



CITY OF SHEBOYGAN
PUBLIC WORKS

SHORELINE RESTORATION MANAGEMENT PLAN 2022



SPIRIT OF THE LAKE

HOME TO 36 BEAUTIFUL PARKS

705 ACRES OF NATURE TRAILS

8 MILES OF PAVED TRAILS



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PROJECT SUMMARY

Foth Infrastructure & Environment, LLC (Foth) was retained by the City of Sheboygan (City) to prepare a shoreline management report to advance restoration of the shoreline and provide resilient shore access for future generations.

PURPOSE

The purpose of the shoreline management report is to assess the current state of the shoreline, identify distinct project areas, develop solutions that address the issues facing different regions of the City shoreline and prioritize project sites based on need and City desire. The shoreline condition was assessed via field and shoreline surveys, aerial photography, and historical data on shoreline protection.



SCOPE

Evaluations of erosion along City's Lake Michigan Shoreline, discussion of regional wave climate, analysis of climate change effects on the great lake, rising lake effects, assessment of historical shoreline management in the region, investigation of shoreline conditions in the different prospect areas, solution alternatives, solution feasibility, costs and funding, and scheduling options were completed as part of this shoreline management plan.

CONCLUSIONS

Based on the findings of this report, the following conclusions can be made:

- High lake levels, a more forceful wave climate, and increased storm surges seen in recent years have led to continuous erosion of the Sheboygan coastline and created an urgent need to restore the shoreline and provide resilient, but adaptable solutions.
- 6 distinct project areas have been identified as needing urgent restoration and protection due to the areas' susceptibility to erosion and impacts to private and public infrastructure.
- The southern shoreline, sites 1 to 4, are made up of public parks, long stretches of beach, and contain many shoreline protection structures. The major issues effecting the southern shoreline, are shoreline retreatment, sediment erosion, and failing shoreline structures. Restoration solutions in this area include beach nourishment, habitat restoration, revetment rehab, and failing shoreline structure removal.
- The northern Sheboygan shoreline, site 6, is made up of residential properties that sit along bluffs with steep slopes that are covered in shrubbery. With changing Lake Michigan levels and wave climate, these houses are at increased risk of damage due to instability, poor drainage, and bluff erosion. Restoration solutions in this region include toe protection, beach nourishment, and drainpipe installation.
- Continuous upkeep will be required for long lasting shore protection at all 6 distinct project areas. Upkeep will be extensive for sites 2, 4, and 5, where soft engineering solutions are providing the bulk of shoreline protection.
- Grant acquisition will ease city cost for the project for sites 2, 5, and 6. It is recommended that the city self-funds the majority of site 3.
- Sites 2, 3, and 5 are the priority as determined by the desire of the City and the high impacts on private and public infrastructure.

RECOMMENDATIONS

Based on the findings of this shoreline management report, the Sheboygan shoreline needs advanced restoration and resident solutions that protect the shoreline.

The following recommendations are made:



SITE 1

LAKE VIEW PARK

- An armor stone revetment is necessary for protection. Design of this structure is being completed under a separate project with the city.
- It is anticipated that this work will be completed in 2022/2023.
- For further details regarding the project see “2459-21” (Foth 2021).

SITE 2

KING PARK



SITE 3

BLUE HARBOR RESORT



- A combination of beach nourishment and habitat restoration to increase beach width, dissipate wave energy, and combat erosion.
- Issues regarding the exposed manhole and drainage pipes are being addressed in a separate project with the city. For further details regarding the project see “2459-21” (Foth 2021).
- Funding to come from both the city and grant acquisition.
- Top priority site with recommendation that Engineering and Design start date TBD.

- Restore current revetment to protect against rising lake levels and increased wave energy
- City will pay for the project in full as grants are limited and should be left to projects with higher grant funding potential.
- Top priority site with design start date TBD.



SITE 4

SHEBOYGAN POINT

- Complete a sediment transportation study to understand the issue and determine a course of action to address the sediment transportation effecting the southern portion of Sheboygan Point.
- From the study, determine if the failing groins and stone armor revetment need to be removed or rehabilitated. Utilize beach nourishment to restore even beach width across the region, combat erosion, and dissipate wave energy.
- Apply and acquire grants for sediment transportation study. Funds for solution will depend on results of the study.
- Lower priority site. Study start date TBD with next phases to follow.



SITE 5

NORTH BLUFFS

- Immediate action is needed to protect the residential homes and improve bluff stability.
- A combination of increased toe protection, beach nourishment, and drainpipes will combat erosion.
- Funding to come from both the city and grant acquisition.
- Bluffs will require extensive upkeep to prevent major erosion.
- Top priority site. Design start date TBD.

1

INTRODUCTION

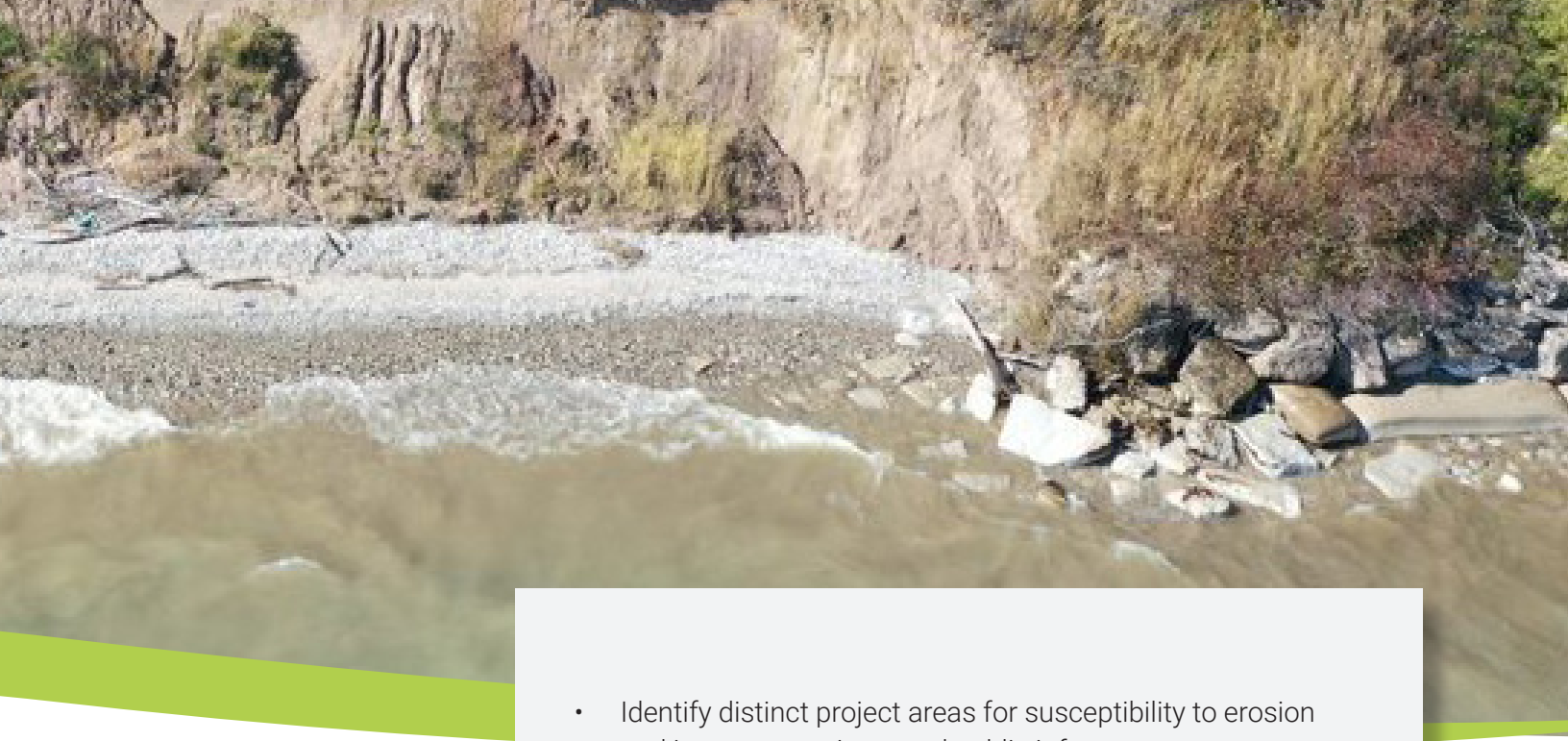
1.1 PROJECT BACKGROUND

Located on the western shoreline of Lake Michigan, the City of Sheboygan (City) has over six miles of shoreline that separates the lake from residential houses, apartment buildings, public facilities, parks, and the Harbor Centre Marina. This city owned shoreline ranges in type from sandy beaches to high bluffs. Various types of shoreline protection structures (groins, revetments, bulkheads) have been utilized and are located throughout the shoreline. These shoreline areas are the first line of defense against high water and waves, which are present on Lake Michigan.

The City retains ownership to all shoreline within its boundaries, as well as some shoreline in the Town of Sheboygan. The City is the owner of the shoreline and is responsible for maintenance of the shoreline protection structures, as feasible, to protect public and private infrastructure. The shorelines of Lake Michigan are considered receding shorelines, in that they are forever facing erosion processes dating back to the creation of the lakes and the influence of geologic formation. These erosion processes include beach loss and bluff line erosion, which are long term processes that can be mitigated but not stopped.

Bluff erosion has been a significant issue throughout the Great Lakes and in particular the State of Wisconsin. Shoreline erosion bluff data has been collected back to the 1960's, including aerial photography and shoreline cross sections. These have been preserved and presented in the Wisconsin Shoreline Inventory and Oblique Photo Viewer (Wisconsin Shoreline Inventory and Oblique Photo Viewer, 2021).

This viewer is an internet-based GIS visualization tool that allows users to see shared observed shoreline data along the Wisconsin shoreline. This program is one of the main monitoring programs that cover the Sheboygan shoreline and will be used as the existing conditions baseline. The Photo Viewer has a collection of aerial photos dating back to 1976, as well as bluff condition, beach protection, and shore structure reports that cover short term and long-term bluff crest and toe recessions, and profile databases that show the bluff and near shore profiles. Using this database, lakefront communities along the shoreline of Lake Michigan can track the movement of the shoreline beach/bluff accretion and recessions either using measured data points or referencing yearly taken aerial photos (NOAA, 2020).



1.2

PROJECT GOALS

- Identify distinct project areas for susceptibility to erosion and impacts to private and public infrastructure
- Develop alternatives which focus on providing solutions that are resilient and benefit both the public and nature
- Prioritize project sites for design and construction
- By achieving these goals, the City can develop a framework to advance restoration of their shorelines and provide resilient lake shore access for future generations. Additionally, this document will be intended as a basis for partnership between the City of Sheboygan and its citizens, businesses, property owners, governmental entities, and non-governmental organizations. The plan will aim to ensure conservation, protection, enhancement, and proper management of natural resources and shoreline, while providing for a balanced pattern of development and the needs of the citizens of the City.

2


CURRENT SHORELINE CONDITIONS

While the energy of a deep-water wave is often dissipated by the time the wave reaches the shoreline, elevated water levels and significant near shore erosion has led to shoreline conditions where larger waves are attacking the coast.

In recent years harsh storms and increasing lake levels have become typical of the great lakes, and specifically Lake Michigan. Storm winds cause rapid changes in lake water levels by dragging water downwind resulting in a temporary rise in local water level. This phenomenon is referred to as a storm surge. Storm surges on open coasts, such as the Sheboygan coast, can cause a one to two feet rise in lake levels. With storms increasing in frequency and intensity in recent years storm surges have more potential to cause damage to the shoreline as impacts are more frequent.

Beyond storm surges, waves caused by storms have always presented a challenge to the Wisconsin coastline. High wind events build large deep-water waves on Lake Michigan. Wind speed, length of water surface exposed to the wind and duration are all factors that contribute to the varied characteristics of deep-water waves. A typical fall storm can result in deep water (offshore) wave heights greater than 17 feet in a short period of time. These deep-water waves dictate shallow-water wave conditions. Deep-water waves diffract and refract in response to sensing the lake bottom and near-shore obstacles, determining the characteristics of a shallow-water wave. While the energy of a deep-water wave is often dissipated by the time the wave reaches the shoreline, elevated water levels and significant near shore erosion has led to shoreline conditions where larger waves are attacking the coast.

Along the city of Sheboygan's shoreline, the increased erosion has led to receding shorelines. These receding shorelines have led to bluff erosion and collapse, beach loss, and direct wave impacts to critical city infrastructure. Steps must be taken to mitigate the loss of shoreline, while also providing a resilient solution to mitigate future climactic changes.



2.1

EFFECTS OF CLIMATE CHANGE

Climate change projections for the Great Lakes Region show increased air temperature (+1.8 ° -5.4° F by year 2050), increased precipitation, and an increase in extreme weather events (GLISA, 2020). In general, climate change is expected to have the following impacts on the Great Lakes:

1 REDUCE ICE COVERAGE

According to the Great Lakes Shoreline Resilience Planning Guide, average annual ice cover in the Great Lakes has declined 71 % from 1973-2010. This trend is likely to continue as air temperature rises (GLISA, 2020).

2 INCREASED VARIABILITY IN WATER LEVELS

Future water levels are dependent on precipitation, runoff, evaporation, land use and lake regulations. Because these factors are difficult to predict, water level projections vary. Current projections indicate increasing variability in lake levels (GLCR, 2013).

3 INCREASED WATER TEMPERATURE

Increasing air temperatures will raise water temperatures in the Great Lakes. This can lead to toxic algal blooms, increased stratification, and harm the Great Lakes ecology (GLISA, 2020).

4 MORE FREQUENT EXTREME WIND/WAVE EVENTS

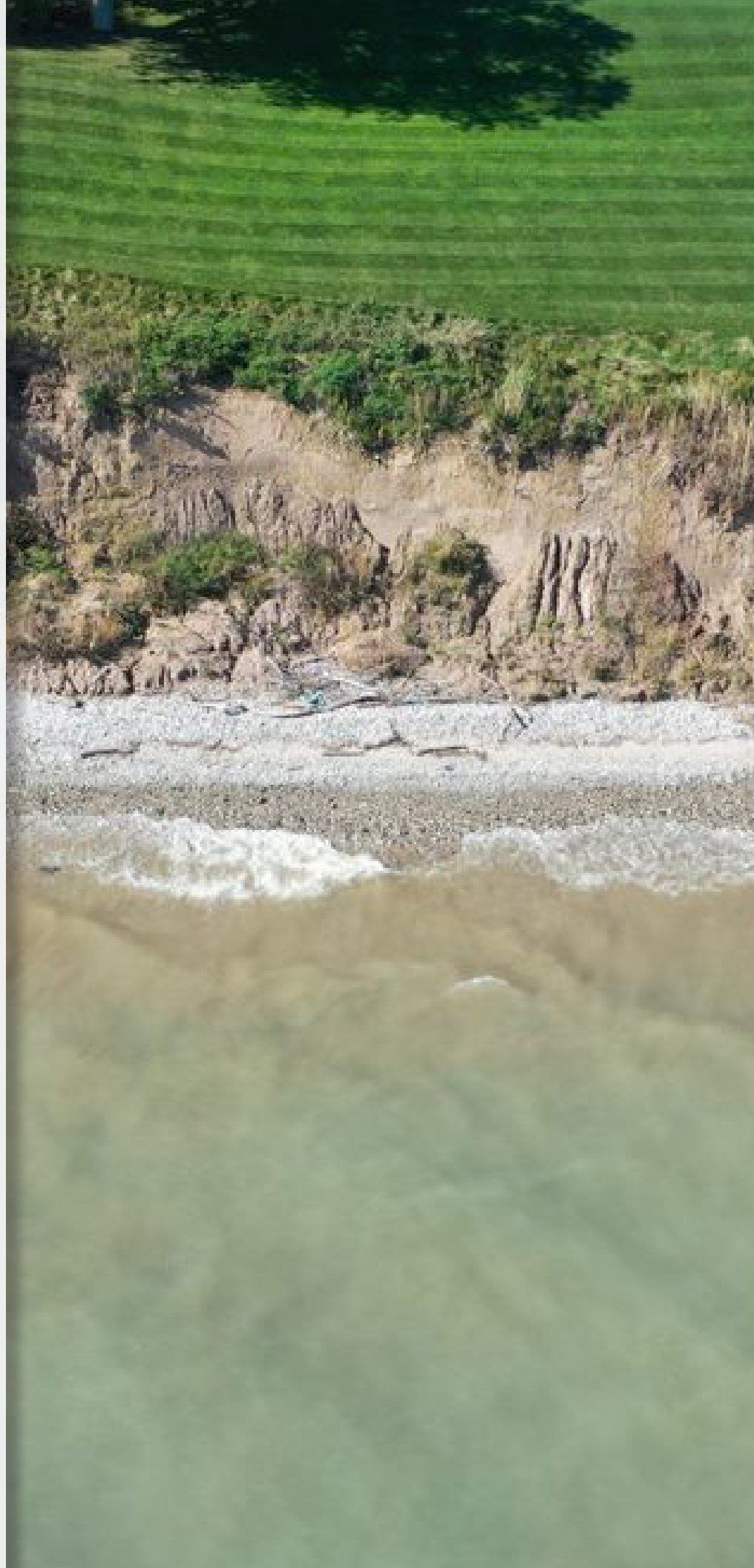
A warmer atmosphere leads to more frequent intense storms that generate large waves. This may lead to more erosion and damage on shoreline structures (GLCR, 2013).

The shoreline improvements will allow for the potential effects of climate change, including being functional as water level fluctuations increase and protecting against more frequent large wave events.

2.2

SITE VISIT

On July 16th, 2020 Foth made a site visit with the client to go over the sites and review what information was known including major areas of concern, site specific issues, and to develop the existing conditions for each site. 11 different sites were identified as needing immediate restoration and protection. The major issues effecting the southern shoreline, as determined by the 2020 site visit, are shoreline retreatment, sediment erosion, and failing shoreline structures. The northern Sheboygan shoreline is made up of bluffs with issues regarding bluff stability, drainage, and bluff erosion. A photo log taken during this visit is included in Appendix A. It contains photos from all sites.



3

SITE EVALUATIONS

For this study, Foth took the eleven sites visited in 2020 and developed five key shoreline areas for the city to address based on geographical location and common shoreline issues. These five areas shown in Figure 1 below include all eleven sites visited, as well as areas of shoreline that are vulnerable to continued erosional processes but were not visited or accessible that day.



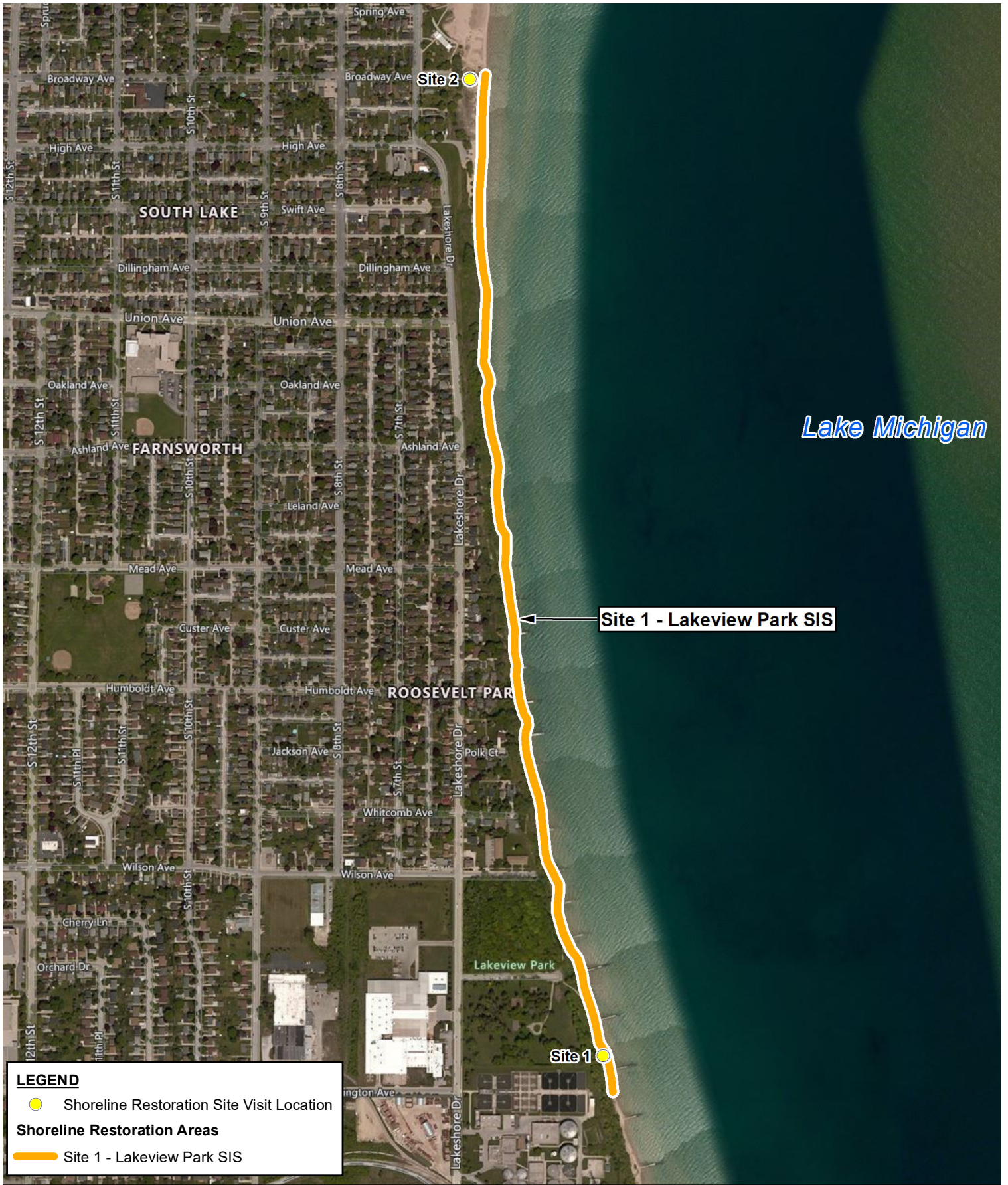


FIGURE 2

3.1 SITE ONE

LAKE VIEW PARK & SOUTHSIDE SANITARY SEWER INTERCEPTOR

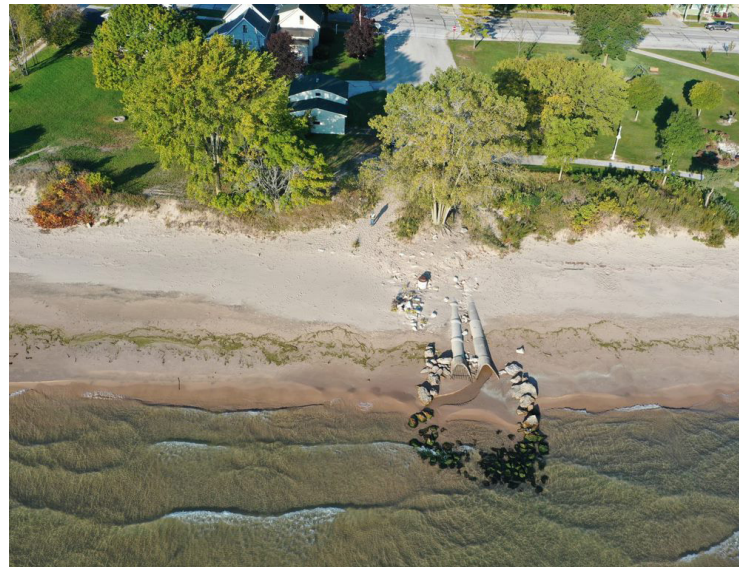
The Lake View Park site encompasses the lake front along Lake View Park, just north of the water treatment plant. As part of this study, the site also includes the shoreline northward toward King Park Beach and is part of the Southside Sewer Interceptor Rehab and Protection Project, currently undergoing final design by Foth.

3.1.1 EXISTING CONDITIONS

Lake View Park represents one of several public beach access areas within the City of Sheboygan. For the purposes of this study, the limits of this site area are approximately 4,350 linear feet of shoreline stretching from the southern end of Lake View Park north to the southern end of King Park Beach as shown in Figure 2 to the left. This stretch of shoreline contains a variety of shoreline structures that were built to provide protection, including revetments of varied materials (concrete debris, armor stone riprap) and 17 groins. Most sections of the revetments are in disrepair and need restoration to provide the protection intended. The 17 groins are damaged and providing no benefit. In addition, there is city sanitary sewer infrastructure present on the lake side of the bluff. This infrastructure includes a buried sanitary sewer interceptor and associated manhole access points. These manholes are in direct attack from Lake Michigan waves, due to the high lake levels.

3.1.2 PROPOSED SOLUTIONS

Due to the nature of the shoreline along this stretch, and the presence of critical city infrastructure, it was determined that an armor stone revetment was necessary for protection. Design of this structure is being completed under a separate project with the city. It is anticipated that this work will be completed in 2022. For further details regarding the project see “2459-21” (Foth 2021). In addition, as part of the revetment work, the groins located along this stretch will be removed which will allow for resumption of longshore sediment transport.



3.1.3 FEASIBILITY

Due to the nature of the shoreline along this stretch, and the presence of critical city infrastructure, it was determined that an armor stone revetment was necessary for protection. Design of this structure is being completed under a separate project with the city. It is anticipated that this work will be completed in 2022. For further details regarding the project see “2459-21” (Foth 2021). In addition, as part of the revetment work, the groins located along this stretch will be removed which will allow for resumption of longshore sediment transport.

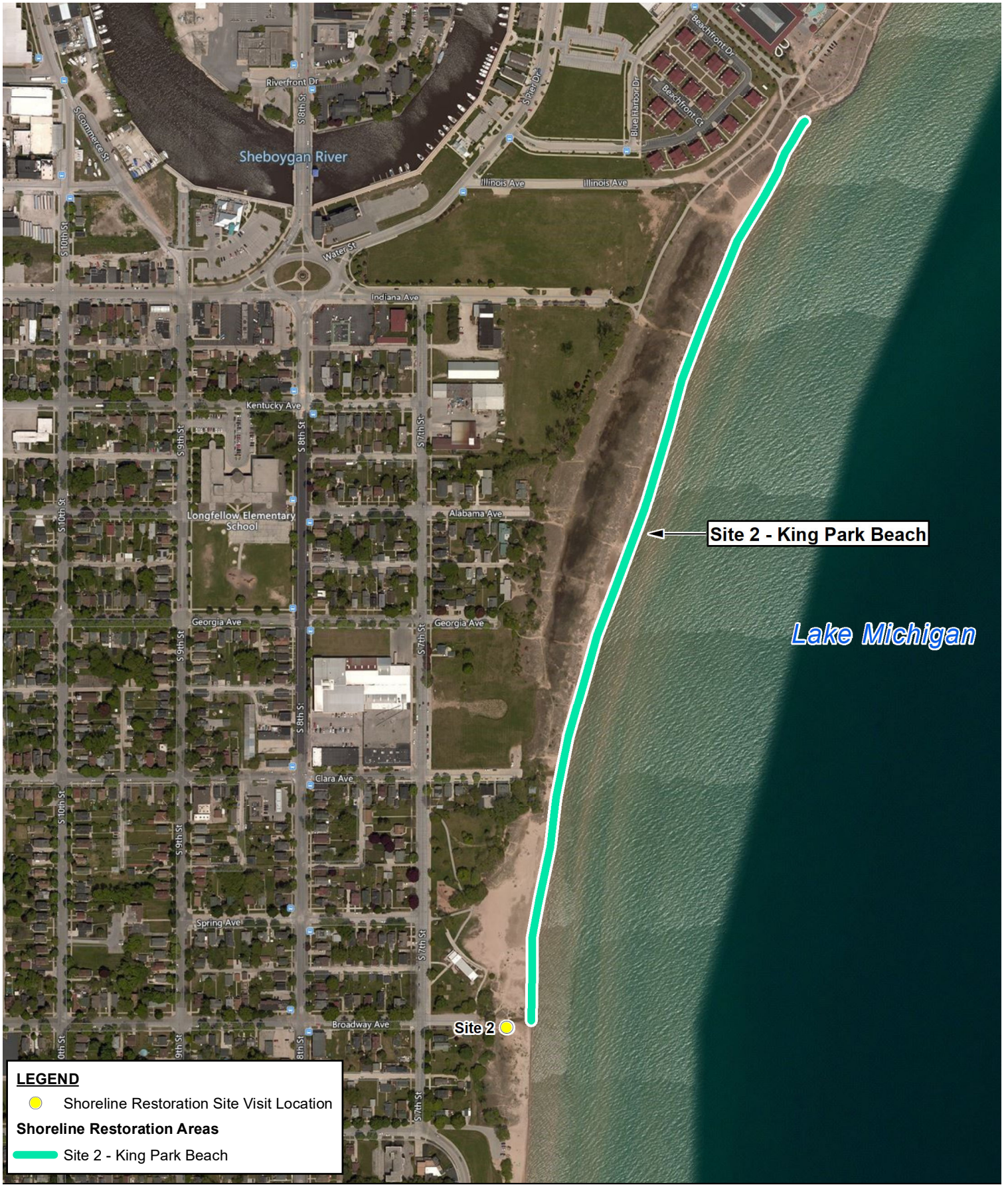


FIGURE 3

3.2 SITE TWO

KING PARK BEACH

The Lake View Park site encompasses the lake front along Lake View Park, just north of the water treatment plant. As part of this study, the site also includes the shoreline northward toward King Park Beach and is part of the Southside Sewer Interceptor Rehab and Protection Project, currently undergoing final design by Foth.

3.2.1 EXISTING CONDITIONS

The King Park beach site is approximately 3,000 linear feet of sand beach and sand dunes stretching from roughly Broadway street to the shoreline in front of the Blue Harbor resort as shown in Figure 3 to the left. In recent years, high lake levels and storms have eroded shore sediments offshore resulting in a shoreline retreat of 20-30 feet. This shoreline erosion has limited public access to the public beaches while additionally eroding adjacent shoreline which impacts city and private infrastructure. Further erosion could additionally impact shoreline dunes resulting in a loss of critical animal and plant habitats.

3.2.2 PROPOSED SOLUTIONS

Protecting the natural habitats and sand shoreline are critical to the King Park shoreline. With that in mind, soft solutions have been determined as the best course of action. Two solutions proposed are beach nourishment and shoreline habitat restoration. These solutions will work in conjunction to provide a resilient shoreline in along this stretch that will also increase public access and critical habitats.

Beach nourishment is the process of adding sediment, typically sand, to a beach and the near-shore area to increase beach width. At King Park, successful beach nourishment would replace beach lost to erosion and protect against future beach loss. An increased beach width reduces risk to shoreline damage by increasing protection against wave action and water level changes.

Near-shore habitat restoration would focus on creating near shore wetlands in areas where the sand beach has completely eroded away, as well as reconstructing any lost dune systems. Similar to beaches, near-shore wetlands have been proven to reduce impacts to shorelines from wave action and water level changes by utilizing vegetation and sediments to provide natural attenuation of energy. In addition, the wetlands can provide a sediment sink, further decreasing shoreline erosion risk. A final key component of habitat restoration is an increase in native vegetation as well as habitat for waterfowl and aquatic life.



3.2.3 FEASIBILITY

3.2.3.1 ENGINEERING

Developing a cohesive solution to this stretch of shoreline will be important to achieving a resilient long-term design. While an engineering challenge, similar projects have been developed and completed on all the Great Lakes. When considering feasibility of solutions, beach nourishment and habitat are feasible and realistic solutions. These solutions have been applied across the Great Lakes, most recently on Lake Michigan at Waukegan, Illinois and Grand Haven, Michigan. Each solution, while not technically challenging, can provide a challenge in both cost and permitting. Design challenges will be focused on achieving project goals while minimizing construction cost, and meeting permit agency requirements. It will be critical to engage both Wisconsin Department of Natural Resources (WDNR) and United States Army Corps of Engineers (USACE) to develop a design which meets permit requirements.

3.2.3.2 FUNDING

State and Federal sources are available to provide funds or assistance through grants or services. Design and construction are anticipated to be in the range of \$2M to \$5M. Utilizing public funds may help provide an avenue to achieving not only a resilient shoreline but one which provides improved Great Lakes habitat and public access. During design the City should coordinate with WDNR and USACE to identify where both grants and other funds could be utilized to reduce the city's cost share.

3.2.3.3 SCHEDULE

Design, Permitting, and Grant funding activities are expected to take two years, and construction to take an additional one and a half to two years. That is a total of four years to complete the work on this site.



3.3 SITE THREE

BLUE HARBOR RESORT WATERFRONT

3.2.1 EXISTING CONDITIONS

The blue harbor resort resides on the lake Michigan shoreline at the mouth of the Sheboygan river. It was designed by Smith Group and constructed in 2000. Located on approximately 2,000 feet of shoreline, this site stretches from Illinois Avenue to the south breakwater as shown in Figure 4 to the right. At the south end of the site the shoreline is characterized by sand dunes and beach, and transitions to armor stone protected dunes toward the north. Areas of the existing rock revetment have failed resulting in dune erosion. It is likely that with high water and high waves the armor stone size was not large enough to provide protection.



NOTES

FIGURE 4

3.3.2 PROPOSED SOLUTIONS

The current revetment protecting the Blue Harbor Resort is no longer adequate in providing shoreline preservation in this region. Rock revetments readily absorb wave energy protecting the shoreline from erosion and storm damages. Currently, onshore damage is occurring, indicating the revetment is not working properly. A revetment with larger stones will provide more protection against the large storm waves that have been increasingly seen on the Great Lakes as the larger rocks can more readily absorb wave energy. Additionally, a redesign of the revetment will allow for protection against current conditions and increased toe and flank protection.

3.3.3 FEASIBILITY

3.3.3.1 ENGINEERING

Design and construction of the replacement revetment does not pose a significant technical challenge. Challenges will be in developing plans for reconstruction while minimizing impacts to infrastructure and the dune system. Permitting is also not expected to pose a challenge as the construction can be considered restoration of existing facilities.

3.3.3.2 FUNDING

Funding from outside sources is unlikely, therefore the city will probably be required to cover the entire cost of the project. While total cost of the revetment will be based on the length required for replacement, current estimates for revetment costs are \$1,300 per linear foot. If the entire 2,000 feet were replaced this would result in a total project cost greater than \$2.5 million. It is expected that during design, efforts will be made to reduce the areas requiring reconstruction and thus the total cost could be significantly less.

3.3.3.3 SCHEDULE

It is anticipated that design, permitting, and construction can all be completed within 2 years of project initiation.



3.4 SITE FOUR

SHEBOYGAN POINT

Sheboygan Point area has been identified as the stretch of shoreline from the north breakwater to Park Avenue shown in Figure 5 to the right.

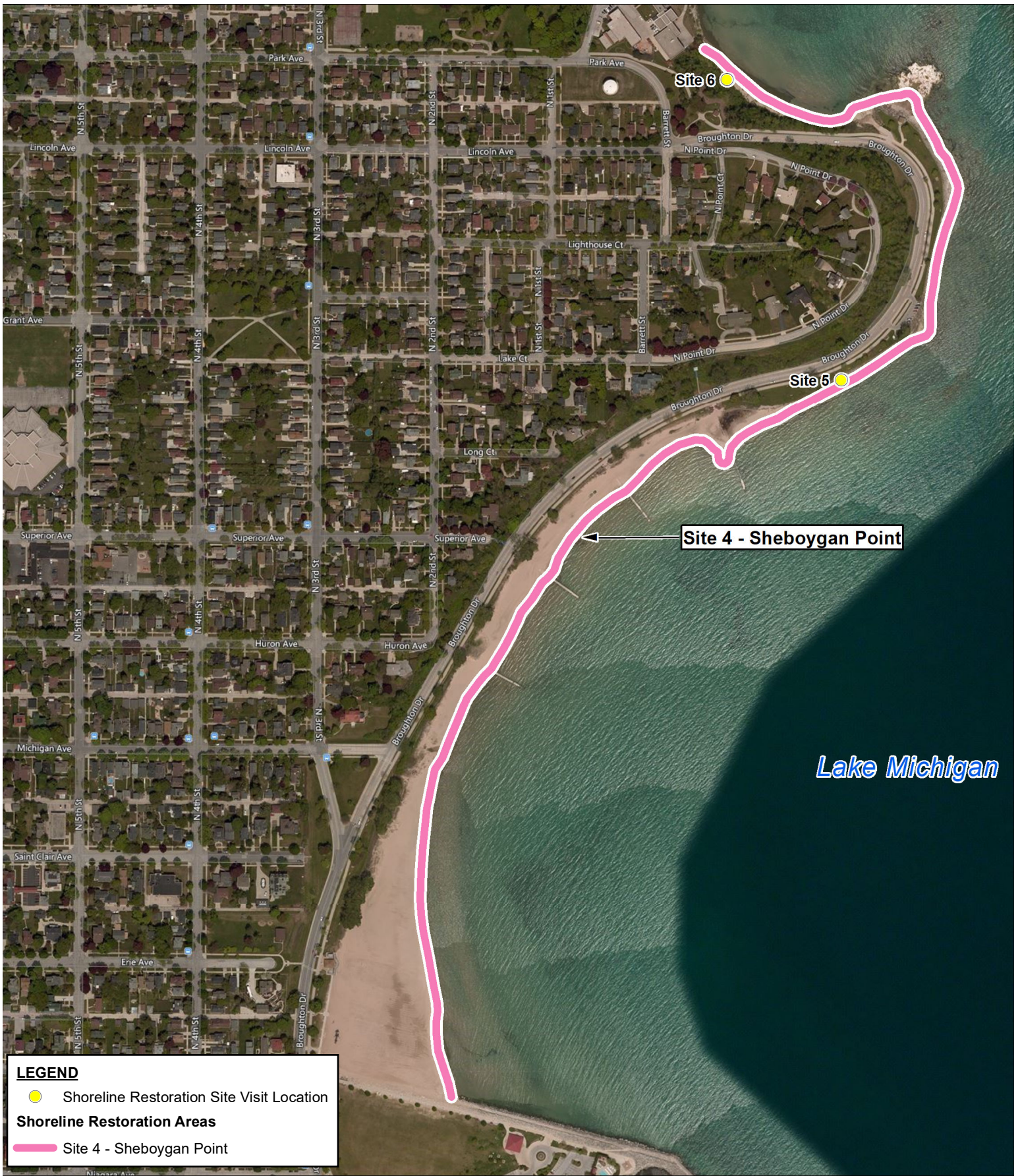


FIGURE 5

3.4.1 EXISTING CONDITIONS

The Sheboygan Point stretch of shoreline is characterized by sandy beaches which utilize various means of shoreline structures to provide protection. These structures include revetments of varied materials (concrete debris, armor stone rip-rap) and groins. The groins are located on the southern region of the point and act to help maintain some of the public beach by preventing longshore transport of sand. At the point itself, the shoreline is largely protected by a revetment which has been damaged due to longterm exposure to wave impacts. Sediment transport has been observed offshore of the point where shoals have formed.

3.4.2 PROPOSED SOLUTIONS

The failing shoreline structures are providing little shoreline protection while interfering with natural sediment movements. Groin rehab or removal will be an important factor in the solution to the current sediment transportation issue. Groins are used to restrict longshore sediment transport by capturing the sand transported down drift. Improper use of a groin interferes negatively with sediment transportation and creates an erosion problem downstream of the groin. The uneven beach width seen in this stretch of shoreline is a result of improper sediment transport from the groins. Beach nourishment will also likely be a critical aspect in remediating the sediment transportation issue. A study is needed to understand the details of this sediment transport problem. Solutions, including the details of the rehab or removal of the groins and beach nourishment, will follow this shoreline study.

Addressing the failing revetment is an important aspect of Sheboygan point shoreline protection. By rehabbing the revetment to meet current lake protection needs, the revetment could properly dissipate wave energy and protect the shoreline against further erosion. An alternative to revetment rehab is the removal of the failing structure in combination with beach nourishment. Removing the failing structure would allow for the use of the soft engineering technique to combat erosion. Beach nourishment would replace sediment and beach width that has been lost to erosion, moving the current shoreline seaward and providing increased dissipation of wave energy.

3.4.3 FEASIBILITY

3.4.3.1 ENGINEERING

As a total project, evaluation of sediment transport and long-term erosion processes will be critical to this project area. A study will need to be undertaken to better understand where and how sediment is transported, and the affects to which the groins play a role. This study should be completed before any one solution is identified.

Individually the revetment rehab or removal will need a carefully engineered design to ensure shoreline protection. A redesign will need to address the current protection shortcomings of the revetment evident by shoreline erosion. Beach nourishment considerations will vary in the southern and northern region of the point. In the southern region of the point, uneven beach widths have formed due to the use of groin structures. Beach nourishment could re-establish a more natural beach profile, and if combined with changes to groin layout, could restore natural littoral sand transport. In the northern region of Sheboygan point, beach nourishment could be employed to replace the areas where the revetment has been damaged. In all parts of Sheboygan point, the upkeep of beach nourishment needs to be considered. Beach nourishment requires continuous maintenance to replace sediment lost to storms and high lake levels to keep the extended beach width.

3.4.3.2 FUNDING

The first cost consideration is the study needed on the sediment transportation issue. This study is necessary to determine a course of action. Grants or other public dollars could be made available for studies of this nature and will reduce City costs. Further engagement of the USAGE may be a realistic path forward as the Federal breakwater is adjacent to the project area and may be a contributing factor. Beach nourishment will be part of the solution and grant acquisition will be important in the funding of this solution. Removal or rehab of the failing shoreline structures will be the highest costing aspect of the project. Details of the exact cost will depend on the determined course of action based on the initial study. It is unlikely that public funding will be available to directly replace failing revetments.

3.4.3.3 SCHEDULE

Gathering and analyzing data in the critical sediment transportation study will take about a year. After this study the next phases can begin. Design, permitting, and grant acquisition will take a year after a course of action is determined. Construction is dependent upon this course of action. Thus, it is likely that this project will stretch beyond two to three years. In a longer term, ongoing maintenance will be necessary to mitigate future erosion issues, especially if softer solutions are chosen for the project site.



3.5 SITE FIVE

NORTHERN BLUFFS

Site 5 is a stretch of shoreline stretching from Vollrath Boulevard to Pigeon River. It is the northern bluff region of the Sheboygan coastline. It includes many areas of concern for the city and its residents: 27 45 Highland Terrace, 3333 N 6th Street, the city outfall, 3619 N 6th Street, and 506 Grand Avenue. The approximate boundaries of the region can be seen in Figure 6 below.

3.5.1 EXISTING CONDITIONS

This shoreline region is marked by steep cliff slopes with a small beach at lake level. The bluffs are often vegetated, however as many homes back up to these bluffs, grass yards exist close to the bluff crest. Many of the residential houses are only yards back from the steep cliff edge. Typical to the Great Lakes, these bluffs face erosion issues from both the Lake but also from runoff on the top side. During high wave events, the toe of the bluffs can be exposed to wave action where it erodes and results in collapse of the bluff face. This is an ongoing problem. Further, due to the location of houses and other infrastructure on the top side of the bluff, precipitation drainage issues lead to gullying and other erosion mechanisms which increase the risk to the retreating bluff face.

3.5.2 PROPOSED SOLUTIONS

The northern bluff region of the Sheboygan coastline presents layers of problems, many with costly solutions. Immediate action is needed to protect the residential homes and improve bluff stability. Increased toe protection at the base of the bluff will prevent waves from undercutting the bluff and reduced sliding and erosion, consequently increasing slope stability. Horizontal drains will allow for better drainage. Improper drainage leaves a bluff more susceptible to erosion, so installing horizontal drains will help protect the bluffs and nearby residential homes. Beach nourishment will also help protect the bluffs as an increases beach width will dissipate the wave energy that can reach the bluffs. These solutions will all increase bluff stability immediately but provide reduced long-term protection. The bluffs are a highly sensitive stretch of coastline that need extensive hard engineering solutions for any long-term protection. These solutions will be costly and will require artificially reconstructing the bluffs to have a slope that provides more stability and extensive shoreline protection structures.

3.5.3 FEASIBILITY

3.5.3.1 ENGINEERING

The soft engineering solutions above as well as reducing residential construction near the bluffs are feasible solutions to the immediate issues facing the northern bluff region. The solutions that would provide long term protection against increasingly damaging lake conditions are less feasible. Many of these solutions are not allowed under current permitting regulations that limit lake Michigan shoreline protection structures. Continuous upkeep of bluff drainage, beach nourishment and toe protection will extend the life of the bluffs and slow erosion, without the need for extensive hard engineering solutions. Protecting the bluffs will be a continuous process and will require reevaluation of methods frequently.

3.5.3.2 FUNDING

Due to the significant size and cost of protecting a large portion of the city's shoreline, funding avenues for all sources should be investigated. Depending on desired solutions to protect the bluffs, it is likely that a combination of public grants, tax levy's where applicable, and city funds will be utilized. Significant investment should be made into better understanding the impacts to this stretch of shoreline and identifying where shoreline processes are a driver, and where other processes such as drainage issues are drivers.

3.5.3.3 SCHEDULE

The ongoing nature of the solutions required for this region of the Sheboygan coastline means this project does not have a clear schedule. A detailed study should first be completed to evaluate the entirety of this stretch. Bluff retreat is not just a localized problem. It is anticipated that addressing all concerns along this shoreline is something that will take years, if not decades, to accomplish.



OUR MISSION

**IMPROVE THE QUALITY OF LIFE
BY EFFECTIVELY DEVELOPING,
MAINTAINING, AND IMPROVING
THE INFRASTRUCTURE,
NATURAL RESOURCES, AND
COMMUNITY SERVICES.**

4

RECOMMENDATIONS

4.1 SITE RECOMMENDATIONS

Based on the findings of this shoreline management report, the Sheboygan shoreline is in need of advanced restoration and resilient solutions that protect the shoreline. Recommendations for each side are noted to the right.

4.2 PRIORITIZATION

In prioritizing sites Foth has focused on Areas 2-5, as Area 1 is already under final design for construction. The preliminary priority for design and implementation is as follows:



HIGHEST PRIORITY

- North Bluffs: The North Bluffs area is one of the highest priorities due to the potential risk to public infrastructure and private residences. In addition, the long duration aspects of addressing issues along this stretch of shoreline mean that it is in the best of interest to start the engineering work as soon as possible such that any immediate risks could be mitigated. Further this would allow the city to develop the long-term funding plan for implementation.
- Blue Harbor Shoreline: The Blue Harbor Shoreline is actively failing and exposing habitat and trails to increased damage risk. Mitigating future erosion will reduce long term implementation costs. It is expected that during design the limits of the revetment restoration can be minimized to minimize the total project cost.
- King Park Beach: Although Lake Michigan water levels have receded, the damage has been done to the King Park Beach area. In addition to restoring the public beach, this project has a higher priority due to the potential impacts to city residents on the southern end. Given the 2-4 year implementation timeline, this project is a key candidate for starting engineering and funding work now.



MEDIUM PRIORITY

- Sheboygan Point: While the revetment at Sheboygan Point has been damaged in recent years, the reduction in Lake Michigan water levels has bought some time for action. Similar to the North Bluffs area, a study designed to better understand the details of the sediment conditions in this area should be the next step.



1 LAKE VIEW PARK

- An armor stone revetment is necessary for protection. Design of this structure is being completed under a separate project with the city.
- It is anticipated that this work will be completed in 2022/2023.
- For further details regarding the project see "2459-21" (Foth 2021).

2 KING PARK

- A combination of beach nourishment and habitat restoration to increase beach width, dissipate wave energy and combat erosion.
- Funding to come from both the city and grant acquisition.

3 BLUE HARBOR RESORT

- Restore current revetment to protect against rising lake levels and increase wave energy
- City will pay for the project in full as grants are limited and should be left to projects with higher grant funding potential.

4 SHEBOYGAN POINT

- Complete a sediment transportation study to understand the issue and determine a course of action to address the sediment transportation effecting the southern portion of Sheboygan Point.
- Use study to determine if the failing groins and stone armor revetment need to be removed or rehabilitated.
- Utilize beach nourishment to restore even beach width across the region, combat erosion and dissipate wave energy.
- Apply and acquire grants for sediment transportation study. Funds for solution will depend on results of the study.

5 NORTH BLUFFS PARK

- Immediate action is needed to protect the residential homes and improve bluff stability.
- A combination of increased toe protection, beach nourishment and drainpipes will combat erosion and increase bluff stability.
- Funding to come from both the city and grant acquisition.
- Bluffs will require extensive upkeep to prevent major erosion.

An aerial photograph showing a rocky shoreline on the left, a paved path and green lawn in the middle, and a park area with trees and a playground on the right. The water is visible on the far left.

OUR GOALS

PROVIDE QUALITY INFRASTRUCTURE

PROVIDE CLEAN AND BEAUTIFUL PUBLIC SPACES THAT MAXIMIZE THE NATURAL ENVIRONMENT TO ENHANCE THE OVERALL QUALITY OF LIFE.

4.3 IMPLEMENTATION

Discussion with the city will determine a general schedule for implementation of the recommended projects.

4.4 FUNDING SOURCES

The matrix in appendix E presents state and federal programs that may be appropriate funding mechanisms for the City of Sheboygan's shoreline restoration project. The grants and loans were identified based on the nature of the project and the goals and requirements of each program. A targeted funding strategy can be developed as the project(s) progress.

Although not included in this matrix, emerging trends suggest governments are attempting to use increased infrastructure spending as a tactic for economic stimulus; additional dollars may become available in the near term and will be appropriately vetted for this project. If Covid-19 or infrastructure stimulus funding provides possible funding for this project, Foth will immediately consult with the City of Sheboygan regarding the potential opportunity.

If the dollars in each of these programs can be leveraged with each other or with other stakeholder funds, they can generate an even more profound impact on the restoration project and the City of Sheboygan.

4.5 AGENCY COORDINATION

Working with different engineering and governing agencies will be required for successful implementation of all 5 restoration projects. These agencies include:



**United States Army
Corps of Engineers
(USACE)**



**Wisconsin Department
of Natural Resources
(WDNR)**



**Environmental
Protection Agency
(EPA)**

Working in tangent with these organizations will allow for smooth permit and natural material acquisition. USACE provides vast experience in beach nourishment, having successfully completed many nourishment and re-nourishment projects. Collaborating with the USACE provides expertise as well as sandy material acquisition as they have unparalleled access to dredging materials. Working with the WDNR and EPA will help ease the extensive permitting process required for the completion of the vast shoreline restoration projects.



5

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REFERENCES AND RESOURCES

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APPENDIX

A

SITE VISIT
PHOTOGRAPHY LOG

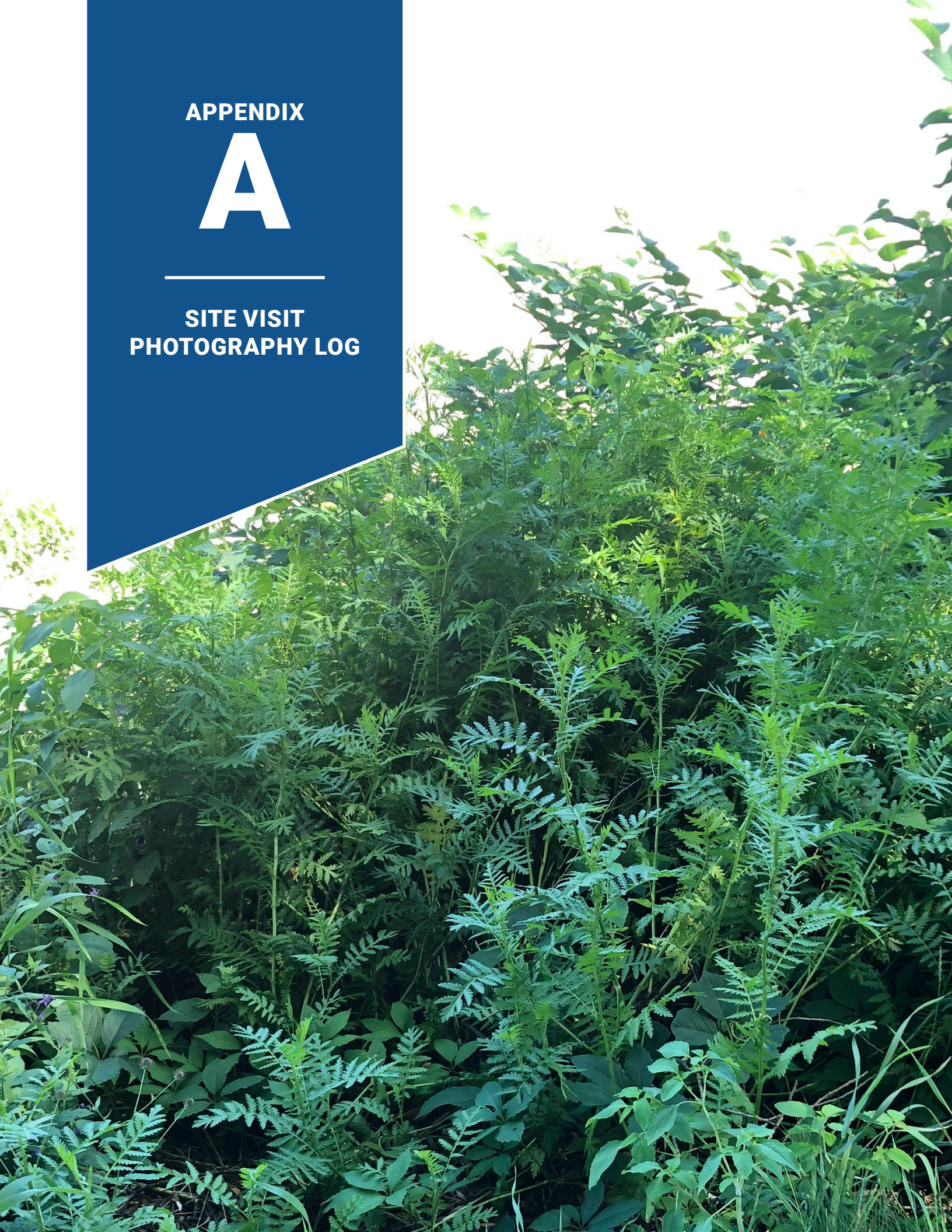




Photo No.
1.1

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KCKC

Description:
Lake View Park
Exposed Outfall
Manhole Cover



Photo No.
1.2

Date:
7/16/20

Direction Photo Taken:
N/A

Photo Taken By:
KC

Description:
Lake View Park
Sinkhole Adjacent to
Outfall Pipe



Photo No.
1.3

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KC

Description:
Lake View Park
Typical Shoreline in
need of repair



Photo No.
1.4

Date:
7/16/20

Direction Photo Taken:
N/A

Photo Taken By:
KC

Description:
Lake View Park
Path to Site



Photo No.
2.1

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KC

Description:
King Park
Exposed Outfall Pipe
and Man Hole



Photo No.
2.2

Date:
7/16/20

Direction Photo Taken:
South

Photo Taken By:
KC

Description:
King Park
Shoreline South of
Exposed Outfall Pipe



Photo No.
2.3

Date:
7/16/20

Direction Photo Taken:
Northeast

Photo Taken By:
KC

Description:
King Park
Shoreline North of
Exposed Outfall Pipe



Photo No.
2.4

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KC

Description:
King Park
Site View from Inland



Photo No.
3.1

Date:
7/16/20

Direction Photo Taken:
Southwest

Photo Taken By:
KC

Description:
Blue Harbor
Shoreline Damage



Photo No.
3.2

Date:
7/16/20

Direction Photo

Taken:
N/A

Photo Taken By:
KC

Description:
Blue Harbor
Shoreline Damage
Area 2



Photo No.
3.3

Date:
7/16/20

Direction Photo Taken:
Northeast

Photo Taken By:
KC

Description:
Blue Harbor
Typical Revetment
North of Area 1



Photo No.
3.4

Date:
7/16/20

Direction Photo Taken:
Northeast

Photo Taken By:
KC

Description:
Blue Harbor
Site View from Inland



Photo No.
4.1

Date:
7/16/20

Direction Photo Taken:
Southwest

Photo Taken By:
KC

Description:
Shbg. Point
Typical Shoreline at
Point South



Photo No.
4.2

Date:
7/16/20

Direction Photo Taken:
N/A

Photo Taken By:
KC

Description:
Shbg. Point
Typical



Photo No.
4.3

Date:
7/16/20

Direction Photo Taken:
Northeast

Photo Taken By:
KC

Description:
Shbg. Point
Typical Shoreline at
Point North



Photo No.
5.1

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at
2745 Highland Terrace



Photo No.
5.2

Date:
7/16/20

Direction Photo Taken:
Southeast

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at
2745 Highland Terrace



Photo No.
5.3

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at
3333 N 6th Street



Photo No.
5.4

Date:
7/16/20

Direction Photo Taken:
Northwest

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at
3333 N 6th Street



Photo No.
5.5

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at city
outfall



Photo No.
5.6

Date:
7/16/20
Direction Photo

Taken:
East

Photo Taken By:
KC

Description:
Northern Bluffs
Path to city outfall



Photo No.
5.7

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at



Photo No.
5.8

Date:
7/16/20

Direction Photo Taken:
Southeast

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at
3619 N 6th St. Srg



Photo No.
5.9

Date:
7/16/20

Direction Photo Taken:
Northwest

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at
3619 N 6th St. Srg



Photo No.
5.10

Date:
7/16/20

Direction Photo Taken:
East

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at
506 Grand Ave



Photo No.
5.11

Date:
7/16/20

Direction Photo Taken:
Northwest

Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline at
506 Grand Ave



Photo No.
5.12

Date:
7/16/20

Direction Photo Taken:
Southeast

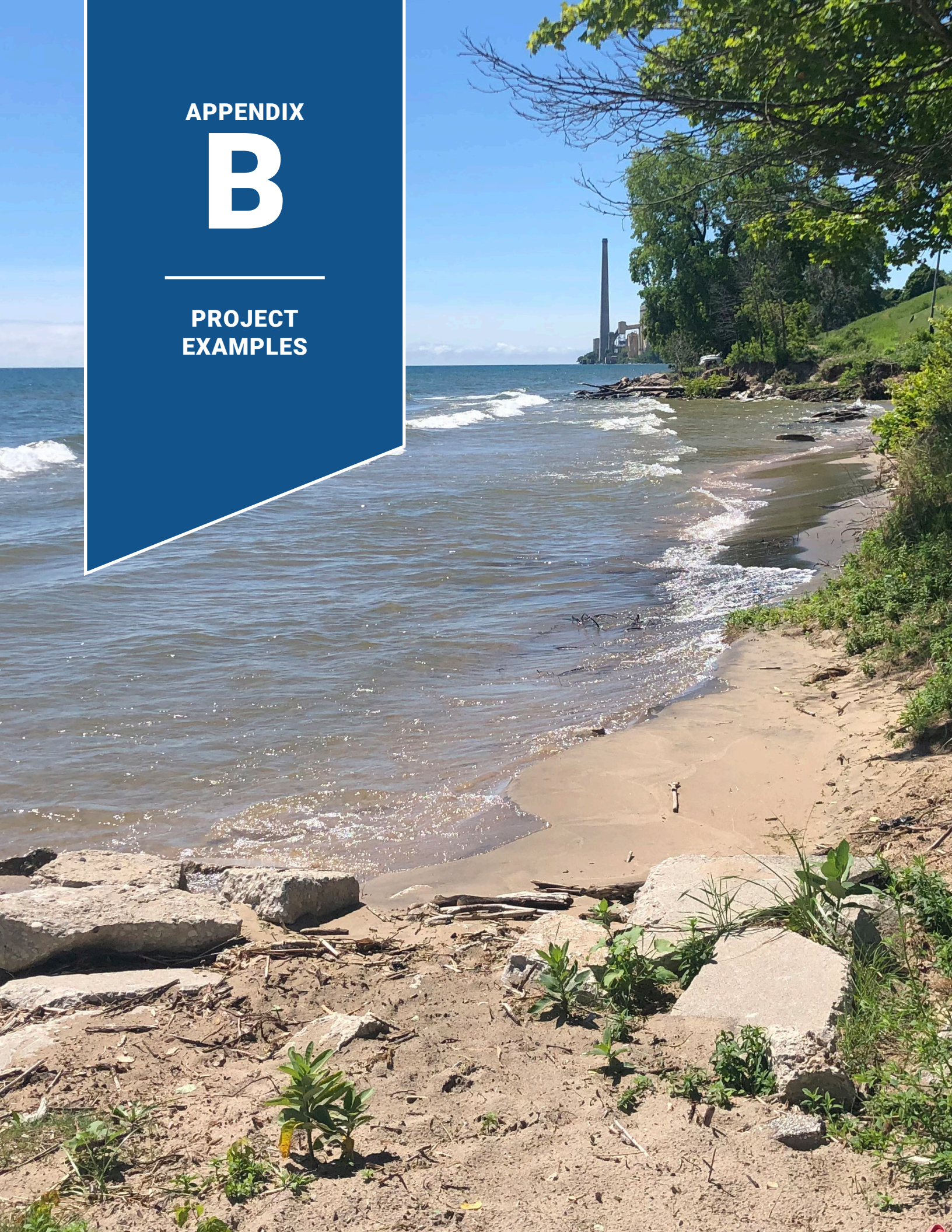
Photo Taken By:
KC

Description:
Northern Bluffs
Typical Shoreline Slope
at 506 Grand Ave

APPENDIX

B

PROJECT
EXAMPLES





GRAND HAVEN BEACH STATE PARK

GRAND HAVEN, MI

In 2020 the U.S. Army Corps of Engineers replenished sand along the Lake Michigan coast of Grand Haven, Michigan. The process added over 200,000 square feet of sand, nearly doubling the size of the beach. Erosion due to high-water levels, evolving wave climate and storm surges left Grand Haven beach with only 100 feet of beach between the park's campsite and the waterline. This beach nourishment project replaced beach lost while protecting the parks infrastructure from the effects of erosion. It is an ongoing project , with plans for yearly re-nourishment.



BEACH NOURISHMENT



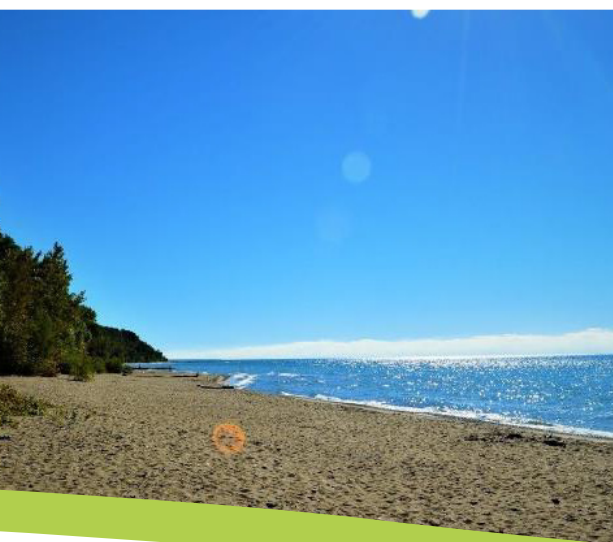
HENNEPIN MARSH

MI

The Hennepin Marsh borders the shoreline of Grosse Ile in the Trenton Channel and connects to Lake Michigan. The Friends of the Detroit River awarded over \$4 million for the restoration of the marsh. The project began mid 2021 after the completion of a feasibility study. The project site encompasses approximately 25 acres of island shoals and emergent wetlands. The current, wave, and ice actions of the Channel have eroded the island shoals and damaged the surrounding wetlands. A variety of engineering methods are being used to restore the site and protect the islands from future erosion. This process includes placement of heavy stone and native plant materials to stabilize eroded wetland areas. As well as habitat improvements, including habitat logs, mudpuppy structures and re-establishment of native vegetation. These habitation restoration techniques have been successfully implemented along the Detroit River. By restoring the natural wetland, wave energy is dissipated before meeting the shore and future erosion is mitigated. Additionally, native plantings and branched trees combined with strategically placed stone will enhance habitat for wetland organisms.



HABITAT RESTORATION



GRANT PARK

MILWAUKEE, WI

Grant Park borders Lake Michigan along the Milwaukee shoreline. It includes both sandy beaches and vegetation covered bluffs. In 2007 a heavy rainstorm triggered multiple mudslides along the Grant Park shoreline; both trees and mud slide down the bluffs and into the lake. In response the city authorized a \$10 million project to promote better drainage along the bluffs. The project spanned 2,800 feet across the shoreline. Drains were built into the stretch of bluffs to collect and redirect water away from the bluff to drastically increase bluff stability. Additionally, wetland creation, switchback construction and shoreline revetments were used to reduce wave energy and protect the base of the bluffs from storm surges, wave action and rising lake levels.



BLUFF PROTECTION



HABITAT RESOTRATION



2015
Rosewood Beach
Swimming and Nature Coves



2019
Rosewood Beach
Swimming and Nature Coves



HENNEPIN MARSH

MI

Rosewood beach sites along the Lake Michigan coast in Illinois. Rising lake levels have eroded the beach in recent years and the shore has receded approximately 55 feet, limiting its recreational use. Working with SmithGroup, the city approved a large-scale beach nourishment project. This is an ongoing project with frequent re-nourishment that began in October 2019. In the first phase of beach nourishment, sand from an Illinois quarry was brought in to expand the shoreline 40 feet and help mitigate against future erosion. This process will repeat yearly to ensure the shoreline does not recede further and the structures along the shoreline are protected.

APPENDIX

C

GRANT MATRIX



FEMA: HMA - BRIC

Mitigation project; goal is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding in future disasters.

Application Due: January Grant/Match Cost Share: 75/25 Maximum Request: Varies by category

Notes: Apply as sub-applicant thru state

WEDC: COMMUNITY DEVELOPMENT INVESTMENT

Redevelopment efforts by providing financial incentives for shovel-ready projects with emphasis on, but not limited to, downtown community-driven efforts; infrastructure efforts, including disaster prevention measures, providing substantial benefits to downtown residents/property owner; lead to measurable benefits in job opportunities, property values and/or leveraged investment by local and private partners.

Grant/Match Cost Share: Check with Account Manager Maximum Request: \$250,000

Notes: Work with Account Manager

US HUD (THRU WDOA): CDBG PF

Support infrastructure and facility projects for communities.

Application Due: May Grant/Match Cost Share: 50/50 Maximum Request: \$1M

Notes: Must meet a CDBG National Objective: 1) benefit to low and moderate income (LMI) persons; 2) prevent/eliminate slum or blight; 3) urgent need

WNDR: STEWARDSHIP

Several programs preserving important natural communities, protect water quality and fisheries, and expand opportunities for outdoor recreation.

Application Due: May Grant/Match Cost Share: 50/50 Maximum Request: Varies by program

NOAA (THRU WDOA): COASTAL MANAGEMENT

Supports the management, protection and restoration of Wisconsin's coastal resources, and increases public access to the Great Lakes.

Application Due: November Grant/Match Cost Share: 40/60; 50/50 Maximum Request: Contact Program if >\$100,000

BCPL: BOARD OF COMMISSIONER OF PUBLIC LANDS LOAN PROGRAM

Summary: Loans to municipalities & school districts for public purpose projects including economic development, local infrastructure, capital equipment and vehicles, building repairs and improvements, and refinancing; there are General Obligations Loans and Revenue Obligation Loans.

Specific Requirements/Terms: Offers fixed rate loans with interest rates that are competitive with the bond market and other financial institutions; there are no application fees, prepayment penalties, or other fees.

Availability: Funds available 30-60 days from initial application.

Security/Underwriting: G.O. borrower, requires borrower to levy a tax sufficient to make principal and interest payments when due R.O. are secured by a pledge and assignment of revenues generated by specific project.

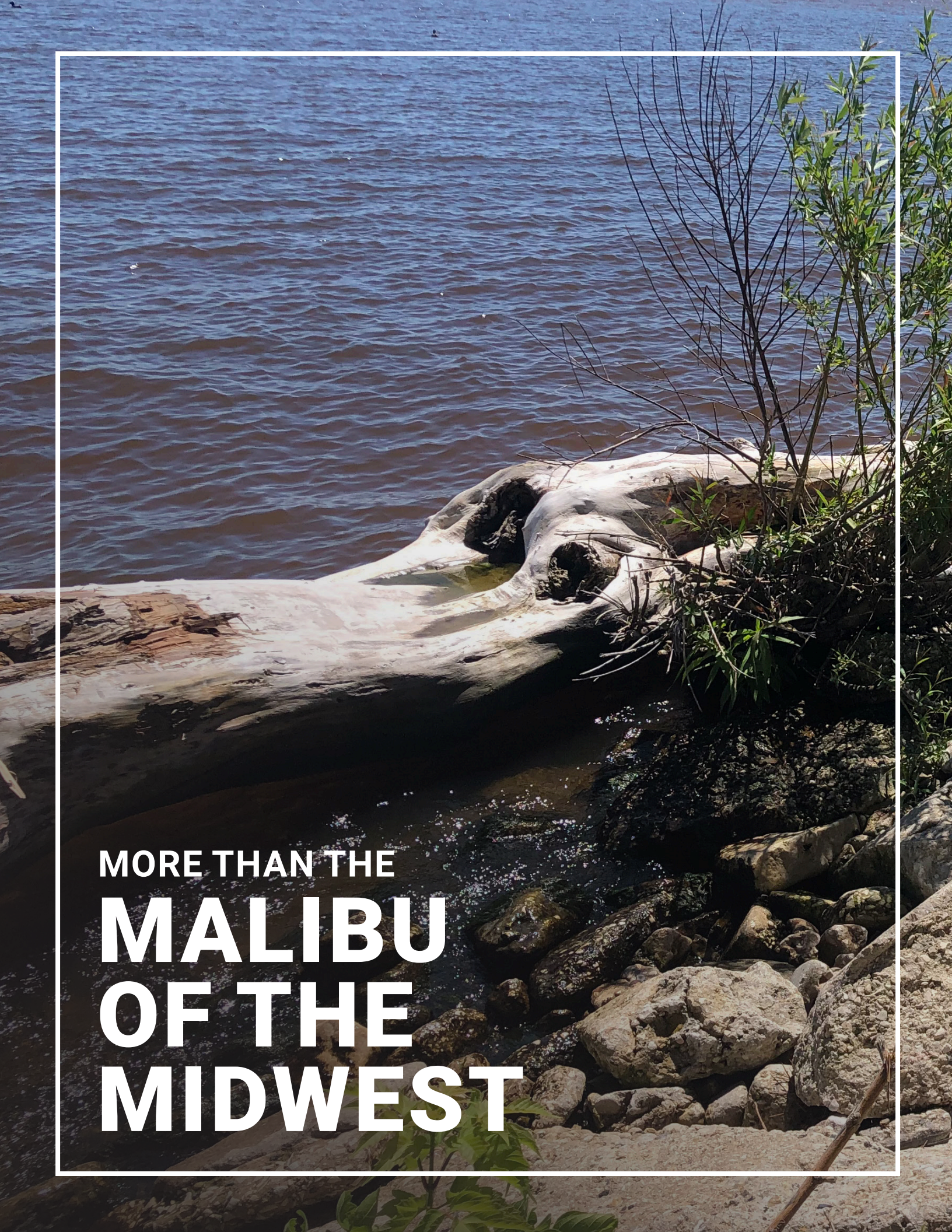
Notes: *Submit worksheet to BCPL, application mailed to requestor; work with program staff.*

USEPA: WATER INFRASTRUCTURE FINANCE AND INNOVATION ACT (WIFIA)

Summary: Accelerates investment in our nation’s water infrastructure by providing long-term, low-cost supplemental loans for regionally and nationally significant projects; works with clean Water State Revolving Fund; \$5M to 20M (min loans).

Specific Requirements/Terms: Up to 35 yrs.; fund up to 49% of eligible project costs; NEPA, Davis-Bacon, etc.

Security/Underwriting: Application fee, credit processing fee, servicing fee (credited toward final payment for successful applicants).

A photograph of a large piece of bleached driftwood on a rocky shore next to a body of water. The driftwood is light-colored and has several holes and a hollowed-out section. It is surrounded by dark, wet rocks and some green vegetation. The water is a deep blue color with ripples. The scene is captured from a slightly elevated angle, looking down at the driftwood and the rocks.

MORE THAN THE
MALIBU
OF THE
MIDWEST



WISCONSIN COASTAL MANAGEMENT PROGRAM



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