4.2.14 Town of West Seneca Comprehensive Plan 2006, East of Burchfield (Buffalo Creek)

The Town of West Seneca Comprehensive Plan 2006, East of Burchfield site is located along both banks of Buffalo Creek east of Union Road. This site is comprised of multiple public and private parcels and riparian land features that total approximately 28 acres. The public parcels of the site are owned by the Town of West Seneca and include the Burchfield Nature and Art Center (Center), a public park located in the downstream portion of the site. The site also includes well-vegetated riparian areas along the left descending bank (LDB) and right descending bank (RDB) that extends approximately 2,800 feet upstream of the Center. The site is approximately 2.8 miles upstream from its confluence with Buffalo River and Cayuga Creek (see Figure 4.2.14-1). Most of the site is within a Federal Emergency Management Agency (FEMA) mapped floodplain. Adjacent land uses include public, residential, commercial, and agricultural land.

Figure 4.2.14-1 Town of West Seneca Comprehensive Plan 2006, East of Burchfield Site Location Map

4.2.14.1 Site Description

Biologists conducted a field assessment of the site in early November 2010 to identify existing habitats within the site associated with Buffalo Creek and determine their distribution and status. The following descriptions are based on observations made during the field assessment.

In-channel and Nearshore

The in-channel and nearshore area varies between approximately 80 and 100 feet wide throughout the site. The channel bed is smooth bedrock throughout the site, except in the upstream portion of the site where gravel and cobble overlies the bedrock. There is no channel-to-floodplain connection along either the LDB or RDB for approximately 800 feet upstream of the Union Road bridge. The channel is confined in this area by a shale cliff along the RDB and a stabilized em-

bankment along the LDB. Water depth is very shallow during low-flow conditions and water (approximately 6 inches to 1 foot deep) flows over exposed, smooth bedrock. High-flow conditions at this site often cause water levels to rise up to the 7-foot flood stage or higher, especially during ice jam conditions.

Photo 4.2.14-1 Channel bedrock and shale on the RDB 300 feet upstream from the Union Road bridge

There are short riffle-run features throughout the stream over the slight elevation variance in the smooth bedrock, which includes some cobble, gravel, and sand aggradation. The Seneca Creek outflow into Buffalo Creek along the LDB is approximately 1,500 feet upstream from the Union Road bridge. There was no submerged aquatic vegetation present with the exception of small occurrences of waterweed (*Elodea* sp.) and coontail (*Ceratophyllum demersum*) in nearshore scour pools downstream from the Seneca Creek confluence.

There is a split channel segment that flows along the RDB separating two large gravel bar islands in the stream located approximately 2,000 feet upstream of the Center. A flood control structure, which was constructed in 1964 is located between the two islands.

Photo 4.2.14-2 Upstream view of the 1964 flood control structure along the RDB

This flood control structure directs the majority of the volume of flow back to the main channel while allowing a greatly reduced volume to enter an overflow channel through spillways between the RDB and the larger island located downstream. The spillways were constructed to convey high flows at a controlled rate to the diversion channel but are choked with large woody debris. The diversion channel behind the flood control structure is approximately 50% open water and 50% fallen trees and large woody debris. Due to spillway constriction, the majority of volume that was designed to enter the diversion channel is redirected back to the main channel during flood events. Only a portion of high-flow volume enters the diversion channel. Standing water impounded by large woody debris and alluvium in the diversion channel inhibits drainage to the main channel at the downstream end. The channel upstream of the flood control structure carries shallow water during low-flow conditions and deeper scouring water during high-flow conditions over a sand and cobble substrate. There is no significant submerged aquatic vegetation or emergent wetland communities within the overflow channel.

Shoreline

The shoreline along the LDB of the main channel is smooth bedrock with some narrow mudflats and sand and gravel bars that are exposed during low-flow conditions. These features are vegetated with emergent wetland plants and shrubs including: purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*), river bulrush (*Scirpus fluviatalis*), common reed (*Phragmites aus-*

tralis), red osier dogwood (*Cornus sericea*), and occasional crack willow (*Salix fragilis*) and American sycamore (*Platanus occidentalis*) saplings.

Photo 4.2.14-3 Concrete toe protection along the LDB approximately 800 feet upstream of the Union Road bridge

The shoreline is characterized by smooth bedrock in some areas, but is predominantly unvegetated sand, gravel, and cobble with an occasional boulder cluster. A stable area with concrete toe slope protection is located where the shoreline ends along most or the LDB. There are some emergent plants along the shoreline behind large cobble and fallen trees where alluvial material and course woody debris has been deposited. Three large cottonwood (*Populus deltoides*) trees have fallen into the creek channel from the LDB approximately 2,000 feet upstream of the Center. These trees fell as a result of stream bank undercutting and failure. Active scouring and stream bank erosion occur behind the fallen trees. It is expected that high-flow conditions would move the trees and rootwads downstream and expose the remaining stream bank to scouring and erosion.

The shoreline along the RDB upstream of the shale cliff face is narrow, approximately 4 to 10 feet wide, and gradually slopes into the floodplain. It is a combination of unconsolidated gravel bars that are sparsely vegetated with crack willow, red osier dogwood, reed canarygrass, and purple loosestrife. There is approximately 300 feet of concrete block toe protection along the RDB shoreline between the shale cliff and the gravel shoreline near and upstream of the flood control structure.

Stream Bank

The LDB from the Union Road bridge is approximately 20 feet high near the Center. Approximately 1,500 feet of articulated concrete block toe protection is pinned into the bedrock along the LDB at the toe of the stream bank beginning approximately 800 feet upstream of the Center. Approximately 300 feet of toe protection is in place along the RDB of the large island upstream of a shale cliff and concrete retaining wall and opposite of the Seneca Creek confluence along the LDB. This toe protection armoring was installed by the Erie County Soil and Water Conservation District to reduce flood damages to the Buffalo River watershed and reduce sedimentation in the Buffalo River. There is some erosion which has begun behind the existing toe protection on the LDB upstream of Seneca Creek where undercutting occurs behind the concrete bocks. There is evidence of ice scour along the banks and stream bank erosion above the armoring as well as scrapes from ice on tree trunks along the stream bank.

Photo 4.2.14-4 LDB stream bank failure and tree loss upstream of Seneca Creek confluence

The LDB is approximately 6 feet high near the upstream end of the site. The RDB is approximately 2 to 3 feet high with a gradual slope to the top of the stream bank in the upstream end of the site. The RDB rises to approximately 25 feet in the form of a shale cliff downstream near the Union Road bridge. The vegetation on the LDB near the toe is predominantly reed canarygrass (*Phalaris arundinacea*) and little blue stem (*Schizachrium scoparium*), purple loosestrife (*Lythrum salicaria*), beggar ticks (*Bidens frondosa*), and crack willow (*Salix fragilis*) saplings.

Inland and Upland

Inland and upland areas along the LDB from the top of the stream bank between the Center and Seneca Creek are a combination of parkland and a mature floodplain forest with elevated boardwalks and trails leading to the creek with a series of interpretive wildlife viewing areas. Soils are fertile Teel silt loam and Wayland silt loam alluvial floodplain soils. Common native tree species include cottonwood, common buckthorn, slippery elm (*Ulmus fulva*), red oak (*Quercus rubra*), quaking aspen (*Populus tremuloides*), black walnut (*Juglans nigra*), and American sycamore (*Platanus occidentalis*). Abundant terrestrial invasive plants in this area include Japanese knotweed (*Polygonum cuspidatum*), mugwort (*Artemisia vulgaris*), common buckthorn (*Rhamnus cathartica*), and bush honeysuckle (*Lonicera morrowii*).

Photo 4.2.14-5 LBD upstream of Seneca Creek confluence looking downstream

The area upstream of the Seneca Creek confluence along the LDB is highly modified by grading and contouring of land from the top of the stream bank inland. In this 100-foot-wide area, there are worn paths through a complex of lanes used as a BMX bicycle race course with dirt ramps beginning approximately 15 to 20 feet inland from the top of the stream bank. There is a trail that runs along the bank from the BMX course outside the site boundary to the east. The upland area is predominantly bottomland forest dominated by cottonwood trees overhanging the creek in some areas. Other species identified include red maple (*Acer rubrum*), Norway maple (*Acer platanoides*), red oak, and black walnut.

A mix of vegetative communities covers the inland and upland areas along the RDB upstream of the shale cliff. An early successional floodplain forest ranging from 50 to 200 feet wide extends to the top of the stream bank and provides open canopy shade. The understory is dominated by Japanese knotweed, bush honeysuckle, and reed canarygrass with some white snakeroot (*Ageratina altissima*). The top of the stream bank is occupied by well-established, narrow stands of little bluestem (*Schizachyrium scoparium*), which are a product of the revegetation following construction of the flood control structure in 1964. The inland and upland component of the floodplain extends inland to a steep embankment along Clinton Street in the downstream portion of the site. In the upstream portion of the site, the inland and upland component is forested and extends to a sloped bank along residential landscapes at the rear of a residential area. There is evidence of severe over browsing by deer in this area.

4.2.14.2 Restoration Opportunities and Actions

The existing land use, including public access and infrastructure as well as the available land within the riparian corridor along the LDB, provides a number of habitat restoration and soil stabilization design opportunities. In addition, the amount of available space increases the number of restoration options for resistive and redirective in-channel and nearshore features as well as bank re-shaping techniques that would have to be tied back into stable bank areas. Their implementation would address soil instability and improve water quality, and allow natural regeneration of native plant communities in the shoreline, stream bank, and inland and upland areas. Those measures would also increase wildlife habitat structure and function. Together, proposed restoration measures would, therefore, contribute to the BUI delisting process (see Table 4.2.14-1 and Figure 4.2.14-2).

In-Channel and Nearshore

The main channel is wide and shallow from the Union Road bridge to the Seneca Creek confluence. Smooth bedrock substrate and shallow flow provides minimal opportunity for effective fishery and benthos habitat enhancement, especially during seasonal low flow conditions. The in-channel and nearshore restoration opportunities would primarily be resistive and redirective features designed to stabilize the nearshore. The result would be a positive impact on shoreline habitat areas along the LDB.

Resistive features are effective against scour erosion of the stream banks and shoreline from high flows and ice-out conditions. Log revetments and similar structures would deflect the scouring velocity of high flows as well as protect stream bank soils and root systems. A smooth, deflective surface would decrease impacts of near-bank scouring velocity and shear stress on shoreline and stream bank during channel forming flow levels. Also, resistive features would hold soils in place in freeze/thaw conditions.

Redirective features, such as vanes and Bendway weirs, are effective in redirecting both ice and high flows away from the shoreline and bank. Redirective fea-

tures would cause direct ice flow toward the center of the channel with less impact on the shoreline and stream banks.

In areas without toe protection or where failures in this feature have occurred, resistive features, such as toe protection and log revetments, would help to protect the bank and stabilize the shoreline. Redirective features would move stream flow away from the shoreline (typically away from vulnerable banks and trees at the top of stream bank) and toward the center of the channel. Redirective features include, but are not limited to, bendway weirs and vanes.

The in-channel and nearshore restoration opportunities are primarily features designed to support the deposition of alluvial material nearshore along stabilized shoreline areas. The capture and retention of sediment would expand the width of the shoreline area and support establishment and expansion of emergent wetland communities. The wetland communities would provide aquatic habitat value, cover, and forage for aquatic, bird, and terrestrial wildlife species. Vanes could be placed at appropriate distances to redirect high velocity flows, causing sediment to be deposited immediately downstream of these features between the vanes and the shoreline. Flows would then create scour pools in the deposited sediment, providing fish and benthos habitat close to shore. The opportunity for in-channel fishery and benthos habitat enhancement is limited due to the smooth bedrock channel and exposed, shallow water during low-flow conditions

The channel immediately downstream of the flood control structure along the RDB is contained by approximately 300 feet of concrete block toe protection. Gravel bars and depositional features in the nearshore area along the RDB are expanding naturally. The design and construction of in-channel and nearshore features must support natural aggradation in this area and be designed to withstand the scouring action associated with annual ice flow dynamics and ice jam flooding conditions in this area. The detailed planning and design process would have to evaluate all proposed restoration features to ensure that the structures would not impede ice flows.

Shoreline

The bank and riparian areas in the locations discussed above warrant immediate attention for habitat restoration and enhancement activities. Specifically, the in-channel and nearshore features discussed above would provide the foundation to support the use of bioengineering methods to stabilize channel bed load and nearshore depositional material. If scour was reduced, soil and organic matter would be retained and would allow the emergent aquatic plant communities to regenerate, thereby creating a more natural shoreline that would be resilient to erosion from flowing water and ice. With seeding and planting, the exposed sand and gravel shoreline areas along the RDB in proximity of the flood control structure could support a diverse emergent plant community. The shoreline along the RDB and LDB of the side channel between the large island and the floodplain forest area is vegetated with Japanese knotweed, which is expanding and eliminating native plant communities. Invasive species control and management integrated

with native plant community regeneration in this area would provide valuable habitat in areas not vulnerable to velocity scour. This area provides ideal conditions for live staking, seeding, and planting with a high probability of establishment due to the presence of saturated, fertile, and stable soils.

Stream Bank

Bioengineered approaches, such as live siltation, live staking, vegetated riprap, and coir logs would complement the stream bank reshaping design. Reshaping vertical banks combined with appropriate bioengineering methods and restoration features designed to stabilize toe of the stream bank would provide a naturally resilient stream bank that would resist undercutting during high-flow events. It is expected that following the seeding and planting of native emergent and terrestrial plant species, communities would develop in stable, depositional areas at the toe of stream banks and on stream bank faces.

Bioengineering for soil stabilization and bank re-shaping along with invasive species control integrated with a native species planting plan would provide hydraulic roughness during high-flow and flood events. Sediment transport mechanisms would provide alluvial material for capture and deposition, thereby, improving habitat and increasing overall shoreline and stream bank resilience to scouring flow conditions.

Invasive species control and management integrated with native plant community regeneration as discussed above is directly applicable to stream bank areas along the RDB and LDB of the side channel between the large island and the floodplain forest area.

Inland and Upland

The area along the LDB within the entire site presents opportunities for riparian habitat enhancement and connection of existing features within the riparian corridor. The forested floodplain within the Center's trail complex represents native species richness and valuable riparian habitat. The shrub and herbaceous understory in this area could be enhanced with additional species of high wildlife value. Native species richness and density declines upstream of the Center's walking trail complex and the confluence of Seneca Creek. Native tree, shrub, and herbaceous species could be introduced by planting and seeding to improve habitat diversity in each vegetation layer.

Four invasive species—Japanese knotweed, mugwort, common buckthorn, and bush honeysuckle—are well established throughout the upland and inland area along the LDB and RDB. Densities were variable and were observed to be expanding throughout the site. Control and management of these species in the proposed project work areas followed by aggressive planting would prevent them from re-establishing large communities. Planting native species in this area and throughout the riparian corridor for diversity would enhance habitat by regeneration of native plant communities and would stabilize the fertile alluvial soil. Candidate species known to be part of primeval forests in the region that are recom-

mended for reintroduction to the site include American basswood (*Tilia Americana*), shagbark hickory (*Carya ovata*), burr oak (*Quercus macrocarpa*), American sycamore, swamp white oak (*Q. bicolor*), and pin oak (*Quercus palustris*).

Photo 4.2.12-6 LDB stream bank and toe protection failure along shoreline erosion immediately upstream of the Seneca Creek confluence

Evidence of deer overpopulation and beaver presence was observed during the site survey and represent a severe constraint to the regeneration of native plant communities. Control of invasive plant communities is expected to be more difficult due to the palatability and preference of native plants over non-native, invasive species present on the site.

Table 4.2.14-1 Summary of Restoration Opportunities for the Town of West Seneca Comprehensive Plan 2006- East of Burchfield Site

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-Channel and Nearshore	Minimal fish and benthos habitat enhancement In-stream structure creation and enhancement Emergent and submerged aquatic vegetation bed development Nearshore sediment stabilization and emergent wetland community regeneration	Bioengineering with resistive and re-directive features to preserve natural channel geomorphology Hydraulic cover stones Re-directive features – bendway weirs, locked logs, rootwads, hydraulic cover stones Nearshore structure to support submerged aquatic vegetation
Shoreline	Bank stabilization Toe protection Sediment and erosion control Expansion of emergent wetland community	Large woody debris for sediment retention and capture Repair existing toe protection Longitudinal toe protection Native wetland species plantings and live staking in combination with coir log and log revetment toe protection and other stabilizing features for sediment retention over time
Stream Bank	In-channel hydraulic modification of flow/velocity Sediment and erosion control Increasing stream bank vegetation diversity to enhance habitat value and soil stability	Bioengineering for soil stabilization, bank re-shaping Geotextile erosion control, live staking, vegetated riprap, longitudinal toe protection integrated with side slope native riparian plantings – herbaceous, shrub, and tree layers
Inland and Upland	Enhancing upland habitat structure, complexity, and diversity Invasive species control and management	ISCMP integrated with revegetation plan and planting plan to regenerate native communities - warm season grasses and forbs, mast bearing and canopy shade producing trees with shrub understory Forested floodplain habitat enhancement for riparian bird and amphibian species

4.2.14.3 Considerations and Potential Constraints for Restoration

The wide riparian corridor along the RDB would allow for substantial bank re-shaping and inland and upland restoration design. Riparian alluvial soils are excellent for re-establishing native plant communities. A cooperative effort by landowners and other stakeholders to address bank erosion could be facilitated by the landowners' incentive to stop the loss of their land and tree cover.

Restoration design and planting plans would require the development of a strategy to address damage to vegetation caused by white-tailed deer and beaver. There is ample evidence of stress to native vegetation across the site by these species.

Invasive Plant Communities

All restoration methods and techniques should be integrated with a site-wide ISCMP. Invasive species control measures would be implemented to address the ecological impacts and physical constraints that invasive plant communities present to restoration planning and design phases. A multi-season effort is recommended to establish a control and management regime that would prepare the site for regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities requires the integration of control and management methods and re-vegetation plans. Chemical and mechanical control methods should focus on areas from top of stream bank to inland and upland areas prior to constructing the remainder of the habitat restoration design. If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP.

Bank Erosion and Bank Failure Control Features

Stream bank stabilization features to address severe erosion would be designed and installed to substantially reduce sediment loading from the site. During the planning and design process, priority should be given stabilization of stream banks with severe erosion and those exhibiting conditions of imminent failure in the short term.

Pre-Construction Work

Examination of the hydraulic environment along the affected reaches, as well as upstream and downstream of those areas, would be necessary to determine the specific variables that create the current situation. Further field evaluations would need to be performed in order to develop a functional design that would protect the LDB and RDB of this portion of Buffalo Creek.

The design of restoration features for use in the channel and in nearshore, shoreline, and stream bank areas would require additional analyses in order to more closely define the types and siting of the features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data

would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems, or impediments to navigation, would not occur upstream or downstream of the site if in-channel structures were constructed.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.14-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

4.2.14.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.14-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Preconstruction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Stone-pinned rootwads,

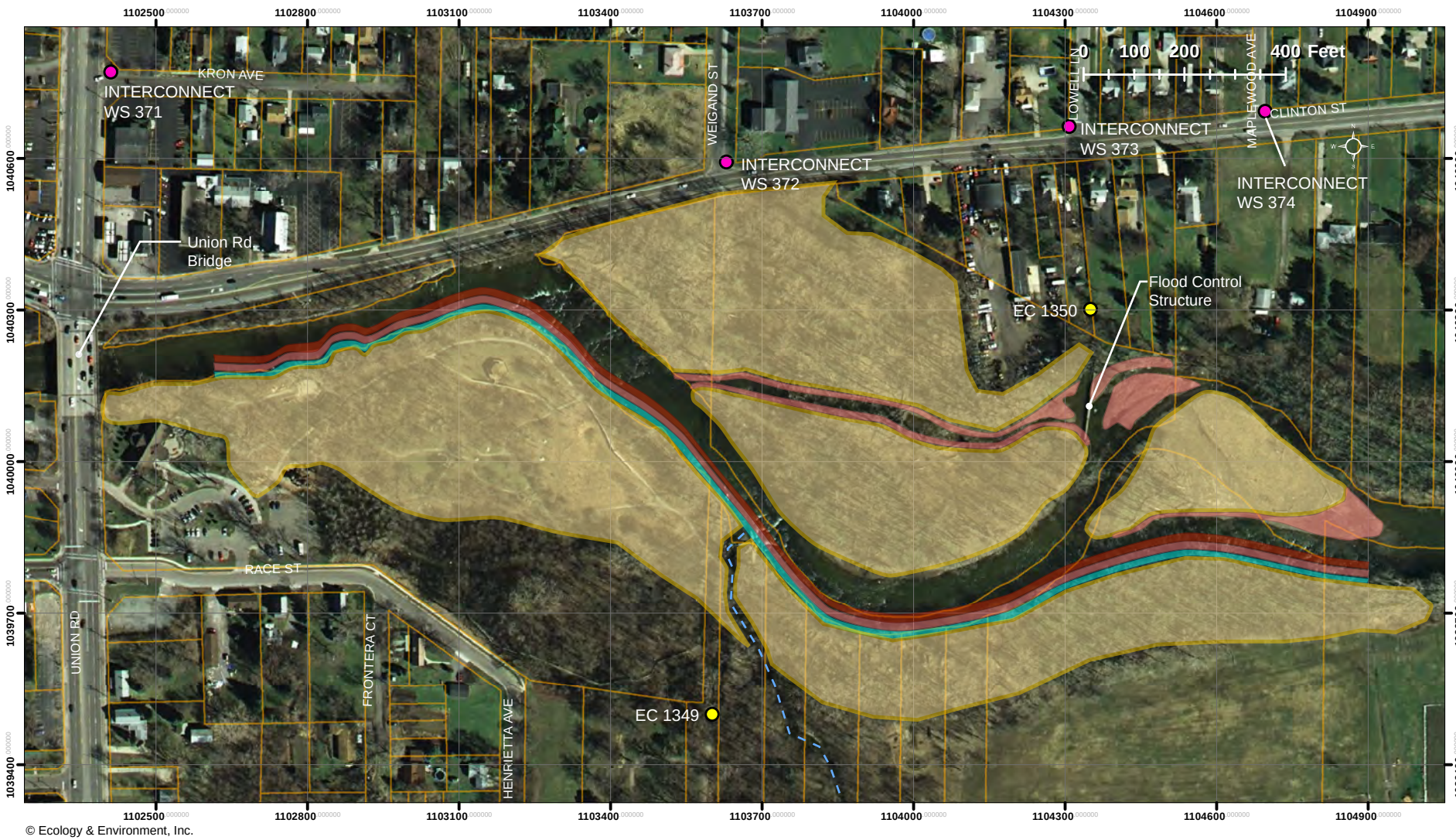
- Single stone bendway weirs,
- Rock keys (tiebacks for bendway weirs),
- Stone toe protection,
- Log revetment,
- Vegetated riprap, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $1,758,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.14.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 located in Section 5.5. Project sponsors are advised that there could be other permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.



(All Areas Approximate)

In-channel and Nearshore | Shoreline | Stream Bank | Inland and Upland

Stormwater Outfall | Stormwater Interconnect | SPDES | Seneca Creek

Parcel | Federal Navigation Channel, Approximate Location | Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.14-2
Potential Restoration Areas
Town of West Seneca
Comprehensive Plan 2006,
East of Burchfield
Nature Center

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W E
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4.2.15 Thruway to Railway (Cazenovia Creek)

The Thruway to Railway site is located along both banks of Cazenovia Creek, extending upstream of the Orchard Park Road bridge crossing to the railroad bridge crossing north of Orchard Park Road. Multiple public and private properties comprise this site, which lies approximately 2.0 miles upstream of the confluence of Cazenovia Creek and the Buffalo River. Adjacent land uses are primarily commercial, with some residential areas and vacant parcels.

Figure 4.2.15-1 Thruway to Railway Site Location Map

4.2.15.1 Site Description

Field biologists conducted an assessment of the site in October 2010 to identify existing habitats within the Seneca Bluffs site and determine their distribution and status. The following descriptions are based on observations made during the field assessment.

In-channel and Nearshore

The channel width is approximately 100 feet throughout the entire section between the railroad lines and the Orchard Park Road bridge. The channel bed is composed of smooth bedrock covered in most areas with gravel and cobble. There are many linear gravel and sediment bars along the left descending bank (LDB), which in shallow nearshore areas are vegetated with crack willow (*Salix fragilis*), purple loosestrife (*Lythrum salicaria*), river bulrush (*Scirpus fluvitalis*), and other emergent aquatic macrophytes. Because of the flat bedrock stream bed and channel width, the channel is primarily a riffle-and-run feature, with only a few pools. There was no evidence of submerged aquatic vegetation in nearshore areas.

Photo 4.2.15-1 Nearshore gravel and sediment bars with emergent aquatic vegetation

Photo 4.2.15-2 Floodplain access along the RDB

The channel has no access to the floodplain along the LDB, but the channel is well connected to the floodplain along the right descending bank (RDB). The floodplain is approximately 150 feet wide and 2,000 feet long.

Shoreline

There is no defined shoreline along the LDB, with the exception of occasional sediment and gravel depositional areas. The depositional areas closer to the stream bank are vegetated, as noted above, but most are transient features that are mobilized and transported downstream during high-flow conditions.

Photo 4.2.15-3 Steep stream bank without contiguous shoreline

Stream Bank

The two banks along Cazenovia Creek at the Thruway to Railway site have different characteristics. The LDB has nearly vertical, modified slopes and is approximately 10 to 15 feet high, and there is a man-made berm at the top of the bank. The stream bank is composed primarily of native soils, with added fill material and some riprap scattered throughout. There is armor along the toe of the slope, which is non-continuous. Some undercutting and scour of the toe area of the stream bank is evident downstream of the railroad bridge for approximately 200 feet. Invasive plant communities are well established throughout the site, but Japanese knotweed (*Polygonum cuspidatum*), common buckthorn (*Rhamnus cathartica*), and Morrow's bush honeysuckle (*Lonicera morrowii*) are dominant along the LDB and contribute to soil and slope instability. Other species present include Canada goldenrod (*Solidago canadensis*) and common reed (*Phragmites*

australis) near the toe of the stream bank. Reed canarygrass (*Phalaris arundinacea*), mugwort (*Artemisia vulgaris*), and riverbank grape (*Vitis riparia*) are also present in the herbaceous layer. In addition, cottonwood (*Populus deltoides*) and tree of heaven (*Ailanthus alitissima*) are near the top of the stream bank and overhang the slope.

The LDB is severely eroding approximately 1,600 feet downstream of the railroad bridge, exhibiting mass wasting conditions for approximately 300 feet. The stream bank in this area is nearly vertical, approximately 12 feet high, and is covered with a monoculture of Japanese knotweed, which extends from the toe of the slope to the top of the bank and inland. The managed landscape near the top of bank area has few trees and is mowed to the edge of the bank to control the knotweed. Several large cottonwood trees have fallen into the channel in recent years due to bank instability.

Photo 4.2.15-4 Fallen trees and mass wasting conditions

Alluvial soils are exposed from the top of the stream bank to the water's edge and are being undercut and eroded during high-flow and ice-out conditions. Stone armoring material placed irregularly along the slope has retarded bank failure and tree loss. There is some regeneration of crack willow saplings near the toe of the slope in collapsed stream bank soil beds. Without reinforcement or protection, this vegetation is expected to be eroded and transported downstream during high-flow or ice-out conditions in the near future.

Photo 4.2.15-5 Stream bank failure

The RDB is approximately 4 to 6 feet high and slopes directly into the stream without a shoreline. This bank is adjacent to the active forested floodplain. In the downstream portion of the site, along the long outside bend where the stream nears Seneca Street, the RDB is armored along the toe of the stream bank and up the slope. Upstream, near the railroad bridge, the RDB is not armored. Vegetation along the RDB consists primarily of cottonwood and willow, which overhang the stream channel, and Japanese knotweed, which is present in the understory.

Inland and Upland

Along the LDB, the land from the top of bank area to the inland and upland areas is a combination of reverting old fields, a narrow riparian buffer, and commercial properties with their respective managed landscapes. The riparian buffer is wooded with cottonwood, green ash (*Fraxinus pennsylvanica*), common buckthorn, hawthorn (*Crataegus* sp.), Morrow's honeysuckle, mugwort, and Japanese knotweed.

The area behind the RDB is forested floodplain. The tree layer is dominated by cottonwood and crack willow. The understory is dominated by Japanese knotweed.

4.2.15.2 Restoration Opportunities and Actions

The primary restoration opportunity is stabilization of approximately 300 feet of the identified eroding stream bank along the LDB, near the Ironworker's Union Hall on Orchard Park Road. The existing composition, structure, and uses of the

Thruway to Railway site offer a number of habitat restoration opportunities that would result in the improvement of water quality and increase fish and wildlife habitat structure and function. The proposed measures would contribute to the BUI delisting process (see Table 4.2.15-1 and Figure 4.2.15-2). Control and management of invasive species communities on this stream bank section should be followed by redirective and resistive features in nearshore and toe of stream bank areas, with bioengineering measures used to restore native plant communities for soil and slope stabilization.

Control and management of riparian invasive species in stream bank and upland areas would enhance wildlife habitat, stabilize soil, and develop a native plant seedbank for dispersal and colonization in downstream and off-site areas.

In-channel and Nearshore

In the nearshore area adjacent to the identified area of stream bank failure along the LDB, the design and construction of single stone bendway weirs, rock vanes, log or stone revetments, and rootwads would move the thalweg and scouring flows away from vulnerable or eroding banks. The proper orientation of these features as resistive and redirective structures would reduce the impact of ice and velocity scour during high-flow conditions by diverting hydraulic energy toward the center of the channel. The design and orientation of hydraulic cover stones, locked logs, and pinned rootwads could enhance fish habitat by increasing in-channel structure and complexity, and protect stream banks and shoreline areas from scouring flows. In addition, these features would provide in-stream cover and oxygenation during low-flow conditions, thereby improving fishery and benthic organism habitat.

Shoreline

The introduction of structure to provide “hydraulic roughness” to capture sediment and gravel during flood events would support the formation of emergent aquatic plant communities and protect existing vegetated bar features from erosion. Large woody debris or logs combined with strategic placement of stone toe protection and planted with appropriate plant species would provide natural stream bank protection and enhance habitat values.

Stream Bank

Severe stream bank erosion in the areas described above could be stabilized by passive bioengineering methods and techniques. There is room on this site to excavate the top of the stream bank in order to create a gentler, more stable slope. There is also room to install structures in the nearshore area and establish native vegetation from the shoreline to the top of the stream bank. These measures could provide the physical structure for stream bank reshaping to accommodate the addition of soil amendments to facilitate native species regeneration. A diverse native riparian plant community would provide greater soil stability, be more resilient to ice scour, and improved riparian habitat.

Inland and Upland

Japanese knotweed control and management is critical to the design and regeneration of native plant communities from the top of the stream bank to inland. The existing managed landscape could be modified to include an approximately 100 feet wide riparian buffer that would be fully integrated with stream bank and shoreline revegetation. Forest restoration in this area would provide canopy shade and a dense shrub and herbaceous understory, which would compete with future recruitment of invasive plants. Property owners' need for stream access or desire for a less wild appearance can be addressed by designing tree and shrub islands with integrated paths or trail access routes.

4.2.15.3 Considerations and Potential Constraints for Restoration

Pre-Construction Work

The design of restoration features for the in-channel and nearshore, shoreline, and stream bank areas would require additional analyses in order to more accurately define the types and siting of the features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems would not occur upstream or downstream of the site if the channel cross section or stream bank were modified.

Invasive Plant Communities

Control measures could be implemented to address the ecological impacts and physical constraints presented by invasive plant communities to restoration planning and design. A multi-season effort is recommended to establish a control and management regime that would prepare the site for regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities would require the integration of control and management methods and revegetation plans. Chemical and mechanical control methods should focus on infested areas prior to constructing the remainder of the habitat restoration design (e.g., native plantings). Invasive species control and management should be coordinated with implementation of other restoration measures for proper sequencing and effectiveness.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.15-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Map-

per Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

Table 4.2.15-1 Summary of Restoration Opportunities at the Thruway to Railway Site, Cazenovia Creek

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-channel and Near-shore	In-channel habitat structure and complexity Integrated resistive and redirective hydraulic features with stream bank soil bioengineering with to preserve natural channel geomorphology to enhance fishery and benthos	Redirective features – bendway weirs, rock vanes, stone or log revetments, locked logs, and rootwads
Shoreline	Shoreline stabilization Sedimentation and erosion control Aquatic habitat diversity	Longitudinal toe protection Native wetland species plantings in combination with log or stone toe revetments and other stabilizing features for shoreline soil stabilization and sediment retention over time Seeding and planting of emergent aquatic macrophytes for shoreline community diversity and habitat value
Stream Bank	Bank stabilization Toe protection Sediment and erosion control Increasing riparian structure and diversity to enhance habitat value and soil stability	Bioengineering for soil stabilization and retention Bank reshaping Geotextile erosion control with native riparian plantings – herbaceous, shrub, and tree layers. Integrated soil bioengineering with resistive and redirective features designed to protect toe of stream bank from undercutting and preserve natural stream bank and shoreline geomorphology

Table 4.2.15-1 Summary of Restoration Opportunities at the Thruway to Railway Site, Cazenovia Creek

Focus Area	Restoration Opportunities	Restoration Features and Methods
Inland and Upland	Invasive plant community control an management to increase native species richness Increase habitat connectivity and habitat structure and complexity to complement existing restoration design for restored parts of the site	Multi-layered plantings of diverse native species to enhance tree, shrub, and herbaceous riparian buffer communities Regeneration of floodplain forest on a larger portion of the site Introduction of species to produce a "habitat modification" effect (canopy shade, mast production, seedbank enhancement)

4.2.15.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.15-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Stone–pinned rootwads,
- Bendway weirs,
- Single-stone bendway weirs,
- Stone toe protection,

- Rock vanes,
- Tiebacks for single-stone bendway weirs,
- Coir logs, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $1,062,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.15.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 in Section 5.5. Project sponsors are advised that there could be additional permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.

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(All Areas Approximate)

In-channel and Nearshore

Shoreline

Stream Bank

Inland and Upland

Stormwater Outfall

Stormwater Interconnect

SPDES

Parcel

Federal Navigation Channel, Approximate Location

Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.15-2
Potential Restoration Areas
Thruway to Rail Way
West Seneca, New York

4.2.16 Railway to Ridge Road (Cazenovia Creek)

The Railway to Ridge Road site is located in West Seneca along the left descending bank (LDB) of Cazenovia Creek. The site extends approximately 3,100 feet from an abandoned railroad bridge north of Orchard Park Road at the downstream end to approximately 1,200 feet north of Ridge Road at the upstream end. This site covers approximately 20 acres and is located approximately 4 miles upstream of the confluence of Cazenovia Creek with the Buffalo River. The site is owned by multiple public and private owners. Adjacent land uses include residential, industrial, commercial, and a public school. Seneca Street parallels the top of the right descending bank (RDB) within the upstream portion of the site for approximately 1,300 feet.

Figure 4.2.16-1 Railway to Ridge Road Site Location Map

4.2.16.1 Site Description

Field biologists conducted an assessment of the site in October 2010 to identify existing habitats within the Railway to Ridge Road site and associated resources in proximity to Cazenovia Creek and determine their distribution and status. The following descriptions are based on observations made during the field assessment.

In-channel and Nearshore

The channel and nearshore width ranges from approximately 80 to 100 feet along the site. This section of the stream channel is generally shallow, ranging from approximately 1 to 3.5 feet deep. The channel substrate and nearshore area are a mix of boulder, cobble, and gravel with a thin layer of sand on top.

Photo 4.2.16-1 Channel upstream of the abandoned railroad bridge (looking downstream)

Photo 4.2.16-2 Steep stream bank without contiguous shoreline (looking downstream)

Masonry debris is present in the channel and nearshore areas, primarily in the upstream portion of the site. Run, riffle, and pool habitats are located within the site, the most notable being a run habitat where the creek winds through dense beds of water willows (*Justica americana*) on mud flats. This habitat is present on both sides of the stream channel for approximately 2,000 feet in the upstream portion of the site. No other aquatic vegetation was observed.

The channel has no access to the historic floodplain along the LDB for approximately 1,000 feet upstream of the abandoned railroad bridge due to modification and shaping of the LDB to accommodate development on this site; further upstream, the channel does have access to the floodplain. The channel is well connected to its floodplain along the right descending bank (RDB), allowing for overbank flooding and flood flow storage and dissipation.

Shoreline

There is no defined shoreline along the LDB for approximately 1,000 feet upstream of the abandoned railroad bridge, with the exception of a few small areas of gravel deposits.

Stream Bank

The LDB ranges from 6 to 15 feet high and is vegetated throughout, except where there is serious erosion. The stream bank is nearly vertical for approximately 1,000 feet upstream of the abandoned railroad bridge. The stream bank appears to have been shaped and stabilized into a constructed berm that extends inland approximately 50 feet and is approximately 200 feet long. This was constructed sometime after 1927, based on an analysis of aerial photography. A 1927 aerial photo of the site clearly shows a narrow, forested buffer between the stream channel and cultivated farmland, as well as large gravel bars near the abandoned railroad bridge along the LDB. Upstream of this portion of the site, the stream banks are steep along the inside bend and appear to have been shaped. However, all banks more than approximately 1,000 feet upstream of the abandoned railroad bridge have more natural slopes, slope toes, and shoreline features. A small tributary flows into the stream from a culvert under Seneca Street, near the beginning of the long outside bend in the middle portion of the site.

The dominant vegetation on the stream bank along the LDB consists of crack willow (*Salix fragilis*), Japanese knotweed (*Polygonum cuspidatum*), and reed canarygrass (*Phalaris arundinacea*). Water willow is the dominant species along the toe of the stream bank to shoreline area and into the mid-channel along both the LDB and RDB, with some purple loosestrife (*Lythrum salicaria*), upstream of the proposed restoration area (see Figure 4.2.16.2)

There is significant stream bank erosion on the LDB approximately 300 to 400 feet upstream of the abandoned railroad bridge, where an overhead electric transmission line crosses the stream. The bank is eroding toward, and could eventually reach, the power line if the erosion is not controlled. High-velocity, high-stage flows and ice scouring are also causing erosion on the upper slopes.

Invasive plant communities are well established throughout the site. Japanese knotweed (*Poligonum cuspidatum*), common buckthorn (*Rhamnus cathartica*), and Morrow's honeysuckle (*Lonicera morrowii*) are dominant along the LDB and contribute to soil instability and habitat degradation throughout the site. Other invasive species present on stream banks include mugwort (*Artemisia vulgaris*) and common reed (*Phragmites australis*) near the toe of the stream bank. In addition, several specimens of tree of heaven (*Ailanthus alitissima*) grow near the top of the stream bank and overhang the slope. Reed canarygrass is abundant in the understory where Japanese knotweed is not dominant.

Photo 4.2.16-3 Active erosion along LDB with invasive species (looking upstream)

Inland and Upland

A forested riparian buffer approximately 20 to 60 feet wide occurs on the top of stream bank along the LDB throughout most of the site. This area is a mix of early successional softwood trees, including European black alder (*Alnus glutinosa*), crack willow, black willow (*S. nigra*), cottonwood (*Populus deltoides*), and a few sycamores (*Platanus occidentalis*). The understory of the forested buffer consists of Japanese knotweed and mugwort.

The inland to upland area along the LDB, between the narrow forested buffer and commercial development on the site, is a mix of reverting old field vegetation and dense stands of European black alder. Other species along edges of black alder tickets include cottonwood, green ash (*Fraxinus pennsylvanica*), common buck-

thorn, hawthorn (*Crataegus* sp.), Morrow's honeysuckle, mugwort, common reed, and Japanese knotweed. Because of canopy shade, the Japanese knotweed understory that is dominant in the thin forested buffer area and elsewhere on the site is not present in the European alder thickets.

Beaver (*Castor canadensis*) are cutting all species of trees on the site except tree of heaven. Over-browsing by deer is impacting the natural regeneration and survival of native plant communities throughout the site.

4.2.16.2 Restoration Opportunities and Actions

Control and management of invasive species communities on stream banks and inland to upland areas is a priority action and should be followed by the regeneration of native plant communities. This would provide for soil stabilization and habitat enhancement throughout the site. According to the Erie County Soil Survey, the majority of the site is deep, fertile Hamlin Silt Loam and Teel Silt Loam. These soils are classified as "prime agricultural" soils and would support the regeneration and resilience of native plant communities.

Potential in-channel and nearshore restoration activities include development of scour pools and shoreline creation in portions of the stream upstream of the abandoned railroad bridge. In-channel and nearshore resistive and redirective structures would provide stream bank protection and stable shoreline areas, which would foster the development of emergent plant communities. The emergent water willow communities established on mud flats and gravel bars are considered to be reference features within the watershed. Among other functions, these vegetated gravel bars increase habitat complexity and increase hydraulic roughness. The water willow communities could be utilized as "donor sites" for nearshore emergent plant restoration.

Photo 4.2.16-4 An emergent community of water willow (*Justicia Americana*) (looking downstream)

Low-growing trees and shrubs could be planted or seeded on the upland terrace to increase diversity and function while also maintaining areas of grasses and herbaceous plants.

Implementation of habitat restoration features would contribute to the BUI delisting process (see Table 4.2.16-1 and Figure 4.2.16-2).

In-channel and Nearshore

In the nearshore area adjacent to the identified area of stream bank failure along the LDB, the design and construction of single-stone bendway weirs, rock vanes, log or stone revetments, and rootwads would move the thalweg and scouring flows away from vulnerable or eroding banks. The proper orientation of these features as resistive and redirective structures would reduce the impacts of ice and velocity scour during high-flow conditions by diverting hydraulic energy towards the center of the channel. The design and orientation of hydraulic cover stones, locked logs, and pinned rootwads would enhance fish habitat by increasing in-channel structure and complexity while protecting stream banks and shoreline areas from scouring flows. In addition, these features would provide in-stream cover and oxygenation during low-flow conditions, thereby improving fishery and benthic organism habitats.

Shoreline

Structures could be installed to provide hydraulic roughness, capture sediment and gravel during high-flow events, and stabilize depositional areas. The stabilization of depositional areas would support the formation of emergent aquatic plant communities and protect existing vegetated bars from erosion. Natural shoreline roughness could be provided by a combination of strategically placed stone toe protection, plantings of appropriate plant species, and anchoring of large, woody debris or logs. Together, these measures would reduce the impacts of scouring on developing emergent aquatic habitat features.

Stream Bank

Stream banks experiencing severe erosion could be stabilized by integrating passive bioengineering methods with traditional stone toe protection. This site has adequate space to reshape the stream bank and integrate structures and native plantings in the area extending from the nearshore to the top of the stream bank. These measures could provide the physical structure for stream bank reshaping, which would facilitate native species regeneration. A diverse native riparian plant community would provide greater soil stability, resilience to velocity and ice scour, and valuable wildlife habitat.

Inland and Upland

Japanese knotweed control and management is critical to the design and regeneration of native plant communities from the top of the stream bank to inland areas. The existing reverting old field landscape could be restored to a significant riparian forest community, which would provide effective competition to the colonization of invasive plants. Floodplain forest restoration in this area would provide canopy shade and a dense shrub and herbaceous understory that would compete with future incursions of invasive plants.

4.2.16.3 Considerations and Potential Constraints for Restoration

Pre-Construction Work

Design of restoration features in in-channel and nearshore, shoreline, stream bank, and inland and upland areas would require additional analyses in order to more accurately define the sizes, total areas, and locations for the features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For instance, regulators may require project sponsors to use hydrologic models to demonstrate that flooding or excessive bank erosion would not occur upstream or downstream of the site if the channel cross section or stream bank were modified.

Invasive Plant Communities

All restoration methods and techniques should be integrated with a site-wide ISCMP. Control measures could be implemented to address the ecological impacts and physical constraints presented by invasive plant communities to restoration planning and design. A multi-season effort is recommended to establish a control and management regime that would prepare the site for the regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities requires the integration of control and management methods and re-vegetation plans. Chemical and mechanical control methods should focus on these areas prior to constructing the remainder of the habitat restoration design, including native plantings. Sequencing of activities would need to focus on effective invasive species management scenarios while also protecting other elements of the restoration project.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.16-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

Table 4.2.16-1 Summary of Restoration Opportunities for the Railway to Ridge Road Site (Cazenovia Creek)

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-channel and Near-shore	In-channel habitat structure and complexity Integrated resistive and redirective hydraulic features Stream bank soil bioengineering to preserve natural channel geomorphology Nearshore structure to enhance fishery and benthos habitat	Redirective features – bendway weirs, rock vanes, hydraulic cover stones, stone or log revetments, locked logs, rootwads
Shoreline	Shoreline stabilization Sedimentation and erosion control Aquatic habitat diversity	Longitudinal toe protection Native wetland species plantings in combination with log or stone toe revetments and other stabilizing features for shoreline soil stabilization and sediment retention over time Seeding and planting of emergent aquatic macrophytes for shoreline community diversity and habitat value
Stream Bank	Bank stabilization Toe protection Sediment and erosion control Riparian structure and diversity to enhance habitat value and soil stability	Bioengineering for soil stabilization and retention Bank reshaping Geotextile erosion control with native riparian plantings – herbaceous, shrub, and tree layers Soil bioengineering for stream bank stability integrated with resistive and redirective features designed to protect the toe of the stream bank from undercutting and preserve natural stream bank and shoreline geomorphology

Table 4.2.16-1 Summary of Restoration Opportunities for the Railway to Ridge Road Site (Cazenovia Creek)

Focus Area	Restoration Opportunities	Restoration Features and Methods
Inland and Upland	Invasive plant community control and management Increase native species richness Increase habitat connectivity, structure, and complexity	Invasive plant community control and management Plantings of diverse, multi-layered native species to enhance tree, shrub, and herbaceous riparian buffer communities Regeneration of floodplain forest on a larger portion of the site Introduce species to produce a "habitat modification" effect (canopy shade, mast production, seed bank enhancement)

4.2.16.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.16-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Preconstruction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Stone-pinned rootwads,
- Bendway weirs,
- Hydraulic cover stones,
- Vegetated riprap for stream bank and shoreline,
- Stone toe protection along the shoreline, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $1,393,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.16.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 in Section 5.5. Project sponsors are advised that there could be additional permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.

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(All Areas Approximate)

In-channel and Nearshore | Shoreline | Stream Bank | Inland and Upland

Stormwater Outfall | Stormwater Interconnect | SPDES

Parcel | Federal Navigation Channel, Approximate Location | Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.16-2
Potential Restoration Areas
Railway to Ridge Road
West Seneca, New York

N W E S

4.2.17 West Seneca Development Center (Cazenovia Creek)

The West Seneca Development Center is located in the town of West Seneca on Cazenovia Creek, approximately 6.8 miles upstream from the confluence with the Buffalo River (see Figure 4.2.17-1). The site, which is owned by the State of New York, is surrounded by residential properties on the ridges and one area of commercial properties at the bend upstream from the bridge at Leydecker Road. The approximately 15-acre site is largely wooded floodplain and upland.

Figure 4.2.17-1 West Seneca Development Center Site Location Map

4.2.17.1 Site Description

Biologists conducted a field assessment of the site in early November 2010 to identify existing habitats along the left descending bank (LDB) and associated floodplain terrace and to determine their distribution and status. Based on the results of the assessment, potential habitat restoration opportunities and constraints were identified. The following descriptions are based upon observations made during that field effort.

In-channel and Nearshore

The channel substrate is predominantly bedrock with cobble and boulder along the edges and few large boulders scattered in the downstream portion of the area surveyed. Gravel bars are located downstream of the bridge where run habitat gives way to a long riffle. The remainder of the creek downstream is a repeating series of run-riffle-run habitats; pool habitat was not observed. There are some gravel bars along the right descending bank (RDB), but they also occur in the stream channel in shallow areas. The gravel bars split stream flow into smaller "sub-channels." Water depths are relatively shallow, ranging from less than 0.5 feet to 2 feet.

Photo 4.2.17-1 Downstream view of mass wasting along the LDB

Shoreline

The shoreline habitat zone along the majority of the site is becoming temporarily buried by sloughing of the stream bank. A number of shoreline gravel bars were noted, some with water willow (*Justicia sp*.) and other herbaceous vegetation. Other areas along the shoreline include exposed bedrock, gravel, and rock. With the exception of the gravel bars there is essentially no shoreline. Instead, an increasingly wide channel cross-section is present as a result of the mast wasting of the LDB stream bank along the entire shoreline.

Stream Bank

The creek channel and the entire surrounding floodplain and terraces occur within a larger ravine with high ridge walls that parallel the stream on both sides. Bank heights along the LDB vary in height, ranging from 3.5 to 7 feet. The bank line is predominantly natural along both stream banks through this area. Armoring is evident only in the vicinity of the bridge. It is evident that downstream areas along the LDB (beginning approximately 600 feet downstream of the bridge at Leydecker Road) are actively eroding because sloughing banks are releasing sediments, rock, cobble, and soil into the creek. The erosion is significant along the surveyed portions of the creek. It extends an estimated 3,000 feet downstream, which effectively causes mass wasting along this entire reach of the LDB. The overall volume of soil and rock and the loss of land area are extensive. High flows and ice scour are directed to and along the LDB which is eroding from the ordinary water level up the bank approximately 3 to 4 feet.

Photo 4.2.17-2 View of erosion on the LDB and dense growth of Japanese knotweed

Photo 4.2.17-3 Upstream view of erosion on the LDB and active tree loss in the riparian corridor

The soils are native and comprised of fine-grained alluvium with sand lenses, gravel, rock, and cobble. These soils appear to be vulnerable to erosive forces. The loss of mature, large trees and the expanses of Japanese knotweed (*Polygonum cuspidatum*) within the riparian area contribute to soil/bank instability and lessen river bank's ability to hold area soils, respectively.

Inland and Upland

The erosive forces discussed above have lead to bank undercutting. As a result, the top of bank no longer has support from below. This causes long sections of stream bank, trees, and other vegetation to slump into the creek channel along the inland area adjacent to the top of the stream bank. Some of the observed portions of stream bank and areas immediately inland that had recently slumped, or were about to fall into the creek, were 30 feet long by 3 feet wide.

Farther inland, away from the top of the stream bank, the upland terrace is characterized by an undulating topography from historic clearing and logging and occasional borrow pits within the floodplain terrace. There are a number of drainage features that convey storm water from the high ridge that have created narrow, shallow channels within the terrace. Some channels drain to the creek. A small emergent wetland area occurs near the downstream extent of the terrace where surface drainage from the upper ridge collects. There is no direct channel that connects the creek to the wetland, although surface flow and subsurface seepage were observed along the stream bank down gradient from the wetland. Overstory trees are predominantly eastern cottonwood and crack willow near the creek channel. Additional common species include soft stem bulrush (*Schoenoplectus tabernaemontani*), bulrush sp., goldenrod (*Solidago spp*.), reed canarygrass (*Phalaris arundinacea*), box elder (*Acer negundo*), ostrich fern (*Matteuccia struthiopteris*), and bush honeysuckle (*Lonicera spp*.). There has been significant tree loss on the LDB, which has increased the rate of erosion. Japanese knotweed occurs in the riparian corridor closest to the stream bank, most commonly in dense thickets. The largest stand is at the downstream extent of the terrace where the knotweed is the only understory vegetation.

4.2.17.2 Restoration Opportunities and Actions

The existing composition, structure, and condition of this stretch of Cazenovia Creek and the associated upland terrace provide for a number of habitat restoration opportunities that would support the improvement of water quality and increase fish and wildlife habitat structure and function and, therefore, contribute to the BUI delisting process (see Table 4.2.17-1 and Figure 4.2.17-2). The most pressing and severe issue is associated with the mass wasting of the stream bank and the related vegetation and soil loss. Due to the extensive stream bank erosion and its effects on nearshore and shoreline habitats, the discussion regarding restoration opportunities purposely combines these areas. A similar approach is presented for the stream bank, and inland and upland areas.

In-channel, Nearshore, and Shoreline

This site is extremely vulnerable due to the excessive erosion and bank loss that occurs. Large volumes of soil, rock, gravel, and cobble enter the creek as weakened undercut banks slump into the channel. The result is an over-widened stream channel, loss of many shoreline areas, and loss of riparian corridor trees and other vegetation. If no action is taken to protect the shoreline and stream bank areas, the floodplain and inland and upland areas will continue to erode. In-channel and nearshore restoration and protection efforts would focus on re-directive features in order to move channel flows away from the LDB where the severe erosion occurs.

Stream Bank, Inland, and Upland

In combination with re-directive measures, additional stream bank protection is necessary for stabilizing this long stretch of creek along the LDB and for restoring ecosystem function and form. A combination of bank longitudinal toe protection, log or stone revetments, and native species plantings could control current erosion, and bank and vegetation loss.

Invasive species, such as Japanese knotweed and common mugwort, are common throughout the site, particularly along the banks where their root structures are not extensive enough to hold soils in place. These species would be managed by chemical or mechanical processes. Management of these species would enable restoration of native species and wildlife habitat improvement. A phased approach should be developed for managing invasive species and the re-establishment of a stream bank and riparian corridor vegetation community. The planting of native species would increase the diversity of plants in the riparian areas and uplands, providing habitat for wildlife.

All restoration methods and techniques should be integrated with a site-wide ISCMP. If chemical control methods are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP.

Table 4.2.17-1 Summary of Restoration Opportunities at the West Seneca Development Site, West Seneca

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-Channel, Near-shore, and Shoreline	Bank stabilization, sedimentation and erosion control Enhancement of aquatic habitat for fish and wildlife	Re-directive features: bendway weirs, locked logs, j-hooks, hydraulic cover stones, rootwads Longitudinal toe protection, native wetland species plantings in combination with log or stone toe revetments and other stabilizing features for side-slope soil stabilization and sediment retention over time
Stream Bank, Inland, and Upland	Bank stabilization, sediment and erosion control, increasing riparian structure and diversity Increase native species richness Increase habitat connectivity and habitat structure and complexity	Bioengineering for soil stabilization, bank re-shaping; ISCMP, geotextile erosion control with native riparian plantings – herbaceous, shrub, and tree layers Integrated soil bioengineering with resistive and re-directive features to preserve natural channel geomorphology ISCMP, multi-layered native diversity plantings to enhance tree, shrub, and herbaceous communities in inland and upland areas

4.2.17.3 Considerations and Potential Constraints for Restoration

Existing Site Use and Site Conditions

There were identifiable existing site uses along this property; presumably some use the area for hiking or to access the creek for fishing or other activities. There were no potential constraints observed that might affect the restoration planning and design process (e.g., fill material and utility easements). Mounds that occur sporadically in the inland and upland area appear to be from historic land clearing/logging activities. Some of the mounds appeared to have construction related-debris (e.g., concrete, old piping, and bricks). There was no observable evidence of any dumping of materials that might be of environmental concern (for instance, no oil or chemicals). If project sponsors include areas where the debris piles are located, determinations will need to be made regarding the composition of the debris piles. Debris composition would determine whether the material could be left on site or if the material should be removed from the site and how to appropriately dispose of the debris. The site should be checked for buried utilities before any site grading and/or excavation work is performed

Pre-Construction Work

The most prominent consideration is the large magnitude of the current problems and the consequential effect on the size of this habitat restoration project. The long stretch of stream bank is vulnerable to continuing erosion and loss of land into the stream channel. The loss of land contributes to the degradation of water quality and channel substrates due to increased turbidity and sedimentation.

The design of restoration features for use in the channel and in nearshore, shoreline, and stream bank areas would require additional analyses during design in order to more closely define feature types and sites. Design would need to consider stream hydraulics, ice scour, channel cross section, and other factors in order to specify the appropriate sizing, volumes, and locations of habitat restoration features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems, or impediments to navigation, would not occur upstream or downstream of the site if in-water structures were constructed.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. see Figure 4.2.17-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

4.2.17.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.17-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,

- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Stone–pinned rootwads,
- Bendway weirs,
- Stone toe protection,
- Longitudinal stone toe protection, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $1,352,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.17.5 Potential Permitting Requirements.

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 located in Section 5.5. Project sponsors are advised that there could be other permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.

(All Areas Approximate)

In-Channel/Nearshore Shoreline

Stream Bank/Inland and Upland

Stormwater Outfall

Stormwater Interconnect

SPDES

Parcel

Federal Navigation Channel, Approximate Location

Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.17-2
Potential Restoration Areas
West Seneca Development Center
West Seneca, New York

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4.2.18 Erie County Sewer District Cayuga Creek Overflow (Cayuga Creek)

The Erie County Sewer District Cayuga Creek Overflow site is located west of Union Road and southeast of Cayuga Creek Road in the town of Cheektowaga (see Figure 4.2.18-1). The approximately 35-acre site is owned and operated by the Erie County Sewer District No. 1 and includes a waste water treatment facility and a New York State permitted discharge outfall to the creek (No. NY0091731, Outfall No. 015; see SPDES label along stream bank in southern portion of site in Figure 4.2.18-2 for approximate location). There are residential properties to the north and south of the site on the east side of Cayuga Creek (see Figure 4.2.18-2). Commercial properties are located east of the creek and early successional forest areas are located west of the creek. Much of the inland and upland portion of the site from the top of stream bank is urban fill with abundant piles and concrete debris, as well as concrete mixed with limestone riprap armor, along both banks. The majority of the eastern portion of the site is Hamlin silt loam soil. The balance of area to the west is Teel silt loam with potential hydric inclusions. The entire site is within the Federal Emergency Management Agency's (FEMA's) designated floodplain.

The approximately 4,500 linear feet of stream bank along the right descending bank (RDB) varies in height ranging from 8 feet to 12 feet with steep, nearly vertical banks in the upper reaches of the site area. An approximately 1,000-foot-long section of the upstream reach of the survey area has been channelized. This section is characterized by steep armored banks associated with urban fill and residential housing along the left descending bank (LDB). The downstream channel is in a natural state with pool-riffle-run features, gravel point bars, and early successional, vegetated mud flats.

Figure 4.2.18-1 Erie County Sewer District Cayuga Creek Overflow Site Location Map

4.2.18.1 Site Description

Field biologists conducted an assessment of the site in early November 2010 to identify existing habitats within the site associated with Cayuga Creek and determine their distribution and status. The following descriptions are based on observations made during the field assessment.

In-channel and Nearshore

The channel and nearshore areas are deep, incised, and characterized by soft sediments in the upstream channelized reaches. There is no channel-to-floodplain connection for approximately 1,000 feet along the upstream portion of the survey area. This is a result of channel realignment (e.g., channelization) and development along the RDB and LDB.

Photo 4.2.18-1 Channel realignment and modified stream banks

The downstream reaches (along the stream bank that roughly lie along the southern boundary of the site, see Figure 4.2.18-2) are connected to the creek's floodplain and have a shallow channel underlain by bedrock and boulders with cobble and silt. There are a few deep pools near the first bend where the channel has not been channelized and is therefore less disturbed. Sediment deposition has created gravel point bars in downstream reaches with scour pools in association with boulder/cobble clusters. Point bars and nearshore mudflat plant communities are transient due to seasonal high-flow scour, freeze-thaw cycles, and rain events exacerbated by unstable banks and effects of intermittent bank armor.

Channel modification in the upper reaches has impaired in-channel habitat by widening and incising channel flow pattern, thereby diminishing structure in the water column and nearshore vegetation. Tree canopy shade is absent on the steep, armored, nearly vertical slopes that are almost completely dominated by invasive plants in the herbaceous layer. Full sun exposure contributes to thermal loading and lack of cover of fish and benthic organism habitats.

Shoreline

The most severe bank erosion is in the form of mass wasting and tree loss along the RDB beginning at the first inside bend and continuing for approximately 2,700 feet downstream to a point near the mapped SPDES discharge to the creek. Intermittent armoring totaling approximately 1,200 feet is present along the shoreline and the toe of the stream bank along the LDB and RDB upstream near the residential development. Severe and active undercutting of vertical banks and subsequent mass wasting in most downstream areas along LDB is evident and directly associated with sandy, loam alluvial soils with monotypic stands of invasive species that provide minimal soil stability. Channel incision and scour in shoreline areas removes areas of deposition and immature emergent vegetation during high flow events. Shoreline areas above mean water level are ephemeral due to the instability of nearshore bed load material and the impact of scouring velocity during high flow events.

Photo 4.2.18-2 Shoreline scour and stream bank failure

Stream Bank

Downstream of the modified channel and elevated stream banks, the RDB is nearly vertical and 4 to 6 feet high. Japanese knotweed (*Polygonum cuspidatum*) and mugwort (*Artemisia vulgaris*) are pervasive in the herbaceous/shrub layers along the stream bank and throughout the inland floodplain area along the RDB. Eastern cottonwood (*Populus deltoides*), box elder (*Acer negundo*), and crack willow (*Salix fragilis*) are common trees on the stream bank with bush honeysuckle (*Lonicera morrowii*) and common buckthorn (*Rhamnus cathartica*) abundant in the shrub layer near the top of the stream bank. The extensive growth of Japanese knotweed contributes to soil bank erosion by exposing extensive bare soil areas during dormant season high flow and ice-out events.

Photo 4.2.18-3 Floodplain and riparian area with Japanese knotweed understory

Natural succession of plant communities and subsequent development of habitat quality on the site is directly impaired by the dominance of invasive species within all vegetation layers.

Areas of bank armor and steep slopes along the LDB redirect high flow and velocity to the opposite banks (inner bends) which incur severe undercutting resulting in mass wasting and loss of trees at the top of banks on the primary terrace. However, varying levels of bank failure and tree loss were observed along the steep LDB stream bank caused by a combination of high flow and ice scour. Shallow soils are vegetated with mature hardwoods that are collapsing into the channel due to a combination of undercutting due to lack of toe protection and

wind action. With exception of the upper reaches, most all stream banks are unstable and actively eroding along the RDB. Steep stream banks along the LDB are moderately stable with exception of localized areas of the wooded slopes that are being undercut and collapsing into the channel.

Inland and Upland

Inland and upland areas from the top of stream bank are a combination of cleared land and an active composting operation associated with the wastewater treatment facility. Early successional bottomland or floodplain forest exists on the balance of the site. Most the site from the top of the stream bank to the inland area includes a series of graded berms, debris piles, and depressions presumed to be borrow pits. Most of the inland and upland area along the RDB appears to be within the creek floodplain with the exception of a few elevated fill piles and berms. There is evidence of overbank sediment deposition as well as large and small woody debris in low areas immediately behind the top of bank and primary terrace. Soils are a combination of silty sediments with sand and gravel lenses combined with urban fill material, concrete, and stone debris. Soil characteristics are representative of the mapped soil types which include Hamlin silt loam in the upstream (eastern) portion of the site and Teel silt loam in the downstream (western) inland areas. Most areas are well drained with no seeps or seasonal wetland depressions observed. Overall habitat value is low due to the density of Japanese knotweed and mugwort in the herbaceous layer, which inhibits colonization of native shrub and tree species. There is evidence of overbrowsing by deer on native plant communities, which exacerbates the impact of invasive species not palatable to deer.

4.2.18.2 Restoration Opportunities and Actions

The existing land use and limited access and infrastructure as well as the available land within the riparian corridor provide a number of habitat restoration and soil stabilization design opportunities. In addition, the availability of space increases the number of restoration options for resistive and re-directive in-channel and nearshore features as well as bank re-shaping techniques requiring keys or tie-backs into stable bank areas. Implementation of features would address soil instability, improvement of water quality, natural regeneration of native plant species, increased fish and wildlife habitat structure and function, and, therefore, contribute to the BUI delisting process (see Table 4.2.18-1).

In-Channel and Nearshore

This site is notable because most bank instability and subsequent sediment loading occurs as a result of velocity scour during high flow events and ice scour on the inside bend of the creek along the RDB. A number of hydraulic conditions contribute to this including steep slopes along the LDB which redirects flow and velocity as well as ice towards the opposite bank. Bendway weirs, rock vanes, hydraulic cover stones, and J-hooks could be designed for use upstream and along both banks as “redirective” features to divert water at high flow towards the center of the channel to prevent the erosion and ice scour. These “redirective” features would require careful design and strategic placement in the water column

in the nearshore area. Each feature would require rock keys and tie backs into stable portions of the bank to prevent high flows from flanking or scouring around the structures. Each structure would create elements of fishery enhancement in the form of scour pools, lower flow/velocity back eddies, and gravel bars or mudflats to support overhanging vegetation. These in-channel and nearshore features could be foundation components to support nearshore bioengineering structures, such as pinned root wads, coir log or log revetments, and locked logs designed to provide toe in-stream habitat complexity through the use of hydraulic cover stones, locked logs, and pinned rootwads. Uplift of fishery, benthos, and aquatic emergent and submerged vegetation communities would result.

Shoreline

The bank and riparian areas in the locations discussed above require the most immediate attention for habitat restoration activities. Specifically, the in-channel and nearshore features discussed above would provide the foundation or infra-structure to support the use of bioengineering methods to stabilize channel bed load and nearshore depositional material. Reduction of scour would retain soil and organic matter in shoreline areas and allow the regeneration of emergent aquatic plant communities thereby creating a more natural shoreline.

Stream Bank

Bioengineered approaches, such as live siltation, live staking, and vegetated rip-rap, would complement stream bank reshaping design. Reshaping vertical banks combined with appropriate bioengineering methods and restoration features would provide a natural, vegetated stream bank that could arrest undercutting during high flow events.

Photo 4.2.18-4 Stream bank failure

Bioengineering for soil stabilization, including bank re-shaping along with an invasive species control plan and a native species planting plan, would provide hydraulic roughness during flood events that would collect sediment and organic debris, improve habitat, and increase overall channel and riparian corridor function.

Inland and Upland

Four invasive species (Japanese knotweed, mugwort, common buckthorn, and bush honeysuckle) were identified throughout the survey area but greatest densities were observed within inland areas. Management of these species in the proposed project work areas followed by aggressive planting would prevent re-establishment of large communities. Planting native species in the inland and upland areas along the stream banks and in the riparian corridor would enhance habitat by regenerating native plant communities as well as stabilizing unconsolidated soil.

Table 4.2.18-1 Summary of Restoration Opportunities Erie County Sewer District Cayuga Creek Overflow, Cayuga Creek

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-Channel and Nearshore	Fish habitat enhancement In-stream structure creation and enhancement Emergent and submerged aquatic vegetation bed development Nearshore sediment stabilization and emergent wetland community regeneration	Bioengineering with resistive and redirective features to preserve natural channel geomorphology, especially scour pools Re-directive features: bendway weirs, locked logs, rootwads, hydraulic cover stones Nearshore structure to support submerged aquatic vegetation
Shoreline	Bank stabilization Toe protection Sedimentation and erosion control Expansion of emergent wetland community	Large woody debris for sediment retention and capture Longitudinal toe protection Native wetland species plantings in combination with coir log and log revetment toe protection and other stabilizing features for sediment retention over time

Table 4.2.18-1 Summary of Restoration Opportunities Erie County Sewer District Cayuga Creek Overflow, Cayuga Creek

Focus Area	Restoration Opportunities	Restoration Features and Methods
Stream Banks	In-channel hydraulic modification of flow/velocity	Bioengineering for soil stabilization, bank reshaping
	Bank stabilization	ISCMP
	Sediment and erosion control	Geotextile erosion control, live staking, vegetated rip rap, longitudinal toe protection integrated with side slope native riparian plantings – herbaceous, shrub, and tree layers
	Increasing stream bank vegetation	
	Diversity to enhance habitat value and soil stability	

4.2.18.3 Considerations and Potential Constraints for Restoration

Existing Site Use and Site Considerations

The Erie County Sewer District No. 1 Facility and composting operation and the New York State Pollutant Discharge Elimination System permitted discharge outfall to the creek (No. NY0091731, Outfall No. 015) provide opportunities for implementing habitat restoration measures. Land use and ownership may expedite restoration planning process.

The riparian corridor is wide along RDB which would allow for substantial bank reshaping and inland and upland restoration design. Riparian alluvial soils are excellent for re-establishing native plant communities. Land use and landowner loss of land and tree cover from erosion could facilitate cooperative effort to address bank erosion.

Restoration design and planting plans would require the development of a strategy to address damage to vegetation by white-tailed deer and beaver. There is ample evidence of stress to vegetation across the site by these species.

Invasive Plant Communities

Implementation of control measures to address the ecological impacts and physical constraints invasive plant communities present to restoration planning and design phases would be necessary. A multi-season effort is recommended to establish a control and management regime that would prepare the site for regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities requires the integration of control and management methods and re-vegetation plans. Chemical and mechanical control methods should focus on stream bank and inland areas prior to constructing the remainder of the habitat restoration design (e.g., native plantings).

Bank Erosion and Bank Failure Control Features

Design and installation of the appropriate stream bank stabilization features to address severe stream bank erosion would reduce or stop the sediment loading from the site. Priority should be given to restoration measures that would stabilize stream banks with severe erosion and to those likely to fail in the short term.

Pre-Construction Work

Because of the observed extent of land loss and severe bank erosion, the hydraulic environment would need to analyzed along the affected reaches, as well as upstream and downstream of those areas, to determine the specific variables that are creating the current situation. That work would need to be completed prior to finalizing the design of habitat restoration features. Further field evaluations would need to be performed in order to develop a functional design that would protect the LDB and RDB of this portion of Cayuga Creek.

Restoration design in the in-channel and nearshore, shoreline, and stream bank areas would require additional analyses in order to define the types and siting of the specific features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems would not occur upstream or downstream of the site if the channel cross section or stream banks were modified.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.18-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

4.2.18.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.18-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Traffic control/hydraulic cover stones,
- Vegetated riprap,
- Bendway weirs,
- Stone toe protection, and
- Live stakes and seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $859,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.18.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 in Section 5.5. Project sponsors are advised that there could be additional permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.

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(All Areas Approximate)

In-channel and Nearshore
Shoreline
Stream Bank
Inland and Upland

Stormwater Outfall
Stormwater Interconnect
SPDES

Parcel
Federal Navigation Channel, Approximate Location
Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.18-2
Potential Restoration Areas
Erie County Cayuga Creek Overflow
Cheektowaga, New York

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4.2.19 Stiglmeier Park (Cayuga Creek)

Stiglmeier Park is located in the town of Cheektowaga along the south shore of Cayuga Creek from approximately 600 feet downstream of Como Park Boulevard bridge to the park's western boundary approximately 3,500 feet downstream of Como Park Boulevard bridge (see Figures 4.2.19-1 and 4.2.19-2). This site is owned by the Town of Cheektowaga. Potential restoration areas within this site have been identified as Upstream and Downstream (see Figure 4.2.19-2).

Figure 4.2.19-1 Stiglmeier Park Site Location Map

The approximately 300-acre park is owned and maintained by the Town of Cheektowaga and includes nature trails and sports fields. The area assessed for potential restoration opportunities was limited to the creek channel, side slope, and terraces. A well-maintained trail system, including wooden boardwalks and overlooks, can be found along the entire length of the creek. Land uses/land cover in the vicinity of the creek channel include bottomland and upland forest along riparian areas on both sides of the creek, managed park landscapes to the south, and predominantly residential land use with some forested and industrial areas to the north. The survey area borders the Reinstein Woods Nature Preserve, managed by the New York State Department of Environmental Conservation (NYSDEC) Region 9, located immediately east of Stiglmeier Park. The Preserve contains approximately 300 acres of high quality wildlife habitat in the forms of mature hardwood forests, ponds, and wetlands.

4.2.19.1 Site Description

Biologists conducted a field assessment of the site in October 2010 to determine the presence, distribution, and status of existing habitats within the portion of Stiglmeier Park associated with Cayuga Creek, and to identify habitat restoration opportunities and constraints. Approximately 5.8 acres were identified for potential habitat restoration measures. The following descriptions are based upon observations made during that field effort.

Photo 4.2.19-1 Hiking trail in the forested inland and upland in the Upstream Area

Photo 4.2.19-2 Recent bank failure in the Upstream Area on the LDB's outside bend looking upstream

In-channel and Nearshore

The creek channel is in a natural state with long meandering curves. Bedrock and gavel/cobble substrate are present in the upper reaches that were surveyed downstream of Como Park Boulevard. This section of the creek is characterized by a series of riffles, runs, and pools followed by a deeper and wider sediment-bottom channel through the downstream reaches within the survey area. The nearshore environment is shallow channel underlain by bedrock and boulders at the upstream end of the site, which grades to cobble and silt downstream around the large bend. The channel is characterized by runs and riffles, with deep pools where bank erosion and scouring have occurred along the outside of the sharp bend downstream of Como Park Boulevard. Severe and continuous undercutting of vertical banks in this area is evident and has resulted in recent mass wasting of banks along the first outside bend downstream of Como Park Boulevard. This condition of severe bank loss and erosion appears to influence the channel substrate with soft sediments overlying presumably rock, cobble, gravel, and bedrock.

Photo 4.2.19-3 Mass wasting of the LDB near the downstream end of the Downstream Area with an active undercut bank

Shoreline

Shoreline areas are a combination of sediment, gravel, and cobble along the LDB near the Como Park Boulevard bridge. Shoreline areas do not exist downstream due to undercutting, bank failure, and recent tree loss. Some existing toe of slope

protection is present along outside bends on the left descending bank (LDB) between long areas of eroding banks.

Stream Bank

Stream banks along the approximately 4,000 linear feet of channel surveyed vary in height ranging from 8 to 12 feet. Most banks are relatively stable in locations near the Como Park Boulevard bridge and upstream of the sharp bend in the creek. However, stream banks along two reaches of the creek totaling approximately 800 feet were observed to be highly unstable because they contain actively undercut and collapsed banks. Erosion is severe in each area due to undercutting, mass wasting and recent tree loss. Some existing toe of slope protection is present along outside bends on the left descending bank (LDB) between the failed banks.

Inland and Upland

The riparian zone along the top of bank and within the primary terrace is well vegetated with herbaceous species, such as goldenrod (*Solidago gigantea*), under a cottonwood (*Populus deltoides*) canopy. Other species identified include Japanese knotweed (*Polygonum cuspidatum*), reed canarygrass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), and black willow (*Salix nigra*). The adjacent secondary terrace and upland areas are forested on the east side of the site and grassland on the west side. The dominant species include red oak (*Quercus rubra*) and burr oak (*Q. macrocarpa*) in the overstory, and little bluestem (*Schizachyrium scoparium)* which covers large areas in openings between tree and shrub layers. Other species identified include Norway maple (*Acer platanoides*), American sycamore (*Platanus occidentalis*), slippery elm (*Ulmus fulva*), and basswood (*Tilia americana*). Invasive species, including Japanese knotweed, purple loosestrife, and black swallowwort (*Cynanchum nigrum*), were observed in small patches along the LDB.

Monotypic stands of Japanese knotweed are present along the shoreline, side slope, and extend inland along the right descending bank (RDB). The upstream portion of the RDB is almost entirely covered by Japanese knotweed and common mugwort.

4.2.19.2 Restoration Opportunities and Actions

The existing land use and managed park access and infrastructure provide a number of habitat restoration and soil stabilization design opportunities (see Table 4.2.19-1 and Figure 4.2.19-2). An Upstream Area and a Downstream Area of approximately 3.0 and 2.8 acres, respectively, have been identified as potential restoration areas. Each area exhibits severe bank erosion, unstable near shore and shoreline areas, invasive species communities, and low diversity within the riparian corridor. The implementation of the restoration plan for each area would improve water quality and increase fish and wildlife habitat structure and function contributing to the BUI delisting process.

In-channel and Nearshore

Bendway weirs could be used upstream of the sharp bend as redirective features to divert water during high-flow events towards the center of the channel to prevent the erosion of the outside bend (LDB) of the creek. Other opportunities include fish habitat enhancement and increasing in-stream complexity through the use of hydraulic cover stones, locked logs, and pinned rootwads. Habitat for emergent and submerged aquatic vegetation beds would be created by these features.

Also, planting native species along the banks could enhance in-channel and nearshore habitat by regenerating native plant communities for shade and cover as well as stabilizing unconsolidated soil.

Stream Bank

The bank and riparian areas in the locations discussed above require the most immediate attention and have the greatest opportunity for habitat restoration. Specifically, toe protection and reshaping vertical banks to a natural form at the downstream portion of the creek could arrest undercutting during high-flow events and stabilize eroding slopes. Bioengineering for soil stabilization, bank reshaping along with invasive species control and management and a planting plan would modify direction of channel flow, improve habitat, and increase overall channel and riparian corridor function.

Upland and Inland

Regeneration of the hardwood forest communities similar to those present in the upper terrace areas in the upstream portions of the site would enhance riparian habitat and stabilize soils from the top of stream bank and inland. Fertile sedimentary soils in the riparian corridor would support the planting and establishment of native tree, shrub and herbaceous plant communities.

Three invasive species—Japanese knotweed, purple loosestrife, and black swallowwort—were identified in small patches along the south bank (LDB). Control of these species followed by aggressive planting would prevent them from establishing large communities and overtaking the area. The Stiglmeier Park site would be a good reference site for a riparian corridor due to relatively intact plant communities and high quality habitat in the surrounding area.

4.2.19.3 Constraints and Considerations for Restoration

There is a maintained trail along the length of the creek that is part of Stiglmeier Park. The potential restoration opportunities can and should be designed to avoid impacting these trails and passive wildlife observation in this section of the park. Revegetation design and planting plans would require the development of a strategy to address damage to vegetation caused by white-tailed deer (*Odocoileus virginiana*) and beaver (*Castor canadensis*).

The degree of land loss and severe bank erosion will require examination of the hydraulic environment along the affected reaches as well as upstream and down-

stream of those areas to determine the specific variables responsible for the current situation. It is likely that further field evaluations would need to be performed in order to develop a functional design that would protect the LDB of this portion of Cayuga Creek.

Invasive Plant Communities

All restoration methods and techniques should be integrated with a site-wide ISCMP. Invasive species control measures would be implemented to address the ecological impacts and physical constraints presented by invasive plant communities to restoration planning and design phases. Black swallowwort is present, but low density provides the opportunity to implement effective control measures and possible eradication. A multi-season effort is recommended to establish a control and management regime that would prepare the site for regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities requires the integration of control and management methods and revegetation plans. Chemical and mechanical control methods should focus on areas prior to constructing the remainder of the habitat restoration design (e.g., native plantings). If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP. Upland and inland areas should be evaluated for planting of canopy shade and mast producing tree species to compete with existing invasive plant communities when mechanical and chemical treatments are not feasible.

Bank Erosion and Bank Failure Control Features

The severity and imminence of failing stream banks would be considered during construction sequencing. Design and installation of the appropriate stream bank stabilization features to address severe stream bank erosion would address the mass wasting conditions, reduce or stop sediment loading from the site, as well as provide areas for regeneration of stream bank and shoreline plant communities.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.19-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

Table 4.2.19-1 Summary of Restoration Opportunities at Stiglmeier Park, Cayuga Creek, Cheektowaga

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-Channel and Nearshore	Fish habitat enhancement In-stream structure creation and enhancement Submerged aquatic vegetation bed development Bank stabilization	Hydraulic cover stones, bendway weirs or vanes to preserve scour pools Redirective features: bendway weirs, locked logs, and rootwads
Shoreline	Bank stabilization Sedimentation and erosion control Expansion of emergent, shoreline wetland community	Large woody debris for sediment retention and capture Longitudinal toe protection Native wetland species plantings in combination with log revetments and other stabilizing features for sediment retention over time
Stream Bank	Bank stabilization Sediment and erosion control Increasing riparian structure and diversity to enhance habitat value and soil stability	Bioengineering for soil stabilization, bank re-shaping, invasive species control and management, geotextile erosion control with native riparian plantings – herbaceous, shrub, and tree layers Integrated soil bioengineering with resistive and re-directive features to preserve natural channel geomorphology, especially scour pools
Upland and Inland	Floodplain and hardwood forest regeneration Riparian habitat enhancement	Native species introductions in all vegetation layers for plant species richness and diversity Riparian wildlife habitat enhancement

4.2.19.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.19-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

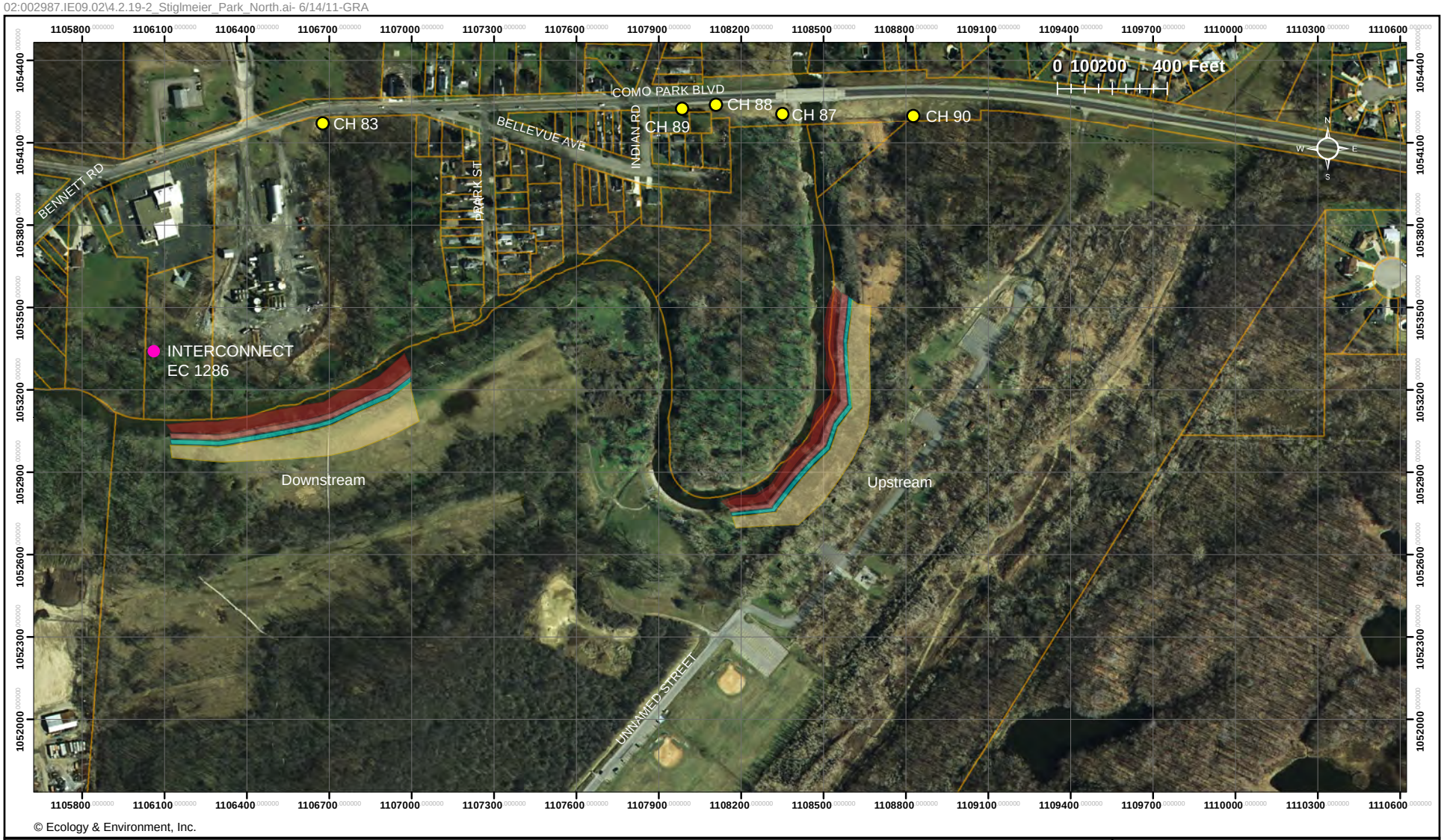
- Stone-pinned rootwads,
- Bendway weirs,
- Hydraulic cover stones,
- Longitudinal stone toe protection,
- Vegetated riprap, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $2,148,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.19.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 located in Section 5.5. Project sponsors are advised that there could be other permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.



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(All Areas Approximate)

In-channel and Nearshore | Shoreline | Stream Bank | Inland and Upland

Stormwater Outfall | Stormwater Interconnect | SPDES

Parcel | Federal Navigation Channel, Approximate Location | Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.19-2
Potential Restoration Areas
Stiglmeier Park
Cheektowaga, New York

4.2.20 LA-7 Wetland Cheektowaga (Cayuga Creek)

The LA-7 Wetland Cheektowaga site is a forested floodplain along the left descending bank (LDB) of Cayuga Creek. The site is located north of Rowley Road in Cheektowaga, New York, approximately 6.0 miles upstream of the confluence of Cayuga Creek with the Buffalo River. The site is comprised of multiple privately owned, vacant parcels that border the creek and a number of residential parcels on Rowley Road to the south. NYSDEC-regulated Wetland LA-7 covers approximately 60% of the site and nearly all the vacant parcels along the creek. Land use to the north, along the right descending bank (RDB), is a combination of an active municipal landfill operation and vacant public land that includes an inactive landfill. An abandoned railway corridor borders the site to the west.

Figure 4.2.20-1 LA-7 Wetland Cheektowaga Site Location Map

4.2.20.1 Site Description

Field biologists conducted an assessment of the site in October 2010 to identify existing habitats within the LA-7 Wetland Cheektowaga site and determine their distribution and status. The following descriptions are based on observations made during the field assessment.

In-channel and Nearshore

The channel width is approximately 100 feet throughout the site. The predominant in-channel habitat within the site is characterized by a long riffle-run sequence, with several deep pools located throughout the channel. The creek substrate changes from gravel and silts with municipal debris in the deep channel section to bedrock in the shallow riffle areas. Deep pools are located along the LDB below the largest riffle-run feature in the upstream portion of the channel. The nearshore area is shallow with some transitory and unstable scour pools associated with bank undercutting and tree failures along the LDB. The nearshore substrate is variable and consistent with the creek bed substrates, transitioning from sand to cobble and gravel mixed with silt. Some nearshore areas consist of

smooth bedrock. Several large gravel bars are present in nearshore areas that are connected to the LDB and RDB during low-flow conditions. Channels exist behind the gravel bars, which are active during high-flow conditions. Channel and nearshore substrate material has been recently deposited and is unstable, with the exception of some large boulders and cobble clusters. No submerged or emergent aquatic vegetation was noted.

Shoreline

The shoreline is narrow throughout the site, ranging from 0 to 4 feet wide. Severe stream bank failures create a depositional layer of sand, gravel, and soil from collapsed stream banks. Velocity scour, sediment mobilization and transport, and undercutting in the shoreline area contribute to the reshaping of this area during high-flow conditions. There are no large or extended established plant communities along the shoreline due to instability and scouring forces, with the exception of small patches of reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), and occasional saplings of crack willow (*Salix fragilis*) and red osier dogwood (*Cornus sericea*). Even during moderate flow conditions, the smooth bedrock combined with velocity scour frequently results in the mobilization and transport of alluvial material and large woody debris in the shoreline area.

Stream Bank

The LDB above the shoreline is combination of a natural configuration with constructed drainage swales and berms that join the LDB. The LDB in the downstream portion of the site is relatively stable and ranges in height from approximately 4 to 8 feet. An established tree layer extends inland from the top of the stream bank into the wetland area. Stream bank cover consists predominantly of Japanese knotweed (*Polygonum cuspidatum*) and common reed, with occasional red osier dogwood and crack willow saplings, and extends into the inland understory. Severe stream bank undercutting and failure occurs for approximately 500 feet along the LDB from the mid-section of the site upstream to the natural bedrock riffle feature near the eastern end of the survey area (see Photos 4.2.20-1 and 4.2.20-2).

The eroding stream bank along the RDB is not part of the LA-7 Wetland Cheektowaga site, but it affects the degree of ecological restoration that could be achieved at this site. The RDB is approximately 12 feet high and is comprised of deep alluvial sand and gravel deposits combined with urban fill. The downstream portion of RDB across from the site is a long outside bend, part of which is actively eroding into an inactive landfill on public land (see Photo 4.2.20-3). The RDB in this portion of the stream is sloughing into the channel due to velocity scour from medium to high flows, which undercut the toe of the stream bank, and due to ice scour in spring (see Photo 4.2.20-4). Parts of the stream bank are only sparsely vegetated with early successional plant communities that provide little stabilization or protection from erosion. This condition continues upstream along the RDB for a distance of approximately 1,500 feet.

Photo 4.2.20-1 LDB stream bank failure and tree loss near middle of site, looking upstream

Photo 4.2.20-2 LDB steam bank mass wasting downstream of natural rock riffle feature near upstream end of site, looking upstream

Photo 4.2.20-3 RDB undercutting and failure near the active landfill (across the stream from the LA-7 Wetland Cheektowaga site)

Photo 4.2.20-4 RDB failure exposing municipal waste upstream of the active landfill site and across from the LA-7 Wetland Cheektowaga site

Inland and Upland

Floodplain forests that dominated riparian sites in this area were logged and cleared for agriculture in the late 1800s and early 1900s. It was determined from aerial photo interpretation that the site was open agricultural land from as early as 1927 through the early 1950s. During that period, a series of earthen berms approximately 8 feet high and perpendicular to the channel were constructed along with several north-south drainage swales that discharge into the stream along the LDB.

Since the 1950s, the site has reverted to forested wetland and floodplain. A dense approximately 60-year-old deciduous tree canopy currently covers the site. The tree species include Eastern cottonwood (*Populus deltoides*), crack willow (*Salix fragilis*), black willow (*S. nigra*), burr oak (*Q. macrocarppa*), and occasional slippery elm (*Ulmus fulva*), black walnut (*Juglans nigra*), and shagbark hickory (*Carya ovata*).

Photo 4.2.20-5 Eroding LDB, inland tree cover with Japanese knotweed understory, looking downstream

A small hardwood forest component comprised of mature red oak (*Quercus rubra*), red maple (*Acer rubrum*), and witch hazel (*Hamamelis* sp.) is present in the upstream portion of the site. These trees are on the top of the LDB and are being severely undercut during every high-flow event.

Photo 4.2.20-6 LDB, undercutting of red oaks at the top of the stream bank

4.2.20.2 Restoration Opportunities and Actions

There is significant restoration potential for this site. The NYSDEC-regulated wetland and 100-foot buffer provide access, work space, and compatible land use to develop habitat enhancement features. Areas where physical restoration and enhancement would provide immediate functional and biological uplift include the in-channel and nearshore areas, shoreline, and stream bank. Invasive plant control and management should precede stream bank reshaping and regeneration of native plant communities.

Stabilization of the shoreline up to the toe of the stream bank would physically support the natural succession and regeneration of native riparian plant communities. This would be followed by implementation of a native plant community restoration plan. The replacement of Japanese knotweed and mugwort with native species in the area extending from the stream bank to inland areas, combined with in-channel redirective structures and toe protection features, would stabilize shoreline and stream bank soils, reduce sediment loading, and enhance riparian habitat function and value. An expansion of riparian vegetation would provide hydraulic roughness along the stream banks and shoreline areas. Increased roughness would reduce scour impacts by dissipating the energy of high-velocity flows and would capture sediment, nutrients, organic matter, and seed bank materials. Implementation of habitat restoration features would contribute to the BUI delisting process (see Table 4.2.20-1 and Figure 4.2.20-2).

In-channel and Nearshore

Single-stone bendway weirs, rock vanes, log or stone revetments, and rootwads, with appropriate keys and tiebacks into stable bank areas, could be designed for use along appropriate sections of the LDB. These resistive and redirective structures would reduce the impact of ice and velocity scour by diverting the thalweg and high flows toward the center of the channel. The design and orientation of hydraulic cover stones, locked logs, embedded large and small woody debris, and pinned rootwads could enhance fish habitat by increasing in-channel structure and complexity. Secure and resilient nearshore structures would stabilize existing scour pools, resist ice and hydraulic scour, help stabilize shoreline and stream bank areas, and support the regeneration of native plant communities. In addition, these features would improve habitat for benthic organisms and fish by providing in-stream cover, refuge, and oxygenation during low-flow conditions.

Shoreline

Constructed nearshore structures would be integrated into shoreline areas along the LDB to provide hydraulic roughness and preserve existing habitat features. These resistive features extending into nearshore water from shoreline areas would create areas of sediment, gravel, and organic material deposition during high flows, especially during flood events. These capture areas would help stabilize the shoreline by supporting the formation of shoreline habitat by the subsequent establishment and expansion of native emergent plant communities that are currently prevented by scour erosion.

Stream Bank

Measures to address severely eroding stream bank areas could be integrated into nearshore and shoreline restoration designs. Stream banks could be reshaped, planted, and integrated with shoreline plant communities. Stream bank stabilization measures utilizing erosion control geotextiles, large woody debris, and stone features to support revegetation could provide the physical structure needed for stream bank stability. Given the availability of space inland of the eroding stream bank, a sloped stream bank with a diverse native riparian plant community would provide easier access to the floodplain, hydraulic roughness to dissipate high-flow energy, greater soil stability, resilience to ice scour, and a natural interface between the aquatic and terrestrial riparian habitats.

Steam bank reshaping would accommodate the integration of keys or tiebacks installed below grade. These structures are required for the construction of in-channel and near shore rock vanes, weirs and revetments discussed above. After excavation and removal of invasive species, all disturbed soil and land areas would be stabilized by geotextile erosion control blankets and revegetated. A variety of bioengineering techniques would be appropriate for this site including: live staking, pole planting, vegetated riprap or coir log revetments.

Inland and Upland

The site provides the opportunity to remove invasive species and implement a restoration planting plan in areas that presently provide limited riparian habitat. The

occurrence of native alluvial soils on the site would facilitate the planting and rapid establishment of a more diverse riparian tree and shrub community from the top of the stream bank through the inland and upland habitat area. The existing berm features provide upland soils and hydrology within the wetland to support floodplain hardwood species. A native canopy- and mast-producing hardwood forest with a diverse shrub and herbaceous understory would be an appropriate design for this site to control existing invasive communities, resist their future colonization, and provide a more natural riparian habitat. The site contours would allow for the regeneration of upland and wetland species known to be part of the primeval vegetation cover types in this watershed. This combination of aquatic and terrestrial hummock, or tree island, habitat within the wetland area would provide a diverse and structurally complex riparian habitat.

4.2.20.3 Considerations and Potential Constraints for Restoration

The NYSDEC Wetland LA-7 regulatory designation could support a variety of restoration and enhancement scenarios and could facilitate a teaming arrangement with state and federal agencies. Coordination to insure regulatory compliance is critical to planning and design. Implementation of habitat restoration features would contribute to the BUI delisting process (see Table 4.2.20-1 and Figure 4.2.20-2).

Restoration design and planting plans would require the development of a strategy to address damage to vegetation by white-tailed deer (*Odocoileus virginianus*) and beaver (*Castor Canadensis*). Such a strategy could include exclusionary features and the use of native species that are resistant to browsing. Currently, the understory consists almost entirely of species that are unpalatable to wildlife, such as Japanese knotweed and white snakeroot (*Ageratina altissima*).

Pre-Construction Work

The detailed planning and design of restoration features in the in-channel and nearshore, shoreline, and stream bank areas would require additional analyses in order to more accurately define the types and siting of features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems would not occur upstream or downstream of the site and that ice flows would not be impeded if the channel cross section and/or stream bank were modified.

Invasive Plant Communities

All restoration methods and techniques should be integrated with a site-wide ISCMP. Invasive species control measures could be implemented to address the ecological impacts and physical constraints invasive plant communities present to restoration planning and design. A multi-season effort is recommended to establish a control and management regime that would prepare the site for regeneration of native plant communities. Chemical and mechanical control methods should focus on areas that would be disturbed by restoration activities prior to construction of the remainder of the habitat restoration design. If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.20-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

Table 4.2.20-1 Summary of Restoration Opportunities at the LA 7 Wetland (Cayuga Creek)

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-channel and Near-shore	In-channel habitat structure and complexity for fishery and benthos habitat Integration of resistive and redirective hydraulic features with shoreline structural complexity to create a more natural channel geomorphology	Redirective and resistive features – bendway weirs, rock vanes, hydraulic cover stones, locked logs, embedded large and small woody debris, and rootwads

Table 4.2.20-1 Summary of Restoration Opportunities at the LA 7 Wetland (Cayuga Creek)

Focus Area	Restoration Opportunities	Restoration Features and Methods
Shoreline	Shoreline stabilization	Longitudinal toe protection
	Integrated habitat and resistive structure to capture sedimentation and provide erosion control	Native wetland species plantings in combination with log or stone toe revetments and other stabilizing features extending into nearshore areas
		Emergent plant community regeneration
		Embedded or keyed-in structures for shoreline soil stabilization and sediment retention (see Stream Bank Restoration Features below)
		Seeding and planting of emergent aquatic macrophytes for shoreline community diversity
Stream Bank	Bank reshaping and stabilization	Bioengineering for soil stabilization and retention
	Toe protection	Stream bank reshaping
	Secured structural features for sediment and erosion control	Stream bank toe protection
	Increase riparian structure and diversity to enhance habitat value and soil stability	Geotextile erosion control with native riparian plantings – herbaceous, shrub, and tree layers
		Integrated soil bioengineering with resistive and redirective features to protect toe of stream bank from undercutting and preserve the natural stream bank and shoreline geomorphology

Table 4.2.20-1 Summary of Restoration Opportunities at the LA 7 Wetland (Cayuga Creek)

Focus Area	Restoration Opportunities	Restoration Features and Methods
Inland and Upland	Native plant community and soils mapping and characterization Assess need for soil amendments Invasive plant community mapping Increase native species richness Increase habitat connectivity, structure and complexity	Soil surface and substrate amendment Invasive plant community control and management Multi-layered plantings of diverse native species to enhance tree, shrub, and herbaceous riparian buffer communities Regeneration of the floodplain forest on a larger portion of the site Introduce species to produce a habitat modification effects (canopy shade, mast production, seed bank enhancement) Deer and beaver damage controls

4.2.20.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.20-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

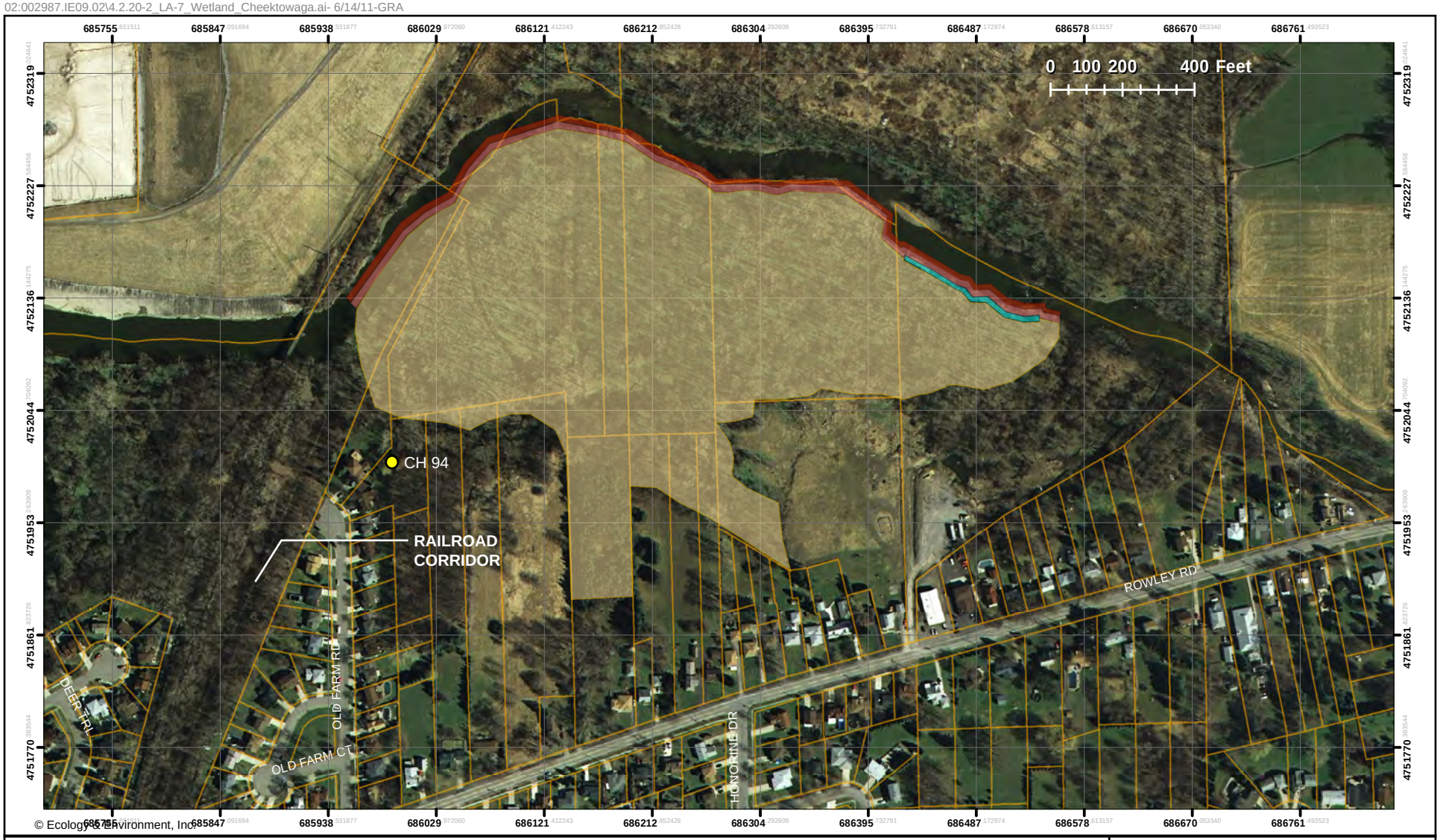
- Stone-pinned rootwads,
- Bendway weirs,
- Single-stone bendway weirs,
- Vegetated riprap,
- Hydraulic cover stones,
- Longitudinal stone toe protection,
- Live stakes, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $1,683,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.20.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 5, 6, and 7, as provided in Table 5-1 in Section 5.5. Project sponsors are advised that there could be additional permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.



(All Areas Approximate)

In-channel and Nearshore

Shoreline

Stream Bank

Inland and Upland

Stormwater Outfall

Stormwater Interconnect

SPDES

Parcel

Federal Navigation Channel, Approximate Location

Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.20-2
Potential Restoration Areas
LA-7 Wetland Cheektowaga
Cheektowaga, New York

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4.2.21 Smith Street Park (Buffalo River)

The Smith Street Park site is located along the north bank (right descending bank [RDB]) of the Buffalo River, west of Smith Street and east of the CSX railroad. The site is 3.7 miles upstream of the mouth of the river. The site is owned and managed as an urban "pocket" park by the County of Erie Department of Environment and Planning (Erie County). Volunteers from the Valley Community Center, located to the north, provide stewardship and routine maintenance of the site.

Figure 4.2.21-1 Smith Street Park Site Location Map

4.2.21.1 Site Description

The approximately 7-acre park parcel is located on an outside bend of the Buffalo River and contains a parking area, approximately 800 linear feet of shoreline, a fishing overlook, nature trail, and an informal canoe launch. In 2002, Erie County restored habitat on the western portion of the site. The Smith Street Park Habitat Restoration Project involved re-constructing a backwater wetland similar to riparian and floodplain habitat features that were common in the lower Buffalo River watershed prior to development of the lake and river shorelines. Underwater log structures were placed in the backwater wetland to improve habitat for aquatic flora and fauna. Native trees and shrubs were planted around the backwater wetland and throughout the site. A "riverine wetland" was constructed by placing a rock reef in the channel to provide structural support. The parking area is located at the end of Smith Street and a nature trail connects the Valley Community Center on South Park Avenue to a public access point at the river. The park is used by hikers, anglers, and birders. The informal canoe launch is used for canoes, kayaks, and small motor boats.

Biologists conducted a field assessment in October 2010 to identify existing habitats in the Smith Street Park area and determine their distribution and status. The

following descriptions are based upon observations made during the field assessment.

Photo 4.2.21-1 Smith Street Park RDB shoreline and nearshore at upstream end of the site

In-Channel and Nearshore

Historic land use and railroad infrastructure has modified the channel from its natural state.

The channel is characterized by armored banks and shorelines with large boulders and riprap along the RDB. Stone armor protection is especially heavy and intact at the railroad bridge at the downstream end of the site. Unconsolidated shoreline sediments and debris mobilize and are transported downstream during high-flow events as a result of river channel modification and existing geomorphology. Subsequently erosion was observed to occur in nearshore and shoreline areas where there is no vegetation or other physical structure to anchor sediment and substrates at the interface between nearshore and shoreline.

Shoreline

The shoreline is the result of land filling and bank reshaping associated with construction of railroad bridge crossings and routine dredging of the navigation channel. An outfall pipe is located immediately upstream of the parking area and discharges at the shoreline (see Figure 4.2.21-2). The toe of the stream bank along the site is armored with large boulders and riprap that secure the bank line at an elevation above mean water level. The shoreline between the armored bank and

mean water level is an exposed mud flat of varying widths (approximately 15 to 35 feet) extending into the nearshore area. As a result of river channel geomorphology, unconsolidated shoreline sediments and debris are mobilized and transported downstream during high-flow events. Subsequently erosion occurs where there is no vegetation or other features to anchor shoreline substrates. Substrate material noted along the shoreline includes debris (e.g., large trees, trash, concrete materials, and glass), sand, silts, clay, and rocks of various sizes. Habitat value and structural function are transient because high flows move any large woody debris that is scattered on the shoreline and nearshore.

Photo 4.2.21-2 Shoreline and stream bank along RDB at the railroad bridge

Stream Bank

The stream bank within the park is composed of large boulders and riprap that armor the bank line and provide support for the access road, boat launch, parking area, and riparian corridor. The bank ranges from 8 feet high at the upstream portion of the site to 4 to 5 feet in height at the downstream portion. Minor-to-moderate erosion was observed at various locations along the bank within the armored area due to fluctuating water levels and ice scour.

Vegetation is sparse along the riprap side slope and at the top of the bank, creating a narrow, early successional riparian corridor in those locations away from the access road, parking area, and river access ramp. The predominant riparian species include crack willow (*Salix fragilis*) in the tree stratum with approximately 30% cover and Japanese knotweed (*Polygonum cuspidatum*) in the herbaceous

stratum with approximately 35% cover. Other identified species include goldenrod (*Solidago* spp.), cattail (*Typha* sp.), and European black alder (*Alnus glutinosa*).

Photo 4.2.21-3 Mowed field in the inland and upland area

Inland and Upland

The areas to the west of the parking lot include the previously restored upland area that contains mowed walking trails and the created backwater wetland feature. The backwater wetland and upland area are separated from the shoreline by a constructed berm. The upland area is composed of scattered tree growth in small "islands" and thickets, and in portions surrounding the wetland. Commons species observed during the field assessment included planted oak (*Quercus* sp.), black locust (*Robinia pseudo-acacia*), basswood (*Tilia* sp.), and cottonwood (*Populus deltoids*). Much of the area is mowed trail consisting of common urban-suburban grasses. Additional herb and shrub species include Japanese knotweed, common reed (*Phragmites australis*), and switchgrass (*Panicum virgatum*). Much of the upland appears to be built land containing fill material with a topsoil surface. Evidence of beaver activity was noted.

4.2.21.2 Restoration Opportunities and Actions

The existing composition, structure, and uses of Smith Street Park offer a number of habitat restoration opportunities that would support the improvement of water quality and increase fish and wildlife habitat structure and function. Implementation of the proposed habitat restoration features would contribute to the BUI delisting process (see Table 4.2.21-1 and Figure 4.2.21-2).

In-channel and Nearshore

The in-channel restoration opportunities focus largely on two general methods including resistive and redirective features. Resistive features, such as toe of slope protection and log revetments would help to protect the bank and stabilize the shoreline while redirective features would move stream flow away from the shoreline (typically away from vulnerable banks or infrastructure) and toward the center of the channel. Redirective features include, but are not limited to bendway weirs and vanes (see Table 4.2.21-1).

The in-channel and nearshore restoration opportunities focus on creating structure within nearshore areas to support the deposition of river sediments transported from upstream. The Buffalo River navigation channel may constrain the design and construction of deeper water habitat features. The capture and retention of sediment would expand the width of the shoreline area and support the establishment of emergent wetland communities. Sediment retention in nearshore areas would support the expansion of existing submerged aquatic vegetation beds. Both features would provide cover and foraging areas for bird and other wildlife species. The use of locked logs and cribbing features would support shoreline stability and trap sediments, while increasing in-channel habitat structure and diversity. Bendway weirs or other redirective features would move the higher, erosion- and scour-inducing, flows toward the middle of the channel. Scour pools would be created immediately downstream of these features, providing deep pool/nearshore habitat close to shore. Submerged aquatic vegetation beds would be restored in the lower flow zones downstream of the redirective features. In addition, the in-channel and nearshore restoration would increase cover for fish species and provide a variety of substrates and hydraulic gradients for benthic organisms. With appropriate design, the redirective restoration features could reduce the amount of debris accumulation along the Smith Street Park shoreline.

Shoreline

Exposed land in areas above the mean water level and the stream bank are valuable sites for shoreline habitat enhancement. Shoreline mud flats and gravel bars are currently unstable and do not support the recruitment and colonization of native emergent plant communities. Large woody debris, rootwads, log revetments, stone toe slope protection and rock vanes or weirs would provide structure that would resist scouring during high-flow conditions and collect sediment and organic matter that would support emergent plant communities. Vegetated shoreline areas would provide hydraulic roughness and stabilize substrates to enhance the resiliency of shoreline and stream bank habitat to physical and biological stressors.

Stream Bank

The habitat restoration approach for this area focuses primarily on increasing the biological diversity and function of the shoreline and bank, and increasing shoreline stability through bioengineering methods. The restoration activities include bank stabilization (vegetating existing riprap); sedimentation and erosion control;

and expansion of the emergent wetland community. A variety of methods could be used at this site, including sediment retention, toe of slope and shoreline protection, locked logs and log revetments, anchored large woody debris, geotextile erosion control blankets, and an integrated ISCMP including the regeneration of the native riparian zone – herbaceous, shrub, and tree layers. Native species plantings would increase the diversity of plants in the riparian areas and uplands, and provide habitat for wildlife, including forage material and nesting sites for a variety of bird species.

Inland and Upland

Invasive plant communities were observed to be well established and expanding in upland areas within the park. Invasive plant species observed on site include Japanese knotweed, tree of heaven (*Ailanthus altissima*), and common mugwort (*Artemisia vulgaris*). Although Japanese knotweed represents the most serious threat to wildlife habitat in the park, control of each of these species would enable successful restoration of native plant communities and wildlife habitat improvement.

An integrated plan for invasive species control and management coupled with a phased planting and seeding program has produced good results within the watershed. A site-specific monitoring plan would be developed to track the success of an ISCMP, restoration planting efforts, and outline steps for maintenance activities. It is critical to design and implement control measures that would address the ecological impacts on habitat and the physical constraints to revegetation presented by invasive plant communities. A multi-season effort is recommended to establish a control and management regime that would prepare the site for regeneration of native plant communities.

All restoration methods and techniques should be integrated with a site-wide ISCMP. Chemical and/or mechanical control methods should focus on areas prior to construction and implementation of the habitat restoration design (e.g., native plantings). If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP.

Inland and upland areas should be evaluated for planting of canopy shade and mast producing tree species to compete with existing invasive plant communities when mechanical and chemical treatments are not feasible.

Table 4.2.21-1 Summary of Restoration Opportunities for the Smith Street Park, Buffalo River, City of Buffalo

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-Channel and Nearshore	Fish habitat enhancement In-stream structure creation and enhancement Submerged aquatic vegetation bed development Nearshore area stabilization	Hydraulic cover stones Bendway weirs or vanes to create scour pools Submerged and vertical cribbing, Locked logs, rootwads
Shoreline	Bank stabilization Sediment and erosion control Expansion of emergent wetland community	Large woody debris for sediment retention and capture Toe protection Native wetland species plantings in combination with log revetments and other stabilizing features for sediment retention over time
Stream Bank	Bank stabilization Sediment and erosion control Increasing riparian structure and diversity	Bioengineering for bank stabilization/vegetated rip rap (within existing bank) Geotextile erosion control Integrated ISCMP with regeneration of native riparian zone – herbaceous, shrub, and tree layers
Inland and Upland	Enhancing upland habitat structure and complexity	Modify site management (reduction of mow zones), native upland plantings – warm season grasses, mast bearing trees, shrubs for a variety of wildlife

4.2.21.3 Considerations and Potential Constraints for Restoration

Considerations for restoration planning and implementation include recreational use of the area; existing access road, parking area, and mowed walking trails; fill material underlying the surface; large riprap; and the CSO.

The poor quality of the soil would determine species selection. Species would be selected based upon their ability to grow in nutrient deficient soils and to fix nitrogen.

Pre-Construction Work

The design of restoration features for use in the channel and in nearshore, shoreline, and stream bank areas would require additional analyses during design in order to more closely define the types and siting of the features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems, or impediments to navigation and ice flows, would not occur upstream or downstream of the site if in-channel structures were constructed.

Invasive Plant Communities

Control measures should be implemented to address the ecological impacts and physical constraints invasive plant communities present to restoration planning and design. Site preparation activities and sequencing of construction tasks on sites with invasive species communities must be integrated with invasive species control and management efforts and re-vegetation plans.

Remedial Sediment Dredging Project

The timing of a restoration project within this site would have to be coordinated with the dredging of the Buffalo River currently planned by the U.S. Army Corps of Engineers (USACE) and the Great Lakes National Program Office of the U.S. Environmental Protection Agency (EPA). (See Section 4.1 for overview of the remedial dredging projects.) The first of these two major environmental dredging projects is expected to begin in spring 2011 and will be conducted by the USACE to address contaminated sediments in the federal navigation channel. The second project, to be implemented with oversight of the EPA, would address contaminated river sediments outside of the navigation channel. The remediation would occur mostly along the shoreline of the river in targeted areas of a 6.2-mile stretch of the lower Buffalo River and a 1.4-mile stretch of the City Ship Canal. Habitat restoration construction in the Smith Street Park area should be planned with full knowledge of the remedial dredging schedule.

4.2.21.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.21-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Stone–pinned rootwads,
- Bendway weirs,
- Tiebacks for bendway weirs,
- Stone toe protection,
- Live stakes for mudflats,
- Vegetated riprap, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $632,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.21.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 located in Section 5.5. Project sponsors are advised that there could be other permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.

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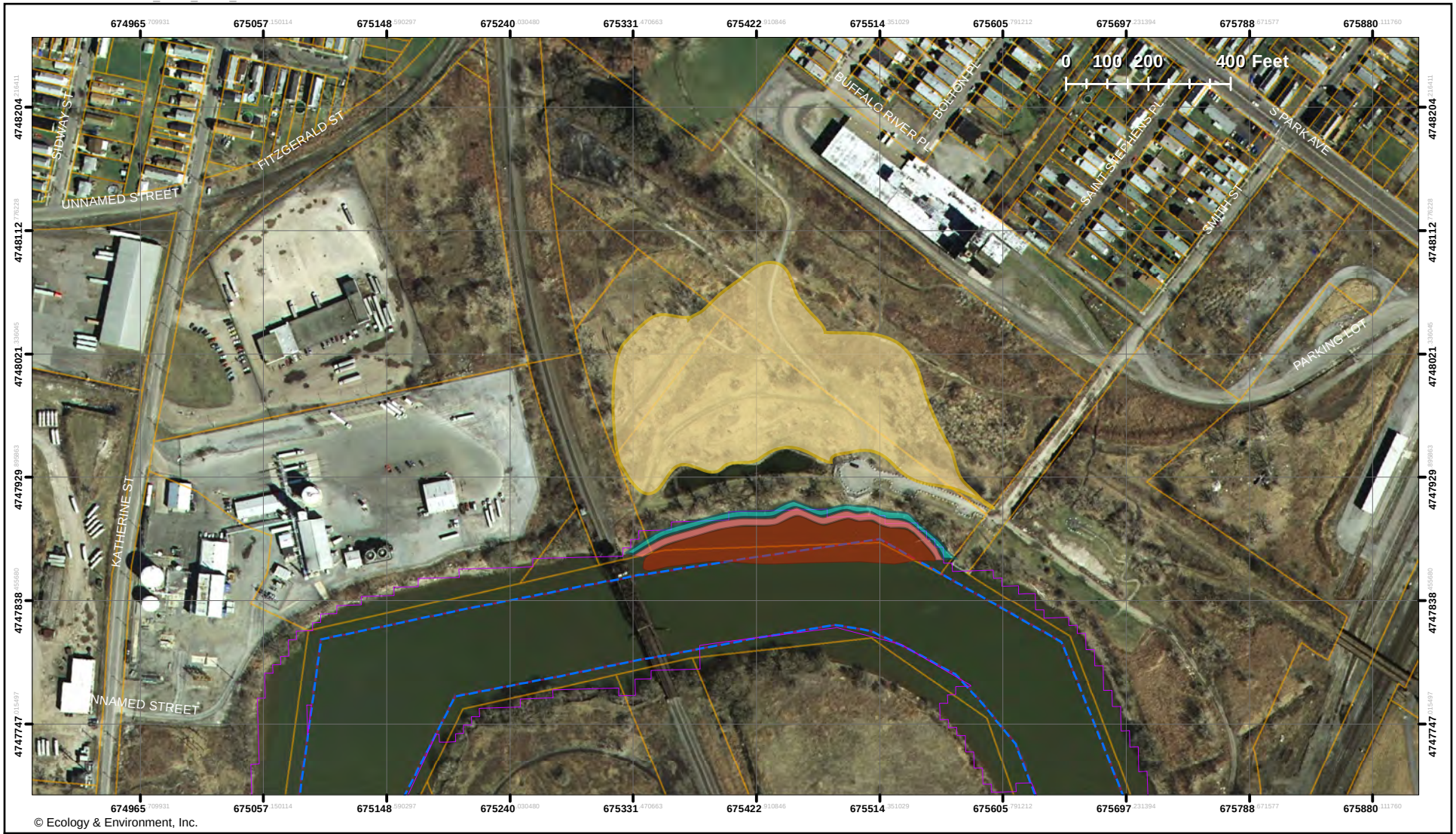

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(All Areas Approximate)

In-channel and Nearshore

Shoreline

Stream Bank

Inland and Upland

Stormwater Outfall

Stormwater Interconnect

SPDES

Parcel

Federal Navigation Channel, Approximate Location

Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.21-2
Potential Restoration Areas
Smith Street Park
Buffalo, New York

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4.2.22 Town of West Seneca Special Focus Area 1 (Buffalo Creek)

The Town of West Seneca Special Focus Area 1 site is located at a bend in Buffalo Creek northeast of the intersection of Mineral Springs Road and Indian Church Road in the town of West Seneca. The site comprises four areas separated from each other by Buffalo Creek and a railroad bed. The four parcels are owned by various individuals and utilities. The total area of the four properties is approximately 79 acres. A railroad bridge crosses the creek near the parking lot along Indian Church Road. A large parking area used for fishing access is located just upstream of the railroad bridge between the left descending bank (LDB) and Indian Church Road. The parking area is compacted and sloped towards the creek, with all parking area runoff flowing directly into a narrow riparian area and the creek. Multiple informal trails connect the parking area to the creek.

The properties south of the creek are a combination of industrial, commercial, residential, and vacant land. The properties to the north of the creek are dissected by the railroad and are in active row crop production. There is a narrow fringe of early successional woodland between the cultivated fields, along the right descending bank (RDB), and along the elevated railroad bed. The area is a popular warm and cool water fishery that attracts local and regional anglers especially during the steelhead run from September through April each year.

The areas assessed for potential restoration opportunities include the in-channel and nearshore, shoreline, stream bank, and inland and upland areas along the RDB and LDB.

Figure 4.2.22-1 Town of West Seneca Special Focus Area 1 Site Location Map

4.2.22.1 Site Description

Biologists conducted a field assessment of the site in October 2010 to identify existing habitats within the Town of West Seneca Focus Area 1 site and determine their distribution and status. The following descriptions are based on observations made during the field assessment. Little restoration is needed downstream of the railroad bridge except in the inland and upland areas. Most of the discussion below, with respect to the in-channel and nearshore, shoreline, and stream bank areas, centers on the area upstream of the railroad bridge.

In-channel and Nearshore

The in-channel and nearshore environment is a mixture of bedrock, boulder, cobble, gravel, and silt with a run-riffle-pool habitat in the creek. The creek upstream of the railroad bridge is evolving in reaction to an exposed pipeline crossing, eroding banks, and extensive bedload deposition immediately upstream of the railroad bridge. There are two large, elevated gravel bars approximately 100 feet upstream of the railroad bridge. The largest gravel bar in the center of the creek channel is 0 to 4 feet above mean water level and approximately 125 feet long by 30 feet wide. This bar is well vegetated with crack willow (*Salix fragilis*), sandbar willow (*S. exigua*), and American sycamore (*Platanus occidentalis*) saplings. The smaller gravel bar is newly developed and more sparsely vegetated with the same species. Based on aerial photo interpretation, these features have developed significantly since 2005.

The channel has widened in the recent past upstream of the railroad bridge due to recent bank erosion along the LDB in proximity of the bridge. A deep scour pool exists along the LDB near the base of the bridge as a result of the vegetated gravel bars redirecting flow and velocity towards the LDB. An increase in scouring flows in this area has widened and deepened the channel in this location causing growth of the mid-channel gravel bars from deposition of coarse gravel and sediment. Smaller channels have developed in between the gravel bars in the mid-channel and along the RDB. The configuration and redirection of flow resulting from the presence of the channels between the gravel bars have moved the thalweg. High flow velocities are now directed into the LDB while secondary channels moderate scouring flows. However, the deep scour pools upstream of the railroad bridge along each bank provide fishery habitat and refuge during low-flow conditions. Additional hydraulic analysis is required to identify the appropriate in-channel resistive and redirective features needed to address bank erosion and enhance fishery and benthic habitat. Nearshore submerged aquatic vegetation is sparse due to bedrock channel bottom, excessive scour of sediment, and excessive foot traffic.

Smaller point bars are actively forming along the RDB while in-channel boulder clusters create scour and depositional areas relative to their position in the channel. Along the RDB, where the creek actively accesses the floodplain, a combination of hydraulic roughness and channel width is causing sediment and gravel deposition. The current orientation of scouring flow and the thalweg is located along the LDB upstream of the railroad bridge.

The creek channel downstream of the railroad bridge is wide and well connected to a vegetated floodplain along the LDB and RDB. A series of well established and connected gravel bars occurs nearshore and within the shoreline area along the LDB downstream of the railroad bridge. A review of aerial photography indicates that these formed prior to 2005 and are relatively stable. Each gravel bar is heavily vegetated with willow saplings. An overflow area parallels the shoreline between the LDB and the gravel bars; it is approximately 3 feet deep by 10 feet wide and about 200 feet long. The overflow channel is open to flow and recharge at mean water levels only at the downstream end.

Photo 4.2.22-1 Gravel bars immediately upstream of the railroad bridge, looking upstream

Shoreline

Shoreline areas upstream of the railroad bridge are primarily flat bedrock with some depressions and transient gravel bars along the LDB. Vegetation in shoreline areas is routinely scoured during high-flow events up to vertical, undercut stream banks. As a result the LDB is being undercut and trees and shrubs fall into the channel at the shoreline along with considerable soil mass. Some large woody debris persists and collects sediment and organic matter, but most debris is buoyant and carried downstream. The shoreline along the LDB in vicinity of the main access trail adjacent to the parking lot is composed of native soil with some riprap toe protection which overlays the bedrock channel. Herbaceous vegetation along the shoreline is fragmented and immature as the result of periodic scour.

Vegetation is dense and well established in the shoreline area downstream of the railroad bridge. Species downstream of the bridge include mature cattail (*Typha latifolia*), reed canarygrass (*Phalaris arundacea*), purple loosestrife (*Lythrum salicaria*), and saplings of crack willow, sandbar willow and a few American sycamores.

Stream Bank

Bank vegetation is limited to mature eastern cottonwood (*Populus deltoides*) and crack willow with scattered silky dogwood (*Cornus amomum*) in the understory. An open tree canopy provides approximately 30% cover. In addition to crack and sandbar willow, box elder (*Acer negundo*), bush honeysuckle (*Lonicera morrowii*), Japanese knotweed (*Polygonum cuspidatum*), and riverbank grape (*Vitis riparia*) are abundant.

Photo 4.2.22-2 Exposed pipe and bank failure on the LDB upstream of the railroad bridge, looking downstream

Banks and access trails between the parking area and the creek have areas of exposed soil with sparse vegetation. Exposed soils are subject to slope drainage from the parking area and a subsurface drainage pipe outfall in the middle of an access trail. Active side slope and bank erosion is evident in the fishing access area and side trails and is exacerbated by toe undercutting during high flows.

A large steel pipe crosses the creek approximately 500 feet upstream of the railroad bridge along the LDB. The pipe emerges from the LDB and gradually angles downward into the stream bed near the middle of the stream. At the stream

bank, the pipe is approximately 18 inches above mean water level causing redirected flow, and downstream channel and bank scour. Bank erosion is severe in proximity of the pipe line, but has generated sediment deposition downstream that is beginning to support vegetation. Most of the severe bank erosion is in the form of undercutting, mass wasting, and tree loss. Severe erosion occurs along the LDB from approximately 200 feet downstream of the pipeline upstream to the apartment complex near the limit of the survey area. The type of pipeline and its ownership were not determined at the time of this report's publication. That determination should be a priority in any detailed planning process.

The RDB is stable within the survey area with the exception of approximately 200 feet under the overhead electric utility line in the upstream end of the survey area that has been clear cut of trees.

Inland and Upland

The inland area within 100 feet of the top of bank along the LDB is a primary terrace. It is vegetated with early successional bottomland forest species, cottonwood, crack willow, box elder, and occasional basswood (*Tilia Americana*). The understory is dominated by knotweed, common reed (*Phragmites australis*), bush honeysuckle, common buckthorn (*Rhamnus cathartica*), and some reed canarygrass (*Phalaris arundacea*). A stand of mature red oak (*Quercus rubra*) and black cherry (*Prunus serotina*) exists on a secondary, upper terrace approximately 1,500 feet upstream of the railroad bridge along the LDB adjacent to an apartment complex. Toe undercutting and bank failures threaten the oak stand in the stand near the channel. The oak stand feature is representative of species common in the primeval forests of the area and uncommon in the immediate area of the watershed.

Natural regeneration of native species is severely limited by the density of invasive species in the herbaceous layer. Upland areas beyond 100 feet of the RDB are deep, well drained, fertile alluvial soils currently in agricultural production.

4.2.22.2 Restoration Opportunities and Actions

The existing land use, public fishing access, rail and utility corridors, fertile soils, agricultural farmland as well as the width of available land within the riparian corridor provide a number of habitat restoration and soil stabilization design opportunities. The size of the project area and potential uplift with respect to sediment loading, habitat, and native community restoration is significant.

Except for the inland and upland areas, the greatest potential for ecological restoration and uplift is concentrated in the area on and near the LDB upstream of the railroad bridge.

The availability of space increases the number of restoration options to protect natural resources and infrastructure. Having adequate space in off-channel areas in this reach of Buffalo Creek is critical to the successful construction and effectiveness of resistive and redirective in-channel and nearshore features. Features,

such as bank re-shaping techniques, would require keys or tiebacks into stable bank areas, thereby requiring significant space (see Figure 4.2.22-2). Their implementation would address soil instability, support the improvement of water quality, allow natural regeneration of native plant species, increase fish and wildlife habitat structure and function and, therefore, contribute to the BUI delisting process (see Table 4.2.22-1).

In-Channel and Nearshore

Channel alignment of the thalweg and high-flow pattern within the survey area has been altered by the formation of mid channel gravel bars and the exposed pipeline along the LDB. A number of hydraulic conditions have resulted that have redirected high flows and ice toward the LDB. Bendway weirs and rock vanes could be designed for use upstream of the eroding banks and along both banks as redirective features to divert water at high flow towards the center of the channel to prevent the erosion and ice scour. These redirective features would require careful design and strategic placement and orientation within the bank as well as in the water column. Each feature would require rock keys to tie the features into stable portions of the bank to prevent high flows from flanking or scouring around these structures. Hydraulic cover stones could be pinned in areas of mid-channel to create scour pools, oxygenate water and provide cover for fish at high and low-flow conditions. Each structure would create elements of fishery enhancement associated with scour pools and sediment deposition by supporting the development of lower flow and velocity back eddies. Deposition of gravel bars or mudflats would support overhanging vegetation. These in-channel features could be foundation components to support nearshore bioengineering structures, such as pinned root wads, coir log or log revetments, and locked logs, designed to provide in-stream habitat complexity. Uplift of fishery, benthos, and aquatic emergent and submerged vegetation communities would result.

Shoreline

The bank and riparian areas adjacent to the channel along the LDB upstream of the railroad bridge require the most immediate attention for habitat restoration activities. The in-channel and nearshore features discussed above would provide the foundation to support the use of advanced bioengineering methods integrated with appropriate toe protection to stabilize unconsolidated shoreline and side-slope soils. Bioengineered approaches, such as live siltation, live staking, and vegetated riprap, would complement bank reshaping design. A design for reshaping vertical banks upstream of the fishing access area along the LDB could be developed to integrate toe slope protection with appropriate bioengineering methods. Integrated restoration design with bioengineering features would provide a naturalistic vegetated side slope that would hold soils and sediment. Such a design would also stabilize the shoreline by stopping undercutting during high-flow events and preventing stream bank failures which will continue without corrective action. Bioengineering for soil stabilization, bank re-shaping, implementing an ISCMP, and a native species planting plan would improve habitat, stabilize the nearshore and stream bank areas, and increase overall channel and riparian corridor function.

Four invasive species, Japanese knotweed, mugwort, common buckthorn, and bush honeysuckle, were identified throughout the survey area. Management of these species in the proposed project work areas followed by aggressive planting would prevent them from re-establishing large communities. Planting of native species along the banks and in the riparian corridor could enhance the habitat by regeneration of native plant communities and seedbank as well as stabilization of unconsolidated soil.

Stream Bank

Measures to address severely eroding stream bank areas would be integrated into nearshore and shoreline restoration designs. Stream banks would be reshaped and stabilized by a combination of soil bioengineering techniques and stone armoring. Stream bank stabilization measures would use erosion control geotextiles to stabilize soils until seeding and plantings become established. Integration of resistive features to dissipate the energy of scouring, high flows would include large woody debris and stone features to provide the physical structure needed to support regeneration of native riparian plant communities. Bank reshaping would also accommodate the construction of rock keys below grade to support in-channel and nearshore redirective structures discussed above. Stream bank reshaping and revegetation would provide several functional benefits:

- Better access to the existing floodplain,
- Hydraulic roughness to dissipate high-flow energy and to promote greater soil stability and resilience to ice scour, and
- A natural interface between the aquatic and terrestrial riparian habitats.

Inland and Upland

The electric utility, railroad, and pipeline rights of way as well as cultivated farmland on this site present distinct opportunities for terrestrial upland habitat restoration or enhancement. Utility and pipeline corridors management requires periodic tree removal. These areas could be designed to support native grassland habitat or low growing shrub communities that would suppress tree regeneration while providing valuable habitat for a variety of flora and fauna.

The fertile alluvial soils in upper terraces along the RDB currently in cultivation could be reforested with a native species assemblage of hardwoods with shrub and herbaceous understory. This community type would provide a valuable riparian habitat type of significant size that is rare in this part of the watershed.

Table 4.2.22-1 Summary of Restoration Opportunities at the West Seneca Focus Area 1, West Seneca

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-channel and Near-shore	Fish habitat enhancement In-stream structure creation and enhancement Emergent and submerged aquatic vegetation bed development, bank stabilization In-channel features for hydraulic modification of flow/velocity, bank stabilization, sediment and erosion control	Bioengineering with resistive and re-directive features to restore and pre-serve natural channel geomorphology, especially existing scour pools. Re-directive features – bendway weirs, locked logs, rootwads, hydraulic cover stones, bendway weirs or vanes specifi-cally for scour pools
Shoreline	Bank stabilization Toe protection Sedimentation and erosion con-trol Expansion of emergent wetland community	Bank reshaping Pipeline stabilization and protection Large woody debris for sediment reten-tion and capture Longitudinal toe protection Planting of native emergent wetland species in combination with coir log and log revetment toe protection and other stabilizing features for sediment retention over time
Stream Bank	In-channel features for hydraulic modification of flow/velocity Bank stabilization Erosion control Increasing riparian structure and diversity to enhance habitat value and soil stability	Stone keys/tiebacks for in-channel redi-rective features Bioengineering methods and techniques for soil stabilization Bank re-shaping Geotextile erosion control mats, live staking, vegetated rip rap, longitudinal toe protection integrated with an ISCMP and side slope native riparian plantings – herbaceous, shrub, and tree layers Protection of mature hardwood com-munity on upper terrace

Table 4.2.22-1 Summary of Restoration Opportunities at the West Seneca Focus Area 1, West Seneca

Focus Area	Restoration Opportunities	Restoration Features and Methods
Inland and Upland	Enhancing upland habitat structure, complexity and diversity Invasive species control and management	ISCMP integrated with revegetation plan and planting plan to regenerate native communities - warm season grasses and forbs, mast bearing and canopy shade producing trees with shrub understory, reforestation and creation of native plant communities in current agricultural land

4.2.22.3 Considerations and Potential Constraints for Restoration

Public fishing access to the creek and seasonal recreational use, such as swimming, may limit the extent and density of restoration plantings. Geotextiles, geogrid erosion control systems, permeable pavement and defined pathways for ingress and egress may be required to accommodate the multiple uses of this site.

Management regime for utility, pipeline, and railroad rights of way may be compatible with selective habitat restoration methods, but coordination with rights-of-way managers should be initiated to maximize restoration opportunities. Landowners may be active partners in restoration efforts and design that does not conflict with operations or routine maintenance. Pipeline stabilization measures could provide in-channel and nearshore habitat value as well as maintaining the pipeline's integrity.

The degree of land loss and severe bank erosion would require examination of the hydraulic environment along the affected reaches as well as upstream and downstream areas to determine the specific variables creating the current situation. It is likely that further field evaluations would need to be performed in order to develop a functional design that would stabilize banks subject to erosion and failure while avoiding impacts to existing infrastructure and private property.

Project sponsors should work with the owners of agricultural lands and local, state, and federal agricultural agencies to investigate how their programs (e.g., the USDA's Conservation Reserve Program) could benefit the farmers and the environment while simultaneously implementing habitat restoration and facilitating the viability of the farm businesses.

Pre-Construction Work

The design of restoration features for use in the channel and in nearshore, shoreline, and stream bank areas would require additional analyses during design in order to more closely define the types and siting of the features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative

success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems would not occur upstream or downstream of the site if in-water structures were constructed.

Invasive Plant Communities

Control measures would be implemented to address the ecological impacts and physical constraints posed by invasive plant communities to the restoration planning and design phases. A multi-season effort is recommended to establish a control and management regime that would prepare the site for the regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities requires the integration of control and management methods and revegetation plans. Chemical and mechanical control methods should focus on areas to be disturbed by construction prior to bank reshaping, toe stabilization, and implementation of the remainder of the habitat restoration design, including planting native species. Upland and inland areas should be evaluated for planting of canopy shade and mast-producing tree species to compete with existing invasive plant communities when mechanical and chemical treatments are not feasible.

All restoration methods and techniques should be integrated with a site-wide ISCMP. If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP.

Bank Erosion and Bank Failure Control Features

Another construction sequencing consideration for this site would be to place priority on addressing severe and imminent stream bank failures. Design and installation of the appropriate stream bank stabilization features to address severe stream bank erosion would significantly reduce the sediment loading from the site and preserve existing floodplain and hardwood woodlands in the upland areas along the RDB.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.22-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the

Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

4.2.22.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.22-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Planting for RDB and shoreline,
- Bendway weirs,
- Hydraulic cover stones,
- Rock vanes,
- LUNKERS,
- Stone-pinned locked logs,
- Longitudinal stone toe protection,
- Vegetated riprap, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $1,598,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the

region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.22.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 located in Section 5.5. Project sponsors are advised that there could be other permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.

(All Areas Approximate)

In-channel and Nearshore

Shoreline

Stream Bank

Inland and Upland

Stormwater Outfall

Stormwater Interconnect

SPDES

Power Line Approximate Location

Pipeline Approximate Location

Parcel

Federal Navigation Channel, Approximate Location

Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.22-2
Potential Restoration Areas
Town of West Seneca
Special Focus Area 1
West Seneca, New York

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4.2.23 Town of West Seneca Special Focus Area 2 (Buffalo Creek)

This site was identified during the stakeholder meeting in June 2010 and was identified in the Town of West Seneca Municipal Open Space and Greenway Protection Report prepared for the Town Board in January 1999. It was subsequently named "Special Focus Area 2" for the purposes of this plan. The site is composed of a number of privately owned parcels along the right descending bank (RDB) and left descending bank (LDB) of Buffalo Creek. Located approximately 1 mile upstream of the Union Road bridge and the Burchfield Nature and Art Center, the site extends approximately 2,400 feet upstream along both sides of the stream. Soils within the site are fertile and mapped as "prime agricultural" in the Erie County Soil Survey. Early successional floodplain forest is the dominant cover type on the site within 300 feet of Buffalo Creek. Adjacent land use is residential and agricultural.

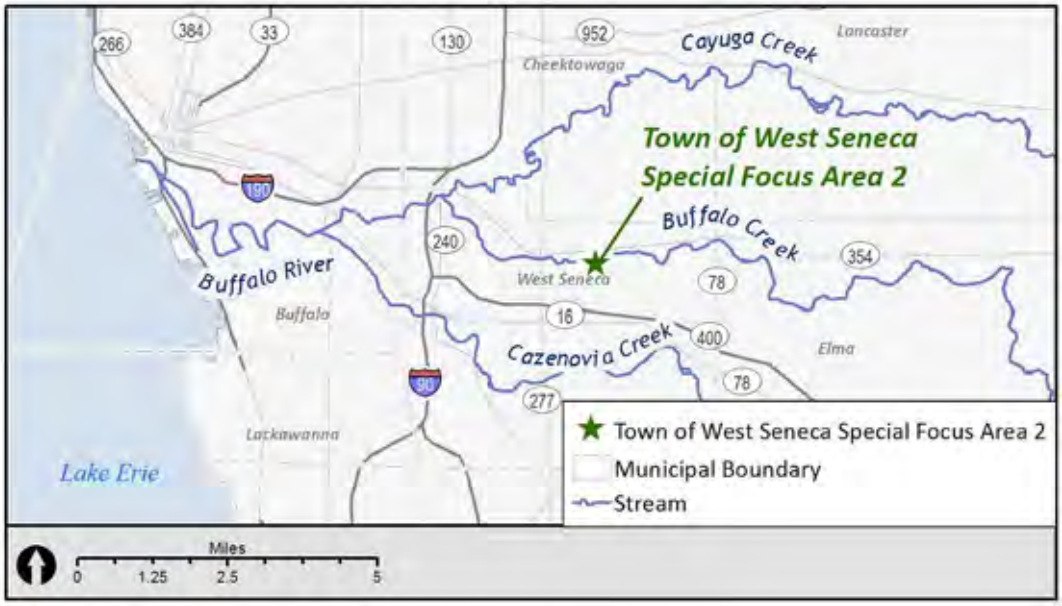


Figure 4.2.23-1 Town of West Seneca Special Focus Area 2 Site Location Map

4.2.23.1 Site Description

Field biologists conducted an assessment of the site in early November 2010 to identify existing habitats within the site and determine their distribution and status. The following descriptions are based on observations made during the field assessment.

In-channel and Nearshore

The channel and nearshore area ranges from approximately 80 to 100 feet wide. The channel bed consists of smooth bedrock throughout the site, with some gravel and cobble overlaying bedrock in the channel in the upstream portion of the site. A thin layer of silt overlays much of the nearshore areas. There is channel-to-floodplain connection along the LDB in the downstream portion of the site and along the RDB in the upstream half of the site.

Water depth is approximately 6 inches to 1 foot deep during low-flow conditions. High-flow conditions at this site often result in water levels to rise up to the 7-foot flood stage or higher, especially during ice jam conditions. Linear pools, formed by fractures in the shale, freeze-thaw cycles, and scouring forces, exist throughout the channel and nearshore areas. Ice jams and associated flooding occur in this area of Buffalo Creek.

Photo 4.2.23-1 Shale stream bank and shoreline sloping into bedrock stream bed, looking downstream.

No submerged aquatic vegetation was present in the stream, with the exception of small areas of waterweed (*Elodea* sp.) and coontail (*Ceratophyllum demersum*), which were identified in scour pools in the nearshore area. Small clumps of river bulrush (*Scirpus fluvitalis*), an emergent aquatic species, occur in sediment deposits within crevices and depressions in the bedrock. The diversity of aquatic plant communities is low due to the predominance of bedrock stream bed, high-flow and ice scour, and lack of protective nearshore structure.

Shoreline

The shoreline along the LDB is smooth bedrock in the upstream portion of the site in proximity to the shale cliff, with narrow mudflats and sand and gravel bars that are exposed during low-flow conditions. The mudflats and gravel bars of the downstream LDB shoreline have very little vegetation.

Throughout the site, the RDB shoreline is more developed due to floodplain access and lower stream banks. Gravel bars and depositional features range in

width from 3 to 40 feet. These features are stable and vegetated with emergent wetland plants and shrubs, including purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*), river bulrush, common reed (*Phragmites australis*), red osier dogwood (*Cornus sericea*), and occasional crack willow (*Salix fragilis*) saplings.

Photo 4.2.23-2 Natural and managed floodplain landscape

Stream Bank

The LDB ranges in height from 3 feet in the downstream portion of the site to approximately 10 feet along the shale cliff in the upstream portion of the site. Approximately 500 feet of riprap armoring extending from toe of the slope to the top of the stream bank is in place along the LDB in the central portion of the site. This stream bank protection is exposed and unvegetated and appears to have been installed approximately 5 years ago.

The shale cliff occurs along the LDB, immediately upstream of the riprap armoring, is approximately 900 feet long and 10 feet high. Articulated concrete block toe protection (installed at an unknown time) is pinned in place along portions of the outside bend along the LDB downstream of the shale cliff and near the riprap stream bank armoring shown in Photo 4.2.23-3. This toe protection is identical to that installed by the Erie County Soil and Water Conservation District downstream of this site to reduce flood damages to the Buffalo River watershed and reduce sedimentation in the Buffalo River. There is evidence of ice scour along the LDB and minor stream bank erosion and failure downstream of the armored area. Vegetation near the toe on the LDB consists predominantly of reed canary

grass (*Phalaris arundinacea*), little blue stem (*Schizachrium scoparium*), purple loosestrife (*Lythrum salicaria*), beggar ticks (*Bidens frondosa*), crack willow (*Salix fragilis*), box elder (*Acer negundo*), eastern cottonwood (*Populus deltoides*), morrow's honeysuckle (*Lonicera morrowii*), and common buckthorn (*Rhamnus cathartica*).

Photo 4.2.23-3 Riprap armored section along the LBD in the central portion of the site

Along the RDB there are more frequent and larger expanses of a low floodplain, which is variably vegetated due to management of the properties by land owners. The RDB is approximately 2 feet to 3 feet in height. Due to presence of saturated soils and gradual slope from shoreline, the RDB vegetation communities are a combination of emergent aquatic plants near the toe of slope and wetland species to the top of stream bank and inland. RDB plant communities are well established and include purple loosestrife, reed canary grass, beggar ticks, crack willow, sandbar willow and red osier dogwood.

Inland and Upland

Inland and upland areas along the LDB from the top of the stream bank are a combination of reverting field, fallow agricultural land, pasture, and mature floodplain forest. The early successional floodplain forest species present include eastern cottonwood (*Populus deltoides*), common buckthorn (*Rhamnus cathartica*), American basswood (*Tilia Americana*), slippery elm (*Ulmus fulva*), quaking aspen (*Populus tremuloides*), and occasional red oak (*Quercus rubra*), black walnut (*Juglans nigra*), and American sycamore (*Platanus occidentalis*). A narrow,

elevated rim runs along the south side of the forested floodplain in the central portion of this site where the oldest hardwood trees, consisting of red oak, burr oak (*Q. macrocarpa*), black cherry (*Prunus serotina*) and black walnut, occur. These trees are much older than the floodplain trees and appear to delineate a line separating historic farmland from bottomland that is too wet cultivate. There is a similar assemblage of old hardwoods on an elevated knob at the upstream end of the site, with an understory of morrow's honeysuckle and witch hazel (*Hamamelis* sp.).

Photo 4.2.23-4 Upland hardwood area between the open field and the floodplain

Inland old-field communities in fallow agricultural areas include Canada goldenrod (*Solidago canadensis*), late goldenrod (*S. giganteus*), grey dogwood (*Cornus racemosa*), morrow's honeysuckle, white snake root (*Ageratina altissima*), and established stands of big bluestem (*Andropogon gerardi*). There is a cleared and graded area above the armored section of stream bank along the bend in the creek. This area appears to be in the preliminary stages of construction.

On the RDB, the floodplain vegetation is variable due to management of the area, such as mowing of the understory, by the property owners. It is vegetated primarily by eastern cottonwood, Japanese knotweed (*Polygonum cuspidatum*), and white snake root. There is evidence of severe over-browsing by deer throughout this site.

4.2.23.2 Restoration Opportunities and Actions

As a result of information obtained during the field assessment, it was determined that the LDB has the most opportunity for ecological restoration. The discussion below, therefore, does not include the nearshore, shoreline and inland and upland of the RDB.

The existing land use and fertile, sedimentary soils within the riparian corridor along the LDB provide a number of riparian habitat restoration design opportunities. In addition, the availability of space also increases the number of restoration options for resistive and re-directive in-channel and nearshore features, which would require keys or tiebacks into stable bank areas. Although the stream banks are stable, the site provides the ability to secure structural material into bedrock and to construct keys into stream bank areas which would allow for the design and construction of nearshore structures needed for shoreline creation and nearshore aquatic habitat enhancement. Such structures would improve aquatic habitat in the existing bedrock substrate and allow natural regeneration of native plant communities by creating stabile, depositional areas.

The high-quality soils in the stream bank and inland and upland areas provide significant opportunities for regenerating native plant communities, thereby increasing wildlife habitat structure and function within the riparian corridor. Landowner support would be critical to the successful design and implementation of riparian wildlife habitat restoration and soil stabilization features. Conservation easements or a riparian buffer setback from the creek would be required to ensure the resiliency and conservation of riparian resources on this site.

Implementation of habitat restoration features would contribute to the BUI delisting process (see Table 4.2.23-1 and Figure 4.2.23-2).

In-Channel and Nearshore

The main channel is wide and shallow along the entire length of this site. Smooth bedrock substrate along the LDB and shallow flow provides minimal opportunity for effective fishery and benthos habitat enhancement, especially during seasonal low-flow conditions. However, the integration of resistive and redirective features with nearshore structures would lessen the impact of scouring flows and create stability, which would support the creation of depositional areas and regeneration of emergent and aquatic plant communities. In areas without toe protection or where failures in this feature have occurred, resistive features such as toe protection and log revetments would provide additional stream bank and shoreline protection, while redirective features would move scouring flow toward the center of the channel. Redirective features include, but are not limited to, bendway weirs and vanes.

In-channel and nearshore restoration opportunities include expanding the width of the shoreline area and establishing and expanding emergent wetland communities. These objectives would be facilitated by the deposition of alluvial material in nearshore and along shoreline areas. Also, the proper design and placement of

rock vanes would re-direct high-velocity flows and create scour pools immediately downstream of the vanes. This additional habitat area would provide value, cover, and forage for aquatic, avian, and terrestrial wildlife species. In-channel fishery and benthos habitat enhancement would occur in the form of small but significant submerged and emergent aquatic vegetation communities.

The channel and nearshore area along the RDB is relatively stable. The existing gravel bars and depositional features in the nearshore area along the RDB are expanding naturally but are frequently mobilized and modified by channel-forming flows. Designed features similar to those recommended for the LDB would support the establishment of submerged and emergent aquatic vegetation within stabilized areas. The design and construction of in-channel and nearshore features must withstand the scouring action associated with annual ice flows and ice jam conditions in this area.

Shoreline

The constructed in-channel and nearshore restoration features (e.g., rock vanes) discussed above would provide the foundation to support the use of bioengineering methods to capture and stabilize channel bed load and nearshore depositional material. Reducing the impact of scouring flows along the LDB and RDB shorelines would allow for the retention of soil and organic matter and the regeneration of emergent aquatic plant communities. Shoreline structural features would create a more natural shoreline that would be resilient to erosion and sediment loss caused by high-flow and ice-scouring forces. With seeding and planting, the exposed sand and gravel shoreline areas along the RDB would provide a stable, diverse emergent plant community that would allow the natural recruitment and colonization of successional tree and shrub species.

Stream Bank

Bioengineering methods such as live siltation, live staking, vegetated riprap treatments, and coir logs would complement in-channel and nearshore habitat restoration design. Stream bank disturbance would be limited to excavated keys to secure nearshore and shoreline habitat structures and features. The approximately 500 feet of existing riprap along the LDB near the middle of the site could be amended with topsoil and planted and seeded with appropriate native species. A vegetated riprap design is appropriate for this location to increase riparian habitat. A planting plan would be required for the seeding and planting of native aquatic and terrestrial plant species in all areas of stream bank disturbance and for the seeding and overplanting of existing stream bank areas. This approach would initiate and support the establishment of native plant communities in stable, depositional areas at the toe of the stream bank and up to the top of the stream bank.

Inland and Upland

The old field and fallow agricultural areas along the LDB within the site present opportunities to enhance riparian habitat and to integrate restoration features with existing habitat features within the riparian corridor. For example, a number of planting plans could be developed to improve wildlife habitat and riparian con-

nectivity. Grassland habitat with native tree and shrub islands would provide habitat for resident songbirds, raptors, and neotropical migratory birds. The forested floodplain area is rich in native species and valuable riparian structure that would benefit from the introduction of additional species of high wildlife value. Native tree, shrub, and herbaceous species could be introduced by planting and seeding to improve habitat diversity in each vegetation layer.

Four invasive species—Japanese knotweed, mugwort, common buckthorn, and bush honeysuckle—occur on the site along the LDB and RDB upland areas but are not well established. Densities were variable and observed to be limited by canopy shade throughout the forested floodplains on the site. Control and management of these species in the proposed project work areas by removal or chemical treatment followed by aggressive planting would prevent them from re-establishing and expanding into larger communities. Candidate species that are known to be part of primeval forests in the region that are recommended for reintroduction to the site include American basswood, shagbark hickory (*Carya ovata*), burr oak, American sycamore, swamp white oak (*Q. bicolor*), and pin oak (*Quercus palustris*).

Evidence of an overabundance of white-tailed deer (*Odocoileus virginianus*) and the presence beaver (*Castor canadensis*) were observed during the site survey, and these represent severe constraints to the regeneration of native plant communities. Control of invasive plant communities is expected to be more difficult due to the palatability and preference of native plants over non-native, invasive species present on the site.

Table 4.2.23-1 Summary of Restoration Opportunities for Town of West Seneca Special Focus Area 2 (Buffalo Creek)

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-Channel and Nearshore	Creation of in-stream structure and enhancement to restore and expand fish and benthos habitat	Bioengineering with resistive and redirective features to preserve natural channel geomorphology Hydraulic cover stones
	Emergent and submerged aquatic vegetation bed development	Redirective features – bendway weirs, locked logs, rootwads, hydraulic cover stones
	Nearshore sediment stabilization and emergent wetland community regeneration	Nearshore structure to support submerged aquatic vegetation

Table 4.2.23-1 Summary of Restoration Opportunities for Town of West Seneca Special Focus Area 2 (Buffalo Creek)

Focus Area	Restoration Opportunities	Restoration Features and Methods
Shoreline	Resistive structure for sediment capture Toe protection Sedimentation and erosion control Expansion of emergent wetland community	Large woody debris for sediment retention and capture Native wetland species plantings and live staking in combination with coir log and log revetment toe protection and other stabilizing features for sediment retention over time
Stream Bank	Keys and stability structures for in-channel and nearshore features Increasing stream bank vegetation diversity to enhance habitat value and soil stability	Bioengineering for vegetation diversity Live staking, vegetated riprap for existing stream bank armoring Longitudinal toe protection integrated with side slope native riparian plantings – herbaceous, shrub, and tree layers
Inland and Upland	Enhancing upland habitat structure, complexity, and diversity Invasive species control and management	ISCMP integrated with revegetation plan and planting plan to regenerate native communities - warm season grasses and forbs, mast-bearing and canopy shade-producing trees, with shrub understory Forested floodplain habitat enhancement for riparian bird and amphibian species

4.2.23.3 Considerations and Potential Constraints for Restoration

Private ownership and variable land use and management may require public outreach to establish conservation easements or riparian setback agreements to initiate the restoration planning process.

The riparian corridor is wide along the RDB and LDB, which could allow for substantial stream bank and shoreline reshaping and upland/inland restoration design. Riparian sedimentary soils are excellent for re-establishing native plant communities. Landowners' loss of land and tree cover from erosion along the RDB could facilitate cooperative effort to address bank erosion.

Restoration design and planting plans would require the development of a strategy to address vegetation damage by white-tailed deer and beaver. There is ample evidence of stress to existing native vegetation across the site by these species to conclude restoration plantings would be vulnerable.

Project sponsors should work with the owners of agricultural lands and local, state, and federal agricultural agencies to investigate how their programs (e.g., the USDA's Conservation Reserve Program) could benefit the farmers and the environment while simultaneously implementing habitat restoration and facilitating the viability of the farm businesses.

Pre-Construction Work

The design of restoration features for use in the channel and in nearshore, shoreline, and stream bank areas would require additional analyses during design in order to more closely define the types and siting of the features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems, or impediments to navigation, would not occur upstream or downstream of the site if in-water structures were constructed.

Invasive Plant Communities

All restoration methods and techniques should be integrated with a site-wide ISCMP. Invasive species control measures would be implemented to address the ecological impacts and physical constraints that invasive plant communities present to restoration planning and design. A multi-season effort is recommended to establish a control and management regime that would prepare the site for regeneration of native plant communities. Chemical and mechanical control methods should focus on the area extending from the top of the stream bank to inland and upland areas prior to constructing the remainder of the habitat restoration design. If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP.

4.2.23.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor

needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.23-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

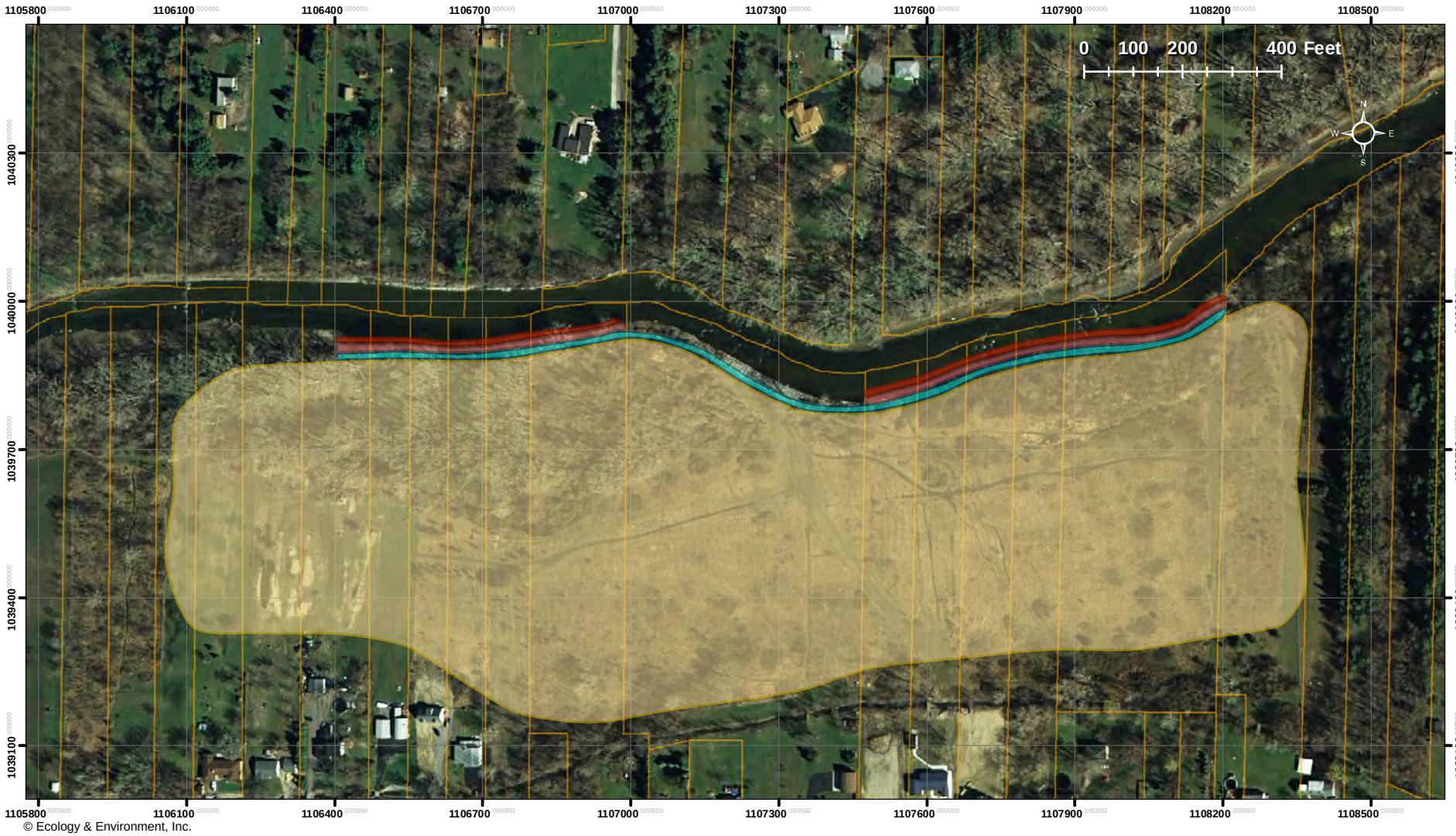
- Stone toe protection,
- Planting for shoreline,
- Single-stone bendway weirs,
- Stone pinned rootwads,
- Hydraulic cover stones,
- Tiebacks for bendway weirs,
- Vegetated riprap, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $1,232,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.23.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 in Section 5.5. Project sponsors are advised that there could be additional permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.



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(All Areas Approximate)

In-channel and Nearshore
Shoreline
Stream Bank
Inland and Upland

Stormwater Outfall
Stormwater Interconnect
SPDES

Parcel
Federal Navigation Channel, Approximate Location
Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.23-2
Potential Restoration Areas
Town of West Seneca
Special Focus Area 2
West Seneca, New York

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4.2.24 Private Land Not Developed (Buffalo Creek)

The Private Land Not Developed site is located approximately 2,000 feet downstream of the Borden Road bridge over Buffalo Creek (see Figure 4.2.24-1). The site is comprised of several large, privately owned parcels that extend along the left descending bank (LDB) of the stream between Clinton Street to the north and Seneca Creek Road to the south, in the town of West Seneca, New York (see Figure 4.2.24-2). This site has approximately 2,000 feet of channel and associated riparian areas. Approximately half of the land on this site is in cultivation, while the balance is an irregularly shaped successional bottomland forest that extends inland approximately 100 feet to 600 feet from the Buffalo Creek channel. The potential restoration areas have been identified as the Upstream Area (approximately 1.5 acres) and the Downstream Area (approximately 2.75 acres). These areas are separated by approximately 600 feet of stream bank along the outside bend in the middle portion of the site was armored by the Soil and Water Conservation Service (SCS). Adjacent land use is residential and agricultural.

Figure 4.2.24-1 Private Land Not Developed Site Location Map

4.2.24.1 Site Description

Biologists conducted a field assessment of the site in early November 2010 to identify existing habitats within the site associated with Buffalo Creek and determine their distribution and status. The following descriptions are based on observations made during the field assessment.

In-channel and Nearshore

The channel and nearshore area ranges from approximately 150 feet wide in the upstream portion of the site to 100 feet wide in the middle and downstream portions. The channel bed has a high width-to-depth ratio and consists of smooth bedrock and significant deposits of gravel, cobble, and large boulders. The predominant in-channel habitat along this stretch of creek is an irregular riffle-run feature. The water depth is relatively uniform, ranging from approximately 6

inches to 1 foot. Several large, natural rock vanes along the downstream portion of the site create large, stable vegetated gravel bars and shallow backwater areas. Submerged aquatic vegetation (SAV) was observed mostly in slow-moving water adjacent to the gravel/cobble stream bed areas, but SAV was also seen growing in cracks in the bedrock areas. The SAV was identified as Eurasian milfoil (*Myriophyllum spicatum*).

Small clumps of river bulrush (*Scirpus fluvitalis*), an emergent aquatic species, occur on sediment deposits within crevices and depressions in the bedrock and on stable gravel bars. The diversity of aquatic plant communities is low due to the bedrock geology, high flow and ice scour, and a lack of protective nearshore structure and available substrate. Emergent vegetation (EV) was also observed in nearshore areas and on gravel bars that extend into shoreline areas. The EV was identified as cattails (*Typha* sp.), reed canarygrass (*Phalaris arundinacea*), bulrush (*Juncus effusus*), river bulrush, sedges (*Carex* sp.), and purple loosestrife (*Lythrum salicaria*). The vegetation observed on the elevated gravel bars in the channel consisted primarily of sedges and reed canarygrass, along with scattered cattails.

Photo 4.2.24-1 Channel with boulders, gravel bars, and emergent bulrush vegetation (looking downstream)

The middle reach of the channel within the site is confined by a riprap embankment that extends approximately 600 feet along the LDB of an outside bend. The stream flows over exposed, smooth bedrock, cobble, and gravel. Water depths are very shallow during low-flow conditions due to the high width-to-depth ratio

within the channel. High-flow and ice jam conditions at this site often cause flows to extend onto the floodplain. Linear pools formed by fractures in the shale, freeze-thaw cycles, and scouring forces exist throughout the channel and near-shore areas. During high-flow conditions, there is direct channel-to-floodplain connection along the RDB, where the stream bank is approximately 2 feet high, and along portions of the LDB, where bank heights within the site range from 2 feet to 6 feet.

Shoreline

The shoreline along the LDB varies in composition along the length of the site, consisting of smooth bedrock with boulders and large woody debris associated with sand and gravel bars that are exposed during low-flow conditions.

Photo 4.2.24-2 Irregular shoreline with boulders, large woody debris, and gravel bar structures along the LDB (looking downstream from the upstream terminus of the site)

Shoreline areas, with the exception of the 600 feet of vegetated riprap armoring, are naturally sloped from shallow water to the toe of the stream bank. The armored stream bank along the outside bend of the LDB has no shoreline. The natural sections of shoreline consist mainly of cobble and gravel covered with soil and are well vegetated. The dominant species on the shoreline are sedges and reed canarygrass. Also present are white snake root (*Ageratina altissima*), yellow iris (*Iris pseudacorus*), purple loosestrife, common mugwort (*Artemisia vulgaris*) on higher ground, goldenrod (*Solidago* sp.), and riverbank grapevine (*Vitis riparia*). A few overhanging tree and nearly fallen trees provide overhead cover

along the shoreline. Gravel bars and depositional features connected to the shoreline range from 3 to 40 feet in width. Irregular shoreline features are vegetated with emergent wetland plants and shrubs, including purple loosestrife, reed canarygrass, river bulrush, common reed (*Phragmites australis*), red osier dogwood (*Cornus sericea*), and occasional crack willow (*Salix fragilis*).

Photo 4.2.24-3 Vegetated gravel bar along the LDB in the downstream portion of the site (looking downstream)

Stream Bank

The stream banks along this reach of creek range from 2 to 6 feet in height. A small foot/ATV path is present at the top of the bank for most of the shoreline's length. The stream bank areas without the riprap armoring contain native substrate, and various locations along the stream bank in the upstream portion of the site show signs of moderate undercutting and scour erosion. The stream bank with riprap armoring has no discernable signs of erosion, is soil choked, and is well vegetated with native species similar to those identified on the natural stream bank areas. Several large trees had significant scarring from ice scour. Mature trees with undercut, exposed roots are present along the LDB in proximity to the outside bend in the upstream portion of the site, and some trees have fallen from the bank into the stream channel or onto the floodplain.

Photo 4.2.24-4 Bank failure and tree loss near the beginning of the outside bend (looking downstream)

Photo 4.2.24-5 Stream bank with vegetated riprap armoring in the middle of the site (looking downstream)

Stream bank vegetation along the LDB is dominated by reed canarygrass and sedges. Other observed stream bank vegetation includes goldenrod, cattail, common mugwort, cottonwood (*Populus deltoides)*, white snake root, raspberry or blackberry (*Rubus* sp.), bush honeysuckle (*Lonicera morrowii*), and yellow iris. The tree layer along the stream bank, which consists of cottonwood, willow (*Salix* sp.), and red maple (*Acer rubrum*), provides overhead canopy to the stream bank in many areas.

The RDB slopes more gently to the top of the bank and toward the inland area than the LDB, and unlike the LDB, the RDB is not armored. The species present on the stream bank and shoreline along the RDB are similar to those present along the LDB.

Inland and Upland

The upland area of this site consists of approximately 30 acres of successional old-field, forested floodplain, active agricultural areas, and managed residential landscape areas. The inland area south of the creek is a large, irregularly shaped forested floodplain with groomed walking trails. A small tributary flows across the site from east to west and discharges into Buffalo Creek immediately downstream of the proposed restoration area. The tributary meanders roughly parallel to the LDB at a distance of 100 to 220 feet from the stream bank before turning toward Buffalo Creek. Its channel is approximately 8 feet wide and 2 feet deep and has steep banks. At the time of the field survey, the water in the tributary was approximately 6 inches deep and flowing slowly. A small depressional wetland in the upland area is associated with this tributary. The dominant vegetation in this wetland is sensitive fern (*Onecela sensibilis*). Additional species identified in the upland area include birch (*Betula* sp.), pine (*Pinus* sp.), cottonwood, butternut (*Juglans cineria*), ash (*Fraxinus* sp.), black cherry (*Prunus serotina*), red maple, oak (*Quercus* sp.), hawthorn (*Crataegus* sp.), reed canarygrass, honeysuckle, white snake root, goldenrod, and grapevine. Invasive species such as Japanese knotweed (*Polygonum cuspidatum*), common mugwort, purple loosestrife, and common reed are present throughout the site. The upland area along the RDB is predominantly floodplain forest and is similar in elevation and species composition to the upland area along the LDB.

4.2.24.2 Restoration Opportunities and Actions

The existing land use and fertile, sedimentary soils within the riparian corridor along the LDB provide a number of riparian habitat restoration design opportunities. In addition, the significant amount of available space increases the number of restoration options by allowing for the use resistive and redirective features in in-channel and nearshore areas and keys and tiebacks to stabilize bank areas. Although most of the LDB stream bank is stable, the ability to secure structural material into bedrock and to construct keys into stream bank areas would allow for the design of nearshore habitat features for shoreline creation, stabilization, and aquatic habitat enhancement. Their implementation would improve aquatic habitat in the existing bedrock substrate and foster the natural regeneration of native

plant communities by creating new depositional areas and stabilizing existing areas. The high-quality stream bank and inland and upland soils provide significant opportunities for regenerating native plant communities, thereby increasing wildlife habitat structure and function within the riparian corridor. Landowner support would be critical to the successful planning and design of riparian wildlife habitat restoration and soil stabilization features. Conservation easements or a riparian buffer setback from the creek would be required to ensure the resiliency and conservation of riparian resources on this site.

Implementation of habitat restoration features would contribute to the BUI delisting process (see Table 4.2.24-1 and Figure 4.2.24-2).

In-Channel and Nearshore

The main stream channel is wide and shallow along the length of the site, but some in-channel and nearshore habitat structure and complexity are present. Although fragmented, the existing aquatic habitat features created by boulders, natural rock vanes, and large woody debris provide some habitat structure in the in-channel and nearshore area. This existing structure can be expanded upon and integrated with nearshore restoration features designed to further stabilize depositional areas that would, in turn, support submerged and emergent aquatic vegetation communities. Along the LDB, the existing bedrock substrate and transitory gravel bars and boulder deposits provide some fishery and benthos habitat, but with functional values lower during seasonal low-flow conditions. The integration of resistive and redirective features with nearshore structures would lessen the impact of scouring flows and promote the development of depositional areas, which would support the regeneration of emergent and aquatic plant communities. In areas without toe protection or where shoreline erosion is significant, resistive features such as toe protection and log revetments would provide additional stream bank and shoreline protection, while redirective features would move scouring flows toward the center of the channel. Redirective features include, but are not limited to, bendway weirs and vanes.

The in-channel and nearshore restoration opportunities focus on features designed to support the deposition of alluvial material in nearshore areas. The capture and retention of sediment would expand the width of the shoreline area and support the establishment and expansion of emergent wetland communities. This habitat area would provide value, cover, and forage for aquatic, bird, and terrestrial wildlife species. Vanes could be placed at appropriate distances to redirect high-velocity flows and create scour pools immediately downstream of these features, providing fish and benthos habitat close to shore. In-channel fishery and benthos habitat enhancement would occur in the form of small but significant submerged and emergent aquatic vegetation communities.

The channel and nearshore area along the RDB are relatively stable due to the stream's direct connection to the right-side floodplain during high-flow conditions. Because the RDB on this portion of the stream runs along a large inside bend, the existing gravel bars and depositional features in the nearshore area

along the RDB are expanding naturally and will, over time, redirect scouring flows to areas along the LDB. Although the RDB is outside of the proposed project area, design features similar to those recommended for the LDB would support the establishment of submerged and emergent aquatic vegetation within stabilized areas.

In-channel and nearshore features must be designed and constructed to withstand the scouring action associated with annual ice flows and ice jam conditions in this area.

Shoreline

Restoration opportunities along the shoreline would build upon the in-channel and nearshore features discussed above through the use of bioengineering methods to support the capture of channel bed load and the development of emergent vegetation communities. Reducing the impact of scouring flows along the LDB shoreline would help retain soil and organic matter and foster the regeneration of emergent aquatic plant communities. Shoreline structural features could be used to create a more natural shoreline that would be resilient to erosion and sediment loss caused by high flows and ice scouring. With seeding and planting, the new depositional areas and the exposed sand and gravel shoreline areas along the LDB would provide a stable emergent plant community with hydraulic roughness, which would allow the natural recruitment and colonization of successional tree and shrub species.

Constructing habitat restoration features would contribute to the BUI delisting process (see Table 4.2.24-1 and Figure 4.2.24-2).

Stream Bank

The area upstream of the existing armored bank along the outside bend of the LDB could be protected from further erosion by extending the toe protection, reshaping the stream bank to a gentler slope, and planting it with deep-rooted vegetation to provide soil stability and hydraulic roughness. Boulders, large woody debris, and log revetments, in combination with the nearshore restoration features, could be used to create additional wildlife habitat structure and complexity. The old-field floodplain could be planted with native tree species to create a forested floodplain, which would increase species diversity and riparian and upland wildlife habitat.

Bioengineering methods such as live siltation, live staking, vegetated riprap treatments, and coir logs could be used along stream bank toe areas and would complement in-channel and nearshore habitat restoration design. Stream bank disturbance would be limited to excavated keys to secure nearshore and shoreline habitat structures and features. A planting plan would be required for the seeding and planting of native aquatic and terrestrial plant species in all areas where the stream bank has been disturbed, as well as for the overplanting of the remaining undisturbed stream bank areas. This approach would initiate and support the establishment of native plant communities in stable, depositional areas at the toe of

the stream bank and up to the top of the stream bank. A top-of-stream-bank canopy and mast-producing trees would limit habitat for invasive plant species and enhance riparian habitat.

Inland and Upland

Invasive species such as Japanese knotweed, common mugwort, purple loosestrife, and common reed are present throughout the site. These species can be controlled by chemical or mechanical means. Control of these species would enable the restoration of native species in all areas and increase the quality of wildlife habitat.

The old-field, forested floodplain, active agricultural areas, and managed landscape areas along the LDB within the site presents opportunities for riparian habitat enhancement and connection of existing features within the riparian corridor. A number of planting plans could be developed to improve wildlife habitat and riparian connectivity. The creation of grassland habitat with native tree and shrub islands within a portion of the land currently under cultivation would provide high-quality habitat for resident songbirds, raptors, and neotropical migratory birds. The existing forested floodplain area is rich in native species and valuable riparian structure and would benefit from the introduction of additional species of high wildlife value that were historically present on the site. Species known to have been part of primeval forests in the region that are recommended for reintroduction to the site include American basswood (*Tilia Americana*), shagbark hickory (*Carya ovata*), burr oak (*Q. macrocarpa*), American sycamore (*Platanus occidentalis*), swamp white oak (*Q. bicolor*), and pin oak (*Quercus palustris*). Additional native tree, shrub, and herbaceous species could be introduced by planting and seeding to improve habitat diversity in each vegetation layer.

Evidence of white-tailed deer (*Odocoileus virginiana*) and beaver (*Castor canadensis*) was observed during the site survey. The presence of these species represents a severe constraint to the regeneration of native plant communities at this site.

Table 4.2.24-1 Summary of Restoration Opportunities for the Private Land Not Developed Site (Buffalo Creek)

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-channel and Near-shore	Fish and benthos habitat enhancement In-stream structure creation and enhancement Emergent and submerged aquatic vegetation bed development Nearshore sediment stabilization and emergent wetland community regeneration	Bioengineering with resistive and redirective features to preserve natural channel geomorphology Additional hydraulic cover stones Redirective features – bendway weirs, locked logs, rootwads Nearshore structure and complexity to support submerged aquatic vegetation
Shoreline	Resistive structure for sediment capture Toe protection Sedimentation and erosion control Expansion of emergent wetland community	Large woody debris for sediment retention and capture Native wetland species plantings and live staking in combination with coir log and log revetment toe protection and other stabilizing features for sediment retention over time
Stream Bank	Keys and stability structure for in-channel and near shore features Increasing stream bank vegetation Diversity to enhance habitat value and soil stability	Bioengineering for vegetation diversity, including live staking, vegetated riprap, longitudinal toe protection integrated with side-slope native riparian plantings – herbaceous, shrub, and tree layers
Inland and Upland	Enhancing upland habitat structure, complexity, diversity and connectivity Invasive species control and management	ISCMP integrated with revegetation plan and planting plan to regenerate native communities - warm season grasses and forbs, mast-bearing and canopy-shade-producing trees with shrub understory Forested floodplain habitat enhancement for riparian bird and amphibian species

4.2.24.3 Considerations and Potential Constraints for Restoration

Land use and ownership may require public outreach, conservation easements, or riparian setback agreements to initiate the restoration planning process. The spatial extent of riparian floodplain habitats warrants consideration for designation as a municipal conservation area.

The riparian corridor is relatively wide along LDB, which would allow for substantial stream bank or shoreline reshaping and inland and upland restoration. Riparian sedimentary soils are excellent for re-establishing native plant communities. Land use and landowner loss of land and tree cover due to erosion along the RDB could facilitate cooperative efforts to address bank erosion.

Restoration design and planting plans would require the development of a strategy to address damage to vegetation caused by white-tailed deer and beavers. There is sufficient evidence of stress to existing native vegetation across the site by these species to conclude that restoration plantings would also be vulnerable.

Project sponsors should work with the owners of agricultural lands and local, state, and federal agricultural agencies to investigate how their programs (e.g., the USDA's Conservation Reserve Program) could benefit the farmers and the environment while simultaneously implementing habitat restoration and facilitating the viability of the farm businesses.

Pre-Construction Work

The design of restoration features for use in the channel and in nearshore, shoreline, and stream bank areas would require additional analyses during design in order to more closely define the types and siting of the features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding, bank erosion problems, or obstructions to ice flow would not occur upstream or downstream of the site if in-water structures were constructed.

Invasive Plant Communities

All restoration methods and techniques should be integrated with a site-wide ISCMP. Control measures would be implemented to address the ecological impacts and physical constraints invasive plant communities present to restoration planning and design. A multi-season effort is recommended to establish a control and management regime that would prepare the site for the regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities requires the integration of con-

trol and management methods and revegetation plans. Chemical and mechanical control methods should focus on the area from the top of the stream bank to inland and upland areas prior to constructing the remainder of the habitat restoration design. If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP.

4.2.24.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.24-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

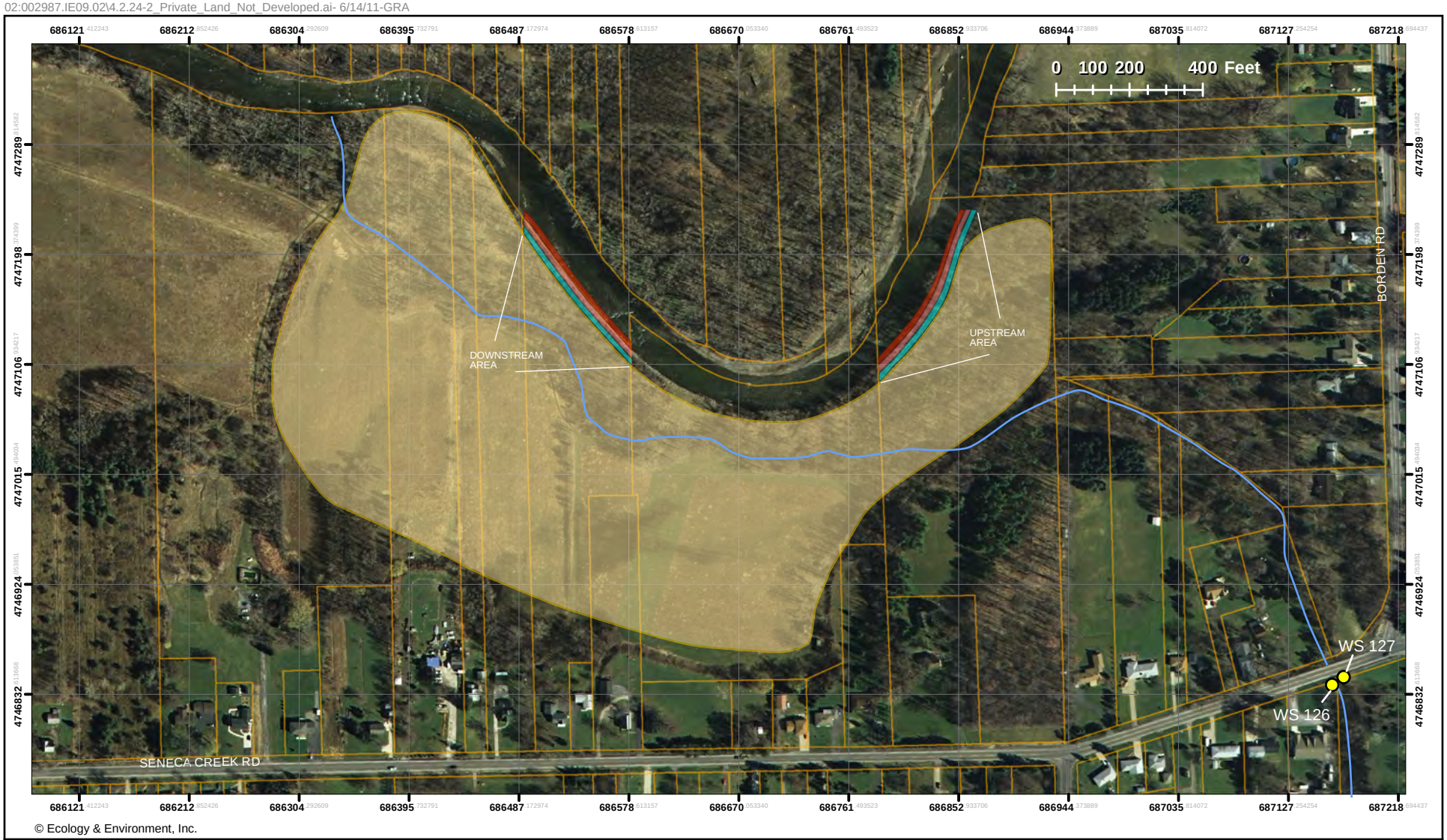
- Stone toe protection along the stream bank and shoreline,
- Planting and logs for the shoreline,
- Single-stone bendway weirs,
- Tiebacks for bendway weirs,
- Vegetated riprap, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $1,332,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.24.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 in Section 5.5. Project sponsors are advised that there could be additional permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.



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(All Areas Approximate)

In-channel and Nearshore
Shoreline
Stream Bank
Inland and Upland

Stormwater Outfall
Stormwater Interconnect
SPDES
Tributary (approximate channel location)

Parcel
Federal Navigation Channel, Approximate Location
Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.24-2
Potential Restoration Areas
Private Land Not Developed
West Seneca, New York

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4.2.25 Borden Road at Clinton Street (Buffalo Creek)

The Borden Road at Clinton Street site covers approximately 12 acres and is located along the left descending bank (LDB) of Buffalo Creek, upstream and downstream of the Borden Road bridge south of Clinton Street (see Figures 4.2.25-1 and 4.2.25-2). The site is owned by the County of Erie. As identified by stakeholders, a 2-acre portion of this site extends west of the bridge along the LDB. The properties to the north and west of the site are residential. A small parking area just east of the bridge is used by fishermen to access the creek, primarily during the September through April steelhead season. This site is generally characterized by a riffle-run stream environment and an associated elevated floodplain.

Figure 4.2.25-1 Borden Road at Clinton Street Site Location Map

4.2.25.1 Site Description

Field biologists conducted an assessment of the site in October 2010 to identify existing habitats within or associated with this site and determine their distribution and status. The following descriptions are based on observations made during that field effort.

In-Channel and Nearshore

The channel is approximately 100 feet wide near the Borden Road bridge and expands to an estimated 130 feet wide in upstream reaches within 1,000 feet of the bridge. The channel bed consists primarily of smooth bedrock, with areas of large cobble and boulders nearshore and in mid-channel, forming a long riffle without run or pool features. Fishery and benthic habitat are low due to the natural bedrock bottom and channel width combined with no defined low-flow channel. The diversity of aquatic organisms is typically low in smooth bedrock channels, especially in wide, shallow reaches without scour pools or in-channel submerged structures. Some access to the floodplain is available along the LDB in the upstream reaches within the survey area, but no floodplain connection is available

along the right descending bank (RDB), which is a vertical shale cliff approximately 40 feet high.

The stream bed is predominantly bedrock except in the lower stream portion where a riffle begins. A large gravel bar is present in the downstream section (adjacent to the riffle), immediately upstream of the Borden Road bridge. The gravel bar is well established and has abundant vegetation and a small backwater area.

A large, well-vegetated gravel bar measuring approximately 300 feet long by 50 feet wide exists immediately upstream of the Borden Road bridge. A shallow backwater channel separates the main channel from the LDB and functions as a high-flow bypass channel during flood events. The stream channel and nearshore area are naturally formed, with hydraulic features and structures typical of smooth bedrock stream beds.

Shoreline

The area between mean water level and the stream bank is combination of mudflat and gravel/cobble that supports emergent, herbaceous vegetation with some shrubs and tree saplings. The LBD shoreline is up to 12 feet wide at mean water level conditions and is densely vegetated. Abundant herbaceous shoreline plant species include saplings of crack willow (*Salix fragilis*), black willow (*S. nigra*), sandbar willow (*S. exigua*), American sycamore (*Platanus occidentalis*), reed canarygrass (*Phalaris arundinacea*), boneset (*Eupatorium perfoliatum*), red osier dogwood (*Cornus sericea*), Jerusalem artichoke (*Helianthus tuberosa*), Joe-Pye weed (*Eupatorium maculatum*) woodland sunflower (*H. divaricatus*), and purple loosestrife (*Lythrum salicaria*). The shoreline is stable and well vegetated, supporting a high-quality habitat.

Photo 4.2.25-1 View of the in-channel and LDB shoreline, looking upstream in the middle portion of the site

Stream Bank

The majority of the stream bank along LDB is well-established, stable, and comprised of native materials. It has a well-established native plant community and is densely vegetated with many of the species listed in the shoreline description above, as well as eastern cottonwood (*Populus deltoides*), box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and silky dogwood (*Cornus amomum*).

Photo 4.2.25-2 View of the stream bank with a floodplain connection looking downstream toward the RDB in the upstream portion of the site

Some areas along the top of the stream bank are overgrown with common mugwort (*Artemisia vulgaris*), common buckthorn (*Rhamnus cartartica*), and Japanese knotweed (*Polygonum cupsidatum*). These invasive species continue inland and are expanding into the understory of the mature floodplain woodland, which is composed of eastern cottonwood and willow. This wooded area forms a buffer between the riparian stream bank area and an active hayfield.

Inland and Upland

A wooded, elevated terrace approximately 30 feet wide exists along the LDB, extending from the top of the stream bank to the active hayfield. This area is inundated only during periods of flood-stage flows. Habitat value within this narrow woodland buffer is diminished by a dense understory of Japanese knotweed and common mugwort, which exhibits limited species richness and ecological function. Dominant tree species in the buffer area include eastern cottonwood, crack willow, box elder (*Acer negundo*), and green ash. The hayfield is about 8 acres and is highly productive due to the fertile, sedimentary soils and well-drained substrate. With the exception of a small surface drainage swale and small forested wetland inclusion, the active hayfield is cut several times each growing season for hay or silage.

A flood control project in the upland area on the east side of Borden Road collects storm water runoff from the hayfield and flood water from the stream, diverting a

significant volume of water under the road to a return channel, which empties into the stream downstream of the bridge.

4.2.25.2 Restoration Opportunities and Actions

Some areas at the top of the stream bank and extending into the inland to upland area along the LDB are dominated by Japanese knotweed and glossy buckthorn. Soils in these areas are unstable due to the presence of these invasive plants and provide minimal riparian habitat value. Each riparian area provides a number of habitat restoration and bank stabilization design opportunities (see Table 4.2.25-1 and Figure 4.2.25-2). Japanese knotweed control and management combined with implementation of stream bank stabilization measures would reduce sediment loading and thereby improve water quality. The regeneration of native plant communities would increase riparian habitat value and stabilize existing sedimentary soils. In-channel and nearshore features would increase fish and wildlife habitat structure and function.

Implementation of the proposed habitat restoration features would contribute to the BUI delisting process.

In-channel and Nearshore

The stream channel and nearshore environment is stable, and flow management and in-channel modification are not recommended. Although channel form has been modified by the shale cliff face along the RDB and Borden Road bridge design, hydraulic functions associated sediment transport and flood water conveyance function well.

Shoreline

The shoreline is well vegetated, and its connections with the stream bank and the riparian floodplain appear to have developed naturally. This area supports high-quality habitat, structure, and complexity. With the exception of introducing native plants to increase species richness, further modification or enhancement of the shoreline is not recommended, as this habitat zone is well established and relatively stable.

Photo 4.2.25-3 Natural shoreline and stream bank along the LDB in the downstream portion of the site

Stream Bank

Stream banks in the survey area are stable and well vegetated with the exception of some areas along the top of stream bank into the inland and upland area. No bank modification or reshaping for stabilization is necessary. Control of existing invasive species and the re-introduction of native species to increase species richness in all vegetation layers in areas dominated by invasive plants along the top of the LDB would enhance riparian habitat, promote the proliferation of the native species seed bank, and increase soil and stream bank stabilization.

Inland and Upland

The site contains an intact and functional floodplain and an active hayfield, which are separated by a narrow riparian buffer. All vegetation layers in the narrow buffer lack species diversity due to inadequate habitat form and function. The prevalence and expansion of invasive species is reducing the habitat and wildlife functions and values of this area. Without management and restoration efforts, soils would become less stable due to expansion of invasive plant communities, contributing to downstream sediment loading and water quality issues. Control and management of invasive species in the understory of the narrow wooded buffer from the top of the bank inland to the hayfield would be necessary to maintain and improve the site's ecological functions and values. The introduction of native species in all vegetation layers in the riparian buffer is recommended.

The active hayfield in the upland area and the smaller parcel west of the bridge present an opportunity for regeneration of a floodplain forest community with a species assemblage similar to the primeval forest cover type known to occur in this area. Conversion of all or a portion of this agricultural land would substantially increase the contiguous riparian area, improve habitat values, and promote wildlife use.

Table 4.2.25-1 Summary of Restoration Opportunities at the Borden Road at Clinton Street Site, Buffalo Creek, West Seneca, New York

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-channel and Nearshore	In-channel/nearshore area is stable	None recommended
Shoreline	Increased species richness	Installation of additional native plant species Protection of existing aquatic emergent vegetation
Stream Bank	Increased species richness Enhance riparian habitat Soil stabilization Stream bank stabilization Increase native seed bank	Integrated ISCMP with introduction of native species
Inland and Upland	Decrease downstream sediment loading Increase water quality Improved ecological function and value Re-establish native floodplain species community Increase contiguous riparian area Increase habitat values and wildlife use	Integrated ISCMP with introduction of native species Conversion of agricultural land back to forested floodplain with tree and shrub species known to occur in primeval forests in the area

4.2.25.3 Constraints and Considerations for Restoration

Existing Site Use and Site Conditions

The upland portion of the site is privately owned and leased to a local farmer for hay production. The LDB near the bridge over Buffalo Creek is accessible from the fisherman access area, which could facilitate planning and implementation of restoration design. The site should be evaluated for buried utilities before any site grading and/or excavation work is performed.

Restoration design and planting plans would require the development of a strategy to address damage to vegetation by white-tailed deer (*Odocoileus virginianus)* and beavers (*Castor canadensis*), as there was ample evidence of stress to vegetation across the site by these species.

Project sponsors should work with the owners of agricultural lands and local, state, and federal agricultural agencies to investigate how their programs (e.g., the USDA's Conservation Reserve Program) could benefit the farmers and the environment while simultaneously implementing habitat restoration and facilitating the viability of the farm businesses.

Invasive Plant Communities

All restoration methods and techniques should be integrated with a site-wide ISCMP. Invasive species control measures could be implemented to address the ecological impacts and physical constraints presented by invasive plant communities on restoration planning and design. A multi-season effort is recommended to establish a control and management regime that would prepare the site for the regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities requires the integration of control and management methods and re-vegetation plans. Chemical and mechanical control methods should focus on these areas prior to constructing the remainder of the habitat restoration design, including native plantings. If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.25-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

4.2.25.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.25-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Log revetment and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $638,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.25.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 in Section 5.5. Project sponsors are advised that there could be additional permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.

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(All Areas Approximate)

In-channel and Nearshore
Shoreline
Stream Bank
Inland and Upland

Stormwater Outfall
Stormwater Interconnect
SPDES

Parcel
Federal Navigation Channel, Approximate Location
Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.25-2
Potential Restoration Areas
Borden Road at Clinton Street
West Seneca, New York

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4.2.26 Bippert Farms (Buffalo Creek)

Bippert Farms is a 22.5-acre site located on the north shore of Buffalo Creek between Transit Road and North Blossom Road in the town of Elma. The site is privately owned, active farmland with a vegetated shoreline and side slope and a narrow tree and shrub primary terrace (at the top of the stream bank) adjacent to the cultivated fields. The surrounding parcels are pasture, a farm store, and residential and commercial operations downstream of the site, along Clinton Street and south along Transit Road.

Figure 4.2.26-1 Bippert Farms Site Location Map

4.2.26.1 Site Description

Field biologists conducted an assessment of the site in October 2010 to identify existing habitats within the Bippert Farms site and determine their distribution and status. The following descriptions are based on observations made during the field assessment.

In-channel and Nearshore

The stream bed within the site is composed primarily of continuous, smooth bedrock for the full width of the channel.

Occasional boulders and small areas of cobble and gravel are interspersed throughout the channel. Fine-grained sediment deposits up to 12 inches deep are evident along the shoreline in the upstream reaches the stream, near the North Blossom Road bridge. All but the largest boulders are transient and are moved downstream during high-flow events.

Photo 4.2.26-1 Wide, shallow bedrock channel, looking toward the LDB

A riffle-run feature begins at a waterfall located upstream east of the North Blossom Road bridge. The riffle is approximately 100 feet long and is followed by a much longer run extending downstream to the Transit Road bridge. Pools were not observed and may not occur due to the bedrock channel formation. The site is a popular fishing area for steelhead from October through May each year.

Shoreline

The shoreline along the right descending bank (RDB) is a narrow, well-vegetated area approximately 25 to 40 feet wide. This area is above the mean water level of the stream channel and extends up the toe of the stream bank. The vegetation is a combination of grasses and forbs, with some emergent herbaceous species in shallow shoreline depressions or scour holes behind larger boulders. Well-established tree and shrub species include crack willow (*Salix fragilis*), American sycamore (*Platanus occidentalis*), sandbar willow (*S. exigua*) saplings, and red osier dogwood (Cornus sericea) shrubs. Herbaceous species established along the shoreline include reed canarygrass (*Phalaris arundacea*), purple loosestrife (*Lythrum salicaria*), soft-stem bulrush (*Scirpus tabernaemontani*), beggar ticks (*Bidens frondosa*), boneset (*Eupatorium perfoliatum*), and Joe-Pye weed (*Eupatorium maculatum*).

Stream Bank

Discussion of the stream bank on this site is limited to the right descending bank (RDB). The RDB is armored with a combination of concrete, old appliances, stone aggregate material, and large woody debris. The banks are composed of a

combination of native soil, concrete, stone aggregate, and riprap. The stream bank is vegetated with a mixture of eastern cottonwood (*Populus deltoides*), crack willow, box elder (*Acer negundo*), common buckthorn (*Rhamnus cathartica*), bush honeysuckle (*Lonicera morrowii*), common mugwort (*Artemisia vulgaris*), and green ash (*Fraxinus pennsylvanica*).

The stream bank exhibits moderate scour and sloughing. Tree root systems are exposed along the bank approximately 275 feet upstream from Transit Road. Erosion and undercutting of trees is caused by scouring from high-flow conditions and ice flows in the winter and spring.

Photo 4.2.26-2 Active undercutting along the RDB

The RDB is consistently 7 to 9 feet high and is armored with riprap material. Small pits in the stream bank and along the toe of the stream bank have been created by hydraulic scouring during periods of high flow and ice scour.

Inland and Upland

There is a vegetated buffer that is approximately 25 feet wide along the RDB between the top of the stream bank and a cultivated field. This area includes a narrow vegetated area approximately 15 feet wide composed of shrubs and grasses with only a few mature trees near the top of stream bank near the Transit Road bridge in the downstream portion of the site. A farm vehicle access road approximately 10 feet wide adjacent to the cultivated field extends from Blossom Road to Transit Road. Tree and shrub species present from the top of the bank to

the cultivated fields include eastern cottonwood, box elder, green ash, common buckthorn, and bush honeysuckle.

Photo 4.2.26-3 Unstable stream bank and narrow riparian buffer along the RDB

This is an active row crop production area (typically corn and pumpkins) approximately 20 acres in size. It is an active floodplain during high flows, especially during ice jam conditions originating at the Transit Road bridge. Despite seasonal flooding, the alluvial soils are deep, fertile, and highly productive for agricultural crops and pasture.

4.2.26.2 Restoration Opportunities and Actions

The existing composition, structure, and uses of the Bippert Farms site offer a number of habitat restoration opportunities that would support the improvement of water quality and increase fish and wildlife habitat structure and function.

Stabilization of the shoreline and stream bank along the RDB followed by an active planting plan would facilitate the regeneration of native riparian species, which would lead to the enhancement of plant community diversity and habitat value. An expansion of the existing riparian vegetated buffer would stabilize stream bank and shoreline soils, thereby reducing flood and ice-scour impacts. Implementation of habitat restoration features would contribute to the BUI delisting process (see Table 4.2.26-1 and Figure 4.2.26-2).

In-channel and Nearshore

Single-stone bendway weirs could be used along the RDB beginning approximately 800 feet downstream of the Blossom Road bridge as redirective features to reduce the impact of ice and velocity scour by diverting the highest velocity flows towards the center of the channel. The design and orientation of hydraulic cover stones, locked logs, and pinned rootwads could enhance fish habitat by increasing in-channel structure and complexity. These features would improve habitat for

benthic organisms and fish by providing in-stream cover and oxygenation during low-flow conditions.

Shoreline

Stabilization of the existing "hydraulic roughness" in the shoreline area along the RDB would result in periodic sediment and gravel deposition during flood events, thereby facilitating an expansion of shoreline habitat and the recruitment of an emergent community.

Stream Bank

The stream bank could be stabilized by bioengineering methods and could provide an opportunity for reshaping and adding soil amendments to facilitate native species regeneration. An enhanced assembly of native species would provide greater soil stability, resilience to ice scour, and riparian habitat.

Inland and Upland

The fertile cropland area provides a great opportunity for expansion of the riparian habitat in an otherwise developed corridor. The design and implementation of a planting plan to establish a wider riparian buffer from the top of the bank to a point approximately 100 feet inland or a larger floodplain forest with an upland forest planted in hardwoods across this portion of the site would provide riparian habitat structure and function for a number of wildlife species.

4.2.26.3 Considerations and Potential Constraints for Restoration

Existing Site Use and Site Considerations

The site is privately owned and currently in cultivation. Detailed discussions would need to be conducted with the landowner regarding the idea of habitat restoration implementation and acceptable locations across their property. The site must be evaluated for buried utilities before any site grading and/or excavation work is performed.

Restoration design and planting plans would require the development of a strategy to address damage to vegetation caused by white-tailed deer (*Odocoileus virginianus)* and beavers (*Castor canadensis*), as there was ample evidence of stress to vegetation across the site by these species.

The composition of the debris in and along the stream bank would need to be identified in order to determine whether the material can be left on-site, or, if the material needs to be removed from the site, how to appropriately dispose of it.

Project sponsors should work with the owners of agricultural lands and local, state, and federal agricultural agencies to investigate how their programs (e.g., the USDA's Conservation Reserve Program) could benefit the farmers and the environment while simultaneously implementing habitat restoration and facilitating the viability of the farm businesses.

Pre-Construction Work

As indicated above, design of restoration features for the site would require additional analyses in order to more accurately define the sizes, total areas, and locations for the features. Additional analyses would be required to quantify erosion and scour in order to determine what, if any, shoreline stabilization/resistive features are necessary. The resulting quantitative data would allow for the development of site-specific quantitative success criteria against which the success of each project stabilization feature can be judged.

Permitting agencies will want to review the results of the detailed evaluations to ensure that the appropriate analyses have been completed. For example, regulators may require that project sponsors use hydrologic models to ensure that flooding or bank erosion problems would not occur upstream or downstream of the site if in-water structures were constructed.

Invasive Plant Communities

All restoration methods and techniques should be integrated with a site-wide ISCMP. Invasive species control measures could be implemented to address the ecological impacts and physical constraints invasive plant communities present to restoration planning and design. A multi-season effort is recommended to establish a control and management regime that would prepare the site for regeneration of native plant communities. Site preparation activities and sequencing of construction tasks on sites with invasive species communities requires the integration of control and management methods and re-vegetation plans. Chemical and mechanical control methods should focus on these areas prior to constructing the remainder of the habitat restoration design (e.g., native plantings). If chemicals are selected to control and manage invasive species, all materials and methods used must be in accordance with federal and state regulations, particularly with respect to avoiding harm to aquatic organisms and habitat. State-of-the-art control protocols should be used when planning and implementing the ISCMP. Sequencing of activities would need to consider effective management scenarios while also protecting other elements of the restoration project.

Stormwater Outfalls, CSOs and SSOs

One or more stormwater outfalls are in the vicinity of this site. See Figure 4.2.26-2 for the locations of stormwater outfalls near the Project site. Due to the scale of the figure, other stormwater outfalls near the site may not appear on the figure. Detailed information on the locations of stormwater outfalls in the Project area is available from the Western New York Stormwater Coalition and its Outfall Mapper Web application (http://www2.erie.gov/environment/index.php?q=western-new –york-stormwatercoalition). Potential Project sponsors should contact the Buffalo Sewer Authority and/or NYSDEC to obtain location information for CSOs and SSOs.

Table 4.2.26-1 Summary of Restoration Opportunities at the Bippert Farms Site, Elma, New York

Focus Area	Restoration Opportunities	Restoration Features and Methods
In-channel and Near-shore	In-channel habitat structure and complexity Preserve natural channel geomorphology	Redirective features – bendway weirs, locked logs, rootwads Integrated resistive and redirective hydraulic features with stream bank soil bioengineering
Shoreline	Shoreline stabilization Sedimentation and erosion control Aquatic habitat diversity	Longitudinal toe protection Plantings of native wetland species in combination with log or stone toe revetments and other stabilizing features for shoreline soil stabilization and sediment retention over time Seeding and planting of emergent aquatic macrophytes for shoreline community diversity
Stream Bank	Bank stabilization Sediment and erosion control Increasing riparian structure and diversity to enhance habitat value and soil stability	Bioengineering for soil stabilization and retention Bank reshaping Geotextile erosion control with native riparian plantings – herbaceous, shrub, and tree layers
Inland and Upland	Increase native species richness Increase habitat connectivity and habitat structure and complexity	Plantings of diverse, multi-layered native species to enhance tree, shrub, and herbaceous riparian buffer communities Regeneration of the floodplain forest on a larger portion of the site

4.2.26.4 Costs

Preliminary cost estimates were developed based on (a) the physical and biological impairments identified during the field assessment and (b) approximations made regarding the type and amount of restoration features, materials, and labor needed to design and implement habitat restoration in the potential restoration areas shown on Figure 4.2.26-2.

These preliminary cost estimates were based on assumptions made regarding the following:

- Mobilization and demobilization,
- Access to and preparation of a staging area,
- Development of access and haul roads,
- Pre-construction site preparation (including the clearing of trees) and final grading after the completion of restoration work,
- A topographic survey, and
- Site construction management.

To support the development of a cost estimate, it was assumed that the following restoration features would be needed:

- Stone-pinned rootwads,
- Single-stone bendway weirs,
- Tiebacks for bendway weirs,
- Stone toe protection, and
- Seeding.

The preliminary estimate of the cost to complete the restoration work is approximately $503,000. Site-specific detailed planning and analysis would be required to finalize the design restoration features and refine the cost estimate, which could differ from the restoration features and cost estimate presented here.

The long-term cost to maintain the restoration project(s) could be significant. Project sponsors will need to include long-term cost estimates at the start of the planning process based on the experiences of agencies and organizations in the region. Those agencies and organizations, including the USACE, Buffalo Niagara RiverKeeper, and NYSDEC, can assist project sponsors in estimating long-term maintenance costs.

4.2.26.5 Potential Permitting Requirements

Based upon the restoration concepts provided, the applicable permits required for habitat restoration construction include permit numbers 1, 2, 3, 6, and 7, as provided in Table 5-1 in Section 5.5. Project sponsors are advised that there could be additional permit requirements and are urged to discuss other potential requirements with local, state, and federal agencies.

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(All Areas Approximate)

In-channel and Nearshore | Shoreline | Stream Bank | Inland and Upland

Stormwater Outfall | Stormwater Interconnect | SPDES

Parcel | Federal Navigation Channel, Approximate Location | Remedial Design Dredging Footprint, Approximate Location

Figure 4.2.26-2
Potential Restoration Areas
Bippert Farms
Elma, New York

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