City of Geneva
Waterfront Infrastructure Feasibility Study

June 2012

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CITY OF GENEVA NEW YORK 1897 SEAL
INGENIO ET VIRIBUS

NEW YORK STATE
DEPARTMENT OF STATE

This study was prepared by Parsons Brinckerhoff, Inc. and Trowbridge Wolf Michaels Landscape Architects, LLP for the City of Geneva and the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

City of Geneva, New York

Waterfront Infrastructure Feasibility Study

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RESOURCES AND CONTRIBUTORS

Computer mapping of water, storm and sanitary sewer, gas and electric utilities, LIDAR data and aerial photography in the Feasibility Study area was provided by the Ontario County Planning and Research Department. Design mapping of the project area was completed with these resources and is intended as a graphic resource for preliminary engineering.

The following groups are recognized for their much appreciated input and knowledge sharing:

- City of Geneva Historical Society
- Hobart and William Smith Colleges
- Finger Lakes Boating Museum

Aerial Image of the Geneva Waterfront

City of Geneva

Waterfront Infrastructure Feasibility Study

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Introduction

OVERVIEW

Parsons Brinckerhoff, Inc. (PB) and its project partners Trowbridge Wolf Michaels Landscape Architects, LLP (TWMLA) were contracted by the City of Geneva to undertake a Waterfront Infrastructure Feasibility Study (Feasibility Study) based on the recommended public infrastructure outlined in the *2009 City of Geneva Lakefront/Downtown Development Plan*. This Feasibility Study and the 2009 study were funded by and prepared in partnership with the New York State Department of State (NYSDOS).

The purpose of this study is to provide preliminary engineering and design to obtain budgetary construction values to advance the conceptual design of the discrete waterfront enhancements outlined in the 2009 study. PB and TWMLA worked with the City of Geneva's Office of Neighborhood Initiatives and Department of Public Works, Ontario County's Planning and Research Department, and NYSDOS to advance the design of the proposed enhancements. Local private and public sector stakeholders including the Geneva Historical Society and the Boat Museum Steering Committee, attendees of public meetings and previous studies provided valuable insight and knowledge for this study.

The *2009 City of Geneva Lakefront/Downtown Development Plan,* shown in *Figure 1,* identified the need to study the technical feasibility of the following waterfront enhancements:

- *Extension of Long Pier as a "marina breakwater"*
- *Construction of a new Pedestrian Pier at the foot of Castle Street*
- *Construction of a second breakwater and a new Lakefront Beach*
- *Implementation of critical long-term Shoreline Stabilization improvements*
- *Construction of a Waterfront Promenade/Boardwalk*

The Geneva Waterfront Infrastructure Feasibility Study outlines the design concept, construction effort, and budgetary construction estimate for six major waterfront infrastructure enhancements. They are as follows:

- Long Pier Extension
- Castle Street Pier
- Castle Street Promenade
- Castle Creek
- Lakefront Beach
- Edge Treatment

Previous City of Geneva waterfront studies include:

1958: City Master Plan

1966: Park Harbor Proposal

1983: Routes 5/20 Lakefront Arterial Improvement Design Report

1986: Geneva Development Project

1991: Gateway Design Study & Highest and Best Use Study

1992: Geneva Waterfront Plan and Design Guidelines

1995: Gateway Design Plan

1997: Geneva Marina Market Feasibility Study

1997: City Master Plan

1997: Local Waterfront Revitalization Plan

1998: Geneva's Magnificent Waterfront Master Plan

2001-2004: Lakefront Visioning Sessions

2009: City of Geneva Lakefront/Downtown Development Plan

2010: City of Geneva Lakefront/Downtown Connectivity Study

2011: City of Geneva Draft Economic Development Strategies

These improvements will substantially enhance public access within the study area that extends from Long Pier north along the water's edge to the historic Sea Wall. The design and construction of these infrastructure improvements are intended to enhance and promote utilization of the City's waterfront for recreation and events; creating a desirable destination for visitors and the local public alike.

Figure 1: City of Geneva 2009 Lakefront/Downtown Development Plan

PROJECT STUDY AREA

The Geneva Waterfront Infrastructure Feasibility Study area follows the Seneca Lake shoreline north from Long Pier to the historic Sea Wall as shown in *Figure 2*. This Feasibility Study area incorporates the following six major enhancements:

- Long Pier Extension
- Castle Street Pedestrian Pier and Promenade
- Castle Street Boardwalk
- Castle Creek
- Lakefront Beach
- Edge treatment

As the Feasibility Study progressed, slight alterations were made to the preliminary study area as depicted in the 2009 Lakefront/Downtown Study. Based on a preliminary construction cost analysis and design conversations with the City, the Beach location was moved north from its location south of Long Pier (as outlined in the *2009 Lakefront/Downtown Development Study*) to the existing beach along the historic Sea Wall. Additionally, the integral connection between the terminus of Castle Street and the water's edge was incorporated into the Feasibility Study's study area as the Castle Street Pedestrian Promenade.

Figure 2: Geneva Waterfront Infrastructure Feasibility Study area

Planning Context

HISTORIC OVERVIEW

The City of Geneva waterfront has a rich and dynamic history incorporating canals, railways, highways, industry, boating, and waterfront real estate. Several locations on site are historically significant due to their role in the industrial and cultural fabric of the region, and an understanding of this history has informed waterfront enhancement design decisions. Every attempt was made to incorporate historic elements into the design in a sensitive manner.

Figure 3: City of Geneva Map, 1871

The City of Geneva sits at the northwest corner of Seneca Lake in Ontario County, New York. Geneva's waterfront is a sixty acre multi-use property created in 1987 by the relocation of State Routes 5 and 20 from the shores of Seneca Lake to the historic Cayuga and Seneca Canal alignment. Since the road relocation, the City has worked with many State and Federal agencies to create a local and accessible waterfront destination to serve residents and visitors in the Finger Lakes Region of New York.

Waterfront Development

Geneva's waterfront location has changed over the years as dominant industrial interests in the region have evolved. The construction of the Cayuga Seneca Canal, connecting Seneca Lake to the Erie Canal, was the first major waterfront development. *Figure 3* shows the historic Long Pier and Sea Wall, constructed to protect canal barges passing from Geneva's expanding industrial harbour to the Erie Canal via the Cayuga Seneca Canal. Long Pier and the canal opening contributed to the expansion of the Geneva's industrial development into Seneca Lake.

Introduction of the railroad caused the second major shift in the Geneva waterfront. The railroad was originally constructed on a trestle bridge over water to avoid infringing on the property rights of lakefront landowners. In time the water behind the trestle bridge stagnated and filled with sediment, effectively expanding Geneva's waterfront out to the location of the trestle bridge.

The advent of the automobile and construction of highways caused the third major change to Geneva's waterfront as shown in *Figure 4*. In the 1950s, the post-industrial waterfront and stagnant canal were filled and capped and State Routes 5 and 20 were constructed along the new waterfront edge; severing direct access to the waterfront and separating it from downtown Geneva.

Figure 4: Routes 5 & 20 along the Geneva waterfront

In 1987, State Routes 5 and 20 were shifted away from Seneca Lake and reconstructed along the historic Cayuga Seneca Canal alignment. This allowed for mixed use development and public access along the Geneva waterfront once again. Geneva's waterfront currently reflects the efforts of many decades of NYSDOS supported revitalization studies responsible for design guidelines and small improvements to enhance waterfront utilization and accessibility.

Boating and Boat Building

Geneva has a rich boating history including Iroquois Nation craft, canal barges, barge flotillas, steamers (in excess of 100 feet), and sailboat regattas. The Onondaga and Schuyler steamers shown docked to Long Pier in *Figure 5* were part of a Seneca Lake steamer line that carried 2,000 passengers daily between Geneva and Watkins Glen. The proposed Finger Lakes Boating Museum (to be located at the site of the existing Geneva Chamber of Commerce between Castle Creek and the Boat Launch) is dedicated to preserving the rich boat building history of the region.

Figure 5: The Onandonga and The Schyuler on Long Pier

Canal

Constructed in 1818, the approximately 20 mile Cayuga Seneca Canal, connecting Seneca Lake and Cayuga Lake to the Erie Canal, was directly responsible for a 100 percent growth rate in Geneva between 1820 and 1840. Before the canal, Geneva's farmers processed their fruits and grains into alcohol in waterfront distilleries to avoid spoiling. The canal provided farmers an efficient and reliable method for delivering their goods to larger markets without spoiling. An Erie Canal signature Whipple Bridge is shown in *Figure 6* over the Cayuga Seneca Canal. The importance of the canal to Geneva's industry faded with the introduction of the railroad and later the automobile. The canal was filled and capped in the 1930s.

Figure 6: Whipple bridge over the Cayuga Seneca Canal

Rail

Geneva's railroad history began in 1836 with the construction of the Auburn and Rochester rail line, connecting the citizens of Geneva from Geneva's East Lewis Street Station to Buffalo, Niagara Falls, and Albany. *Figure 7* shows a train passing along the Geneva waterfront on the railroad trestle bridge. By 1853 the line had been consolidated into the New York Central Railroad, and by 1873 citizens of Geneva could ride to New York City via the Geneva and Ithaca and Erie Railroad at Waverly. By 1876 the Geneva lines had effectively been consolidated into The Lehigh Valley Railroad, and in 1890, the Lehigh Valley Railroad created its largest and most ornate station between New York City and Buffalo in Geneva at Sherril Street and Wilbur Avenue. Railroads continued to grow and expand through the early 1920s, but rapidly declined after the first World War and the advent of the automobile. Passenger and freight traffic in Central New York declined throughout the remainder of the Twentieth Century, and the railroads were eventually combined into Conrail in 1973.

Figure 7: Train passing along the Geneva waterfront

Industry

Geneva's first industry was agriculture, fueled by the excellent soils of the region. Before the Cayuga Seneca Canal, farm produce was generally shipped as whiskey or brandy, which supported thirteen distilleries in Geneva until 1830. With the construction of the Cayuga Seneca Canal, the distilling industry declined and agriculture boomed as farmers were able to ship their produce directly to markets. Railroads came to Geneva in the 1840's, leading to the development of new industries and factories as well as expansion of existing nursery and farming industries. *Figure 8* shows the City of Geneva's harbor booming with industry along the waterfront in 1872. The introduction of electricity, initiated the expansion of factories and foundries as well.

Figure 8: City of Geneva harbor, 1872

Geneva also grew dramatically in the 1940s when the Sampson Naval Base, now Sampson State Park, trained recruits for World War II along the Seneca Lake shores. Today Geneva's once industrial shoreline has been reclaimed and converted into Lakefront Park, a linear park with a multi-use trail.

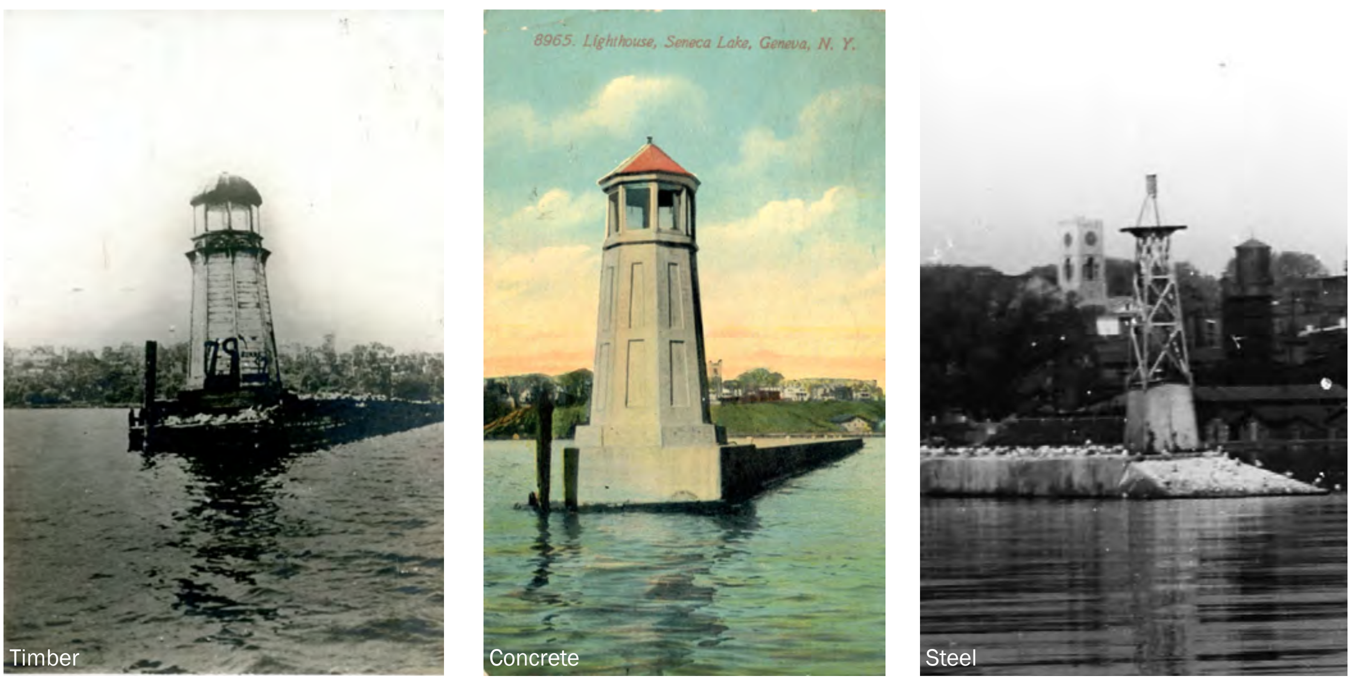

Figure 9: Historic Lighthouses

Lighthouse

Geneva's historic lighthouses were all located on the eastern end of a detached breakwater to the south of Long Pier. The Geneva Historical Society provided images of the historic timber, concrete and steel lighthouses depicted in *Figure 9*. Images of the lighthouses were utilized in public participation to provide an example for the waterfront iconic features proposed in the Feasibility Study. Consideration was given to rehabilitating and reinstalling the steel lighthouse (currently in storage) at the terminus of the Long Pier Extension.

Long Pier

Figure 10: Boat Houses on Long Pier

Long Pier is a historic structure on the Geneva waterfront, originally constructed to protect the industrial harbour and Cayuga Seneca Canal entrance in the early 1800s. In the canal era Long Pier was a timber pier and nearly twice its current length. Additionally, more than a dozen boathouses, seen in *Figure 10*, were attached to the harbor side of Long Pier.

Long Pier was shortened by the railroad trestle bridge and then halved by the construction of State Routes 5 and 20 directly along the waterfront in the early 1950's. The State Routes eliminated direct access to Long Pier from downtown, and in time the boat houses were removed and Long Pier fell into disrepair.

The first phase of the Long Pier renovation began by filling below Long Pier with stone riprap, creating a solid breakwater to lakebed. The final phase was completed in early summer 2002, with the construction of a concrete path and tubular steel railings atop the rip rap breakwater. This structure effectively protects the current Marina from most wave action and has also contributed to the establishment of a small wetland habitat on the north side of the intersection of Long Pier and the shoreline.

Sea Wall

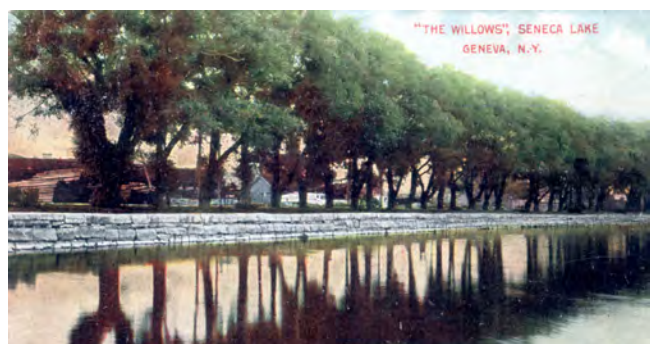

Figure 11: Geneva Sea Wall

The Sea Wall is a historic structure on the waterfront constructed to protect Cayuga Seneca Canal barges from Seneca Lake wave action by dividing the Cayuga Seneca Canal from Seneca Lake. Elm trees were planted along the length of the Sea Wall, and dedicated with memorial plaques to soldiers lost in the First World War. Unfortunately, Dutch elm disease killed the elm trees which were replaced by willows and the plaques have since been placed in storage. *Figure 11* shows the historic Geneva seal all circa 1940.

Lakeside Park

Figure 12: Lakeside Park entrance at Castle Street

Established in the early 1900s, Lakeside Park was a Victorian park spanning from its entrance at Castle Street, as seen in *Figure 12*, to Long Pier. The park was used as a fairground and included a pavilion, fountain, multiple gardens and a complex network of paths.

Lakeside Park was removed with the reconfiguration of State routes 5 and 20 in the early 1950s and was replaced by the contemporary Lakefront Park. Lakefront Park spans the Geneva waterfront between State Routes 5 and 20 and Seneca Lake, from Castle Street to Seneca Lake State Park.

EXAMPLES FROM PEER CITIES

The project team reviewed waterfront development in surrounding and peer communities. A number of waterfront spaces and structure designs were reviewed in other communities with similar site characteristics and history as Geneva. Examples of waterfront amenities are pictured in *Figures 13 through 23* and include promenades, piers, bulkheads and beaches. Many of these examples illustrate the positive impact that the NYSDOS has on waterfront development, and increasing public access to waterfronts.

Figure 13: Pier at Lakeside Park in Watkins Glen, NY

Figure 14: Landscaped multiuse path with signage at Tonawanda Gateway Harbor Park in Tonawanda, NY

Figure 15: Terraced access to water's edge along Inlet Island in Ithaca, NY

Figure 16: Terraced waterfront amphitheater at Tonawanda Gateway Harbor in Tonawanda, NY

Figure 17: Integrated boardwalk and multiuse path along Pittsford Canal in Pittsford, NY

Figure 18: Boardwalk along water's edge at marina at 55 Water Street Plaza in New York, NY

Figure 19: Waterfront park entrance marks historic canal alignment at Gateway Harbor Park in Tonawanda, NY

Figure 20: Park beautification and plantings at Minn's Garden, Cornell University

Figure 21: Integrated pedestrian roundabout with park and boardwalk at Tom McCall Waterfront Park in Portland, OR

Figure 22: Creek bank revitalization at Wee Stinky Glen, Cornell University

Figure 23: Pavilion along Pittsford Canal inspired by local agrarian architecture in Pittsford, NY

Existing Conditions

EXISTING CONDITIONS OVERVIEW

In evaluating the most feasible enhancement elements for the project area, the existing conditions of the current edge treatment, shoreline erosion patterns, public land use, land ownership, and recreational features were assessed. The Seneca Lake wind patterns and wave action were also analyzed during this Feasibility Study to adequately investigate options for the Long Pier Extension and the Beach location. Neither a bathymetric survey nor geotechnical subsurface investigation were conducted as part of this Feasibility Study.

SENECA LAKE CONDITIONS

Seneca Lake is one of 13 Finger Lakes in central New York. It is 35 miles long with 81 miles of shoreline perimeter. The water depth is 650 feet deep at its deepest point with its water elevation regulated by the New York State Canal System. Water elevations, shown in *Figure 24*, range from 444.7 feet at the winter minimum target level to 446.3 feet at summer maximum target level. Lake levels approach 448 feet during the spring months as its 733 square mile watershed thaws and empties into the Lake. Lakebed depth information was gathered from the NOAA Chart No. 14791, shown in *Figure 26*, showing Seneca Lake depth soundings in feet. Water depth along the project area edge condition ranges from one to two feet at the shoreline and deepens at a gentle slope to approximately 12 feet at 30 feet off shore. Seneca Lake lakebed fines along the project area edge are granular sands.

A preliminary wave analysis was completed by PB for this project area and is included as Appendix 1. The waterfront enhancement study area is on the north western shore of Seneca Lake, therefore the south and southeast winds were used as the predominant wind conditions for the design. Extreme wind data from the Rochester Airport was used to calculate extreme 2-year and 50-year wind. About 10 years of wind data from the Penn Yan Airport and a seasonal buoy in Seneca Lake is also available but was not used in the calculation of the extreme wind loading cases because the data is young in comparison with the Rochester Airport data. As indicated in the preliminary wave analysis, the maximum 50-year significant wave height is 4.90 feet with a peak wave period of 5.4 seconds generated from southeast winds. The maximum 2-year significant wave height occurs with winds from the south producing a significant wave height of 4.5 feet and a peak wave period of 4.5 seconds.

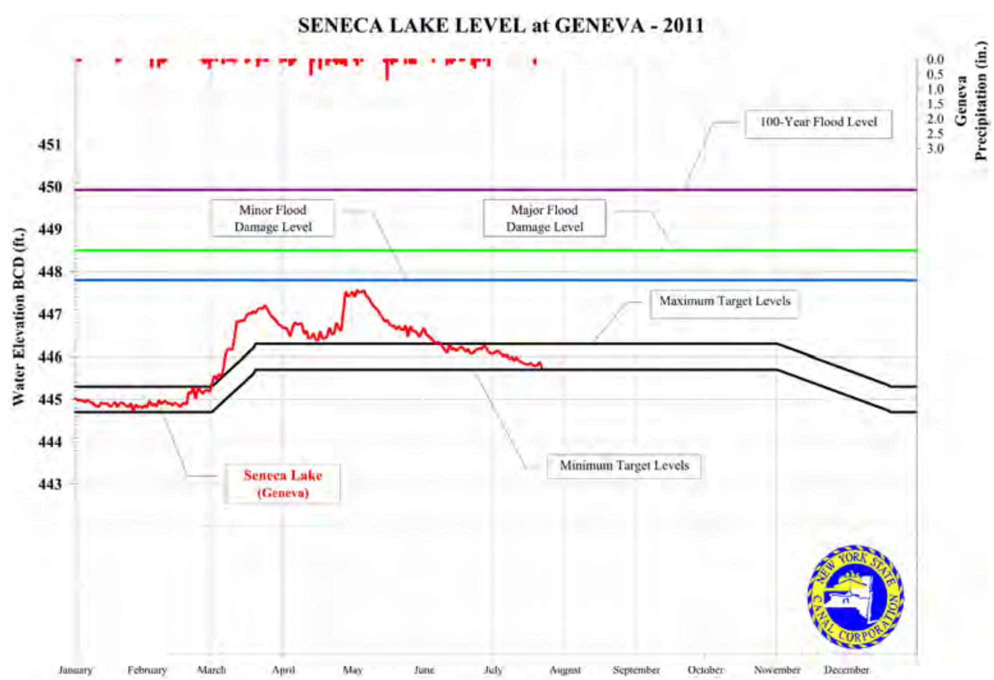

Figure 24: Seneca Lake water levels. Source: New York State Canal Corporation

SHORELINE EDGE CONDITIONS

The existing shoreline edge condition is shown in *Figure 25* and is composed of large broken rubble and large concrete blocks with overgrown vegetation, uneven surfaces and jagged edges. Currently this rip rap impedes safe and gentle access to the water's edge in all areas. The City of Geneva intends to make the water's edge accessible while maintaining its integrity to withstand crashing waves and mitigate shoreline erosion. Tactical edge terracing and rehabilitating edge conditions with smaller more consistent stone sizes integral with native plantings are options to be incorporated into the different edge conditions along the project area.

Two foot topography contours were received from the Ontario County planning department as a LIDAR (Light Detection and Ranging) data file. This information was converted into a manageable AutoCAD format and evaluated. The project area's top of shoreline is generally flat at elevation 450 feet, and slopes to the waterline at a 1 on 2 or a 2 on 3 slope depending on edge location. For example, the edge condition from Long Pier to the Chamber of Commerce is a gentler slope of approximately 1 vertical on 2 horizontal with 2 foot rip rap and concrete rubble pieces; whereas, the edge condition from the Boat Launch to the seawall slopes at approximately 2 vertical on 3 horizontal, or steeper, with 3 foot rip rap and instances of larger concrete blocks or broken foundation pieces with exposed steel rebar.

Figure 25: Existing shoreline edge

Shoreline conditions at the mouth of Castle Creek are gently sloped coarse sands at approximately 1 vertical on 10 horizontal. The water depth at the mouth of the creek is shallow with sediment build up making it an ideal location to launch kayaks or other small human powered watercraft. Per information gathered in field measurements, the Castle Creek concrete box culvert is 22 feet wide by 55 feet long with 23 foot long wing walls. The top of the culvert elevation is approximately 452 feet with sloped sides. This size box culvert interrupts the natural edge conditions and natural aesthetics of Castle Creek.

The beach along the historic Sea Wall on the lake's north shore is naturally occurring due to the jetty influence of the concrete foundation wall in the prominent wave directions. The Sea Wall's top elevation is 450 feet and the beach sands begin at 448 feet naturally sloping to a grade difference of about 6 feet, 20 to 30 feet off shore. Lakebed characteristics at this location are natural coarse sands with traces of smooth stone, similar to that of pea gravel. These natural conditions make this beach location a prime site for beach enhancement.

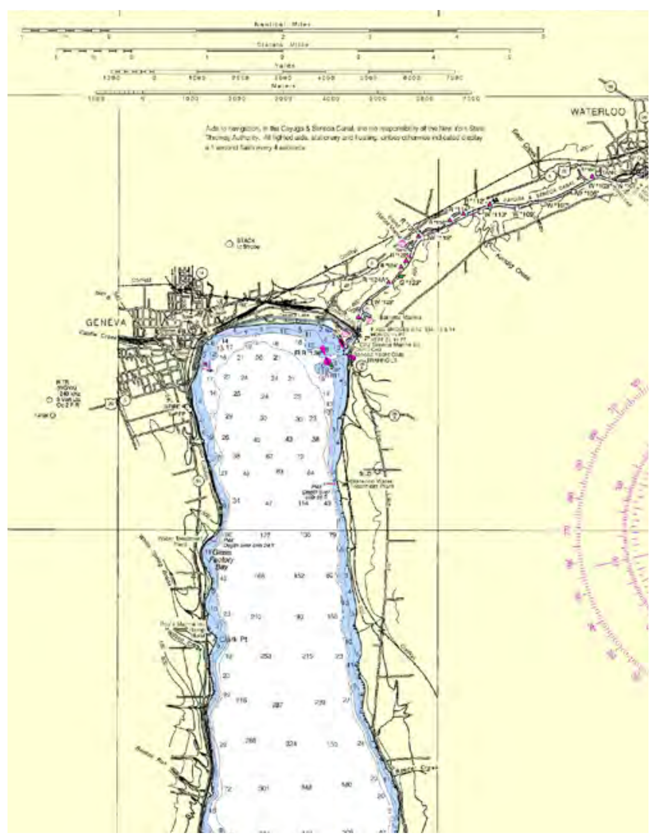

Figure 26: NOAA water depth mapping. Source: NOAA Chart No. 14791

WETLANDS AND FLOOD PLAINS

Wetland and flood plain maps were obtained from the New York State Department of Environmental Conservation (NYSDEC) and FEMA maps. In the FEMA map shown in *Figure 27*, the Feasibility Study project area falls to the south and northeast of the Castle Creek area. The Castle Creek basin with the Feasibility Study's project limits is shown on the map with Zones A1, A3, and Zone B. Much of Lakefront Park is located in Zone B which designates areas between the 100-year and the 500-year flood boundary. Zones A1 and A3 designate 100-year flood zones. The base flood elevation for Seneca Lake is 449 feet, reference to the National Geodetic Vertical Datum of 1929. The 100-year flood elevation for the project area is elevation 450 feet.

The small wetlands area between Long Pier and the shore noted during a site walk is not recognized by the NYSDEC as a New York State designated wetland as shown in *Figure 28*; however, the location of this wetland played an important role in assessing the structure options for the Long Pier Extension.

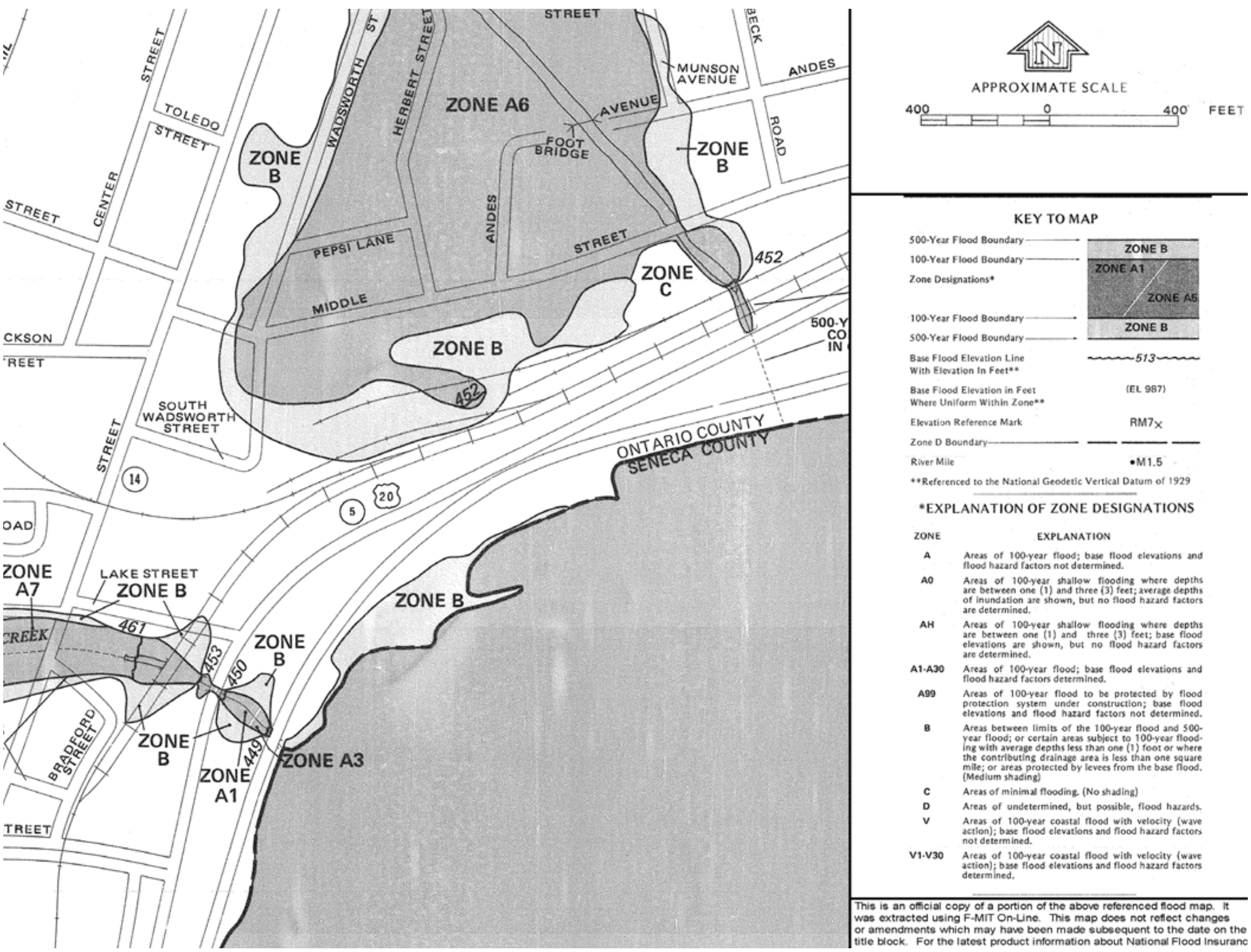

Figure 27: FEMA flood mapping. Source: FEMA FIRM ID: 360599001B

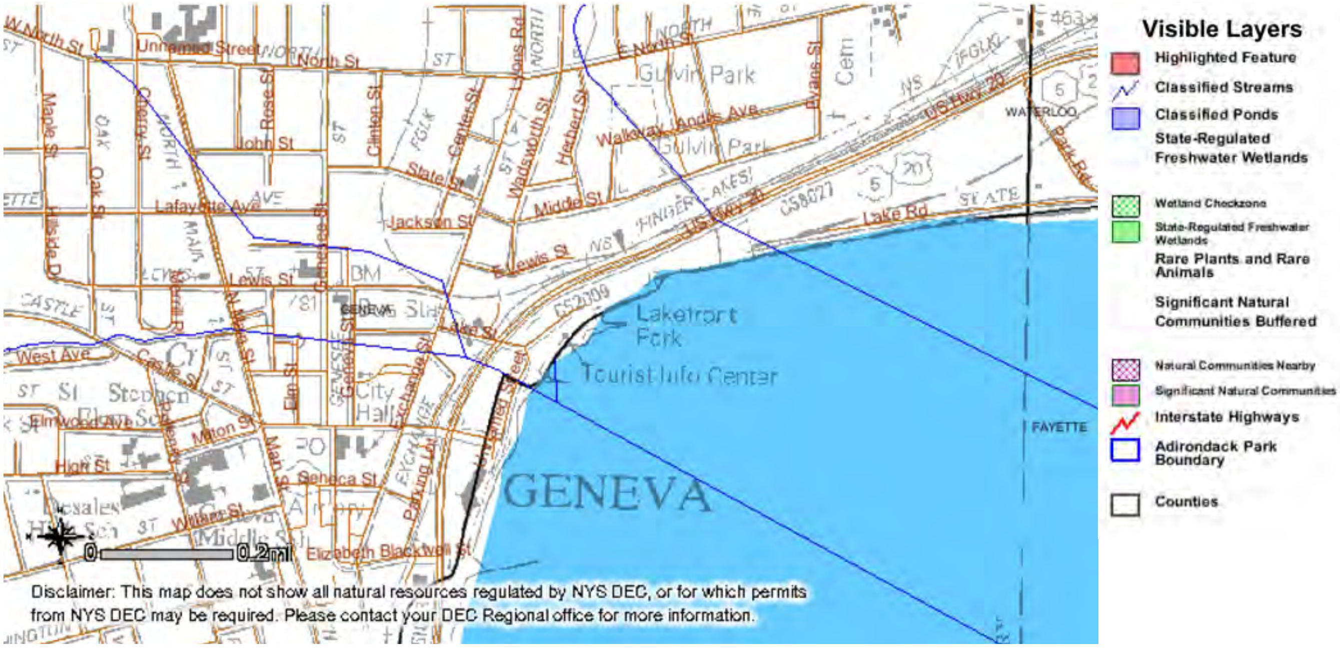

Figure 28: NYSDEC Wetland and species mapping. Source: NYSDEC

LAND USE

The Seneca Lake waterfront is home to many New York State Finger Lakes Region winery tours, festivals, foot races and water sports. Visitors to the Geneva waterfront today can rent kayaks and human powered water craft by the hour, launch their own kayaks at Castle Creek, launch their boat at the boat launch adjacent to the Chamber of Commerce, dock their boat at the marina by the Ramada Hotel and get an ice cream cone at the ice cream stand. The nearby Seneca Lake State Park, bordering Lakefront Park to the north-east, also provides visitors with marine and pedestrian recreation opportunities.

The City of Geneva boasts a prime position along the lake's waterfront, but it remains an underutilized resource for recreation and tourism. Currently, the lake and its waterfront are used almost solely for recreational purposes. The interconnecting multi-use paths extending along the waterfront is highlighted with way-finding signs and plaques describing the history and significance of Geneva's waterfront. These paths are utilized by joggers, cyclists, rollerbladers and walker and are too narrow to accommodate all of its uses. This study recommends that the existing path system be replaced by a single wider multi-use path along the entire length of the Lakefront Park waterfront to accommodate the quantity of pedestrian and bicycle traffic.

In summer months, the Geneva Chamber of Commerce hosts free outdoor summer concerts every Wednesday night in July and August at the adjacent pavilion. Additionally, the Ramada Hotel uses its beautiful Seneca Lake backdrop to host large events from weddings to conventions. The Ramada and the Chamber of Commerce parcels adjacent to the waterfront are the only commercial use portions of the study area.

Figure 29: Marina and Ramada from Long Pier terminus

Enhancements

OVERVIEW

The Feasibility Study follows the vision of the Local Waterfront Revitalization Program (LWRP), which is to:

> *"…Foster a pattern of waterfront development that enhances community character, preserves open space, makes efficient use of infrastructure, makes beneficial use of waterfront location, and minimize the adverse effects of development… Protect environmental resources from inappropriate development and actions that cause their degradation…Minimize loss of life, structures, and natural resources from flooding and erosion… Maximize public access and recreational opportunities to the shoreline and to waterways… Preserve resources of historic significance within the waterfront area… Protect and improve the visual quality of the waterfront… [and] protect and improve water resources…"*

The Feasibility Study, illustrated in plan in *Figure 30*, engages the full extents of public access along the waterfront, with a focus on the connection to downtown, water access, user experience, shoreline aesthetics, material longevity and maintenance. As a prerequisite to implementation, the Long Pier Extension, Castle Street Pedestiran Pier and Castle Creek Revitalization improvements will require geotechnical survey work and marine engineering.

Figure 30: Geneva Waterfront Infrastructure Feasibility Study Plan

The new Pedestrian Promenade aligns the main park axis with Castle Street, creating unblocked views from downtown to the waterfront, thereby establishing a direct visual connection between downtown and the waterfront. A new Pedestrian Pier extends from the Castle Street Pedestrian Promenade, and includes an iconic lighthouse feature at the end of the Pier. The iconic feature is highly visible from downtown, State Routes 5 and 20, most locations along the waterfront, and watercraft on the lake. A new Pedestrian Boardwalk is parallel to the shoreline and connects to the Pier, creating a unique, high value waterfront enhancement that is designed to interface as an extension of the multi-use path and as a waterfront amenity for future private development.

The multi-use path along the waterfront is upgraded to a 12 foot width to allow comfortable access to multiple modes of transportation while streamlining maintenance by removing some redundant paths, and improving accessibility. The box culvert bridge at the intersection of the multi-use path and Castle Creek is removed and replaced by a bridge. The longer bridge span allows the mouth of Castle Creek to widen and improves the ecological health and waterfront aesthetics of the Creek. At the north east end of the multi-use path, the Lakefront Beach adds a sought after amenity to the waterfront, and takes advantage of naturally occurring wave action forces that act to create a sandy beach in the chosen location. The Boat Launch Pier adjacent to the Lakefront Beach is also renovated to permit access for dredging equipment and pedestrians. Lastly, the Long Pier at the southern end of the multi-use path is extended with a wave attenuation structure that will allow for future expansion of marina capacity.

Figure 31: Long Pier Extension and Marina Expansion sketch

LONG PIER EXTENSION

The Long Pier Extension is a proposed breakwater oriented parallel to the marina shoreline, extending perpendicular from the end of Long Pier. The Long Pier Extension is a concept identified in previous studies as an opportunity to increase the existing marina docking space. Breakwater options, including floating wave attenuators, seasonal wave attenuators, rubble mound breakwaters, and pile supported breakwaters were considered to mitigate waves approaching the marina from the south and east. The Long Pier structure was previously a pile supported timber pier two times its current length; however the current pier is constructed of stone fill gently sloped from the lakebed to the concrete pedestrian walkway elevation at approximately 450 feet.

Considering the wave action presented in the wave analysis, predominant wind direction, wetland conditions, and NYSDEC permitting concerns with placing fill in the lake, a 300 foot long pile supported breakwater with a curtain wall was selected as the preferred option for the Long Pier Extension. Any rubble mound breakwater or solid wall wave attenuators in this area would likely reduce or eliminate water undercurrents and expand the wetland in this area. To avoid permitting concerns with placing fill in the Lake and encouraging wetland expansion, the curtain wall breakwater structural system is designed with an open base allowing the solid curtain walls to attenuate wave energy from the lake to the marina while still allowing fish and marine life and water to circulate below the curtain wall. This design reduces stagnation behind the breakwater, slowing wetland expansion within the marina.

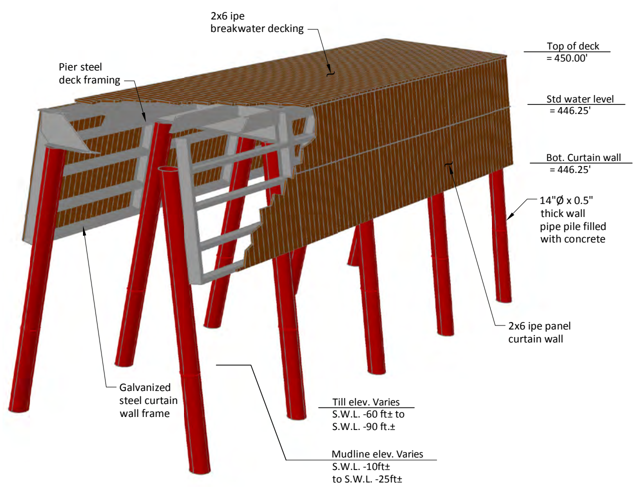

Figure 32: Proposed Long Pier extension

Figure 33: Existing Marina and Long Pier

Construction feasibility influenced the Pier's design and material choice. Underwater concrete placement, welding, and field connections would increase the structure's installation price. A steel pile and timber wall system with prefabricated curtain wall sections and above water field connections was determined to be most efficient and effective design.

Shown in *Figure 32*, the preliminary design of the Long Pier Extension yields a fixed curtain wall breakwater supported by battered twelve inch steel pipe pile bents at 10 feet on center. The curtain walls on each side of the pile bents are shop fabricated with Ipe or marine-grade timbers bolted to 10 foot by 8 foot steel frame panels. The dense marine-grade timber panels are capable of withstanding the loads determined in the wave analysis. Ipe wood is a tropical hardwood with an extremely high loading capacity. This wood is typically used in marine applications because of its longevity and strength.

The pile bents are connected at the top with field bolted moment connections constructed with a splice plate through the piles and back to back galvanized steel channels. Once a pair of pile bents is installed, steel Z-bars are welded to the piles to accept the 10 foot by 8 foot prefabricated Ipe timber curtain walls. The curtain walls are constructed of 8 foot vertical 2x6 marine-grade timbers attached to a galvanized steel panel frame. These walls will extend approximately 4 feet below mean water level. The breakwater deck elevation is 450 feet, 4 feet above mean water level, and also constructed of 2x6 marine-grade timbers spanning steel channels which are field bolted to the pile bents.

The curtain wall breakwater was analyzed for the wave and ice-impact loads using structural analysis software for the 2-year and 50-year storm events including wave and ice-impact load as provided by the wave analysis with lakebed elevations at 10, 15 and 20 feet below mean water level. The Long Pier Extension carries electric utility only and should not take load from floating docks.

A beacon light structure occupies the end of the 300 foot pile supported curtain wall breakwater for navigation. Attaching a beacon light to the existing historic steel truss lighthouse was discussed as a design option; however a smaller less expensive interpretive beacon light is priced for this Feasibility Study. The Long Pier extension allows marina docking space for additional water craft of sizes varying from jet skis to 35 foot boats. Additional marina capacity, circulation, and depth were only preliminarily reviewed for this Feasibility Study.

Figure 34: Marina expansion

Figure 35: Proposed pier and boardwalk

CASTLE STREET PEDESTRIAN PIER

The Castle Street Pedestrian Pier enhancement is aligned with Castle Street's downtown alignment, providing an unblocked view of the new iconic lighthouse from downtown Geneva. The Pier is an Ipe or marine-grade timber deck structure that extends on axis with Castle Street beyond the new boardwalk into the lake and terminates at a new lighthouse designed in the style of Geneva's 1800's timber lighthouse. This new iconic lighthouse is visible from downtown and visually links the waterfront to downtown. Construction of the Castle Street Pedestrian Pier into the lake provides local colleges and educational institutions the opportunity to utilize Seneca Lake as a water education resource.

Castle Street Pier is preliminarily designed as a steel pile supported timber deck pier that extends 120 feet from the shore into the lake. The pier structure is estimated as 12 inch steel pile piles at 16 feet on center. The pier deck is a 14 foot wide timber deck supported by galvanized steel wide flange joists at two feet on center supported by galvanized steel beams at the piles. The terminus of the pedestrian pier is hexagonal

Figure 36: Proposed pier and boardwalk section

Figure 37: Early sketch of pedestrian pier and promenade with railing

and supports an iconic 28 foot tall historic timber lighthouse replica as seen in *Figure 35*. The lighthouse is approximately 15 feet at the base allowing for a 15 feet wide space between the light house walls and the pier railing. The lighthouse is supported by a steel pipe pile per point.

The pier railing posts attach to the fascia joists of the decking substructure with a galvanized bolted plate connection at six feet on center. This pier and all its elements would be designed to meet ADA marine standards. The pier's top of deck elevation is approximately 450 feet, and is flush with the timber boardwalk multi-use path designed at this enhanced edge. Integrating varying decking materials, such as bar grating, provides pedestrians with an alternate pier experience, allowing them to see and interact with the marine life below the pier.

Per discussions with the permitting agencies this pier will need to demonstrate a water dependent use. This pier will be utilized for fishing and to research and monitor the lake's marine life in partnership with the local colleges.

Figure 38: Existing view of proposed pier location

Figure 39: Aerial oblique view of Castle Street Pedestrian Pier

CASTLE STREET PEDESTRIAN PROMENADE AND BOARDWALK

The Castle Street Pedestrian Promenade is preliminarily designed with a new 14 foot wide scored concrete walkway with aesthetic edging created along the Castle Street alignment from Castle Street's terminus at Routes 5 and 20 to the water. This Promenade creates a direct sightline from downtown to the iconic lighthouse feature at the end of the Castle Street Pedestrian Pier. The Promenade is flanked by decorative cherry trees to the water and includes a concrete plaza with a low height stone sign that marks the gateway at the entrance to the park.

Aligning this promenade with Castle Street's downtown alignment creates a wedge-shaped open space between the new concrete walkway and the Ramada Hotel parking lot access road. This design removes the existing parking lot access road up to the parking lot entrance and utilizes the new space as a park. The park includes space for a large pavilion with surrounding tiered quarry block amphitheater seating shaded by canopy trees specifically selected to maintain views to the lake. This promenade creates an inviting destination and path across Routes 5 and 20 and would improve the connection between downtown and the waterfront.

Figure 40: Pavilion and Iconic Lighthouse perspective view looking east

The Castle Street Boardwalk is an Ipe timber decked boardwalk at the foot of the Promenade. The boardwalk follows the contour of the water's edge for 340 feet, extending approximately 215 feet north and 125 south from the Castle Street Pedestrian Pier. Designed to sit just out of ordinary high water (448 feet), the boardwalk measures approximately 51 feet wide at its northern end, and approximately 14 feet wide at its southern end. The Boardwalk's top of deck elevation is flush with the pedestrian pier and multi-use path at approximately 450 feet. *Figure 36* shows the interface of the boardwalk with the Castle Street Pedestrian Pier.

Figure 41: Existing Castle Street road alignment

The boardwalk's Ipe timber decking spans pressure treated wood deck joists supported by 12 inch wide reinforced concrete grade beams to frost line. A concrete threshold grade beam runs the length of the interface between boardwalk construction and asphalt multi-use path. The waterside of the boardwalk is faced with a 2x12 fascia beam and a 4x4 Ipe timber curb in compliance with ADA standards. The boardwalk is elevated no more than 30 inches above the top of the shoreline elevation, eliminating the need for a railing.

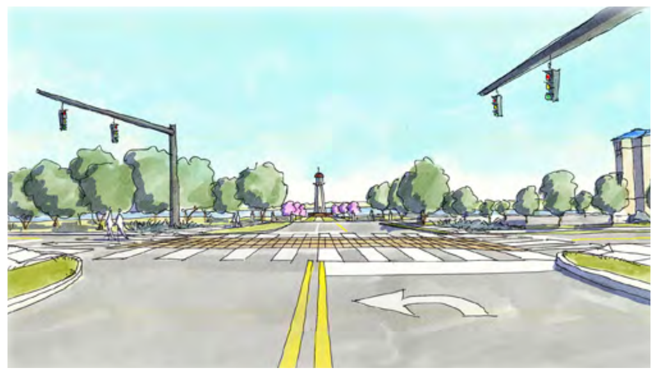

Figure 42: Proposed Castle Street alignment sketch

This boardwalk is designed to serve the immediate need for improved access to the water's edge and creates a natural gathering place. The landside the boardwalk is backed by planting beds and stone seat walls.

Figure 43: Castle Street Pedestrian Promenade alignment perspective looking east towards proposed pedestrian pier

Figure 44: Proposed Castle Creek aerial oblique view

CASTLE CREEK REVITALIZATION

Proposed enhancements at Castle Creek improve accessibility and ecology in and around the Castle Creek basin. On the north side of the creek the existing creek mouth sands are groomed and additional sand is added to achieve a gently graded slope to the water to maintain the kayak and human powered watercraft launching capabilities. The shoreline on both sides of the creek mouth is stabilized and protected with tiered quarry block walls set into the slope providing natural terraced seating.

Figure 45: Proposed Castle Creek sketch

Figure 46: Existing Castle Creek outlet

The existing concrete culvert is removed and replaced with a 55 foot span by 9 foot wide pedestrian bridge capable of supporting vehicle traffic for events, and designed with historic or iconic styling. The proposed crossing bridge would be designed for the loads and geometry prescribed for in the latest American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications. The bridge abutments are estimated to be pile supported and buried into the embankment. Embankment slope is 1 vertical on 2 horizontal maximum.

Increasing the bridge span from the current culvert mouth opening of 22 feet to 55 feet allows the Castle Creek banks to return to a more natural width and slope. This widening improves the ecological health of Castle Creek and also creates a more natural creek crossing experience and will be a pleasing visual feature in the landscape.

A circular raised planter with a quarry block seat-wall edge enhances the intersection between the waterfront path, kayak parking and proposed boat museum. Mixed shrub and grass planting, with a centrally planted specimen tree or alternatively, a public sponsored sculpture enhances this path node. The existing parking lot adjacent to the creek is improved with an asphalt surface and integrated into the waterfront path design.

Figure 47: Proposed Castle Creek raised planter; could also sponsor public sculpture

Figure 48: Proposed Lakefront Beach and picnic pavilion perspective view

LAKEFRONT BEACH

The proposed Lakefront Beach enhancements improve access and desirability of the existing naturally occurring gravelly sand beach along the historic seawall. The adjacent historic concrete foundations and Sea Wall are preserved and integrated with the design maintaining the industrial theme while creating a desirable waterfront destination.

A new pavilion is erected with a concrete sidewalk or paver patio at the corner of the concrete foundation walls as shown in *Figures 48 and 51*. Additionally, a new play area is proposed adjacent to the pavilion. The pavilion provides shade and seating with a view of the beach and play area. Preliminary design assumes the pavilion rests on concrete spread footings to frost line below a 6 inch concrete slab plaza. The concrete slab and additional edge treatments are preliminarily designed to be found on a minimum of six inches of compact base materials.

An eight foot wide concrete ramp from beach grade to path grade is proposed where the historic Sea Wall meets the concrete building foundation. This ramp, sloped at 1 on 12 (per ADA requirements) parallel to

Figure 49: Existing beach location view

Figure 50: Existing Beach view from foundation

the seawall provides beach access to persons with disabilities as well as beach maintenance equipment. Construction for this ramp requires saw cutting the concrete foundation and diverting or extending an existing storm line. This Study assumes diverting the stormline to an outfall just north of the proposed ramp location.

Maintenance vehicle access to the beach allows the existing sands to be weeded and groomed, and new beach sands to be added. Approximately 250 cubic yards of additional beach sand is added to raise the grade of the existing beach by six inches and widen it approximately six feet. The amount of new sand retained after one season will be used as a measurement of the intensity of wave action and erosion at this location.

Improvements to the existing concrete foundation include grout filling the large voids and cracks and bush hammering the wall face to remove dangerous edges and uneven surfaces. Rusted reinforcement, anchors, or base plates are removed or ground smooth to the surface and the top of the wall is cleaned and resurfaced with quick setting levelling grout.

The introduction of hybrid elm trees that recall the historic elm planting are proposed to eventually replace the row of willow trees along the historic Sea Wall. Additional trees planted along the edge of Route 5 and 20 create a sound barrier between the road traffic and the large lawn space behind the historic Sea Wall.

Figure 51: Proposed Beach sketch

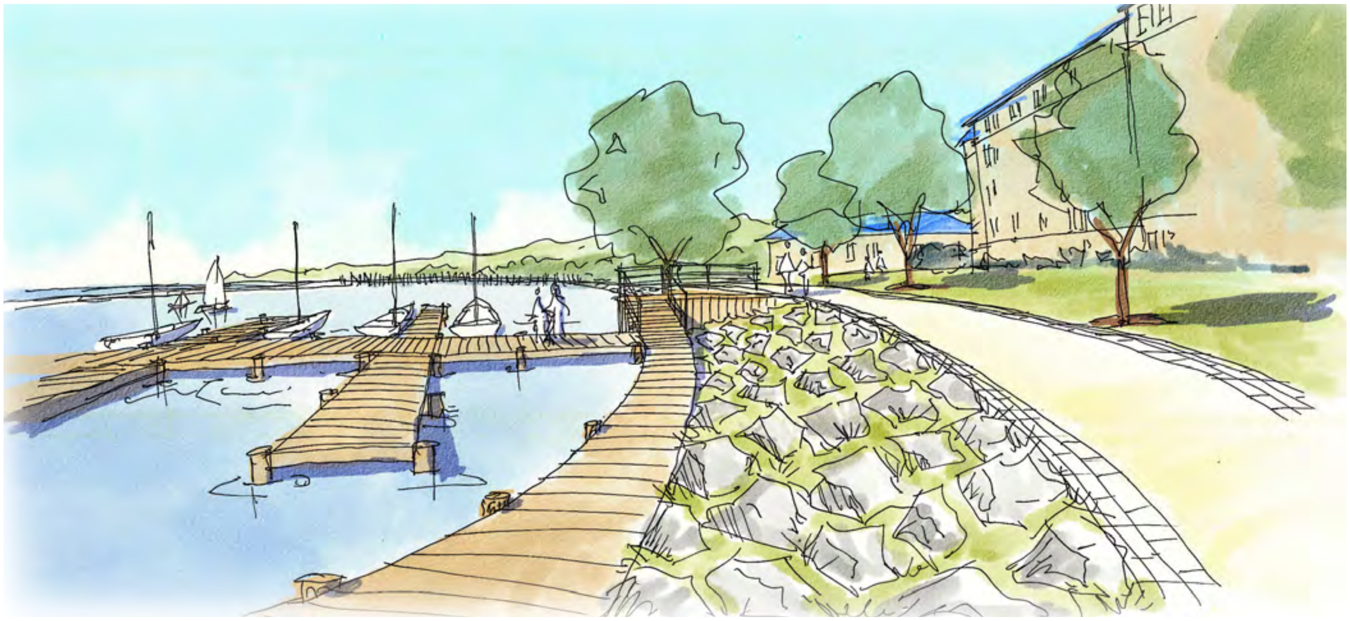

Figure 52: Proposed shoreline stabilization sketch

SHORELINE STABILIZATION/EDGE TREATMENT

The existing edge treatment along the Feasibility Study project extents is composed of many large and dissimilar sized stones and materials making it a treacherous transition between the top of the shoreline bank and the water level. Though shore protection is needed to impede erosion events during the larger storms, alternative stone edge options are available that both protect the shoreline and provide a smoother transition from multi-use path to water.

This Feasibility Study proposes a shoreline stabilization construction section that stacks more uniformly sized stone at a one on two slope, integral with native planting stakes and geotextile reinforcing, all keyed into the lake's bottom for longevity and effectiveness. Options for accomplishing the edge condition, as shown in *Figure 52*, vary depending on location and the condition of the existing rip rap.

Many of the larger pieces of stone are broken up into smaller one to two foot stone and replaced in place; however some of the larger concrete rubble with exposed rebar is removed. Proper slopes and rip rap stone size should be chosen based on the edge conditions per shoreline location. Uniformity in stone size and proper base setting stone is the key condition for the proposed section. See *Figures 54 and 55* for the shoreline stabilization and edge treatment conditions proposed for the project study area conditions.

Figure 53: Rubble shoreline near Boat Launch

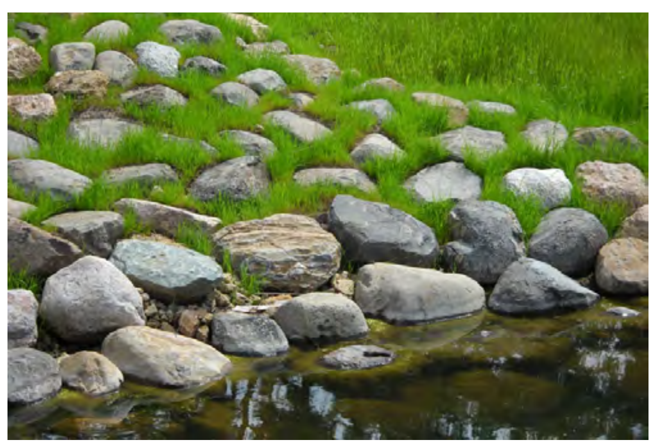

Figure 54: Photograph of proposed rip rap edging

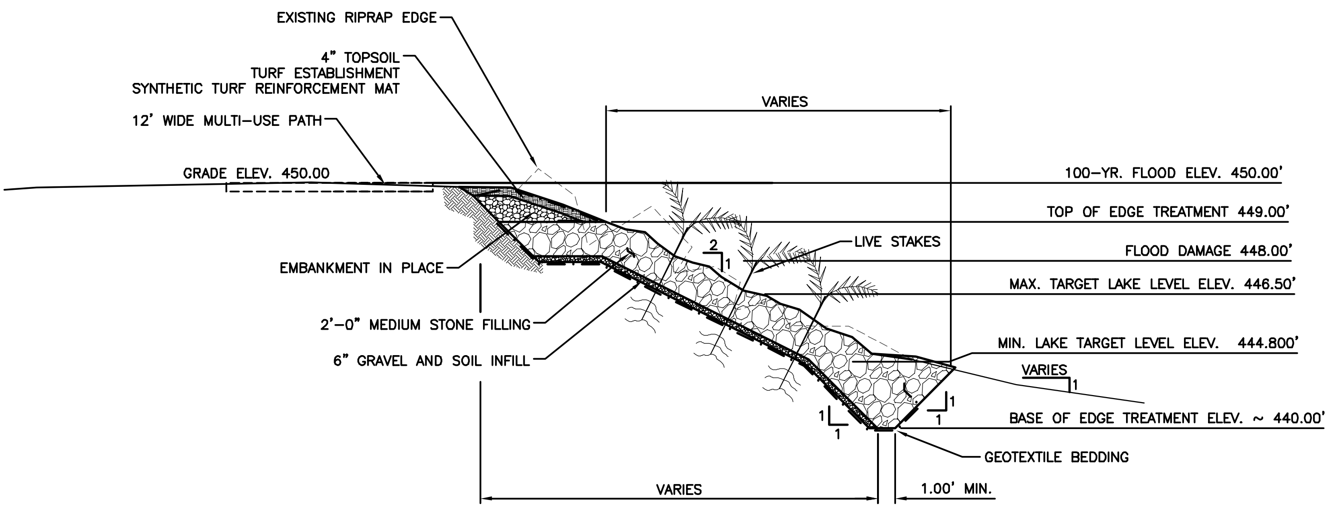

Figure 55: Proposed rip rap section

BOAT LAUNCH

The Boat Launch is located south of the historic Sea Wall and proposed beach area and just east of the Chamber of Commerce. The launch is bordered by the Sea Wall and a jetty of fill and oversized concrete rubble. The proposed ten foot wide by 100 foot long concrete topping of the breakwater will provide the City of Geneva a level drive surface for boat launch dredging equipment.

To create a level drive surface the jetty's concrete rubble topping is hammered to smaller more manageable pieces of about six to twelve inches that distribute themselves amongst the crevasses between the large stones. Oversized concrete foundation pieces or rubble with unruly rusted rebar are removed where possible. Steel pins are drilled and grouted into the top of the breakwater leaving enough reveal to be cast into a six inch concrete slab. A two foot setting base of two to four inch stone fills all remaining voids and acts as the setting base for the six inch concrete slab. The reinforced concrete slab is designed to take the wheel loads of the dredging equipment with construction joints at a maximum of 40 feet on center.

Figure 56: Existing Boat Launch breakwater

Implementation

PROJECT PHASING

Each waterfront enhancement contributes to a cohesive waterfront experience. However, the advantage of this scheme is that each element can also be constructed individually based on available funds and the City's and region's priorities. Below is a suggested phasing plan developed with the input of the City of Geneva's strategy. In all cases the construction sequencing should start at the water's edge and work back to the land. For example, all shoreline revitalization should be completed before multi-use path construction to avoid damaging the path with heavy equipment loads.

Phase 1 is planned to be integral with the construction of the new Boat Museum. Phase 1 would revitalize the rip rap shoreline edge from Lakefront Beach to Castle Creek, including the Boat Launch jetty improvements and construct the multi-use path at these extents. The shoreline revitalization construction including the Boat Launch jetty should be completed before the construction of the multi-use path. If the path is installed first it will need substantial protection during the shoreline revitalization and jetty construction.

Phase 2 will continue all shoreline revitalization and new multi-use path construction from Castle Creek to Long Pier, and includes the timber boardwalk within these extents. Construction sequence should start with the boardwalk and edge revitalization and work backwards to the tiered quarry blocks and multi-use path. If adequate funds are available at this time it is recommended that the Castle Street Pedestrian Pier is constructed integral with the timber boardwalk to preserve a less expensive landside construction. If funds are not available the Castle Street Pedestrian Pier is slated for construction in Phase 4.

Phase 3 includes the Castle Creek naturalization, new pedestrian bridge and revitalized kayak launch. The most extensive of the proposed enhancements of this report is the Castle Creek Bridge. The demolition of the box culvert requires a large construction area, and it will not be possible to cross the creek along the shore once demolition starts. The closest crossing point is route 5 and 20. Construction equipment will have to occupy both sides of the creek, with the possibility of the heavier equipment to remain on the north side. Careful construction, engineering and planning will be required for this enhancement.

Phase 4 will complete the construction of the Castle Street Pedestrian Pier if funds are not available to complete it in Phase 2. Since the Pier is an extension of the Boardwalk, costs will have to be included for integrating these two structures and water side construction (i.e. from barges) so as not to damage the Boardwalk. Waterside construction would add significant cost to the Pedestrian Pier and will limit the season of work.

Phase 5a completes shoreline revitalization efforts along the project extents with the construction of the Lakefront Beach area enhancements. The construction of the ramp, the new pavilion erection, and concrete wall improvements should be completed before the remaining multi-use path extents from the concrete wall to the seawall. The grooming of the Beach with the additional sand can be completed on its own construction timeline after the ramp is complete. Because the Lakefront Beach enhancements are relatively small and independent of other waterfront construction, these enhancements could be completed under any phase that has adequate additional funding.

Phase 5b completes the Castle Street Pedestrian Promenade, including the roadway reconfiguration and all elements included in the new park. The Promenade construction should be associated with improvements to the pedestrian crossing at Routes 5 and 20. The construction of the promenade creates the sightline from downtown to the iconic lighthouse at the end of the Castle Street Pedestrian Pier and invites citizens and visitor alike to Geneva's revitalized waterfront.

Phase 6 will complete the most detached and independent of the enhancements, the Long Pier Extension. This structure is constructed from the water on barges and therefore can be built at any time without affecting the feasibility or phasing of other enhancements and improvements. Completion of this enhancement will allow for marina expansion also inviting more visitors to Geneva's waterfront.

PHASING PLAN

Phase 1: Boat Launch / Multi-use Path / Shoreline Revitalization

- Shoreline revitalization from Castle Creek to Lakefront Beach
- Multi-use path from Castle Creek to Lakefront Beach
- Boat Launch jetty improvements
- Raised planter roundabout with multi-use path allowances to connect to the Boat Museum

Phase 2: Waterfront Boardwalk / Multi-use Path / Shoreline Revitalization

- Shoreline revitalization from Long Pier to Castle Creek
- Timber waterfront Boardwalk
- Multi-use path from Long Pier to Castle Creek
- Castle Creek path crossing to roundabout (placeholder until Castle Creek improvements completed)

Phase 3: Castle Creek Revitalization

- Culvert removal
- Castle Creek Bridge
- Castle Creek naturalization
- Quarry block terracing and Kayak Launch beach sands

Phase 4: Castle Street Pedestrian Pier

- Pier pile foundation and framing
- Pier railings, light fixtures and conduit
- Pier lighthouse

Phase 5a: Lakefront Beach

- Lakefront Beach pavilion and plaza
- Beach access ramp and stairs, with all concrete wall rehabilitation
- Beach grooming and additional beach sands
- Elm trees
- Multi-use path

Phase 5b: Castle Street Promenade

- Ramada parking lot entrance road modifications
- Park area with pavilion and terraced quarry blocks
- Pedestrian Path and plaza area from Routes 5 and 20 to Boardwalk
- Waterfront sign and trees

Phase 6: Long Pier Extension

- Long Pier Extension Structure

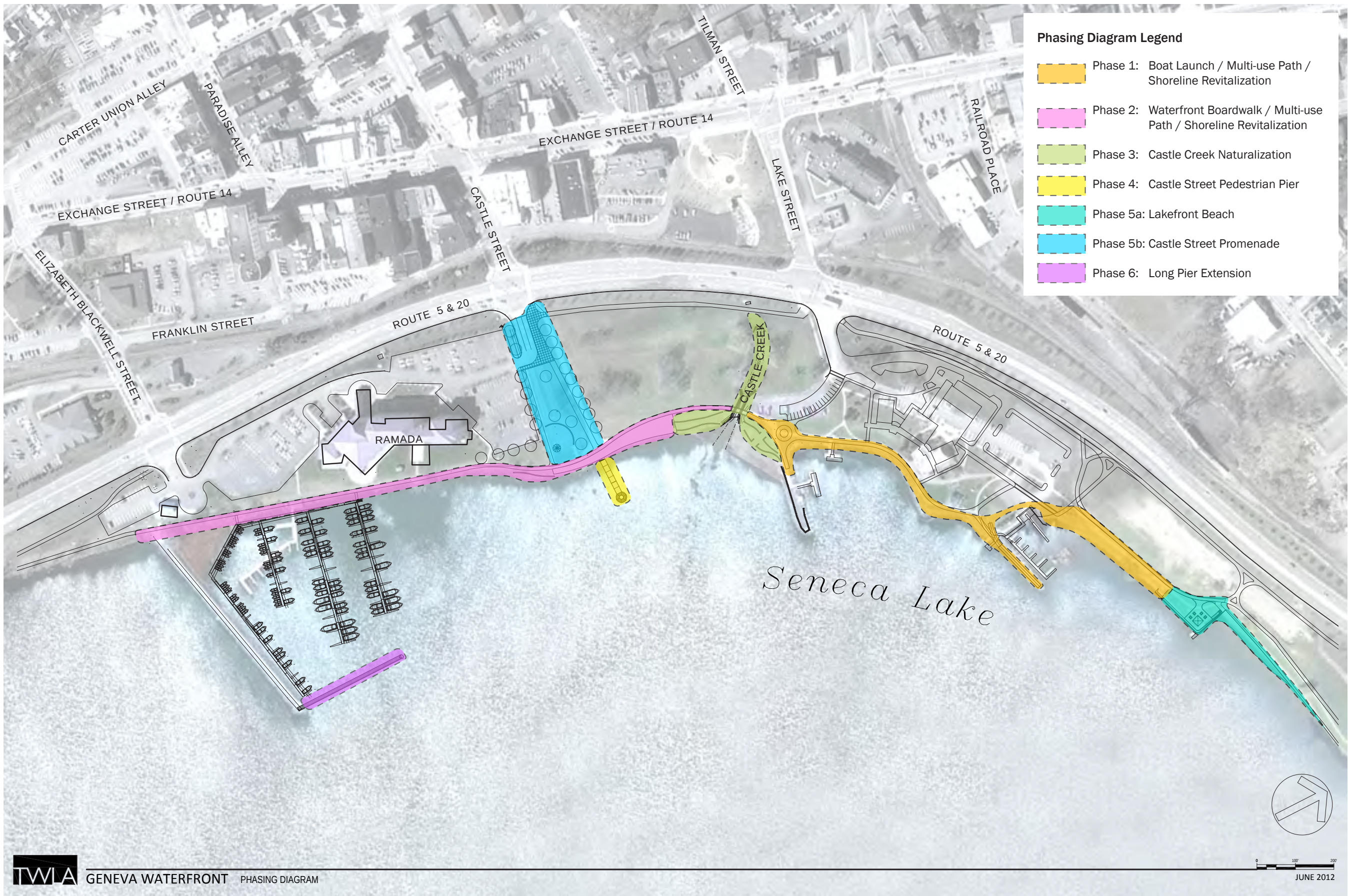

Figure 57: Phasing Diagram

PERMITTING

LIST OF APPLICABLE PERMITS

Project Sponsor: City of Geneva

Name of Permit	Regulatory Agency Contact Information	Applicable to:	Public Notice Required (Yes/No)	Application Fee:	Approximate Review Period:	Public Meetings Required:
US Army Corps of Engineers, Section 404 Permit Federal Water Pollution Control Act (1972), as amended by the Clean Water Act (1977& 1987): 33 U.S.C. 1251-1376 Restore and maintain chemical, physical, and biological integrity of the Nation's waters through prevention, reduction, and elimination of pollution.	United States Army Corps of Engineers, Buffalo District 1776 Niagara Street Buffalo, NY 14207 (716) 879-4330	- Shoreline Edge treatment - Castle Creek revitalization - Beach	No	No	14 to 60 days	No
US Army Corps of Engineers, Section 10 Permit Rivers and Harbors Act of 1899: 33 U.S.C. 40. Must obtain approval for plans for construction, dumping, and dredging permits.	United States Army Corps of Engineers 1776 Niagara Street Buffalo, NY 14207 (716) 879-4330	- Long Pier Extension - Castle Street Pier	No	No	14 to 60 days	No
US Army Corps of Engineers, **Nationwide Permit 3, Maintenance & Repair**	United States Army Corps of Engineers 1776 Niagara Street Buffalo, NY 14207 (716) 879-4330	- Shoreline Edge treatment - Boat Launch - Beach	No	No	14 to 60 days	No
Section 401 Water Quality Certification – Protection of Waters Permit	New York State Department of Environmental Conservation (NYS DEC) Region 8 6274 East Avon-Lima Rd. Avon, NY 14414-9519 r8dep@gw.dec.state.ny.us (585) 226-2466	- Castle Creek - Beach	No	No	14 to 60 days	No
Notice of Intent - General Permit (GP-0-10-001) **Permission to Inspect Property** **Notice of Intent (NOI)** **SEQR _Short Form**	New York State Department of Environmental Conservation (NYS DEC) Region 8 6274 East Avon-Lima Rd. Avon, NY 14414-9519 r8dep@gw.dec.state.ny.us (585) 226-2466		No	No	14 to 60 days	No
Coastal Zone Consistency Determination Coastal Zone Management Act of 1972: 16 U.S.C. 145. Preserve, protect, develop, and restore and enhance resources of the coastal zone.	New York State Department of State (NYS DOS) John Wimbush 518-486-3108 John.Wimbush@dos.state.ny.us Office of Coastal, Local Government and Community Sustainability One Commerce Plaza 99 Washington Avenue, Suite 1010 Albany, New York 12231-0001	- Shoreline Edge Treatment - Beach	DOS will provide Public Notice (15 day Public notice)	No	14 days - Review completeness of Assessment 60 day Department review period 15 day max. Department review extension if required	No
SHPO Project Review	New York State Office of Parks, Recreation and Historic Preservation (NYS SHPO) Robert Englert Conservation Planner (518) 237-8643 ext. 3268	- Long Pier Extension - Beach	No	No	30 Days – dependent on approval of information provided	No
Endangered Species Act	US Fish and Wildlife Services (FWS) Robyn Niver *(or Noelle Raymond)* 3817 Luker Road Cortland, NY 13045 (607) 753-9334	-Long Pier Extension - Shoreline Edge Treatment	N/A	$100	90 days- dependent on approval of information provided	

ESTIMATE

Phase 1	Boat Launch/Multi-use path / Shoreline Revitalization				
	Shoreline Excavation Preparation			$	536,300.00
	Unclassified Excavation, incld. all	$	140,000.00		
	Rubblize Rip Rap	$	396,000.00		
	Shoreline Revitalization			$	160,790.00
	Stone	$	68,600.00		
	Screened Gravel	$	32,500.00		
	Gravel/Soil	$	53,000.00		
	Seeding	$	6,690.00		
	12 ft wide Multi-use path (incl. excavation)			$	63,530.00
	12 ft wide path (incl. excavation)				
	<u>Boat Launch</u>				
	Rubblize Jetty			$	9,750.00
	Infill Stone and Gravel w/ reinforcing ties			$	22,125.00
	Stone and Gravel	$	21,000.00		
	No. 9 reinforcing bar	$	1,125.00		
	Concrete Cap (incl. reinforcing)			$	46,163.00
	Concrete Path Jetty			$	4,400.00
	Site Furnishings			$	42,000.00
	Benches				
	Bike Racks				
	Trash Recepticals				
	Circular Raised Bedding			$	5,990.00
	Landscaping			$	44,690.00
	Site Improvements			$	57,125.00
			Subtotal	$	992,863.00
	Contingency Fee		15%	$	148,929.45
			Subtotal	$	1,141,792.45
	Professional Design Fee		10%	$	114,179.25
	Boat Launch/Multi-use path / Shoreline Revitalization			$	1,255,971.70

Phase 2	Waterfront Boardwalk/ Multiuse Path / Shoreline Revitalization			
	Excavation/Site Preparation			$ 296,510.00
	Unclassified Excavation, incld. all			
	Rubblize Rip Rap			
	Shoreline Revitalization			$ 305,076.00
	Stone			
	Gravel/Soil			
	Seeding			
	Boardwalk			$ 278,386.00
	Grade Beam Foundation	$	147,292.00	
	Framing and Decking	$	131,094.00	
	Park			$ 43,590.00
	Lawn	$	8,190.00	
	Install Quarry Blocks	$	9,900.00	
	Trees	$	10,500.00	
	Multi-use Path			$ 88,460.00
	Path (incl. excavation)	$	21,250.00	
	Site Furnishings			$ 118,700.00
	Benches			
	Bike Racks			
	Trash Recepticals			
			Subtotal	$ 1,130,722.00
	Contingency Fee		15%	$ 169,608.30
			Subtotal	$ 1,300,330.30
	Professional Design Fee		10%	$ 130,033.03
			Waterfront Boardwalk/ Multiuse Path / Shoreline Revitalization	$ 1,430,363.33

Phase 3	Castle Creek Naturalization				
	Sediment and Erosion Control			$	5,000.00
	Culvert Removal			$	269,600.00
	Bridge			$	623,600.00
	Foundation	$	205,000.00		
	Structure	$	418,600.00		
	Block Terracing			$	81,335.00
	Creek Bank Naturalization			$	200,000.00
	Edge Revitalization			$	29,710.00
	Stone	$	16,900.00		
	Gravel/Soil	$	12,000.00		
	Seeding	$	810.00		
	Sand Kayak Launch			$	18,270.00
	Landscaping			$	15,500.00
			Subtotal	$	1,243,015.00
	Contingency Fee		15%	$	186,452.25
			Subtotal	$	1,429,467.25
	Professional Design Fee		10%	$	142,946.73
			Castle Creek Naturalization	$	1,572,413.98

Phase 4	Castle Street Pedestrian Pier				
	Shoreline Stabilization Allowance			$	15,000.00
	Pier			$	426,470.00
	Pile Foundation	$	251,420.00		
	Framing	$	175,050.00		
	Pier Lighting Fixtures and Conduit			$	38,900.00
	Pier Railing			$	116,000.00
	Pier Lighthouse			$	150,000.00
	Furnishings			$	20,000.00
			Subtotal	$	766,370.00
	Contingency Fee		15%	$	114,955.50
			Subtotal	$	881,325.50
	Professional Design Fee		10%	$	88,132.55
			Castle Street Pedestrian Pier	$	969,458.05

Phase 5a	Lakefront Beach				
	Ramp to Beach			$	136,900.00
	Excavation	$	3,500.00		
	Fill, Subbase & Concrete	$	133,400.00		
	Stairs			$	2,900.00
	Existing Wall Repair/Revitalization			$	9,950.00
	Grout Inject holes and cracks	$	3,700.00		
	Bush hammer finish	$	6,250.00		
	Pavilion Hardstand Patio (incl. edge treatment)			$	15,330.00
	Pavilion			$	20,000.00
	Beach Sands			$	16,950.00
	Backfill Sand	$	10,200.00		
	Cover Sand	$	6,750.00		
	Picnic Tables			$	2,600.00
	Railing			$	80,000.00
	Site Furnishings			$	13,800.00
	Benches				
	Bike Racks				
	Trash Recepticals				
	Lighting			$	45,000.00
	Landscaping	$	15,000.00	$	15,000.00
			Subtotal	$	358,430.00
	Contingency Fee		15%	$	53,764.50
			Subtotal	$	412,194.50
	Professional Design Fee		10%	$	41,219.45
			Lakefront Beach	$	453,413.95

Phase 5b	Castle Street Promenade			
	Excavation site preparation (incl. road removal)		$	69,000.00
	Special Lighting		$	138,600.00
	Promenade Paver Plaza		$	50,000.00
	Promenade Path		$	-
	Path	$ 313,635.00		
	Path Edge Treatment	$ 110,400.00		
	Park		$	82,650.00
	Benches	$ 10,000.00		
	Quarry Blocks	$ 16,650.00		
	Pavilion	$ 50,000.00		
	Trash recepticals	$ 4,500.00		
	Bike Racks	$ 1,500.00		
	Landscaping		$	130,900.00
	Trees			
	Lawn			
	Promenade Waterfront Sign		$	24,970.00
	Parking lot access Reconfiguration		$	10,500.00
		Subtotal	$	506,620.00
	Contingency Fee	15%	$	75,993.00
		Subtotal	$	582,613.00
	Professional Design Fee	10%	$	58,261.30
		Castle Street Promenade	$	640,874.30

Phase 6	Long Pier Extension			
	Steel Piles		$	390,000.00
	Steel Framing		$	638,665.00
	Decking Framing			
	Steel Panel Framing			
	Lighting Fixtures and Conduit		$	18,490.00
	Ipe Wood Decking and Paneling		$	165,515.00
		Subtotal	$	1,212,670.00
	Contingency Fee	15%	$	181,900.50
		Subtotal	$	1,394,570.50
	Professional Design Fee	10%	$	139,457.05
		Long Pier Extension Total	$	1,534,027.55

CONCLUSION

This Study focuses on the feasibility of enhancements that improve the waterfront connection to downtown, water access, user experience, shoreline aesthetics and accessibility, and material longevity and maintenance.

This Study has refined the described enhancements for technical feasibility and worked with the City of Geneva in collaboration with the NYSDOS to prioritize their implementation. Moving forward, the City of Geneva will need to identify and secure funding for each enhancement phase, develop and publish requests for design proposals, and retain consultants to complete design and work with the permitting agencies to get project construction approval.

Appendices

Appendix A: Feasibility Study Plan

TWLA GENEVA WATERFRONT ALTERNATIVE ALIGNMENT

Appendix B: Wave Action Study

Project Memo

To: Joseph Fonzi, PB – Buffalo

From: Jerald D. Ramsden

Date: June 12, 2012

Copy: File

Re: Geneva Waterfront Infrastructure Feasibility Study: Wind Waves

Introduction

Parsons Brinckerhoff (PB) is conducting a feasibility study for the Seneca Lake waterfront in the City of Geneva, New York. As part of the study, PB conducted a wind wave analysis to identify design wave conditions for use in the feasibility assessment of breakwater alternatives and shoreline protection. In addition, wave loads and wave transmission were calculated for a fixed wave screen alternative. This memorandum presents the methodology and results of the wave analysis.

Wind Waves

Wind waves were calculated using standard procedures outlined in the Coastal Engineering Manual (CEM) (USACE, 2002). Wind directions were considered corresponding to E, ESE, SE, SSE and S due to the location of the project site and the orientation of over-water distances where appreciable wind-wave generation can occur. The project location and geometry of Seneca Lake limit the wave fetch. Figure 1 shows the fetch lengths which were measured at 6 degrees increments to define the overwater distances along which wind wave generation can occur. The restricted fetch methodology outlined in the CEM applies the concept of wave development in off-wind directions and considers the shape of the lake.

The winds were analyzed based on thirty years of hourly wind data obtained from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) in Asheville, NC. The wind data was part of a larger data set available on the NCDC's SAMSON data set (period of record 1961-1990). Winds from the Rochester and Binghamton Airports were assumed to be representative of extreme wind speeds at the project site. The reported wind speeds were observed or averaged for approximately two to three minutes every hour on the hour and are assumed to be representative of wind speeds with a one hour duration.

Wind data from the period of record 1961-1990 was used calculate extreme wind speeds recurrence interval winds with a 2% and 50% chance of occurrence in a given year (e.g. the wind storm with an average recurrence interval of 50 years and two years, respectively). The wind data was adjusted to a consistent anemometer height of 32.8 feet above the ground using the $1/7^{th}$ power law relationship for a fully developed turbulent boundary layer per guidance in the CEM. Consideration of the atmospheric boundary layer stability due to the air-water temperature difference and associated stability correction was beyond the scope of this study. Thus, following guidance in the CEM, a stability coefficient, R_t, of 1.1 was multiplied by the wind speed to account for the unknown stability conditions.

The SAMSON data set includes 16 wind directions (i.e. N, NNE, NE, etc.). After adjustment of the wind data to a consistent anemometer height and application of the stability correction, the annual maximum observed wind for each direction of interest was modeled with a Type I Extreme Value Distribution which is commonly referred to as the Gumbel Distribution (Simiu and Scanlan, 1996). The probability distribution was fit to the data and then used to estimate extreme wind speeds for storms with several average annual recurrence intervals including 50 years and 2 years. The extreme wind speeds at Rochester and Binghamton Airports were compared. The Rochester Airport data was used due to closer proximity to the site and higher maximum wind speeds than those from the Binghamton Airport. The extreme one hour wind speeds calculated from the Rochester Airport wind data are shown in Table 1.

Note that other wind data is available closer to the project site including about one decade of data from Penn Yan Airport and some seasonal data from a buoy in Seneca Lake. The seasonal wind measurements are not suitable for calculation of extreme winds. A method does exist to use shorter wind data sets such as that at Penn Yan for estimation of 50 year wind (Simiu and Scanlan, 1996). The wind data from the buoy deployment can be used to assess the land to overwater air speed corrections calculated for this study. This additional work, using the buoy and Penn Yan Airport wind data, was beyond the scope of this study and is recommended for preliminary and final design.

The overwater wind speeds and resulting wind waves were calculated using the U.S. Army Corps of Engineers (USACE) model Automated Coastal Engineering System (ACES, Leenknecht et al., (1992)). Table 1 is a summary of the wave analysis results calculated using the ACES model including the significant wave height H_s, peak wave period T_p and wave direction θ for each fetch based on the 50 year and two year wind storms. The significant wave is the average wave height of the largest 1/3 of waves in a random wave field. The wave heights provided below are for offshore locations in deep water and do not include wave shoaling or refraction. As indicated in Table 1, the maximum 50 year significant wave height is 7.1 feet with a peak wave period of 5.4 seconds generated from southeast winds. For the two year storm the largest wave condition occurs for winds from the south and yields a significant wave height of 4.5 feet and a peak wave period of 4.5 seconds.

Table 1: Significant wave heights and periods for 50 year and two year wind waves in deep water offshore of the project site.

Wind direction	Average recurrence interval (yr)	One hour wind speed (mph)	Significant wave height (ft)	Peak wave period (sec)	Wave direction (deg.)
S	50	43	6.5	5.2	171
SSE	50	45	6.7	5.3	170
SE	50	48	7.1	5.4	168
ESE	50	39	5.5	4.8	166
E	50	33	4.0	4.2	162
S	2	32	4.5	4.5	171
SSE	2	29	4.0	4.3	170
SE	2	26	3.6	4.0	168
ESE	2	25	3.4	3.9	166
E	2	23	2.8	3.5	162

Local Wave Transformation

An approximate refraction coefficient was developed using the ratio of the lake width approximately 2.5 miles south of the project site between 12 foot depth contours (7400 ft) to the approximate shoreline distance around the 12 foot depth contour at the upper end of the lake (13,500 feet). This ratio is used as an approximation of the lateral spread of wave energy as the wave approaches the northern end of the lake and begins refracting towards the west in the vicinity of Geneva and to the east on the other side of the lake. This approximate refraction method yields a 26% reduction in wave height between the wave conditions shown in Table 1 and the wave conditions at the project site. Wave shoaling was estimated using Figure II-3-6 from the CEM. Together these approximations of the refraction and shoaling yield a reduction of the 7.1 foot significant wave height in deep water to a significant wave height of approximately 5.0 feet in depths ranging from 10 feet to 20 feet. This wave height of approximately 5.0 feet was used in the wave force calculations below. The wave refraction and wave shoaling approximations reduce the two year deep water significant wave height of 4.5 feet to approximately 3.2 feet for depths ranging from 10 feet to 20 feet in the vicinity of the project site.

The approximate methods noted above were used due to the limited scope of this study. For preliminary and final design use of a numerical wave model is recommended to account for the effects of the lake bathymetry and shoreline configuration on the wind waves. A wave transformation model such as CMS Wave, developed by the U.S. Army Corps of Engineers, could be used to calculate wave conditions at the project site accounting for the bathymetry, shoreline configuration and effects of structures such as the rubble mound breakwater and proposed breakwater extension.

Wave Loads and Wave Transmission at a Fixed Wave Barrier

Wave loads were calculated using three methods including:

1) Goda (1985) as summarized in the CEM for a vertical wall extending from the mudline to some height above the still water level;
2) Kriebel, et al. (1998) for a wave barrier consisting of a wall that extends below the water line to some desired depth above the mudline and above the water line to a level that prevents wave overtopping;
3) Suh, et al. (2006) for a wave barrier consisting of a wall that extends below the water line to some desired depth above the mudline and above the water line to a level that prevents wave overtopping. The results reported in the paper include piles below the barrier that block half of the available area below the wave barrier.

Wave load results from the three papers above indicate that as the wave barrier reaches depths near the mudline the Goda method begins to agree well with the other two methods. For relatively shallow wave barrier depths the Kriebel, et al. and Suh, et al. methods yield smaller loads than the Goda method and this is expected due to the transmission of wave energy under the wave barrier leading to smaller wave reflection and in turn smaller wave loads. Since the Kriebel, et al. and Suh, et al. papers do not provide wave pressure diagrams associated with the maximum wave load, the pressure distribution from the Goda method was used but the wave pressures were reduced based on the ratio of the Suh, et al. to Goda wave force. The results of Suh, et al. are used in favor of the Kriebel, et al. results to reduce the wave pressure due to the presence of piles in the laboratory and theoretical work of Suh, et al. whereas piles are not included in the laboratory or theoretical model of Kriebel, et al. Thus, the results of Suh et al. with the high density of piles yield larger and somewhat conservative wave force results relative to the lower anticipated pile density of the proposed wave barrier.

Table 2 provides a summary of the wave loads; maximum pressure, which is assumed to occur at the still water level; and wave transmission coefficients. The results in Table 2 are presented for different relative depths (w/d) of the wave barrier where w is the distance the wave barrier extends below the still water level and d is the depth of water. The wave forces shown are from the results of Suh, et al. except for w/d=0.8 where the results from Goda are used since Suh, et al. did not provide results for this wave barrier depth. The wave pressures are calculated as noted above. The transmission coefficients shown are from Kriebel & Bollmann (1996) which will be slightly conservative due to the lack of piles below the barrier in their laboratory measurements. The wave transmission coefficient is the ratio of the transmitted wave height to the incident wave height. Note the transmission coefficient did not change with depth for the 50 year wave condition.

Table 2. Wave load, maximum pressure at the still water level and transmission at the proposed fixed wave barrier for the 50 year wave condition.

Water depth d (feet)	Parameter	w/d 0.2	w/d 0.4	w/d 0.6	w/d 0.8
20	Wave force (kips/ft)	1.64	3.7	5.3	6.0
20	Maximum wave pressure (psf)	82	210	300	360
20, 15 &10	Transmission coefficient	0.98	0.80	0.60	0.40
15	Wave force (kips/ft)	1.36	3.1	4.4	5.7
15	Maximum wave pressure (psf)	44	138	240	410
10	Wave force (kips/ft)	0.84	1.90	2.5	4.2
10	Maximum wave pressure (psf)	34	109	193	400

Guidance for design of small boat harbors is provided in ASCE (2000) and includes wave condition criteria for small boat mooring and operations. Two of these criteria state that moderate harbor conditions are associated with significant wave heights less than 2.5 feet and 1.25 feet for head seas in 50 year and maximum annual storms, respectively. For the purposes of this study, the two year wave condition is considered representative of the annual maximum wave. For the 50 year incident significant wave height of 5.0 feet, a transmission coefficient of 0.5 or less is needed to achieve a moderate wave condition of 2.5 feet within the marina. For the two year wave with a significant wave height of 3.2 feet a transmission coefficient of 0.38 or less is needed to achieve a moderate wave condition in the harbor. Table 3 shows the transmission coefficients calculated from the results published in Kriebel and Bollmann (1996). From Table 3 and the above marina condition criteria from ASCE a relative wave barrier penetration depth, w/d, of about 0.8 is needed to meet the moderate wave condition in the marina during the annual maximum event. However, some of the marina will also be protected by the rubble mound breakwater which has a very low transmission coefficient. The area shielded by the rubble mound breakwater will cause the transmitted wave under the wave barrier to diffract into this quiescent zone. The wave diffraction will tend to spread the wave energy laterally and thus the wave heights will be less than what is indicated by the wave transmission results alone.

Table 3. Wave transmission at the proposed fixed wave barrier for the two year wave condition.

Water depth d (feet)	Parameter	w/d 0.2	w/d 0.4	w/d 0.6	w/d 0.8
20	Transmission coefficient	0.98	0.72	0.53	0.35
15 & 10	Transmission coefficient	0.98	0.80	0.60	0.40

Measurement of detailed local bathymetry and nearshore wave modeling are recommended for preliminary and final design. The more accurate calculation of the wave transformation process using the wave model may yield somewhat smaller wave conditions at the project site resulting in reduced wave barrier penetration depths and associated wave loads. The wave model will include both the rubble mound breakwater and the proposed wave barrier allowing a more accurate representation of the future wave conditions within the marina. An additional wind analysis to account for the limited boating season is recommended for the design phase of this project in order to identify possible reductions of the design wave conditions and associated wave barrier depth.

References

American Society of Civil Engineers (ASCE), 2000. "Planning and Design Guidelines for Small Craft Harbors." ASCE Manual and Reports on Engineering Practice No. 50, ASCE, New York, New York.

Goda, Y., 1985. " Random Seas and Design of Maritime Structures." University of Tokyo Press, Tokyo, Japan.

Kriebel, D. and Bollmann, C.A., 1996. "Wave Transmission past Vertical Wave Barriers." Proceedings of the Coastal Engineering Conference, Orlando, Florida, American Society of Civil Engineers, New York, New York.

Kriebel, D., Sollitt, C. and Gerken, W., 1998. "Wave Forces on a Vertical Wave Barrier." Proceedings of the Coastal Engineering Conference, Copenhagen, Denmark, American Society of Civil Engineers, Reston, Virginia.

Leenknecht, Szuwalski and Sherlock, 1992. "Automated Coastal engineering System, user Guide and Technical Reference, Version1.07." Coastal Engineering Research Center, Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, MS.

Simiu, Emil and Robert Scanlan, 1996. "Wind Effects on Structures." Third Edition, John Wiley & Sons, Inc. New York, NY.

Suh, K., Shin, S. and Cox, D., 2006. “Hydrodynamic Characteristics of Pile-Supported Vertical Wall Breakwaters.” Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 132, No. 2, March 1, 2006, American Society of Civil Engineers, Reston, Virginia.

U.S. Army Corps of Engineers (USACE). 2002. “Coastal Engineering Manual.” Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, Washington, D.C. (in 6 volumes).

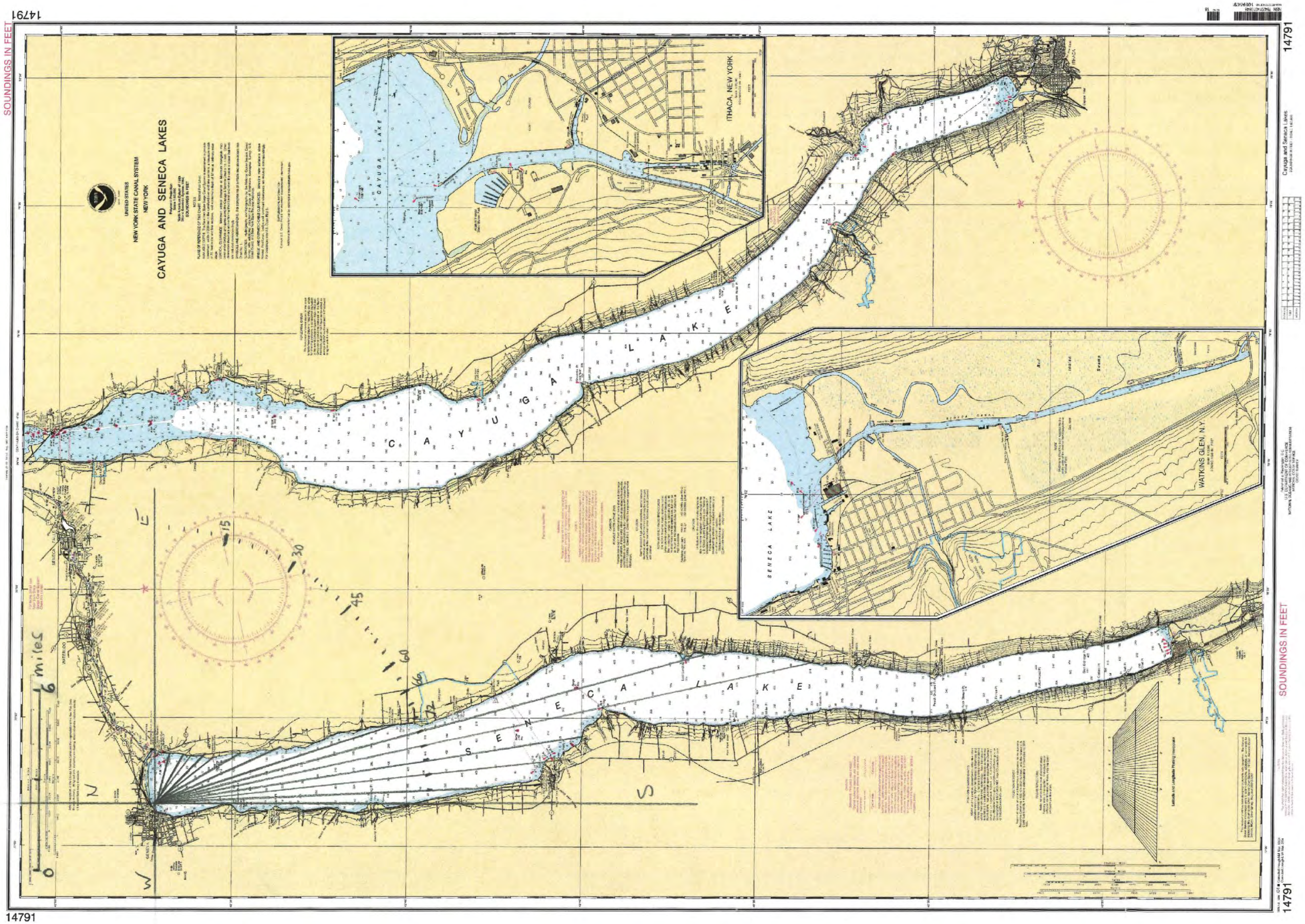

Figure 1. NOAA Chart No. 14791 showing Seneca Lake and the fetch lengths used in the wind wave analysis.