.90	7.70	0.90	7.70	0.90	7.70	0.90	7.70	0.90
V7	Average total dissoved solids level (May to Oct)	95.80	1.00	95.80	1.00	95.80	1.00	95.80	1.00	95.80	1.00	95.80	1.00	95.80	1.00	95.80	1.00	95.80	1.00	95.80	1.00	95.80	1.00
V8	minimum dissolved oxygen	0.00	0.01	8.00	1.00	8.00	1.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
V9	max monthly turbidity in summer	10.80	1.00	10.80	1.00	10.80	1.00	10.80	1.00	10.80	1.00	10.80	1.00	10.80	1.00	10.80	1.00	10.80	1.00	10.80	1.00	10.80	1.00
V10	water temp -adult (May to Oct)	20.11	0.90	20.11	0.90	20.11	0.90	20.11	0.90	20.11	0.90	20.11	0.90	20.11	0.90	20.11	0.90	20.11	0.90	20.11	0.90	20.11	0.90
V11	water temp in spawning habitats (May to Jun)	19.93	1.00	19.93	1.00	19.93	1.00	19.93	1.00	19.93	1.00	19.93	1.00	19.93	1.00	19.93	1.00	19.93	1.00	19.93	1.00	19.93	1.00
V12	water temp - fry (May to Oct)	21.14	0.95	21.14	0.95	21.14	0.95	21.14	0.95	21.14	0.95	21.14	0.95	21.14	0.95	21.14	0.95	21.14	0.95	21.14	0.95	21.14	0.95
V13	water temp - juveniles (May to Oct)	20.71	0.95	20.71	0.95	20.71	0.95	20.71	0.95	20.71	0.95	20.71	0.95	20.71	0.95	20.71	0.95	20.71	0.95	20.71	0.95	20.71	0.95
V14	Water level flux during spawning	stable	1.00	stable	1.00	stable	1.00	stable	1.00	stable	1.00	stable	1.00	stable	1.00	stable	1.00	stable	1.00	stable	1.00	stable	1.00
V15	NA																						
	CF - Food		0.36		0.74		0.74		0.74		0.74		0.30		0.45		0.20		0.51		0.12		0.49
	CC - Cover		0.40		0.76		0.76		0.76		0.76		0.36		0.52		0.31		0.62		0.29		0.59
	CWQ - Water Quality		0.80		0.96		0.96		0.80		0.80		0.80		0.80		0.80		0.80		0.80		0.80
	CR - Reproduction		0.30		0.92		0.92		0.43		0.43		0.27		0.33		0.22		0.35		0.17		0.35
	HSI Calculation		*0.43*		*0.84*		*0.84*		*0.66*		*0.66*		*0.39*		*0.50*		*0.32*		*0.55*		*0.26*		*0.53*
	Final HSI Score		0.30		0.84		0.84		0.43		0.43		0.27		0.33		0.22		0.35		0.17		0.35

Note: Proposed Action is Alternative Number 5. A description of the 5 alternatives and their individual components may be found in the Integrated Detailed Project Report on pages 52 – 63.

Table B-2: Aquatic Habitat Benefits Calculations

	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HUs	AAHU	CHU
Alt 2	436	0.84	365.03	0.84	365.03	365.03	18251.55
FWOP	436	0.30	129.67	0.30	129.67	129.67	6483.36
Net Change						235.36	11768.20

	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HUs	AAHU	CHU
Alt 3	436	0.84	365.03	0.84	365.03	365.03	18251.55
FWOP	436	0.30	129.67	0.30	129.67	129.67	6483.36
Net Change						235.36	11768.20

	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HUs	AAHU	CHU
Alt 4	436	0.43	185.86	0.43	185.86	185.86	9292.84
FWOP	436	0.30	129.67	0.30	129.67	129.67	6483.36
Net Change						56.19	2809.48

	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HUs	AAHU	CHU
Alt 5	436	0.43	185.86	0.43	185.86	185.86	9292.84
FWOP	436	0.30	129.67	0.30	129.67	129.67	6483.36
Net Change						56.19	2809.48

	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HUs	AAHU	CHU
Twin Bridge	55	0.33	18.40	0.33	18.40	18.40	919.79
FWOP	55	0.27	15.02	0.27	15.02	15.02	750.92
Net Change						3.38	168.87

		Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HUs	AAHU	CHU
Southern High Ban	223	0.35	79.15	0.35	79.15	79.15	3957.73
FWOP	223	0.22	49.34	0.22	49.34	49.34	2466.97
Net Change						29.82	1490.76

	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HUs	AAHU	CHU
Moe Banks	37.2	0.35	12.97	0.35	12.97	12.97	648.72
FWOP	37.2	0.17	6.39	0.17	6.39	6.39	319.74
Net Change						6.58	328.98

Note: AAHU – Average Annual Habitat Units, CHU – Cumulative Habitat Units

1.3 Riparian Habitat Benefits - Floristic Quality Assessment

Section 3.5.2.2, P1.

Field surveys of existing site conditions were conducted by the Seneca Nation project team. Plant management areas were identified and 6 points were selected for each given area. Each point was used to identify a plot that extended 6 ft in all directions from the center. The points

were picked to capture the diversity of the area as a whole and a summary of all plants identified is summarized in Section 2.4. The plant list was identified and entered in the Floristic Quality Assessment (FQA) calculator on the Penn state website with the results summarized in Section 3.1.3. Two runs were completed for each area that was selected with one representing the current condition and one based on result of proposed plant management alternative. For the "Removal of Invasive Plant Species" measure outlined in Section 3.5.2.2, it was assumed that all invasive species would be removed from the site and this revised plant list was entered into the system. The sponsor would maintain these areas to ensure that invasive species would not become established in these areas within the period of analysis.

New species lists were developed for restoration plantings associated with the floodplain wetlands, floodplain shelf, reshape existing banks and greenwalls measures. To determine the benefits of the various measures, we used the total mean coefficient of conservation (Total Mean C below) as a metric of habitat quality. Since this number ranges from 0 to 10, dividing Total Mean C by 10 provides a habitat quality index that can be applied to a given acreage in order to obtain "habitat units" that measure both the quantity and quality of habitat to be restored. For each measure, a habitat quality index (HQI) was applied to a given acreage based on the specifics of the area to be restored for each alternative. A summary of the HQIs is listed below. For the Invasive Species Removal Measure, the difference in HQI between the restored and the existing condition was used to measure change in quality.

Table B-3: Summary of FQA Model Results

Site	acres	FWOP Total Mean C	HQI	FWP Total Mean C	HQI
Bear Claw Area 1	0.64	2.7	0.27	3.9	0.39
Bear Claw Area 2	0.8	2.5	0.25	2.9	0.29
Lowbanks Area 3	0.67	2.1	0.21	2.7	0.27
Lowbanks Area 4	0.43	2.2	0.22	2.7	0.27

Table B-4: Riparian Habitat Benefits Calculations

Area 1	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HU	AAHU	CHU
FWP	0.64	0.39	0.25	0.39	0.25	0.25	12.48
FWOP	0.64	0.27	0.17	0.27	0.17	0.17	8.64
Net Change						0.08	3.84

Area 2	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HU	AAHU	CHU
FWP	0.8	0.29	0.23	0.29	0.23	0.23	11.60
FWOP	0.8	0.25	0.20	0.25	0.20	0.20	10.00
Net Change						0.03	1.60

Area 3	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HU	AAHU	CHU
FWP	0.67	0.27	0.18	0.27	0.18	0.18	9.05
FWOP	0.67	0.21	0.14	0.21	0.14	0.14	7.04
Net Change						0.04	2.01

Area 4	acres	Year 0 HSI	Year 0 HUs	Year 50 HSI	Year 50 HU	AAHU	CHU
FWP	0.43	0.27	0.12	0.27	0.12	0.12	5.81
FWOP	0.43	0.22	0.09	0.22	0.09	0.09	4.73
Net Change						0.02	1.08

Figure B-3a: Floristic Quality Assessment Reports (Area 1)- Future Without Project

8/28/2017

Floristic Quality Assessment Report

Site name: area 1 bearclaw
Ecoregion: Allegheny Plateau

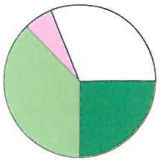
RESULTS

FQI	13.0
Adjusted FQI	22.3

Total Mean C	2.7
Total Count	16

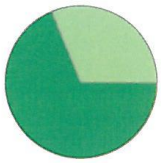
Native Mean C	3.9
Native Count	11

Tolerance



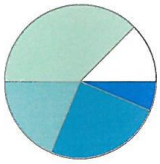
☐ high (4)
☐ intermediate (6)
☐ poor (1)
☐ very poor (0)
☐ not applicable (5)

Natives



☐ native (11)
☐ introduced (5)

Wetland Indicator Status (WIS)



☐ obligate wetland (1)
☐ facultative wetland (4)
☐ facultative (3)
☐ facultative upland (6)
☐ obligate upland (0)
☐ not applicable (2)

PLANT LIST

Scientific Name	Native	C	WIS
Trillium erectum	Y	7	FACU
Arabidopsis thaliana	N		
Ranunculus acris	N		FAC
Geranium maculatum	Y	5	FACU
Sassafras albidum	Y	3	FACU
Vitis riparia	Y	4	FACW
Populus deltoides	Y	4	FAC
Acer saccharinum	Y	5	FACW
Rhus typhina	Y	2	
Impatiens capensis	Y	3	FACW
Plantago major	N		FACU
Taraxacum officinale	N		FACU
Sorghastrum nutans	Y	5	FACU
Cornus amomum	Y	4	FACW
Myosotis scorpioides	N		OBL
Toxicodendron radicans	Y	1	FAC

Tolerance class by C value: High (0-3), Intermediate (4-6), Poor (7-8), Very Poor (9-10).

WIS: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL), not applicable (N/A).

Floristic Quality Assessment (FQA) Calculator courtesy of Riparia at Penn State (www.riparia.psu.edu). Plant data compiled by Sarah Chamberlain (Riparia); application development by Center for Environmental Informatics.

Report created 8/28/17 by r. Ground.

1/2

Figure B-3b: Floristic Quality Assessment Reports (Area 2)- Future Without Project

8/28/2017

Floristic Quality Assessment Report

Site name: area 2 bearclaw
Ecoregion: Allegheny Plateau

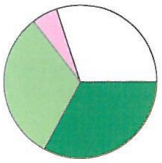
RESULTS

FQI	25.9
Adjusted FQI	21.2

Total Mean C	2.5
Total Count	73

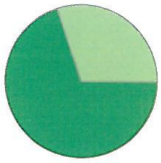
Native Mean C	3.6
Native Count	51

Tolerance



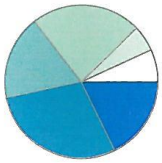
☐ high (24)
☐ intermediate (23)
☐ poor (4)
☐ very poor (0)
☐ not applicable (22)

Natives



☐ native (51)
☐ introduced (22)

Wetland Indicator Status (WIS)



☐ obligate wetland (13)
☐ facultative wetland (21)
☐ facultative (13)
☐ facultative upland (17)
☐ obligate upland (4)
☐ not applicable (5)

PLANT LIST

Scientific Name	Native	C	WIS
Acer rubrum	Y	1	FAC
Acer saccharinum	Y	5	FACW
Toxicodendron radicans	Y	1	FAC
Aralia nudicaulis	Y	7	FACU
Ambrosia artemisiifolia	Y	1	FACU
Artemisia vulgaris	N		UPL
Aster tataricus	N		
Bidens frondosa	Y	2	FACW
Helianthus annuus	N		FAC
Leucanthemum vulgare	N		UPL
Eupatorium purpureum	Y	5	
Eupatorium perfoliatum	Y	3	FACW
Gnaphalium uliginosum	N		FAC
Verbesina alternifolia	Y	2	FAC
Myosotis scorpioides	N		OBL
Lobelia inflata	Y	1	FACU
Lobelia cardinalis	Y	6	FACW
Nicotiana tabacum	N		UPL
Hypericum mutilum	Y	3	FACW
Hypericum perforatum	N		FAC
Hypericum ellipticum	Y	8	OBL
Cornus amomum	Y	4	FACW
Cornus racemosa	Y	5	FAC

1/3

Acalypha rhomboidea	Y	1	FACU
Trifolium repens	N		FACU
Geranium maculatum	Y	5	FACU
Glechoma hederacea	N		FACU
Lycopus americanus	Y	4	OBL
Lycopus virginicus	Y	4	OBL
Mentha arvensis	Y	3	FACW
Mentha spicata	N		FACW
Mentha x piperita	N		FACW
Prunella vulgaris	N		FACU
Scutellaria lateriflora	Y	5	FACW
Teucrium canadense	Y	3	FACW
Fraxinus americana	Y	5	FACU
Oxalis stricta	Y	0	FACU
Plantago major	N		FACU
Fallopia japonica	N		
Polygonum punctatum var. confertiflorum	Y	4	
Rumex verticillatus	Y	6	OBL
Rumex crispus	N		FAC
Onoclea sensibilis	Y	3	FACW
Lysimachia nummularia	N		FACW
Lysimachia ciliata	Y	4	FACW
Ranunculus repens	N		FAC
Geum canadense	Y	3	FACU
Potentilla simplex	Y	3	FACU
Rosa multiflora	N		FACU
Galium aparine	Y	2	FACU
Cephalanthus occidentalis	Y	7	OBL
Penthorum sedoides	Y	4	OBL
Mimulus ringens	Y	5	OBL
Veronica americana	Y	6	OBL
Stellaria media	N		UPL
Ulmus rubra	Y	4	FAC
Boehmeria cylindrica	Y	5	FACW
Phryma leptostachya	Y	5	FACU
Viola sororia	Y	3	FAC
Parthenocissus quinquefolia	Y	3	FACU
Vitis vinifera	N		
Carex grayi	Y	7	FACW
Carex scoparia	Y	4	FACW
Carex squarrosa	Y	4	FACW
Carex lurida	Y	3	OBL
Cyperus strigosus	Y	2	FACW
Carex vulpinoidea	Y	2	OBL
Eleocharis acicularis	Y	5	OBL
Iris pseudacorus	N		OBL
Juncus tenuis	Y	1	FAC
Elymus virginicus	Y	4	FACW
Dichanthelium clandestinum	Y	2	FAC
Phalaris arundinacea	Y	0	FACW

Tolerance class by C value: High (0-3), Intermediate (4-6), Poor (7-8), Very Poor (9-10).

WIS: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL), not applicable (N/A).

Floristic Quality Assessment (FQA) Calculator courtesy of Riparia at Penn State (www.riparia.psu.edu). Plant data compiled by Sarah Chamberlain (Riparia); application development by Center for Environmental Informatics.

Report created 8/28/17 by R. Ground.

Figure B-3c: Floristic Quality Assessment Reports (Area 3)- Future Without Project

8/28/2017

Floristic Quality Assessment Report

Site name: area 3 lowbanks
Ecoregion: Allegheny Plateau

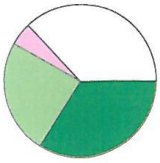
RESULTS

FQI	21.3
Adjusted FQI	17.0

Total Mean C	2.1
Total Count	62

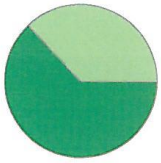
Native Mean C	3.4
Native Count	39

Tolerance



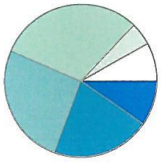
☐ high (21)
☐ intermediate (15)
☐ poor (3)
☐ very poor (0)
☐ not applicable (23)

Natives



☐ native (39)
☐ introduced (23)

Wetland Indicator Status (WIS)



☐ obligate wetland (6)
☐ facultative wetland (13)
☐ facultative (16)
☐ facultative upland (19)
☐ obligate upland (3)
☐ not applicable (5)

PLANT LIST

Scientific Name	Native	C	WIS
Populus tremuloides	Y	4	FAC
Rosa multiflora	N		FACU
Apios americana	Y	6	FACW
Cornus racemosa	Y	5	FAC
Onoclea sensibilis	Y	3	FACW
Toxicodendron radicans	Y	1	FAC
Prunella vulgaris	N		FACU
Ranunculus repens	N		FAC
Dichanthelium clandestinum	Y	2	FAC
Aster tataricus	N		
Geranium maculatum	Y	5	FACU
Lysimachia nummularia	N		FACW
Phalaris arundinacea	Y	0	FACW
Lysimachia ciliata	Y	4	FACW
Cornus amomum	Y	4	FACW
Plantago major	N		FACU
Plantago lanceolata	N		UPL
Ambrosia artemisiifolia	Y	1	FACU
Rhus typhina	Y	2	
Acer saccharinum	Y	5	FACW
Lycopus americanus	Y	4	OBL
Lycopus virginicus	Y	4	OBL
Populus deltoides	Y	4	FAC

1/2

Galium aparine	Y	2	FACU
Vitis vinifera	N		
Apocynum cannabinum	Y	2	FACU
Carya laciniosa	Y	8	FAC
Salix alba	N		FACW
Salix nigra	Y	2	OBL
Fallopia japonica	N		
Lysimachia vulgaris	N		FAC
Geum canadense	Y	3	FACU
Leucanthemum vulgare	N		UPL
Asclepias incarnata	Y	5	OBL
Lactuca canadensis	Y	3	FACU
Chelone glabra	Y	7	OBL
Acer rubrum	Y	1	FAC
Mentha x piperita	N		FACW
Bidens vulgata	Y	2	FAC
Linaria vulgaris	N		
Hypericum ellipticum	Y	8	OBL
Hypericum mutilum	Y	3	FACW
Hypericum perforatum	N		FAC
Trifolium repens	N		FACU
Trifolium pratense	N		FACU
Rubus flagellaris	Y	1	FACU
Agrostis perennans	Y	4	FACU
Taraxacum officinale	N		FACU
Oxalis stricta	Y	0	FACU
Nicotiana tabacum	N		UPL
Lobelia cardinalis	Y	6	FACW
Viola sororia	Y	3	FAC
Sassafras albidum	Y	3	FACU
Euthamia graminifolia	Y	3	FAC
Urtica dioica	N		FACU
Cichorium intybus	N		FACU
Lobelia inflata	Y	1	FACU
Mentha arvensis	Y	3	FACW
Mentha spicata	N		FACW
Dioscorea villosa	Y	5	FAC
Sambucus nigra	N		FAC
Ulmus rubra	Y	4	FAC

Tolerance class by C value: High (0-3), Intermediate (4-6), Poor (7-8), Very Poor (9-10).

WIS: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL), not applicable (N/A).

Floristic Quality Assessment (FQA) Calculator courtesy of Riparia at Penn State (www.riparia.psu.edu). Plant data compiled by Sarah Chamberlain (Riparia); application development by Center for Environmental Informatics.

Report created 8/28/17 by R. Ground.

Figure B-3d: Floristic Quality Assessment Reports (Area 4)- Future Without Project

8/28/2017

Floristic Quality Assessment Report

Site name: area 4 lowbanks
Ecoregion: Allegheny Plateau

RESULTS

FQI	20.8
Adjusted FQI	18.3

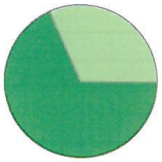
Total Mean C	2.2
Total Count	60

Native Mean C	3.2
Native Count	41

Tolerance

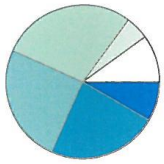
☐ high (20)
☐ intermediate (20)
☐ poor (1)
☐ very poor (0)
☐ not applicable (19)

Natives



☐ native (41)
☐ introduced (19)

Wetland Indicator Status (WIS)



☐ obligate wetland (5)
☐ facultative wetland (14)
☐ facultative (15)
☐ facultative upland (17)
☐ obligate upland (3)
☐ not applicable (6)

PLANT LIST

Scientific Name	Native	C	WIS
Fallopia japonica	N		
Populus tremuloides	Y	4	FAC
Lysimachia ciliata	Y	4	FACW
Lactuca canadensis	Y	3	FACU
Populus deltoides	Y	4	FAC
Lycopus americanus	Y	4	OBL
Lycopus virginicus	Y	4	OBL
Aster tataricus	N		
Oxalis stricta	Y	0	FACU
Agrostis perennans	Y	4	FACU
Viola sororia	Y	3	FAC
Ranunculus repens	N		FAC
Prunella vulgaris	N		FACU
Trifolium pratense	N		FACU
Trifolium repens	N		FACU
Plantago major	N		FACU
Digitaria ischaemum	N		UPL
Rumex crispus	N		FAC
Plantago lanceolata	N		UPL
Taraxacum officinale	N		FACU
Phalaris arundinacea	Y	0	FACW
Juncus tenuis	Y	1	FAC
Acer rubrum	Y	1	FAC

1/2

Cornus amomum	Y	4	FACW
Cornus racemosa	Y	5	FAC
Erigeron annuus	Y	0	FACU
Bellis perennis	N		
Salix interior	Y	6	FACW
Lysimachia nummularia	N		FACW
Asclepias incarnata	Y	5	OBL
Urtica dioica	N		FACU
Scutellaria lateriflora	Y	5	FACW
Leucanthemum vulgare	N		UPL
Acer saccharinum	Y	5	FACW
Galium aparine	Y	2	FACU
Galium tinctorium	Y	4	OBL
Platanus occidentalis	Y	5	FACW
Ambrosia artemisiifolia	Y	1	FACU
Eupatorium perfoliatum	Y	3	FACW
Onoclea sensibilis	Y	3	FACW
Geranium maculatum	Y	5	FACU
Potentilla simplex	Y	3	FACU
Carex squarrosa	Y	4	FACW
Cyperus strigosus	Y	2	FACW
Carex grayi	Y	7	FACW
Euthamia graminifolia	Y	3	FAC
Salix nigra	Y	2	OBL
Vitis vinifera	N		
Eupatorium purpureum	Y	5	
Clematis virginiana	Y	3	FAC
Sambucus nigra	N		FAC
Rubus allegheniensis	Y	1	FACU
Dioscorea villosa	Y	5	FAC
Solanum dulcamara	N		FAC
Rosa multiflora	N		FACU
Rubus flagellaris	Y	1	FACU
Rubus originalis	Y	2	
Ulmus rubra	Y	4	FAC
Verbena urticifolia	Y	2	FAC
Elymus virginicus	Y	4	FACW

Tolerance class by C value: High (0-3), Intermediate (4-6), Poor (7-8), Very Poor (9-10).

WIS: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL), not applicable (N/A).

Floristic Quality Assessment (FQA) Calculator courtesy of Riparia at Penn State (www.riparia.psu.edu). Plant data compiled by Sarah Chamberlain (Riparia); application development by Center for Environmental Informatics.

Report created 8/28/17 by R. Ground.

Figure B-4a: Floristic Quality Assessment Report (Area 1)– Future With Project Conditions

12/5/2017

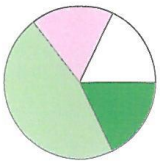
Floristic Quality Assessment Report

Site name: Area 1 bearclaw with native plants list
Ecoregion: Allegheny Plateau

RESULTS

FQI	22.9	Total Mean C	3.9	Native Mean C	4.8
Adjusted FQI	35.6	Total Count	28	Native Count	23

Tolerance

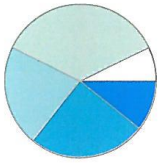


☐ high (5)
☐ intermediate (13)
☐ poor (5)
☐ very poor (0)
☐ not applicable (5)

Natives

☐ native (23)
☐ introduced (5)

Wetland Indicator Status (WIS)



☐ obligate wetland (3)
☐ facultative wetland (7)
☐ facultative (6)
☐ facultative upland (10)
☐ obligate upland (0)
☐ not applicable (2)

PLANT LIST

Scientific Name	Native	C	WIS
Trillium erectum	Y	7	FACU
Arabidopsis thaliana	N		
Ranunculus acris	N		FAC
Geranium maculatum	Y	5	FACU
Sassafras albidum	Y	3	FACU
Vitis riparia	Y	4	FACW
Populus deltoides	Y	4	FAC
Acer saccharinum	Y	5	FACW
Rhus typhina	Y	2	
Impatiens capensis	Y	3	FACW
Plantago major	N		FACU
Taraxacum officinale	N		FACU
Sorghastrum nutans	Y	5	FACU
Cornus amomum	Y	4	FACW
Myosotis scorpioides	N		OBL
Toxicodendron radicans	Y	1	FAC
Quercus bicolor	Y	8	FACW
Liriodendron tulipifera	Y	5	FACU
Pinus strobus	Y	6	FACU
Ulmus rubra	Y	4	FAC
Acer negundo	Y	2	FAC
Alnus incana	Y	7	FACU
Physocarpus opulifolius	Y	7	FACW

1/2

Salix sericea	Y	5	OBL
Salix interior	Y	6	FACW
Cephalanthus occidentalis	Y	7	OBL
Cornus racemosa	Y	5	FAC
Prunus virginiana	Y	5	FACU

Tolerance class by C value: High (0-3), Intermediate (4-6), Poor (7-8), Very Poor (9-10).

WIS: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL), not applicable (N/A).

Floristic Quality Assessment (FQA) Calculator courtesy of Riparia at Penn State (www.riparia.psu.edu). Plant data compiled by Sarah Chamberlain (Riparia); application development by Center for Environmental Informatics.

Report created 12/5/17 by R. Ground.

Figure B-4b: Floristic Quality Assessment Report (Area 2) – Future With Project Conditions

12/5/2017

Floristic Quality Assessment Report

Site name: Area 2 bearclaw with native plants list
Ecoregion: Allegheny Plateau

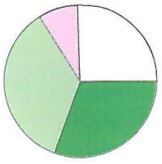
RESULTS

FQI	30.7
Adjusted FQI	25.2

Total Mean C	2.9
Total Count	82

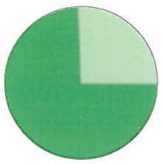
Native Mean C	3.9
Native Count	61

Tolerance



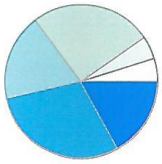
☐ high (25)
☐ intermediate (29)
☐ poor (7)
☐ very poor (0)
☐ not applicable (21)

Natives



☐ native (61)
☐ introduced (21)

Wetland Indicator Status (WIS)



☐ obligate wetland (14)
☐ facultative wetland (24)
☐ facultative (15)
☐ facultative upland (21)
☐ obligate upland (4)
☐ not applicable (4)

PLANT LIST

Scientific Name	Native	C	WIS
Acer rubrum	Y	1	FAC
Acer saccharinum	Y	5	FACW
Toxicodendron radicans	Y	1	FAC
Aralia nudicaulis	Y	7	FACU
Ambrosia artemisiifolia	Y	1	FACU
Artemisia vulgaris	N		UPL
Aster tataricus	N		
Bidens frondosa	Y	2	FACW
Helianthus annuus	N		FAC
Leucanthemum vulgare	N		UPL
Eupatorium purpureum	Y	5	
Eupatorium perfoliatum	Y	3	FACW
Gnaphalium uliginosum	N		FAC
Verbesina alternifolia	Y	2	FAC
Myosotis scorpioides	N		OBL
Lobelia inflata	Y	1	FACU
Lobelia cardinalis	Y	6	FACW
Nicotiana tabacum	N		UPL
Hypericum mutilum	Y	3	FACW
Hypericum perforatum	N		FAC
Hypericum ellipticum	Y	8	OBL
Cornus amomum	Y	4	FACW
Cornus racemosa	Y	5	FAC

1/3

Acalypha rhomboidea	Y	1	FACU
Trifolium repens	N		FACU
Geranium maculatum	Y	5	FACU
Glechoma hederacea	N		FACU
Lycopus americanus	Y	4	OBL
Lycopus virginicus	Y	4	OBL
Mentha arvensis	Y	3	FACW
Mentha spicata	N		FACW
Mentha x piperita	N		FACW
Prunella vulgaris	N		FACU
Scutellaria lateriflora	Y	5	FACW
Teucrium canadense	Y	3	FACW
Fraxinus americana	Y	5	FACU
Oxalis stricta	Y	0	FACU
Plantago major	N		FACU
Polygonum punctatum var. confertiflorum	Y	4	
Rumex verticillatus	Y	6	OBL
Rumex crispus	N		FAC
Onoclea sensibilis	Y	3	FACW
Lysimachia nummularia	N		FACW
Lysimachia ciliata	Y	4	FACW
Ranunculus repens	N		FAC
Geum canadense	Y	3	FACU
Potentilla simplex	Y	3	FACU
Rosa multiflora	N		FACU
Galium aparine	Y	2	FACU
Cephalanthus occidentalis	Y	7	OBL
Penthorum sedoides	Y	4	OBL
Mimulus ringens	Y	5	OBL
Veronica americana	Y	6	OBL
Stellaria media	N		UPL
Ulmus rubra	Y	4	FAC
Boehmeria cylindrica	Y	5	FACW
Phryma leptostachya	Y	5	FACU
Viola sororia	Y	3	FAC
Parthenocissus quinquefolia	Y	3	FACU
Vitis vinifera	N		
Carex grayi	Y	7	FACW
Carex scoparia	Y	4	FACW
Carex squarrosa	Y	4	FACW
Carex lurida	Y	3	OBL
Cyperus strigosus	Y	2	FACW
Carex vulpinoidea	Y	2	OBL
Eleocharis acicularis	Y	5	OBL
Iris pseudacorus	N		OBL
Juncus tenuis	Y	1	FAC
Elymus virginicus	Y	4	FACW
Dichanthelium clandestinum	Y	2	FAC
Phalaris arundinacea	Y	0	FACW
Populus deltoides	Y	4	FAC
Quercus bicolor	Y	8	FACW
Liriodendron tulipifera	Y	5	FACU
Pinus strobus	Y	6	FACU
Acer negundo	Y	2	FAC

Alnus incana	Y	7	FACU
Physocarpus opulifolius	Y	7	FACW
Salix sericea	Y	5	OBL
Salix interior	Y	6	FACW
Prunus virginiana	Y	5	FACU

Tolerance class by C value: High (0-3), Intermediate (4-6), Poor (7-8), Very Poor (9-10).

WIS: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL), not applicable (N/A).

Floristic Quality Assessment (FQA) Calculator courtesy of Riparia at Penn State (www.riparia.psu.edu). Plant data compiled by Sarah Chamberlain (Riparia); application development by Center for Environmental Informatics.

Report created 12/5/17 by R. Ground.

Figure B-4c: Floristic Quality Assessment Report (Area 3) – Future With Project Conditions

12/5/2017

Floristic Quality Assessment Report

Site name: Area 3 Lowbanks with native plant list
Ecoregion: Allegheny Plateau

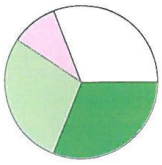
RESULTS

FQI	27.3
Adjusted FQI	22.3

Total Mean C	2.7
Total Count	71

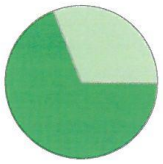
Native Mean C	3.9
Native Count	49

Tolerance



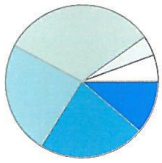
☐ high (22)
☐ intermediate (20)
☐ poor (7)
☐ very poor (0)
☐ not applicable (22)

Natives



☐ native (49)
☐ introduced (22)

Wetland Indicator Status (WIS)



☐ obligate wetland (8)
☐ facultative wetland (16)
☐ facultative (17)
☐ facultative upland (23)
☐ obligate upland (3)
☐ not applicable (4)

PLANT LIST

Scientific Name	Native	C	WIS
Populus tremuloides	Y	4	FAC
Rosa multiflora	N		FACU
Apios americana	Y	6	FACW
Cornus racemosa	Y	5	FAC
Onoclea sensibilis	Y	3	FACW
Toxicodendron radicans	Y	1	FAC
Prunella vulgaris	N		FACU
Ranunculus repens	N		FAC
Dichanthelium clandestinum	Y	2	FAC
Aster tataricus	N		
Geranium maculatum	Y	5	FACU
Lysimachia nummularia	N		FACW
Phalaris arundinacea	Y	0	FACW
Lysimachia ciliata	Y	4	FACW
Cornus amomum	Y	4	FACW
Plantago major	N		FACU
Plantago lanceolata	N		UPL
Ambrosia artemisiifolia	Y	1	FACU
Rhus typhina	Y	2	
Acer saccharinum	Y	5	FACW
Lycopus americanus	Y	4	OBL
Lycopus virginicus	Y	4	OBL
Populus deltoides	Y	4	FAC

1/3

Galium aparine	Y	2	FACU
Vitis vinifera	N		
Apocynum cannabinum	Y	2	FACU
Carya laciniosa	Y	8	FAC
Salix alba	N		FACW
Salix nigra	Y	2	OBL
Lysimachia vulgaris	N		FAC
Geum canadense	Y	3	FACU
Leucanthemum vulgare	N		UPL
Asclepias incarnata	Y	5	OBL
Lactuca canadensis	Y	3	FACU
Chelone glabra	Y	7	OBL
Acer rubrum	Y	1	FAC
Mentha x piperita	N		FACW
Bidens vulgata	Y	2	FAC
Linaria vulgaris	N		
Hypericum ellipticum	Y	8	OBL
Hypericum mutilum	Y	3	FACW
Hypericum perforatum	N		FAC
Trifolium repens	N		FACU
Trifolium pratense	N		FACU
Rubus flagellaris	Y	1	FACU
Agrostis perennans	Y	4	FACU
Taraxacum officinale	N		FACU
Oxalis stricta	Y	0	FACU
Nicotiana tabacum	N		UPL
Lobelia cardinalis	Y	6	FACW
Viola sororia	Y	3	FAC
Sassafras albidum	Y	3	FACU
Euthamia graminifolia	Y	3	FAC
Urtica dioica	N		FACU
Cichorium intybus	N		FACU
Lobelia inflata	Y	1	FACU
Mentha arvensis	Y	3	FACW
Mentha spicata	N		FACW
Dioscorea villosa	Y	5	FAC
Sambucus nigra	N		FAC
Ulmus rubra	Y	4	FAC
Quercus bicolor	Y	8	FACW
Liriodendron tulipifera	Y	5	FACU
Pinus strobus	Y	6	FACU
Acer negundo	Y	2	FAC
Alnus incana	Y	7	FACU
Physocarpus opulifolius	Y	7	FACW
Salix sericea	Y	5	OBL
Salix interior	Y	6	FACW
Cephalanthus occidentalis	Y	7	OBL
Prunus virginiana	Y	5	FACU

Tolerance class by C value: High (0-3), Intermediate (4-6), Poor (7-8), Very Poor (9-10).

WIS: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL), not applicable (N/A).

Floristic Quality Assessment (FQA) Calculator courtesy of Riparia at Penn State (www.riparia.psu.edu). Plant data compiled by Sarah Chamberlain (Riparia); application development by Center for Environmental Informatics.

Report created 12/5/17 by R. Ground.

Figure B-4d: Floristic Quality Assessment Report (Area 4) – Future With Project Conditions

12/6/2017

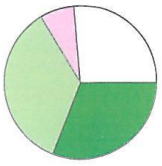
Floristic Quality Assessment Report

Site name: Area 4 Lowbanks with native plants list
Ecoregion: Allegheny Plateau

RESULTS

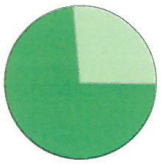
FQI	26.2	Total Mean C	2.7	Native Mean C	3.7
Adjusted FQI	23.3	Total Count	68	Native Count	50

Tolerance



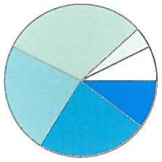
☐ high (21)
☐ intermediate (24)
☐ poor (5)
☐ very poor (0)
☐ not applicable (18)

Natives



☐ native (50)
☐ introduced (18)

Wetland Indicator Status (WIS)



☐ obligate wetland (7)
☐ facultative wetland (16)
☐ facultative (16)
☐ facultative upland (21)
☐ obligate upland (3)
☐ not applicable (5)

PLANT LIST

Scientific Name	Native	C	WIS
Populus tremuloides	Y	4	FAC
Lysimachia ciliata	Y	4	FACW
Lactuca canadensis	Y	3	FACU
Populus deltoides	Y	4	FAC
Lycopus americanus	Y	4	OBL
Lycopus virginicus	Y	4	OBL
Aster tataricus	N		
Oxalis stricta	Y	0	FACU
Agrostis perennans	Y	4	FACU
Viola sororia	Y	3	FAC
Ranunculus repens	N		FAC
Prunella vulgaris	N		FACU
Trifolium pratense	N		FACU
Trifolium repens	N		FACU
Plantago major	N		FACU
Digitaria ischaemum	N		UPL
Rumex crispus	N		FAC
Plantago lanceolata	N		UPL
Taraxacum officinale	N		FACU
Phalaris arundinacea	Y	0	FACW
Juncus tenuis	Y	1	FAC
Acer rubrum	Y	1	FAC
Cornus amomum	Y	4	FACW

1/2

Cornus racemosa	Y	5	FAC
Erigeron annuus	Y	0	FACU
Bellis perennis	N		
Salix interior	Y	6	FACW
Lysimachia nummularia	N		FACW
Asclepias incarnata	Y	5	OBL
Urtica dioica	N		FACU
Scutellaria lateriflora	Y	5	FACW
Leucanthemum vulgare	N		UPL
Acer saccharinum	Y	5	FACW
Galium aparine	Y	2	FACU
Galium tinctorium	Y	4	OBL
Platanus occidentalis	Y	5	FACW
Ambrosia artemisiifolia	Y	1	FACU
Eupatorium perfoliatum	Y	3	FACW
Onoclea sensibilis	Y	3	FACW
Geranium maculatum	Y	5	FACU
Potentilla simplex	Y	3	FACU
Carex squarrosa	Y	4	FACW
Cyperus strigosus	Y	2	FACW
Carex grayi	Y	7	FACW
Euthamia graminifolia	Y	3	FAC
Salix nigra	Y	2	OBL
Vitis vinifera	N		
Eupatorium purpureum	Y	5	
Clematis virginiana	Y	3	FAC
Sambucus nigra	N		FAC
Rubus allegheniensis	Y	1	FACU
Dioscorea villosa	Y	5	FAC
Solanum dulcamara	N		FAC
Rosa multiflora	N		FACU
Rubus flagellaris	Y	1	FACU
Rubus originalis	Y	2	
Ulmus rubra	Y	4	FAC
Verbena urticifolia	Y	2	FAC
Elymus virginicus	Y	4	FACW
Quercus bicolor	Y	8	FACW
Liriodendron tulipifera	Y	5	FACU
Pinus strobus	Y	6	FACU
Acer negundo	Y	2	FAC
Alnus incana	Y	7	FACU
Physocarpus opulifolius	Y	7	FACW
Salix sericea	Y	5	OBL
Cephalanthus occidentalis	Y	7	OBL
Prunus virginiana	Y	5	FACU

Tolerance class by C value: High (0-3), Intermediate (4-6), Poor (7-8), Very Poor (9-10).

WIS: obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), upland (UPL), not applicable (N/A).

Floristic Quality Assessment (FQA) Calculator courtesy of Riparia at Penn State (www.riparia.psu.edu). Plant data compiled by Sarah Chamberlain (Riparia); application development by Center for Environmental Informatics.

Report created 12/6/17 by R. Ground.

Appendix C

COST ESTIMATE

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW CERTIFICATION STATEMENT

For Project No. 447448

LRP – Seneca Nation of Indians
Ecosystem Restoration Project Section 1135

The Seneca Nation of Indians Ecosystem Restoration Project – Section 1135 as presented by Pittsburgh District, has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of April 5, 2019, the Cost MCX certifies the estimated total project cost:

FY19 Project First Cost:	$6,268,000
Fully Funded Total Project Cost:	$6,452,000
Federal Cost of Project:	$5,106,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management through the period of Federal participation.

JACOBS.MICHAEL.PIERRE.1160569537

Digitally signed by JACOBS.MICHAEL.PIERRE.1160569537
Date: 2019.04.08 12:43:58 -07'00'

Michael P. Jacobs, PE, CCE
Chief, Cost Engineering MCX
Walla Walla District

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: **Seneca Nation of Indians Territory Ecosystem Restoration Project**
PROJECT NO: **P2 447448**
LOCATION: **Cattaraugus County, NY**

DISTRICT: **LRP Pittsburgh District**
PREPARED: **1/25/2018**
REVISED: **4/4/2019**
POC: **CHIEF, COST ENGINEERING, John Nites**

This Estimate reflects the scope and schedule in report; SNI 1135 DPR Feb 2018

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC):				2019					
						Effective Price Level Date:				1-Oct- 18					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 1-Oct-18 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
06	FISH & WILDLIFE FACILITIES	$3,793	$1,024	27%	$4,817	2.1%	$3,871	$1,045	$4,916		$4,916	2.5%	$3,968	$1,071	$5,040
			-			-						-			
			-			-						-			
			-			-						-			
	CONSTRUCTION ESTIMATE TOTALS:	$3,793	$1,024		$4,817	2.1%	$3,871	$1,045	$4,916		$4,916	2.5%	$3,968	$1,071	$5,040
01	LANDS AND DAMAGES	$175	$47	27%	$222	2.1%	$179	$48	$227		$227		$179	$48	$227
30	PLANNING, ENGINEERING & DESIGN	$569	$154	27%	$723	3.9%	$591	$160	$750		$750	4.3%	$616	$166	$782
31	CONSTRUCTION MANAGEMENT	$284	$77	27%	$361	3.9%	$295	$80	$375		$375	7.4%	$317	$86	$403
	PROJECT COST TOTALS:	$4,821	$1,302	27%	$6,123		$4,936	$1,333	$6,268		**$6,268**	2.9%	$5,080	$1,372	$6,452

_____ CHIEF, COST ENGINEERING, John Nites

_____ PROJECT MANAGER, MAJ Matthew Wright

_____ CHIEF, REAL ESTATE, Ken Lieu

_____ CHIEF, PLANNING, Lenna Hawkins

_____ CHIEF, ENGINEERING, Jeanine Hoey

_____ CHIEF, OPERATIONS, Kathy Griffin

_____ CHIEF, CONSTRUCTION, Mo Ibrahim

_____ CHIEF, CONTRACTING, Joshua Kaufmann

_____ CHIEF, PROGRAMS AND PROJECT MANAGEMENT, Susanne Majewski

_____ CHIEF, DPM, Lenna Hawkins

ESTIMATED TOTAL PROJECT COST:		**$6,452**
ESTIMATED FEDERAL COST:	75%	$4,839
ESTIMATED NON-FEDERAL COST:	25%	$1,613
22 - FEASIBILITY STUDY (CAP studies):		**$335**
ESTIMATED FEDERAL COST:	50%	$268
ESTIMATED NON-FEDERAL COST:	50%	$168
ESTIMATED FEDERAL COST OF PROJECT		**$5,106**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Seneca Nation of Indians Territory Ecosystem Restoration Project
LOCATION: Cattaraugus County, NY
This Estimate reflects the scope and schedule in report; SNI 1135 DPR Feb 2018

DISTRICT: LRP Pittsburgh District
POC: CHIEF, COST ENGINEERING, John Nites

PREPARED: 1/25/2018

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 25-Jan-18 Estimate Price Level: 1-Oct-17				Program Year (Budget EC): 2019 Effective Price Level Date: 1 -Oct-18								
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	PHASE 1 or CONTRACT 1													
06	FISH & WILDLIFE FACILITIES	$3,793	$1,024	27.0%	$4,817	2.1%	$3,871	$1,045	$4,916	2020Q2	2.5%	$3,968	$1,071	$5,040
	CONSTRUCTION ESTIMATE TOTALS:	$3,793	$1,024	27.0%	$4,817		$3,871	$1,045	$4,916			$3,968	$1,071	$5,040
01	LANDS AND DAMAGES	$175	$47	27.0%	$222	2.1%	$179	$48	$227	2019Q1		$179	$48	$227
30	PLANNING, ENGINEERING & DESIGN													
5.0%	Project Management	$190	$51	27.0%	$241	3.9%	$197	$53	$250	2019Q4	3.1%	$203	$55	$258
5.0%	Engineering & Design	$190	$51	27.0%	$241	3.9%	$197	$53	$250	2019Q4	3.1%	$203	$55	$258
2.0%	Engineering During Construction	$76	$20	27.0%	$96	3.9%	$79	$21	$100	2020Q4	7.4%	$85	$23	$107
2.0%	Planning During Construction	$76	$20	27.0%	$96	3.9%	$79	$21	$100	2020Q4	7.4%	$85	$23	$107
1.0%	Project Operations	$38	$10	27.0%	$48	3.9%	$39	$11	$50	2019Q4	3.1%	$41	$11	$52
31	CONSTRUCTION MANAGEMENT													
7.5%	Construction Management	$284	$77	27.0%	$361	3.9%	$295	$80	$375	2020Q4	7.4%	$317	$86	$403
	CONTRACT COST TOTALS:	$4,821	$1,302		$6,123		$4,936	$1,333	**$6,268**			$5,080	$1,372	**$6,452**

Filename: CAP 1135 - Seneca Nation TPCS - 2019 Rev for REP Update_2019-04-04.xlsx
TPCS

Appendix D

REAL ESTATE

US Army Corps of Engineers®

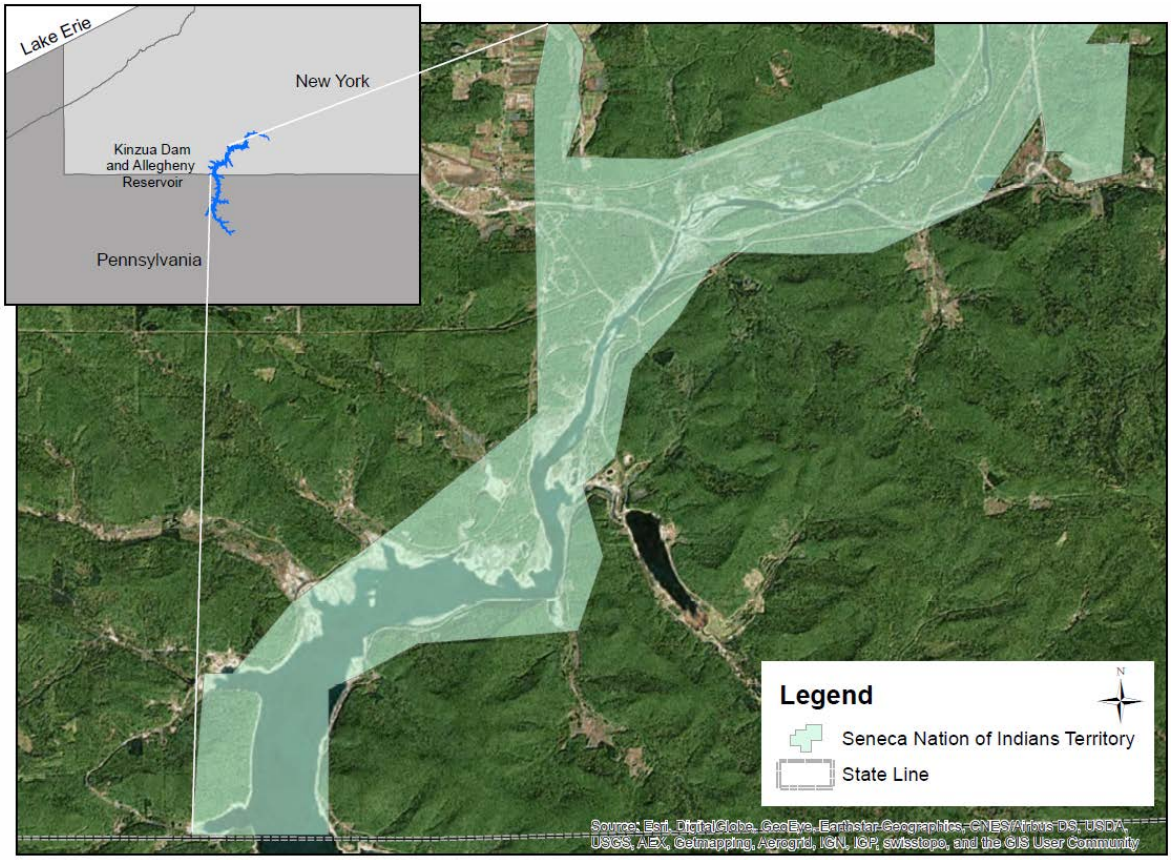
Pittsburgh District

March 2019

REAL ESTATE PLAN

SENECA NATION OF INDIANS TERRITORY ECOSYSTEM RESTORATION SECTION 1135 PROJECT CATTARAUGUS COUNTY NEW YORK

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PENNSYLVANIA 15222



SENECA NATION OF INDIANS TERRITORY ECOSYSTEM RESTORATION
SECTION 1135 PROJECT
KINZUA LAKE
CATTARAUGUS COUNTY, NEW YORK

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
SENECA NATION OF INDIANS TERRITORY ECOSYSTEM RESTORATION
SECTION 1135 PROJECT

REAL ESTATE PLAN

TABLE OF CONTENTS

EXHIBITS

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
PITTSBURGH, PENNSYLVANIA 15222
SENECA NATION OF INDIANS TERRITORY ECOSYSTEM RESTORATION
SECTION 1135 PROJECT
REAL ESTATE PLAN FOR A DETAILED PROJECT REPORT

1.0 References

a. *Project Management Plan for the Seneca Nation of Indians Territory Ecosystem Restoration Section 1135 Project, dated March 22, 2017.*

2.0 Authorization

The Project Management Plan (PMP) has been developed for the Seneca Nation of Indians Territory Ecosystem Restoration Project. The DPR was prepared under the authority of Section 1135 of the Water Resources and Development Act of 1986, as amended (Public Law 99-662). Section 1135 authorizes the Corps to evaluate potential modifications to existing Corps water resource projects for the purpose of improving the environment in the public interest. The Corps' Pittsburgh District, in collaboration with the Seneca Nation, analyzed problems and opportunities in the study area and developed a Federal Interest Determination that was approved by the Corps' Great Lakes and Ohio River Division on July 17, 2015. The project Feasibility Study Cost Share Agreement was executed on August 17, 2016. In December 2016, the Pittsburgh District received the initial portion of federal cost-share funds to initiate the feasibility study and at that time also requested the Seneca Nation's cost share portion. The feasibility cost share proportion is 50/50, with the Seneca Nation providing both funds and work-in-kind value for their portion.

3.0 Background

This study evaluated five alternatives for ecosystem restoration on and adjacent to the Allegheny Reservoir in the vicinity of the Seneca Nations Territory in Cattaraugus County, New York. In New York, the reservoir occupies Seneca Nation lands outlined by the Treaty of 1794. For the Kinzua Dam and Allegheny Reservoir project, constructed in the 1960s, the United States acquired fee simple title to 3,520 acres and flowage easements covering another 5,557 acres.

For this ecosystem restoration project, the Seneca Nation, the Non-Federal Sponsor, owns the land in restricted fee and the Corps has flowage easements over this land. Restricted fee is legal title to land but with restrictions against alienation or encumbrances. See 25 U.S.C. § 177 ("No purchase, grant, lease or other conveyance of lands, or of any title or claim thereto, from any Indian nation or tribe of Indians, shall be of any validity in law or equity, unless the same be made by treaty or convention entered into pursuant to the Constitution.") "Restricted land … means land the title to which is held by … a tribe and which can only be alienated or

encumbered by the owner with the approval of the Secretary [of the Interior] because of limitations contained in the conveyance instrument pursuant to Federal law or because of a Federal law directly imposing such limitations." 25 C.F.R. § 151.2(e).

4.0 Purpose

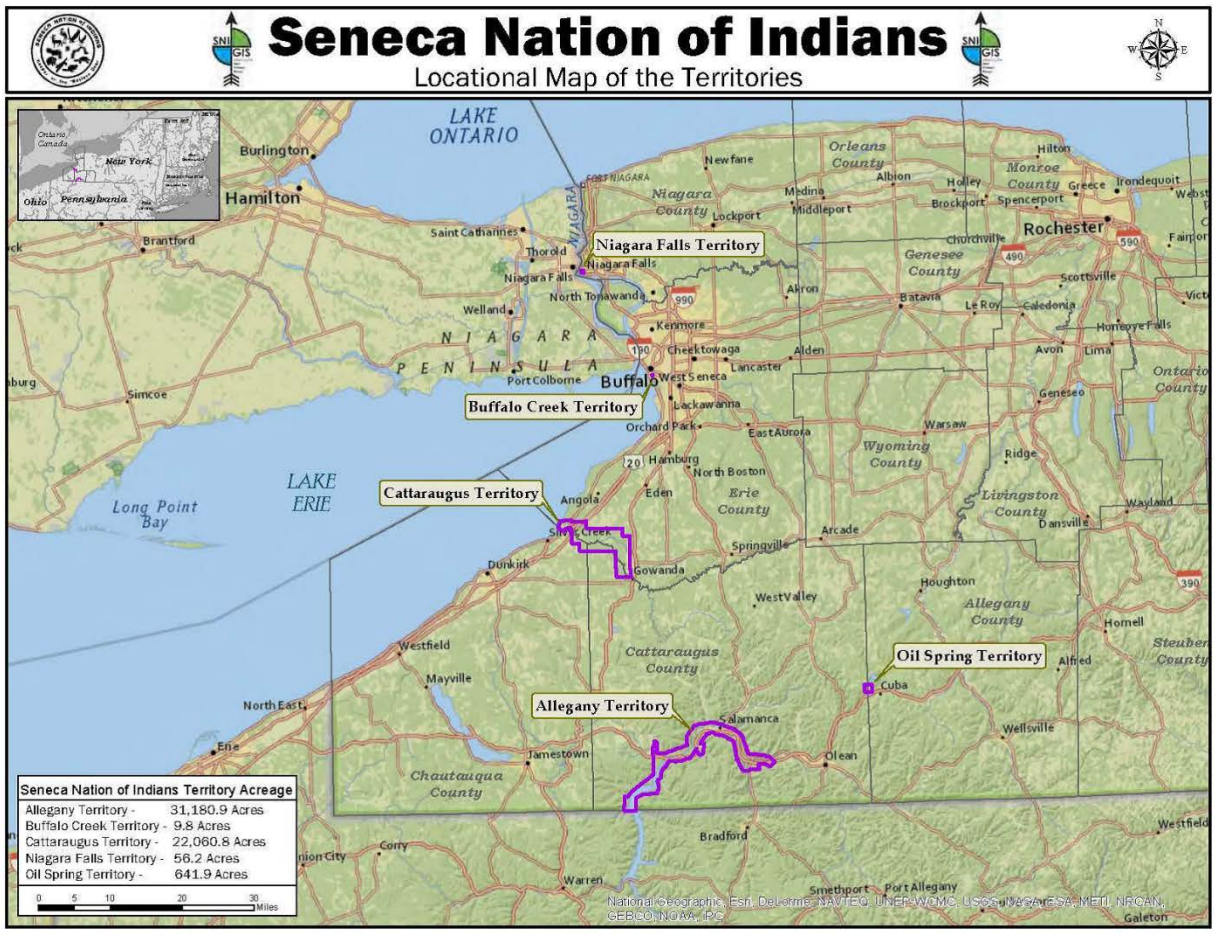
The purpose of this ecosystem restoration project is to restore significant ecosystem function, structure, and dynamic processes characteristic of conditions as they existed prior to construction of Kinzua Dam and Allegheny Reservoir, to the extent consistent with the authorized purposes of the dam and reservoir. The Seneca Nation has identified and prioritized the ecosystem resources of concern in the following order – proliferation of harmful algal blooms (HABs), shoreline erosion/reservoir sedimentation, proliferation of nuisance invasive plants, and degradation of fish habitat.

This study is to determine the feasibility of improving the Reservoir's shoreline and to create a functioning lake with value to both humans (visually and environmentally) and wildlife (e.g., avian, terrestrial and riverine).

Alternative 5 was chosen and includes sediment removal/excavation and seasonal planting of native aquatic plants for HAB improvement, mechanical removal of invasive species followed by targeted chemical treatment (Rodeo Herbicide) and subsequent planting of native vegetation, and bank stabilization utilizing rip rap.

5.0 Location

The lands that are the subject of this Real Estate Plan (REP) are located in Cattaraugus County, on the New York side of the Allegheny Reservoir in the Allegany Territories.



General Location Map

6.0 Project Lands, Easements, Rights-of-Way, Relocations and Disposal Areas (LERRDs)

This ecosystem restoration project requires approximately 286.87 acres that the Seneca Nations owns in restricted fee and that are encumbered by flowage easements that allow the Corps to flood to the 1,365' elevation. These lands are primarily recreational lands that are under water during the summer months. As of the date of this report, the Seneca Nation is the Non-Federal Sponsor for this project. The project limits are located on land owned by the Seneca Nation in restricted fee with occupancy and use agreements reportedly issued to certain members of the Seneca Nation to occupy and use the land. As of the date of this report, the Seneca Nation has not provided the Corps with copies of the occupancy and use agreements. As discussed more fully in Section 3.0, restricted fee is legal title to land but with restrictions against alienation or encumbrances.

For LERRDs purposes, the acreage breakdown is as follows.

a. The project requires a total of 286.87 acres, which the Seneca Nations owns in restricted fee.

b. Subordination agreements and/or access agreements are required from the Seneca Nation members who have use and occupancy rights, for access, construction and O&M for the project. As of the date of this report, the Seneca Nation has not provided the Corps with copies of the use and occupancy agreements or the proposed subordination/access agreements.

c. A consent to cross easement from the Corps will be needed for the flowage easements that encompass 286.87 acres.

d. Access to the property will be from public streets.

Six locations within the study area will include seasonal plantings in October to November. In addition, two one-acre areas in Bear Claw and Low Banks will be used to control Japanese Knotweed by mechanical cutting, which will occur in the June-July time frame. Also the plan includes sediment removal/excavation and seasonal planting of native of aquatic plants for HAB improvement, mechanical removal of invasive species followed by targeted chemical treatment (Rodeo) and subsequent planting of native vegetation, and bank stabilization utilizing hard - rip rap.

There is no disposal site needed as material will be reused for the project. The current plan involves some dredging and reusing the material at the same site at Bear Claw.

There will not be any acquisition of additional lands based on the current plan. Based on the current plan, this project will be constructed during a three-year period.

7.0 Mapping

Mapping is included in the Exhibit B section of this report, and the map is a current map outlining the ecosystem work and tracts of land that are needed for the project. The mapping is for planning purposes only and final mapping will be provided by the Non-Federal Sponsor and reviewed by USACE prior to acquisition. Then a notice to proceed will be sent to the Non-Federal Sponsor for acquiring the real estate interests.

8.0 Existing Federal Projects Within the Project Limits

Kinzua Dam and Allegheny Reservoir is a Federal flood control project within the limits of the ecosystem restoration project. For purposes of the Kinzua Dam and Allegheny Reservoir project, the Corps of Engineers acquired fee and flowage easements. The ecosystem restoration project will be located on land encumbered by the Corps' flowage easements. Those easements authorize the Corps to flood the land to the 1,365' elevation. Based on discussions with the District Operations Division, this project will not interfere with the purpose of the flowage

easements.

9.0 Federally Owned Land

The U.S. Government owns fee and flowage easements within the area of the Kinzua Dam and Allegheny Reservoir. The land within the limits of the ecosystem restoration project is owned in restricted fee by the Seneca Nation, the Non-Federal Sponsor. Such land is encumbered by flowage easements to the Corps of Engineers, authorizing the Corps to flood up to the 1,365' elevation.

10.0 Navigational Servitude

Although the navigational servitude applies to 257.5 miles of the Allegheny River from Pittsburgh, PA to Olean, NY, the ecosystem project limits are outside of the navigational channel; therefore, navigational servitude does not apply.

11.0 Public Law 91-646 Relocations

No persons, farms, or businesses will be relocated. Therefore**,** Title II (Uniform Relocation Assistance) of Public Law 91-646, is not applicable. (See Section 16 for a discussion of public facility relocations.)

12.0 Induced Flooding

The United States holds flowage easements on all of the land within the project limits that allow flooding to the 1,365' level. The ecosystem restoration project will not cause any additional flooding.

13.0 Baseline Real Estate Cost Estimate

		Estimated Cost
Federal Costs		
Real Estate Team Member Costs		$20,000
Coordination with NFS and Counsel		$5,000
Office of Counsel (including review of use and occupancy agreements and access agreements/subordinations)		$10,000
Appraisal and Review		$5,000
Real Estate Certification		$10,000
Crediting and Project Closeout		$10,000
Sub Total		**$60,000**

Non Federal Costs		
Mapping and Legal Descriptions		$5,000
Appraisals		$5,000
Real Estate Interests (Access Agreements/Subordinations)		$50,000
Sub Total		**$60,000**
Land Costs		
Land Costs	286.87 acres	$50,000
Contingency @10%		$5,000
Sub Total Land Costs	286.87 acres	**$55,000**
Grand Total		**$175,000**

14.0 Zoning Enactments

There are no zoning changes or enactments that are needed for this project.

15.0 Mineral Activity

There is no mineral activity in this area.

16.0 Public Facility Relocations

There are no known specific public facilities located in the study area that will be relocated as of the date of this report. The Friends boat launch is not located within the ecosystem restoration area. Rather, that boat launch is located on land owned by the United States and licensed to the People of the State of New York, acting through the Office of Parks and Recreation. The Friends boat launch will not be impacted by the ecosystem restoration project. There will be no impact to the High Banks boat launch and docks as construction will occur at lower pool levels during the fall and winter when the boat launch is not in use according to conversations with the Water Resources Section. Also, the ecosystem restoration project once completed will not require relocation of the boat launch.

17.0 NEPA, NHPA & HTRW Considerations

A NEPA study will be completed upon the culmination of the NEPA public review and comment period from 07 January 2019 to 15 May 2019. HTRW studies are completed and the NHPA studies are being conducted by the Seneca Nation.

18.0 Assessment of Non-Federal Sponsor's Capability

As of the date of this report the Seneca Nation is the Non-Federal Sponsor. The Sponsor is sufficiently capable of providing legal and professional services based on discussions with the Sponsor. The Sponsor has and/or can contract for mapping, legal, and operational and maintenance capabilities for the O&M of the project. As a general matter, the Seneca Nation does have quick take authority and condemnation authority. However, the Seneca Nation has indicated that it will not use that authority for the project and will adjust the project limits if a Seneca Nation member with use and occupancy rights will not cooperate. If that occurs, an evaluation will be conducted to determine whether project benefits remain. An assessment capability of the Seneca Nation was completed and the Sponsor Capability Checklist is part of the addenda and was completed with Seneca Nation in February 2018 and updated in January 2019.

19.0 Non-Standard Estates

There are no non-standard estates needed for this project.

20.0 Project Schedule

The schedule is based on the assumption that the Non-Federal Sponsor will have to acquire a real estate interest and that there will be costs to it which is reflective in the land costs. Any land acquisition activity that may be needed will not occur until after the Sponsor signs the PPA and then a notice to proceed and a final map will be sent to the Non-Federal Sponsor for acquiring the real estate interests.

Task	***Start***	***Finish***
COE Provides Final Acquisition Map	01 Jun 19	30 June 19
NFS Prepares Legal Descriptions and Maps	01 Jul 19	28 Jul 19
NFS Submits Appraiser’s Name to COE for Approval if Needed	01 Jul 19	28 Jul 19
NFS Obtains Appraisals if Needed	01 Aug 19	31 Aug 19
NFS Submits Appraisals for Approval if Needed	01 Sep 19	05 Sep 19
COE Approves Appraisals if Needed	05 Sep 19	30 Sep 19
Notice to proceed with final mapping and acquisition and NFS Acquires Real Estate Interests	01 Oct 19	30 Oct 19

NFS Submits Ownership Documents and Authorization For Entry For Construction	1 Jan 20	30 Jan 20
Certify Real Estate	01 Mar 20	30 Mar 20

21.0 Public Support or Opposition

The Project Manager held meetings with the Sponsor of the project on December 15, 2016 at Kinzua Dam. The Non-Federal Sponsor reported no opposition to this project from the public that would prevent the project from moving forward. The ecosystem restoration project will provide positive benefits to the area and the environment; therefore, public opposition to the project is not anticipated. The FONSI will be sent out for public review after all the environmental studies are completed. The REP will be revised as necessary to address public comments.

22.0 Other Relevant Real Estate Issues

This Real Estate Plan is based on information available as of the date of this report. The assumption is that the Seneca Nation owns the real estate necessary for the Project. The Corps has not been provided documents on ownership or individual land agreements; therefore, there is a need to ensure that the Non-Federal Sponsor has sufficient rights in the land to support the project. The land values estimated for the LERRD (project cost) are for possible crediting purposes and could change between now and the time the project is authorized. Contingencies were added to the estimated land values to account for this risk.

We are requesting approval of this REP as soon as possible. Upon approval, the Non-Federal Sponsor will be notified that the REP has been approved. After the PPA is signed, the Non-Federal Sponsor can move forward with obtaining the real estate interests for project purposes if they are needed.

Real Estate Certification will require compliance with applicable authorities, including receipt of the Authorization for Entry for Construction and a real estate map showing the project limits with ownership data.

Risks involved with the real estate is that the Seneca Nation will have to obtain access agreements/subordinations from the members who use the Seneca Nation lands. If the Seneca Nation cannot obtain agreements from the land users, then the project limits will be scaled back and the project will have to be reevaluated for benefits that it will provide. This could cause delays since the number of agreements needed is unknown.

This REP is tentative in nature and for planning purposes only. Both the final real estate footprint and values are subject to change and all acquisitions (if necessary) would be completed according to PL 91-646.

EXHIBIT A
SPONSOR CAPABILITY CHECKLIST

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

Sponsor(s): Seneca Nation

Authority: Section 1135 of the Water Resources Development Act (WRDA) of 1986

Non-Federal Sponsor Real Estate Contact: Shannon Seneca

I. Legal Authority

a. **Does the non-Federal Sponsor have legal authority to acquire and hold title to real property for project purposes?**

Yes X No ____

Non-Federal Sponsor is authorized to acquire and own land by authority of Treaty of 1784.

Note: If NO, who will acquire LERRD? Who will hold title? See the attached wording to this document from the Seneca Nation.

b. **Does the non-Federal Sponsor have the power of eminent domain for this project?**

Yes X No ____

The use of eminent domain is authorized by Seneca Nation By Laws.

Note: If NO, who will acquire tracts if condemnation is required? For this project the Seneca Nation will not condemn land owners that are not in agreement with the project.

c. **Does the non-Federal Sponsor have "quick-take" authority for this project?**

Yes X No ____

Non-Federal Sponsor's "quick-take" authority is authorized by Seneca Nation By Laws.

Note: If NO, will lack of "quick take" authority impact the project schedule? For this project the Seneca Nation will not condemn land owners. See Ib. Note.

d. **The non-Federal Sponsor has reviewed the project maps and confirmed that all of the lands/ interests in land required for the project are located inside of their political boundary.**

Yes X No ____

Note: If NO, what is the plan for acquiring? Can the non-Federal Sponsor hold title to land outside of their political boundary?

c. **Are any of the lands/ interests in land required for the project owned by an entity whose property the non-Federal Sponsor cannot condemn?**

Yes____ No X

Note: If YES; what is the plan for acquiring?

Section I: James J. Kelly Date: 02 / 27 / 18
Realty Specialist

II. Financial Capability

a. **The non-Federal Sponsor has reviewed and concurs with the real estate cost estimates?**

Yes X No____

Note: If NO; provide the anticipated resolution.

b. **It has been established by the responsible district element that the non-Federal Sponsor is financially capable of fulfilling all requirements identified in the PPA.**

Yes X No____

Note: If NO; is another entity going to provide the non-Federal Sponsor with financial assistance?

Section II: James J. Kelly Date: 02 / 27 / 18
Realty Specialist

III. Willingness To Participate

a. **The non-Federal Sponsor has stated in writing its general willingness to participate in the project and its understanding of the general scope of the project and its part of the project.**

Yes X

Letter of Intent from the NFS dated 06 / 03 / 14 .

Note: If more than one sponsor is to be involved explain the Real Estate roles of each non-Federal Sponsor.

b. **The non-Federal Sponsor is agreeable to signing a project partnership agreement and supplying funding as stipulated in the agreement.**

Yes X

Section III: James J. Kelly Date: 02 / 27 / 18
Realty Specialist

IV. Acquisition Experience and Capability

a. **Taking into consideration the project schedule and complexity, the non-Federal Sponsor has and capability with in house staffing or contract capability, to provide the necessary services such as surveying, appraising, title, negotiating, condemnation, closings, and relocation assistance that will be required for the acquisition of properties for a project.**

Yes X No____

Note: If work will be done in house give brief summary, staff size, expertise, experience, etc.

b. **The non-Federal Sponsor's staff is familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended.**

Yes X No____

Note: If NO; additional funding for USACE training/ oversight will be required.

c. **The non-Federal Sponsor can obtain contractor support in a timely fashion, if necessary.**

Yes X No____

Note: If NO; does the acquisition timeline account for this?

d. **The non-Federal Sponsor's staff is located within a reasonable proximity to the project site.**

Yes X No____

Note: If NO; provide summary of plan to make contact, project office, TDY, local contractors etc.

e. **Will USACE assistance likely be requested by the non-Federal Sponsor in acquiring real estate?**

Yes____ No X

Note: If YES; provide a summary of the level of support that will be requested. Will a Memorandum of Agreement be required in accordance with the PPA?

Section IV: James Kelly
Realty Specialist

Date: 2 / 27 / 18

V. Schedule Capability

The non-Federal Sponsor has approved the tentative project/ real estate schedule/ milestones and has indicated in its willingness and ability to incorporate its financial, acquisition, and condemnation capability to provide the necessary project LERRDs in accordance with proposed project schedules so the Government can advertise and award the construction contract as required by overall project schedules and funding limitations.

Yes X Initials: _____ Date: ____/____/____

Note: Address risks to schedule

Section V. James J. Kelly Date: 02/27/18
Realty Specialist

VI. LERRD Credits

The sponsor has indicated its understanding of LERRD credits and its capability and willingness to gather the necessary information to submit as LERRD credits within six months after possession of all real estate and completion of relocations in order that the project can be financially closed and there can be a final financial accounting with a proper settlement with the sponsor.

Yes X Initials: _____ Date: ____/____/____

Note: If a multi-year project discuss plan for quarterly and/or annual submittals.

Section VI. James J. Kelly Date: 02/27/18
Realty Specialist

VII. Capability

With regard to this project, the non-Federal Sponsor is anticipated to be: Fully Capable.

Note: Choices are: fully capable, moderately capable, marginally capable, and insufficiently capable.

- Fully Capable: *Previous experience. Financially capable. Authority to hold title. Can perform, with in house staff, the necessary services (survey, appraisal, title, negotiation, closing, relocation assistance, condemnation & "quick-take" authority) required to provide LERRD.*
- Moderately Capable: *Financially capable. Authority to hold title. Can provide, with contractor support, the necessary services (survey, appraisal, title, negotiation, closing, relocation assistance and condemnation authority) required to provide LERRD. Does not have "quick-take" authority.*
- Marginally Capable. *Financially capable. Authority to hold title. Will rely on _____ to provide the necessary services (survey, appraisal, title, negotiation, closing, relocation assistance, quick take authority, and authority to condemn) required to provide LERRD.*
- Insufficiently Capable: *Financially capable. Will rely on _____ to provide the necessary services (survey, appraisal, title, negotiation, closing, relocation assistance, quick take authority, and authority to condemn) required to provide LERRD. Will rely on _____ to hold title.*

Summarize what support will be provided to the non-Federal Sponsor to ensure project success.

VIII. Coordination

This assessment has been coordinated with the Non-Federal Sponsor and it concurs with the assessment.

Yes X

This assessment has been coordinated with: Name: Shannon Seneca
Title: Environmental Health Director

Prepared by:

James J. Kelly
Realty Specialist

Reviewed and approved by:

Ken Lieu
Chief, Real Estate Division
Pittsburgh District

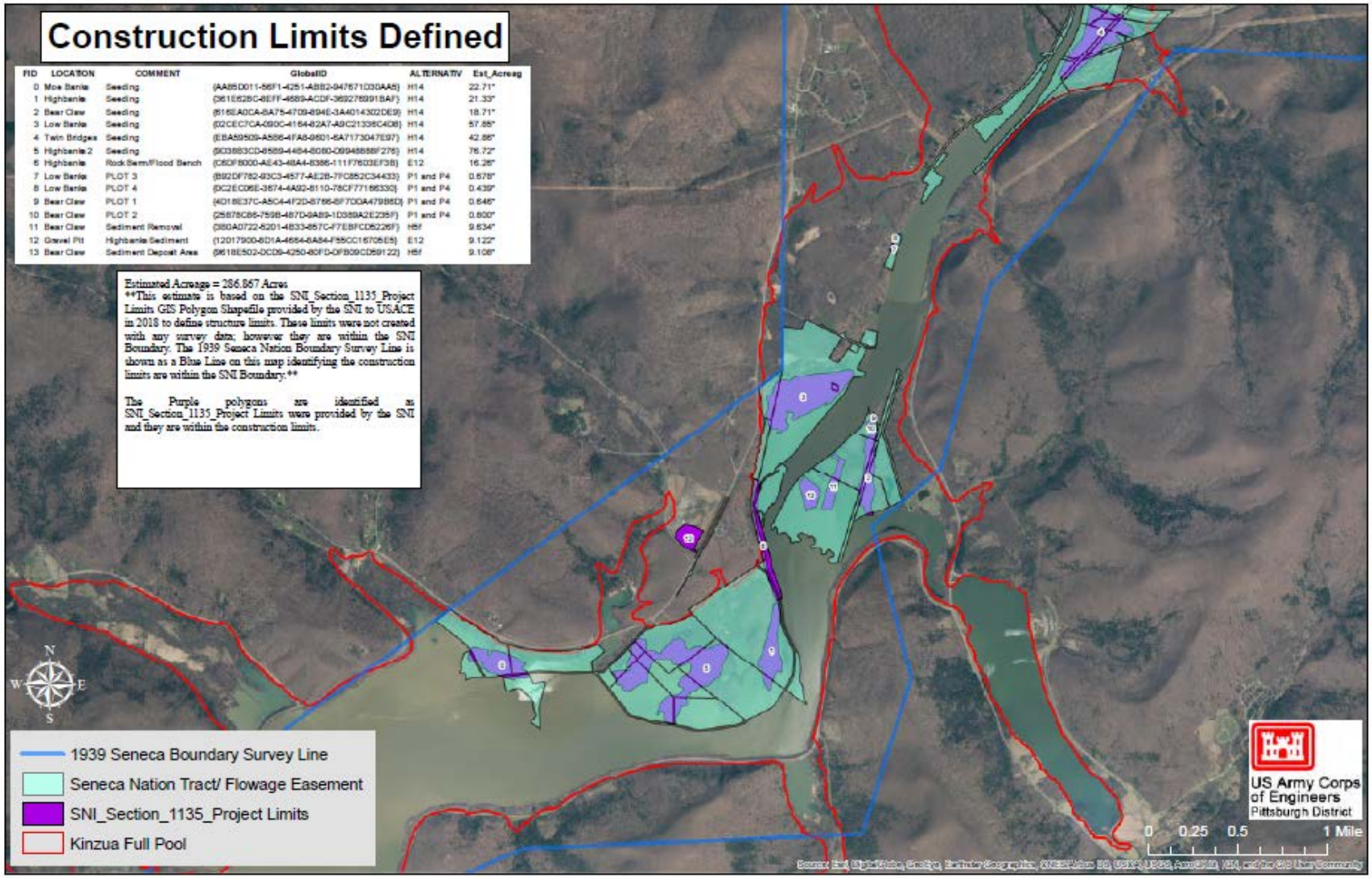
Non-Federal Sponsor Representative:

Signature: Shannon Seneca, PhD, REHS/RS
Name: Shannon Seneca
Title: Environmental Health Director, Sanitarian
Date: 03 / 06 / 18

The Seneca Nation is a federally recognized Indian Nation, whose lands, including those located in the identified project area are owned in restricted fee by the Seneca Nation and not by individual Nation members. As such, it will not be necessary for the Seneca Nation to condemn any properties for the purposes of this project.

To the extent that individual members of the Seneca Nation are owners of use and occupancy rights obtained from the Nation to certain parcels identified in the project area, the Seneca Nation will obtain temporary easements from the individuals identified. The Seneca Nation has used this process for all of our public works projects which impact parcels allocated to individual Nation members. To that end, the project team has consulted with those Nation members who may be impacted by the project. In the unlikely event that the Nation is unable to obtain cooperation from an individual Nation member, the project team intends to amend the project plan to work around such parcels.

EXHIBIT B
PROJECT MAP


Construction Limits Defined
FID LOCATION COMMENT GlobalID ALTERNATIV Est_Acreag
0 Moe Banks Seeding {AA85D011-56F1-4251-ABB2-947671D30AA5} H14 22.71"
1 Highbanks Seeding {961E62BC-8EFF-4589-ACDF-369276991BAF} H14 21.33"
2 Bear Claw Seeding {616EA0CA-8A75-4709-894E-3A4014302DE9} H14 18.71"
3 Low Banks Seeding {02CEC7CA-090C-4164-82A7-A9C21336C4D8} H14 57.85"
4 Twin Bridges Seeding {EBA59509-A586-4FA8-9801-8A7173047E97} H14 42.86"
5 Highbanks 2 Seeding {8C0883CD-8589-44B4-8080-D9948888F276} H14 76.72"
6 Highbanks Rock Berm/Flood Bench {C6DFB000-AE43-48A4-8386-111F76036F3B} E12 16.28"
7 Low Banks PLOT 3 {B92DF782-83C3-4577-AE2B-7FC852C34433} P1 and P4 0.678"
8 Low Banks PLOT 4 {DC2EC06E-3674-4A92-8110-78CF77186330} P1 and P4 0.439"
9 Bear Claw PLOT 1 {4D18E37C-A5C4-4F2D-8766-6F7DDA479B8D} P1 and P4 0.646"
10 Bear Claw PLOT 2 {25878CB6-759B-487D-9AB9-1D38BA2E235F} P1 and P4 0.800"
11 Bear Claw Sediment Removal {380A0722-8201-4B33-857C-F7EBFCD5226F} H5f 9.634"
12 Gravel Pit Highbanks Sediment {12017900-8D1A-4684-8A84-F58CC1670SE5} E12 9.122"
13 Bear Claw Sediment Deposit Area {9618E502-DCD9-4250-80FD-0FB09CD59122} H5f 9.108"
Estimated Acreage = 286.867 Acres
This estimate is based on the SNI_Section_1135_Project Limits GIS Polygon Shapefile provided by the SNI to USACE in 2018 to define structure limits. These limits were not created with any survey data; however they are within the SNI Boundary. The 1939 Seneca Nation Boundary Survey Line is shown as a Blue Line on this map identifying the construction limits are within the SNI Boundary.
The Purple polygons are identified as SNI_Section_1135_Project Limits were provided by the SNI and they are within the construction limits.
N
W
E
S
1939 Seneca Boundary Survey Line
Seneca Nation Tract/ Flowage Easement
SNI_Section_1135_Project Limits
Kinzua Full Pool
US Army Corps of Engineers
Pittsburgh District
0 0.25 0.5 1 Mile

Appendix E

CLIMATE CHANGE ANALYSIS

Allegheny River Basin Analysis

Climate Change Impacts Qualitative Analysis

Phase I: Relevant Current Climate and Climate Change

a) Literature Review.
A May 2017 report conducted by the USACE Institute for Water Resources and the Ohio River Basin Alliance (ORB Pilot Study, Drum et al, 2017) summarizes the available literature for the Ohio River Basin (ORB), which includes the Allegheny River basin. The report presents a pilot study based on global circulation models (GCM) produced by the International Panel on Climate Change Fourth Assessment (2007) and Coupled Model Intercomparison Project-Phase 3 (CMIP3) climate and hydrology projections downscaled to the ORB. Three 30-year time periods from 2011-2099 were established for precipitation and temperature modeling. The NOAA Ohio River Forecast Center used the GCM modeling to simulate annual mean and seasonal flow discharges for 25 forecast points within the basin, as well as a range of temperature changes (annual mean, annual maximum, and annual minimum) for those same points.

For the ORB, modeling results indicate a gradual increase in annual mean temperatures between 2011 and 2040 amounting to one-half degree per decade, with greater increases between 2041 and 2099 of one full degree per decade. Hydrologic flow changes show substantial variability across the ORB through the three time periods, with Hydrologic Unit Code-4 (HUC4) sub-basins located northeast, east, and south of the Ohio River expected to experience greater precipitation and thus higher stream flows—up to 50% greater—during most of the three 30-year periods. Conversely, those HUC4s located north and west of the Ohio River are expected to experience ever-decreasing precipitation (especially during the autumn season) resulting in decreased in-stream flows—up to 50% less—during the same periods.

b) The USACE Climate Hydrology Assessment Tool.
Historic trends in instantaneous peak flows at Allegheny River gages were analyzed using the USACE Climate Hydrology Assessment Tool (CHAT) at three gages located upstream, downstream, and within the project area: Allegheny River at Parker, PA (USGS 03031500), Allegheny River at Kittanning, PA (USGS 03036500), and Allegheny River at Natrona, PA (USGS 03049500). Results from the CHAT analysis of annual peak instantaneous streamflow are presented in the figures below. Note that all three gages display **a negative trend** in the annual peak streamflow linear regression that is **statistically significant** (i.e., p-value less than 0.05). This trend may be due in part to the construction of flood control reservoirs within the Allegheny River basin (1940-1973) and the lack of recent basin-wide floods of record.

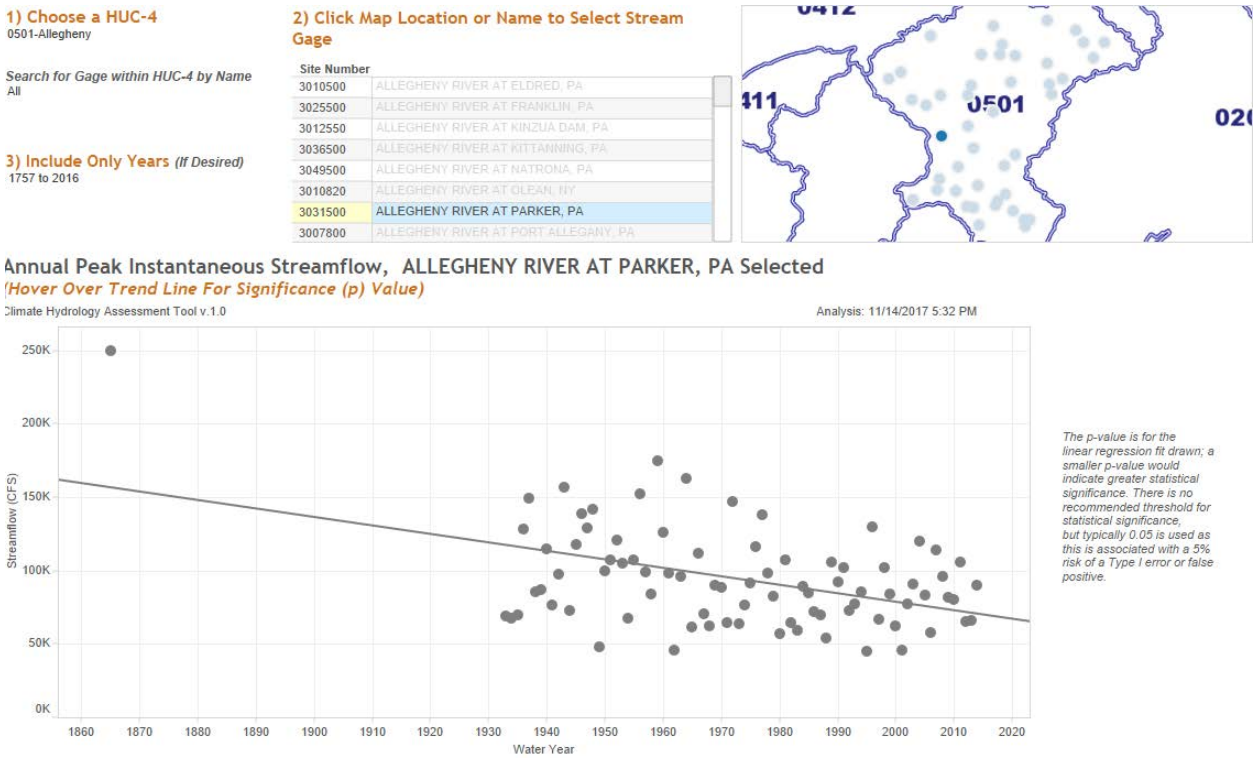


Figure 1: Annual Peak Instantaneous Streamflow, Allegheny River at Parker, PA
Linear Regression: Value = -578*Water Year + 1234230, R-Squared: 0.203, P-value: <0.0001

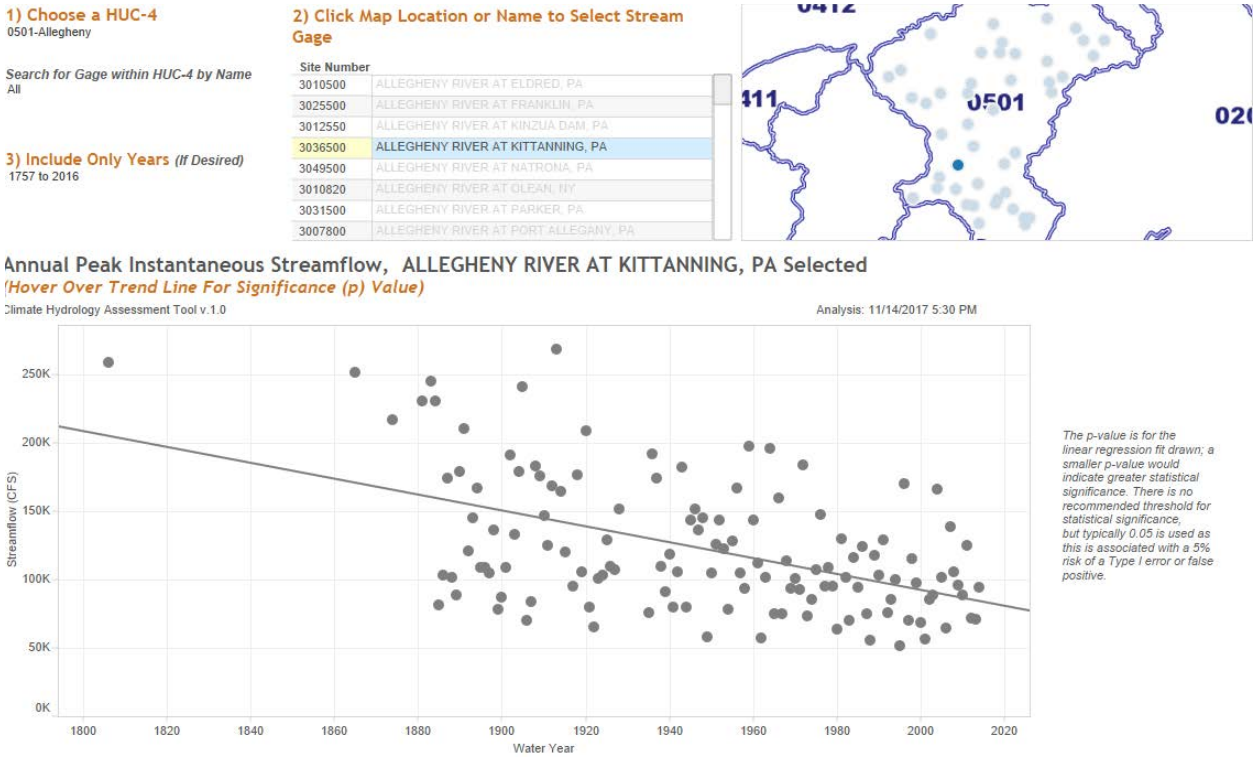


Figure 2: Annual Peak Instantaneous Streamflow, Allegheny River at Kittanning, PA
Linear Regression: Value = -581*Water Year + 1255450, R-Squared: 0.252, P-value: <0.0001

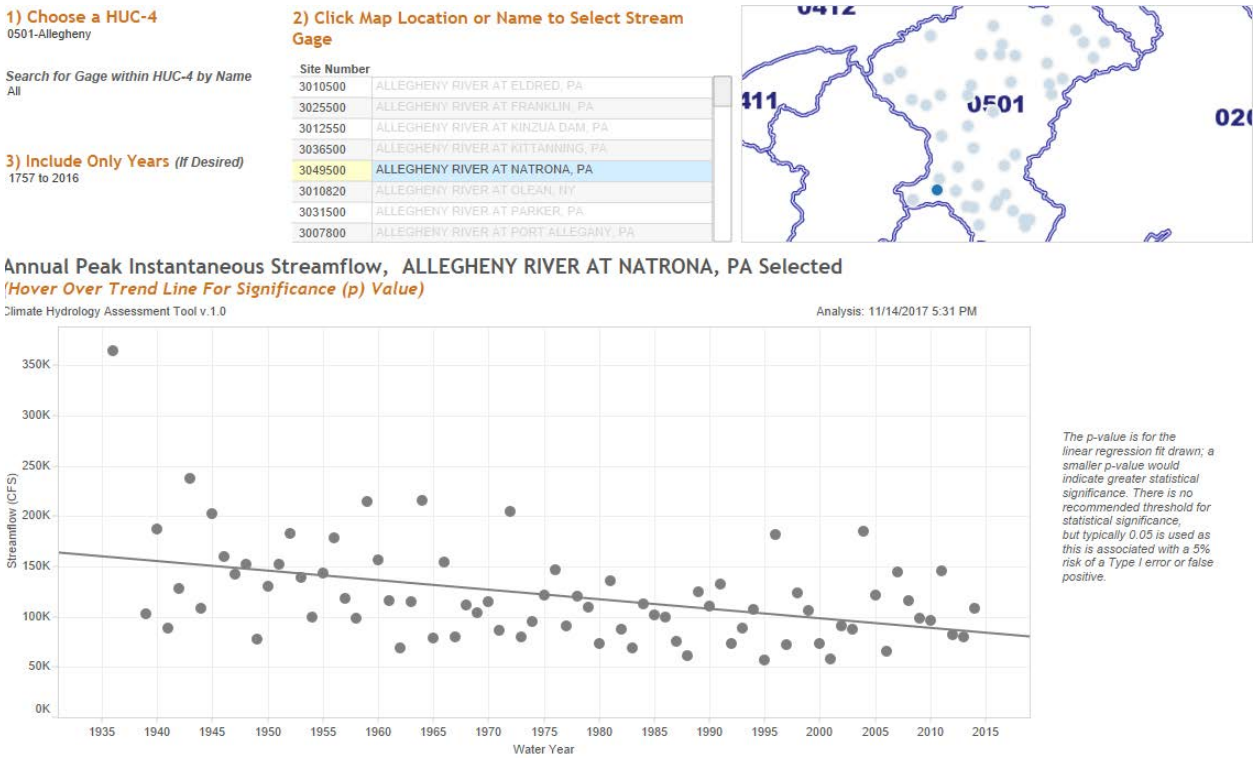


Figure 3: Annual Peak Instantaneous Streamflow, Allegheny River at Natrona, PA
Linear Regression: Value = -949*Water Year + 1995910, R-Squared: 0.183, P-value: 0.0001

c) The USACE Nonstationarity Detection Tool.

The Nonstationarity Tool correctly identified changes to the maximum annual flow due to construction of upstream flood control reservoirs in the Allegheny River basin, most notably Kinzua Dam and Allegheny Reservoir which began operation in 1966. Changes to the mean, standard deviation, and variance were detected for the upstream gage (Parker), while only changes to the mean were detected at the intermediate gage (Kittanning) and the downstream gage (Natrona). A nonstationarity in the 1880's was also identified at the Kittanning gage, but this may be due to the transition between historic and systematic maximum annual flow data. The period of record was limited to 1970-2014 in an effort to isolate the period of regulated flow and there were no periods of nonstationarity detected. The Pittsburgh District Hydrology and Hydraulics Unit is currently planning an evaluation of the nonstationarity of unregulated flows for the Allegheny River at Natrona for FY18Q3.

Results from the Nonstationarity Detection Tool are presented in the figures below. A trend analysis was also completed using this tool and a statistically significant negative trend was detected for all three gages using the full period of record, which verifies the CHAT results. When the period of record is limited to 1970-2014, no statistically significant trend is detected.

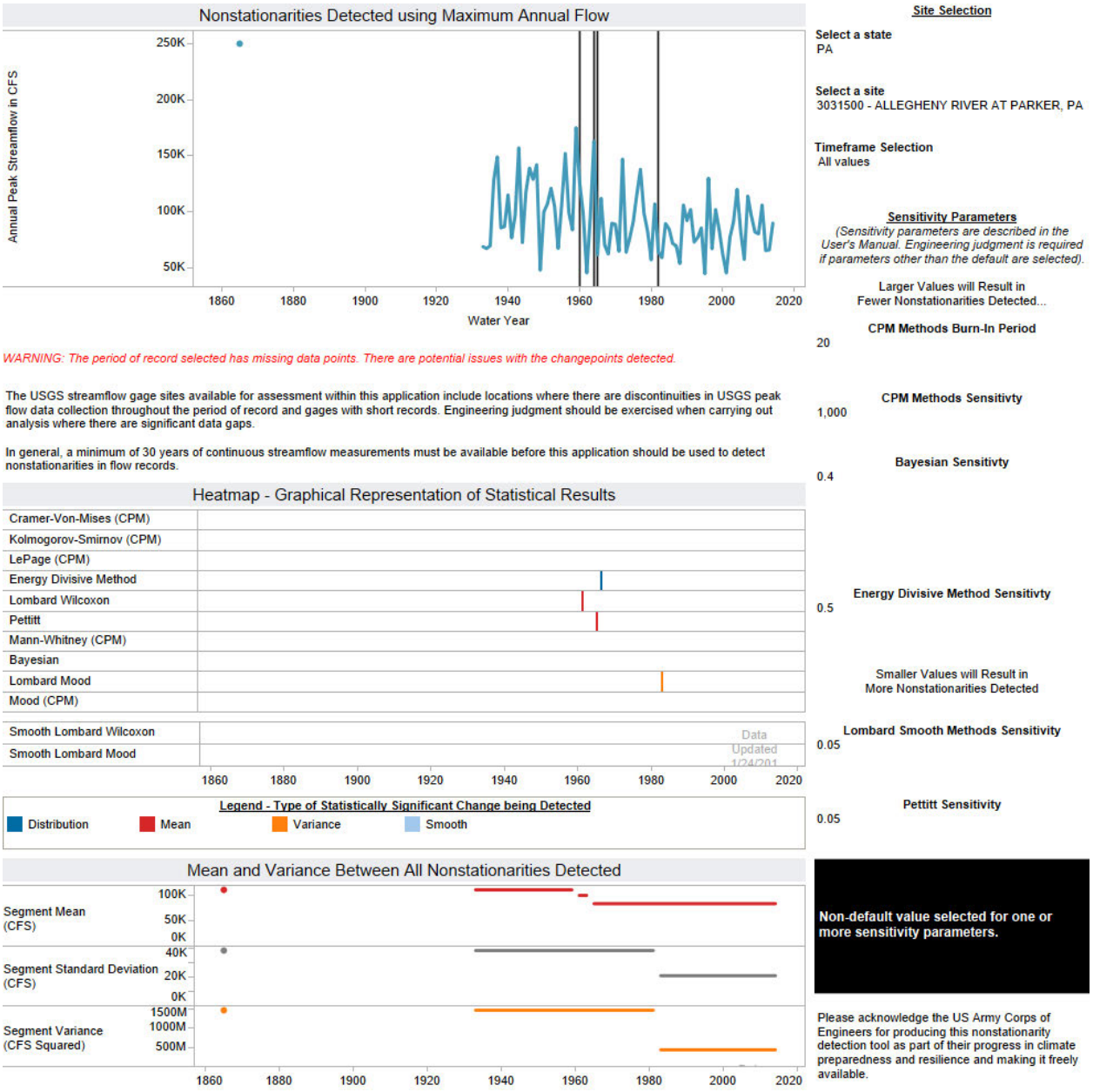


Figure 4: Nonstationarity Analysis of Maximum Annual Flow, Allegheny River at Parker, PA

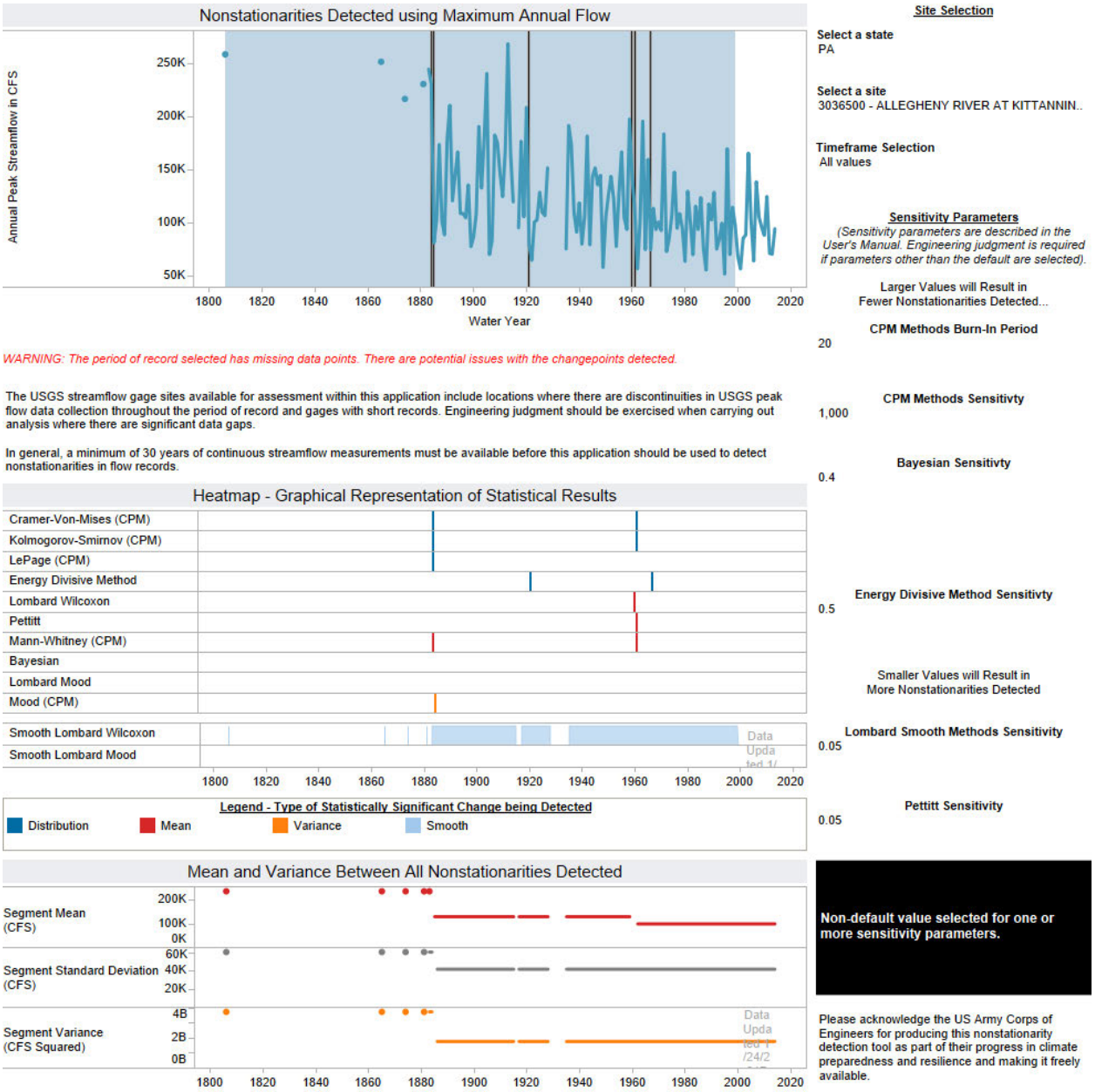


Figure 5: Nonstationarity Analysis of Maximum Annual Flow, Allegheny River at Kittanning, PA

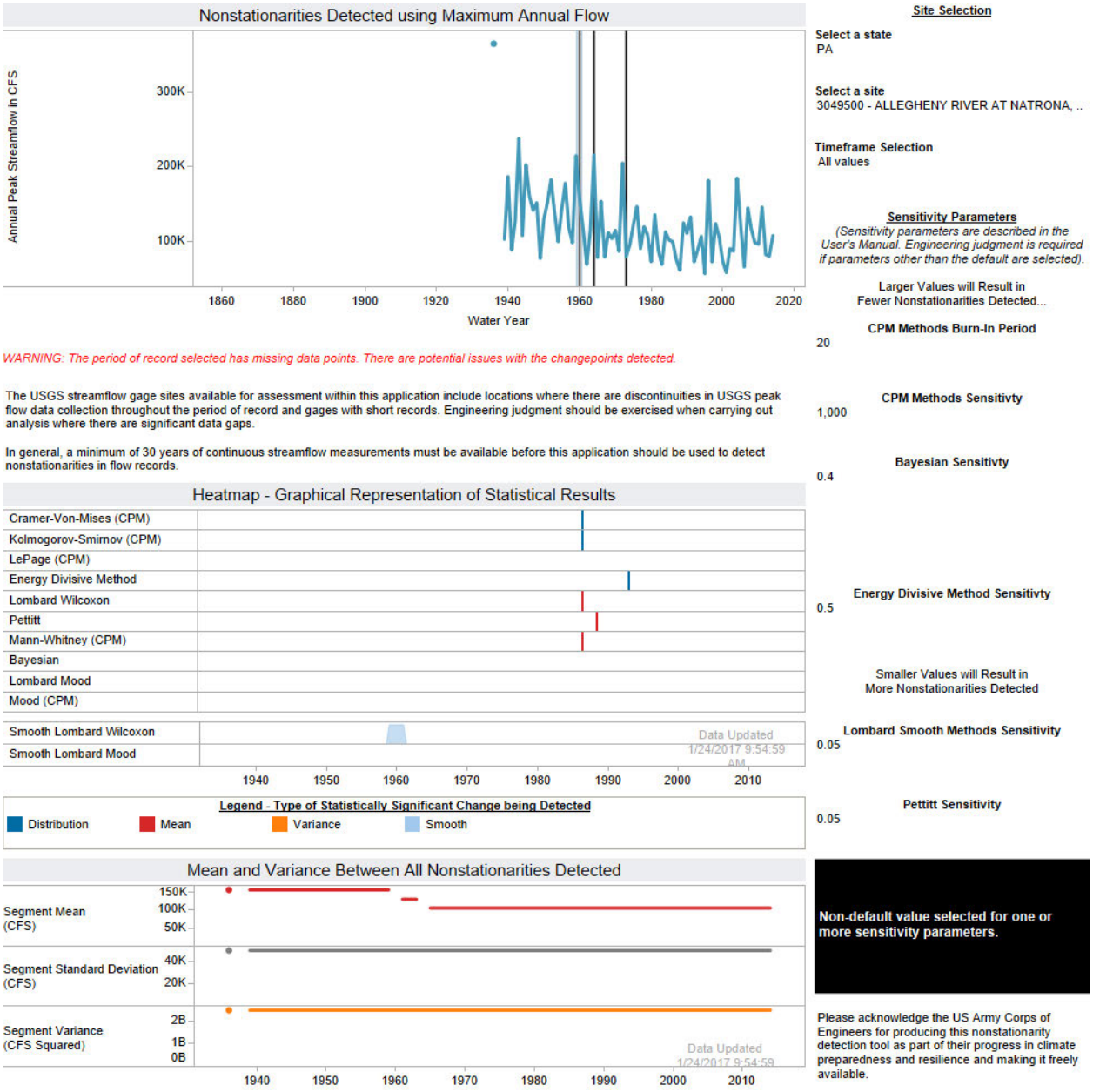


Figure 6: Nonstationarity Analysis of Maximum Annual Flow, Allegheny River at Natrona, PA

Phase II: Projected Changes to Watershed Hydrology and Assessment of Vulnerability to Climate Change.

a) The USACE Climate Hydrology Assessment Tool.
The CHAT was used to identify projected changes in annual maximum monthly flows for the Allegheny River basin, HUC4 0501. Figure 7 displays the range of the projected annual maximum monthly streamflows computed by 93 different combinations of GCM/RCP (Representative Concentration Pathways) model projections for a period of 1950 to 2099. Figure 8 presents a trend analysis of mean projected annual maximum monthly streamflow, but there is **no statistically significant trend**.

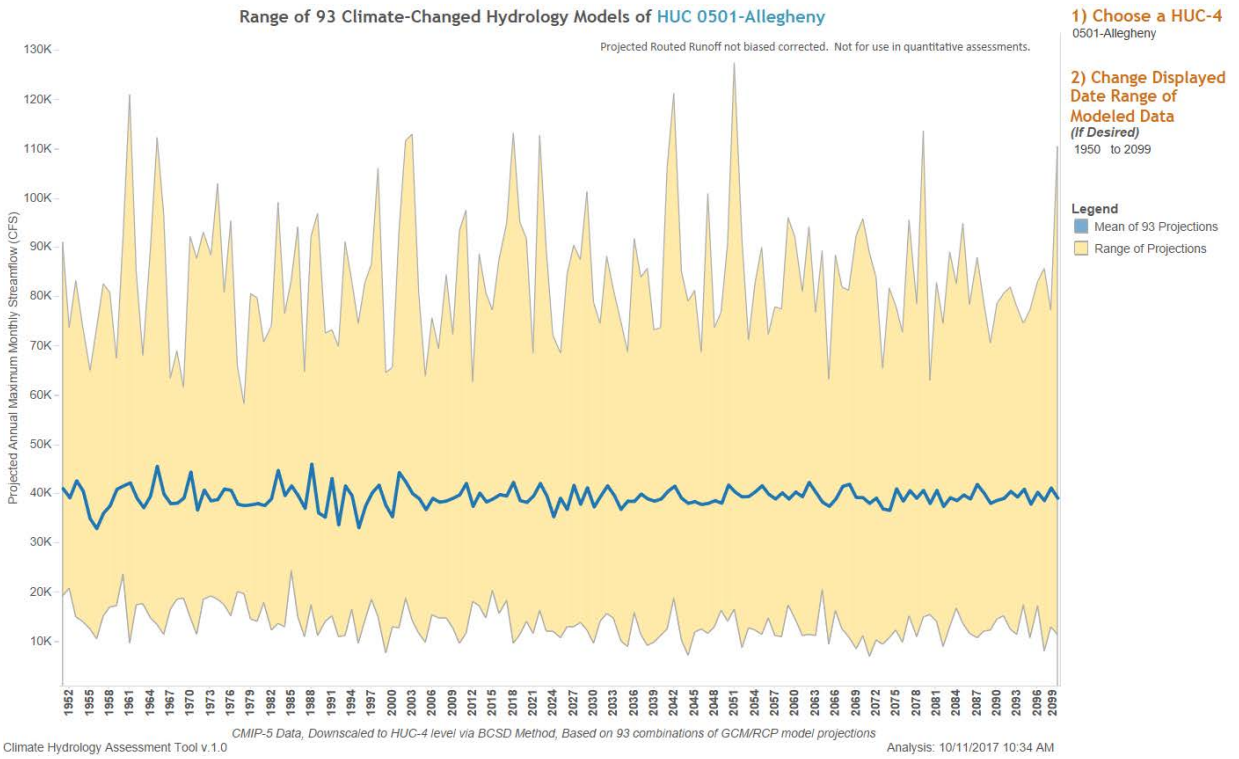


Figure 7: Range of Projected Annual Maximum Monthly Streamflow using 93 Climate-Changed Hydrology Models, HUC 0501 Allegheny River, Pennsylvania

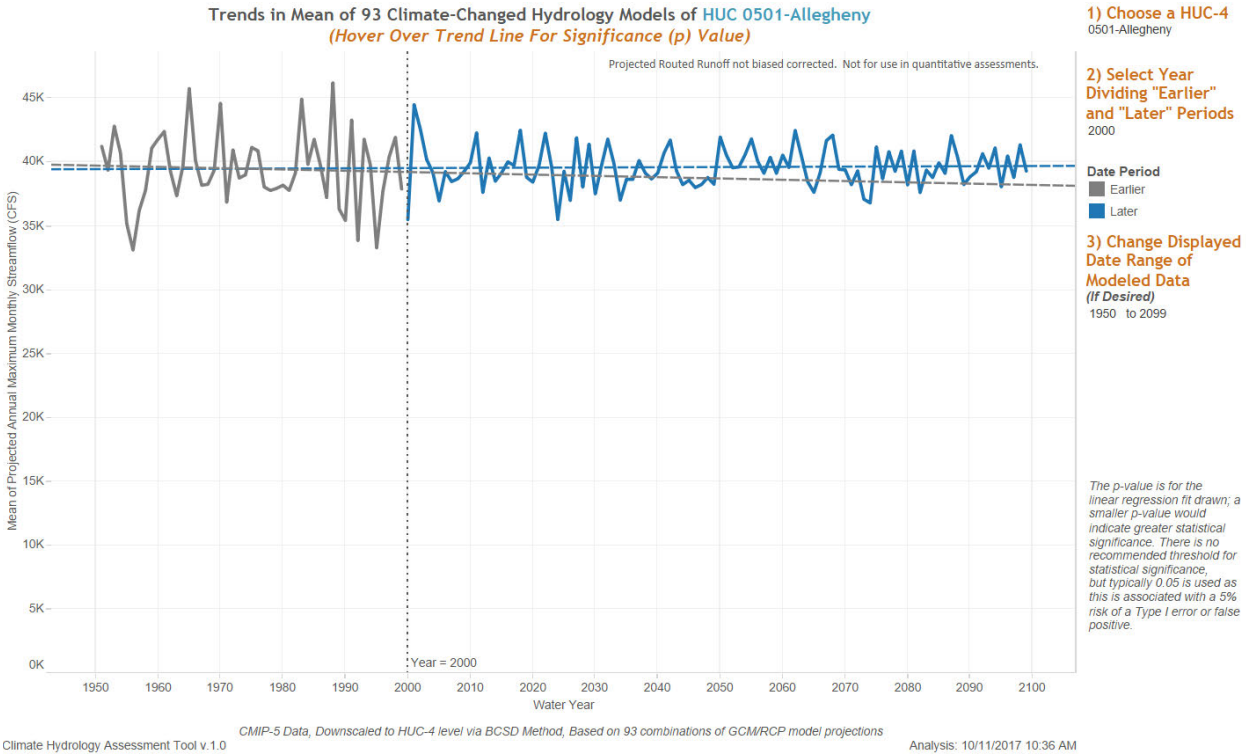


Figure 8: Mean of Projected Annual Maximum Monthly Streamflow, HUC 0501 Allegheny River, Pennsylvania, Earlier period P-value: 0.74, Later period P-value: 0.77

b) The USACE Watershed Climate Vulnerability Assessment Tool.

The Watershed Climate Vulnerability Assessment (VA) Tool was used to provide information on the relative vulnerability of the Allegheny River basin to climate change using a wider variety of flow variables. The tool enables a VA assessment for each USACE business line within each HUC4 watershed across the United States and provides a Weighted Order Weighted Average (WOWA) score to evaluate composite indices of climate change indicators. This qualitative analysis focused on the Navigation and Recreation business lines for the Allegheny River basin. The primary indicators for the Navigation business line were low flow reduction during the dry scenarios (29% of WOWA score) and flood magnification during the wet scenarios (also 29% of WOWA score). Overall, the Navigation business line does not appear to have high vulnerability in HUC 0501 when compared nationally or divisionally for either the Dry or Wet scenarios. In fact, Pittsburgh District watersheds (HUC4 0501, 0502, and 0503) are not identified as vulnerable for any USACE business lines.

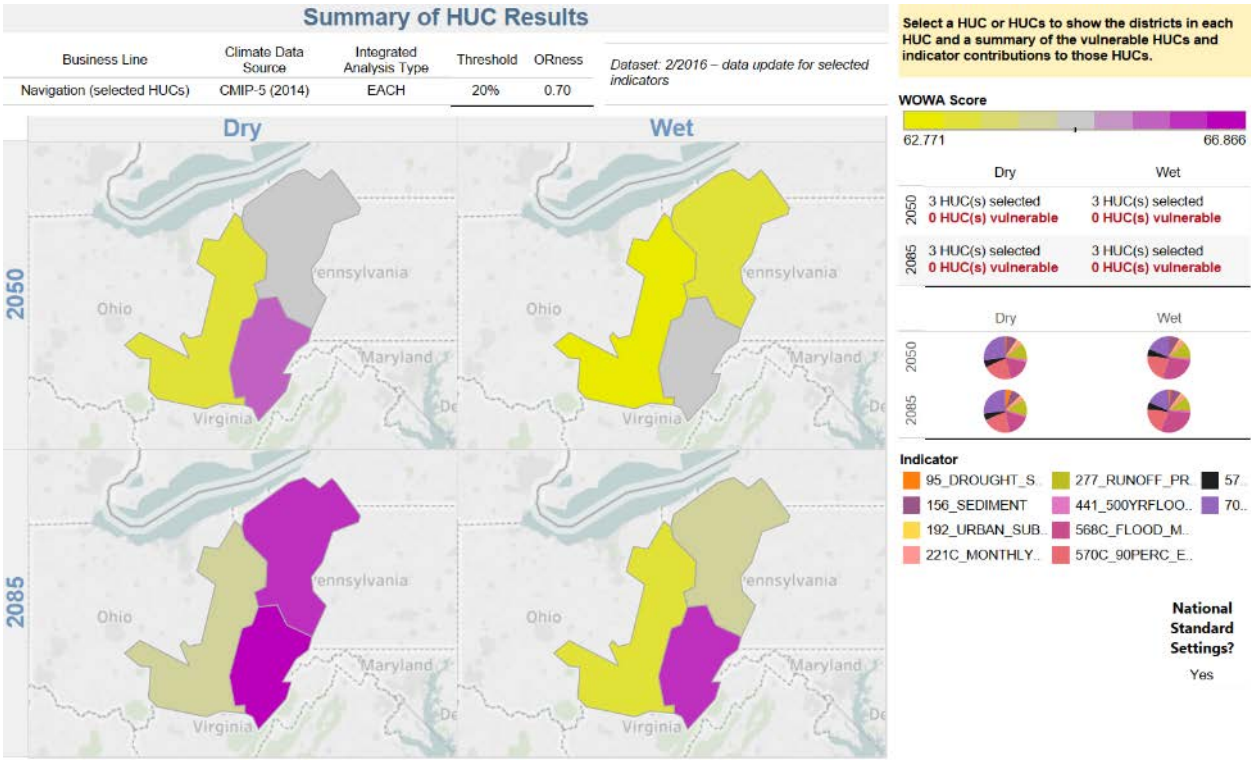


Figure 9: USACE Watershed Climate Vulnerability Assessment for the Pittsburgh District, Navigation Business Line

Conclusions.

Overall, no strong signal exists within the Allegheny River basin qualitative analysis to indicate what definitive impacts climate change will hold for the river hydrology. While the ORB pilot study indicates that there will be increases in temperature, precipitation, and streamflow, the IWR qualitative tools using available USGS gage data do not display the same increases in streamflow. This may point to the importance of producing an unregulated streamflow record for analysis.

Recommendations.

Based on this assessment, which shows no significant signals, the recommendation is to treat the potential effects of climate change as occurring within the uncertainty range calculated for the current hydrologic analysis. There may be other indicators of climate change, such as changes in biotic communities, but this analysis is focused on changes in climate hydrology. Methods of translating climate change impact uncertainty for an engineering-based analysis do not currently exist. In this analysis, no compelling evidence exists to alter the execution of the project to incorporate climate change.

References.

Drum, R. G., J. Noel, J. Kovatch, L. Yeghiazarian, H. Stone, J. Stark, P. Kirshen, E. Best, E. Emery, J. Trimboli, J. Arnold, and D. Raff (2017), Ohio River Basin–Formulating Climate Change Mitigation/Adaptation Strategies Through Regional Collaboration with the ORB Alliance, May 2017. Civil Works Technical Report, CWTS 2017-01, U.S. Army Corps of Engineers, Institute for Water Resources: Alexandria, VA

Appendix F

PUBLIC COMMENTS

The draft Detailed Project Report/Environmental Assessment (DPR/EA) was circulated for public review and comment from June 17, 2019 to August 1, 2019 (45 days). In addition, a public meeting was held on June 24, 2019, from 5:00 – 7:00pm at the Seneca Nation of Indians headquarters in Salamanca, New York, to provide information on the project and solicit public comment. A total of five comments were received and are attached as follows. No changes were made to the DPR/EA as a result of comments received.

Public comments and responses:

Comment: Four commenters expressed concerns over the use of Rodeo herbicide, which contains glyphosate, to treat invasive plants species.

Corps response: Please see Table 12 in Section 3.4.1.3 and Section 3.5.2.2 (P1. Chemical treatment of invasive plants & P4. Native plantings) of the DPR/EA for discussion of the proposed herbicidal treatment.

Comment: One commenter requested the use of community volunteers to help with certain project activities, such as removal of invasive species and replanting native species.

Corps response: Thank you for your comment.

US Army Corps of Engineers®

Pittsburgh District
Planning and Environmental Branch
William S. Moorhead Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

PUBLIC COMMENT FORM

Draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact

Seneca Nation of Indians Territory Ecosystem Restoration Project
Cattaraugus County, New York

Name (optional): MARK Alessi

Address (optional): 11642 Young RD Conewango Valley NY. 14726

Phone No. (optional):

Email (optional): MAlessi@frontiernet

Comment: I Believe that intensive Mechanical Methods For Removal of invasive species should be Attempted Before committing To the use of chemicals that would also inhibit the Restoration of native species.

The draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact are available electronically at:

http://www.lrp.usace.army.mil/Missions/Planning-Programs-Project-Management/

Comments can be sent to the mailing address at the top of the page, or via email to lrp.plan.enviro@usace.army.mil. Comments submitted via email must include the project title, "Seneca Nation of Indians Ecosystem Restoration Project," in the email subject line. Comments must be received or post-marked on or before 17 July 2019 to ensure consideration.

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Pittsburgh District
Planning and Environmental Branch
William S. Moorhead Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

PUBLIC COMMENT FORM

Draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact

Seneca Nation of Indians Territory Ecosystem Restoration Project
Cattaraugus County, New York

Name (optional): Jil St. Ledger-Roky
Address (optional): 3688 Route 98 S Franklinville NY 14737
Phone No. (optional): 716 676 5242
Email (optional): jil.st.ledger-roky@outlook.com (all small letters)

Comment: I have serious considerations and concerns about the use of rodeo anywhere near the river. There does not appear to be any way that it wouldn't get into the water.

The draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact are available electronically at:

http://www.lrp.usace.army.mil/Missions/Planning-Programs-Project-Management/

Comments can be sent to the mailing address at the top of the page, or via email to lrp.plan.enviro@usace.army.mil. Comments submitted via email must include the project title, "Seneca Nation of Indians Ecosystem Restoration Project," in the email subject line. Comments must be received or post-marked on or before 17 July 2019 to ensure consideration.

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Pittsburgh, Pennsylvania 15222

PUBLIC COMMENT FORM

Draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact

Seneca Nation of Indians Territory Ecosystem Restoration Project
Cattaraugus County, New York

Name (optional): Joseph Hill
Address (optional): 313 Auburn Ave Buffalo, NY 14213
Phone No. (optional): 716 812-2458
Email (optional): jhill3915@gmail.com

Comment: #1 Chemical Treatment of Invasive Plants

The World Health Organization, and other agencies have determined that Glyphosate ~~is~~ a widely used herbicide IS PROBABLY CARCINOGENIC TO HUMANS

Members of the Seneca Nation consume fish and wildlife which may be affected by application of Glyphosate

The draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact are available electronically at:

http://www.lrp.usace.army.mil/Missions/Planning-Programs-Project-Management/

Comments can be sent to the mailing address at the top of the page, or via email to lrp.plan.enviro@usace.army.mil. Comments submitted via email must include the project title, "Seneca Nation of Indians Ecosystem Restoration Project," in the email subject line. Comments must be received or post-marked on or before 17 July 2019 to ensure consideration.

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Planning and Environmental Branch
William S. Moorhead Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

PUBLIC COMMENT FORM

Draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact

Seneca Nation of Indians Territory Ecosystem Restoration Project
Cattaraugus County, New York

Name (optional): _____

Address (optional): _____

Phone No. (optional): _____

Email (optional): _____

Comment: Request community participation in teams to remove Knotweed etc (after) training - esp HS community houses and planting of natives

The draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact are available electronically at:

http://www.lrp.usace.army.mil/Missions/Planning-Programs-Project-Management/

Comments can be sent to the mailing address at the top of the page, or via email to lrp.plan.enviro@usace.army.mil. Comments submitted via email must include the project title, "Seneca Nation of Indians Ecosystem Restoration Project," in the email subject line. Comments must be received or post-marked on or before 17 July 2019 to ensure consideration.

US Army Corps of Engineers®

Pittsburgh District
Planning and Environmental Branch
William S. Moorhead Federal Building
1000 Liberty Avenue
Pittsburgh, Pennsylvania 15222

PUBLIC COMMENT FORM

Draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact

Seneca Nation of Indians Territory Ecosystem Restoration Project
Cattaraugus County, New York

Name (optional): Barbara L

Address (optional): Bradford, PA

Phone No. (optional):

Email (optional):

Comment: I do not believe it is safe to use glyphosate in any amt. I due to many/much research that has been done recently

The draft Integrated Detailed Project Report, Environmental Assessment, and Finding of No Significant Impact are available electronically at:

http://www.lrp.usace.army.mil/Missions/Planning-Programs-Project-Management/

Comments can be sent to the mailing address at the top of the page, or via email to lrp.plan.enviro@usace.army.mil. Comments submitted via email must include the project title, "Seneca Nation of Indians Ecosystem Restoration Project," in the email subject line. Comments must be received or post-marked on or before 17 July 2019 to ensure consideration.

Appendix G

LETTER OF INTENT

Seneca Nation of Indians

Fish & Wildlife Department

90 Ohi:yo' Way, Salamanca, NY, 14779 PH: 716-945-2779

03 June 2014

Lenna Hawkins, Deputy for Programs and Project Manager
US Army Corps of Engineers, Pittsburgh District
William S. Moorhead Federal Building
100 Liberty Avenue
Pittsburgh, Pennsylvania 15222

Dear Ms. Hawkins:

In accordance with the provisions of Section 1135 of the Water Resource Development Act of 1986, as amended, the Seneca Nation of Indians (SNI) requests the Corp of Engineers to undertake a study to determine the feasibility of an environmental restoration project at the Kinzua/Allegany Reservoir on Seneca Nation of Indians Territories.

The SNI has two main concerns that have been well documented in recent years. The first concern is with large blue green algae blooms. The SNI and Corp of Engineers have been working jointly on water sampling within the Seneca Nation Territories for the previous 3 years and have documented the presence of enormous blue green algae blooms. The severity of these blooms have prompted the SNI and Corp of Engineers to post public warnings as early as late June and lasting through the month of December. These warnings have made the waters within the SNI Territory unsafe for public use and the fish/wildlife that depend on these waters. The Seneca Nation Community is unable to use their own waters for any purpose because the severity of the warnings issued. The cause of the algae bloom is unknown at this time; speculation has put the focus on the nutrient levels within the sediment/ silt that has accumulated since the Kinzua Dams inception.

The second concern within the SNI Territory is fish entrapment in critical nursery areas during pool level draw downs. There are a number of areas that land lock fish as the water pool levels are reduced. The times this event happens varies due to unpredictable weather patterns. Hundreds of thousands of fish die each year during these draw downs. The fish range from adult fish to young of year fish of ALL species. The majority of fish that perish are young of year fish, due to the fact that these areas of concern are shallow nursery areas. The areas get cut off from the natural river channel and the fish are not afforded a means of dispersal. The fish that are stranded die off due to a number

of reasons; oxygen deprivation, predation, evaporation and winter die offs or freezing of the remaining pools. Efforts are made by the SNI Fish & Wildlife Department to remove the stranded fish by use of nets and buckets but these efforts have proven to be futile. We are losing an enormous number of fish each year within the reservoir system. These populations, of assorted species, of fish are paramount to maintaining a healthy and balanced ecosystem.

The SNI looks forward to any recommendations and/or solutions to the issues that the Army Corp may provide. We are eager to find solutions and to implement them in order to restore our environment and ecosystem.

We are aware of the following cost sharing requirements associated with projects undertaken under this authority.

a) Feasibility Phase is federally funded up to $100,000. Costs in excess of $100,000 are cost share on a 50/50 basis with the Seneca Nation of Indians. The SNI's 50% share of any costs over $100,000 may be provided by in-kind services.
b) The preparation of plans and specifications is cost shared in the same proportion as construction.
c) The non-federal interests shall provide 25% of the cost of construction including the provision of all lands, easements, rights-of-way, and necessary relocations.
d) The non-federal share of the construction costs shall be paid after the project is approved for implementation and before a construction contract is awarded.
e) The sponsor is responsible for the operations and maintenance of the [project after completion.

It is understood that if it is found feasible and advisable to develop an environmental restoration project, the Seneca Nation of Indians would be required to provide the local cooperation and cost sharing prescribed by the Secretary of the Army.

If you have any questions please contact Shane Titus, Seneca Nation of Indians Fisheries Manager at (716)474-8642; 3689 Center Road Salamanca, NY 14779 or by email; shane.titus@sni.org

Sincerely,
Shane M Titus
Seneca Nation of Indians Fisheries Manager