Hika Park Boat Launch Feasibility Study

Study Report

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Study Report

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Rev A	2/24/2023	Draft	For comment	PST	RPA	MD
Rev 0	5/26/2023	Final	For Issue	PST	MD	RPA

Table of Contents

Tables

Figures

1. Introduction

Hika Bay Park (Hika) is a unique public park located on Lake Michigan in the Village of Cleveland, Wisconsin. Hika spans across approximately 1,000 lineal feet (LF) of open shoreline with the northern 700 LF consisting of a public beach area. A small, naturalized stream, the Centerville Creek, drains into Lake Michigan near the southern end of the beach area. The shoreline south of the stream outlet consists of nearly 300 LF of stone revetment, which was installed in late 2020, with a two-lane concrete launch ramp at the southern end of Hika. An overview of the existing conditions is provided in the image below.

Figure 1.1: Hika Bay Park Overview Map

The primary objective of this study is to assess the feasibility of improving the boat launch capabilities at Hika. The existing launch ramp simply provides a concrete ramp that slopes directly into Lake Michigan. While this has served local boaters and anglers for several decades, it is both degrading and often has limited functionality due to its direct exposure to the open coast environment. Over the past few years, the Village has retained various consultants, including MSA Professional Services, Inc. (MSA) and Cedar Corporation, to develop initial concepts for reconfiguring the park and boat launch. Most recently, three conceptual boat launch replacement alternatives were presented within the Hika Park Master Plan update, issued by Cedar Corporation in 2020.

Figure 1.2: Boat Launch Concepts from 2020 Hika Park Master Plan Update (c/o Cedar Corporation)

The Hika boat launch ramp is an important amenity to the community. However, simply replacing in-kind may not solve issues that inhibit ramp functionality and use (i.e., wave exposure, sedimentation, and limited depth during periods of lake levels) and more costly options, such as those shown above, risk not performing as planned. To that end, the Village of Cleveland, WI has retained W.F. Baird & Associates (Baird) to study the feasibility of constructing a new boat launch facility at Hika Park. The purpose of this study is to evaluate the functionality and feasibility of several boat launch alternatives, including those previously developed by others, and help the Village select the most practical option.

1.1 Report Purpose

The purpose of this report is to provide a summary of the work completed to fulfill the project objectives, which include:

1. Investigate and address various engineering and environmental criteria for boat launch improvement concepts, including detailed data collection, wave and sediment transport modeling, and impacts to adjacent properties;
2. Comparatively assess the immediate capital expenditure (CAPEX) and long-term maintenance costs (OPEX) to develop probable life-cycle costs for each viable option; and
3. Document key decisions and consensus regarding a preferred boat launch improvement concept.

This report shall serve as a basis to help the Village make informed decisions regarding potential Hika boat launch ramp improvement options.

1.2 Funding Acknowledgement

This study was funded, in-part, by the Wisconsin Coastal Management Program and the National Oceanic and Atmospheric Administration, Office for Coastal Management under the Coastal Zone Management Act, Grant # NA22NOS4190085.

Additional local funding for this study was also provided by Cleveland Fish and Game.

2. Existing Conditions

An in-depth understanding of the physical setting and geomorphology of the project site is fundamental for comparatively assessing Hika boat launch ramp improvement concepts. Review of site conditions and its history often provides the best direct or indirect evidence on the local coastal conditions. A sound geomorphic understanding of a project area is also required to avoid unexpected negative impacts or unforeseen operational costs, such as related to dredging. This section provides a list of previous studies compiled and reviewed, a summary of Baird observations during the site reconnaissance visit, and results of several field investigations conducted for this study to better understand the ongoing littoral processes including sediment sources and sinks at the project site and to provide input conditions for numerical models.

2.1 Background Data Review

Several different groups have completed studies of the Hika shoreline over several decades. Table 2.1 provides a list of previous studies that were compiled and reviewed at the onset of this study. This was completed prior to undertaking field investigations to assess relevant data previously collected and identify data gaps to address during this study.

Table 2.1: Previous Hika Shoreline Studies

Year	Study
1972	Boat Launching Facilities Report (Donohue)
1987	Revetment Operations & Maintenance Manual for north unit of Hika Park shoreline, previously Village Wastewater Treatment Facility (US Army Corps of Engineers)
1996	Hika Bay Park & Dam Impoundment Area Park Site Master Plan (Bay-Lake Regional Planning Commission)
2001	Centerville Creek Watershed Evaluation and Streambank Stabilization (Inter-Fluve, Inc.)
2018	Harbor of Refuge Preliminary Coastal Analysis Report (MSA Professional Services c/o FreshWater Engineering)
2020	Site Observation Report – Hika Park Shoreline Protection Installation (Miller Engineers & Scientist)
2020	Hika Park Master Plan Update (Cedar Corporation)

2.2 Field Investigations

The Baird team completed the following field investigation tasks for this study from July 18th – 21st, 2022:

1. Visually assess/ photo-document site conditions;
2. Hydrographic survey (completed by J.F. Brennan Company, Inc.);
3. Lakebed jet probes (measuring nearshore sediment layer thickness); and
4. Lakebed sediment sampling.

Details and results for each field investigation task are provided below. Data collected during the field investigations were crucial inputs to the sediment transport modeling completed for this study.

2.2.1 Photo-documentation

The Baird team conducted a visual assessment of the Hika shoreline conditions during the field investigations. The following images depict key existing features, such as the boat launch ramp, removable boat pier, Centerville Creek bridge/ outlet, new shoreline revetment, and the naturalized beach area. Notable observations included:

- While the existing boat launch ramp is functional, observations of the concrete ramp structure indicate that this feature has undergone several ad-hoc repairs and currently showing signs of degradation/ disrepair (as shown in Figure 2.1 - Figure 2.3). The removable boat pier is typically in the water between April and October, and does not appear to impact the shoreline condition.
- The new revetment structure immediately north of the boat launch (constructed in 2020) appears to be in sound condition.
- Sediment buildup was observed at the Centerville Creek outlet but was not completely blocking flow into Lake Michigan.

Figure 2.1: Existing Concrete Boat Launch Ramp (Photo 1 – Baird, 2022)

Figure 2.2: Existing Concrete Boat Launch (Photo 2 – Baird, 2022)

Figure 2.3: Existing Concrete Boat Launch (Photo 3 – Google, 2022)

Figure 2.4: Shoreline Revetment (Baird, 2022)

Figure 2.5: Centerville Creek Outlet (Baird, 2022)

Figure 2.6: Photos of boat launch and project shoreline taken from boat (top, July 2022) and from air (bottom, April 2021 – c/o Wisconsin Coastal Management Shoreline Inventory)

2.2.2 Hydrographic Survey

Reliable bathymetric data is one the most important pieces of information required for setting up numerical model simulations of coastal conditions, including nearshore wave and sediment transport processes. A comprehensive hydrographic survey was specified by Baird and executed by the J.F. Brennan survey team for this study. Brennan utilized a multibeam echosounder (MBES) to acquire complete coverage of the lakebed in areas with depths >6 feet. For areas with less than 6 feet of water depth a single beam echosounder (SBES) was used to collect lakebed elevation profiles at 50 feet intervals. The hydrographic survey was supplemented by a topographic survey of the shoreline and Centerville Creek (approximately 500 feet upstream from Lake Michigan). Figure 2.7 shows the resulting combined elevation surface. The data extends approximately 1,500 ft on either side of the boat launch and out to approximately the 10 ft depth contour (approximately 1000 feet offshore). The figure indicates a sandbar is present out to approximately 5 feet depth, after which the lakebed is characterized by glacial till and limestone cobble and boulders, which was confirmed through jet probing.

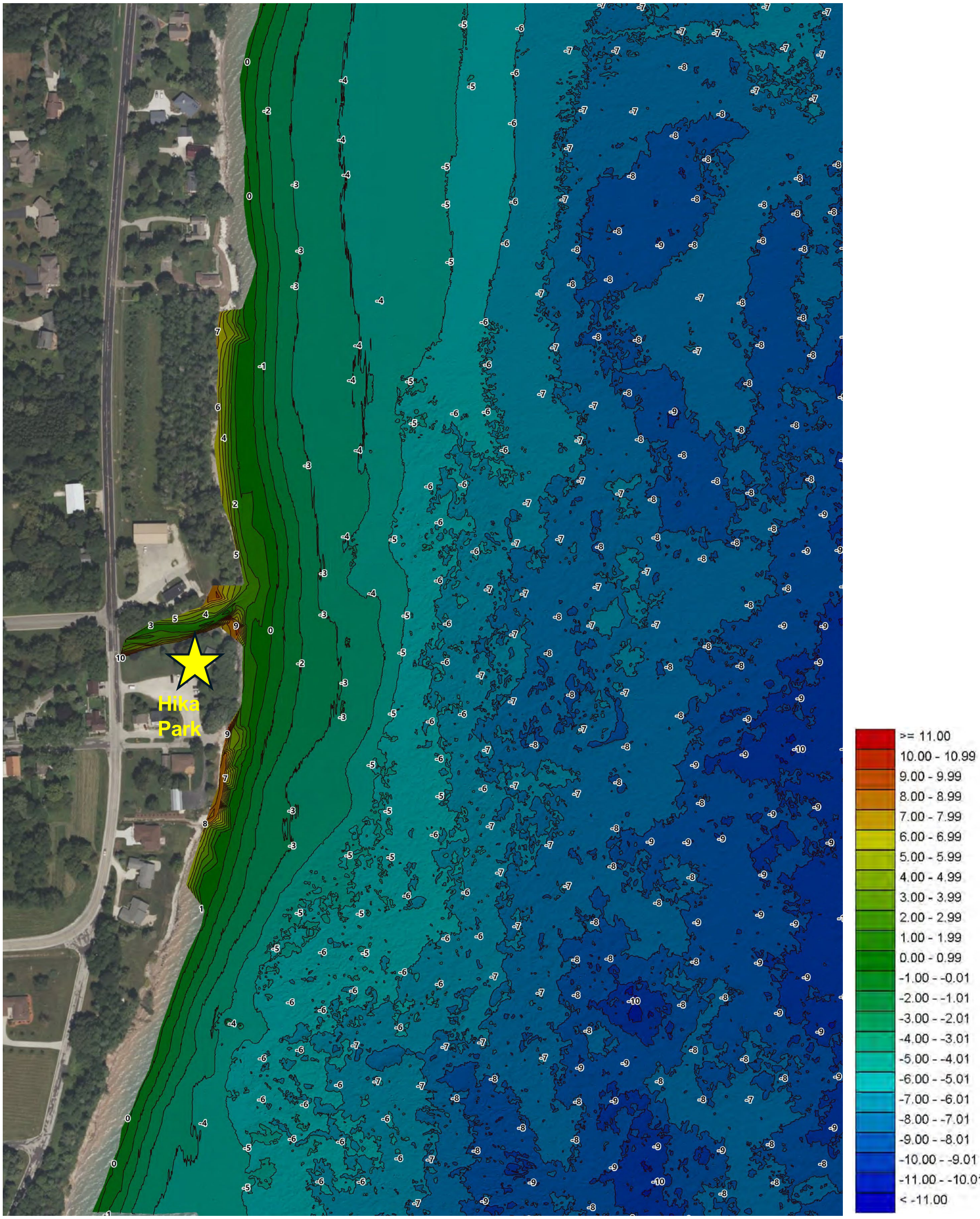


Figure 2.7: Bathymetry at Hika Park (ft, relative to Low Water Datum (LWD))

2.2.3 Jet probes

Baird field crew performed jet probe tests from onboard the J.F. Brennan survey vessel on July 27, 2022. A total of 39 jet probes were conducted to measure the thickness of erosive material (i.e., sand sediment) above the cohesive lakebed (i.e., glacial till, cobble material). Each jet probe location was surveyed with a GNSS rover using RTK corrections acquired through WISCORS Network, and located such that the nearshore sand cover could be interpreted across the site. For each jet probe, depth from the waterline to top-of-sand was measured using an expandable measuring rod, then sand sediment thickness was measured by driving a pipe (connected to a water pump) through the sediment layer until refusal.

Measured sand thicknesses (in feet) are shown along with bathymetry in Figure 2.9. Sand thickness generally varies from approximately 0.3 to 1.7 ft from the shore to the 5 feet depth contour, to essentially being absent further offshore except for intermittent pockets of sand between limestone cobble. An isolated pocket of deeper sand is found in the immediate vicinity of the existing boat ramp. It was observed during field investigations that significant prop wash occurred as the survey boat was being removed from the lake, as shown in Figure 2.8, and it can be supposed that this deeper pocket of sand is an artifact of this activity creating a scour hole which then traps sediment. In general, the Hika Park shoreline is thus located in a environment with limited sediment supply where sand appears only as a narrow band along the shoreline and in the nearshore area.

Figure 2.8: Prop Wash Exhibited During Vessel Takeout

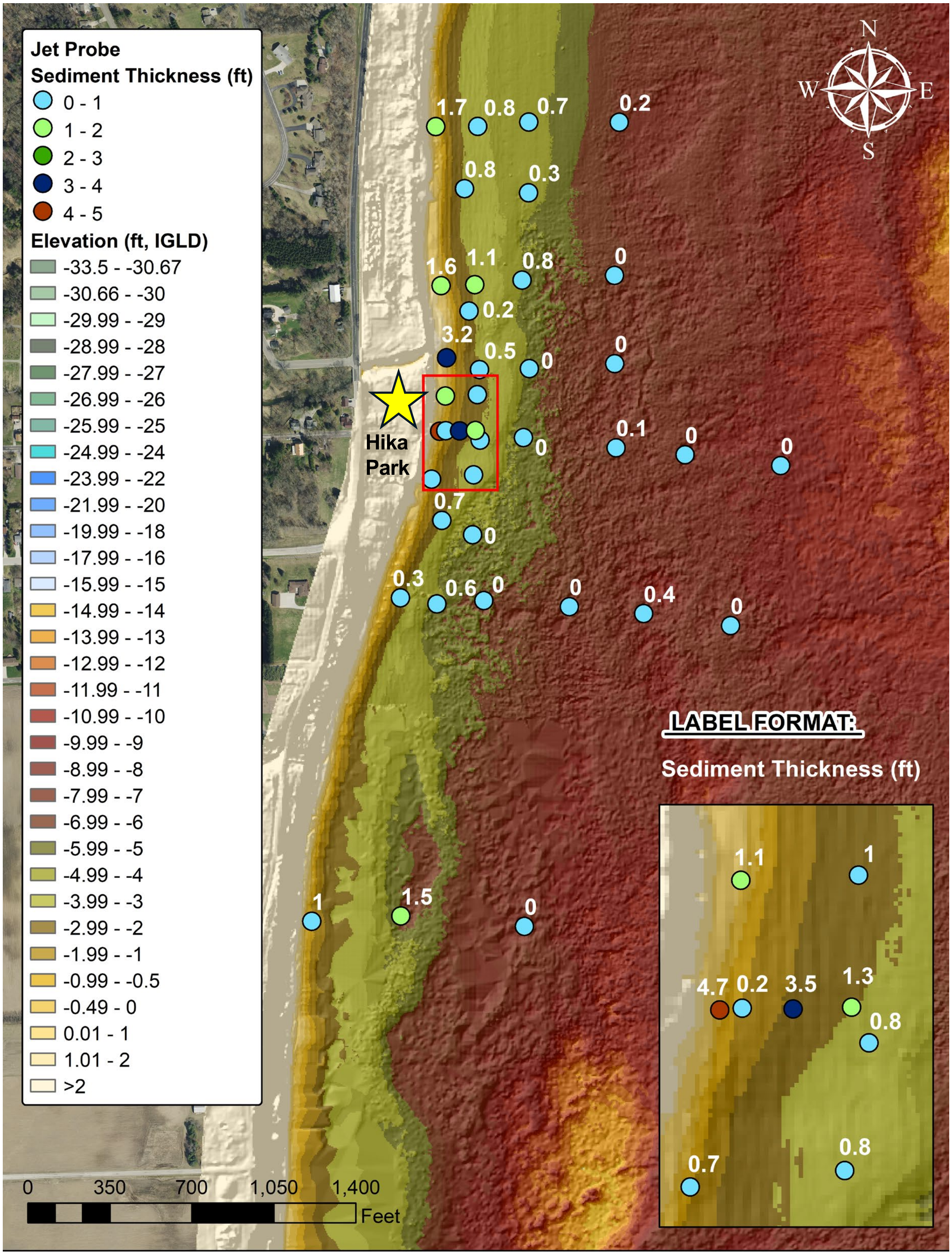


Figure 2.9: Sediment thickness measurements (ft)

2.2.4 Sediment sampling

Sediment samples were collected at six different nearshore locations using a PONAR grab sampler (Figure 2.10). Sieve gradation testing and hydrometer analysis were performed on selected samples by CGC in Madison, WI, the detailed results of which are include in Appendix A. Figure 2.11 provides results of particle size analysis for collected sediment samples. Lakebed sediment throughout the project area is composed of fine sand to silt, with coarse and medium sand representing less than 3% of all samples. The sediment grain size distribution results are key inputs to subsequent numerical modeling of coastal processes for this study.

Figure 2.10: Example of sediment documentation and sampling from onboard survey vessel

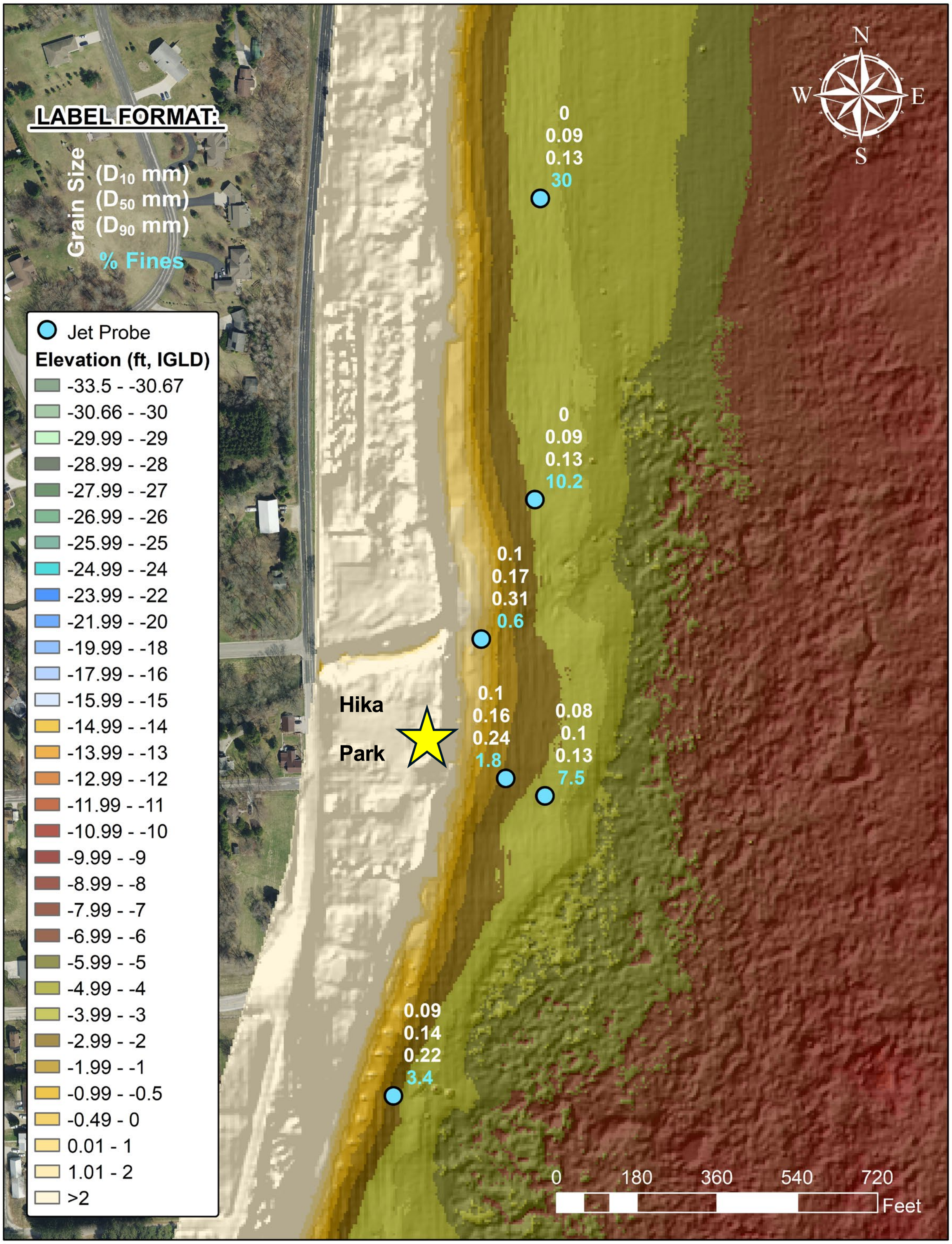


Figure 2.11: Sediment grain size distribution at Hika Park

2.3 Numerical Modeling of Existing Coastal Conditions

Numerical modeling is a powerful tool that helps coastal engineers 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 summary of water levels and a brief review of the wave climate - the main driving force behind sediment movement. Numerical simulation of longshore sediment transport in the project area using the COSMOS model is then presented to provide a better understanding of the sediment supply conditions. This information is important as any potential shoreline improvements that impede sediment transport need to be evaluated relative to the available supply. The MIKE21 modeling package by Danish Hydraulic Institute (DHI) is then applied to simulate sedimentation processes along the shoreline. A detailed understanding of the existing coastal conditions is key to comparatively evaluating proposed shoreline modifications.

2.3.1 Water Levels

Water levels on Lake Michigan vary on several different time scales in response to climatic processes. At the longest time scale, water levels vary on multi-year cycles based on changing precipitation and evaporation patterns over the Great Lakes drainage basin. As shown in Figure 2.12, the lake level has been higher than average since 2015 (following an extended period of below average lake levels) and reached a record high in 2020. In addition to long-term fluctuations in lake level, there are seasonal changes that take place within any particular year due to precipitation patterns and spring runoff, and the instantaneous water levels may be much higher or lower than the monthly average. The lake level generally reaches its maximum in the summer and its minimum in the winter.

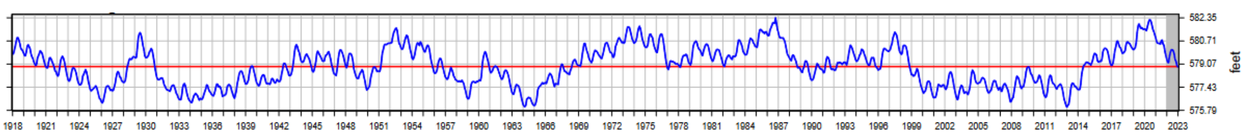


Figure 2.12: Lake Michigan Monthly Mean Water Levels (1918-2022)

Water level data recorded by NOAA at Kewaunee, WI was analyzed to define extreme water levels at the project site. More specifically, combined probability analyses of the historical water level record at Kewaunee (1976-2021) were undertaken to define extreme high water and extreme low water levels as a function of return period. The analyses included estimates of extreme values for static lake levels and storm surges, as well as their combined effect.

The extreme value analysis was carried out for water level elevations for the 5, 10, 25, 50, and 100-year events. A peak over threshold algorithm was utilized to identify significant surge events, and a combined probability analysis was completed to estimate the combined water level of monthly mean water level and storm surge. Table 2.2 displays the results of the combined water level as a function of return period.

Table 2.2: Extreme Water Levels as a Function of Return Period

	Combined Water Level	Return Period (years)				
		5	10	25	50	100
High Water	(ft IGLD85)	582.7	583.1	583.3	583.3	583.4
	(ft LWD)	5.2	5.6	5.8	5.8	5.9
Low Water	(ft IGLD85)	576.2	575.6	574.9	574.5	574.1
	(ft LWD)	-1.3	-1.9	-2.6	-3.0	-3.5

2.3.2 Offshore 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 1979-2018 period (i.e., 40 years) for a series of locations throughout the Great Lakes. Data from WIS Station 94076 located in approximately 34 m (112 ft, 43.92° Lat and -87.64° Lon) water depth offshore of Cleveland was used for this analysis.

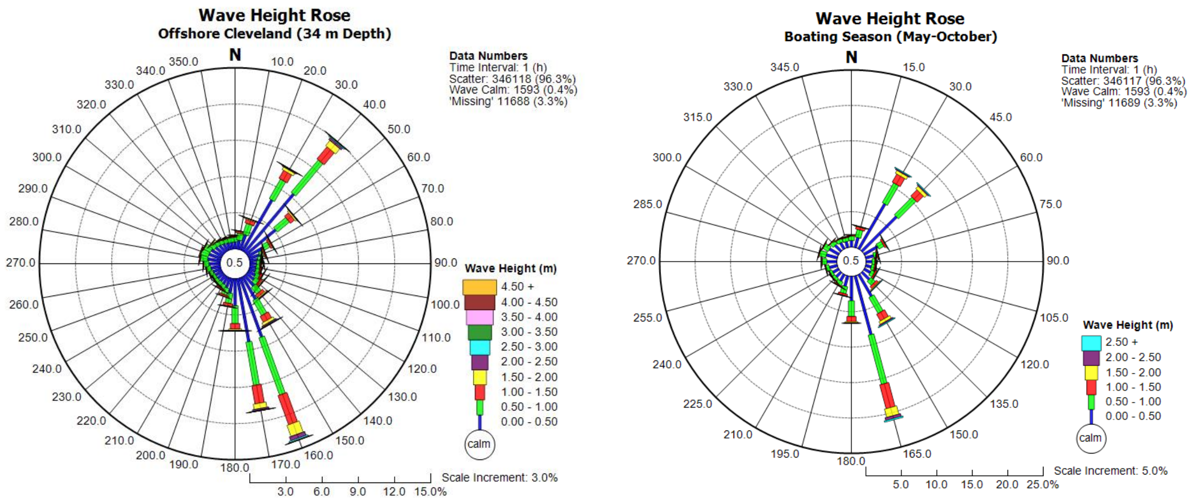


Figure 2.13: Offshore Wave Height Rose (Left Image, Full Calendar Year; Right Image, May-October)

The corresponding offshore/ deepwater wave rose(s) are shown in Figure 2.13. The left wave rose provides details for a full calendar year, while the right wave rose only shows data for the boating season (May – October). Further examination of the wave data indicates the following:

- Offshore waves arrive from the north (N) to east (E) window, generating southward directed transport, approximately 34% of the time.
- Significant wave heights up to 15 to 16 ft may occur during extreme storms from northeast direction.
- Significant wave heights up to 14 to 15 ft may occur during extreme storms from southeast direction.
  - During the boating season (May – October) significant offshore wave heights during extreme storms from either direction (i.e., northeast or southeast) are approximately 8 to 10 ft.
- Offshore waves arriving from the north (N) to northeast (NE) window occur approximately 27% of the time, with wave heights reaching up to 13 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 7% of the time.
- Predicted wave periods range between 2 and 10 seconds.

2.3.3 Longshore Sediment Transport (COSMOS Modeling)

Longshore sediment transport (LST) is the natural migration of nearshore sand material parallel to a shoreline. To develop a better understanding of 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, wave, and water level data as input, to predict LST rates. The model has been extensively used, 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 LST rates. Figure 2.14 shows the predicted net annual potential LST and its eastward and westward components for the 1979-2018 period. The results indicate considerable variability in the predicted annual potential LST direction and rate. LST is bimodal along this shoreline, meaning that while in any given year the predominant sediment transport direction may be to the north (green) or to the south (blue), the Hika Park shoreline will experience transport from both directions, annually as well as over a multi-year period. The following key details were derived from the COSMOS model results:

- The maximum predicted net annual LST was approximately 183,000 cubic yards (in 1993), which was predominantly to the south.
- Conversely, the maximum predicted net annual LST to the north was approximately 86,000 cubic yards (in 2019).
- The minimum values for the same metrics were approximately 3,000 cubic yards to the south (in 2012), and approximately 3,000 cubic yards to the north (in 2002).
- The predicted long-term average net potential transport is approximately 18,000 yd3/year towards the south, with 80,000 and 98,000 yd3/year northward and southward components, respectively.

Figure 2.15 shows the predicted LST rate and its northward and southward components as functions of depth. This figure indicates that northward longshore transport is greater than the southward transport in water depths less than 10 feet, while in depths >10 feet (green arrow) southward transport predominates. Predicted sediment transport in depths greater than 30 ft is insignificant.

It is noted that COSMOS assumes that the entire profile is covered with sand. The jet probe data collected by Baird (presented in Section 2.2.3/ shown in Figure 2.9) indicated that only a narrow band of sand is present in the nearshore area. Actual LST rates are thus less than the predicted potential values presented above. Figure 2.9 also indicates that the narrow band tapers down between -3 ft and -5 ft LWD depths and almost disappears beyond/ offshore of the -5 ft LWD depth. From Figure 2.15, it is observable that actual net annual LST rates out to -3 ft and -5 ft LWD depths are predicted to be predominately northward at approximately 4,300 and 3,500 yd^3/year, respectively (red arrows). In other words, while the potential net transport is predicted towards the south, the actual net transport is towards the north due limited availability of the sediment. Nevertheless, given the bimodal nature of the LST along this shoreline, any proposed shore-perpendicular structure could potentially impede sediment transporting in either direction.

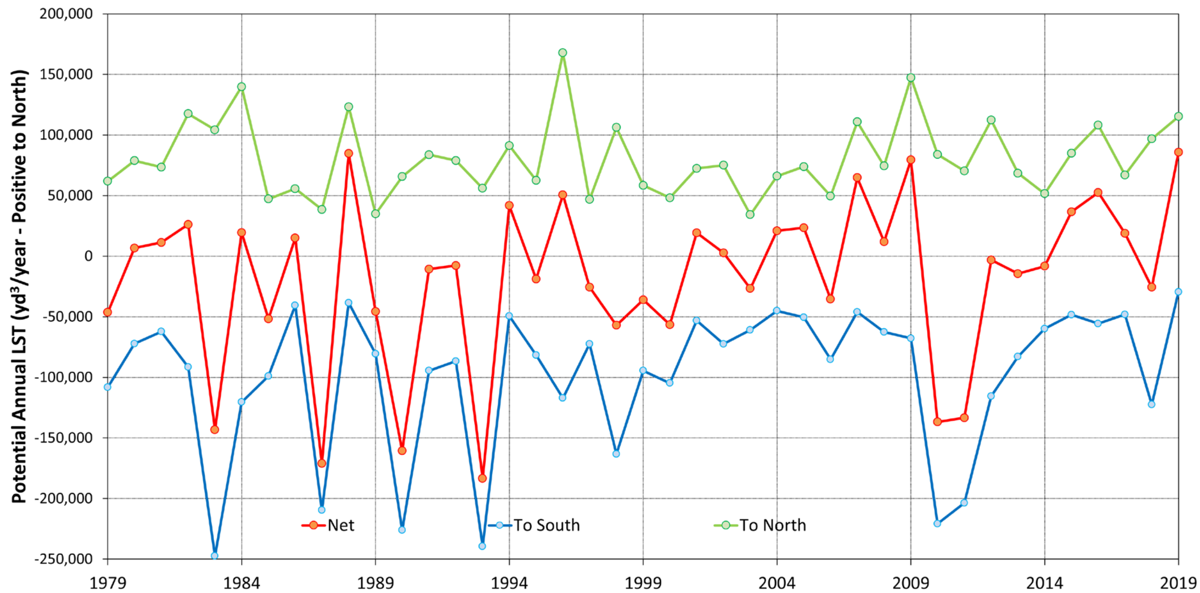


Figure 2.14: Predicted potential annual longshore transport rates (yd³/year)

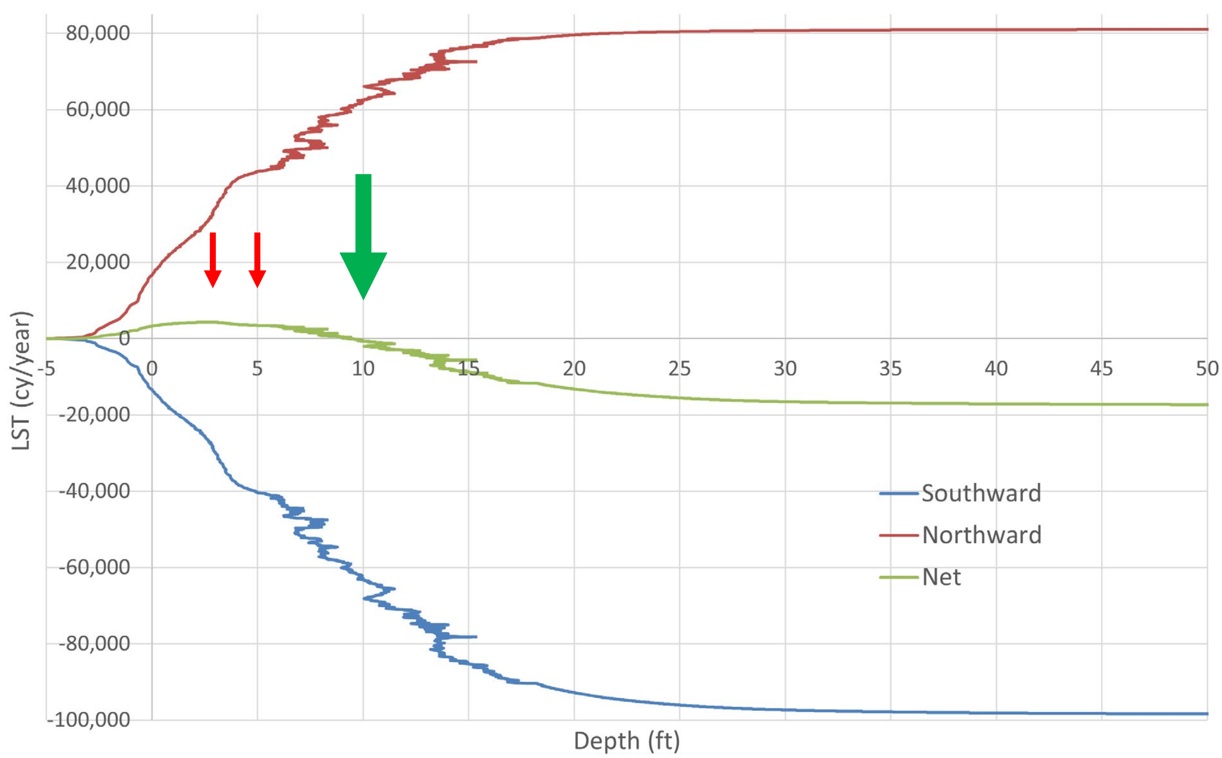


Figure 2.15: Predicted potential annual longshore transport rates (yd3/year) compared to depth (ft, LWD)

2.3.4 Nearshore Coastal Processes (MIKE 21 Modeling)

The Danish Hydraulic Institute (DHI) MIKE21 modeling package was used to model the nearshore coastal processes for this study. The MIKE21 modeling 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 lakebed sedimentation. The model domain for this study is shown in Figure 2.16.

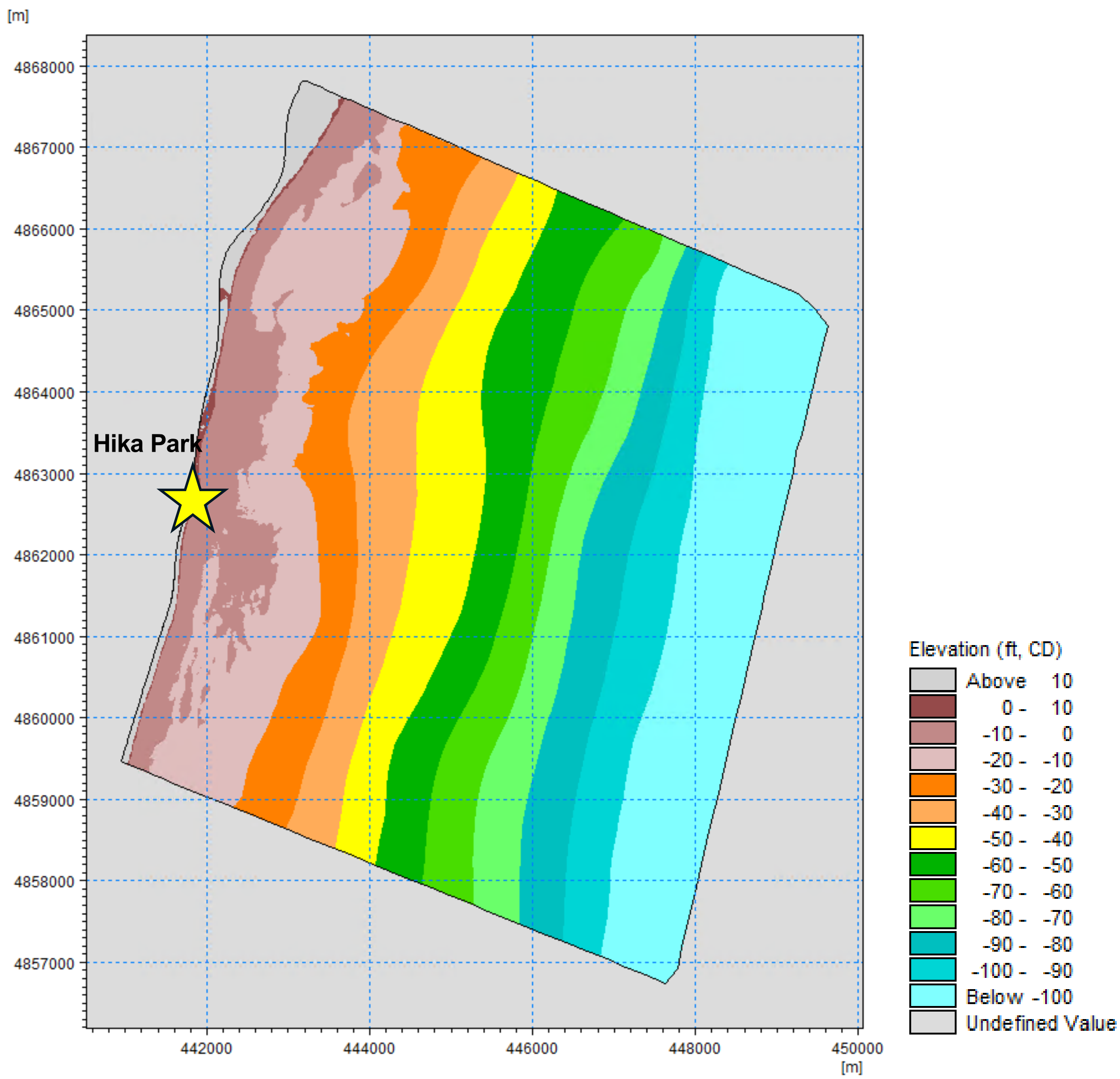


Figure 2.16: Model domain and bathymetry for sediment transport calculations (UTM coordinates)

The hydrographic survey, sediment thickness measurements, and grain size information discussed in Section 2.2 were used to create a sediment thickness map as input to the ST model. Sand was removed at depths greater than -5 ft LWD as the hydrographic survey showed glacial lakebed offshore of that depth. Maximum sediment thickness was capped at 3 ft based on jet probe measurements. Sand with median grain size of 0.2 mm was assumed.

2.3.4.1 Wave Transformation (SW) & Hydrodynamic (HD) Modeling

Figure 2.17 shows an example of simulated waves around the Hika shoreline in either a southerly or a northerly storm event. Offshore northerly and southerly waves undergo refraction and arrive from the east direction as they approach the Hika shoreline. There are currently no man-made offshore structures (i.e., breakwater) to shelter the shoreline from incoming waves. However, the profile of Hika Bay is relatively shallow, 1:50 up to -3 ft LWD and then flattening to 1:120 or greater beyond that, resulting in gradual wave energy dissipation in the nearshore, especially at lower water levels. Furthermore, as there are no manmade or natural bed features running perpendicular to the shoreline, these waves generate currents that enable an uninterrupted longshore sediment transport pattern along the Hika shoreline.

Figure 2.18 shows the predicted nearshore currents corresponding to the wave conditions presented in Figure 2.17. Under both a southerly and a northerly storm event, the incoming longshore current passes uninterrupted along the shoreline, as expected given the lack of shore-perpendicular impediments. The nearshore current pattern indicates that sediment is free to move in both the north and south directions at this location.

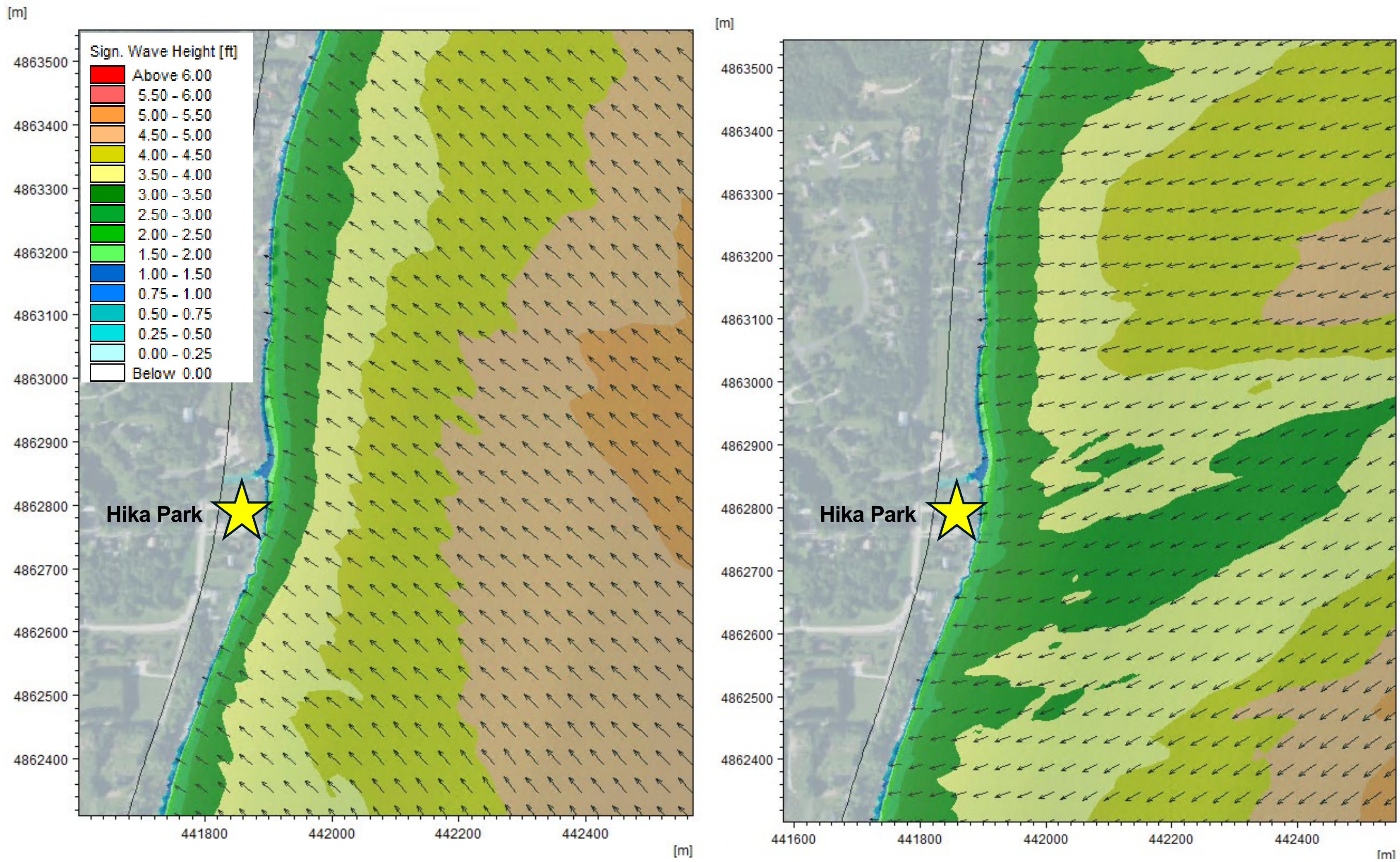


Figure 2.17: Example model results for nearshore wave transformation in a design southerly storm (left) and northerly storm (right)

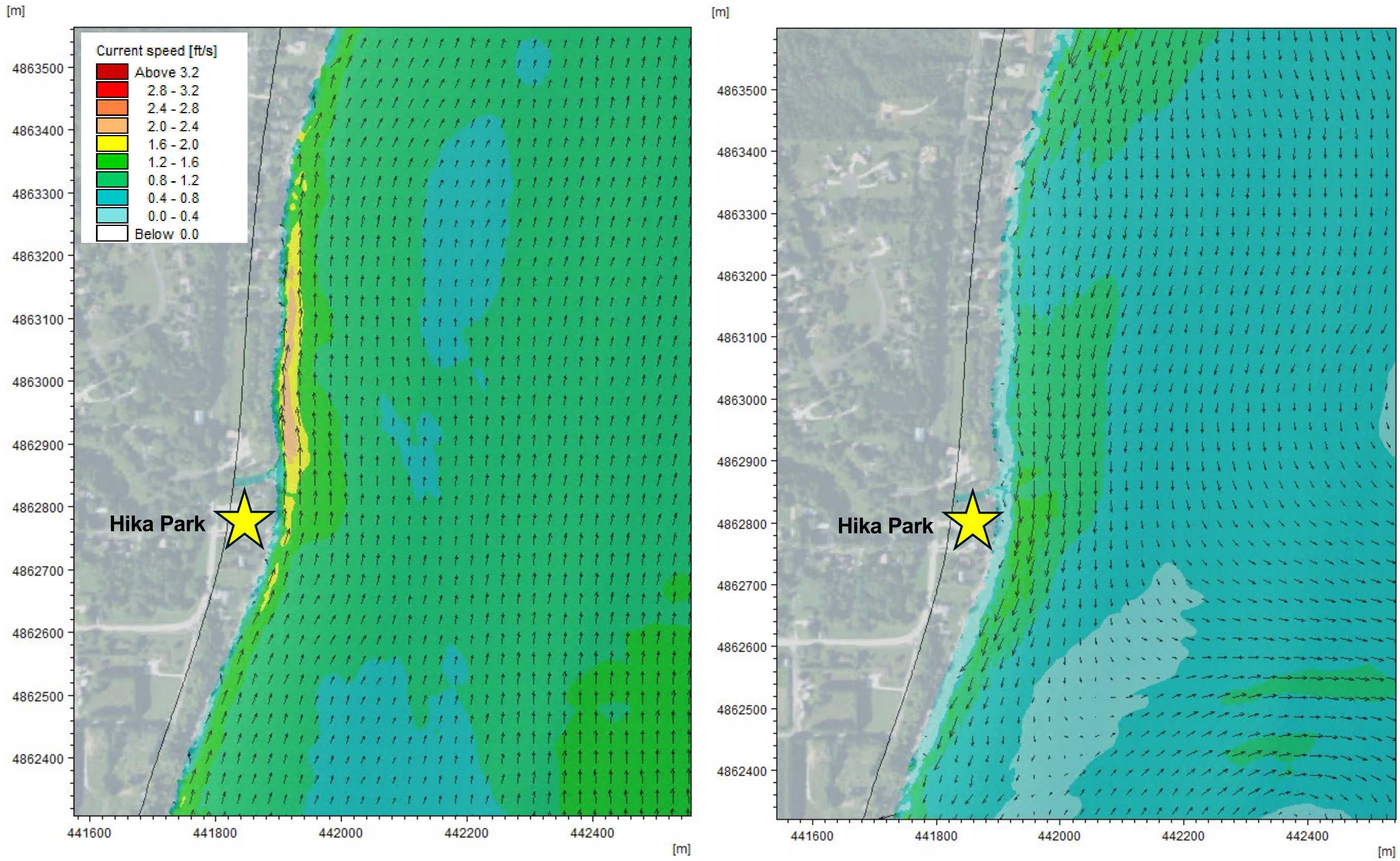


Figure 2.18: Example model results for nearshore currents in a design southerly storm (left) and northerly storm (right)

2.3.4.2 Sedimentation (ST) Modeling

Existing sedimentation processes were modeled using a time series of wave conditions that represent a one-year long simulation. The WIS data indicated that 2000 was an average year in terms of recorded wave energy during the hindcast period (Figure 2.19) and was thus selected as the simulation year to showcase the sedimentation processes. Because sediment transport calculations are time demanding the following parameters were utilized for setting up the MIKE21 ST model to simulate sedimentation volumes across the Hika shoreline:

- Since most of the transport occurs during storm events, offshore waves of 4.9 ft (1.5 m) height and greater were selected to create an hourly time series of input wave conditions (see Figure 2.20).
  - This led to a total of 359 hourly wave conditions to represent one-year of storm wave action.
  - The largest wave height in the time series was approximately 11.6 ft high with 8.5 s wave period.

Figure 2.21 shows the modeled sediment transport patterns developed during the year-long simulation. Model results indicate that sedimentation occurs in a depositional sand bar from the shoreline to approximately the 5 feet depth contour. Sedimentation at the mouth of Centerville Creek is also reproduced by the model. Whether or not significant sedimentation is contributed from Centerville Creek is unknown, as insufficient data is available for that assessment. The model therefore only considers sediment contributed through wave-driven longshore transport.

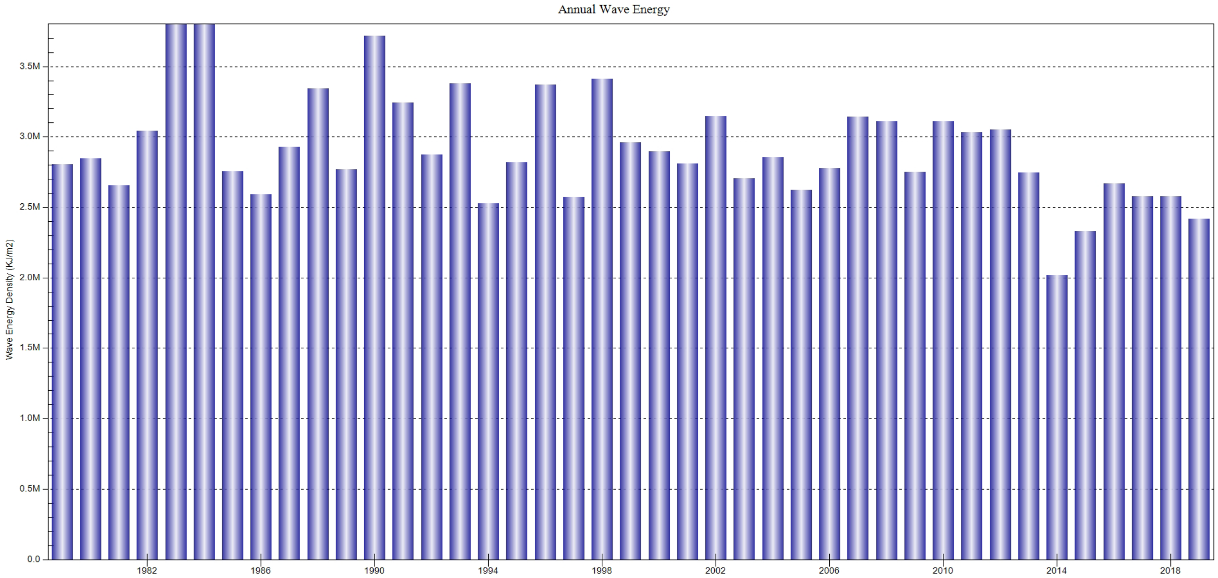


Figure 2.19: WIS annual wave energy (WIS 1979 – 2018)

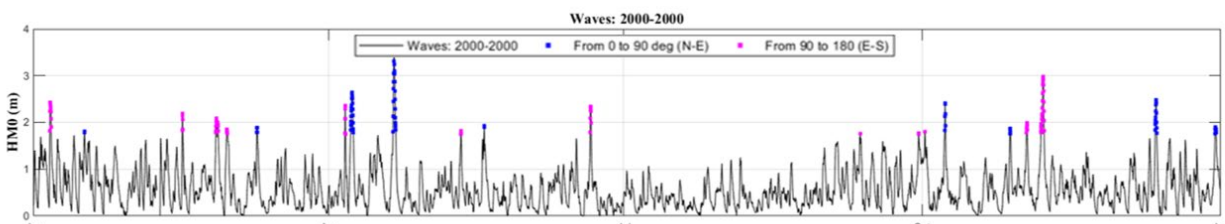


Figure 2.20: Recorded wave events in year 2000 above 4.9 ft (1.5 m) peak height (HM0) threshold

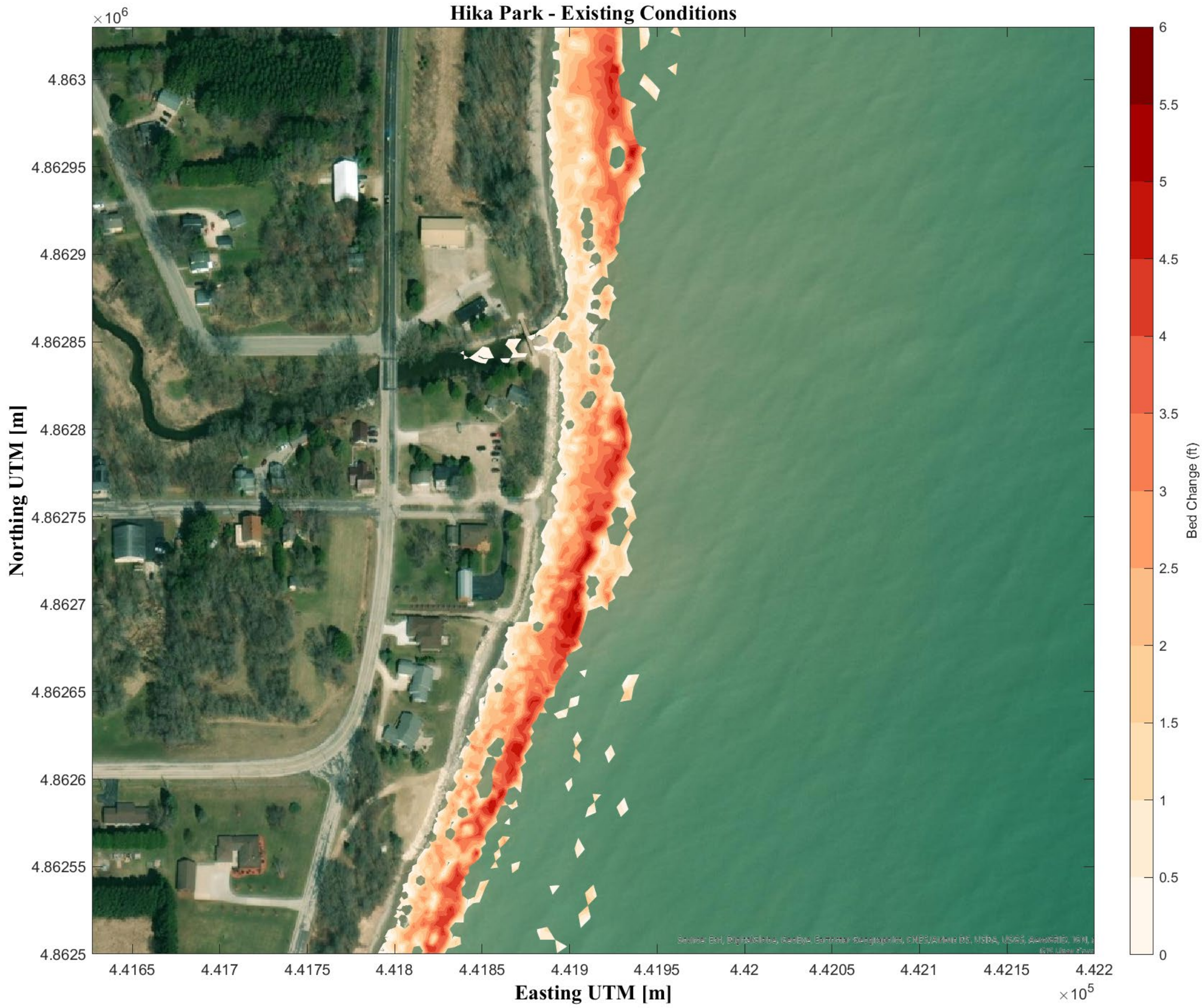


Figure 2.21: Predicted sedimentation pattern at the end of one-year simulation – Existing conditions

3. Schematic Design

Users of the Hika Park boat launch currently face scenarios where, because of the unprotected nature of the launch, a boat going out in favorable (i.e., calm) conditions may end up returning in moderate or rough conditions where it is dangerous to attempt docking and removing their boat. At times when multiple boats are queuing to leave, the danger of drifting off-course and encountering hazards increases. As such, boat launch users have expressed a desire to create a harbor of refuge around the Hika Park boat launch which would provide shelter and improve safety.

The objective in this section is to both evaluate/ refine schematic concepts previously developed by others (i.e., MSA and Cedar Corporations) and explore the functionality/ feasibility of alternative boat launch improvement concepts. In total, four different schematic concepts have been evaluated for this study, including:

- Concept 1 – MSA Preferred Alternative
- Concept 2 – Single Groin Alternative
- Concept 3 – Double Groin Alternative
- Concept 4 – Replace-in-Kind

Numerical modeling was completed to assess the functionality of the proposed schematics (i.e., sheltering) and evaluate potential impacts (i.e., sedimentation, erosion, maintenance dredging, etc.). An engineer's opinion of probable construction cost (OPCC), including both capital expenditures (CAPEX) and operating expenditures (OPEX), was developed for each option to comparatively evaluate the feasibility of the concepts.

Of note, a preliminary evaluation of the three options presented in the Hika Park Master Plan Update (Cedar Corporation, 2020) was completed prior to advancing the assessment of schematic concepts through modeling and costing. The results of the preliminary evaluation are presented below.

3.1 Evaluation of Preliminary Options

Option 1 from the Hika Park Master Plan Update, also known as the MSA Preferred Alternative, was determined to be feasible for modeling and cost estimation based on the following:

- Option 1 was selected as the preferred alternative by the public.
- No obvious obstacles to construction or operation were identified.

This option is referred to as Concept 1 – MSA Preferred Alternative for this study.

Option 2 from the Hika Park Master Plan Update, a single groin adjacent to a relocated and reoriented boat launch, was evaluated as being infeasible for modeling and cost estimation. As conceived, the groin is not shown at a realistic scale (i.e., footprint shown is too small). However, it was determined that with modification to show the groin at a realistic scale and based on conceptual engineering calculations, this single-groin alternative could be modeled and costed for comparative assessment. The modified version of this concept is referred to as Concept 2 – Single Groin Alternative for this study.

Option 3 from the Hika Park Master Plan Update, two groins on either side of the mouth of Centerville Creek with an expanded mouth to act as a harbor, was evaluated as being infeasible for modeling and cost estimation. Similar to Option 2, the groins are not shown at a realistic scale, and dredging the mouth of Centerville Creek to create a harbor would be a considerable undertaking both from an engineering and a regulatory standpoint. The mouth of the harbor would be narrower than recommended according to published design guidelines[1] and would prove to be dangerous to navigate and maneuver in with a small craft. In principle, however, the design has merits. A modified concept was drafted and presented to the Village of Cleveland which extended and widened the two groins, and following that presentation, was modeled and costed. The modified version is referred to as Concept 3 – Double Groin Alternative for this study.

Lastly, for comparative purposes, a replace-in-kind scenario was also considered where the current boat launch would be rehabilitated in its current position with no protection structures added. This option is referred to as Concept 4 – Replace-in-Kind for this report.

Descriptions of the four schematic boat launch improvement concepts evaluated for this study are provided below, followed by a discussion of the concept's functionality (numerical modeling) and feasibility assessment.

3.1.1 Concept 1 – MSA Preferred Alternative

Concept 1 features two shore-perpendicular stone groins, one a stub groin (275 LF) to the south and the other groin (533 LF) wrapping around the north and east side of a proposed harbor of refuge. Dredging within the proposed harbor area is required to provide sufficient depths for accessing the new/ sheltered launch ramp. Additional improvements include reconfigurations to the existing parking lot and the option of including a seasonal floating pier for temporarily docking small crafts (i.e., recreational, transient, and charter vessels).

The harbor basin will be dredged to -4.5 ft LWD, which provides nearly 6 feet of navigable water depth when compared to the long-term mean Lake Michigan water level (1.4 ft LWD). The proposed harbor basin is approximately 170 feet wide on the north-south axis and 235 feet wide on the east-west axis, which provides ample space for launching and maneuvering small craft vessels. The initial dredge volume for the Concept 1 harbor basin is approximately 9,500 cubic yards (CY), comprised of surficial sands atop cobble/ glacial till. Regulatory agencies typically require placing imported sand adjacent to shore-perpendicular structures to create a fillet beach for the purpose of reducing negative shoreline impacts (i.e., downdrift erosion due to sand supply reduction). As such, fillet beaches have been included both north and south of the proposed harbor.

A rendering depicting Concept 1 from an aerial perspective is shown below in Figure 3.1. A schematic plan and section are shown in Figure 3.3.

[1] American Society of Civil Engineers (ASCE) Manual of Practice No. 50, Planning and Design Guidelines for Small Craft Harbors (2012).

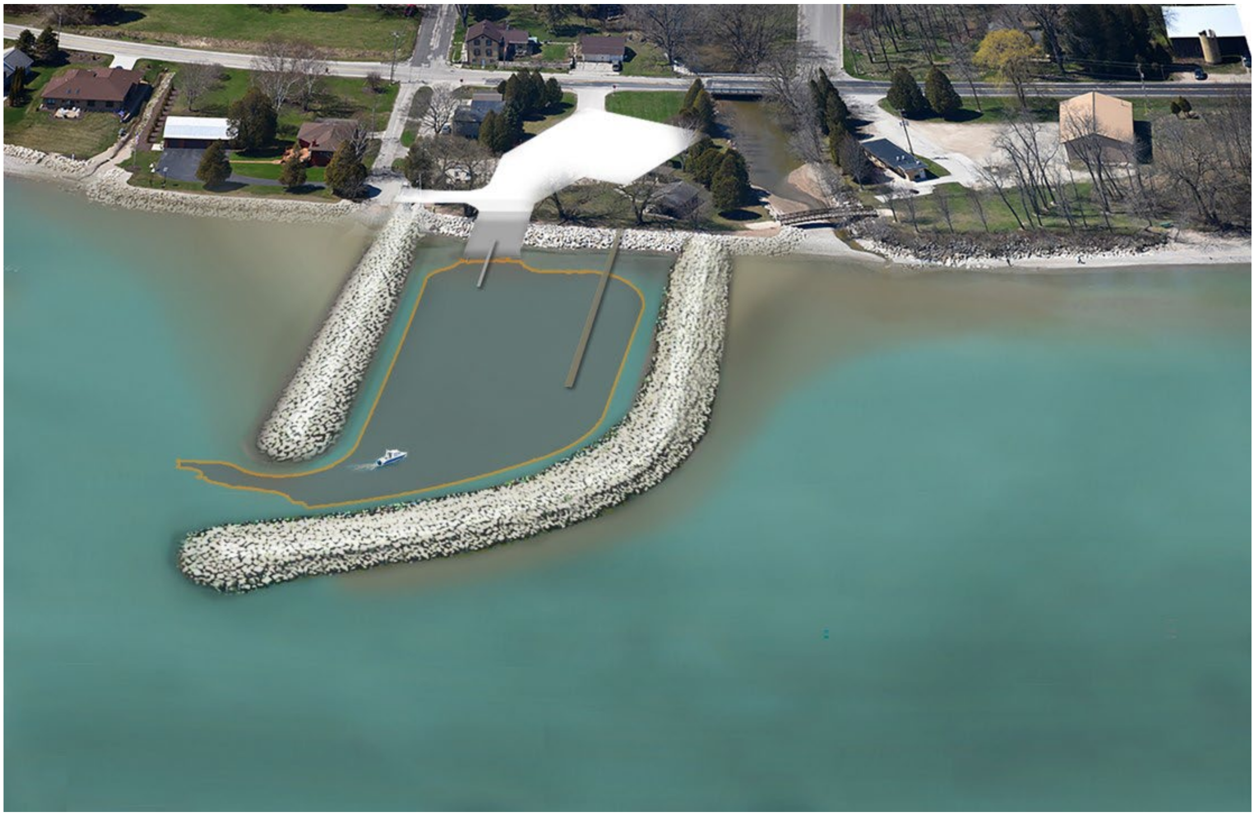


Figure 3.1: Concept 1 Rendering

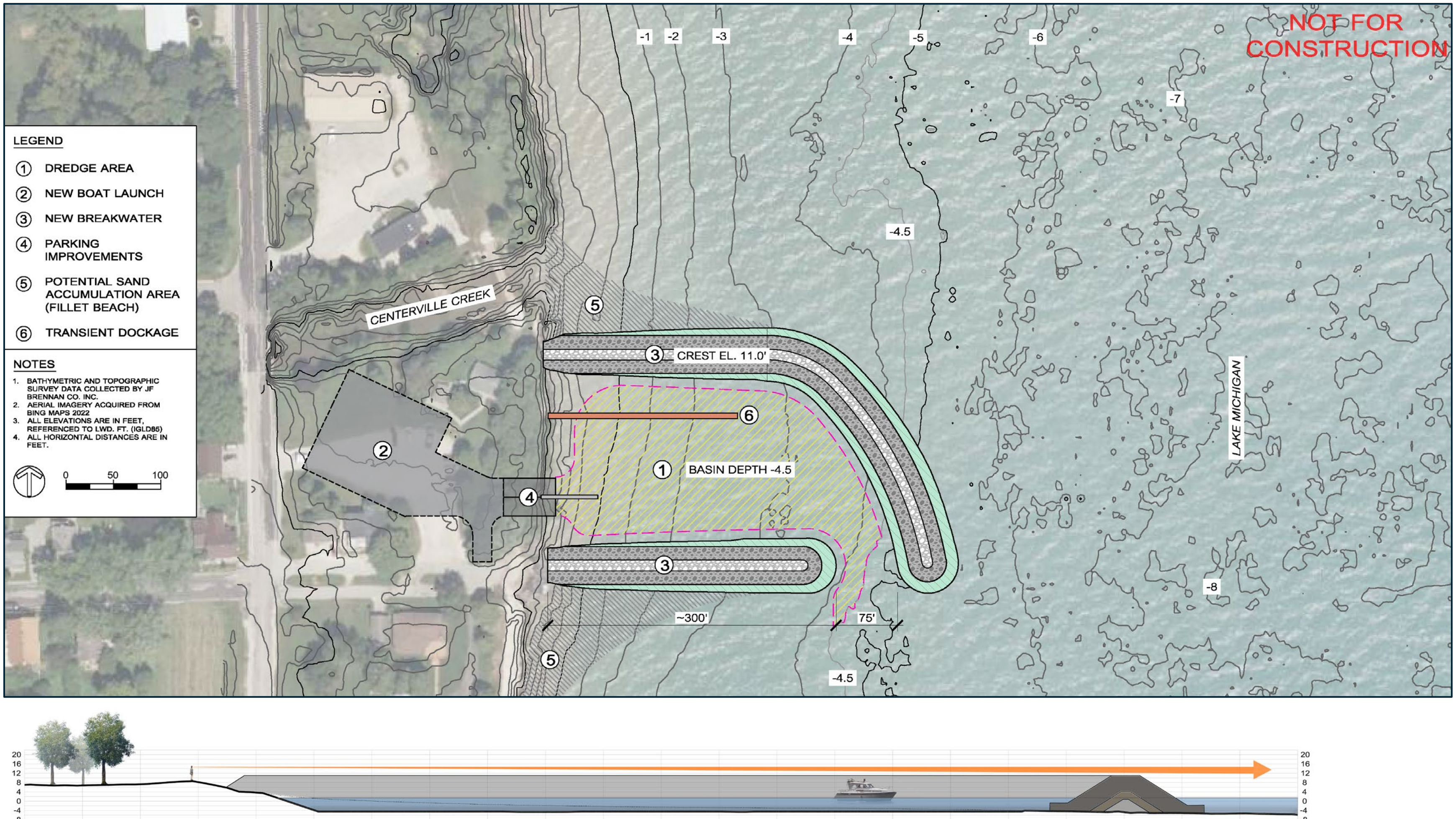


Figure 3.2: Concept 1 Plan and Section

3.1.2 Concept 2 – Single Groin Alternative

Concept 2 features a single (250 LF) shore-perpendicular groin located at the approximate midpoint of the existing shoreline revetment, with a reconstructed boat launch in its current location. The purpose of the groin structure is to offer the launch ramp some degree of sheltering from northerly-oriented waves, however, use of the ramp will likely still be similar to existing conditions due to the limited protection provided by the sole groin.

Of note, shoreline perpendicular groin structures can trap sediment naturally moving along the shoreline and because longshore sediment transport is bimodal here, sediment would accrete on both sides of the groin. The proposed groin location (i.e., mid-way between the ramp and creek outlet) was selected to maximize the space for fillet beach development on both sides of the groin, while minimizing additional sedimentation near the boat launch and/ or Centerville Creek. No initial dredging to deepen the lakebed near the ramp approach is proposed, as that would quickly re-fill with sediment, but sediment accretion may require some degree of maintenance dredging. Numerical modeling of both waves and sedimentation patterns was completed for this concept, the results of which are presented in Section 3.2 of this report.

Figure 3.3: Concept 2 Rendering

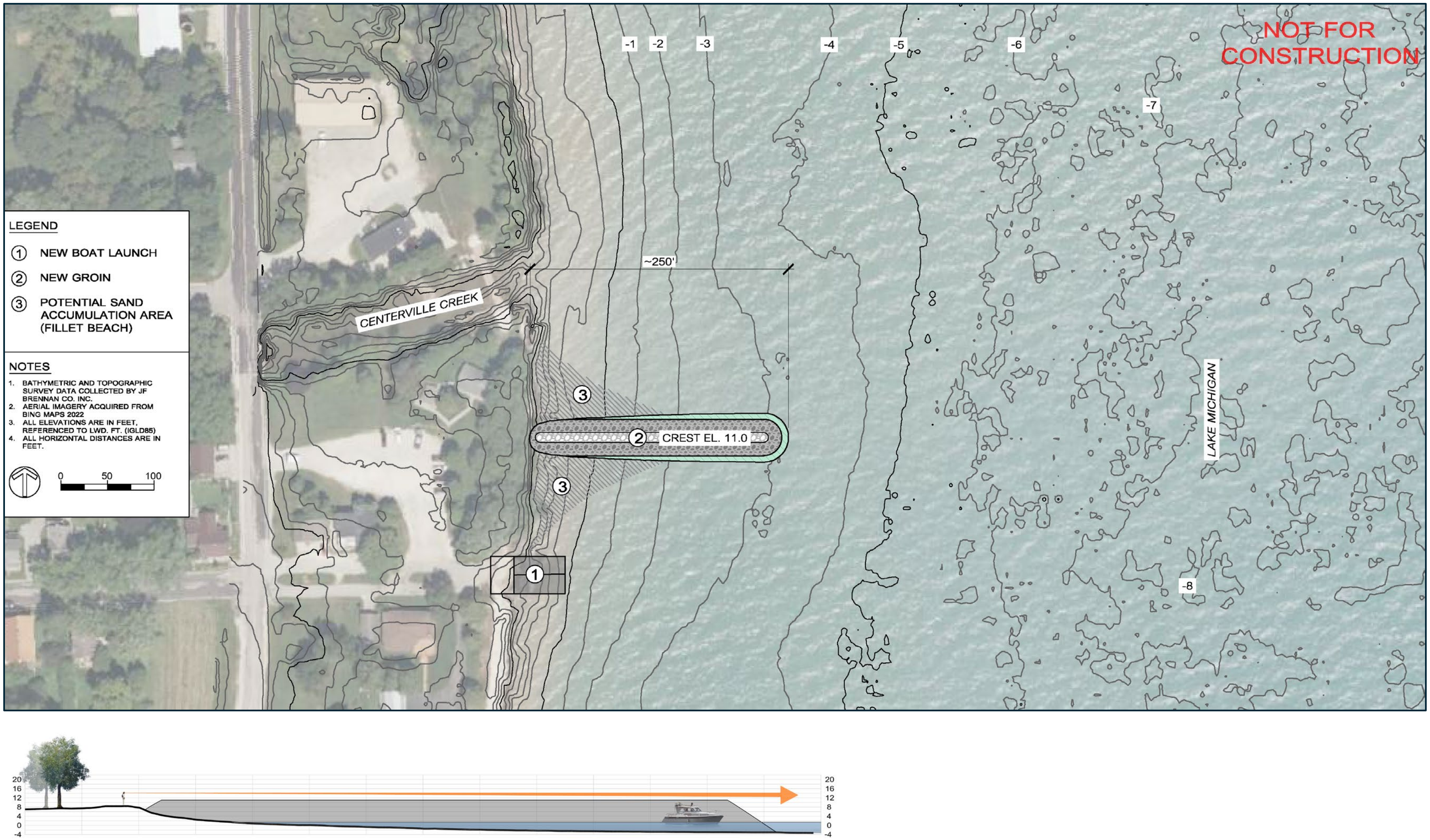


Figure 3.4: Concept 2 Plan and Section

3.1.3 Concept 3 – Double Groin Alternative

Concept 3 features two curved shore-perpendicular stone groins, which are each approximately 545 feet in length and mirrored on either side of the mouth of Centerville Creek. The proposed groins were located such that Centerville Creek outlet will not be impacted by sediment buildup, and curved to facilitate sediment bypassing and minimize downdrift impacts. The boat launch is relocated to the sheltered area between the proposed groins and reoriented to match the proposed dredge channel alignment. Additional improvements to the existing landside/ parking lot are also required for this concept. The floating pier featured in Concept 1 has been omitted in this schematic design; however, there is ample space for this structure in the proposed protected harbor area created by the two groin structures.

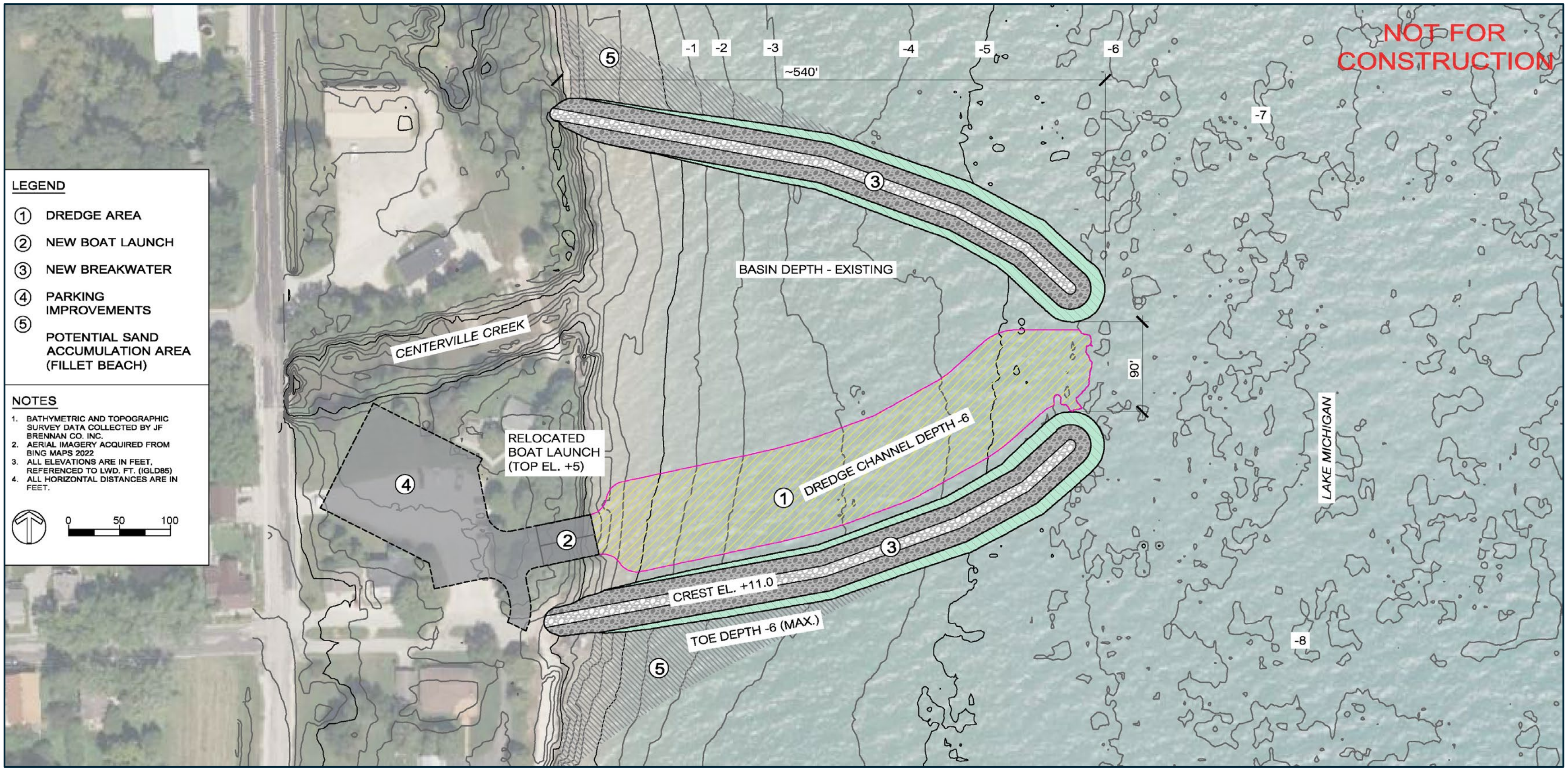
While this groin design creates a larger protected area, only the southern portion will require modification for boating. Dredging is proposed to provide a 90-foot-wide navigation channel from the harbor entrance to the proposed launch ramp. The proposed dredge depth for the navigation channel is -6 ft LWD, which provides approximately 7.4 ft of water depth when compared to the long-term mean Lake Michigan water level (1.4 ft LWD). Approximately 4,200 CY of material (i.e., sand and cobble) would be dredged to construct this channel. Dredged sand material could be re-used for the construction of fillet beaches, which are proposed both north and south of the protected area.

While the northern portion of the protected area is left unaltered in the currently proposed schematic design, this would be an ideal location for future aquatic habitat improvements (i.e., seiche wetland) given the existing depths (~1 to 6 ft), proximity to the Centerville Creek outlet, and protection from coastal waves and ice flow. Similar to Concepts 1 and 2, numerical modeling was utilized to refine this proposed concept, the results of which are presented in the next section of this report (Section 3.2).

3.1.4 Concept 4 – Replace-in-kind

Concept 4 involves removing/reconstructing the Hika boat launch in the same location. No numerical modeling was completed for this concept as it the dredging is minimal compared to other concepts and there are no engineered shoreline protection improvements. Refer to Section 4 of this report for an engineer's OPCC for this/ each proposed schematic design concept.

Figure 3.5: Concept 3 Rendering



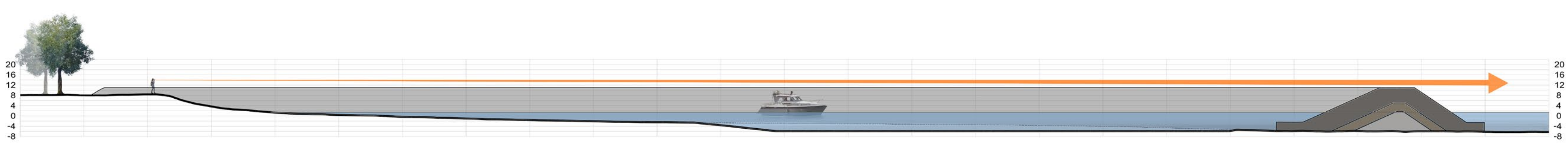


Figure 3.6: Concept 3 Plan and Section

3.2 Numerical Simulation of the Proposed Concepts

The proposed concepts described above were included in the numerical model domain and their performance in reducing wave energy and their impacts on sediment transport were simulated. The concepts were modeled using the MIKE21 modeling package under the same parameters for the existing conditions for Hika Park as noted in Section 2.3.4, namely simulating waves around the Hika shoreline with both southerly and northerly storm events as well as the selected year-long wave climate (i.e., 359 hourly wave conditions to represent one-year of storm wave action) for sediment transport simulations. It is assumed Concept 4 would not differ from the existing conditions, as this alternative is a replace-in-kind design, so it was not modeled.

3.2.1 Criteria for Modeling Evaluation

To evaluate the functionality of the different concepts, both wave height and peak wave period were considered. Generalized harbor tranquility goals established in the ASCE 50 Planning and Design Guidelines for Small Craft Harbors, broken down by wave direction, were then applied to give an indication of performance for each concept. The harbor tranquility goals are intended for evaluating boats berthed in a marina on a permanent basis, and so are conservative for the situation at the Hika Park boat launch where boats will principally be in transit.

Table 3.1: Generalized Harbor Tranquility Goals (Provisionally Recommended Criteria for a "Good" Wave Climate in a Small Craft Harbor)[2]

Direction of Design Harbor Wave	Wave Event Exceeded Once a Year
Head Seas	Less than 1-ft wave height
Beam Seas	Less than 0.5-ft wave height

3.2.2 Concept 1 Modeling Results

The wave model results for Concept 1 – MSA Preferred Alternative (Figure 3.7) show that the proposed harbor shelters the launch ramp from significant wave action during northerly and southerly storm conditions. The condition at the entrance to the harbor in a northerly storm is as sheltered as the rest of the harbor (i.e., waves <1 ft) with very minimal wave transformation around the eastern leg of the north breakwater. In a southerly storm, because of the predominant wave direction, there is more wave penetration into the harbor, creating a choppier condition at the harbor entrance with waves of around 2 to 3 feet, but over a short distance calming to waves of 18 inches and then 6 inches or less in the harbor. Nevertheless, the entrance to the harbor in a southerly storm could be hazardous if navigable depths are not maintained (i.e., if a sand bar is allowed to build up near the entrance it increases risk of boats running aground/ capsizing). For boats queuing in the harbor basin or moored at the transient dock, waves of between 6 and 18 inches could be experienced, depending on wave direction. In both a northerly and southerly storm, the condition at the boat launch is tranquil with waves of less than six inches.

[2] The complete ASCE 50 Guidelines break down the evaluation of harbor tranquility by wave direction as well as by peak wave period. All model runs simulated showed a peak wave period of 6.5 seconds, so tranquility evaluation criteria below this threshold were not included for simplicity. The guidelines also break down event occurrence as once in 50 years, once a year and once a week events, which were simplified to once a year to reflect the timeframe that was simulated.

The sediment model results for Concept 1 (Figure 3.8) show a sediment pattern at the end of one simulated year. North and south of the harbor, the pattern of sediment accumulation reflects the existing sand bar running parallel to the shoreline. Within and adjacent to the harbor, the model shows an altered pattern as a result of the proposed harbor. This pattern is indicative of places where sediment will continue to build up if not maintained (i.e., dredged) or naturally bypassed once equilibrium is reached (i.e., fillet beaches established). As a result of the proposed condition, the pattern shows sediment accumulating in three noteworthy places:

1. South of the southern breakwater including in front of/ within the harbor entrance
2. At the mouth of Centerville Creek; and
3. Along the east leg of the north breakwater.

Item 3 is the area of greatest change shown at the end of the one-year model simulation, but it is important to note that this sediment would continue to migrate to the north and south versus building up in this exposed area. Furthermore, the pattern of sedimentation shows accumulation in the form of fillet beaches at the mouth of Centerville Creek and at the harbor entrance. If sediment accumulation prevents Centerville Creek from draining into Lake Michigan, this potentially will cause upland flooding, especially during spring snowmelt and during heavy rainfall events. The dynamics of Centerville Creek were not studied as part of this report, so specific risks were not assessed. As previously noted, sedimentation at the harbor entrance/ within the harbor could be a potential hazard, particularly during periods of low lake levels, if navigable depths are not maintained.

Based on detailed assessment of the modeling results, it is estimated that the volume of annual sediment accumulation in front of/ within the proposed harbor entrance could vary from approx. 4,200 and 6,000 CY. OPEX estimates utilize these values for the low-end (4,200 CY) and high-end (6,000 CY) annual maintenance dredge volumes. It is important to note that there are many climatic factors that can impact the volume of annual sediment accumulation and/ or need for dredging (i.e., water level, ice cover, wind, wave, and storm events), but this methodology provides a means to comparatively assess each concept to identify which is most practical and economically viable overtime.

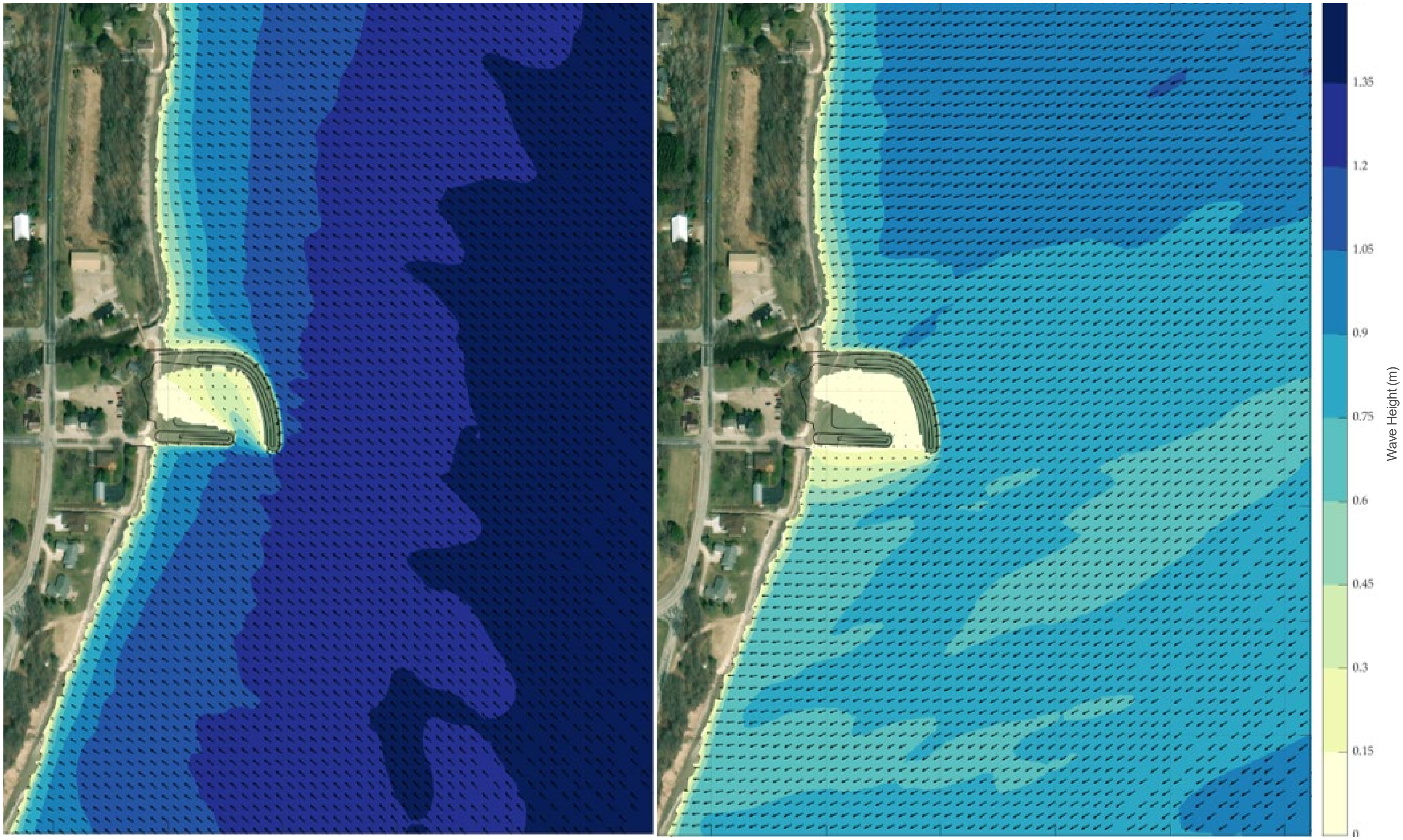


Figure 3.7: Concept 1 model results for nearshore wave transformation in a design southerly storm (left) and northerly storm (right)

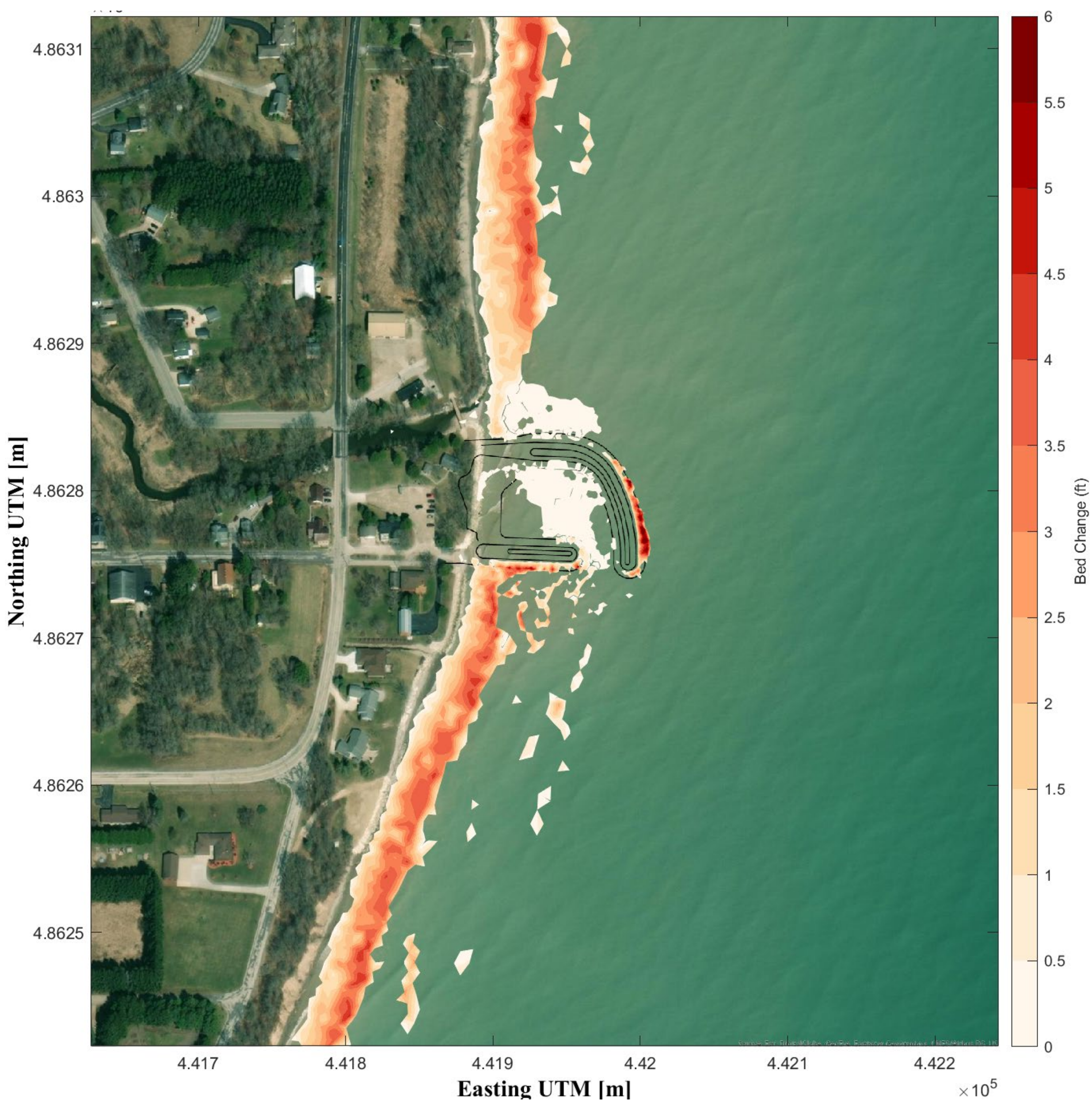


Figure 3.8: Predicted sedimentation pattern at the end of one-year simulation – Concept 1

3.2.3 Concept 2 Modeling Results

The wave model results for Concept 2 (Figure 3.9) show that the groin provides very minimal wave sheltering benefits near the proposed boat launch, during both northerly and southerly storm events. Wave conditions would be similar to existing, and unfavorable based on ASCE 50 wave criteria guidelines (refer to Table 3.1).

The sediment model results for Concept 2 (Figure 3.10) show sediment accumulating on both sides of the proposed groin at the end of the one-year simulation. The groin in Concept 2 does not have as significant an impact on longshore sediment transport as the groins in Concept 1, but nevertheless will cause some impact. From the modeling results, it is estimated that between 200 and 500 CY of sediment deposits near the groin annually. Pre-filling with sand adjacent to the groin is recommended to minimize adverse impacts downdrift. The position of the groin in Concept 2 was selected to allow for pre-filling/ reduce associated sediment accumulation at the boat launch and near the Centerville Creek outlet.

In general, constructing a single groin is not recommended due to the lack of functional benefits it provides (i.e., very minimal wave sheltering at boat launch and potential adverse longshore sediment transport impacts); however, for completeness, an OPCC has been developed for this concept to comparatively assess feasibility.

Figure 3.9: Alternative 2 model results for nearshore wave transformation in a design southerly storm (left) and northerly storm (right)

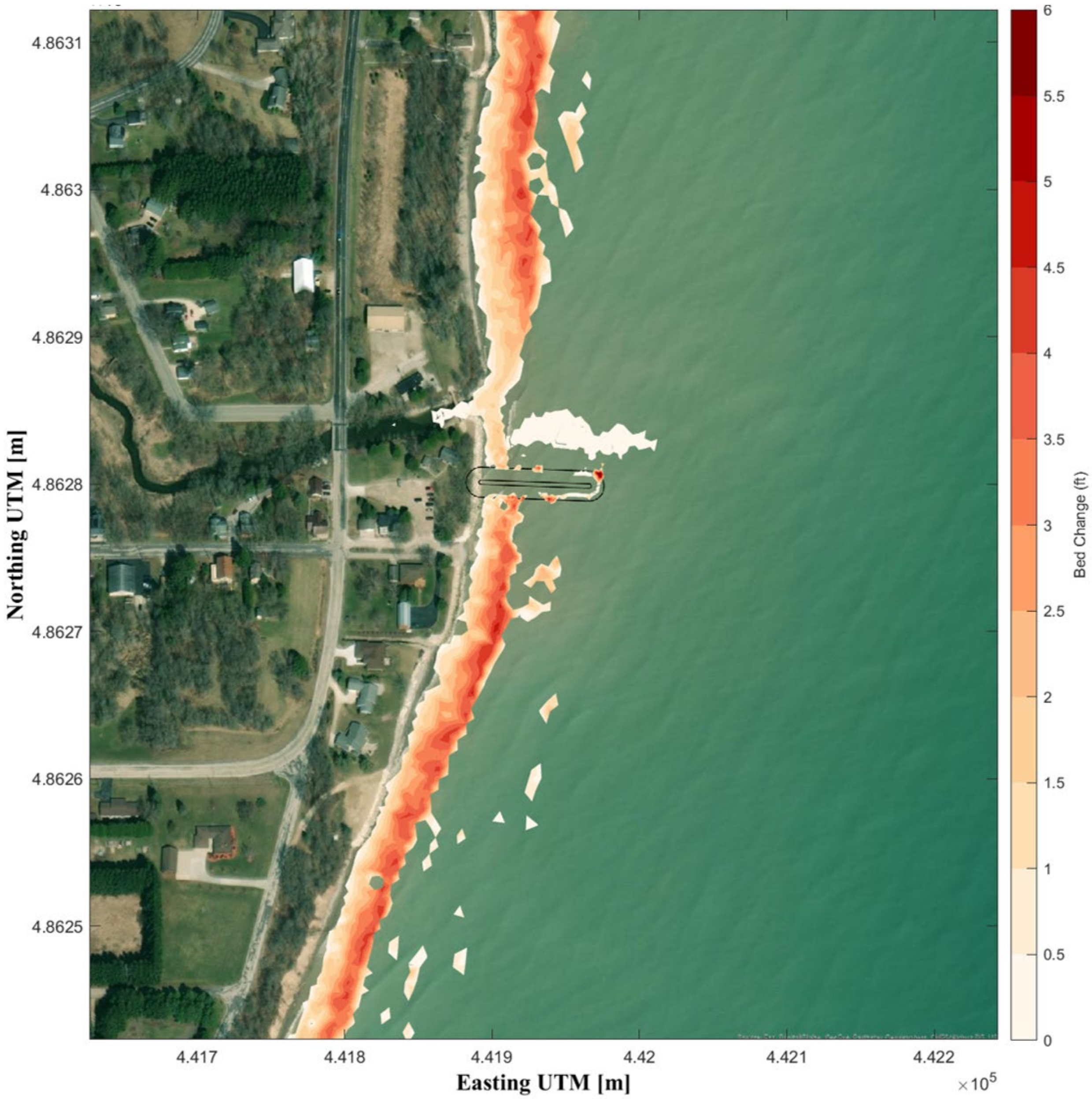


Figure 3.10: Predicted sedimentation pattern at the end of one-year simulation – Concept 2

3.2.4 Concept 3 Modeling Results

The wave model results for Concept 3 (Figure 3.11) show an overall reduction in wave height in the proposed harbor area for both northerly and southerly storm events. The location of the entrance gap (i.e., due east) was selected to facilitate sediment bypassing; however, that location allows wave energy in/ through the entrance gap during both northerly and southerly storms, which could make navigating through the gap challenging during extreme events. Modeling shows that wave heights significantly dissipate by the time they reach the boat launch (i.e., waves 1 ft or less at boat launch), which is located near the south corner of the protected area, approximately 550 LF from the gap.

The sediment model results for Concept 3 (Figure 3.12) show the pattern of where sediment will continue to build up if not maintained (i.e., dredged). As a result of the proposed condition, the pattern shows sediment accumulating along the shoreline, against the outer edge of the stone structures, both north and south of the proposed improvements – as expected. There is little indication of sedimentation occurring at the entrance to the harbor, meaning the layout is facilitating sediment bypassing. However, the results do indicate that some sediment does deposit in the proposed protected area. It is estimated that approximately 1,000 CY (low-end) to 2,000 CY (high-end) of sediment annually deposited in the protected area would accumulate in the navigation channel and require dredging.

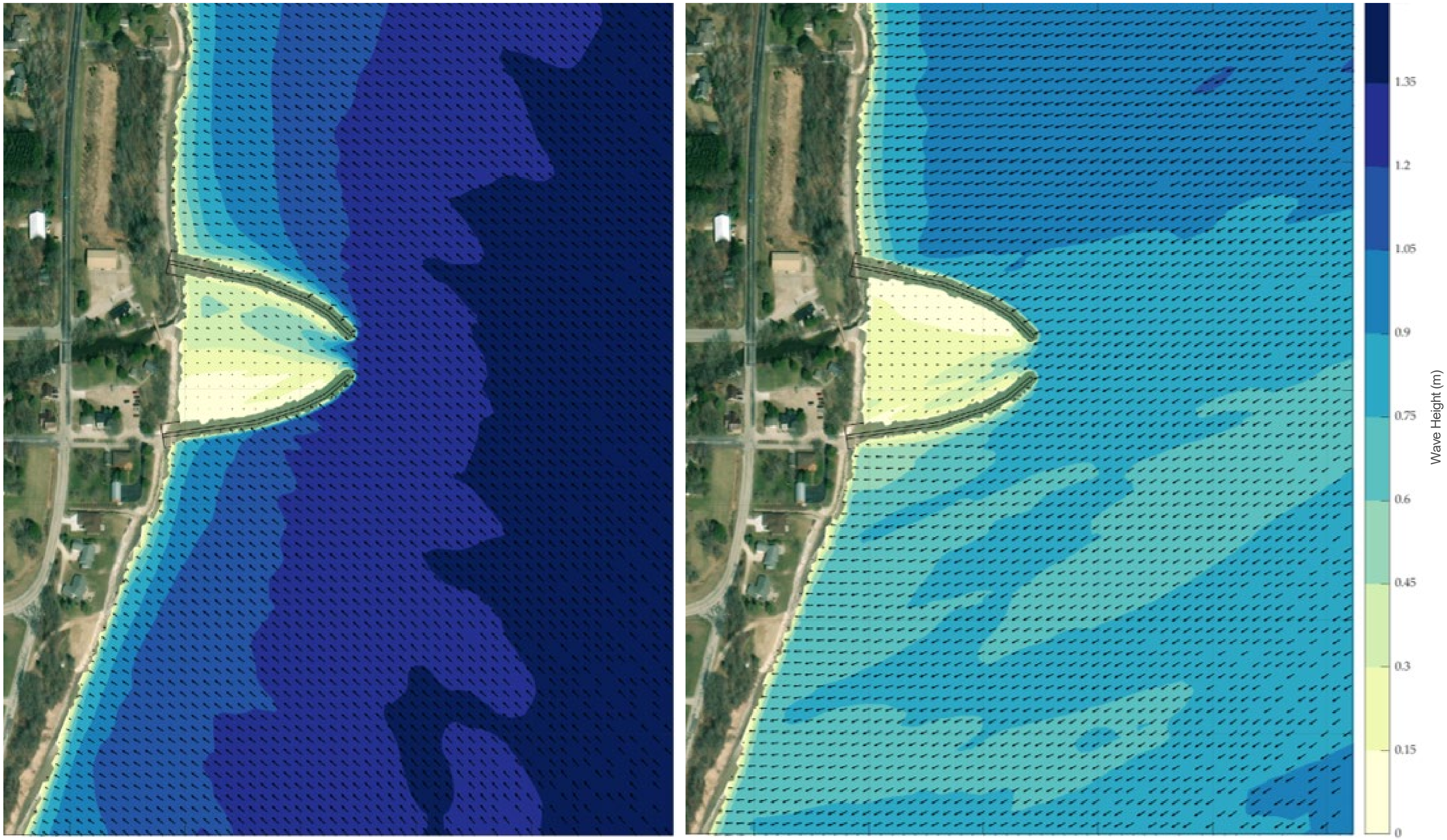


Figure 3.11: Concept 3 model results for nearshore wave transformation in a design southerly storm (left) and northerly storm (right)

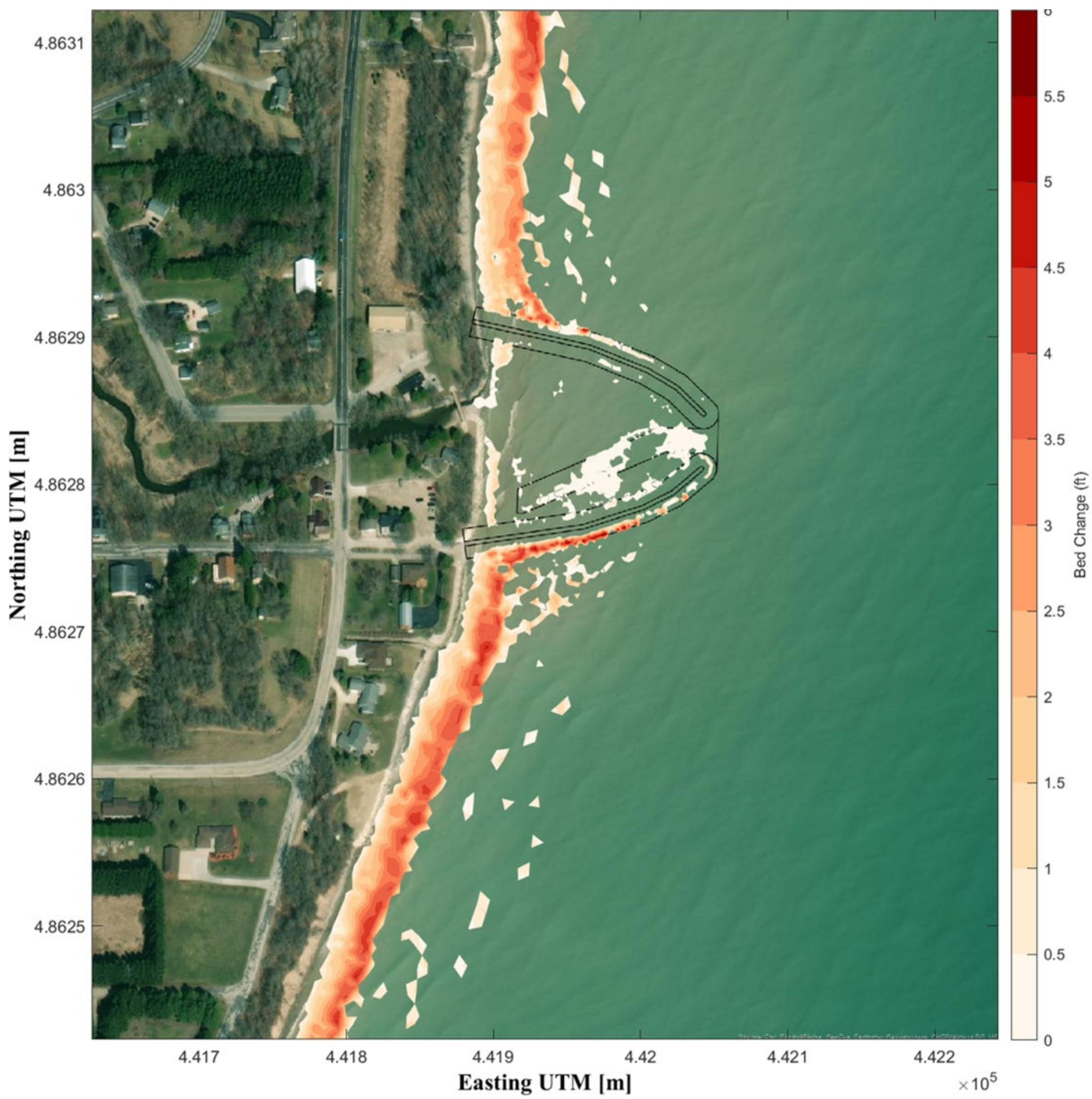


Figure 3.12: Predicted sedimentation pattern at the end of one-year simulation – Concept 3

3.2.5 Summary of Modeling

Modeling results for each concept are presented below, which compare wave height at the boat launch, at the harbor entrance (where applicable), and

In summary, MIKE21 model results confirmed satisfactory performance of Concepts 1 and 3 in reducing wave energy, while Concept 2 showed minimal reduction in wave energy. **Error! Reference source not found.** provides a summary of predicted annual maintenance dredging volumes for all concepts, based on sediment transport modeling. Operating expenditures (OPEX) associated with predicted annual maintenance dredging volumes are discussed in Section 4 of this report.

Table 3.2: Predicted lower and higher end sedimentation rates for proposed concepts

	Estimated Sedimentation Rate (yd^3/year) Lower end estimates	Estimated Sedimentation Rate (yd^3/year) Higher end estimates
Concept 1	4200	6000
Concept 2	200	500
Concept 3	1000	2000
Concept 4	Negligible	Negligible

3.2.6 Model Uncertainties and Limitations

It is important to note that all numerical models typically make assumptions to simplify complicated physical processes such that they can be mathematically expressed and numerically calculated. The models are an important and valuable tool helping the coastal engineer to better understand the physical environment and predict how his/her design would interact with nature thus supporting the engineer in making his/her final engineering judgment. Nevertheless, model results are limited by their underlying simplifying assumptions, and by both the spatial and temporal model input conditions. While the results provide reasonably accurate insight into the existing conditions and the performance of various design concepts relative to each other as discussed in the following section, actual required dredging volumes may vary depending on future wave and lake level conditions.

3.3 Rubblemound (Stone) Structure Design Assessment

Typical cross sections were developed and utilized for modeling and costing each concept, and are shown in Figure 3.13, Figure 3.14, and Figure 3.15. Initial design parameters for rubblemound (stone) structures were inferred from the previous MSA design, but as no design calculations were available, these were adjusted based on the following design sequence. Engineer's opinion of probable construction costs developed for this study, which are presented in the next section of this report, utilized the results of this assessment. Key results of relevance to the development of the stone structure configurations shown in schematic design concepts are summarized below:

- Design nearshore wave height is depth-limited, and controlled by lakebed elevation at toe of structure and design high water level (assumptions based on the geometry of Concept 3, which reaches furthest out into Lake Michigan);
- Assumed design high water level (combination of still water high lake level and storm surge) = +5.6 ft LWD, + 5.8 ft LWD, and +5.9 ft LWD (10-, 25-, and 100-year water levels, respectively);
- Assumed 3 feet of maximum downcutting at the toe of the structure over 50 years (based on the interpretation of numerical modeling results (Baird, 1999);
- Design breaking wave height is limited to approximately 70% of water depth; estimates using the procedure of Goda (1970) as follows (assuming 10- to 100-year offshore storm and DHWL = +6.0 ft LWD):
    - Structure at -9.0 ft LWD (water depth = 14.6 ft) = design Hsb = 9.6 ft,
    - Structure at -9.0 ft LWD (water depth = 14.8 ft) = design Hsb = 9.6 ft.
    - Structure at -9.0 ft LWD (water depth = 14.9 ft) = design Hsb = 9.9 ft.

Baird has defined armor stone sizing using Hudson's equation, as presented in the Coastal Engineering Manual (USACE, 2012), and the stability coefficients defined in the 3rd Edition of the Shore Protection Manual (USACE, 1977). It is noted that the stability coefficients presented in the 4th Edition of the Shore Protection Manual (USACE, 1984) are overly conservative.

The filter and core stone are sized based on design guidance in the design manuals noted above as well as Baird's experience with the design and construction of similar structures in the region. In addition, the specifications of all required stone gradations should consider the practicalities and costs of production and transport of the materials from the source to the site.

3.3.1 Crest Elevation and Width

A crest elevation of +11 ft LWD is proposed in the conceptual design; this crest elevation will result in a "relative freeboard" (height of structure above the water level, F, divided by the significant wave height, Hs) under the extreme design conditions of approximately 0.5-0.6 (Note: the crest elevation of MSA's design was +14.5 ft LWD). A minimum breakwater crest width of three stone dimensions will be required based on hydraulic stability considerations.

3.3.2 Front and Rear Slope

The front and rear slopes of the structures will be set at 1.5 H: 1 V to minimize stone quantities and lakebed coverage (Note: the front and back slopes of MSA's design were assumed at 2 H: 1 V and 1.5 H: 1 V, respectively).

3.3.3 Stone Gradation

The suggested armor stone gradations are considered to be a practical range for production. Also, it is noted that the filter stone gradation is based on the larger armor stone gradation, although a smaller filter stone gradation could be used at shallower sections.

Concept 2 is based more on a conventional breakwater design, having a symmetric double layer of (2-5 ton) armor stone on both sides, as both sides will be exposed to a similar wave climate. Concepts 1 and 3 are designed with a double layer of (2-5 ton) armor stone on the front slope but a single layer of larger (5-7 ton) armor on the crest and rear slope. This less conventional design reduces armor stone quantity and allows higher core stone elevation, thereby reducing wave transmission.

3.3.4 Structure Foundation

The results of jet probes by Baird (2022) showed a limited depth of sand cover over the clay till, loose sediment thicknesses ranging from 0 to 3 feet. For the design of the stone structures, the sand will be excavated from within the footprint of the structure to expose the cobble/ till, and the structure will be constructed directly on that material. The outer toe of the structure will include a toe berm to accommodate the lakebed downcutting anticipated over the life of the structure.

If the excavated sand is suitable for use as beach fill, it can be placed as part of the pre-filling of the fillet beaches to the north and south of the proposed harbor, which is typically required by regulatory permitting to minimize sand accretion/ downdrift impacts.

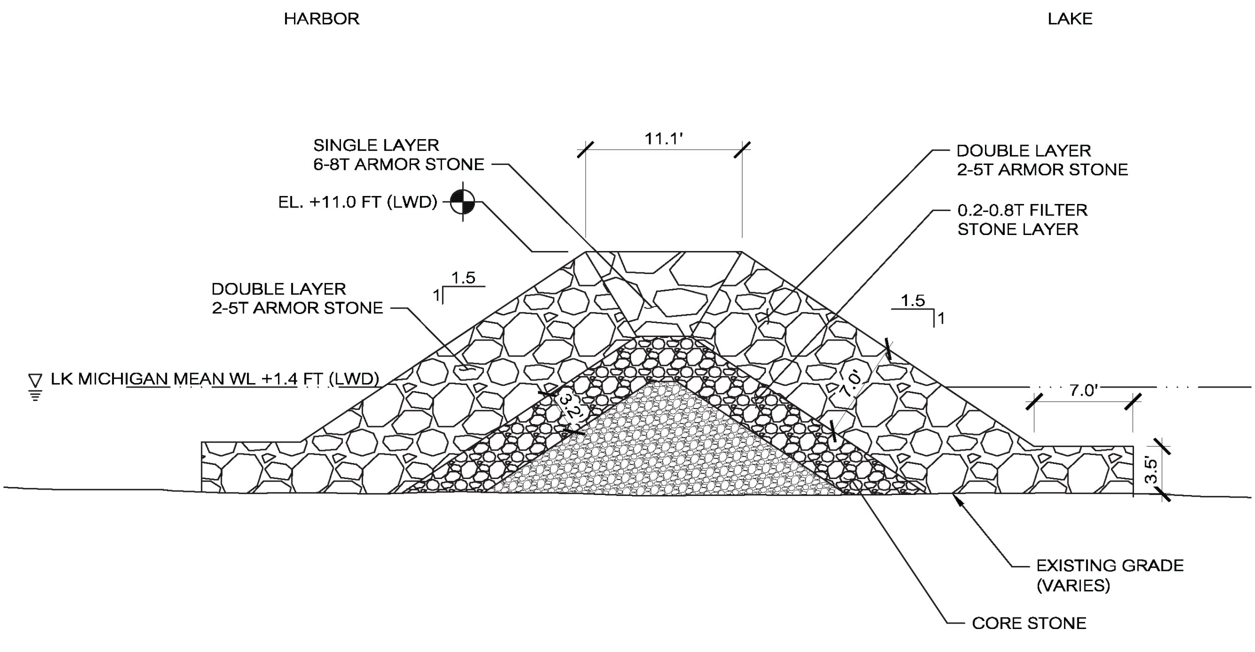


Figure 3.13: Typical Cross Section – Concept 1 & 3 – Head of Groin

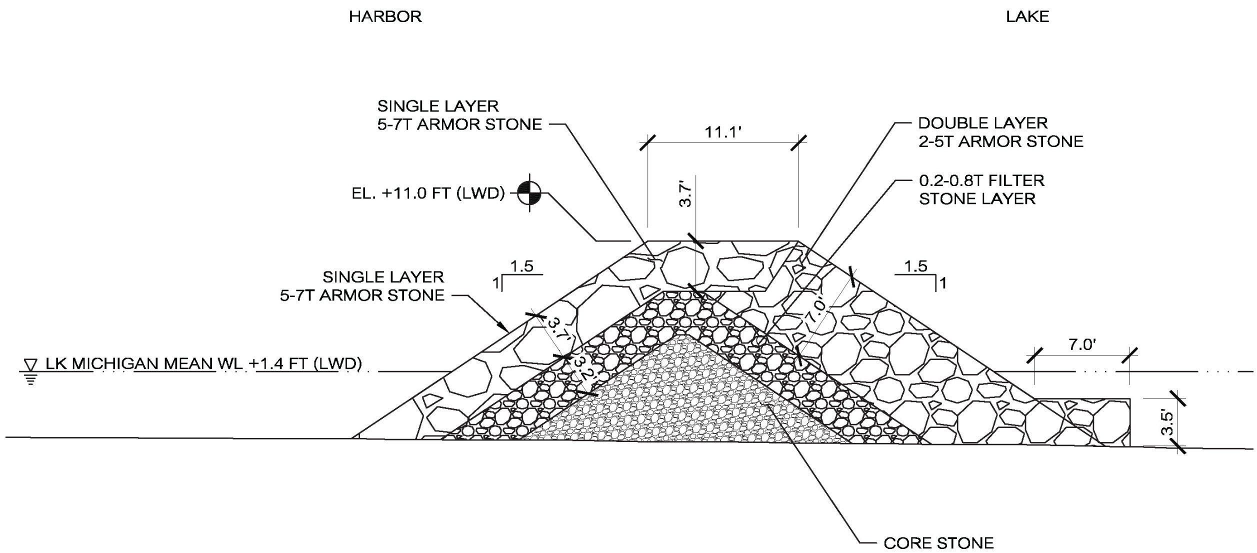


Figure 3.14: Typical Cross Section – Concept 1 & 3 – Trunk of Groin

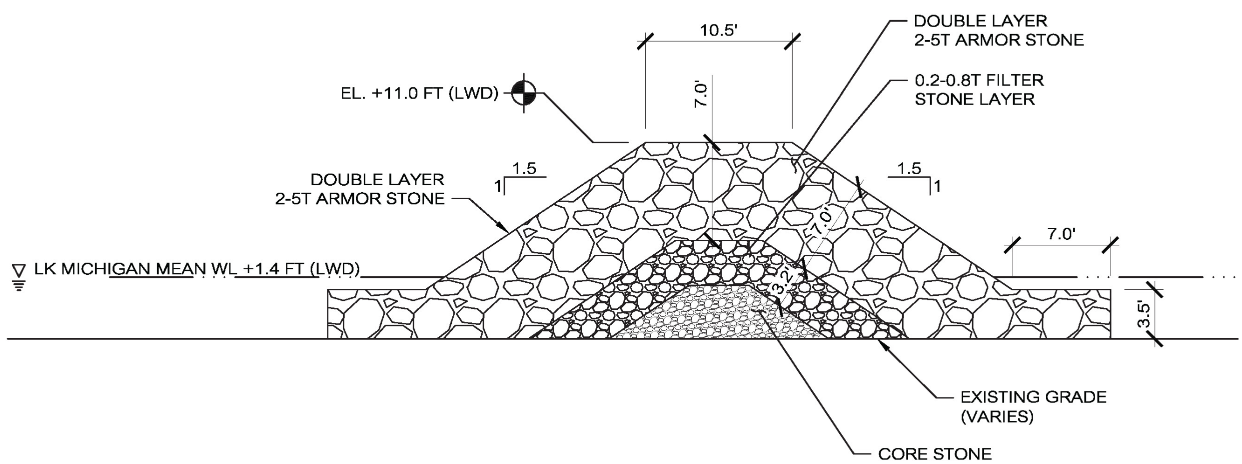


Figure 3.15: Typical Cross Section – Concept 2

4. Feasibility Assessment

Baird developed an Opinion of Capital Expenditure (CAPEX) to comparatively assess the costs associated with the initial construction of the proposed boat launch improvement concepts.

In addition to assessing CAPEX, Baird developed comparative Opinion of Operational Expenditure (OPEX) to assess the cost of each proposed concept over a 25-year period to identify the most economically viable. Items factored into the OPEX costs included maintenance dredging and structural maintenance. A summary of key assumptions, and the results of the CAPEX and OPEX analysis are provided below.

The CAPEX and OPEX calculations were then utilized in net present value (NPV) calculations to directly compare the options from a financial perspective. NPV calculations convert future cash outflows to the present time utilizing discount rates for a commensurable comparison of total project financial value.

4.1.1 CAPEX

An Opinion of Capital Expenditure (CAPEX) estimate was developed for each concept. Baird reviewed recent contractor bids and coordinated with local material suppliers to acquire rates for equipment and materials and utilized MCASES MII, a crew-based estimation methodology adopted by the USACE, to develop each CAPEX estimate. Construction material volumes were developed by building each concept in 3D CAD software (Autodesk Civil 3D). Each alternative considered the cost of each item in the construction process, including contractor mobilization/demobilization, demolition of the existing boat launch and portions of the existing revetment (where needed) and other site preparation, the construction of the stone groins/ harbor breakwaters, placement of sand pre-fill material on either side of the proposed harbor including re-use of any sand available from the initial dredging of the harbor, construction of a new boat ramp, the initial dredging of the harbor, and then site restoration and other landside improvements (i.e., expansion/reconfiguration of the parking lot). Additionally, the transient dockage noted in the MSA Preferred Alternative was costed as an optional item.

Finally, as the concept plan designs were developed to a AACE Class 4 level[3], the level suitable for a feasibility study, a contingency of 25% was added to the estimate to account for unknowns typically associated with schematic design. The estimate including contingency is not an upper bound but rather a point representing 50th percentile of costs that may occur. The estimate accuracy for a feasibility study is generally +25/-15% which accounts for various factors that can significantly impact the estimate including market and environmental conditions at the time of construction (i.e., supply and demand, contractor/material availability, construction site access, lake levels, etc.). Consistent with industry practice for cost estimation, markups were added to each item which reflect contractor bond, job office overhead, and contractor overhead and profit.

Material and equipment rate assumptions utilized for developing the comparative CAPEX estimates are presented in Table 4.1.

Table 4.1: Material Procurement and Equipment Rate Assumptions

Material	Cost/Unit
6-8 Ton Armor Stone	$132/Ton
2-5 Ton Armor Stone	$84/Ton
Filter Stone	$55/Ton

[3] AACE Cost Estimation Classification: https://www.costengineering.eu/Downloads/articles/AACE_CLASSIFICATION_SYSTEM.pdf

Material	Cost/Unit
Core Stone	$75/Ton
Sand	$60/CY
Dredge (Mechanical)	$56/CY
Equipment	**Cost/Day**
150 T Crane	$3,000
Excavator	$2,500
Front End Loader	$2,300
Barge	$1,300
Tug	$2,000

The total CAPEX for all proposed concepts is provided in the chart below, followed by an itemized summary for each concept. As previously noted, CAPEX estimates only include the cost to construct new infrastructure and do not include annual maintenance costs (i.e., dredging, structural repairs, etc.).

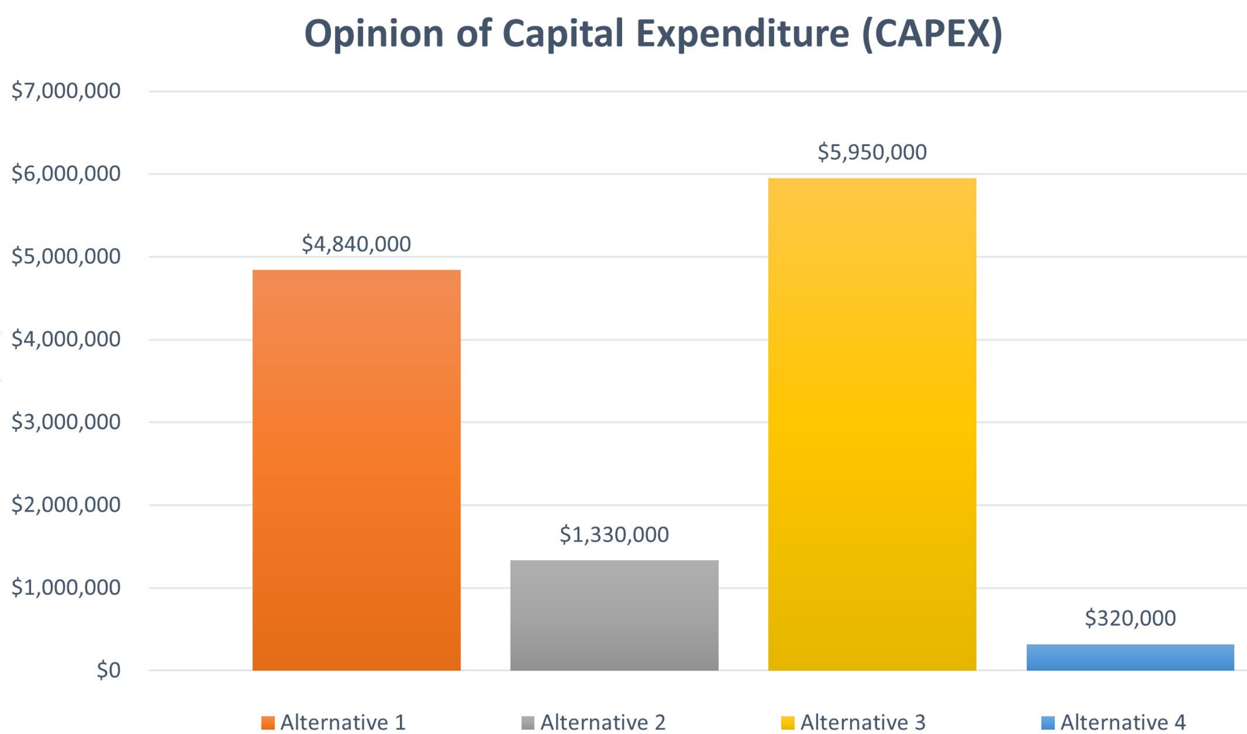


Figure 4.1: Preliminary Opinion of Capital Expenditure (CAPEX) (Rounded up to nearest $10,000)

Concept 1 (MSA Preferred Alternative)

	Required Items	Subtotal	Bond (1%)	JOOH[4] (5%)	O&P[5] (15%)	Contingency[6] (25%)	Total[7]
	Mobilization/Demobilization	$294,643	$2,946	$14,732	$44,196	$89,129	$445,647
1	Demolition/Site Preparation	$36,373	$364	$1,819	$5,456	$11,003	$55,015
2	North Groin (533 LF)	$1,434,076	$14,341	$71,704	$215,111	$433,808	$2,169,040
3	South Groin (275 LF)	$738,863	$7,389	$36,943	$110,829	$223,506	$1,117,531
4	North Regulatory Pre-Fill Area	$131,564	$1,316	$6,578	$19,735	$39,798	$198,990
5	South Regulatory Pre-Fill Area	$131,564	$1,316	$6,578	$19,735	$39,798	$198,990
6	Sand Reuse Credit	-$154,611					-$154,611
7	Boat Ramp	$150,000	$1,500	$7,500	$22,500	$45,375	$226,875
8	Initial Harbor Dredge	$221,486	$2,215	$11,074	$33,223	$66,999	$334,997
9	Site Restoration and Landside Improvements	$102,500	$1,025	$5,125	$15,375	$31,006	$155,031
						Grand Total	$4,747,505
						Lower Range Estimate (-15%)	$4,035,379
						Upper Range Estimate (+25%)	$5,934,381

Optional Items

9	Transient Dockage Installation	$350,000	$3,500	$17,500	$52,500	$105,875	$529,375

[4] JOOH = Job Office Overhead (separate from Overhead & Profit)
[5] O&P = Overhead and Profit
[6] Contingency is calculated as the sum of the subtotal, bond, JOOH and O&P, multiplied by 25%
[7] Grand Total is the sum of the Subtotal, bond, JOOH, O&P and contingency. The Grand Total does not include Optional Items.

Concept 2 (Single Groin Alternative)

	Required Items	Subtotal	Bond (1%)	JOOH (5%)	O&P (15%)	Contingency (25%)	Total
	Mobilization/Demobilization	$78,003	$780	$3,900	$11,700	$23,596	$117,979
1	Demolition/Site Preparation	$19,499	$195	$975	$2,925	$5,899	$29,493
2	Single Groin (250 LF)	$552,901	$5,529	$27,645	$82,935	$167,253	$836,263
3	North Regulatory Pre-Fill Area	$26,313	$263	$1,316	$3,947	$7,960	$39,798
4	South Regulatory Pre-Fill Area	$26,313	$263	$1,316	$3,947	$7,960	$39,798
5	Boat Ramp	$150,000	$1,500	$7,500	$22,500	$45,375	$226,875
6	Site Restoration and Landside Improvements	$5,000	$50	$250	$750	$1,513	$7,563
						Grand Total	$1,297,768
						Lower Range Estimate (-15%)	$1,103,103
						Upper Range Estimate (+25%)	$1,622,210

Concept 3 (Two Groin Alternative)

	Required Items	Subtotal	Bond (1%)	JOOH (5%)	O&P (15%)	Contingency (25%)	Total
	Mobilization/Demobilization	$365,166	$3,652	$18,258	$54,775	$110,463	$552,313
1	Demolition/Site Preparation	$36,373	$364	$1,819	$5,456	$11,003	$55,015
2	North Groin (542 LF)	$1,476,456	$14,765	$73,823	$221,468	$446,628	$2,233,140
3	South Groin (542 LF)	$1,537,622	$15,376	$76,881	$230,643	$465,131	$2,325,654
4	North Regulatory Pre-Fill Area	$39,469	$395	$1,973	$5,920	$11,939	$59,697
5	South Regulatory Pre-Fill Area	$39,469	$395	$1,973	$5,920	$11,939	$59,697
6	Sand Reuse Credit	-$111,342					-$111,342
7	Boat Ramp	$150,000	$1,500	$7,500	$22,500	$45,375	$226,875
8	Initial Harbor Dredge	$248,769	$2,488	$12,438	$37,315	$75,253	$376,263
9	Site Restoration and Landside Improvements	$123,500	$1,235	$6,175	$18,525	$37,359	$186,794
						Grand Total	$5,964,106
						Lower Range Estimate (-15%)	$5,069,490
						Upper Range Estimate (+25%)	$7,455,132

Concept 4 (Replace-in-Kind Alternative)

	Required Items	Subtotal	Bond (1%)	JOOH (5%)	O&P (15%)	Contingency (25%)	Total
	Mobilization/Demobilization	$19,000	$190	$950	$2,850	$5,748	$28,738
1	Demolition/Site Preparation	$40,000	$400	$2,000	$6,000	$12,100	$60,500
2	Boat Ramp	$150,000	$1,500	$7,500	$22,500	$45,375	$226,875
3	Site Restoration and Landside Improvements	$5,000	$50	$250	$750	$1,513	$7,563
						Grand Total	$297,934
						Lower Range Estimate (-15%)	$253,244
						Upper Range Estimate (+25%)	$372,418

4.1.2 OPEX

An Opinion of Operating Expenditure (OPEX) estimate was developed for each concept to compare the total project life-cycle cost over a 25-year period. It is important to note that each of the concepts under consideration come with maintenance responsibilities to ensure their function, whether in the form of an annual (or semi-annual) dredging to clear sediment from the harbor entrance or other areas of concern, or in the form of the long-term maintenance of the breakwater structures themselves. Table 4.2 presents the breakdown of a single-year operating expense for each concept.

The dredge maintenance cost was estimated at $56/CY and assumes the work will be executed using mechanical dredging methods, such as using an excavator on one barge to excavate material and deposit it into another barge for transport. The cost assumptions also factor that while not a large volume of material will be removed, it may be dispersed over a large area and require frequent barge movement. Hydraulic dredging methods could achieve lower costs, on the order of low $20s per cubic yard, however hydraulic dredges are less common in the Great Lakes and the small volume of material to be removed in maintenance may limit contractor availability/interest. Structure maintenance cost was built up as a percentage of the capital expense for the breakwater structures (or boat launch, in the case of Concept 4). This cost accounts for normal wear and tear to the structures. OPEX capture future maintenance costs, which were converted to present value to comparatively assess the concepts using net present value (NPV).

The following assumptions were factored into the 25-year comparative OPEX analysis.

- Maintenance costs for proposed structures (1.5% CAPEX/year)
  - It is assumed that the cost will not be realized annually but rather it will be realized in a single maintenance event at the end of the project life-cycle.
- Variable future dredging costs (3% inflation/ year)
  - Because future dredge rates vary based on water levels and storm occurrence two conditions were assumed for future annual dredging costs (low-end and high-end dredge scenario).
- A discount rate of 2% was used to convert future expenditures into present value for the NPV assessment.

Table 4.2: Breakdown of Single-Year Operating Expense (OPEX) by Concept

Concept	Annual Dredge Cost (Low End Dredge Requirement)	Annual Dredge Cost (High End Dredge Requirement)	Structure Maintenance Cost
1	$235,200	$336,000	$49,300
2	$11,200	$28,000	$12,600
3	$56,000	$112,000	$68,400
4	<$1,000	<$1,000	$600

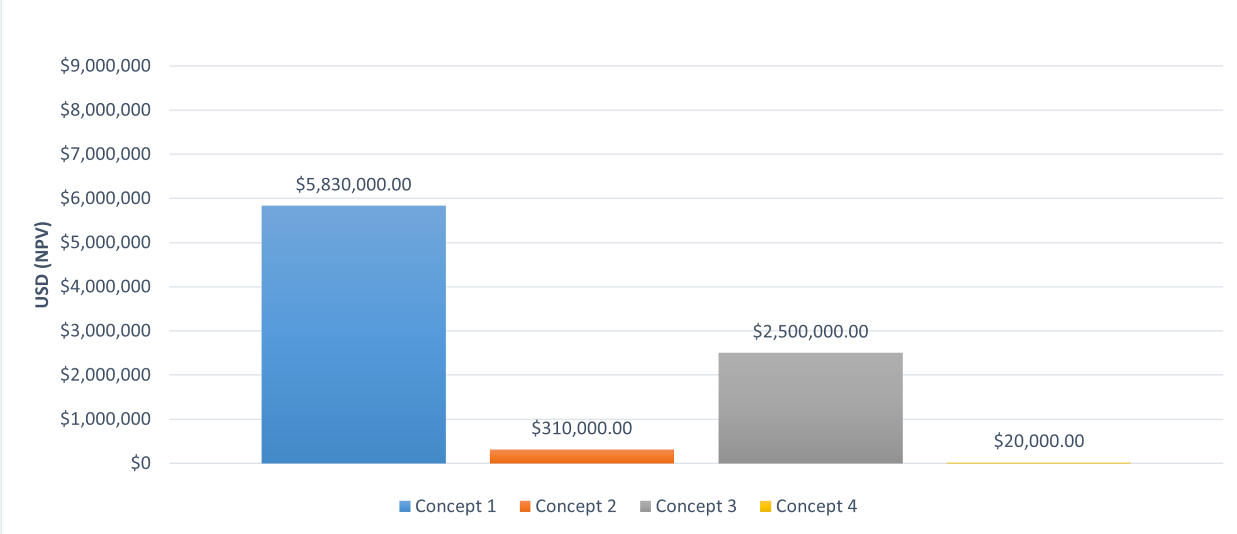


Figure 4.2: 25-year OPEX (Low-end Annual Dredging Requirement)

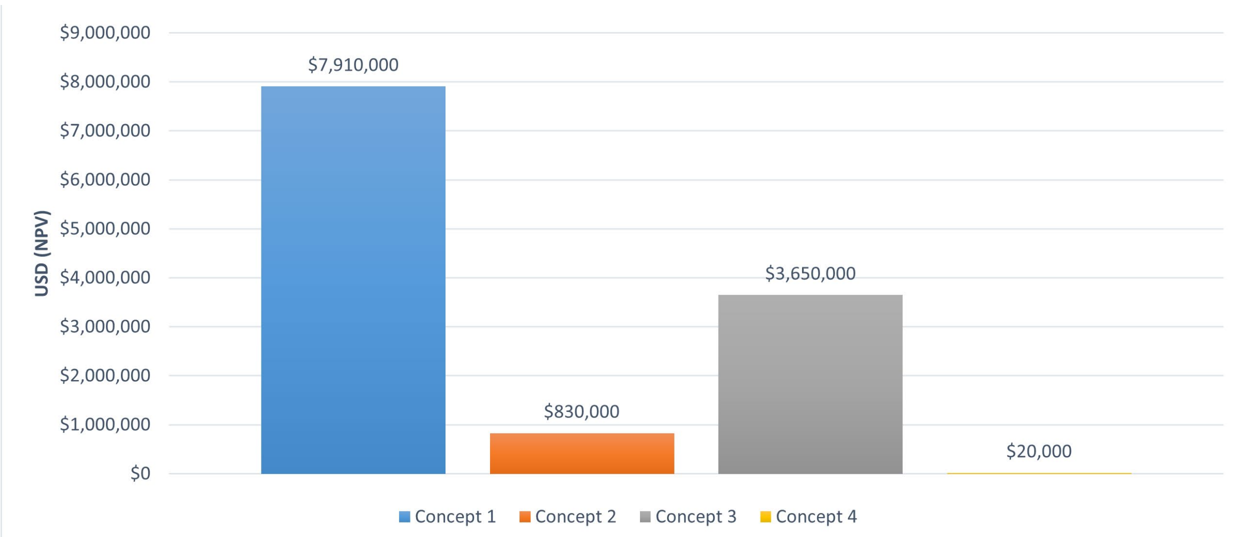


Figure 4.3: 25-year OPEX (High-end Annual Dredging Requirement)

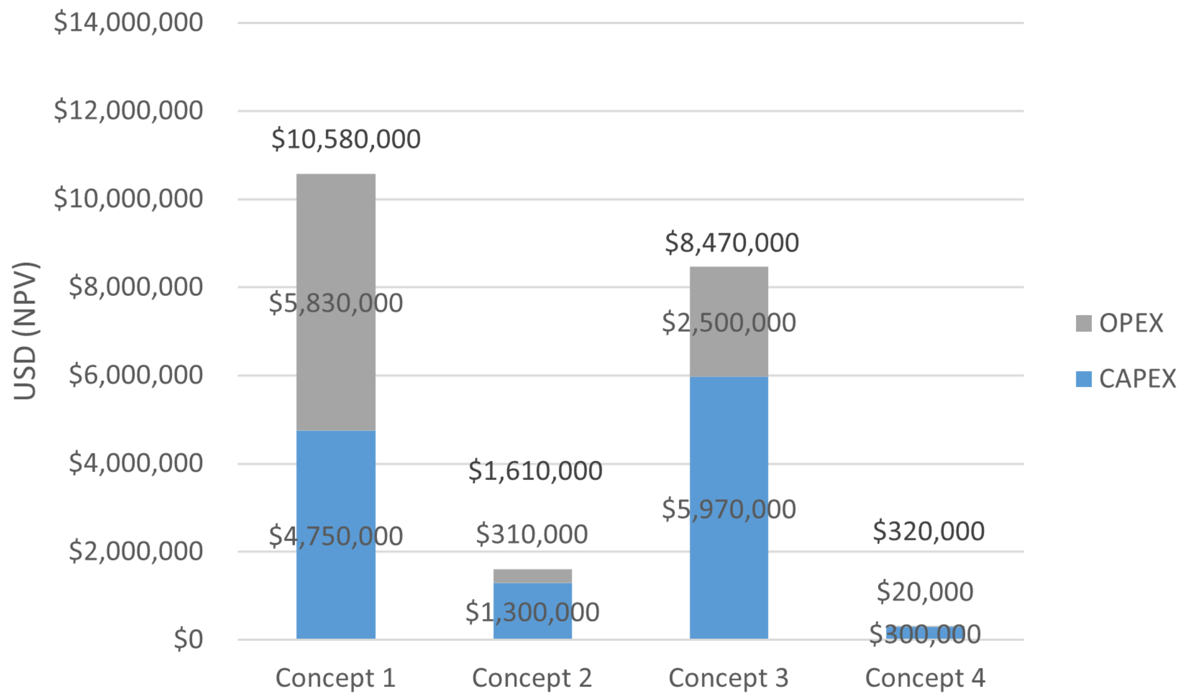


Figure 4.4: 25-year OPEX (Low-end Annual Dredging Requirement) + CAPEX

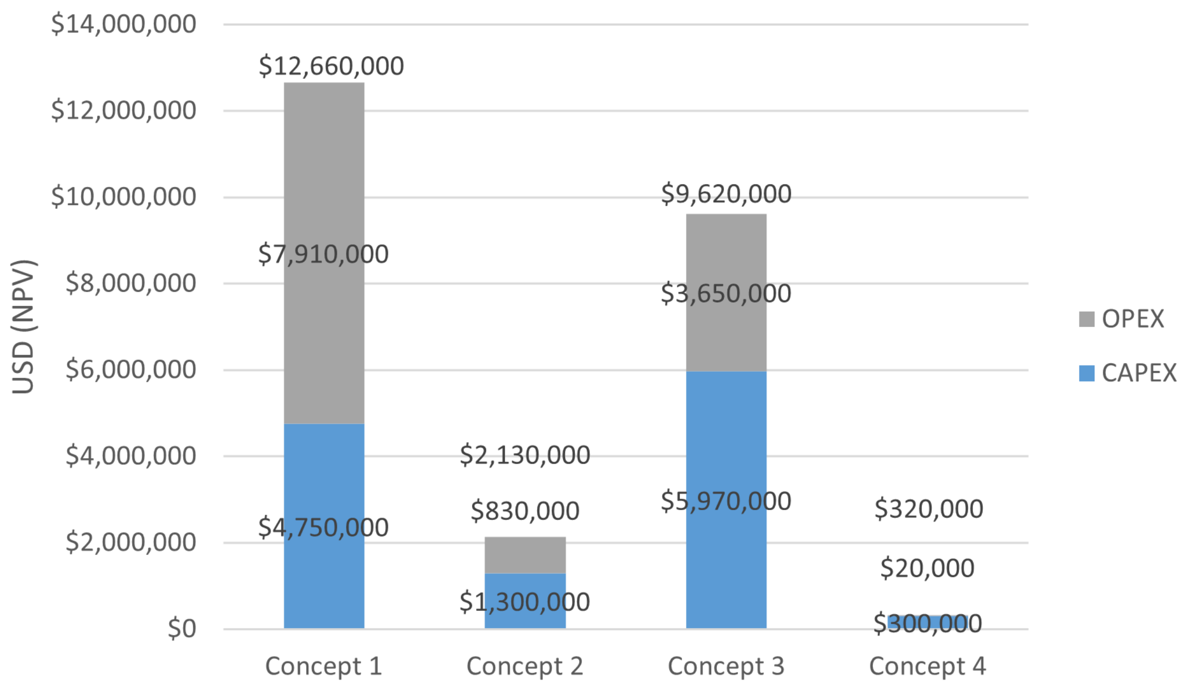


Figure 4.5: 25-year OPEX (High-end Annual Dredging Requirement) + CAPEX

5. Study Summary

The Baird team completed field investigations, desktop analysis, and numerical modeling to better understand coastal processes (i.e., wave conditions and sediment transport) at Hika Park and evaluate multiple boat launch improvement concepts. Three unique concepts for reconfiguring the Hika boat launch/ shoreline were considered and assessed with numerical modeling to understand their performance to protect against high-energy waves and ability to minimize longshore sediment transport impacts, sedimentation, and dredging. An engineer's opinion of probable construction costs, including both CAPEX and OPEX, was developed for each concept, including replacing the boat launch ramp in-kind, to evaluate financial feasibility as well. The study findings were presented to the public on December 7, 2022 to gather input and feedback from the local community, wherein both support (from boating advocates) and opposition (based on project costs) for the project were voiced. The following provides a concise summary of the study results, which aims to assist the Village with making informed decisions regarding the future of the Hika boat launch ramp.

5.1 Functionality Evaluation

The results of this study indicate that Concepts 1 and 3 could provide a more accessible/ safer boat launch facility for Hika Park, albeit both would require periodic dredging to maintain adequate depths for navigation. Modeling indicates that Concept 1 traps a larger volume of sediment than Concept 3 annually, which amplifies maintenance dredging requirements and potential for downdrift impacts (i.e., erosion and/ or accretion). Concept 2 does not perform adequately in this regard as it provides only a minimal wave shadow in the lee of the structure, but generally leaves the boat launch unsheltered/ exposed to coastal waves and ice, similar to existing conditions. Reconstructing the boat launch ramp as-is (Concept 4) does not improve functionality.

5.2 Feasibility Evaluation

Life-cycle costs (OPEX + CAPEX), shown in NPV (2022 US$), are summarized for the low-end and high-end dredge scenarios, see Figure 4.4 and Figure 4.5. The following are key take-aways:

- While Concepts 1 and 3 have similar capital expenses - $4.75M for Concept 1, $5.97M for Concept 3, a difference of $1.23M - the 25-year OPEX costs vary from each other considerably more. The OPEX of Concept 1 ranges between $5.83M and $7.91M, while the OPEX of Concept 3 ranges between $2.50M and $3.65M, a difference of $3.33M to $4.26M.
- Concept 2 total 25-year life-cycle cost ($1.61M to $2.13M) is considerably less than Concepts 1 or 3, but is not recommended due to the limited project benefits and impacts associated with constructing a single groin.
- Concept 4 total 25-year life-cycle cost ($320K) shows that this is by far the most economically viable option, as it may only require minimal dredging and structure maintenance. However, this does nothing to improve functionality and/or safety for the Hika boat launch, whereas Concepts 1 and 3 provide a sheltered harbor.

5.2.1 Cost Reduction Options

Our team evaluated potential cost savings options that could be applied to these concepts, which include:

- Reduce initial/ maintenance dredge volumes by decreasing the dredge area and depth within protected areas (i.e., Concept 1 and 3).
- Reduce total length of groins/size of protected area for Concept 3, such that the curved groins extend to an existing depth of -5 ft LWD, versus -6 ft LWD.

- Stone structure designs are conservative. Value engineering and defining an acceptable level of risk (during detailed/final design) would likely result in a more efficient design section that reduces the stone volumes and associated costs.
- Work with stakeholder groups (i.e., Cleveland Fish and Game) to undertake annual maintenance.
- Program a revenue source into the design of the project (e.g., usage fees) to offset maintenance debit.
- Integrate programming into the design to satisfy state and federal grant opportunities, such as commercial harbor grants.
- Do not construct the optional transient dock.

6. Responses to Public Questions

The following are responses to questions which were received and answered informally during the December 7th, 2022 public meeting in Cleveland, WI. The responses below expand upon and, if and where contradictory, supersede those given during the public meeting. Only questions which were recorded in the official minutes during the public meeting have been responded to, and comments have been omitted for clarity of Baird's response.

1. **Would there be less sediment build up on the shoreline if some space was left between the shore and where the groins start?**

   Response: No, leaving a gap between the shoreline and the groins would not likely result in sediment bypassing through the marina basin, as the wave sheltering offered by a proposed harbor would allow this sediment to fall out of suspension and settle within the marina basin, resulting in additional maintenance dredging in the basin/ near the boat launch.

2. **What is the potential amount of grant funding the Village could receive?**

   Response: The potential amount of grant funding for a selected boat launch improvement option is highly variable, depending on project timing/ available grants.

3. **Are grants more available for capital expenditures vs. operation/maintenance costs?**

   Response: Securing grants for capital expenditures is more realistic than grants for operation/maintenance costs. Typically, permits for constructing shoreline infrastructure of this nature (i.e., stone groins) contain conditions stating that the owner is responsible for maintaining the permitted structure. If maintaining the structures is not feasible (without securing grant funding) it may cause future issues.

4. **Could the Village incur liability if there's an issue in the safe harbor area?**
   Response: Village should seek legal council to answer this question.

5. **Did the sediment transport study include only the months of May-October (typical boating season), or an entire year?**

   Response: An entire year was simulated. Refer to Section 2.3.4.2 of this report for details.

6. **Were the operating/maintenance costs calculated using net present value?**

   Response: Yes. Refer to Section 4.1.2 of this report for details.

7. **Were offshore breakwaters looked at?**

   Response: Offshore breakwaters were not considered due to the potential for sediment accretion in the lee of the offshore breakwater structure.

8. **What would be the estimated usage of the boat launch?**

   Response: This study did not assess the projected usage of the boat launch.

9. **Were there any other small harbors on the eastern Wisconsin shoreline?**

   Response: An example of a small harbor on the eastern Wisconsin shoreline is Bender Park in Oak Creek. Most of Wisconsin's small craft harbors and recreational boat launch facilities are located within larger, sheltered port facilities (i.e., Milwaukee, Sheboygan, Manitowoc, etc.).

10. **Would disposal of dredging materials be done via downdrift disposal or taken offsite?**

    Response: Disposal of dredging material would be subject to USACE/WI DNR permitting and those permit requirements would dictate placement location.

11. **Would the southern groin of Option 3 support equipment on it to use for dredging?**

    Response: The southern groin could be developed to support equipment; however, it would be difficult for such equipment to dredge the entire channel without utilizing marine equipment (i.e., tug, barge, etc.).

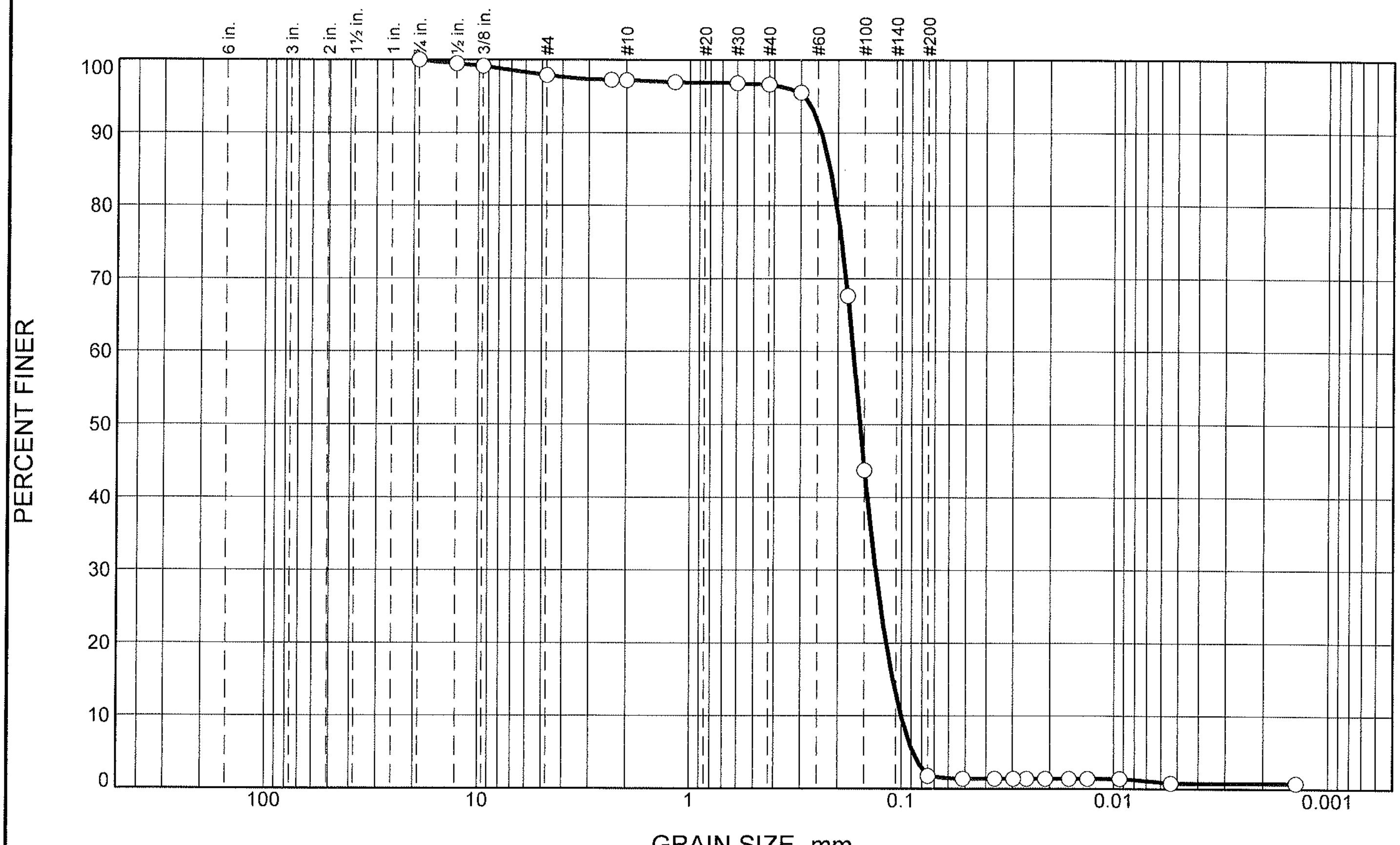
12. **Could we build in the waters off Hika Park due to the NOAA marine sanctuary designation?**

    Response: If the project does not cause impacts to known shipwrecks, it will likely not be an issue, but the selected alternative should be presented to regulatory agencies and NOAA officials before moving into final design for confirmation. It is possible that future permits for this work may contain special conditions if an unknown shipwreck is discovered/ will be impacted by the proposed improvements.

Appendix A

CGC Sediment Sample Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.1	0.7	0.6	94.8	1.0	0.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	99.5		
3/8	99.1		
#4	97.9		
#8	97.3		
#10	97.2		
#16	97.0		
#30	96.8		
#40	96.6		
#50	95.5		
#80	67.6		
#100	43.7		
#200	1.8		

* (no specification provided)

Material Description

Tan Fine Sand, Trace Gravel, Silt and Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2409 D_{85}= 0.2188 D_{60}= 0.1694
D_{50}= 0.1574 D_{30}= 0.1328 D_{15}= 0.1101
D_{10}= 0.1006 C_u= 1.68 C_c= 1.03

Classification

USCS= SP AASHTO=

Remarks

Sample Number: DB

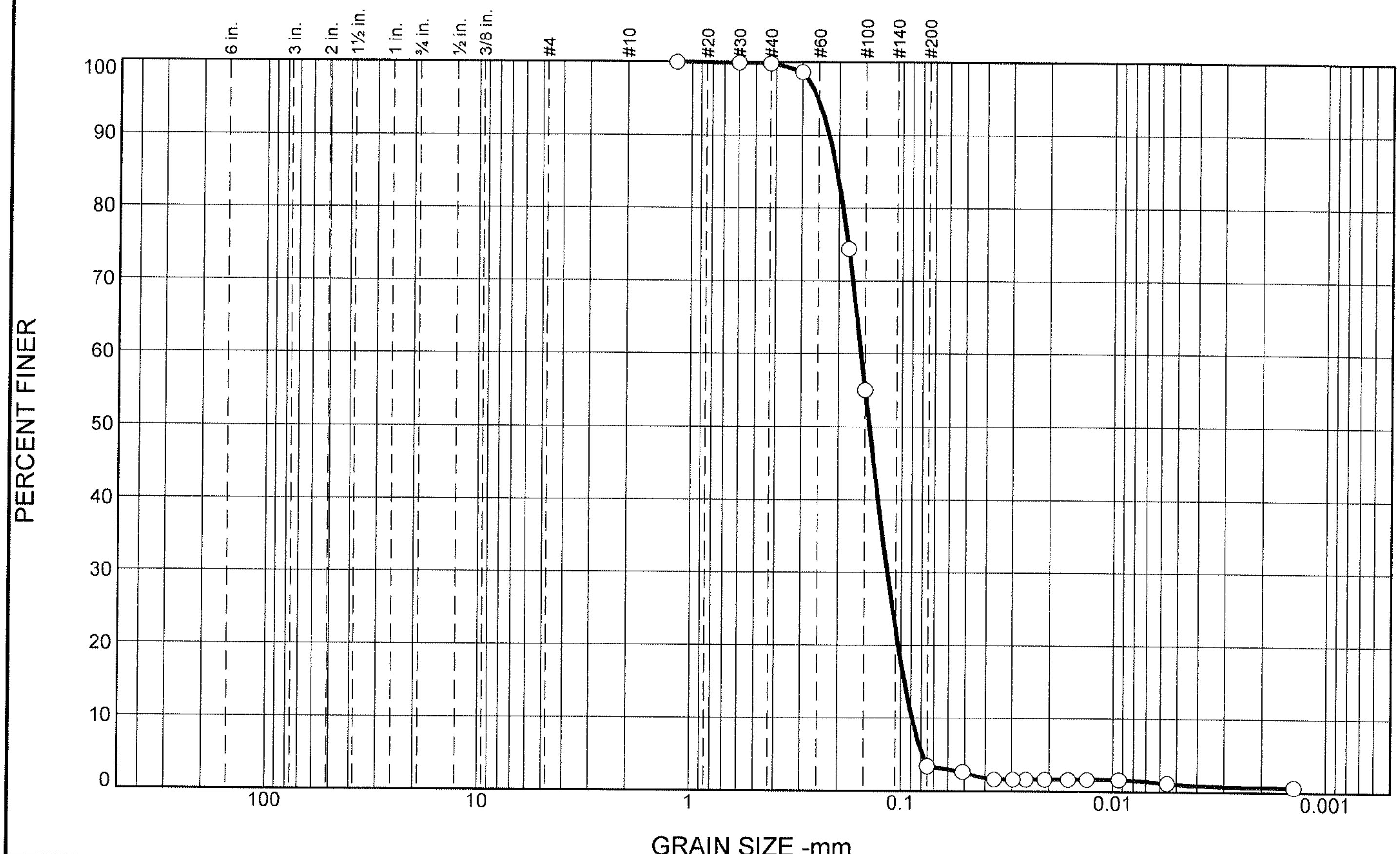
Date: 8/3/22

CGC, Inc.

Client: Baird
Project: Village of Cleveland-Hika Park
Project No: C22047-1 **Figure**

Tested By: JFS **Checked By:** KJS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	96.5	2.4	1.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#30	99.9		
#40	99.9		
#50	98.6		
#80	74.4		
#100	55.0		
#200	3.4		

* (no specification provided)

Material Description

Tan Fine Sand, Trace Silt and Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2245 D_{85}= 0.2058 D_{60}= 0.1569
D_{50}= 0.1432 D_{30}= 0.1170 D_{15}= 0.0967
D_{10}= 0.0890 C_u= 1.76 C_c= 0.98

Classification

USCS= SP AASHTO=

Remarks

Sample Number: 1A

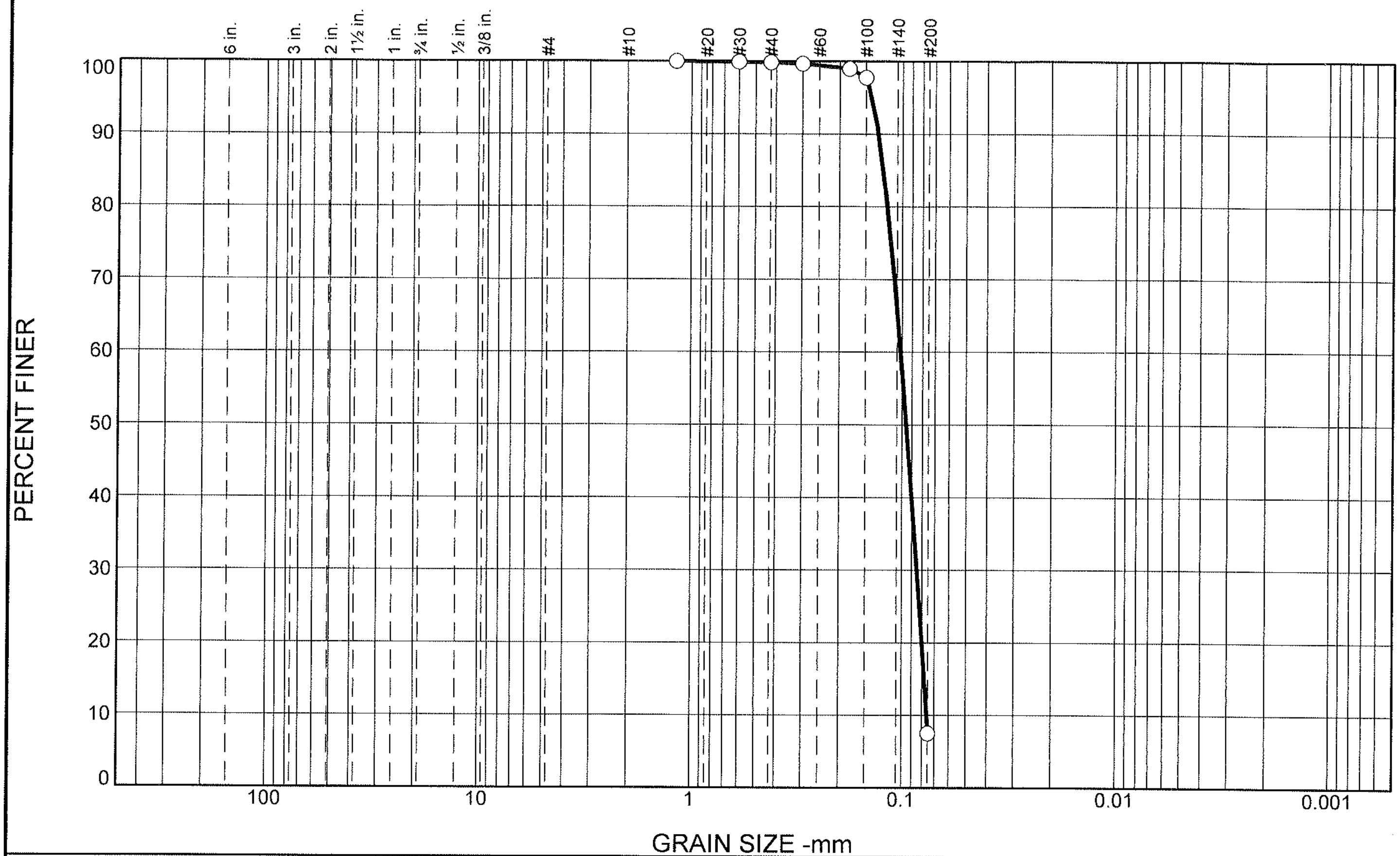
Date: 8/3/22

CGC, Inc.

Client: Baird
Project: Village of Cleveland-Hika Park
Project No: C22047-1 **Figure**

Tested By: JFS **Checked By:** KJS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	92.3	7.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#30	99.9		
#40	99.8		
#50	99.7		
#80	99.0		
#100	97.8		
#200	7.5		

* (no specification provided)

Material Description

Gray Fine Sand, Little Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1313 D_{85}= 0.1243 D_{60}= 0.1022
D_{50}= 0.0958 D_{30}= 0.0851 D_{15}= 0.0782
D_{10}= 0.0760 C_u= 1.34 C_c= 0.93

Classification

USCS= SP-SM AASHTO=

Remarks

Sample Number: 2B

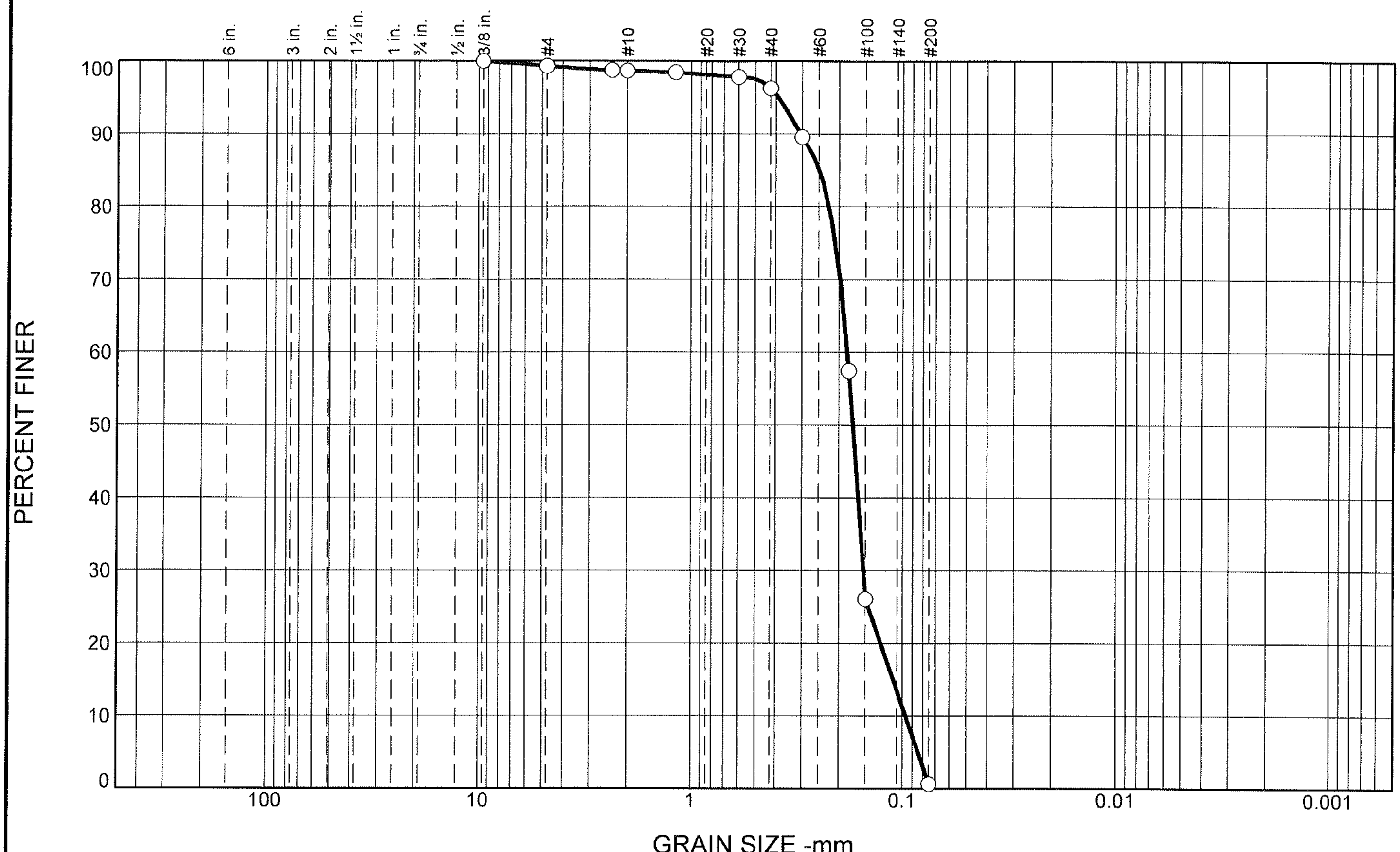
Date: 7/28/22

CGC, Inc.

Client: Baird
Project: Village of Cleveland-Hika Park
Project No: C22047-1 **Figure**

Tested By: JFS **Checked By:** KJS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.6	2.4	95.7	0.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100.0		
#4	99.3		
#8	98.8		
#10	98.7		
#16	98.4		
#30	97.9		
#40	96.3		
#50	89.6		
#80	57.4		
#100	26.1		
#200	0.6		

* (no specification provided)

Material Description

Gray Fine Sand, Trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.3064 D_{85}= 0.2492 D_{60}= 0.1831
D_{50}= 0.1721 D_{30}= 0.1536 D_{15}= 0.1109
D_{10}= 0.0968 C_u= 1.89 C_c= 1.33

Classification

USCS= SP AASHTO=

Remarks

Sample Number: 4A

Date: 7/28/22

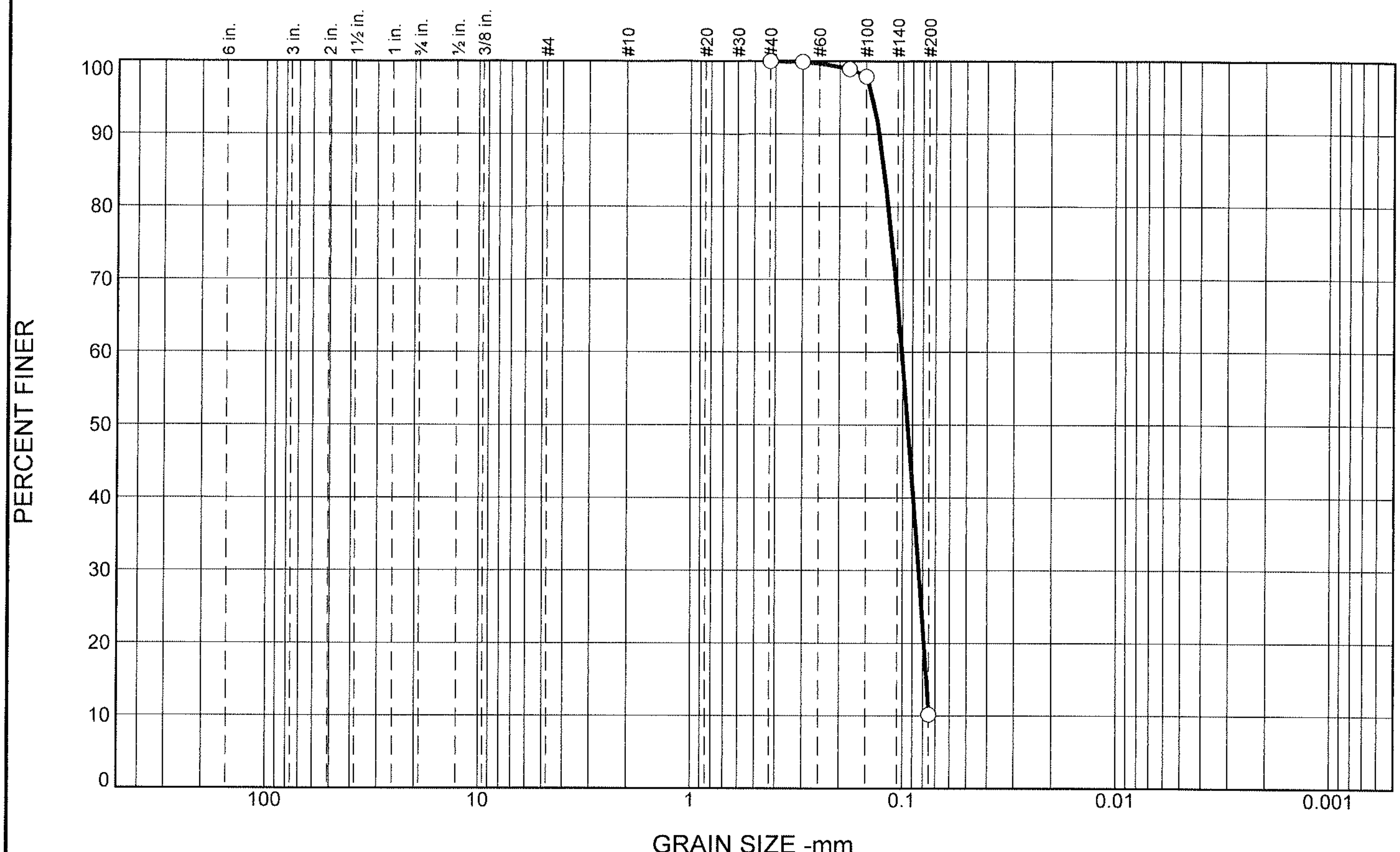
CGC, Inc.

Client: Baird
Project: Village of Cleveland-Hika Park

Project No: C22047-1 **Figure**

Tested By: JFS **Checked By:** KJS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	89.8	10.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#40	100.0		
#50	99.9		
#80	98.9		
#100	97.9		
#200	10.2		

* (no specification provided)

Material Description

Gray Fine Sand, Little Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1306 D_{85}= 0.1236 D_{60}= 0.1013
D_{50}= 0.0949 D_{30}= 0.0841 D_{15}= 0.0771
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Sample Number: 5B

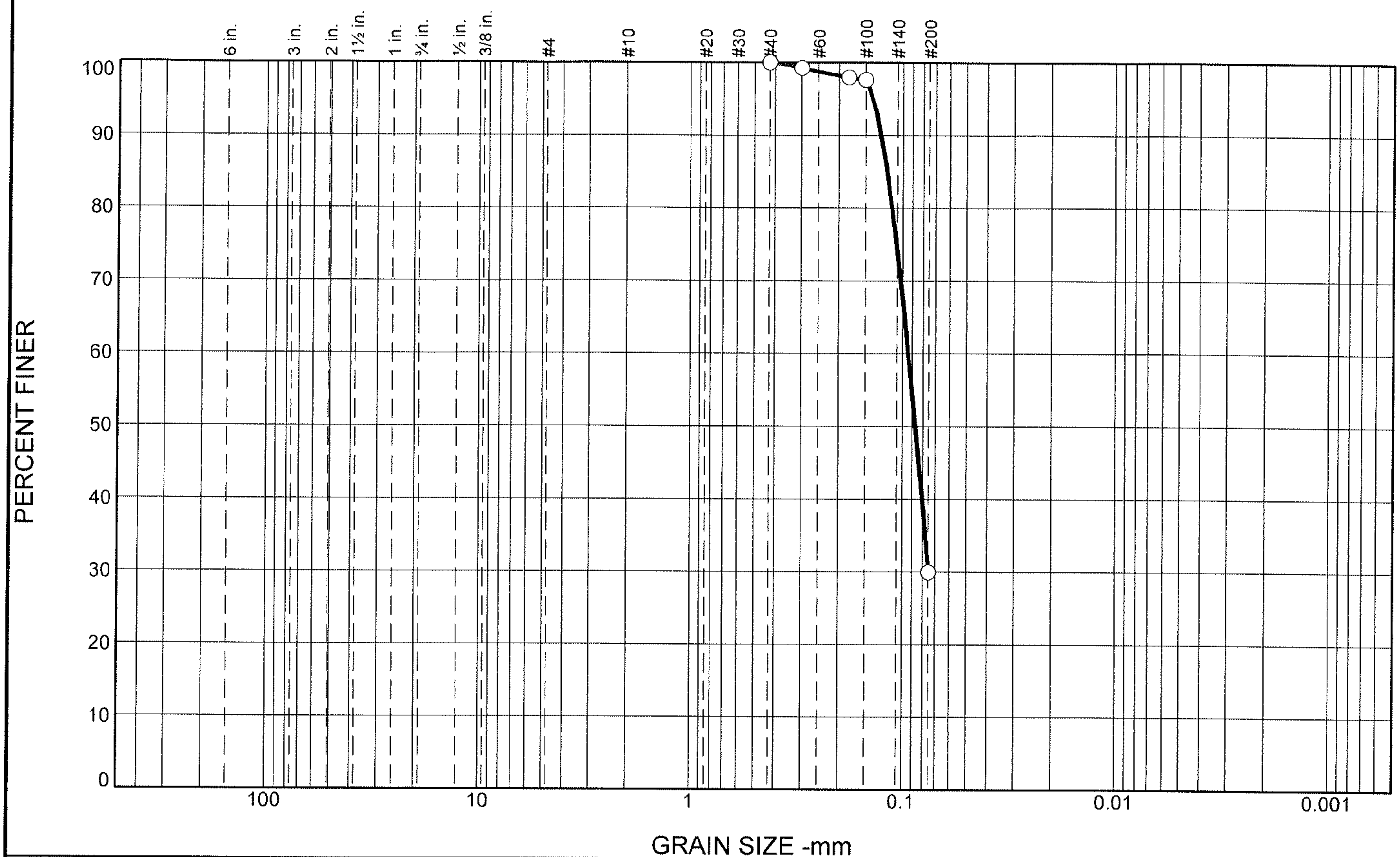
Date: 7/28/22

CGC,Inc.

Client: Baird
Project: Village of Cleveland-Hika Park
Project No: C22047-1 **Figure**

Tested By: JFS **Checked By:** KJS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	70.0	30.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#40	100.0		
#50	99.3		
#80	98.0		
#100	97.7		
#200	30.0		

* (no specification provided)

Material Description

Gray Fine Sand, Some Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1270 D_{85}= 0.1191 D_{60}= 0.0942
D_{50}= 0.0871 D_{30}= 0.0750 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample Number: 6B

Date: 7/28/22

CGC, Inc.

Client: Baird
Project: Village of Cleveland-Hika Park
Project No: C22047-1 **Figure**

Tested By: JFS **Checked By:** KJS

Appendix B

Opinion of Probable Construction Cost

Hika Park Boat Launch Feasibility Study

Itemized Opinion of Probable Construction Costs
Concept 1 (MSA Preferred Alternative)

Baird.

Project No 13243.101
Date: 2/24/2023
DRAFT - FOR REVIEW

Item			Unit	Quantity	Unit Cost	Extension	Sub Total
Mobilization/Demobilization			LS	1	$294,643	$294,643	$294,643
	Allow 10% of CAPEX						
Site Prep & Demo of Existing Boat Launch							
Item 1	**Site Prep & Demolition**						$36,373
	Tree Removal		EA	2	$2,400	$4,800	
	Demo existing 100' x 40' concrete boat launch		CY	74	$163	$12,074	
	Reconfigure existing revetment	Stone Material: Reconfiguration	TON	80			
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	7.6	$297	$2,261	
		Equipment: 150 T Crane, Front End Loader	DAY	0.952	$5,500	$5,238	
	Erosion & Sediment Control		LS	1.000	$12,000	$12,000	
Land-Based Groin Construction							
Item 2	**North Groin (533 LF)**						$1,434,076
	Place Armor Stone (6-8T Stone)						
		Stone Material: Procurement, Delivery and Placement	TON	1649	$132	$217,659	
	Place Armor Stone (2-5T Stone)						
		Stone Material: Procurement and Delivery	TON	7412	$84	$622,597	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	151.3	$297	$44,890	
		Equipment: 150 T Crane, Front End Loader	DAY	18.908	$5,500	$103,993	
	Place Filter Stone (600-1400lb Stone)						
		Stone Material: Procurement and Delivery	TON	2365	$55	$130,089	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	236.5	$297	$70,194	
		Equipment: Front End Loader, Excavator	DAY	29.566	$4,800	$141,915	
	Place Core Stone (5-250lb Stone)						
		Stone Material: Procurement and Delivery	TON	927	$75	$69,498	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	37.1	$297	$11,000	
		Equipment: Front End Loader, Excavator	DAY	4.633	$4,800	$22,239	
Item 3	**South Groin (275 LF)**						$738,863
	Place Armor Stone (6-8T Stone)						
		Stone Material: Procurement, Delivery and Placement	TON	1118	$132	$147,584	
	Place Armor Stone (2-5T Stone)						
		Stone Material: Procurement and Delivery	TON	2971	$84	$249,552	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	60.6	$297	$17,993	
		Equipment: 150 T Crane, Front End Loader	DAY	7.579	$5,500	$41,683	
	Place Filter Stone (600-1400lb Stone)						
		Stone Material: Procurement and Delivery	TON	1335	$55	$73,414	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	133.5	$297	$39,613	
		Equipment: Front End Loader, Excavator	DAY	16.685	$4,800	$80,088	
	Place Core Stone (5-250lb Stone)						
		Stone Material: Procurement and Delivery	TON	802	$75	$60,163	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	32.1	$297	$9,522	
		Equipment: Front End Loader, Excavator	DAY	4.011	$4,800	$19,252	
Land-Based Sand Placement							
Item 4	**North Regulatory Pre-Fill Area**						$131,564
	Place Regulatory Sand	Sand Material: Procurement, Delivery and Placement	CY	2,000	$66	$131,564	
Item 5	**South Regulatory Pre-Fill Area**						$131,564
	Place Regulatory Sand	Sand Material: Procurement, Delivery and Placement	CY	2,000	$66	$131,564	
Item 6	**Sand Reuse Credit**						-$154,611
	Place Regulatory Sand	Sand Material: Procurement and Delivery	CY	2,350	-$66	-$154,611	
Boating Infrastructure (Required)							
Item 7	**Boat Ramp**						$150,000
	Precast Concrete Panel Boat Ramp Procurement and Installation)		LS	1	$150,000	$150,000	
Initial Harbor Dredge (Marine-Based)							
Item 8	**Initial Harbor Dredge**						$221,486
	Sand Material: Dredge		CY	2,350	$60	$141,022	
	Rock/Cobble Material: Dredge		CY	1,341	$60	$80,464	
Item 9	**Site Restoration and Landside Improvements**						$102,500
	Site Cleanup and Re-Sodding of Park		LS	1	$5,000	$5,000	
	Parking Lot	Asphalt: Procurement, Delivery and Placement	SF	19,500	$5	$97,500	

Sub-Total	$3,241,068
Bond 1%	$32,411
JOOH 5%	$162,053
O & P 15%	$486,160
Total	$3,921,692
25% Contingency	$980,423
Total W/ Contingency & Credit	$4,747,505
Total -15%	$4,035,378.87
Total +25%	$5,934,380.69

Item		Unit	Quantity	Unit Cost	Extension	Sub Total
Boating Infrastructure (Optional)						
Item 7	**Transient Dockage Installation**					$350,000
	Abutment	LS	1	$100,000	$100,000	
	Gangway	LS	1	$100,000	$100,000	
	Transient Dockage	LS	1	$150,000	$150,000	

Hika Park Boat Launch Feasibility Study

Itemized Opinion of Probable Construction Costs
Concept 2 (Single Groin)

Baird.

Project No 13243.101
Date: 2/24/2023
DRAFT - FOR REVIEW

Item			Unit	Quantity	Unit Cost	Extension	Sub Total
Mobilization/Demobilization			LS	1	$78,003	$78,003	$78,003
	Allow 10% of CAPEX						
Site Prep & Demo of Existing Boat Launch							
Item 1	**Site Prep & Demolition**						$19,499
	Reconfigure existing revetment	Stone Material: Reconfiguration	TON	80			
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	7.6	$297	$2,261	
		Equipment: 150 T Crane, Front End Loader	DAY	0.952	$5,500	$5,238	
	Erosion & Sediment Control		LS	1.000	$12,000	$12,000	
Land-Based Groin Construction							
Item 2	**Single Groin (250 LF)**						$552,901
	Place Armor Stone (2-5T Stone)						
		Stone Material: Procurement and Delivery	TON	4457	$84	$374,398	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	91.0	$297	$26,995	
		Equipment: 150 T Crane, Front End Loader	DAY	11.370	$5,500	$62,536	
	Place Filter Stone (600-1400lb Stone)						
		Stone Material: Procurement and Delivery	TON	610	$55	$33,523	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	61.0	$297	$18,089	
		Equipment: Front End Loader, Excavator	DAY	7.619	$4,800	$36,571	
	Place Core Stone (5-250lb Stone)						
		Stone Material: Procurement and Delivery	TON	7	$75	$535	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	0.3	$297	$85	
		Equipment: Front End Loader, Excavator	DAY	0.036	$4,800	$171	
Land-Based Sand Placement							
Item 3	**North Regulatory Pre-Fill Area**						$26,313
	Place Regulatory Sand	Sand Material: Procurement and Delivery	CY	400	$66	$26,313	
Item 4	**South Regulatory Pre-Fill Area**						$26,313
	Place Regulatory Sand	Sand Material: Procurement and Delivery	CY	400	$66	$26,313	
Land-Based Boat Ramp Installation							
Item 5	**Boat Ramp**						$150,000
	Precast Concrete Panel Boat Ramp Procurement and Installation)		LS	1	$150,000	$150,000	
Item 6	**Site Restoration and Landside Improvements**						$5,000
	Site Cleanup and Re-Sodding of Park		LS	1	$5,000	$5,000	

Sub-Total	$858,028
Bond 1%	$8,580
JOOH 5%	$42,901
O & P 15%	$128,704
Total	$1,038,214
25% Contingency	$259,554
Total W/ Contingency	$1,297,768
Total -15%	$1,103,102.85
Total +25%	$1,622,210.08

Hika Park Boat Launch Feasibility Study

Itemized Opinion of Probable Construction Costs
Concept 3 (Two Groins Around Creek)

Baird.

Project No 13243.101
Date: 2/24/2023
DRAFT - FOR REVIEW

Item			Unit	Quantity	Unit Cost	Extension	Sub Total
Mobilization/Demobilization			LS	1	$365,166	$365,166	$365,166
	Allow 10% of CAPEX						
Site Prep & Demo of Existing Boat Launch							
Item 1	Site Prep & Demolition						$36,373
	Tree Removal		EA	2	$2,400	$4,800	
	Demo existing 100' x 40' concrete boat launch		CY	74	$163	$12,074	
	Reconfigure existing revetment	Stone Material: Reconfiguration	TON	80			
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	7.6	$297	$2,261	
		Equipment: 150 T Crane, Front End Loader	DAY	0.952	$5,500	$5,238	
	Erosion & Sediment Control		LS	1.000	$12,000	$12,000	
Land-Based Groin Construction							
Item 2	North Groin (542 LF)						$1,476,456
	Place Armor Stone (6-8T Stone)						
		Stone Material: Procurement and Delivery	TON	2351	$132	$310,362	
	Place Armor Stone (2-5T Stone)						
		Stone Material: Procurement and Delivery	TON	4628	$84	$388,750	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	94.4	$297	$28,030	
		Equipment: 150 T Crane, Front End Loader	DAY	11.806	$5,500	$64,933	
	Place Filter Stone (600-1400lb Stone)						
		Stone Material: Procurement and Delivery	TON	3034	$55	$166,887	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	303.4	$297	$90,050	
		Equipment: Front End Loader, Excavator	DAY	37.929	$4,800	$182,058	
	Place Core Stone (5-250lb Stone)						
		Stone Material: Procurement and Delivery	TON	2,213	$75	$165,995	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	88.5	$297	$26,273	
		Equipment: Front End Loader, Excavator	DAY	11.066	$4,800	$53,118	
Item 3	South Groin (542 LF)						$1,537,622
	Place Armor Stone (6-8T Stone)						
		Stone Material: Procurement and Delivery	TON	2324	$132	$306,818	
			CH	47.4		$0	
			DAY	5.930		$0	
	Place Armor Stone (2-5T Stone)						
		Stone Material: Procurement and Delivery	TON	4602	$84	$386,552	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	93.9	$297	$27,871	
		Equipment: 150 T Crane, Front End Loader	DAY	11.739	$5,500	$64,566	
	Place Filter Stone (600-1400lb Stone)						
		Stone Material: Procurement and Delivery	TON	3198	$55	$175,891	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	319.8	$297	$94,908	
		Equipment: Front End Loader, Excavator	DAY	39.975	$4,800	$191,881	
	Place Core Stone (5-250lb Stone)						
		Stone Material: Procurement and Delivery	TON	2,608	$75	$195,588	
		Crew: (1) Crane Operator, (1) Oiler, (1) Operater, (1) Laborer	CH	104.3	$297	$30,957	
		Equipment: Front End Loader, Excavator	DAY	13.039	$4,800	$62,588	
Land-Based Sand Placement							
Item 4	North Regulatory Pre-Fill Area						$39,469
	Place Regulatory Sand	Sand Material: Procurement and Delivery	CY	600	$66	$39,469	
Item 5	South Regulatory Pre-Fill Area						$39,469
	Place Regulatory Sand	Sand Material: Procurement and Delivery	CY	600	$66	$39,469	
Item 6	Sand Reuse Credit						-$111,342
	Place Regulatory Sand	Sand Material: Procurement and Delivery	CY	1,693	-$66	-$111,342	
Boating Infrastructure							
Item 7	Boat Ramp						$150,000
	Precast Concrete Panel Boat Ramp Procurement and Installation)		LS	1	$150,000	$150,000	
Initial Harbor Dredge (Marine-Based)							
Item 8	Initial Harbor Dredge						$248,769
	Sand Material: Dredge		CY	1,693	$60	$101,555	
	Rock/Cobble Material: Dredge		CY	2,454	$60	$147,214	
Item 9	Site Restoration and Landside Improvements (Parking lot, etc.)						$123,500
	Site Cleanup and Re-Sodding of Park		LS	1	$6,000	$6,000	
	Parking Lot	Asphalt: Procurement, Delivery and Placement	SF	23,500	$5	$117,500	

Sub-Total	$4,016,825
Bond 1%	$40,168
JOOH 5%	$200,841
O & P 15%	$602,524
Total	$4,860,358
25% Contingency	$1,215,089
Total W/ Contingency & Credit	$5,964,106
Total -15%	$5,069,489.84
Total +25%	$7,455,132.11

Hika Park Boat Launch Feasibility Study

Itemized Opinion of Probable Construction Costs
Concept 4 (Replacement-in-Kind)

Project No 13243.101
Date: 2/24/2023
DRAFT - FOR REVIEW

Item		Unit	Quantity	Unit Cost	Extension	Sub Total
Mobilization/Demobilization		LS	1	$17,907	$17,907	$17,907
	Allow 10% of CAPEX					
Site Prep & Demo of Existing Boat Launch						
Item 1	**Site Prep & Demolition**					$24,074
	Demo existing 100' x 40' concrete boat launch	CY	74	$163	$12,074	
	Erosion & Sediment Control	LS	1.000	$12,000	$12,000	
Land-Based Boat Ramp Installation						
Item 2	**Boat Ramp**					$150,000
	Precast Concrete Panel Boat Ramp Procurement and Installation)	LS	1	$150,000	$150,000	
Item 3	**Site Restoration and Landside Improvements (Parking lot, etc.)**					$5,000
	Site Cleanup and Re-Sodding of Park	LS	1	$5,000	$5,000	

Sub-Total	$196,981
Bond 1%	$1,970
JOOH 5%	$9,849
O & P 15%	$29,547
Total	$238,348
25% Contingency	$59,587
Total W/ Contingency	$297,934
Total -15%	$253,244.32
Total +25%	$372,418.11

Appendix C

Plan Commission Meeting Minutes, December 7, 2022

VILLAGE OF CLEVELAND, WISCONSIN

PLAN COMMISSION

WEDNESDAY, DECEMBER 7, 2022

MINUTES

I. CALL TO ORDER/ROLL CALL/PLEDGE OF ALLEGIANCE/AGENDA APPROVAL. Chair Richard Opie called the meeting to order and led the Pledge of Allegiance at 6:01pm on Wednesday, December 7, 2022, at Lakeshore Technical College, Centennial Hall, 1290 North Ave., Cleveland, Wisconsin.

Commission Present:	Richard Opie, Chair John Ader, Village Trustee (left 6:41pm) Jon Hoffman, Village Trustee Jake Holzwart, Village President Marilyn Mrotek, Citizen Member Fred Sohn, Citizen Member Tom Warosh, Citizen Member Stacy Grunwald, Director of Village Services (non-voting)
Commission Absent:	None
Staff Present:	Julie Rusch, Deputy Clerk-Treasurer
Also Participating:	Peter Truax, W.F. Baird & Associates Rory Agnew, W.F. Baird & Associates

Motion Ader/Holzwart to approve the agenda as posted; carried without negative vote.

II. NOVEMBER 2, 2022, MINUTES. Minutes approval was held over until the next meeting.

III. HIKA PARK WAVE ANALYSIS PRESENTATION: W F Baird & Associates. Motion Mrotek/Warosh to open the floor; carried without negative vote.

Peter Truax of W.F. Baird & Associates gave a presentation on the results of their wave and sediment transport study in relation to how the three previously proposed breakwater designs would function, their impact on neighboring properties, and the costs for construction and ongoing maintenance. Baird also included the option of replacing the existing boat launch.

The following questions/comments were provided by those in attendance:

- Would there be less sediment build up on the shoreline if some space was left between the shore and where the groins start?
- What is the potential amount of grant funding the Village could receive?
- Are grants more available for capital expenditures vs. operation/maintenance costs?
- Residents may have different ideas as to what they'd like to see at the lakeshore; not all support the idea of a breakwater/safe harbor refuge.
- Could the Village incur liability is there's an issue in the safe harbor area?
- Did the sediment transport study include only the months of May-October (typical boating season), or an entire year?
- Were the operating/maintenance costs calculated using net present value?
- Were offshore breakwaters looked at?
- What would be the estimated usage of the boat launch?

- Were there any other small harbors on the eastern Wisconsin shoreline?
- A better boat launch is needed but the Village cannot financially support a project of this scale and expense.
- Would disposal of dredging materials be done via downdrift disposal or taken offsite?
- Would the southern groin of Option 3 support equipment on it to use for dredging?
- Could we build in the waters off Hika Park due to the NOAA marine sanctuary designation?
- NOAA encourages tourism; there are Federal grants to help fund projects.

Motion Warosh/Hoffman to close the floor; carried without negative vote.

Chair Opie explained the Plan Commission will discuss Baird’s report at their next meeting, tentatively scheduled for February 1, 2023.

IV. NEXT REGULAR MEETING: WEDNESDAY, FEBRUARY 1, 2023, 6PM. Noted.

V. ADJOURNMENT. Motion Sohn/Mrotek to adjourn; carried without negative vote. The meeting adjourned at 7:43pm.

Respectfully submitted,

Julie Rusch
Deputy Clerk-Treasurer

Approved on 02/01/23