Illinois Department of Natural Resources, Office of Water Resources

Public Notice

Proposed Shoreline Protection System in Lake Michigan at The Northwestern University Sailing Center, Evanston, IL 60208.

Northwestern University, 2020 Ridge Avenue, Suite 250, Evanston, IL 60208 has applied for an Illinois Department of Natural Resources, Office of Water Resources permit for repairs to the sailing center and beach nourishment in Lake Michigan at 1823 Campus Drive, Evanston, IL 60208.

The applicant’s current shore protection consists of two revetment structures, a jetty structure, a steel sheet pile wall, and a steel sheet pile bulkhead. The applicant proposes to extend an existing jetty structure, construct a new stepped concrete structure, a sheet pile wall, and provide beach nourishment. The existing jetty structure is proposed to be extended by 125ft. The proposed jetty extension will have a crest elevation of 588.15 ft tapering down to 586 ft at the lakeward end. An existing revetment located close to the southern property line will be removed and replaced with a 178 ft. long concrete stepped structure. The concrete structure will have a crest elevation of approximately 586 ft. A 120 ft and 7 in long steel sheet pile wall will be constructed along the concrete stepped structure. The crest elevation of the sheet pile wall will be approximately 582 ft. A minimum of 4720 cubic yards of clean sand will be placed as premitigational fill. All elevations are in International Great Lakes Datum – 1985 adjusted. The proposed project will be reviewed using the Department’s Part 3704 Rules. A location map and plans are attached to this notice.

No work is to start on this project unless and until such a time that the permit is issued.

Plans for the work may be seen at the Office of Water Resources, Chicago Office, 100 W. Randolph Street 15th floor, Chicago, Illinois 60601. Inquiries and requests to review the plans may be directed to James Kessen of the Chicago Office at (312) 793-0990 or james.kessen@illinois.gov. An expanded version of the public notice can be viewed at http://www.dnr.illinois.gov/WaterResources/Pages/PublicNotices.aspx. You are invited to send comments regarding the work to the Chicago Office by July 29, 2022.

June 30, 2022
Northwestern University - Sailing Center Repairs

Permit Application Document

April 14 2022   |   13485.501.R1.Rev0
Northwestern University - Sailing Center Repairs
Permit Application Document

Prepared for: Northwestern University
633 Clark Street
Evanston, IL 60208

Prepared by: W.F. Baird & Associates Ltd.
For further information, please contact
Rory Agnew
www.baird.com

13485.501.R1.Rev0

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Executive Summary

The information presented in this document is provided as supplemental material in support of a completed Joint Permit Application (JPA) for shoreline protection improvements being proposed to the Northwestern University (NU) Evanston campus Lake Michigan shoreline.

The project site is in Evanston, Illinois, at the south end of the NU campus shoreline, adjacent to the City of Evanston (CoE) Clark Street Beach. A plan of the existing conditions is shown in Figure ES.1. A series of design alternatives were developed to improve shoreline protection and minimize damage to existing shoreline infrastructure, namely NU’s Sailing Center building, which experienced wave-induced damage and structural undermining during the recent period of high lake levels.

Numerical modeling, coastal analysis and engineering were conducted to evaluate existing and proposed conditions, and included the following key tasks:

- Defining site conditions;
- Defining metocean conditions (water levels, waves, ice);
- Assessing coastal processes (long-shore and cross-shore sediment transport);
- Assessing potential project impacts on the coastal processes and adjacent properties;
- Evaluating design alternatives and identifying a Preferred Alternative; and
- Developing recommendations for future project monitoring and maintenance plan.

The overall objective of this project is to replace temporary emergency shoreline protection measures with features that will help stabilize the shoreline, enhance protection, and mitigate the need for future shoreline-related repairs to the Sailing Center building. Individual element improvements to accomplish the overall project objective include:

- Extending an existing jetty structure to the south to improve wave sheltering and beach stability;
- Reconstructing the lake-side Sailing Center shoreline protection to make this structure more robust; and
- Importing sand to nourish the existing beach to increase beach width adjacent to the Sailing Center building.

An alternative analysis was completed for this project, from which a Preferred Alternative was identified as providing the best combination of performance, functional requirements, and NU preference. Implementation of the Preferred Alternative will accomplish the goal of improving shoreline protection and minimizing damage to the Sailing Center building while maintaining a similar aesthetic to the surrounding existing site features and character.

The Preferred Alternative is presented in Figure ES.2 and consists of the following key features:

- Extending the existing jetty structure 125 lineal feet (LF) to the south to improve wave sheltering and beach stability;
- Removing temporary emergency revetment repairs and reconstructing the lake-side Sailing Center protection with steel sheeting and concrete to make this structure more robust and permeant; and
- Importing 5,314 cubic yards (yds³) of sand, of which 886 yds³ is for the required 20% overfill volume, to prefill the beach cell/increase beach width adjacent to the Sailing Center building. Sand fill will be sourced from a local approved quarry and material used for prefilling the beach cells will be clean sand with < 20% fines (material passing a #230 U.S. sieve).
Figure ES.1: Plan of Existing Conditions
Figure ES.2: Plan of Preferred Alternative
An assessment of potential project impacts on coastal processes and adjacent properties, and a project monitoring plan was developed for the Preferred Alternative. This report also provides information on the topics below to facilitate public and agency review of the proposed work.

**Threatened or Endangered Species**
- Federal-listed species in Cook County - Preliminary effects determination on the identified species is “No Effect” because suitable habitat is not present; however, after subsequent discussion with regulatory agencies, the USACE advised that Piping plover may transiently stop over at the beach during the nesting period between April 1 and August 31. Construction activities will adhere to any required window of limitation to avoid any negative impact on the habitat of the species listed.
- State-listed species - The EcoCAT consultation identified three threatened (Ground Juniper, Marram Grass, and Sea Rocket) and one endangered (Seaside Spurge) terrestrial plant species that have been documented in the vicinity. As there are no aquatic plants listed and any terrestrial plants plan to be flagged and avoided, the project is not expected to negatively impact the habitat of the species listed.
- Wetland Delineation – A delineation report was prepared for this project and no wetland was identified on the project site; however, Lake Michigan was identified as a Waters of the US (WOUS). The approved jurisdictional determination by the USACE (LRC-2021-00160) confirms this finding.

**Historical Properties**
- After consulting the Historic and Architectural Resources Geographic Information System (HARGIS), the project has no potential to affect historic properties, as defined by the National Register of Historic Places. In addition, after consulting the Historic and Architectural Resources Geographic Information System (HARGIS), it appears that there are no significant cultural resources or landforms within the project area. It is noted that the southern boundary of the project site abuts the Evanston Lakeshore Historic District (HARGIS number 200379; NRHP reference number 80001353), but the project site is not within this historic district.

**Soil Erosion and Sedimentation Control Measures**
- A specific Soil Erosion and Sedimentation Plan has been developed for the project. Soil erosion and sedimentation control measures include the use of silt fences around the site, and potentially the use of a turbidity barrier when placing beach nourishment; however, maintaining a turbidity barrier throughout the duration of the project may be problematic due to potential damage from wave energy.
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1. **Introduction**

The information presented in this document is provided as supplemental material in support of a completed Joint Permit Application (JPA) for shoreline protection improvements being proposed to the Northwestern University (NU) Evanston campus Lake Michigan shoreline.

Below is a summary of information provided within each section of this document:
- Section 2: Project Narrative (narrative for JPA form Blocks 8-13)
- Section 3: Alternative Analysis Process
- Section 4: Assessment of Potential Shoreline Impacts and Beach Maintenance Requirements
- Section 5: Recommendations for Monitoring Program
- Section 6: Additional Information (threatened or endangered species, wetland delineation, historic properties, soil erosion and sedimentation control measures)

In addition, the following is included with this document, as appendices:
- Appendix A: Completed JPA form
- Appendix B: Permit Application Drawing Set
- Appendix C: Wetland Delineation
- Appendix D: IDNR EcoCAT Review Results

A pre-application meeting with representatives from the United States Army Corps of Engineers (USACE), Illinois Department of Natural Resources (IDNR), and Illinois Environmental Protection Agency (IEPA) was held on March 2, 2022. The proposed project and Preferred Alternative were presented during this pre-application meeting to gather information and feedback from regulatory agencies regarding the permit application process and required permits. The USACE indicated that the proposed work would likely qualify for a Lake Michigan Regional General Permit (LMRGP), and the IDNR indicated that an Individual permit would be required for this project, thus the material provided within this document has been organized to satisfy the requirements for said permits.
2. Project Narrative

As noted, a completed JPA form for the proposed improvements is attached to this document (Appendix A). Refer to the completed JPA form for Blocks 1-7. Information provided herein has been organized to supplement JPA form Blocks 8-13.

2.1 Block 8: Project Description

The Northwestern University (NU) campus is located along the shores of Lake Michigan in Evanston, Illinois. The objective of this project is to improve shoreline protection for the southernmost area of the NU campus, as shown in Figure 2.1.

![Figure 2.1: Project Location](image)

The project area currently consists of an existing southerly oriented steel sheet pile jetty structure that was constructed in the 1960s. An ad-hoc riprap shoreline revetment extends west for approximately 200 lineal feet (LF) between the existing jetty and the NU Sailing Center building, fronting a lakefront trailway and upland lawn area. From there, the ad-hoc riprap revetment continues in a southwesterly direction along the lake-side edge of the Sailing Center building until it terminates into an existing beach area. A portion of shoreline protection adjacent to the Sailing Center building also includes a stepped concrete structure, some of which is founded upon a buried steel sheet pile wall. An overview plan of the existing conditions for the project area is shown in Figure 2.2.
Figure 2.2: Overview Plan (Existing Conditions)
The Sailing Center building was subject to wave-induced damage during the recent period of high lake levels. Damages included undermining and collapsing of a concrete structure adjacent to the building. This required the construction of temporary emergency repairs in 2020, which included repairing/ extending the riprap revetment structure and the placement of TrapBags along the lake-side edge of the building. The existing concrete structure that failed was replaced with temporary synthetic decking material. Of note, the existing concrete structure adjacent to the building that failed from wave-induced damage was not founded upon a buried steel sheet pile (ssp) wall, whereas the concrete structure that did not fail was supported by ssp. The image below shows the damages (left) and temporary emergency repairs (right) that were installed in 2020.

![Figure 2.3: Recent Sailing Center Building Damage (Left) and Temporary Emergency Repairs (Right)](image)

The overall objective of this project is to improve shoreline protection for this area of the NU campus and provide long-term protection for the Sailing Center building. Individual element improvements to accomplish the overall project objective include:

1. Extending the existing jetty structure 125 ft to the south to improve wave sheltering and beach stability;
2. Removing temporary emergency repairs and reconstructing the lake-side Sailing Center protection to make this structure more robust and permeant; and
3. Importing sand to nourish the beach to increase beach width adjacent to the Sailing Center building.

An overview plan of the proposed shoreline conditions is shown in Figure 2.4. The purpose and need of the project/ individual element improvements is provided in the following section of this document.
2.2 Block 9: Project Purpose and Need

The overall objective of this project is to improve the shoreline protection system adjacent to the NU Sailing Center building by replacing temporary emergency repairs with more robust, long-term solutions. As shown in Figure 2.4, proposed improvements include:

1. Beach Control Structure;
2. Beach Nourishment; and
3. Sailing Center Protection.

The purpose and need for these elements are discussed below.

Beach Control Structure:

The proposed 125 LF southerly extension of the existing jetty structure will serve as a beach control structure, allowing for increased shoreline protection in the form of an expanded beach adjacent to the existing Sailing Center building. The existing shoreline at the NU Sailing Center and Clark Street Beach exhibits characteristics of what is known as an equilibrium or crenulate bay shape. Hsu and Evans calculations were conducted to determine the change in shoreline position resulting from extending the existing promenade 125 LF further south. From this analysis it was determined that a 125 LF extension, in combination with the placement of imported sand material (beach nourishment) along NU’s shoreline west of the proposed extension, would provide additional beach width to improve shoreline protection for the Sailing Center building during high lake levels. Refer to Section 3 of this document for additional information regarding the coastal engineering analysis (Hsu and Evans calculations) undertaken for the design of the proposed beach control structure.

Beach Nourishment:

During periods of high lake levels, the existing beach area adjacent to the Sailing Center building is completely inundated, as shown in Figure 2.5, which was taken on December 18, 2020. For reference, the Lake Michigan water level on December 18, 2020 was approximately +581.3 ft, IGLD85 (Sta. 9087044, Calumet Harbor, IL). Nourishing the existing beach area with the placement of imported sand material will provide additional shoreline protection to the Sailing Center building from wave induced damage by increasing the distance from the lake-side building edge to the Lake Michigan shoreline. For this to be an effective shoreline protection solution, the proposed 125 LF southerly extension of the existing jetty structure is also required to contain/stabilize the proposed beach nourishment. Without the jetty extension (i.e., beach control structure) the proposed beach nourishment would quickly erode and the beach configuration would generally remain as-is.
Sailing Center Protection:

Proposed structural improvements adjacent to the Sailing Center building include removing the existing ad-hoc revetment and temporary emergency repairs (i.e., TrapBags) to construct a more robust stepped concrete structure. The stepped concrete structure will be founded on a new buried ssp wall, similar to the buried ssp wall that currently exists. The existing riprap stone that is removed will be salvaged and placed along the ssp wall, below the proposed beach nourishment, to provide additional support and scour protection (as shown in Figure 2.6). Additional salvaged riprap stone will be utilized to improve the ad-hoc revetment located between the existing jetty and Sailing Center building and placed along the eastern edge of the proposed beach control structure.

The crest elevation of the proposed Sailing Center protection is set to match the finished floor elevation of the Sailing Center building (+586 ft, IGLD85); therefore, the additional protection and sheltering provided by the other proposed improvements (i.e., proposed beach nourishment placement and beach control structure) are crucial aspects of the proposed shoreline protection system. The additional beach width adjacent to the building will help reduce wave run-up and minimize overtopping and flooding during extreme storm events. However, the Sailing Center protection is a necessary element given the dynamic nature of the beach.
Figure 2.6: Proposed Sailing Center Protection
2.3 Block 10: Reason(s) For Discharge

As previously noted, the overall objective of this project is to improve the shoreline protection system adjacent to the NU Sailing Center building by replacing temporary emergency repairs with long-term shoreline protection measures. The proposed plan will require the placement of material lake-ward of the OHWM (i.e., discharge). A summary of the reason(s) for discharge associated with each proposed project element (1-Beach Control Structure, 2-Beach Nourishment, and 3-Sailing Center Protection) is provided below.

Beach Control Structure:

Extending the existing jetty is required to stabilize the proposed beach nourishment and provide additional sheltering of the Sailing Center building. Additional salvaged scour stone is also proposed along the eastern edge of the beach control structure, which will also provide ecological benefits by creating aquatic habitat.

Beach Nourishment:

The placement of imported sand for beach nourishment is necessary to increase the beach width adjacent to the Sailing Center building to mitigate future wave-induced damage. This element becomes particularly important during periods of high lake levels, when the existing beach adjacent to the Sailing Center building becomes completely inundated, allowing increased energy (i.e., larger waves) to reach the temporary repairs adjacent to the building.

Sailing Center Protection:

As previously noted, the Sailing Center was damaged during the recent period of high lake levels, which required the implementation of temporary emergency repairs, including riprap stone revetment and TrapBags (small cobble stone wrapped in geotextile fabric). The purpose of the proposed Sailing Center protection improvements is to replace the temporary emergency repairs with a long-term solution. Replacing the temporary emergency repairs will reduce the overall footprint of structural protection adjacent to the Sailing Center. Of note, most of the work associated with the proposed Sailing Center protection is above the OHWM.

Figure 2.7: Sailing Center Protection – Existing (Left) vs Proposed (Right)
2.4 Block 11: Types(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards for Waterways

A summary of the type(s) of material being discharged and the amount of each type for each proposed project element (1-Beach Control Structure, 2-Beach Nourishment, and 3-Sailing Center Protection) is provided below.

Beach Control Structure:

1600 yds$^3$ of structural fill (confined by 287 ft of steel sheet pile)
206 yds$^3$ of concrete to cap the structural fill and steel sheet piles
83 yds$^3$ of riprap for scour protection on the lakeside of the structure

Sailing Center Protection:

46 yds$^3$ of scour stone to be covered by beach nourishment

Beach Nourishment:

100 yds$^3$ of specially placed riprap
4720 yds$^3$ of sand nourishment (including overfill factor of 1.2)

The quantities provided above are a summary of discharge volumes below the OHWM. Table 2.1 presents all discharge types and total volumes proposed for this project, including a breakout into above and below the OHWM volumes.

Table 2.1: Material Being Discharged Above and Below the OHWM

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2.5  **Block 12: Surface Area in Acres of Wetlands or other Waters Filled**

A wetland delineation was completed in 2021 for the entire length of NU’s shoreline. As shown in Figure 2.8, one wetland was identified on the north end of the area of interest, which will not be impacted by this project. Lake Michigan was also identified as a Waters of the US through the wetland delineation process. The approved jurisdictional determination by the USACE (LRC-2021-00160) for this wetland delineation is attached (see Appendix C). The total surface area of Lake Michigan waters to be filled (i.e., proposed discharge below the OHWM) is 2.34 acres.

![Figure 2.8: Wetland and Waters Overview](image)

2.6  **Block 13: Description of Avoidance, Minimization and Compensation**

An alternative analysis process was undertaken to develop a Preferred Alternative that fulfills the purpose and needs of the proposed project, which is to replace temporary emergency repairs with long-term shoreline protection measures. The alternative analysis process is presented in the next section of this document (Section 3).
3. Alternative Analysis Process

An alternative analysis process was undertaken to develop the Preferred Alternative. For this process, several jetty extension alternatives (i.e., beach control structures) were developed and evaluated, as summarized below. The proposed beach nourishment correlates directly to the length of the proposed beach control structure and the permanent repairs to the Sailing Center protection are intended to restore and maintain their existing condition. Thus, the alternative analysis process specifically focused on analyzing the beach control structure. The selection of the Preferred Alternative was based upon a number of factors, including level of protection to the Sailing Center building, lake access, estimated construction cost, maintenance, project footprint, regulatory input, and property owner preference.

Further evaluation of the Preferred Alternative was completed to demonstrate that adverse impacts on adjacent shorelines due to disruption of the natural transport of sediment is not anticipated (refer to Section 4). In addition, impact on sensitive aquatic/terrestrial habitat related to threatened or endangered species in also not likely because no sensitive habitat was identified in the project area, with the exception of the beach area, which more recently has been identified as potential nesting habitat for piping plover (refer to Section 5). Fortunately, the implementation of the Preferred Alternative would only create additional beach area/expand nesting habitat for the piping plover.

3.1 Summary of Analysis for Jetty Extension Alternatives Considered

Baird utilized empirical and numerical models to estimate the beach planform, profiles, and volumes expected to be retained by the jetty under the anticipated range in metocean conditions (waves and water levels) over the life of the project, and the associated natural supply/transport of sand along this reach of shoreline (refer to Section 4). Hsu and Evans modeling was performed to better inform the performance of the system from long-shore sediment transport, and COSMOS was utilized to assess cross-shore sediment transport in response to storm induced-waves.

3.2 Assumptions and Approach

Being contained between two jetty structures, the shoreline at the NU Sailing Center and Clark Street Beach exhibits characteristics of what is known as an equilibrium or crenulate bay shape, as shown in Figure 3.1. These curved bay shorelines have been studied at many locations around the world and have been found to exhibit similarities that can be related to the nature of the local headland shape and the prevailing wave conditions.
Hsu and Evans (1989) equations give a reasonable approximation of the equilibrium beach planform for a certain, known set of conditions. Essentially, the equations developed by Hsu and Evans (1989) predict a parabolic shape between a selected control point and the headland, and a straight line that is parallel to the wave crests beyond the selected control point. This approach assumes that the shoreline orientation will generally be parallel to the nearshore wave crest line for a dominant wave direction after the influence of refraction/diffraction processes associated with the presence of the headland.

The three main variables of the Hsu and Evans (1989) approach are: 1) the dominant direction of wave approach; 2) the location of a diffraction point (defining the extent of the shelter zone); and 3) the location of a control point beyond where there is no influence of the headland. At this particular site, there is uncertainty in specifying the wave direction and therefore the control point, as the headland of the NU island shoreline extents to the north has some influence on wave diffraction before the waves reach the diffraction point at the jetty structure. Based on multiple aerial images that capture the wave crests entering the bay and the shape of the stabilized shoreline at the southern end of Clark Street Beach, it was determined that using a wave angle of 70° was appropriate for the analysis. The analysis was completed assuming a high-water level scenario of approximately +582.5 ft, IGLD85, a level that was recorded/exceeded in the summer to fall period of 2020.

Hsu and Evans calculations were conducted to determine the change in shoreline position resulting from installing a steel groin at the south end of the existing jetty structure. Calculations were performed for four onshore diffraction points. The first diffraction point was the end of the existing jetty structure to calibrate the model to fit the 2020 existing shoreline at a high-water level. To calibrate the model, after selecting a diffraction point, a control point and wave crest line parallel to the shoreline at the control point were selected. Different control points and wave crest lines were selected until the predicted shoreline was aligned with the existing shoreline. Then, an additional three diffraction point locations were selected based on the length of the proposed steel groin, ranging from 125 feet to 175 feet from the existing end of the jetty structure.

### 3.3 Alternatives Considered

As noted earlier, three proposed diffraction point locations were evaluated for different length extension possibilities for the jetty. The green, red, and blue shorelines in Figure 3.2 show the new equilibrium shoreline forms expected with the construction of a steel groin of lengths 125 ft, 150 ft, and 175 ft, as predicted with the
Hsu and Evans approach and assumed variable sets. The results show that with a longer the groin (i.e., 175 ft), a wider beach will be expected in front of the Sailing Center building.

Figure 3.2: Expected Shoreline Shape Based on a Single Structure of Various Lengths

The same approach was taken for analyzing the impacts of constructing an alternative shore perpendicular groin structure between Clark Street Beach and the NU Sailing Center, with the exception that southerly waves were considered due to the orientation of this structure. The three new shorelines added in Figure 3.3 demonstrate that a beach control structure in this alternative location would need to be at least 250 feet in length to provide any additional beach width in front of the Sailing Center (in comparison to extending the existing jetty 125 LF). At this point, the design becomes much less aesthetically pleasing and the smaller gap width between the two structure ends could prove to be a navigational hazard for the small sailing vessels that launch from the NU beach/ utilize the Sailing Center facility. For these reasons, a shore perpendicular groin concept was determined not to be a desirable option to consider for further development.
While the analyses presented above were completed with the concept of extending the existing structure with a single steel sheet pile groin, analyses of extending the structure “as-is” would be handled in the same manner and produce the same results, as it is the location of the southernmost point of the structure that influences the expected shoreline shape. The latter option could be seen as the more desirable alternative for numerous reasons that were considered in the alternative selection process, which are explained in further detail in the following section.

3.4 Evaluation of Alternatives and Selection of the Preferred Alternative

3.4.1 Length of Beach Control Structure

The beach plan shape analysis results were discussed with NU for the three extension length alternatives. Since this analysis was completed using a high-water scenario, it was determined that installing a 125-foot extension at the end of the existing jetty structure would provide adequate beach width to protect the Sailing Center in this condition and would provide even more protection during periods of lower water levels. As the wave direction is not constant, a sensitivity analysis was completed to determine the impact of wave directions ±15° at 5° increments from the original 70°. The results of this analysis were that the beach width in front of the Sailing Center could vary from approximately 35-45 feet (for the southerly 125-foot extension option) due to varying wave direction from 55°-85°.

In the event of a storm approaching from the southeast, Baird utilized the COSMOS model to predict the shoreline response. A significant southerly wave event was extracted from WIS station 94021 (Jan 27-29, 1995) and the COSMOS model was applied to estimate the amount of potential cross-shore erosion to be expected after such an event. COSMOS is a two-dimensional vertical (2DV) model of nearshore hydrodynamics, sediment transport and seabed evolution (morphodynamics), and is capable of calculating...
cross-shore transport rates and resulting bed changes. A beach slope of 1:30 was analyzed with a sediment particle size of 0.3 mm. Figure 3.4 presents plot from the COSMOS results, comparing the initial and final beach profiles.

The maximum amount of cross-shore erosion was determined to be approximately 10 feet. This changed the expected beach width range to approximately 25-45 feet for the 125-foot jetty extension option.

The results of the beach plan shape analysis and COSMOS results suggest that the 125-ft extension alternative provides a sufficient level of protection to the Sailing Center and that it facilitates access to Lake Michigan because of the added beach width, while minimizing the project footprint. Extending the jetty further south would create a wider beach but would result in a larger total project footprint. In summary, the Preferred Alternative limits lakebed impact (in comparison to longer structures) while still fulfilling NU’s shoreline protection needs and requirements.

### 3.4.2 Type of Beach Control Structure

The options of installing a single steel groin or a wider jetty extension have been discussed with NU and the regulatory agencies to review the implications of both. As requested, an explanation of the purpose and need of a wider structure was provided to the USACE for review and the response was that the USACE would not object to either design. After further discussions with NU, the jetty extension “as-is” was selected as the Preferred Alternative for the following:

- While a steel groin extension is considered to be a suitable alternative to extending the promenade “as-is”, because of the orientation of this structure (i.e., perpendicular to the incoming wave/offshore), the extension will be exposed to significant wave and ice forces. As such, a double sheet pile wall with fill between is a more robust long-term solution which will likely require less maintenance and repair than a single steel groin extension.
- By extending the existing structure similar in character to the existing south jetty extension, the overall feel and look of the site will be maintained while also providing additional pedestrian access to view the lake from the extension (a feature which the steel groin would not provide). It is NU’s opinion that the promenade extension is more appealing from an aesthetic perspective as it maintains a similar character to the existing and does not detract from the southerly views toward the existing beach, shoreline and Chicago skyline.
- Preliminary engineering calculations indicate that a single steel pile groin extension will require the use of a combi-wall that utilizes 36" diameter pipe piles approximately 90 ft in length, driven to an approx. depth of +495 ft IGLD85, to resist loads associated with extreme waves and ice conditions. Our experience indicates that achieving this driven depth elevation may be difficult to successfully achieve based on the underlaying geotechnical parameters (i.e., stiff glacial till). The jetty extension would require a more practical driven depth elevation of approx. +550 ft IGLD85 LWD. Therefore, there are also constructability reasons under consideration when opting for extending the existing overlook “as-is”.

- The additional width offered by the promenade extension (versus a steel groin extension) will result in less overtopping and wave agitation in the adjacent beach area, in turn reducing potential erosion and loss of beach sand placed adjacent to the Sailing Center, while also providing a safer and more sheltered publicly accessible swimming area.

Subsequent conversations with NU, the regulatory agencies, and Baird’s professional opinion regarding the anticipated performance and potential impacts of each alternative led to the selection of the 125-ft jetty extension as the Preferred Alternative.
4. **Assessment of Potential Shoreline Impacts and Beach Maintenance Requirements**

This section is provided to assist with the interpretation of the sediment transport results towards understanding and controlling project impacts on coastal processes and adjacent shorelines through informed mitigation at the time of construction. The impacts and benefits discussed herein are limited to issues associated with coastal processes.

4.1 **Coastal Processes Analysis**

An appropriate understanding of coastal processes is key to the success of any beach improvement project. Baird undertook several analyses to investigate the evolution of the Clark Street Beach shoreline and to assess longshore sediment transport (LST) and its annual variability in the immediate vicinity of NU’s campus shoreline since the construction of the lakefill in 1964.

4.1.1 **Review of Beach Stability – Historical Shoreline Comparison**

Figure 4.1 shows the 1962-1990-2000-2010 shoreline comparison for Clark Street Beach located immediately south of NU. Clark Street Beach was created circa 1960 (i.e., prior to construction of the NU lakefill) through construction of a 600 ft long hooked jetty and placement of approximately 45,000 cy of sand to mitigate beach erosion\(^1\). Construction of the south end of NU’s lakefill, including the existing jetty, was completed in 1968 forming the existing structure configuration that retains Clark Street Beach today. Figure 4.1 indicates that the growth of Clark Street Beach occurred mainly between the late 1980s and 2000, with no significant change in the shoreline between 2000 and 2010 (except for a slight shift due to lake level variations). A number of storm events in 2020, exacerbated by the high lake levels, have caused beach erosion and damage in this area, resulting in the construction of temporary emergency shore protection (a riprap revetment and TrapBags) to protect NU’s Sailing Center building.

This historical shoreline analysis indicates that Clark Street Beach has reached its capacity and has been stable for at least 20 years. The beach is expected to remain stable as long as lakebed and sediment supply conditions remain similar to those experienced in the past. Variations in Lake Michigan water levels would cause minor adjustments in shoreline positions. Severe storms are still expected to impact the short-term stability of the beach by causing temporary beach erosion.

As noted above, NU has recently installed temporary emergency shore protection to protect the Sailing Center building from damage associated with storm waves. The existing jetty structure, which provides some shelter to this beach, is not long enough to fully protect this area from erosion by waves, particularly with the increased exposure of the shoreline associated with high lake levels. This project’s objective is to provide a long-term erosion mitigation strategy for this beach.

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Figure 4.1: Shoreline comparison – Clark Street Beach Shoreline Analysis
4.1.2 Sediment Transport and Bypassing Shoal

Numerous studies of coastal processes along the southwest shoreline of Lake Michigan have demonstrated that LST in this region is predominantly from north to south and that the LST rate is “supply-limited.” The construction of the NU lakefill in the early 1960s resulted in modifications to the local sand transport processes. In particular, the construction of the lakefill project resulted in the deposition of sand leading to the development of a beach on the north end of the lakefill and a “bypassing shoal” around the lakefill. This bypassing shoal serves as a pathway for LST around the site and its formation resulted in reduced water depths all along this segment of coastline.

A review/comparison of the two bathymetric surveys (1999 and 2020), as shown in Figure 4.2, generally indicate a reduction in water depth (sediment accumulation - red/yellow hues) with some areas of deepening (sediment erosion - blue/green hues) over the past 20+ years.

![Figure 4.2: Comparison of 1999 and 2020 nearshore bathymetric surveys](image)

It is hypothesized that the large erosion zone highlighted in Figure 4.2 is the result of accelerated longshore currents that have developed in this area in response to the beach at the north end of the NU lakefill reaching “maturity”. This process is shown in Figure 4.3, including schematic diagrams that illustrate the longshore
current patterns before and after the north beach reached maturity and hydrodynamic model results that show the wave-induced longshore currents around the lakefill for the latter case.

Figure 4.3: Nearshore current patterns - before (L) and after (C, R) north beach reaches maturity

Based on the available information, it is concluded that the bypassing shoal around the lakefill has been generally stable for at least 20 years. However, there is uncertainty regarding the long-term stability of the sand bypassing shoal given the historical and ongoing reduction in sediment supply to the littoral system due to 120+ years of anthropogenic influences on the shoreline (i.e. harbors, shoreline protection, and dams).

Regarding the area of interest for this project, the current patterns and LST is generally north to south lakeward of the existing jetty structure. However, the jetty, similar to the southern tip of the lakefill to the north, acts as a wave diffraction point and causes a circular current pattern downdrift (left and center images in Figure 4.3). The lakefill to the north also provides some sheltering to the pocket beach and currents significantly decrease adjacent to its opening as they wrap around the shoreline. Without implementation of the current project, wave energy diffracting at the end of the existing structure would generally continue to erode sediment on the north end of the beach cell (assuming no hard shoreline protection was present) and then this sediment would deposit (get trapped) along the existing jetty bounding the beach cell to the south or leave the cell all together if that fillet is fully saturated.

Modeling examined the existing longshore sediment transport pattern along the southern extent of the NU shoreline around the Clark Street Beach embayment, as well as assessing potential large-scale impacts to longshore sediment transport and impacts to sedimentation in local area caused by sediment moving from the proposed beach nourishment at the NU Sailing Center.

Along the NU shoreline, most sediment transport occurs during storm events, and as such, a representative time series of wave hindcast data was selected from the most energetic year in the available dataset and modeled using COSMOS, additionally assuming a 10-year above-average water level. Waves in along the NU shoreline predominantly arrive from a north-northeast direction, with waves arriving from the southeast less frequently and with less intensity.
Both the existing condition and the proposed condition with beach control structure extension were modeled. The extension of the beach control structure streamlines the bypassing of sediment and prevents it from entering the project area because of its shore-parallel orientation, which would be a net positive improvement to longshore sediment transport along the Evanston shoreline.

The MIKE21 model was then run to assess local impacts from sediment transport out of the project area following beach nourishment. The model domain for this covered the entire Evanston shoreline south of Gillson Park in Wilmette to Calvary Cemetery in the south, with the mesh resolution for this model being fine enough to examine both the project area and areas to the south (for instance, the Church Street Boat Ramp).

The modeling concluded that minimal sediment leakage can be expected beyond the beach fill area and the embayment. The planform of the Clark Street Beach should not be affected by the beach nourishment adjacent to the NU Sailing Center. Furthermore, while this modeling did not examine outside causes of sediment transport and deposition such as past occurrences of sedimentation around the Church Street Boat Ramp, it did conclude that the proposed work will have a negligible impact on this issue. It may even be possible the extension of the beach control structure will improve overall LST and thus positively impact the Church Street Boat Ramp or shorelines to the south.

The details of this modeling is described further in Appendix E – Sediment Transport Modeling.

4.2 Assessment of Project Impacts

Given the orientation of the proposed jetty extension, parallel to the shoreline, the structure is not expected to trap sand which is generally moving from north to south along this segment of coastline. Although the proposed structure is expected to cause minimal to no impact on the adjacent downdrift shorelines, pre-filling the updrift fillet beach is intended to further mitigate possible negative project impacts.

4.2.1 Shoreline to the North

The implementation of the Preferred Alternative should not result in any significant impact to the shoreline to the north of the project site. In particular, the design of the Preferred Alternative has been “streamlined” to facilitate natural bypassing of sediment.

4.2.2 Shoreline to the South

The shoreline to the south of the project area, for approx. 5,000 LF, consists of park space owned by the City of Evanston. A property ownership map is included in the permit drawing set. (Appendix B). The first 2,000 ft south of the jetty at Clark Street Beach is characterized by a hardened shoreline comprised mainly of stone revetments, although at lower water levels, some beach area is present lakeward of the revetments. There is also a small boat launch harbor approximately 900 ft south of the jetty at Clark Street Beach. Baird has been informed that the harbor entrance and launch ramps require annual maintenance dredging to remove accumulated sediment, indicating that sediment currently bypasses the project area.

As noted earlier, the design of the Preferred Alternative is intended to facilitate/ maintain natural bypassing of sediment around the project. Specifically, the “streamlined” layout of the project, along with prefilling the beach cell to 120% of its design capacity, will allow sediment that is naturally present and moving along the shoreline to bypass the project and continue to supply the shorelines to the south. As such, no significant changes are expected along the shoreline to the south of the project from the implementation of the Preferred Alternative.
4.2.3 Beach Cell Integrity

The shoreline within the study area is very dynamic and responds to natural variations in lake levels, wave action, and sediment supply/transport. These factors result in a significant variation in the presence, width, and thickness of the beaches fronting the NU Sailing Center. While the proposed project will tend to stabilize the beach in front of the project area through the creation of a sheltered beach cell, the beach planform and profile will still experience some variation, in particular in response to varying lake levels and the passage of individual storm events. Since the fall, winter, and early spring are the most energetic months with respect to wave action, it is expected that there could be some transformation of the beach profile and narrowing of the beaches over the winter months. During the summer months, when there is less wave action, the beaches will tend to build back up as sediment migrates towards the shore. If storm wave action results in sediment being carried out of the beach cells and beyond the structures, re-supply to the beach cell will be dependent upon sediment bypassing associated with natural longshore transport processes.

4.3 Recommended Actions

As noted earlier, the layout of the proposed structure has been “streamlined” to promote natural bypassing and limit adverse impacts on the adjacent shorelines. In addition, it is recommended that the beach cell be pre-filled beyond its estimated maximum capacity to facilitate natural bypassing, and more specifically, to minimize the risk of sediment being trapped by the project. It is thus recommended that the beach cell should be pre-filled to its estimated maximum capacity plus 20% to compensate for formation of bypassing shoals.

4.4 Anticipated Long-Term Outcomes

Over the long-term, the bypassing that occurs with the Preferred Alternative will provide sediment to downdrift shorelines in a volume comparable with existing conditions. Variations in beach width are expected to be mirrored on the downdrift shorelines. This is a natural process and is no different than the expected variations on the existing shorelines.
5. Recommendations for Monitoring Program

The IDNR-OWR and USACE will require 20% beach over-fill be placed during project construction, along with a five-year project monitoring plan. The 20% overfill is regarded as “contingency” to account for unknowns, such as beach profile adjustments after the initial beach fill is placed.

The five-year monitoring plan is primarily intended to demonstrate that the project does not result in any adverse impacts to the natural coastal processes or adjacent shorelines (i.e., it does not trap additional sand after construction, and it does not result in erosion of the adjacent shorelines).

A preliminary outline of the project monitoring plan is provided below, including data collection, data analysis, and summary of findings (project report).

5.1 Area to be Monitored

The minimum area to be covered by the project monitoring plan consists of approximately 900 feet of shoreline, corresponding to the length along the shoreline within the beach cell, including Clark Street Beach. Baird recommends expanding these limits to include the adjacent properties to the north and south of the project, for a total of approximately 2,900 feet of shoreline (500 feet to the north and 1,500 feet to the south of the property).

5.2 Data Collection

The following sub-sections provide the content that will be included in the monitoring plan.

5.2.1 Bathymetric and Topographic Surveys

Bathymetric and topographic surveys (using the site controls established by the 2021 survey) will be conducted immediately after project construction and one and five years later. A summary of the proposed survey data collection methods is provided below:

- Bathymetric surveying (single and multi-beam) will be performed with minimum offshore extents of 300 feet beyond the offshore extents of the proposed improvements.
- For shallow water depths (less than three feet) to the water’s edge, data will be collected with GPS RTK walking survey methods at 50-foot intervals throughout the monitoring area.
- The collected data will be used to develop a digital terrain model (DTM). The DTM will be used as a base to which data (and the DTMs generated from them) obtained from subsequent surveys can be compared.

5.2.2 Visual and Photographic Observation

A digital photographic record will be collected at reproducible locations around the project. The photographic reproduction will identify the evolution of the beach cell.

5.3 Monitoring Schedule

Monitoring surveys will be performed in accordance with the schedule below. The date of “construction” would be defined as the date of completion of the beach fill placement.
5.3.1  Pre-Construction Survey

Based on the regulatory requirements, the pre-construction survey would be at least one month prior to construction. The survey effort would include:

- Bathymetric survey
- Topographic survey

5.3.2  Post-Construction Survey (immediately after construction)

Based on the anticipated project schedule, it is assumed that the post-construction survey would be performed in late 2023. The survey effort would include:

- Bathymetric survey
- Topographic survey
- Digital photographs of the project area from specific locations

5.3.3  One Year after Construction

Based on the anticipated project schedule, it is assumed that the one-year survey would be performed in 2024. The survey effort would include:

- Bathymetric survey
- Topographic survey
- Visual inspection of the beach cell, including digital photographs from previously established locations

5.3.4  Five Years after Construction

Based on the anticipated project schedule, it is assumed that the five-year survey would be performed in 2028. The survey effort would include:

- Bathymetric survey
- Topographic survey
- Visual inspection of the beach cell, including digital photographs from previously established locations
- Complete GIS-based analysis to assess beach and nearshore changes within the project area and to the north and south of the project.

5.4  Data Analysis and Reporting

The data collected during each survey and the associated DTM surfaces will be compared to data collected during the previous survey(s). A volumetric change analysis of the beach and nearshore areas will be performed using the DTM surfaces to estimate the amounts of accretion and erosion throughout the monitoring area. The evolution of any sand bypass shoal will also be documented in this dataset.

Interim reports summarizing each monitoring data collection program and the associated data analyses will be prepared. The report will include digital maps depicting data points, shoreline features, and survey contours. The final report will include detailed results from the volumetric change analysis.

The results of the monitoring program will provide the information necessary to assess the impacts, if any, of the project on the adjacent shorelines, and will also provide information on project performance to assist NU in defining and prioritizing maintenance requirements, if any.
6. Additional Information

Additional analyses were undertaken to support the permit application, as summarized below.

6.1 Threatened or Endangered Species

6.1.1 U.S. Fish and Wildlife Service Endangered Species

The endangered species list with the U.S. Fish and Wildlife Service Endangered Species Program was reviewed for Cook County, Illinois as part of the permit process. The species list identified for Cook County is provided in Table 6.1. Preliminary effects determination on the identified species is “No Effect” because suitable habitat is not present; however, after subsequent discussion with regulatory agencies, the USACE advised that Piping plover may transiently stop over at the beach during the nesting period between April 1 and August 31. Construction will be planned to take place outside of this window to avoid any negative impact on the habitat of the species listed.

Table 6.1: Federal-listed Threatened and Endangered Species Determination

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
<th>Habitat</th>
<th>Preliminary Determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern long-eared bat</td>
<td>Threatened</td>
<td>Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests and woods.</td>
<td>No Effect – Covered under the 4(d) rule</td>
</tr>
<tr>
<td>Myotis septentrionalis</td>
<td>Key to 4(d) Rule</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piping plover</td>
<td>Endangered</td>
<td>Lakeshore beaches</td>
<td>No Effect – habitat is not present. Species may stop-over for feeding or rest, but beach is of insufficient size for nesting</td>
</tr>
<tr>
<td>Charadrius melodus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern massasauga</td>
<td>Threatened</td>
<td>Graminoid dominated plant communities (fens, sedge meadows, peatlands, wet prairies, open woodlands, and shrublands)</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td>Sistrurus catenatus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rufa Red knot</td>
<td>Threatened</td>
<td>Only actions that occur along coastal areas or large wetland complexes during migratory window of May 1 - September 30</td>
<td>No Effect – habitat is not present. Species may stop-over for feeding or rest, but beach is of insufficient size for nesting</td>
</tr>
<tr>
<td>Calidris canutus rufa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hine’s emerald dragonfly</td>
<td>Endangered</td>
<td>Spring fed wetlands, wet meadows and marshes</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td>Somatochlora hineana</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>Status</td>
<td>Habitat</td>
<td>Preliminary Determination</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------------</td>
<td>-------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Hine’s emerald dragonfly</td>
<td>Critical</td>
<td>Cool shallow, slow moving waters (usually only several centimeters deep), spring-fed marshes, and seepage sedge meadows.</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td>Somatochlora hineana</td>
<td>Habitat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rattlesnake-master borer moth</td>
<td>Candidate</td>
<td>Undisturbed prairie and woodland openings that contain their only food plant, rattlesnake-master (<em>Eryngium yuccifolium</em>).</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td><em>Papaipema eryngii</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rusty patched bumble bee</td>
<td>Endangered</td>
<td>Grasslands with flowering plants from April through October, underground and abandoned rodent cavities or clumps of grasses above ground as nesting sites, and undisturbed soil for hibernating queens to overwinter.</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td><em>Bombus affinis</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern prairie fringed orchid</td>
<td>Threatened</td>
<td>Moderate to high quality wetlands, sedge meadow, marsh, and mesic to wet prairie</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td><em>Platanthera leucophaea</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leafy-prairie clover</td>
<td>Endangered</td>
<td>Prairie remnants on thin soil over limestone</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td><em>Dalea foliosa</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mead’s milkweed</td>
<td>Threatened</td>
<td>Late successional tallgrass prairie, tallgrass prairie converted to hay meadow, and glades or barrens with thin soil</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td><em>Asclepias meadii</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prairie bush clover</td>
<td>Threatened</td>
<td>Dry to mesic prairies with gravelly soil</td>
<td>No Effect – habitat is not present</td>
</tr>
<tr>
<td><em>Lespedeza leptostachya</em></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.1.2 Illinois Department of Natural Resources (IDNR)

An EcoCAT consultation was performed in the vicinity to identify if any protected natural resource could be affected by the proposed project. The consultation identified three threatened (Ground Juniper, Marram Grass, and Sea Rocket) and one endangered (Seaside Spurge) terrestrial plant species that have been documented in the vicinity. Table 6.2 further describes the results of the consultation. These species are prevalent on sandy beaches and therefore may be impacted by the project. All four plants are endemic to Lake Michigan shorelines within sandy beaches, dunes, bluffs, or gravelly shorelines. No wildlife species or aquatic plants are on the list.
Table 6.2: State-listed Threatened & Endangered Species Determination

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
<th>Habitat</th>
<th>Determination</th>
<th>Ideal Survey Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Juniper <em>Juniperus communis</em></td>
<td>Threatened</td>
<td>Lakeshore sandy bluffs and dunes</td>
<td>Presence unlikely, but possible: survey beach and other sandy areas within project footprint.</td>
<td>Apr-June (likely vegetatively identifiable)</td>
</tr>
<tr>
<td>Marram Grass <em>Ammophila breviligulata</em></td>
<td>Threatened</td>
<td>Lakeshore beaches and sand dunes</td>
<td>Presence unlikely, but possible: survey beach and other sandy areas within project footprint.</td>
<td>July-Sept</td>
</tr>
<tr>
<td>Sea Rocket <em>Cakile edentula var. lacustris</em></td>
<td>Threatened</td>
<td>Lakeshore beaches, gravelly shorelines</td>
<td>Presence unlikely, but possible: survey beach and other sandy areas within project footprint.</td>
<td>July-Sept</td>
</tr>
<tr>
<td>Seaside Spurge <em>Chamaesyce polygonifolia</em></td>
<td>Endangered</td>
<td>Lakeshore beaches</td>
<td>Presence unlikely, but possible: survey beach and other sandy areas within project footprint.</td>
<td>July-Sept</td>
</tr>
</tbody>
</table>

The IDNR had responded on February 9, 2021, to the EcoCAT review request with the following:

*The Department recommends these plants be searched for, flagged, and avoided if possible. If avoidance is not possible, please consider seed collection and planting, translocation, and surface soil conservation measures to help promote the continued existence of this plant in the area.*

The ideal survey period for each species is provided in Table 6.2. The results of the EcoCAT submission are included (see Appendix D)

### 6.2 Historical Properties

The project has no potential to affect historic properties, as defined by the National Register of Historic Places. In addition, after consulting the Historic and Architectural Resources Geographic Information System (HARGIS), it appears that there are no significant cultural resources or landforms within the project area. It is noted that the southern boundary of the project site abuts the Evanston Lakeshore Historic District (HARGIS number 200379; NRHP reference number 80001353), but the project site is not within this historic district.

### 6.3 Soil Erosion and Sedimentation Control Measures

Soil Erosion and Sedimentation Control measures proposed for this work include installing two rows of silt fences around the project work limits (land-side perimeter), which will be maintained throughout the duration of construction. Additional measures shall be taken if required, including the installation of turbidity barrier, as shown in the permit drawings (see Appendix B). Note, maintaining a turbidity barrier through the duration of the project will not likely be feasible due to the wave action experienced along this reach of shoreline; however, if required during critical aspects of construction, such as the placement of imported sand, turbidity barriers will be utilized while such operations are taking place.
Appendix A

Permit Application
# Joint Application Form for Illinois

## Items 1 and 2 for Agency Use

1. Application Number
2. Date Received

## Name, Mailing Address and Telephone Numbers

<table>
<thead>
<tr>
<th>3a. Applicant's Name:</th>
<th>3b. Co-Applicant/Property Owner Name (if needed or if different from applicant):</th>
<th>4. Authorized Agent (an agent is not required):</th>
</tr>
</thead>
<tbody>
<tr>
<td>David Stone</td>
<td>Company Name (if any):</td>
<td>Rory Agnew</td>
</tr>
<tr>
<td>Company Name (if any):</td>
<td>Northwestern University Address:</td>
<td>Company Name (if any):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W.F. Baird &amp; Associates Ltd. Address:</td>
</tr>
<tr>
<td>Email Address:</td>
<td>Email Address:</td>
<td>Email Address:</td>
</tr>
</tbody>
</table>

## Applicant's Phone Nos. with Area Code

<table>
<thead>
<tr>
<th>Business:</th>
<th>Residence:</th>
<th>Cell:</th>
<th>Fax:</th>
</tr>
</thead>
</table>

## Agent's Phone Nos. with Area Code

<table>
<thead>
<tr>
<th>Business:</th>
<th>Residence:</th>
<th>Cell:</th>
<th>Fax:</th>
</tr>
</thead>
</table>

## Statement of Authorization

I, [Applicant's Name], hereby authorize [Authorized Agent] to act on my behalf as my agent in the processing of this application and to furnish, upon my request, any information contained in this application.

Date: [4/5/2022]

## Adjoining Property Owners (Upstream and Downstream of the Water Body and Within Visual Reach of Project)

<table>
<thead>
<tr>
<th>Name</th>
<th>Mailing Address</th>
<th>Phone No. with Area Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Project Title:

Northwestern University Sailing Center Repairs

## Project Location:

Northwestern University, Evanston Campus, Sailing Center Building

<table>
<thead>
<tr>
<th>LATITUDE: 42.05049</th>
<th>LONGITUDE: -87.67221</th>
</tr>
</thead>
<tbody>
<tr>
<td>°N</td>
<td>°W</td>
</tr>
</tbody>
</table>

## Street, Road, or Other Descriptive Location

<table>
<thead>
<tr>
<th>STREET, ROAD, OR OTHER DESCRIPTIVE LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sailing Center Building Address: 1830 Campus Dr., Evanston, IL 60201</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LEGAL DESCRIPT</th>
<th>QUARTER</th>
<th>SECTION</th>
<th>TOWNSHIP NO.</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATERWAY</td>
<td></td>
<td></td>
<td>26</td>
<td>41</td>
</tr>
</tbody>
</table>

| IN OR NEAR CITY OF TOWN (check appropriate box) |
| Municipality Name: Lake Michigan |

## County, State, and Zip Code

<table>
<thead>
<tr>
<th>COUNTY</th>
<th>STATE</th>
<th>ZIP CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cook</td>
<td>IL</td>
<td>60208</td>
</tr>
</tbody>
</table>

Revised 2010

- [ ] Corps of Engineers
- [ ] IL Dep't of Natural Resources
- [ ] IL Environmental Protection Agency
- [ ] Applicant's Copy
8. PROJECT DESCRIPTION (Include all features):
See Permit Application Document.

9. PURPOSE AND NEED OF PROJECT:
See Permit Application Document.

**COMPLETE THE FOLLOWING FOUR BLOCKS IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED**

10. REASON(S) FOR DISCHARGE:
See Permit Application Document.

11. TYPE(S) OF MATERIAL BEING DISCHARGED AND THE AMOUNT OF EACH TYPE IN CUBIC YARDS FOR WATERWAYS:
   **TYPE:** See Permit Application Document.
   **AMOUNT IN CUBIC YARDS:**
   See Permit Application Document.

12. SURFACE AREA IN ACRES OF WETLANDS OR OTHER WATERS FILLED (See Instructions)
   See Permit Application Document.

13. DESCRIPTION OF AVOIDANCE, MINIMIZATION AND COMPENSATION (See Instructions)
   See Permit Application Document.

---

<table>
<thead>
<tr>
<th>Date activity is proposed to commence</th>
<th>Date activity is expected to be completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2022</td>
<td>Spring 2024</td>
</tr>
</tbody>
</table>

15. Is any portion of the activity for which authorization is sought now complete?  
   Month and Year the activity was completed:  
   Yes ☐ No ☒  
   NOTE: If answer is “YES” give reasons in the Project Description and Remarks section. Indicate the existing work on drawings.

16. List all approvals or certification and denials received from other Federal, Interstate, state, or local agencies for structures, construction, discharges or other activities described in this application.

<table>
<thead>
<tr>
<th>Issuing Agency</th>
<th>Type of Approval</th>
<th>Identification No.</th>
<th>Date of Application</th>
<th>Date of Approval</th>
<th>Date of Denial</th>
</tr>
</thead>
</table>

17. CONSENT TO ENTER PROPERTY LISTED IN PART 7 ABOVE IS HEREBY GRANTED.
   Yes ☒ No ☐

18. APPLICATION VERIFICATION (SEE SPECIAL INSTRUCTIONS)
   Application is hereby made for the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge, the information is complete, and accurate. I further certify that I possess the authority to undertake the proposed activity.

   [Signature]
   Date: 4/5/2022

   [Signature of Applicant or Authorized Agent]
   Date: 

   [Signature of Applicant or Authorized Agent]
   Date:  

---

☐ Corps of Engineers  
☐ IL Dept of Natural Resources  
☐ IL Environmental Protection Agency  
☐ Applicant’s Copy

Revised 2010

SEE INSTRUCTIONS FOR ADDRESS
LOCATION MAP

See permit drawings (sheet G-001 and V-101).
PLAN VIEW

See permit drawings (sheet C-102).
Appendix B

Permit Application Drawings
GENERAL NOTES

1. All distances are in feet.
2. All elevations are in feet.
5. +577.5 FT Low Water Datum (LWD) = +577.5 FT IGLD85. See Datum Chart for additional conversions.
6. Topographic Survey Data, Brennan (November 9, 2021), Baird (December 10, 2020).
8. Survey High Water Mark (OHWM) = +584.0 FT IGLD85. OHWM shown in drawings derived from topographic survey data.

PROJECT CONTROL & SURVEY MONUMENTS

1. Project Control Points: CP-01, CP-02, CP-03
2. Survey Monument: NGS Control Point NSG123
3. See Survey Control Chart for Project Control & Survey Monument Details

SURVEY CONTROL CHART

<table>
<thead>
<tr>
<th>POINT</th>
<th>NORTHERN</th>
<th>EASTING</th>
<th>ELEVATION (IGLD85, FT)</th>
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<tr>
<td>CP-01</td>
<td>1961521.22</td>
<td>1163589.34</td>
<td>583.3</td>
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<tr>
<td>CP-02</td>
<td>1961801.15</td>
<td>1163956.54</td>
<td>586.71</td>
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<td>CP-03</td>
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<td>NSG123</td>
<td>1961182.79</td>
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DATUM CONVERSION:

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<tr>
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<th>IGLD85 WLD @ NU</th>
<th>IGLD85 @ NU</th>
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<td>-578.03</td>
<td>-578.03</td>
<td>-0.53</td>
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</table>

TABLE OF MATERIAL BEING DISCHARGED ABOVE AND BELOW THE OHWM

BEACH CONTROL STRUCTURE

<table>
<thead>
<tr>
<th>Item</th>
<th>Total Quantity</th>
<th>Unit Above OHWM</th>
<th>Unit Below OHWM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Pad + Steps + Capping</td>
<td>84</td>
<td>CY</td>
<td>84</td>
</tr>
<tr>
<td>Steel Sheet Pile</td>
<td>133</td>
<td>LF</td>
<td>133</td>
</tr>
<tr>
<td>Structure Fl</td>
<td>326</td>
<td>CY</td>
<td>326</td>
</tr>
<tr>
<td>Concrete Cutoff Wall</td>
<td>17</td>
<td>CY</td>
<td>17</td>
</tr>
<tr>
<td>Scour Stone</td>
<td>140</td>
<td>CY</td>
<td>93</td>
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</table>

SAILING CENTER PROTECTION

<table>
<thead>
<tr>
<th>Item</th>
<th>Total Quantity</th>
<th>Unit Above OHWM</th>
<th>Unit Below OHWM</th>
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</thead>
<tbody>
<tr>
<td>Riprap</td>
<td>169</td>
<td>CY</td>
<td>69</td>
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BEACH NOURISHMENT

<table>
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<tbody>
<tr>
<td>Riprap</td>
<td>5314</td>
<td>CY</td>
<td>504</td>
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NORTHWESTERN UNIVERSITY SAILING CENTER REPAIRS

GENERAL NOTES

PREPARED FOR: NorthWestern University
PREPARED BY: Baird
PHOTO: 1
DIRECTION: SOUTHEAST
DATE TAKEN: 11-09-2021
NOTES: CONTROL POINT (CP-01)

PHOTO: 2
DIRECTION: SOUTH
DATE TAKEN: 11-09-2020
NOTES: CONTROL POINT (CP-02)

PHOTO: 3
DIRECTION: SOUTHEAST
DATE TAKEN: 11-09-2020
NOTES: CONTROL POINT (CP-03)

PHOTO: 4
DIRECTION: SOUTH
DATE TAKEN: 12-18-2020
NOTES: DRONE AERIAL

PHOTO: 5
DIRECTION: EAST
DATE TAKEN: 01-07-2020
NOTES: SAILING CENTER BUILDING

PHOTO: 6
DIRECTION: WEST
DATE TAKEN: 12-18-2020
NOTES: EMERGENCY REPAIRS 2020

PHOTO: 7
DIRECTION: EAST
DATE TAKEN: 12-18-2020
NOTES: EMERGENCY REPAIRS 2020

PHOTO: 8
DIRECTION: EAST
DATE TAKEN: 12-18-2020
NOTES: EXISTING RIPRAP / JETTY

PHOTO: 9
DIRECTION: EAST
DATE TAKEN: 12-18-2020
NOTES: EXISTING JETTY STRUCTURE

PHOTO: 10
DIRECTION: SOUTHEAST
DATE TAKEN: 12-18-2020
NOTES: EXISTING JETTY STRUCTURE

PHOTO: 11
DIRECTION: SOUTH
DATE TAKEN: 07-29-2021
NOTES: EXISTING JETTY STRUCTURE

PHOTO: 12
DIRECTION: WEST
DATE TAKEN: 12-18-2020
NOTES: EXISTING JETTY STRUCTURE

1. SEE SHEET G-002 FOR GENERAL NOTES.
### ADJACENT PROPERTY OWNERS

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>OWNER</th>
<th>TAXPAYER ADDRESS</th>
<th>ASSESSOR SITE ADDRESS</th>
<th>PIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>THOMAS M麦克纳万</td>
<td>5 MELEEN PK</td>
<td>SAME AS TAXPAYER ADDRESS</td>
<td>11-07-201-015-0000</td>
</tr>
<tr>
<td>2</td>
<td>STEVEN HAGEDO</td>
<td>6 MELEEN PK</td>
<td>SAME AS TAXPAYER ADDRESS</td>
<td>11-07-201-020-0000</td>
</tr>
<tr>
<td>3</td>
<td>WILLIAM C. GOLDEN</td>
<td>7 MELEEN PK</td>
<td>SAME AS TAXPAYER ADDRESS</td>
<td>11-07-201-010-0000</td>
</tr>
<tr>
<td>4</td>
<td>AS HAWKED</td>
<td>8 MELEEN PK</td>
<td>SAME AS TAXPAYER ADDRESS</td>
<td>11-07-201-022-0000</td>
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<tr>
<td>5</td>
<td>WATER TREATMENT PLANT - CITY OF EVANSTON</td>
<td>370 MELEEN ST</td>
<td>SAME AS TAXPAYER ADDRESS</td>
<td>11-07-201-015-0000</td>
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<td>6</td>
<td>NORTHWESTERN UNIV</td>
<td>2205 SHERIDAN RD</td>
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<td>1521 SHERIDAN RD</td>
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<td>11-18-401-001-0000</td>
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<td>8</td>
<td>CENTENNIAL PARK - CITY OF EVANSTON</td>
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<td>9</td>
<td>DAVIES PARK - CITY OF EVANSTON</td>
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<td>13</td>
<td>BURNHAM SHORES PARK - CITY OF EVANSTON</td>
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<td>14</td>
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<tr>
<td>15</td>
<td>WILLIAM L. GRADIN</td>
<td>943 EDGEMERE CT</td>
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</tr>
<tr>
<td>16</td>
<td>RONALD LEDNZY</td>
<td>935 EDGEMERE CT</td>
<td>SAME AS TAXPAYER ADDRESS</td>
<td>11-20-103-005-0000</td>
</tr>
<tr>
<td>17</td>
<td>MICHAEL B. ABBOTT</td>
<td>925 EDGEMERE CT</td>
<td>SAME AS TAXPAYER ADDRESS</td>
<td>11-20-103-005-0000</td>
</tr>
<tr>
<td>18</td>
<td>ROBERT BROWNO</td>
<td>2640 PATRIOT BLVD 2209 GENEVA, IL 60134</td>
<td>907 EDGEMERE CT</td>
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<tr>
<td>19</td>
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<td>915 EDGEMERE CT</td>
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<td>11-20-103-009-0000</td>
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<tr>
<td>20</td>
<td>STACY EMISON</td>
<td>2036 OREGON AVE EVANSTON, IL 60201</td>
<td>917 EDGEMERE CT</td>
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<tr>
<td>21</td>
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<tr>
<td>22</td>
<td>DOMINIC R. BELLCHER</td>
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<td>K R MAUGHAN WITTLESTH</td>
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<td>SAME AS TAXPAYER ADDRESS</td>
<td>11-20-103-015-0000</td>
</tr>
</tbody>
</table>

### PROPERTY TYPE KEY
- **CITY OWNED / PARK SPACE**
- **PRIVATE**
- **NORTHWESTERN UNIVERSITY**

---

**NOTES:**
1. SEE SHEET G-002 FOR GENERAL NOTES.
2. PROPERTY PARCEL INFO: CITY OF EVANSTON PROPERTY BROWSER, [https://evanston.maps.arcgis.com](https://evanston.maps.arcgis.com)
EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)
EXISTING CONCRETE (TO BE REMOVED)
EXISTING RIPRAP (TO BE SALVAGED)
EXISTING DECK (TO BE REMOVED)
EXISTING NU BEACH (LAWDOW AREA TBE)
EXISTING VEGETATION (PRESERVE & PROTECT)
EXISTING GATED CONSTRUCTION ACCESS
EXISTING NEP RAP (PRESERVE & PROTECT)
EXISTING STEEL SHED (HOLD WITH CONCRETE CAP (PRESERVE & PROTECT)
EXISTING FLAGPOLE (REMOVAL, W/VAL)
EXISTING EMERGENCY CALL BOX (PRESERVE & PROTECT)
EXISTING LIGHT POLE (PRESERVE & PROTECT)

LEGEND

Jeanne Voevodin Center (PRESERVE & PROTECT)

NORTH-WESTERN UNIVERSITY SAILING CENTER REPAIRS
SITE PREPARATION & SESC PLAN

QCM - JTW - RPA - XXX - XXX

SHEET NUMBER: C-101

NOTES:
1. SEE SHEET G-002 FOR GENERAL NOTES.
LEGEND

PROPOSED IMPROVEMENTS PLAN
NORTHWESTERN UNIVERSITY SAILING CENTER REPAIRS

SEE SHEET CS-101

LEGEND

PROPOSED SAILING CENTER PROTECTION

PROPOSED BEACH NOURISHMENT
(TOTAL AREA BELOW EXISTING OHWM = 2.2 ACRES, TOTAL FILL VOLUME W/ 20% OVERFILL = 4,720 CUBIC YARDS)

PROPOSED SPECIAL PLACEMENT (SALVAGED RIPRAP)

PROPOSED BEACH CONTROL STRUCTURE
(TOTAL LAKE BOTTOM COVERAGE = 0.11 ACRES)

PROPOSED SCOUR STONE (SALVAGED RIPRAP), TBD.
(TOTAL LAKE BOTTOM COVERAGE = 0.03 ACRES)

PROPOSED BEACH NOURISHMENT TOE (EL. VARIES)

PROPOSED BEACH NOURISHMENT CONTOURS

APPROXIMATE WATER LINE (EL. 579.3 FT.)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

SAILING CENTER BUILDING (PRESERVE & PROTECT)

LAKEFRONT TRAILWAY (PRESERVE & PROTECT)

NU SOUTH PROPERTY LINE

NU LAKEBED GRANT LIMITS

LAKEFRONT LAWN (PRESERVE & PROTECT)

CLARK STREET BEACH BIRD SANCTUARY (PRESERVE & PROTECT)

LEGEND

NOTES:
1. SEE SHEET G-002 FOR GENERAL NOTES.
2. SEE SHEET G-002 FOR SUMMARY OF MATERIAL BEING DISCHARGED ABOVE AND BELOW THE OHWM.

PROPOSED BEACH NOURISHMENT TOE (EL. VARIES)

APPROXIMATE WATER LINE (EL. 579.3 FT.)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

SAILING CENTER BUILDING (PRESERVE & PROTECT)

LAKEFRONT TRAILWAY (PRESERVE & PROTECT)

NU SOUTH PROPERTY LINE

NU LAKEBED GRANT LIMITS

LAKEFRONT LAWN (PRESERVE & PROTECT)

CLARK STREET BEACH BIRD SANCTUARY (PRESERVE & PROTECT)

LEGEND

NOTES:
1. SEE SHEET G-002 FOR GENERAL NOTES.
2. SEE SHEET G-002 FOR SUMMARY OF MATERIAL BEING DISCHARGED ABOVE AND BELOW THE OHWM.

PROPOSED BEACH NOURISHMENT TOE (EL. VARIES)

APPROXIMATE WATER LINE (EL. 579.3 FT.)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

SAILING CENTER BUILDING (PRESERVE & PROTECT)

LAKEFRONT TRAILWAY (PRESERVE & PROTECT)

NU SOUTH PROPERTY LINE

NU LAKEBED GRANT LIMITS

LAKEFRONT LAWN (PRESERVE & PROTECT)

CLARK STREET BEACH BIRD SANCTUARY (PRESERVE & PROTECT)

LEGEND

NOTES:
1. SEE SHEET G-002 FOR GENERAL NOTES.
2. SEE SHEET G-002 FOR SUMMARY OF MATERIAL BEING DISCHARGED ABOVE AND BELOW THE OHWM.

PROPOSED BEACH NOURISHMENT TOE (EL. VARIES)

APPROXIMATE WATER LINE (EL. 579.3 FT.)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

SAILING CENTER BUILDING (PRESERVE & PROTECT)

LAKEFRONT TRAILWAY (PRESERVE & PROTECT)

NU SOUTH PROPERTY LINE

NU LAKEBED GRANT LIMITS

LAKEFRONT LAWN (PRESERVE & PROTECT)

CLARK STREET BEACH BIRD SANCTUARY (PRESERVE & PROTECT)

LEGEND

NOTES:
1. SEE SHEET G-002 FOR GENERAL NOTES.
2. SEE SHEET G-002 FOR SUMMARY OF MATERIAL BEING DISCHARGED ABOVE AND BELOW THE OHWM.

PROPOSED BEACH NOURISHMENT TOE (EL. VARIES)

APPROXIMATE WATER LINE (EL. 579.3 FT.)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

SAILING CENTER BUILDING (PRESERVE & PROTECT)

LAKEFRONT TRAILWAY (PRESERVE & PROTECT)

NU SOUTH PROPERTY LINE

NU LAKEBED GRANT LIMITS

LAKEFRONT LAWN (PRESERVE & PROTECT)

CLARK STREET BEACH BIRD SANCTUARY (PRESERVE & PROTECT)

LEGEND

NOTES:
1. SEE SHEET G-002 FOR GENERAL NOTES.
2. SEE SHEET G-002 FOR SUMMARY OF MATERIAL BEING DISCHARGED ABOVE AND BELOW THE OHWM.

PROPOSED BEACH NOURISHMENT TOE (EL. VARIES)

APPROXIMATE WATER LINE (EL. 579.3 FT.)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

SAILING CENTER BUILDING (PRESERVE & PROTECT)

LAKEFRONT TRAILWAY (PRESERVE & PROTECT)

NU SOUTH PROPERTY LINE

NU LAKEBED GRANT LIMITS

LAKEFRONT LAWN (PRESERVE & PROTECT)

CLARK STREET BEACH BIRD SANCTUARY (PRESERVE & PROTECT)
NOTES:
1. SEE SHEET G-002 FOR GENERAL NOTES.
2. ALL DIMENSIONS ARE NOMINAL.
NOTES:

1. SEE SHEET G-002 FOR GENERAL NOTES.

2. WATER ELEVATION = +579.3 (IGLD85, FT.) ON MARCH 9, 2022 (STA. ID. 9087044).

APPROX. EXISTING GRADE (EL. VARIES)

STRUCTURAL FILL

1:20 SLOPE

1:20 RAMP

HANDRAIL, TYP.

CONCRETE CAP, TYP.

STEEL SHEET PILE, TYP.

DOUBLE CHANNEL WALLER, TYP.

HANDRAIL, TYP.

CONCRETE CAP, TYP.

STEEL SHEET PILE, TYP.

STRUCTURAL FILL, TYP.

DOUBLE CHANNEL WALLER, TYP.

HANDRAIL, TYP.

CONCRETE CAP, TYP.

STEEL SHEET PILE, TYP.

STRUCTURAL FILL, TYP.

TIP EL. (TBD)

SCOUR PROTECTION PAD (SALVAGED RIPRAP), TBD

EXISTING STEEL SHEET PILE (PRESERVE & PROTECT)

EXISTING CONCRETE CURB TO REMAIN

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

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EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)

EXISTING JETTY STRUCTURE (PRESERVE & PROTECT)
Appendix C

USACE Approved Jurisdictional Determination LRC-2021-00160
DEPARTMENT OF THE ARMY
CHICAGO DISTRICT, CORPS OF ENGINEERS
231 SOUTH LA SALLE STREET
CHICAGO, ILLINOIS 60604-1437

January 31, 2022

Operations Division
Regulatory Branch
LRC-2021-00160

SUBJECT: Jurisdictional Determination for the Northwestern Shoreline Protection Study in Evanston, Cook County, Illinois (Latitude 42.050807, Longitude -87.671729)

David Stone
Northwestern University
2020 Ridge Avenue
Evanston, Illinois 60208

Dear Mr. Stone:

This is in response to your request that the U.S. Army Corps of Engineers complete a jurisdictional determination for the above-referenced site submitted on your behalf by Resource Environmental Solutions, LLC. The subject project has been assigned number LRC-2021-00160. Please reference this number in all future correspondence concerning this project.

Following a review of the information you submitted, this office has determined that the subject property contains "waters of the United States".

Waters 1: Lake Michigan & Wetland 1 have been determined to be under the jurisdiction of this office and therefore, subject to Federal regulation.

In the event an application is submitted for work within jurisdictional areas, a concurrence of the wetland boundaries and/or a professional survey of the identified wetland and water features stamped by a professional surveyor will need to be prepared and shall accompany the approved wetland delineation.

For a detailed description of our determination please refer to the enclosed decision document. This determination covers only your project as depicted in the Wetland Delineation Report date July 9, 2021, prepared by RES.

This determination is valid for a period of five (5) years from the date of the letter, unless new information warrants revision of the determination before the expiration date or a District Commander has identified, after public notice and comment, that specific geographic areas with rapidly changing environmental conditions merit re-verification on a more frequent basis.
This letter is considered an approved jurisdictional determination for your subject site. If you object to this determination, you may appeal, according to 33 CFR Part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and a Request for Appeal (RFA) form. If you request to appeal the above determination, you must submit a completed RFA form to the Great Lakes/Ohio River Division Office at the following address:

Jacob Siegrist  
Regulatory Appeals Review Officer  
US Army Corps of Engineers  
Great Lakes and Ohio River Division

In order to be accepted, your RFA must be complete, meet the criteria for appeal and be received by the Division Office within sixty (60) days of the date of the NAP. If you concur with the determination in this letter, submittal of the RFA form to the Division office is not necessary.

This determination has been conducted to identify the limits of the Corps Clean Water Act jurisdiction for the particular site identified in this request. This determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985, as amended. If you or your tenant are USDA program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

It is your responsibility to obtain any required state, county, or local approvals for impacts to wetland areas not under the Department of the Army jurisdiction. For projects located in unincorporated and unauthorized municipalities in Cook County, please contact the Metropolitan Water Reclamation District of Greater Chicago at  
For projects in incorporated areas of Cook County, contact the authorized municipality for information related to the Watershed Management Ordinance.

Pursuant to Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers regulates the discharge of dredged or fill material into waters of the United States, including wetlands. A Department of the Army permit is required for any proposed work involving the discharge of dredged or fill material within the jurisdiction of this office. To initiate the permit process, please submit a joint permit application form along with detailed plans of the proposed work. Information concerning our program, including the application form and an application checklist, can be found at and downloaded from our website:

If you have any questions, please contact Mr. Michael J. Machalek of my staff by telephone at or email at

Sincerely,

Diedra L. McLaurin
Team Lead
Regulatory Branch

Enclosures

Copy Furnished w/out Enclosures

Cook County Building and Zoning (Michael Fazio)
Metropolitan Water Reclamation District of Greater Chicago (Dan Feltes)
RES (Caitlin Burke)
NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: David Stone, Northwestern University

File Number: LRC-2021-00160

Date: January 31, 2022

Attached is:
- INITIAL PROFFERED PERMIT (Standard Permit or Letter of Permission)
- PROFFERED PERMIT (Standard Permit or Letter of Permission)
- PERMIT DENIAL
- APPROVED JURISDICTIONAL DETERMINATION
- PRELIMINARY JURISDICTIONAL DETERMINATION

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/CECW/Pages/reg_materials.aspx or Corps regulations at 33 CFR Part 331.

A. INITIAL PROFFERED PERMIT: You may accept or object to the permit.
   • ACCEPT: If you received a Standard Permit or a Letter of Permission (LOP), you may sign the permit document and return it to the district commander for final authorization. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
   • OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district commander. Your objections must be received by the district commander within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district commander will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district commander will send you a proffered permit for your reconsideration, as indicated in Section B below.

B. PROFFERED PERMIT: You may accept or appeal the permit
   • ACCEPT: If you received a Standard Permit or a Letter of Permission (LOP), you may sign the permit document and return it to the district commander for final authorization. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
   • APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.

C. PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.

D. APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.
   • ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
   • APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.

E. PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.
SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:

Regulatory Branch
Chicago District Corps of Engineers
231 South LaSalle Street, Suite 1500
Chicago, IL  60604-1437

If you only have questions regarding the appeal process you may also contact:

Jacob Siegrist
Regulatory Appeals Review Officer
US Army Corps of Engineers
Great Lakes and Ohio River Division

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Commanders personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15-day notice of any site investigation, and will have the opportunity to participate in all site investigations.

__________________________________________  ________________________  ________________________
Signature of appellant or agent.  Date:  Telephone number:
Appendix D

IDNR EcoCAT Review Results
9 February 2021

Mrs. Genesis Mickel
21938 Mushtown Road
Prior Lake, MN 55372

RE: Northwestern University Wetland and Aquatic Assessment Consultation Program
EcoCAT Review #2110230
Cook County

Dear Mrs. Mickel:

The Department has received your submission of this project for the purposes of consultation pursuant to the Illinois Endangered Species Protection Act [520 ILCS 10/11], the Illinois Natural Areas Preservation Act [525 ILCS 30/17], Title 17 Illinois Administrative Code Part 1075. Additionally, the Department may offer advice and recommendations for species covered under the Fish & Aquatic Life Code [515 ILCS 5, et seq.]; the Illinois Wildlife Code [520 ILCS 5, et seq.]; and the Herptiles-Herps Act [510 ILCS 69].

The proposed action being reviewed in this letter consists of shoreline stabilization in Evanston, Illinois (42.056°, -87.670°).

The natural resource review provided by EcoCAT indicated that the following state-listed plants may be in the vicinity of the proposed action: ground juniper (Juniperus communis), marram grass (Ammophila brevigulata), sea rocket (Cakile edentula var. lacustris), and seaside spurge (Chamaesyce polygonifolia). The Department recommends these plants be searched for, flagged, and avoided if possible. If avoidance is not possible, please consider seed collection and planting, translocation, and surface soil conservation measures to help promote the continued existence of this plant in the area. Pursuant to the Illinois Endangered Species Protection Act [520 ILCS 10/1], state-listed plants belong to the landowner and their fate resides with the landowner’s conservation decisions. Express written permission from the landowner should be obtained from construction companies/crews to take listed plants to comply with the Illinois Endangered Species Protection Act.

Given the above recommendations are adopted, the Department has determined impacts to the other protected resources in the vicinity of the project location are unlikely.

Consultation on the part of the Department is closed, unless the applicant desires additional information or advice related to this proposal. Consultation for Part 1075 is valid for two years.
unless new information becomes available which was not previously considered; the proposed action is modified; or additional species, essential habitat, or Natural Areas are identified in the vicinity. If the action has not been implemented within two years of the date of this letter, or any of the above listed conditions develop, a new consultation is necessary.

The natural resource review reflects the information existing in the Illinois Natural Heritage Database at the time of the project submittal and should not be regarded as a final statement on the project being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are unexpectedly encountered during the project’s implementation, the applicant must comply with the applicable statutes and regulations.

Please contact me with any questions about this review.

Sincerely,

Bradley Hayes
Resource Planner
Office of Realty & Capital Planning
Illinois Dept. of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271
Appendix E

Sediment Transport Modeling
Executive Summary

This modeling examines the existing longshore sediment transport pattern along the southern extent of the Northwestern University (NU) shoreline around the Clark Street Beach embayment (project area), as well as assessing potential large-scale impacts to longshore sediment transport and impacts to sedimentation in local area caused by sediment moving from the proposed beach nourishment at the NU Sailing Center.

Along the NU shoreline, most sediment transport occurs during storm events, and as such, a representative time series of wave hindcast data was selected from the most energetic year in the available dataset and modeled using COSMOS, additionally assuming a 10-year above-average water level. Waves in along the NU shoreline predominantly arrive from a north-northeast direction, with waves arriving from the southeast less frequently and with less intensity.

Both the existing condition and the proposed condition with beach control structure extension were modeled. The extension of the beach control structure streamlines the bypassing of sediment and prevents it from entering the project area because of its shore-parallel orientation, which would be a net positive improvement to longshore sediment transport along the Evanston shoreline.

A MIKE21 model was then run to assess local impacts from sediment transport out of the project area following beach nourishment. The model domain for this covered the entire Evanston shoreline south of Gillson Park in Wilmette to Calvary Cemetery in the south, with the mesh resolution for this model being fine enough to examine both the project area and areas to the south (for instance, the Church Street Boat Ramp).

The modeling concluded that minimal sediment leakage can be expected beyond the beach fill area and the embayment. The planform of the Clark Street Beach should not be affected by the beach nourishment adjacent to the NU Sailing Center. Furthermore, while this modeling did not examine outside causes of sediment transport and deposition such as past occurrences of sedimentation around the Church Street Boat Ramp, it did conclude that the proposed work will have a negligible impact on this issue. It may even be possible the extension of the beach control structure will improve overall LST and thus positively impact the Church Street Boat Ramp or shorelines to the south.
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1. Introduction

This report presents the sediment transport modeling that was undertaken in support of the design development completed for the proposed improvements to the Northwestern University (NU) Sailing Center.

1.1 Project Overview

The project site is in Evanston, Illinois, at the south end of the NU campus shoreline, adjacent to the City of Evanston (CoE) Clark Street Beach, as shown in Figure 1.1. The objective of this project is to improve shoreline protection and minimize damage for this area, namely NU’s Sailing Center building, which experienced wave-induced damage and structural undermining during the recent period of high lake levels.

![Figure 1.1: Project Location](image)

The overall objective of this project is to replace existing temporary emergency shoreline protection measures with features that will help stabilize the shoreline, enhance protection, and mitigate the need for future shoreline-related repairs to the Sailing Center building. Individual element improvements to accomplish the overall project objective include:

- Extending an existing jetty structure to the south to improve wave sheltering and beach stability;
- Reconstructing the lake-side Sailing Center shoreline protection to make this structure more robust; and
- Importing sand to nourish the existing beach to increase beach width adjacent to the Sailing Center building.

1.2 Sediment Modeling Objectives

One objective of this study is to develop a basic two-dimensional sediment transport model of the current shoreline around Northwestern University (NU) and use the model to predict potential impacts on large-scale coastal processes under the proposed beach control structure extension adjacent to the NU Sailing Center.

Another objective is to build upon the initial sediment transport model and utilize it to predict potential impacts on local sedimentation patterns under the proposed beach nourishment in front of the NU Sailing Center.
2. Numerical Modeling

Numerical modeling is a powerful tool that helps coastal engineers to improve and/or confirm their understanding of coastal conditions at a project site. Model results combined with site observations and field measurement data can often provide the most complete possible picture of site conditions. This section provides a brief review of the wave climate as the main driving force behind the movement of sediments and provides an explanation of the water level condition that was selected for modeling. Numerical simulation of longshore sediment transport in the project area using the COSMOS model is then presented to provide a better understanding of the large-scale or regional littoral processes. This information is important as any potential development impact needs to be evaluated relative to the alongshore movement of sediment. An advanced numerical model of sediment transport is then applied to simulate details of littoral processes around the Northwestern campus under existing conditions, as well as to simulate both potential large-scale and local project impacts.

2.1 Waves

Information on the offshore wave environment is available through the Wave Information Studies (WIS) conducted by the United States Army Corp of Engineers (USACE). The data set provides hindcast waves for the 1979-2014 period (i.e., 36 years) for a series of locations throughout the Great Lakes. Data from WIS Station 94023 located in approximately 46 ft (~14m) water depth offshore of the Northwestern site was used for this analysis.

![Wave Height Rose](image)

Figure 2.1: Offshore wave height rose
The corresponding offshore wave rose is shown in Figure 2.1. Further examination of the wave data indicates the following:

- Offshore waves arrive from the northeast (NE) window, generating southward directed transport, approximately 48% of the time.
- Significant wave heights up to 17 to 18 ft may occur during extreme storms from the NNE direction.
- Offshore waves arriving from the southeast (SE) window occur approximately 18% of the time, but the wave height of southeasterly waves is less than 7 ft.
- Wave heights are less than 2.5 ft (i.e., relatively calm conditions) approximately 60% of the time.
- Wave heights are greater than 5 ft approximately 3% of the time.
- Predicted wave periods range between 2 and 12 seconds.

2.2 Water Level

The long-term average lake level on Lake Michigan is +1.4ft (LWD). However, beaches are mostly impacted during above-average water level conditions. Therefore, a constant above-average lake water level of +3.3ft (LWD) was applied in the present simulations. This is approximately a 10-year return period water level and is more representative of recent high lake level conditions of Lake Michigan. Using a water level that is above average lake level is also a more conservative approach, because the higher the water level, the more sediment transport is expected in the nearshore.

2.3 Numerical Modeling of Longshore Transport (COSMOS)

To develop a better understanding of Longshore Sand Transport (LST) potential and its temporal variations in the study area, a detailed 1D coastal processes model (COSMOS) was applied. COSMOS is a processes-based cross-shore profile model that estimates wave transformation, wave-induced currents, and sediment transport across a user-specified nearshore profile. COSMOS uses bathymetry, sediment grain size, and wave and water level as input to predict transport rates. The model has been extensively applied, tested, and verified by Baird in numerous projects around the world.

The hourly time series of WIS hindcast waves was used as input to COSMOS to predict potential longshore sediment transport rates. Figure 2.2 shows the predicted net annual potential longshore transport rate and its northward and southward components for the 1979-2014 hindcast period. Predominant longshore transport is towards the south with a net annual average of 115,000 yd³/year (red points). Predicted average annual northward transport (green points) is approximately 8,000 yd³/year. Predicted average annual southward transport (blue points) is approximately 123,000 yd³/year. The annual northward transport is thus much less than the southward component. The maximum predicted southward annual LST was approximately 400,000 yd³/year in 2011 and a minimum of approximately 47,000 yd³/year in 1982. There is considerable variability in the annual longshore transport volume.

It is noted that COSMOS assumes that the entire profile is covered with sand. Sand thickness investigations have indicated that sand is typically present in the nearshore area out to a depth of approximately 7 to 8 ft (Chart Datum or CD) at this project site. Actual longshore sand transport rates are thus less than the above predicted potential values. A plot of the predicted average net annual longshore transport as a function of depth (not shown) indicated that net annual transport rates out to -8 ft depth (CD) is predicted to be at approximately 40,000 yd³/year.
Sediment starts accumulating on the updrift side of coastal structures that interrupt the alongshore flow of sediment. Figure 2.3 shows sediment accumulation conditions north of the Northwestern lakefill in 1968 (i.e., five years after its construction). It is estimated that approximately 132,000 yd³ of sediment was accumulated in the north beach by 1968. This would translate to a southerly transport of approximately 26,500 yd³/year. Sediment was well sheltered on the north side, and the northerly transport could not carry the trapped sediment back to the littoral system during those initial years. The actual net longshore transport rate is thus expected to be approximately 25,000 yd³/year towards the south.

Figure 2.2: Predicted potential annual longshore transport rates (yd³/year) assuming the entire lakebed is covered with sand. Actual longshore sand transport rates are much less than the potential values.
2.4 Assessment of Potential Large-Scale Project Impacts

In this section we use two-dimensional numerical modeling of waves, longshore currents, and sediment transport to assess if the project has any potential impacts on the overall southward movement of the alongshore transport that was discussed above in Section 2.3.

The Danish Hydraulic Institute (DHI) MIKE21 modeling package was used for this application. The package includes the spectral nearshore wave transformation (SW) module for simulation of waves, the hydrodynamic (HD) module for simulation of nearshore currents, and the Sand Transport (ST) module for simulation of sediment transport processes around the Northwestern campus shoreline.

2.4.1 Model Bathymetry and Grids

Bathymetric LiDAR information from 2008 and topographic LiDAR information from 2012 were used to create the model bathymetry. The final model grid is shown in Figure 2.4 and extends approximately 3 miles along the shoreline on either side of the Northwestern campus, covering nearly the entirety of the City of Evanston's
Figure 2.4: Model domain and bathymetry for sediment transport calculations (UTM coordinates)

2.4.2 Model Calibration

Model calibration is the process of finding an appropriate set of model parameters that provide a good description of the sediment transport patterns and rates. This is achieved in this section by comparing model predictions with the estimated existing sediment transport rates presented in the previous section.

Existing littoral transport processes were modeled using a time series of wave conditions that represent a one-year long simulation. The WIS data indicated that 2011 had the highest wave energy during the hindcast period. 2011 was thus selected as the simulation year to better showcase the sand transport processes. Since most of the transport occurs during storm events, offshore waves of 6.7 ft (2 m) height and greater were selected to create an hourly time series of input wave conditions. This led to a total of 268 hourly wave conditions, which were above the 6.7 ft (2 m) threshold that then represent one-year of storm wave action. Table 2.1, calculated using the COSMOS model, indicates that the predicted LST rate when waves greater than 6.7 ft (2 m) are used is approximately 65% of the total LST. COSMOS also predicted that the LST rate in...
2011 was approximately 3.5 times the average. As a result, predicted transport rates with the MIKE21 model using the above wave conditions is expected to provide transport rates that are approximately 2.2 times the average annual transport rate.

### Table 2.1: Sensitivity of predicted longshore transport rates to the threshold wave height

<table>
<thead>
<tr>
<th>Threshold Wave Height (m)</th>
<th>Northward LST (cy/year)</th>
<th>Southward LST (cy/year)</th>
<th>Net LST (cy/year, negative southward)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>7,827</td>
<td>-123,143</td>
<td>-115,316</td>
</tr>
<tr>
<td>1.0</td>
<td>6,281</td>
<td>-117,001</td>
<td>-110,720</td>
</tr>
<tr>
<td>1.5</td>
<td>2,338</td>
<td>-98,517</td>
<td>-96,178</td>
</tr>
<tr>
<td>2.0</td>
<td>524</td>
<td>-75,249</td>
<td>-74,725</td>
</tr>
</tbody>
</table>

For the calibration runs, it was assumed that sand cover exists only to the north of the Lighthouse Beach groin structure, and incoming transport towards the Northwestern lakefill was predicted (i.e., simulating the 1968 conditions shown in Figure 2.3). Several model runs were completed with grain size and bottom friction as variable parameters. Results are summarized in Table 2.2 and indicate that using a grain size of 0.175 mm with Manning coefficient of 32 would result in an annual longshore transport rate of approximately 25,600 yd³/year.

### Table 2.2: MIKE ST model calibration results

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Manning</th>
<th>Grain size (mm)</th>
<th>Transport Rates (cy/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>50</td>
<td>0.1</td>
<td>342,777</td>
</tr>
<tr>
<td>Existing</td>
<td>50</td>
<td>0.15</td>
<td>86,434</td>
</tr>
<tr>
<td>Existing</td>
<td>50</td>
<td>0.2</td>
<td>39,455</td>
</tr>
<tr>
<td>Existing</td>
<td>32</td>
<td>0.1</td>
<td>188,767</td>
</tr>
<tr>
<td>Existing</td>
<td>32</td>
<td>0.15</td>
<td>48,537</td>
</tr>
<tr>
<td><strong>Existing</strong></td>
<td><strong>32</strong></td>
<td><strong>0.175</strong></td>
<td><strong>25,624</strong></td>
</tr>
<tr>
<td>Existing</td>
<td>32</td>
<td>0.2</td>
<td>16,543</td>
</tr>
</tbody>
</table>

#### 2.4.3 Model Results for Existing Conditions

Sediment was modeled as having been placed on the lakebed north of the Lighthouse Beach groin to simulate sediment transport towards and passing the Northwestern lakefill under existing conditions. The initial lakebed south of the Lighthouse Beach groin was fixed in the model with no sediment such that the flow of sediment coming from the north towards the Northwestern shore can be clearly visualized. The predicted sediment accumulation pattern and thickness for the existing conditions is provided in Figure 2.5 and indicates a relatively uninterrupted flow of sediment passing the existing Northwestern lakefill. The 2011 waves were repeated twice to generate measurable sediment bypassing at the site. The predicted final lakebed elevation
change thus corresponds to approximately 4.5 years of average wave activity. The existing conditions results form the basis for comparison with the proposed condition as presented in the next section.

![Figure 2.5: Predicted sediment transport and accumulation south of the Lighthouse Beach for existing conditions](image)

### 2.4.4 Model Results for Design Conditions

The numerical model domain, shown in Figure 2.4, was modified to include the 125-ft extension of the beach control structure to the south for the design condition simulation. As before, sediment was modeled as having been placed on the lakebed north of the Lighthouse Beach groin to simulate sediment transport towards and passing the Northwestern lakefill and to predict the resulting sediment accumulation pattern for the design conditions. Again, the 2011 waves were repeated twice so that the results could be compared with those from the existing conditions simulation. The same sediment properties were assumed as before.

Model results for the proposed conditions are shown in Figure 2.6. Comparison of these results to Figure 2.5, the results of the modeled existing conditions, indicates that the extension of the beach control structure streamlines the bypassing of sediment and prevents it from entering the NU Sailing Center and Clark Street Beach embayment because of its shore-parallel orientation.
2.4.5 Summary

In summary, the results of this assessment indicate that the project has minimal impacts on the large-scale sediment transport processes at this location. The impact may even be considered positive since the extension of the beach control structure hinders sediment trapping in the Clark Street Beach embayment and facilitate sediment movement towards the south and delivery to downdrift shorelines.

2.5 Assessment of Potential Local Project Impacts

In this section we assess if the project has any potential local impacts within the Clark Street Beach embayment and its vicinity. This is accomplished through prediction of the fate of the nourished sediment and to determine if that the placed material is expected to leave the initial nourishment location and potentially affect neighboring shorelines.

Bathymetric LiDAR information from 2008, topographic LiDAR information from 2012, and hydrographic survey from 2021 (J.F. Brennan Company, Inc.) were used to create the local model bathymetry. The final model grid extends approximately 1,000 feet beyond the City of Evanston limits in both the north and south directions along the shoreline and is shown in Figure 2.7.
The proposed beach fill, with a grain size of 0.175 mm, was placed on the existing lakebed to create the design beach elevation conditions. In Figure 2.8, the proposed sand fill to be placed in the embayment (including an overfill of 20%) is shown as additional bed thickness for input to the ST model. Due to the 20% overfill factor required by the IDNR, minor sediment loss from the beach cell can be expected after construction before the beach reaches equilibrium.

Figure 2.7: Model domain and bathymetry for sediment transport calculations (UTM coordinates)
Figure 2.8: Bed thickness of proposed sand fill for beach nourishment

This model was set up to simulate sediment transport inside and beyond the embayment to predict the movement and fate of the placed sediment. The 2011 waves were again utilized, but this time, a wider range of wave heights and wave directions were considered to include the impact southeasterly waves (which arrive directly at the design beach) as well. The model was thus run with waves greater than 1.6 ft (0.5 m) from both the north and south directions. This scenario represents a more complete picture of the sediment transport that occurs over most of the year. As 2011 had an above-average wave energy, the above arrangement simulated approximately 3.3 years of average wave activity for this site.

Figure 2.9 shows the final predicted bed level change under design conditions and indicates that the adjacent bed level is expected to change insignificantly. The model predicted limited movement of the placed sediment beyond the initial placement area. Sediment volume leaving the project site was quantified both beyond the embayment boundary, as well as beyond the initial beach nourishment extents (shown in Figure 2.10). The total sediment volumes from this analysis are provided in Table 2.3. Given that the total volume of sand to be placed for beach nourishment is approximately 5,300 yds$^3$, even the maximum amount predicted to leave after construction completion (16.3 yd$^3$) is less than 1% of the total placed material volume. In addition, the reality is that the lakebed outside of the beach nourishment area is not actually a hard bed (unlike what was modeled) and has some level of sediment cover. The new sand material being placed will also be either have the same grain size or slightly larger than the existing (D$_{50}$ greater than 0.175 mm). Both factors are expected to further reduce the potential of sediment leaving the project site and the embayment.
Figure 2.9: Predicted bed level change with proposed conditions (waves greater than 0.5m from north to south directions)
Table 2.3: Sedimentation Results

<table>
<thead>
<tr>
<th>Area of Interest</th>
<th>Wave Scenario</th>
<th>Sediment Volume Accumulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beyond Embayment</td>
<td>&gt;0.5m waves (N to S)</td>
<td>7.3 yd³</td>
</tr>
<tr>
<td>Beyond Nourishment</td>
<td>&gt;0.5m waves (N to S)</td>
<td>16.3 yd³</td>
</tr>
</tbody>
</table>

2.5.1 Summary

In summary, the results of this assessment indicate that the project has minor impacts on local sediment transport processes. After initial construction, insignificant amount of sediment leakage can be expected beyond the beach fill area towards the Clark Street beach as well as outside of the embayment, the latter would make its way into the large-scale LST system. However, the corresponding impact is expected to be insignificant compared to the volume of the existing background alongshore transport (i.e., approximately 25,000 yd³/year).
3. Conclusions

Based on the model results, this project is not expected to have significant impacts on any of the neighboring and downdrift shorelines south of the project site, including Clark Street Beach, the Church Street Boat Ramp, or the remainder of the shoreline to the southern City of Evanston limit. The extension of the beach control structure will not block the existing regional southward longshore sediment transport coming from the north, and the additional sand fill will not have a measurable impact on the Clark Street Beach or beaches further to the south.

Variations in Lake Michigan water levels typically cause adjustments in shoreline positions. As demonstrated by Figure 3.1, the width of Clark Street Beach increased during periods of lower water levels (2000 to 2014). This will continue to happen after construction of the proposed improvements as lake levels continue to fluctuate in the future. Severe storms are still expected to impact the short-term stability of the beach by causing temporary beach erosion. Such natural variations would continue to dominate beach conditions in the study area.

Figure 3.1: Shoreline Comparison Under Low Water Levels – Clark Street Beach Shoreline Analysis