

4 Evaluation and Recommendations

4.1 Overview of the Alternatives Evaluation Process

The management alternatives were evaluated in stages using a multi-step process that screened the options based on selected evaluation criteria. A preliminary screening of alternatives based on conformance with the State Coastal Management Policies and the policies outlined in the Town of Huron Local Waterfront Revitalization Program (LWRP) was attempted by the PAC. This screening process was determined to be premature due to the early conceptual stage of the alternatives and lack of information regarding the need and goals for the project. As such, the coastal management policy screening method of evaluation was abandoned as a formal screening process and the project goals were developed to act as the measurement tool for analysis of each alternative. Additional preliminary screening was conducted during the public meeting held on September 8, 2018 at the Elks Lodge in Wolcott, NY. The meeting presented the preliminary management alternatives to the community for review and comment. This information was used to modify the alternatives and considered during the final evaluation.

The final evaluation was conducted in two phases. First, all eight alternatives were evaluated against the overarching project goals and the anticipated coastal processes within the project area. A detailed description of the coastal processes analysis is provided in **Appendix E**. Based on these evaluations, considerations from the PAC, and comments from the public input, three alternatives were removed from further analysis. The remaining five alternatives were then advanced to provide conceptual construction costs and life cycle costs to aid in determining the feasibility of each of the five alternatives. Based on all of these evaluations, the alternative that best met the multiple project goals and indicators was identified as the recommended alternative.

The evaluations are based on the conceptual designs described in **Section 3**. It is important to note that these designs only reflect a schematic level of design to represent varying types of management activities. Any implemented project would still require detailed design prior to permitting by NYSDEC, NYSDOS, NYSOGS, USACE and any other local regulatory agencies to ensure all applicable requirements are met.

The eight alternatives evaluated (described in **Section 3**) are:

- Alternative A: No Action
- Alternative B: Limited Sediment Management
- Alternative C: Nature-Based Barrier Bar
- Alternative D: Adaptive Management
- Alternative E: Infrastructure Protection Measures
- Alternative F: Fortification Using Rock Revetment

- Alternative G: Fortification Using Rock Revetment with Armored Overflow
- Alternative H: Fortification Using Rock Revetment with Culvert(s)

For the purpose of the evaluation, each of the design alternatives (not including Alternative A – No Action) are assumed to be the base condition, as described in **Section 3**, which includes providing reliable equipment access and the limited sediment management outlined as base conditions of Alternative B.

The project goals that were used as the first phase of screening criteria were identified by the PAC; whose input was based on discussions of the Port Bay Working Group. These overarching project goals considered an array of factors—coastal processes, ecological and habitat-related concerns, human priorities and socioeconomic factors—reflecting an ecosystem-based management approach to alternative evaluation and selection, rather than a strictly cost-benefit ratio evaluation. Each of the goals was more specifically defined using a set of indicators that helped to assess how well each alternative supported the broader goal, as outlined in **Table 4.1-1**.

Table 4.1-1 Project Goals and Indicators Used to Screen Management Alternatives

Goals	Indicators
Maintain natural/dynamic coastal features in the nearshore area, beach, and barrier bar.	<ul style="list-style-type: none"> • Minimizes disturbance to east barrier bar • Minimizes disturbance to nearshore area • Reduces long-term breaching or loss of east barrier bar
Maintain and restore natural coastal processes, including sediment transport.	<ul style="list-style-type: none"> • Maintains natural shoreline • Promotes longshore transport (LST) • Maintains low gradient shoreline slopes • Minimizes impacts to downdrift neighbors
Maintain and protect natural habitat areas.	<ul style="list-style-type: none"> • Protects turtle habitat • Protects shorebird habitat / nearshore habitat in lake • Protects fisheries habitat in bay • Protects wildlife habitat in bay • Minimizes impacts to bat habitat
Minimize damage to property and infrastructure, both public (NYSDEC WMA) and private (shoreline residents).	<ul style="list-style-type: none"> • Maintains a continuous east barrier bar • Minimizes potential damage to shoreline properties from debris • Protects against wave action
Ensure human health and safety.	<ul style="list-style-type: none"> • Improves water quality circulation in bay • Minimizes risks to recreational users (boaters, anglers, hikers, beachgoers) • Ensures boaters and other users continued shielding from extreme lake conditions in the bay (i.e., storm events)
Ensure continued fishing and boat access.	<ul style="list-style-type: none"> • Minimizes impacts to boaters in the bay • Maintains shoreline access across east barrier bar

Goals	Indicators
Ensure feasibility of implementation.	<ul style="list-style-type: none"> • Grant funding availability • Minimizes management time commitment • Minimizes risk of emergency responders and maintenance personnel • Maintains equipment access to east barrier bar for dredging / maintenance purposes • Construction Cost (<i>From Phase 2 of evaluation</i>) • Operation and Maintenance Cost (<i>From Phase 2 of evaluation</i>)

4.2 Evaluation of Alternatives Against Project Goals and Indicators

Each of the eight potential alternatives were evaluated against the project goals and indicators as outlined above. Each of the alternatives were evaluated as to how well they met the conditions of each of the indicators. One of six different categories was then assigned to each alternative for a particular indicator: High, Moderate to High, Moderate, Low to Moderate, Low or None. If an alternative could be described to perform well for a particular indicator, it was given a High value, those that performed poorly or would not meet the objective of the indicator, were rated as Low or None (would not meet at all). The following section further describes each of these goals and indicators and how they were evaluated for the purpose of this report. Each evaluation assumed continued implementation over the 30-year design life.

Goal: Maintain natural/dynamic coastal features in the nearshore area, beach, and barrier bar.

Beaches, nearshore areas, barrier islands and other natural protective features help safeguard coastal lands and property from damage. These areas are naturally dynamic and create sensitive habitats and natural ecosystems that function based on the natural fluctuations and processes that occur in these areas. NYS Coastal Management policies dictate that the State must protect and maintain these natural areas to the maximum extent practical.

Minimize disturbance to east barrier bar.

This indicator was based on the level of disturbance associated with construction activities or on-going maintenance. Those activities that involved heavy construction and disturbance to the east barrier bar scored lower.

Minimize disturbance to nearshore area.

This indicator was based on the level of disturbance associated with construction activities or on-going maintenance. Those activities that involved heavy construction and disturbance to the nearshore area scored lower.

Reduces long term breaching or loss of east barrier bar.

A variety of conditions play into the formation of barrier bars: sediment supply, LST, wave conditions, water levels, human impact, etc. The history of this bar indicates, based on historic aerial photos, that the eastern end of the east barrier bar has been progressively narrowing for several decades. Management alternatives that mitigate progressive shoreline erosion and secured the continued existence of the east barrier bar were scored higher, those that provided less assistance to maintain the integrity of the bar scored lower.

Goal: Maintain and restore natural coastal processes, including sediment transport

Long-term integrity of the coast in general and the shoreline at the east barrier bar in particular depend on a fairly stable interplay of major factors including the following:

- Continuity of the LST;
- Undisturbed flow from the Bay into the lake by proper dredging near the channel outlet;
- Mitigation of progressive erosion of the east barrier bar that has taken place in the last few years as manifested in three breaches of 2012, 2016 and 2017;
- Preserving the existing natural low beach slope;
- Preparation for the increased lake water level fluctuations resulting from implementation of IJC Plan 2014; and
- Protecting the downcoast neighbors from shoreline erosion following future potential east barrier bar breaches and the associated eastward LST deficit.

Management activities that incorporate these major factors scored higher.

Maintains natural shoreline.

Hard structures such as groins or detached breakwaters would significantly alter the balance of natural coastal processes and are associated with high economic and environmental costs. Even structures such as rock revetments are associated with a milder degree of the same implications. Therefore, management alternatives associated with hard structures using artificial (e.g., concrete) or non-native (e.g., large rock) materials were given lower values.

Promotes longshore transport (LST).

Previous sediment transport investigations showed that the dominant eastward LST originates from up-coast (westerly) regions. A significant amount of LST is trapped by the pier. The LST that bypasses the pier coupled with the cross-shore sediment movement and placement of the material annually dredged from near the channel outlet play an important role in the integrity of the natural coastal processes occurring along the east barrier bar. It was also noted that previous breaches in the east barrier bar acted as sinks for the eastward LST leading to intrusion of

sediment in the bay and discontinuity of LST for the downcoast regions. While it is true that typically, hardened shorelines are considered to provide negative impacts on LST, for the alternatives evaluated, it was determined that the long-term impacts to LST based on the development of a sink as the result of a breach or the loss of the bar would provide a greater detriment than the short term LST loss due to the hardened structure. Those management alternatives that provide the greatest protection against the development of future breach-induced sinks in terms of LST deficit were given the highest ratings.

Maintains low gradient shoreline slopes.

It was shown that large offshore wave heights are significantly attenuated when waves approach the nearshore over very mild beach slopes in the Port Bay region. Low beach slopes give rise to breakers with smaller wave heights and lower energy when they attack the shore. Steep slopes allow for crashing waves with higher energy, which results in more erosion at the toe. Alternatives that entail rehabilitation measures associated with structures on steep slopes across the shoreline were considered less desirable and scored lower.

Minimizes impacts to downdrift neighbors.

Given the predominant eastward longshore current and sediment transport, alternatives that introduce discontinuity or considerable disturbance for alongshore currents and sediment movement may result in increased erosion downdrift. Potential impacts to downdrift neighbors associated with east barrier bar hardening, wave refraction, and sediment transport were incorporated in the determination of risk of exposure resulting in excessive erosion from the implementation of each of the management alternatives. Those management alternatives that provide the greatest risk for long-term sediment deficit to be cast downstream scored the lowest.

Goal: Maintains and protects natural habitat areas.

The Port Bay barrier bar, as well as the bay area it protects, are part of the Lake Shore Marshes Wildlife Management Area (WMA). The WMA provides a unique combination of lake and bay marshes that provide habitat for many species of fish, mammals, songbirds, and waterfowl. Any proposed management alternative would be required to protect and/or promote the wildlife habitats known to be within the project area.

Protects turtle habitat.

The spiny softshell turtle is listed as an S2S3 Species of Greatest Conservation Need (High Priority) and a Species of Concern by the New York Natural Heritage Program. This species prefers to nest on open, elevated sand or gravel banks or sandbars as close to the water as possible. This type of habitat occurs along the bay side of the east barrier bar. Management alternatives expected to either protect or expand the amount of turtle nesting habitat along the

bay side of the bar were scored high. Alternatives expected to reduce or eliminate available turtle spawning habitat were scored low or none, respectively.

Protects shorebird habitat / nearshore habitat in lake.

The nature of shorebird habitat can vary considerably depending on the shorebird species and the function of the habitat (e.g., nesting, foraging, roosting). Management alternatives were evaluated with these differences in mind, and the score was often contingent on the species or function of the habitat. Some alternatives could thus score high for some species or functions and low or none for others. Nearshore habitat was generally scored in relation to the degree of long-term disturbance or elimination of structural complexity, with higher scores given to alternatives that minimized disturbance of or reduction in structural complexity and poorer scores allotted to alternatives that resulted in long-term homogenization of nearshore habitat.

Protects fisheries habitat in bay.

Fish habitat in the bay that is affected by the east barrier bar management is primarily limited to the vegetated littoral zone. This is an area of relatively high productivity and provides fish spawning and nursery habitat. Management alternatives that minimized or eliminated disturbance to bay-side vegetated nearshore areas were scored higher than alternatives that resulted in significant or ongoing disturbance to such areas. In addition, alternatives that provided increased opportunity for fish passage into and out of the bay were scored favorably.

Protects wildlife habitat in bay.

A wide variety of wildlife, including softshell and other turtles, woodland birds, wading birds, waterfowl, birds of prey, furbearers, and others use the various habitats of the east barrier bar and bay. Management alternatives can differentially affect these different species by protecting, enhancing, or reducing available habitat, so a management alternative score was often contingent on the species or function of the habitat considered. Alternatives that tend to protect or minimize disturbance to vegetated terrestrial and/or aquatic habitats were scored higher than those that reduced or eliminated vegetated habitat or reduced habitat structural complexity. In some cases, a management alternative could score high for protection of wildlife habitat in the bay while at the same time score low for disturbance or reduction in wildlife habitat on the east barrier bar itself.

Minimizes impacts to bat habitat.

Northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Potential habitat for this species occurs in the wooded area of the western two-thirds of the east barrier bar. Management alternatives were scored with regard to

impacts to bat habitat based on the expected degree of disturbance to or removal of large diameter trees that may serve as bat roosting sites. Alternatives that protected such habitat were scored higher than those that would likely result in loss of large diameter trees on the east barrier bar.

Goal: Minimize damage to public (DEC WMA) and private (shoreline residents) property / infrastructure

While there is no longer any infrastructure located on the east barrier bar itself, the remaining land area of the bar is valuable to the people of New York State as a place for public recreation. Additionally, the barrier bar provides protection to the bay and shoreline structures from wave action, ice, and debris that would otherwise enter from the lake.

Maintains a continuous east barrier bar.

Those alternatives that provide the greatest protection against loss of the east barrier bar and resistance to long term damage scored highest. Those with the potential for continued breaching scored lowest.

Minimizes potential damage to shoreline properties from debris.

During previous breaches, it was noted that a significant amount of debris (including trees, shrubs, etc.) was seen to wash through the breach and be carried into the bay. These debris items were caught in docks, repeatedly washed against shorelines exacerbating erosion and acting as deterrents to navigation. The east barrier bar, when fully intact, provides protection against debris washing in from the lake. During winter months, the potential for ice sheets to be conveyed through a breach on the east barrier bar also exists. Alternatives that provide the greatest protection against future breaching and minimize the ability for debris and ice to wash over or through the east barrier bar were given highest scores.

Protects against wave action.

The east barrier bar, when fully intact, allows waves to break on the bar, rather than entering the bay area. During previous breaches, it was noted that waves traveled into the bay creating choppy conditions in the bay. Should the east barrier bar be completely lost, the bay would be subject to an increased fetch, leading to waves within the bay being significantly larger. Alternatives that provided the greatest protection against future breaching, provided greater resistance to wave crashing, and minimized the ability for waves to crash over or roll through the bar were given the highest scores.

Goal: Ensure human health and safety

The east barrier bar and the adjoining waterways are public lands and should be kept in such a condition where continued public use of the public lands is safe and accessible. As such, the management of the east barrier bar must take into account the safety of all potential users as well as the health and safety of those adjacent to the bar.

Improves water quality circulation in the bay.

While no site-specific water quality circulation analysis was conducted, it has been shown in other areas, such as at Fire Island downstate, that breaching of barrier bars can provide some increase in water quality benefit by increasing the circulation and exchange of water between the bay and lake (USACE 1999). However, the size and depth of the breaches in comparison to the size and depth of the bay indicates that breaches would likely only have a limited impact on water quality. Management alternatives that effectively prevented breaches from occurring scored low. Those that allowed or provided for increased conveyance and water exchange scored higher.

Minimizes risks to recreational users (boaters, anglers, hikers, beachgoers).

As public land, the east barrier bar is available for recreational use, be it fishing access, dog walking, sunbathing or other forms of activities. In the past, the breaches have made it dangerous for users to cross the east barrier bar due to the current and waves; therefore, those alternatives with the highest breach potential scored low. However, there are a variety of other potential hazards considered including steep slopes, walkability (i.e., gravel vs. riprap), and debris build up potential.

Ensuring continued shielding of boaters and other users from extreme lake conditions in the bay.

While Port Bay is not a designated “safe harbor”, the inlet channel and bay area still provide refuge for recreational users in the event of storm conditions on Lake Ontario. The bar allows an area for lake waves to break on and creates a calmer water surface within the bay. Alternatives that minimized the potential for breaching, overtopping, or permanent conveyance of flows through the east barrier bar were given higher ratings than those that encouraged or did not prevent lake inflows and breaching.

Minimizes risk of internal bay flooding during winter/spring.

Dredging of the inlet channel is typically done in late March due to weather and permitting restrictions. During winter and spring storms, the sediment transported along the lake shoreline ends up depositing in the inlet channel; often times this elevation can be high – above lake elevations. In these instances, as the early spring snowmelt and runoff conditions increases the inflow into the bay, the bay levels can rise as the conveyance area for equalizing water surface

elevations with the lake is diminished. Under these conditions, the flooding in the bay can become a problem until a point that a break in the inlet channel, dredging, or, as in the past, a breach, allowed water levels to equalize. Management alternatives that provided some permanent connection with the lake or allowed for continued breaching scored higher for this indicator.

Goal: Ensure continued fishing and boat access

Port Bay is widely used for fishing and boating recreation. The vast majority of the homeowners on the bay have boat/dock access along the shoreline. Users of the bay include both motorized and non-motorized boaters. In addition, the east barrier bar itself is often used as a fishing access point.

Minimizes impacts to boaters in the bay.

As many boaters use the bay for fishing and recreational use, calm conditions are ideal. Alternatives where wave or debris intrusion would be encouraged or protection against breaches was limited were scored lower. Alternatives where wave or debris intrusion would be discouraged, or protection against breaches was provided, scored higher.

Maintains shoreline access across east barrier bar.

It is assumed that fishing access would come from walking across the east barrier bar from East Port Bay Road. In the past, walking across breach areas has been dangerous. Therefore, alternatives where protection against breaches was the greatest, scored highest. Alternatives where protection against breaches was limited or not provided, scored lowest.

Goal: Implementation and Feasibility

As with any project, the implementation ability and feasibility of the project can be driving factors. No matter the benefits, if a project is not permissible or fundable, it has no chance of being constructed. NYSDEC has a variety of environmental regulations, budgetary and staffing constraints, and logistical concerns that should be considered when evaluating alternatives.

Grant funding availability.

Typically, grant funding is the easiest way to provide payment for a project such as this. Grant funds such as FEMA or storm recovery are unlikely to be applicable due to the nature of the proposed work and the rules associated with the grants. The most applicable grants will come from green infrastructure improvement funding. Therefore, the alternatives that provide the greenest solutions scored high.

Minimize management time commitment.

NYSDEC has large and far reaching areas of the state under its jurisdiction. It is assumed that all of the build alternatives would require annual maintenance / inspection and coordination with the PBIA; however, other alternatives would require additional levels of oversight, increased maintenance / repair, and evaluation that would require an increased time commitment from NYSDEC staff and other partners. Those alternatives thought to have the largest on-going time commitment scored low.

Minimize risk of emergency responders and maintenance personnel.

Each of the build alternatives includes access across the east barrier bar for channel dredging and sediment management purposes. Those alternatives where potential breaching or damage to this cross-bar access is a risk scored the lowest, and those that provided for continued access scored highest.

Provides equipment access across east barrier bar for dredging / maintenance purposes.

Each of the build alternatives requires access across the bar for channel dredging and sediment management purposes. Those alternatives where the potential for this cross-bar access is at risk due to breaching scored the lowest, and those that provided for continued access scored the highest.

Construction Cost.

Schematic level construction costs were developed for each alternative. These values (described further in **Section 4.3**) take into account potential construction costs.

Operation and Maintenance Cost.

Also described further in **Section 4.3**, each build alternative is assumed to have on-going annual maintenance, inspections and other work that would be required over the assumed 30-year life span of the project. These life cycle costs help to rationalize future money that must be considered for the up-keep and continued protection provided by each of the management alternatives.

Table 4.2-1 provides a visual representation of the evaluations using a red to green color ramp (see **Figure 4.2-1**) representing the evaluation scores. A more detailed summary of the evaluations and the reasoning behind the conclusions are provided in **Table 4.2-2**.

Figure 4.2-1 Color Ramp for Project Goal Evaluation



Table 4.2-1 Visual Summary of Project Goals Evaluation

PROJECT GOALS EVALUATION									
		Alternatives							
Goals	Indicators	A	B	C	D	E	F	G	H
		Do Nothing	Sediment Management	Nature-Based Protection	Adaptive Management	Infrastructure Protection	Rock Revetment	Rock Revetment with Overflow	Rock Revetment with Culverts
Maintain natural/dynamic coastal features (nearshore area, beach, barrier bar)	Minimize disturbance to east barrier bar	High	Moderate to High	Moderate	Moderate	High	None	None	None
	Minimize disturbance to nearshore area	High	Moderate to High	High	Moderate	High	Low	Low	Low
	Reduces long-term breaching or loss of east barrier bar	None	Moderate	Moderate to High	Moderate	Moderate	High	High	High
Maintain and restore natural coastal processes, including sediment transport	Maintains natural shoreline	High	High	High	High	High	Low	Low	Low
	Promotes long-shore transport (LST)	Low	Moderate to High	High	Low	Low	High	High	High
	Maintains low gradient shoreline slopes	High	High	Moderate to High	High	High	Low	Low	Low
	Minimizes impacts to downdrift neighbors	Low	Moderate	Moderate to High	Moderate	Low	High	High	High
Maintains and protects natural habitat areas	Protects turtle habitat	Low	Low	Moderate	Low	Low	None	None	None
	Protects shorebird habitat / nearshore habitat in lake	Low to Moderate	Low to Moderate	High	Moderate	Low to Moderate	Low	Low	Low
	Protects fisheries habitat in bay	Low to Moderate	Low to Moderate	High	Moderate	Low	High	High	High
	Protects wildlife habitat in bay	Low to Moderate	Low to Moderate	High	Low	Low	Moderate	Moderate	Moderate
	Minimizes impacts to bat habitat	Moderate to High	Moderate to High	High	Moderate	Moderate to High	None	None	None
Minimize damage to public (DEC WMA) and private (shoreline residents) property / infrastructure	Maintains a continuous barrier bar	Low	Low to Moderate	Moderate to High	Low to Moderate	Low to Moderate	High	High	High
	Minimizes potential damage to shoreline properties from debris	Low	Low to Moderate	Moderate to High	Low to Moderate	High	High	High	Moderate to High
	Protects against wave action	Low	Low to Moderate	Moderate to High	Low to Moderate	Low to Moderate	High	Moderate to High	High
Ensure human health and safety	Improves water quality circulation in bay	Moderate to High	Low	Low	Low	Moderate to High	None	Moderate	Moderate
	Minimizes risks to recreational users (boaters, anglers, hikers, beachgoers)	Low to Moderate	Moderate	Moderate to High	Low to Moderate	Low	Moderate to High	Moderate to High	Moderate to High
	Ensuring continued shielding of boaters and other users from extreme lake conditions in the bay (i.e., storm events)	None	Moderate	High	Low	Moderate	High	High	High
	Minimizes risk of internal bay flooding during winter/spring	Moderate to High	Moderate	None	Moderate	Moderate to High	None	High	Moderate to High
Ensure continued fishing & boat access	Minimizes impacts to boaters in the bay	None	Moderate	High	Low	Moderate	High	Moderate to High	High
	Maintains shoreline access across east barrier bar	Low	Moderate	High	Moderate	Low to Moderate	Moderate to High	Moderate to High	Moderate to High
Ensure feasibility of implementation	Grant funding availability	High	Low	High	Low	Low	Low	Low	Low
	Minimize management time commitment	High	Moderate to High	Moderate to High	Low	Moderate	High	Moderate to High	Low
	Minimize risk of emergency responders and maintenance personnel	Low	Low to Moderate	High	Low	Low	High	Moderate to High	Low to Moderate
	Maintains equipment access across east barrier bar for dredging / maintenance purposes	None	Moderate	Moderate to High	Moderate	Moderate	High	High	High
	Construction Cost	High	High	Moderate	N/A	Moderate to High	None	N/A	N/A
	Operation and Maintenance Cost	High	High	Low to Moderate	N/A	Low to Moderate	High	N/A	N/A

TABLE 4.2-2: PROJECT GOALS EVALUATION

		Atleaves									
		A	B	C	D	E	F	G	H		
Goals	Indicators	Do Nothing	Sediment Management	Nature-Based Protection	Adaptive Management	Infrastructure Protection	Rock Revetment	Rock Revetment with Overflow	Rock Revetment with Culverts		
Maintain natural/dynamic coastal features (nearshore area, beach, barrier bar)	Minimize disturbance to east barrier bar	High - No human-induced alteration of physical habitat	Moderate to High - Minimal, seasonal modifications to portion of barrier bar. Annual maintenance to encourage natural erosion and repair.	Moderate - Some short-term disturbance to natural shoreline and barrier bar will eventually occur when management is required to enhance natural protective benefits but upper elevations not disturbed.	Moderate - Some short-term disturbance to natural shoreline and barrier bar will eventually occur when management is required to enhance natural protective benefits but upper elevations not disturbed.	High - No human-induced alteration of physical habitat.	None - Involves large-scale modification of habitat. Lakeside habitat will be permanently altered but in the long-term may revert to a "natural" condition.	None - Involves large-scale modification of habitat. Lakeside habitat will be permanently altered but in the long-term may revert to a "natural" condition.	None - Involves large-scale modification of habitat. Lakeside habitat will be permanently altered but in the long-term may revert to a "natural" condition.		
	Minimize disturbance to nearshore area (nearshore area, beach, barrier bar)	High - No human-induced alteration of physical habitat.	Moderate to High - Minimal, seasonal modifications to portion of nearshore area. Annual maintenance to encourage natural erosion and repair.	High - Gravel placement will create a bar similar to the existing conditions with enhanced vegetation for stabilization. Nearshore conditions to remain virtually unchanged.	Moderate - Some short-term disturbance to natural shoreline and barrier bar will eventually occur when management is required to enhance natural protective benefits but upper elevations not disturbed.	High - No human-induced alteration of physical habitat.	None to Low - Involves large-scale modification of lake-side near-shore habitat. Lakeside habitat will be permanently altered but to a lesser degree and in the long-term should revert to a natural condition.	None to Low - Involves large-scale modification of lake-side near-shore habitat. Lakeside habitat will be permanently altered but to a lesser degree and in the long-term should revert to a natural condition.	None to Low - Involves large-scale modification of lake-side near-shore habitat. Lakeside habitat will be permanently altered but to a lesser degree and in the long-term should revert to a natural condition.		
	Reduces long-term breaching or loss of east barrier bar	None - Pattern of breaches and reduced LST indicates breaches will likely continue.	Moderate - Approximately half of potential gravel LST is deposited around channel outlet. Annual dredging and redistribution of this volume will increase the sediment supply to aid in repair and replenishment of material for east barrier bar.	Moderate - Base elements of Alt. B coupled with increased protection. Most vulnerable immediately following construction. Dependent on vegetation establishment.	Moderate - Base elements of Alt. B. Reactive to future breaches.	Moderate - Base elements of Alt. B. No additional protection against long-term breaching.	High - Design intended to minimize potential for breaching.	High - Design intended to minimize potential for breaching.	High - Design intended to minimize potential for breaching.	High - Design intended to minimize potential for breaching.	
Maintain and restore natural coastal processes, including sediment transport	Maintains natural shoreline	High - No modifications to natural conditions. Erosion and repair naturally.	High - Minimal modifications to natural shoreline. Annual maintenance to encourage natural erosion and repair.	High - Enhances natural shoreline to increase natural protective benefits. Enlarges barrier bar footprint.	High - Minimal modifications to natural shoreline. Annual maintenance to encourage natural erosion and repair.	High - Minimal modifications to natural shoreline. Annual maintenance to encourage natural erosion and repair.	None to Low - Involves large-scale modification of lake-side shoreline. Lakeside shoreline will be permanently altered and "artificial". Bay-side shoreline will also be altered but to a lesser degree and in the long-term should revert to a natural condition.	None to Low - Involves large-scale modification of lake-side shoreline. Lakeside shoreline will be permanently altered and "artificial". Bay-side shoreline will also be altered but to a lesser degree and in the long-term should revert to a natural condition.	None to Low - Involves large-scale modification of lake-side shoreline. Lakeside shoreline will be permanently altered and "artificial". Bay-side shoreline will also be altered but to a lesser degree and in the long-term should revert to a natural condition.		
	Promotes long-shore transport (LST)	None to Low - Gaps due to breaches may act as sink for LST as they may draw part of the LST and cross-shore transport into the bay.	Moderate to High - Exposes the spread spoil to wave attack and LST transport into the bay.	High - Mitigates the risk of breaches similar to those in 2012, 2016, and 2017 which could act as sink and discontinuity for LST while maintaining natural sediment and shoreline.	None to Low - Gaps due to breaches may act as sink for LST as they may draw part of the LST and cross-shore sediment transport into the bay.	None to Low - Gaps due to potential breaches may act as sink for LST as they may draw part of the LST and cross-shore sediment transport into the bay.	High - Minimizes the risk of breaches similar to those in 2012, 2016, and 2017 which could act as sink and discontinuity for LST.	High - Minimizes the risk of breaches similar to those in 2012, 2016, and 2017 which could act as sink and discontinuity for LST.	High - Minimizes the risk of breaches similar to those in 2012, 2016, and 2017 which could act as sink and discontinuity for LST.		
	Maintains low gradient shoreline slopes	High - existing low slope nearshore to remain.	High - existing low slope nearshore to remain.	Moderate to high - Sediment management combined with vegetative protection will reduce erosion and allow for transported sediment to continue to build and repair the barrier bar. Slope could reduce gradient.	High - existing low slope nearshore to remain.	High - existing low slope nearshore to remain.	High - existing low slope nearshore to remain.	Low - Large scale revetment will create steep slope at shoreline. Erosion potential at toe.	Low - Large scale revetment will create steep slope at shoreline. Erosion potential at toe.	Low - Large scale revetment will create steep slope at shoreline. Erosion potential at toe.	
		None to Low - On the one hand, to the extent the eroded beaches may act as a sink for LST, the LST will draw sediment into the bay, slightly less sediment may move downdrift. On the other hand, any future beach would cause short-term downdrift equilibrium condition in the downdrift shoreline should breaks similar to those in 2012, 2016 and 2017 take place.	Moderate - Spoil material partly compensate for sediment deficit needed for LST. This slightly mitigates the overall erosion and recession of the east barrier. Beneficial for downdrift neighbors.	Moderate to high - Any stabilization of the east bar minimizes the risk of breaches and therefore, helps stability of downdrift shorelines.	Moderate - Fairly deals with the risk of east bar breaches similar to those of 2012, 2016, and 2017. Any stabilization of the east bar minimizes the risk of breaches and therefore, helps stability of downdrift shorelines.	None to Low - Does not pro-actively deal with the risk of east bar breaches similar to those of 2012, 2016, and 2017. Any stabilization of the east bar minimizes the risk of breaches and therefore, helps stability of downdrift shorelines.	High - Any stabilization of the east bar minimizes the risk of breaches and therefore, helps stability of downdrift shorelines. The contribution to LST will be short-term and a one-off event until a new equilibrium condition is established. The source of LST is up-coast shoreline erosion along many tens of miles in the region. The short-term sediment deficit can be compensated for by a one-off beach nourishment using spoil from dredging.	High - Any stabilization of the east bar minimizes the risk of breaches and therefore, helps stability of downdrift shorelines. The contribution to LST will be short-term and a one-off event until a new equilibrium condition is established. The source of LST is up-coast shoreline erosion along many tens of miles in the region. The short-term sediment deficit can be compensated for by a one-off beach nourishment using spoil from dredging.	High - Any stabilization of the east bar minimizes the risk of breaches and therefore, helps stability of downdrift shorelines. The contribution to LST will be short-term and a one-off event until a new equilibrium condition is established. The source of LST is up-coast shoreline erosion along many tens of miles in the region. The short-term sediment deficit can be compensated for by a one-off beach nourishment using spoil from dredging.	High - Any stabilization of the east bar minimizes the risk of breaches and therefore, helps stability of downdrift shorelines. The contribution to LST will be short-term and a one-off event until a new equilibrium condition is established. The source of LST is up-coast shoreline erosion along many tens of miles in the region. The short-term sediment deficit can be compensated for by a one-off beach nourishment using spoil from dredging.	

TABLE 4.2-2: PROJECT GOALS EVALUATION

		Atterberies							
		A	B	C	D	E	F	G	H
Goals	Indicators	Do Nothing	Sediment Management	Nature-Based Protection	Adaptive Management	Infrastructure Protection	Rock Revetment	Rock Revetment with Overflow	Rock Revetment with Culverts
Protect turtle habitat	Protect shorebird habitat / nearshore habitat in lake	Low - recent breach has reduced the area of suitable turtle nesting habitat. Future breaches are likely to reduce it further.	Low - recent breach has reduced the area of suitable turtle nesting habitat. Future breaches are likely to reduce it further.	Low to High - Depends on project design. If current nesting area is protected and nature-based stabilizing of bay-side east and then turtle habitat will be protected. If barrier stabilization features encroach on turtle habitat, it will not be protected.	Low - recent breach has reduced the area of suitable turtle nesting habitat. Future breaches are likely to reduce it further. Effect of adaptive management will depend on condition of turtle habitat following rock beach and chosen management alternative.	Low - recent breach has reduced the area of suitable turtle nesting habitat. Future breaches are likely to reduce it further.	None - There will likely be complete elimination of existing turtle nesting habitat.	None - There will likely be complete elimination of existing turtle nesting habitat.	None - There will likely be complete elimination of existing turtle nesting habitat.
		Low to Moderate - Habitat for shore birds preferring cobble/gravel bars may not be appreciably affected but those preferring shallow, vegetated foraging areas or wooded shoreline habitat may see a reduction in available habitat.	Low to Moderate - Habitat for shore birds preferring cobble/gravel bars may not be appreciably affected but those preferring shallow, vegetated foraging areas or wooded shoreline habitat may see a reduction in available habitat.	High for shorebird habitat. Low for nearshore lake habitat. Stabilizing the barrier bar should benefit shoreline bird habitat but some nearshore lake habitat will be disturbed/affected by stone protection placement.	Low to high depending on impacts that occur prior to adaptive management action. Once adaptive management alternative is implemented, shoreline bird habitat should be protected but nearshore lake habitat will be assumed at least short-term.	Low to Moderate - Habitat for shore birds preferring cobble/gravel bars may not be appreciably affected but those preferring shallow, vegetated foraging areas or wooded shoreline habitat may see a reduction in available habitat.	None to Moderate - Permanent large-scale modification of lake-side nearshore habitat. Shorebird habitat will also be heavily modified but may recover in the long-term.	None to Moderate - Permanent large-scale modification of lake-side nearshore habitat. Shorebird habitat will also be heavily modified but may recover in the long-term.	None to Moderate - Permanent large-scale modification of lake-side nearshore habitat. Shorebird habitat will also be heavily modified but may recover in the long-term.
Maintain and protect natural habitat areas	Protect fisheries habitat in bay	Low to Moderate - May be some loss or continued suppression of spawning/nursery habitat in vicinity of barrier bar.	Low to Moderate - May be some loss or continued suppression of spawning/nursery habitat in vicinity of barrier bar. Some loss of habitat may be somewhat reduced.	High - Stabilizing the barrier bar should benefit bay-side fish habitat by removing major disturbances caused by breaching.	Low to high depending on impacts that occur prior to adaptive management action. Once adaptive management alternative is implemented, bay-side fisheries habitat should be protected.	Low - May be some loss or continued suppression of spawning/nursery habitat in vicinity of barrier bar. Fishery habitat may be reduced depending on nature of infrastructure protection measures along the shoreline within the bay.	High - May be some short-term impacts to near-shore bay-side fisheries habitat but habitat should be protected long-term. Occasional improved passage conditions for fish into and out of the bay.	High - May be some short-term impacts to near-shore bay-side fisheries habitat but habitat should be protected long-term. Occasional improved passage conditions for fish into and out of the bay.	High - May be some short-term impacts to near-shore bay-side fisheries habitat but habitat should be protected long-term. Improved passage conditions for fish into and out of the bay.
		Low to Moderate - May be some loss or continued suppression of habitat for species like spiny softshell turtle, woodland birds, other wildlife but other species may be unaffected.	Low to Moderate - May be some loss or continued suppression of habitat for species like spiny softshell turtle, woodland birds, other wildlife but other species may be unaffected.	High - Stabilizing the barrier bar should benefit bay-side wildlife habitat by removing major disturbances caused by breaching.	Low to high depending on impacts that occur prior to adaptive management action. Once adaptive management alternative is implemented, bay-side wildlife habitat should be protected.	Low - May be some loss or continued suppression of habitat for species like spiny softshell turtle, woodland birds, other wildlife but other species may be unaffected. Wildlife habitat may be reduced depending on nature of infrastructure protection measures along the shoreline within the bay.	None to High - Large-scale modification of barrier bar wildlife habitat. Wildlife habitat elsewhere in the bay will be protected.	None to High - Large-scale modification of barrier bar wildlife habitat. Wildlife habitat elsewhere in the bay will be protected.	None to High - Large-scale modification of barrier bar wildlife habitat. Wildlife habitat elsewhere in the bay will be protected.
Minimize damage to public (DCE, WMA) and private (shoreline residents' property / infrastructure	Minimizes impacts to bat habitat	Moderate to High - Bat habitat should be unaffected unless future breaches remove large trees favored as roosting or nesting sites. Extending the area receiving dredged material should help protect existing trees.	Moderate to High - Bat habitat should be unaffected unless future breaches remove large trees favored as roosting or nesting sites. Extending the area receiving dredged material should help protect existing trees.	High - Stabilizing the barrier bar should reduce the likelihood of erosion removing large trees favored by bats for roosting or nesting.	Low to high depending on impacts that occur prior to adaptive management action. Once adaptive management alternative is implemented, bat habitat should be protected.	Moderate to High - Bat habitat should be unaffected unless future breaches or measures remove large trees favored as roosting or nesting sites.	None - Any existing bat habitat (e.g., large trees) would be removed from the barrier bar.	None - Any existing bat habitat (e.g., large trees) would be removed from the barrier bar.	None - Any existing bat habitat (e.g., large trees) would be removed from the barrier bar.
		Low - Trends indicate barrier bar will continue to erode, narrow, and shift location	Low to Moderate - Increased sediment supply should flow erosion.	Moderate to High - Increased size and stability should slow erosion. Small waves may increase potential for erosion and potential shifting.	Low to Moderate - Depends on impacts that occur prior to implementing alternative management alternative.	Low to Moderate - Increased sediment supply should flow erosion.	High - Design intended to minimize erosion and maintain bar location and size	High - Design intended to minimize erosion and maintain bar location and size	High - Design intended to minimize erosion and maintain bar location and size
Minimize damage to public (DCE, WMA) and private (shoreline residents' property / infrastructure	Minimizes potential damage to shoreline properties from debris	Low - Trends for continued breaching indicates waves may continue to enter bay through breach	Low to Moderate - Additional sediment supply should decrease potential for breaching and thereby debris access	Moderate to High - Provides increased protection against breaching and thereby reduces debris access	Low to Moderate - Additional sediment supply should decrease potential for breaching and thereby debris access	High - Boom designed to capture debris entering through breach or over bar	High - Design intended to minimize potential for breaching, and thereby debris access	High - Design height and additional boom designed to minimize debris access	Moderate to High - Design height intended to minimize debris access over bar. Culverts may continue to allow some debris access.
		Low - Trends for continued breaching indicates waves may continue to enter bay. Low height allows for wave overlapping.	Low to Moderate - Additional sediment supply should decrease potential for breaching and thereby wave action through to bay.	Moderate to High - Provides increased protection against breaching and thereby reduces wave action in bay.	Low to Moderate - Additional sediment supply should decrease potential for breaching and thereby wave action through to bay.	Low to Moderate - Additional sediment supply should decrease potential for breaching and thereby wave action through to bay.	High - Design intended to minimize potential for breaching, and thereby wave action in bay during high water events.	High - Design intended to minimize potential for breaching, and thereby wave action in bay during high water events.	High - Design intended to minimize potential for breaching, and thereby wave action in bay during high water events.

TABLE 4.2-2: PROJECT GOALS EVALUATION

		Alternatives							
		A	B	C	D	E	F	G	H
Goals	Indicators	Do Nothing	Sediment Management	Nature-Based Protection	Adaptive Management	Infrastructure Protection	Rock Revetment	Rock Revetment with Overflow	Rock Revetment with Culverts
Improves water quality circulation in bay	Moderate to High - Occasional breaches may temporarily increase circulation and improve water quality. If breaches form near the bar, it may result in a net improvement to circulation. Improvement likely to only be located near the breach.	Low - Occasional breaches may temporarily increase circulation and improve water quality. If breaches form near the bar, it may result in a net improvement to circulation. Improvement likely to only be located near the breach.	Moderate to High - Potential for breach remains high; however, during non-breath periods, bar is walkable and easily navigated.	Low - If effective, breaching would be eliminated and over the long-term no increased circulation of bay waters would occur.	Moderate to High - Depends on the size of the breach, timing of repairs, and whether repairs are permanent. The greater more permanent the breach, the greater the improvement to circulation.	None - Would effectively remove potential for breaches to increase in water circulation would occur.	Moderate - Occasional overtopping of barrier in overflow area would increase water circulation for limited periods and likely only isolated area near the overflow	Moderate - Degree of increase in circulation will depend on the effective elevation of the culverts. Increase circulation likely to only be near culverts.	
Ensure human health and safety	Minimizes risks to recreational users (boaters, anglers, hikers, beachgoers)	Moderate to Low - Potential for breach remains high; however, during non-breath periods, bar is walkable and easily navigated.	Moderate - Potential for breach remains high; however, during non-breath periods, bar is walkable and easily navigated.	Moderate to High - Reduced potential for breaches. Gravel material easily walkable and navigable.	Low - Potential for breach remains high; however, during non-breath periods, bar is walkable and easily navigated.	Low - Potential for breach remains high; however, during non-breath periods, bar is walkable and easily navigated.	Moderate to High - Significantly reduced potential for breach and easily walkable top of revetment. However, large stone material on lake side is difficult to walk on an may pose a hazard.	Moderate to High - Significantly reduced potential for breach and easily walkable top of revetment. However, large stone material on lake side is difficult to walk on an may pose a hazard.	
	Ensuring continued shading of boaters and other users from extreme lake conditions in the bay (i.e., storm events)	None - Potential for breaches remain with intrusion of waves and debris to the bay.	Moderate - Potential for breach remains but reduced.	High - Minimized potential for intrusion of waves and debris to the bay.	Low - Potential for breaches remain with intrusion of waves and debris to the bay.	Moderate - Does not protect against breaching, but provides means of capturing debris prior to entering bay. May reduce waves, but not designed to break waves.	High - Minimized potential for breaches. Minimizes potential for intrusion of waves and debris to the bay.	High - Minimized potential for breaches. Minimizes potential for intrusion of waves and debris to the bay.	
	Minimizes risk of internal bay flooding during winter/spring	Moderate to High - Ability for bar to breach allows for potential internal flood relief.	Moderate - Ability for bar to breach allows for potential internal flood relief.	None - High design elevation prohibits outflow of internal flood relief.	Moderate - Ability for bar to breach allows for potential internal flood relief.	Moderate to High - Ability for bar to breach allows for potential internal flood relief.	None - High design elevation prohibits outflow of internal flood relief.	Moderate to High - Culverts allow relief of internal flooding, however have the potential to clog with transported material	
	Minimizes impacts to boaters in the bay	None - Potential for breaches remain with intrusion of waves and debris to the bay, including boating hazards.	Moderate - Potential for breach remains but reduced.	High - Minimized potential for breaches, protecting against waves and debris in the bay.	Low - Potential for breaches remain with intrusion of waves and debris to the bay, including boating hazards.	Moderate - Minimizes debris intrusion; however, boom could provide a navigation obstacle.	High - Minimized potential for breaches, protecting against waves and debris in the bay.	High - Minimized potential for breaches, protecting against waves and debris in the bay.	
Ensure continued fishing & boat access	Maintains shoreline access across east barrier bar	Low - Potential for breaches remain. Poor access from East Bay Road.	Moderate - Improved access from East Bay Road; potential for breach remains.	High - Improved access from East Bay Road; top line of protection accessible; shorelines walkable.	Moderate - Improved access from East Bay Road; potential for breach remains.	Low to Moderate - Improved access from East Bay Road; potential for breach remains; build up of debris could hinder access across bar.	Moderate to High - Improved access from East Bay Road; top line of protection accessible; lake side shore revetment with large stone can be difficult to walk/access	Moderate to High - Improved access from East Bay Road; top line of protection accessible; lake side shore revetment with large stone can be difficult to walk/access	
	Grant funding availability	N/A	Low - Likely need to be considered as ongoing allocation of funds.	High - Funds for green techniques typically available	Low - Likely need to be funded through permanent allocation of funds.	Low - Unknown grant funding source	Low - Hardening shoreline funds typically not provided.	Low - Hardening shoreline funds typically not provided.	
	Minimize management time commitment	None	Annual maintenance coordination with PBA	Annual maintenance coordination with PBA; Bi-Annual Inspections; Routine maintenance (periodic stone placement, potential for imported sediment required)	Annual maintenance coordination with PBA; Annual and following large storm event monitoring (e.g. survey); Emergency response; Post event emergency repair response	Annual maintenance coordination with PBA; Annual deployment and removal (e.g. debris booms, dredging, deployment), clipping or dumping of debris.	Annual maintenance coordination with PBA; Bi-Annual Inspections; Routine maintenance (periodic stone replacement)	Annual maintenance coordination with PBA; Bi-Annual Inspections; Routine maintenance (periodic stone replacement)	
Ensure feasibility of implementation	Minimize risk of emergency responders and maintenance personnel	Low - Potential for breaches remain. Poor access from East Bay Road.	Low to Moderate - Improved access from East Bay Road; potential for breach remains.	High - Improved access, minimized risk of breach, low maintenance once established.	Low - Improved access from East Port Bay Road; potential for breach remains. Continued maintenance; potentially during breach events.	Low - Improved access; maintenance required to remove debris; potential for breach remains.	High - Improved access, minimized risk of breach, low maintenance.	Low to Moderate - Improved access, minimized risk of breach, culverts will likely clog frequently with sediment and debris causing a work and access issues for maintenance personnel.	
	Maintains equipment access across east barrier bar for dredging / maintenance purposes	None - No access	Moderate - Improved access from East Bay Road; potential for breach remains; travel across bar most likely at water's edge or in water.	Moderate to High - Improved access from East Port Bay Road; travel path across top of bar; vegetation may be a hindrance	Moderate - Improved access from East Port Bay Road; potential for breach remains; travel across bar most likely at water's edge or in water.	Moderate - Improved access from East Port Bay Road; potential for breach remains; travel across bar most likely at water's edge or in water.	High - Improved access from East Port Bay Road with revetment across top of revetment.	High - Improved access from East Port Bay Road with revetment across top of revetment.	
	Construction Cost	N/A \$0	\$200,000	\$600,000	\$0	\$400,000	\$21,000,000	\$0	
	Operation and Maintenance Cost	N/A \$0	\$340,000	\$550,000	\$0	\$560,000	\$340,000	\$0	

4.3 Project Costs and Life-Cycle Cost Analysis of Most Feasible Alternatives

As a result of the previous evaluation, and discussions between the PAC members, the following four alternatives (in addition to Alternative A: No Action) were selected to advance to the second phase of the evaluation, a concept level construction cost and life-cycle analysis:

- Alternative B: Limited Sediment Management
- Alternative C: Nature-Based Barrier Bar
- Alternative E: Infrastructure Protection Measures
- Alternative F: Fortification Using Rock Revetment

4.3.1 Conceptual Project Construction Costs

Project construction costs were estimated for the alternatives based on conceptualized designs. Rough order of magnitude quantities have been developed and unit costs have been derived from similar NYSDOT item costs, recommended manufacturer costs and other similar project known costs. The costs are assumed to represent scale differences between the alternatives but are by no means considered accurate for detailed construction estimates. No engineering costs or permitting costs have been included. Alternatives B, C, E, and F each also include the construction costs associated with providing reliable equipment access (**Section 3.1.1**). An assumed cost of \$200,000 was included as part of the initial construction cost of each of these build alternatives to account for the equipment access.

The following summarizes the concept level initial construction cost estimates for each of the evaluated alternatives:

■ Alternative A: No Action	\$0
■ Alternative B: Limited Sediment Management	\$200,000
■ Alternative C: Nature-Based Barrier Bar	\$600,000
■ Alternative E: Infrastructure Protection Measures	\$400,000
■ Alternative F: Fortification Using Rock Revetment	\$2,100,000

Details of the conceptual cost estimates are included in **Appendix C**. These values are also included in **Table 4.2-2**.

4.3.2 Life Cycle Analysis

The life-cycle cost analysis is based on the 30-year design lifespan required for coastal structures by New York State. Some of the factors that are accounted for in the analysis include:

- Annual limited sediment management for all alternatives, with varying values for normal years and difficult years for access and maintenance. PBIA would still be providing funds for

dredging; however, it is assumed NYSDEC would provide additional funds for spreading of the material and placement of material across the east barrier bar would be required.

- Annual maintenance for all alternatives (e.g., debris removal, re-plantings, nourishment of equipment access, replacement of isolated stones)
- Biennial inspections by NYSDEC staff to report on condition, perhaps perform topographic survey and/or sample vegetation, water quality, etc.
- Assumed more substantial maintenance for nature-based barrier bar immediately following construction, assumed to minimize over time as vegetation established (Alternative C only)
- Assumed 15-year life span of boom; no improvements to anchors needed (Alternative E only)
- Assumed 30-year life span for rock revetments with only routine maintenance required

Table 4.3-1 provides a summary of the assumed maintenance activities for each alternative.

Table 4.3-1 Maintenance Activities Summary

Maintenance Activity	Recurrence Interval	Alternative				
		A	B	C	E	F
Employ limited sediment management to east barrier bar (typical year)	1 year		X	X	X	X
Employ limited sediment management to each barrier bar (difficult year)	10 years		X		X	
Initial maintenance of Nature-Based Barrier Bar	5 years for 2 cycles			X		
Remaining maintenance of Nature-Based Barrier Bar	10 years for 2 cycles			X		
Installation / removal of boom	2X per year				X	
Replacement of boom	15 years				X	
Debris removal from boom	2X per year				X	
Revetment crest maintenance	1 year					X
Biennial inspection	2 years		X	X	X	X

Additional assumptions included in the analysis are:

- PBIA to maintain continued dredging within navigation channel (not included in NYSDEC budget)
- Assumed 4% discount rate
- Assumed 30 year life cycle

Table 4.3-2 provides the summary of the life cycle cost analysis over 30 years including construction, operation and maintenance are anticipated for each alternative:

Table 4.3-2 Life Cycle Analysis Costs

	Initial Construction Cost	Life Cycle Cost (Present Value)	Total
Alternative A: No Action	\$0	--	--
Alternative B: Limited Sediment Management	\$200,000	\$340,000	\$940,000
Alternative C: Nature-Based Barrier Bar	\$600,000	\$550,000	\$1,550,000
Alternative E: Infrastructure Protection Measures	\$400,000	\$560,000	\$1,320,000
Alternative F: Fortification Using Rock Revetment	\$2,100,000	\$340,000	\$2,440,000

Details of the life cycle cost analysis are included in **Appendix C**. These values are also included in the project goals evaluation shown in **Table 4.2-2**.

4.4 Recommended Alternative

Should the NYSDEC identify the need to select an alternative other than Alternative A (No Action), this section provides a recommendation for selection of a project alternative. Based on the evaluations outlined in this section and indicators considered, it is recommended that Alternative C: Nature-Based Barrier Bar be selected as the proposed project alternative. This alternative is shown to provide the best blend of positive impacts on the project site, while still achieving the project goals at a reasonable initial construction plus life-cycle cost.

As described in **Section 2.1.2**, the east barrier bar has clearly been diminishing in size for the past several decades. The cottages that were formerly located on the east barrier bar are no longer present, nor would there even be enough land width on the bar to situate such structures today. The pattern of breaches that has occurred over the past six years indicates that this could be the new normal pattern. It is impossible to predict breaches, but the combination of present narrow width, reduced LST throughout the lake, increased occurrences of high water, and increasingly large storm events would indicate that this pattern has a high probability of continuing. While breaches are a natural occurrence of barrier bars, the adverse effects resulting from breaching at this location are thought to outweigh the desire to leave the east barrier bar alone completely. **Section 2.3** describes the diverse natural community that is present on, around and adjacent to the bar. The bar is actively used for recreational purposes and provides a unique natural feature that itself warrants protection. As described in **Section 1.1**, this bar provides an array of beneficial functions. NYSDEC is looking to provide a management alternative that best considers all of these beneficial functions. Based on the

evaluations described herein, the nature-based barrier bar alternative provides the best balance of meeting all of the project goals and indicators.

Section 2.2 discussed some of the property damages associated with the breaches of 2016, 2017 and 2018. This section discussed the results of the survey that was distributed to the residents of Port Bay (also provided in **Appendix B**). While the survey was inconclusive as to damage that occurred during the 2017 season and the differentiation between high water caused damage and breach caused damage, what was plainly evident was that the breach, at minimum, played a role in some of the damage. In 2017 the two sides of the event (high water and breach) were too intertwined to purely blame one or the other, but intuitively it can be seen that each exacerbated the other. Debris was a widely reported issue during 2017 (**Figure 2.1-13**). Some of this debris was reported to have washed through the breach and into the bay. The debris may not have been as significant an issue once inside the bay if the water levels were lower; however, it would remain an issue. The breach also allowed for wave action from the lake to enter the bay. During normal years when the east barrier bar is intact, the water surface within the bay is relatively calm as most waves are broken on the east barrier bar. With a breach, fully developed waves are able to pass into the bay and break on the bay shoreline (**Figure 2.1-35** and **Figure 2.1-36**). While the water level was high, these waves were more damaging since many shoreline protection features were under water; however, even a lower water conditions, large, breaking waves in the bay would be an issue. In order to maintain the protective nature of the barrier bar, some management technique would need to be adopted to either minimize/prevent breaches from occurring or reduce their impacts. For this reason, Alternative A – No Action was not recommended as the recommended alternative.

Alternative B – Limited Sediment Management provides a strong candidate for a management alternative. **Section 2.1.7** delves into the coastal sediment transport conditions at the east barrier bar. The pier on the west side of the outlet channel acts as a disruption to the active LST. As shown in the photos in **Figure 2.1-17** and **Figure 2.1-19**, at times the LST can wash up and over the pier and continue downshore. Also discovered through this study, is that the gravel dredged from the outlet channel each year constitutes a high percentage of the total gravel based LST anticipated each year. This indicates that appropriate management of the dredged materials would play a significant role in maintaining the integrity of the east barrier bar. The typical dredging practices allow for placement of dredged material in spoil areas designated on the west end of the east barrier bar and west of the pier. While the desire has always been to deposit as much material as possible on the east barrier bar, the implementation of this is difficult due to the restrictions of the dredging permit, the cost/available funds for dredging, and the accessibility of the east barrier bar from East Port Bay Road. While a full evaluation of the dredging access and approaches is not part of the scope of this study, this study has been able to show that this may need to be investigated further. Even with diminishing LST within Lake Ontario as a whole, providing limited sediment management in the form of ensuring dredged material is consistently placed and spread on the east barrier bar, additional sediment bypassing,

supplementing materials, etc. could have a significant impact on the reformation of the east barrier bar. While this is a strong candidate for a management alternative and should definitely be considered as an add-on to all alternatives and implemented in the near future, it was shown during the evaluation that it may not go far enough to provide additional protection against breaching, based on the project goals and indicators.

Alternative D – Adaptive Management was a difficult alternative to evaluate. Without a thoroughly designed adaptive management plan, it was difficult to determine all of the benefits a solution like this could provide. The major drawback to this type of solution is the time commitment and funding allocation. Without having permits in place, sources of funding allocated and available for use, this type of reactive management plan would be difficult to implement.

Alternative E – Infrastructure Protection, similar to Alternative A, provides no added protection to minimize the potential for breaching. This alternative requires the installation of a debris boom that would capture debris and potentially reduce waves that may enter through a breach. While this alternative has a lot of positive aspects, as shown in the evaluation, the cost, time commitment and remaining potential for breaching were the leading factors as to why this alternative was not selected.

Alternatives F, G, and H each represent variations of the rock revetment alternative. While rock revetments can provide substantial protection against breaching and the damages incurred therefrom, the impacts they have on the natural condition, ecosystems and habitats, downdrift neighbors, and LST all seem to outweigh the needed protection. While **Section 2.2** describes the damages that were incurred during the breaches of 2017 and 2018, it also continues to conclude that the damages from the breach alone were not substantial enough to justify the cost from this type of feature. Taking the high water condition out of the equation, the damages reported from the breaches of 2012, 2016 and 2018 were relatively minor. While it is impossible to know what would happen with the breaches in the future, the damage costs, at this point, do not justify the significant construction cost expenditures for a revetment alternative. Similarly, at this point in time, the damage reports do not support the permanent alteration and potential loss of the sensitive nature of the ecosystem, the habitats, and the nearshore coastal features along the east barrier bar that revetment alternatives would require. As such, none of the revetment alternatives were proposed as the recommended alternative.

Alternative C – Nature-Based Barrier Bar was shown through the evaluation to provide the best blend and balance of achieving the project goals. This alternative would employ the limited sediment management outlined in Alternative B that would provide a means of promoting more LST past the pier and onto the east barrier bar. The additional gravel and vegetation proposed to build up the east barrier bar would provide a more substantial feature to resist and break the waves from Lake Ontario, while maintaining the natural features of a barrier bar. The ecosystems, habitats, and nearshore coastal features would remain intact. The small section of nature-based barrier bar that was installed in 2016, closing the 2016 breach, remained intact during the 2017 high water season and adjacent breach. This

supports the fact that the nature-based alternative would be able to provide added protection to the east barrier bar and the bay shoreline residents.

Based on the discussions above and the evaluations described in **Table 4.2-2**, the nature-based alternative appears to provide the best balance of meeting the project goals. The alternative described is a conceptual outline and would need to be evaluated further for detailed design and analysis. It is recommended that steps (i.e., permit modification, equipment access, barge consideration, etc.) be taken to evaluate and institute sediment management measures, such as those described in Alternative B, prior to the implementation of the nature-based barrier bar or any proposed build alternative. The design, analysis, permitting, and construction phases will take time, and the sediment management measures can be started quickly. Election of this alternative also allows for a limited “adaptive management” solution, in that, at this time, a more substantial solution does not seem to be supported; however, with time, if this alternative does not meet management goals, there is room to elevate the level of protection and provide added justification for doing so.

4.5 Regulatory Requirements for the Recommended Alternative

The recommended alternative is not a final design. Further consideration is needed for detailed design and analysis of elements that could be provided to maximize the benefits of the design within the available budget and regulatory requirements. Additional consideration must also be provided for the assumed equipment access from East Port Bay Road.

The recommended alternative, or any potential build alternative, must be designed to meet all federal, state and local requirements. Regulatory requirements for each agency may vary. **Table 4.5-1** provides a summary of the potential regulatory reviews and/or authorizations that may be required for the final project. This table is for reference only and should not be considered final. Permits and authorizations will ultimately depend on the final proposed design. Reliance upon the contents of this document in the selection of a preferred alternative should not be considered a pre-approval of the design and does not obviate the need to acquire the necessary permits and authorizations, whose requirements will ultimately depend on the final proposed design.

Table 4.5-1 Potential Regulatory Reviews and Authorizations

Regulatory Agency	Permit / Approval	Authority
US Army Corps of Engineers	Section 404 / Section 10 Permit	Regulates fill and/or discharge of dredged material in Waters of U.S.
U.S. Fish and Wildlife Services	Consultation	Threatened and endangered species review under Endangered Species Act
NOAA / National Marine Fisheries Service	Consultation	Essential Fish Habitat review

Regulatory Agency	Permit / Approval	Authority
NYSDEC	SEQRA	Environmental assessment as presumed lead agency
	Article 15 – Protection of Waters	Disturbance to bed or banks of Port Bay, a Class B waterbody and Lake Ontario, a Class A waterbody
	Article 34 – Coastal Erosion Hazard Area Permit	Disturbance within a designated CEHA area
	Section 401 Water Quality Certification	Individual Water Quality Certificate may need to be obtained depending on Section 404 permit authorization and general/regional conditions
	SPDES General Permit for Stormwater Discharges from Construction Activities (GP-0-15-002)	If project disturbs more than 1 acre, then a SWPPP will need to be prepared for coverage under General Permit
NYS Natural Heritage Program	Consultation	State listed threatened and endangered species and Significant Natural Communities
NYS Department of State	Federal Consistency Review	Conformance with NYS Coastal Management Program
NYS Office of General Services	Authorization	State Lands Underwater
NYS Office of Parks, Recreation and Historical Preservation	Consultation	Review under Section 106 of Historical Preservation Act
Town of Huron	Consultation	Review in accordance with Local Waterfront Revitalization Program (LWRP)