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Appendix C

Marine Physical Effects Assessment

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Marine Physical Effects Assessment

Runway End Safety Area, Billy Bishop Toronto City Airport

PortsToronto

60733457

October 2025

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AECOM: 2024-12-21

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0	November 2024	AECOM	Draft Marine Physical Effects Assessment.
1	May 2025	AECOM	Draft Marine Physical Effects Assessment.
2	October 2025	AECOM	Final Marine Physical Effects Assessment.

Distribution List

# Hard Copies	PDF Required	Association / Company Name
	✓	PortsToronto
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Land Acknowledgement

We acknowledge that Billy Bishop Toronto City Airport is located on the traditional territory of many nations including the Mississaugas of the Credit, the Anishinaabe, the Chippewa, the Haudenosaunee, and the Wendat peoples, and is now home to many diverse First Nations, Inuit, and Métis peoples. PortsToronto also recognizes that Toronto is covered by Treaty 13 signed with the Mississaugas of the Credit, and the Williams Treaties signed with multiple Mississaugas and Chippewa bands.

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1. Introduction

AECOM Canada ULC, herein after referred to as "AECOM", has been retained by Avia NG to complete an Environmental Assessment for the implementation of Runway End Safety Area (RESA) for Runway 08/26 at Billy Bishop Toronto City Airport (the Project). The Billy Bishop Toronto City Airport is owned and operated by PortsToronto (the Project proponent) and is located in the City of Toronto on the Toronto Islands.

The purpose of the Project is to comply with the Canadian Aviation Regulations Part III, Subpart 2, Division VI – Runway End Safety Area (RESA), published in January 2022, which mandate RESAs for airports serving over 325,000 commercial passengers annually. RESAs are designated open spaces at both ends of runways, designed to minimize damage if an aircraft overruns or undershoots the runway. At Billy Bishop Toronto City Airport, the RESA requirements apply only to the primary runway, Runway 08/26, which enables commercial aircraft use.

Although there are no regulatory requirements under the federal or the provincial acts that mandate the Environmental Assessment process for the Project, a Section 82 evaluation under the Impact Assessment Act is required for all Project components that fall on Transport Canada-owned land. A Section 82 evaluation is a requirement under the Impact Assessment Act for projects located on federal lands or being carried out by federal authorities. In the City of Toronto's Official Plan (2024), policies exist that require projects where lakefilling in Lake Ontario is proposed to undertake an Environmental Assessment. As such, PortsToronto has undertaken a non-statutory Environmental Assessment process for the RESA project at Billy Bishop Toronto City Airport.

As part of the Environmental Assessment, PortsToronto has identified and evaluated various alternatives for implementing a RESA at Billy Bishop Toronto City Airport. The Environmental Assessment also considers the opportunities to enhance airport operational safety. This includes minimizing regular non-airport and airport vehicular crossings on Runway 08/26, currently necessary for both airport operations and Toronto Islands access requiring co-ordination with the airport traffic control tower. This effort supports Transportation Safety Board of Canada's objective to reduce the risk of runway incursions at airports. Additionally, the Environmental Assessment examined measures to reduce emissions and ground-based noise levels along the lakefront.

The purpose of this Marine Physical Effects Assessment Report is to review existing and relevant background information to understand the effects of the implementation of RESA Alternatives on the marine physical environment in the study area.

A review and analysis of existing background information has been completed to identify existing conditions and any potential impacts from the three RESA Alternatives which involves RESA landmass expansions. A high-level air photo analysis has also been completed to identify any changes in local shoreline conditions between 2015 and 2022 (the most recent available imagery) occurring within the marine physical study area (as described in **Section 1.1**).

The specific objectives of this study are to:

- Gather and review existing information and data on wave formation, ice accumulation, water levels, currents, and sediment.
- Complete a high-level air photo analysis to assist in the identification of sediment sources, sediment transport, and sediment deposition locations within the marine physical study area.
- Assess the implication of the three RESA alternatives, which involves landmass expansions on sediment transport, wave formation, water levels, currents, ice accumulation as well as erosion and sedimentation during construction, within the marine physical study area.

1.1 Marine Physical Study Area

Billy Bishop Toronto City Airport is located on the northwest end of Centre Island, the largest of a group of islands that form the Toronto Islands. To the east, the airport is bounded by the Inner Harbour, to the west by Lake Ontario, and to the north by the Western Channel, a 120 m wide, 700 m long waterway that connects the Inner Harbour with Lake Ontario (Avia NG, 2024). The study area for the Marine Physical Effects Assessment (marine physical study area) includes the areas in the vicinity of the landmass expansion, including the west and east ends of Runway 08/26, the Western Channel, and the western and eastern shoreline of the West Island (**Figure 1-1**). All construction work will be taking place within the Marine Exclusion Zone.

Figure 1-1: Marine Physical Study Area

2. Background Review of Existing Conditions

A background review of previous relevant studies has been undertaken to document existing conditions:

- Billy Bishop Toronto City Airport (CYTZ) Runway End Safety Area (RESA) Preliminary Design Littoral Sediment Transport Overview (Shoreplan, 2024).
- Runway 08/26 RESA Alternatives Study. PortsToronto / Billy Bishop Toronto City Airport, Avia NG, 2024.
- Climate Change and Extreme Weather Vulnerability Assessment of PortsToronto Assets. (AECOM, 2019).
- Toronto Islands Flood Characterization and Risk Assessment Project. Flood Characterization Report. (Baird & Associates, 2019).
- Updated Analyses using 2019 Water Levels. (Baird & Associates, 2019b).
- Gibraltar Point Erosion Control, Nearshore Reef Design Report. (Baird & Associates , 2018).
- Gibraltar Point Erosion Control Project, Addendum Report. (Toronto and Region Conservation Authority (TRCA), 2018).
- Modelling to Assess Water Quality Impacts from Runway End Safety Area (AECOM, 2018).
- Environmental Assessment of Proposed Runway Extension and Introduction of Jets at Billy Bishop Toronto City Airport Environmental Study Report. Appendix C-1 to C-11. (AECOM, 2017).
- Coastal Environmental Study Supporting the Expansion of Billy Bishop Airport. (WSP Canada , 2015).
- Gibraltar Point Erosion Control Final Design. (Baird & Associates, 2015).
- Billy Bishop Toronto City Airport Lakefill Environmental Assessment Screening, Shoreline and Coastal Environment (Baird & Associates, 2012).
- Lakefill with Marine Exclusion Zone (keep out area) – Toronto Harbour – Draft Environmental Screening Report. (Dillon Consulting Limited, 2012).
- Port Land Flood Protection and Enabling Infrastructure. (Michael Van Valkenburgh Associates Inc, 2021).
- Don Mouth Naturalization and Port Lands Flood Protection Project Environmental Assessment. (TRCA, 2014).

- Environmental Study Report. Gibraltar Point Erosion Control Project, City of Toronto. Unpublished report. (TRCA, 2008).

A gap analysis study completed by AECOM (2024) identified that the previously completed studies provide sufficient information to evaluate implementation of the RESA at Billy Bishop Toronto City Airport with no additional field studies needed for this effects assessment.

2.1 Shoreline Morphology

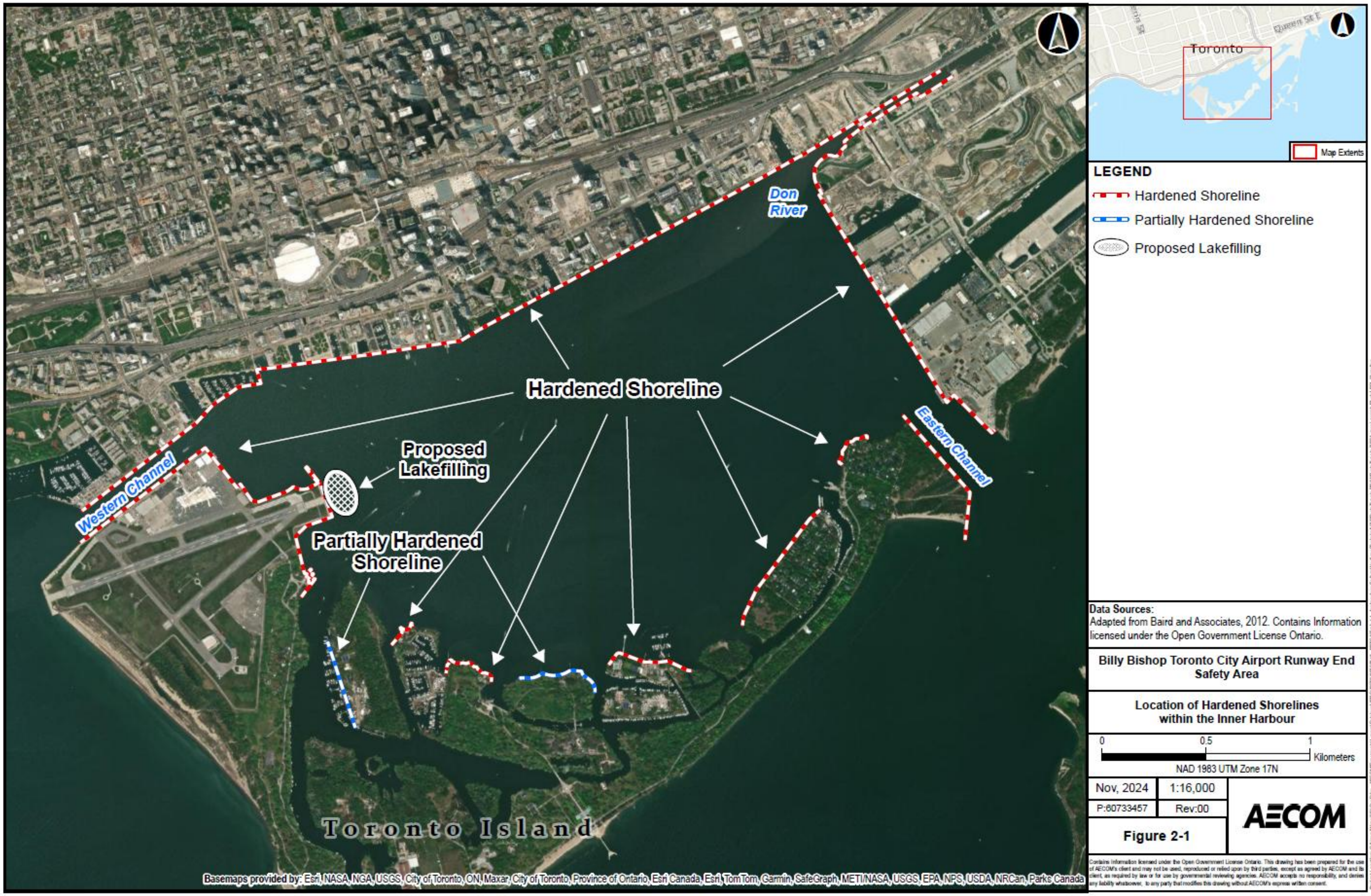
The Toronto Islands are located in a physiographic region known as the Iroquois Plain and consist of clay till deposits and sand deposited in the glacial Lake Iroquois (Dillon, 2012). The bedrock geology consists of shale, limestone, dolostone and siltstone. Previous geotechnical investigations identify the overburden and bedrock to consist of ~ 8 m of silty sand fill, underlain by shale with minor siltstone and limestone (Dillon, 2012). Observations by Dillon (2012) indicate that substrate within the marine physical study area, specifically at the end of the runway, consists primarily of silt with some limestone riprap at the shore (Dillon, 2012).

The formation of the Toronto Islands occurred in the late-glacial and post-glacial period shaped by sediment supplied to Lake Ontario by rivers and erosion along the Scarborough Bluffs (Baird & Associates, 2012). A sand spit developed east of the Don River mouth and extended southwesterly. A major storm in 1852 breached this spit, interrupting the sand supply to the islands (Toronto and Region Conservation Authority, 2018). Later, the construction of the Leslie Street Spit in 1978 disrupted and eliminated the northeast sediment supply to the Gibraltar Point area, on the south side of the island (Toronto and Region Conservation Authority, 2018).

The north, east, and west shores of the Inner Harbour consist of lakefill. Much of the Lake Ontario shoreline has been significantly reinforced through traditional engineering structures (timber cribs, concrete walls, steel sheet piling, revetments and seawalls, etc.) (Baird & Associates, 2012). The north shoreline of Toronto Island has only partial engineering interventions, as shown in **Figure 2-1** below (Baird & Associates, 2012).

Along the south shoreline, sediment transport and erosional processes have led to the formation of Gibraltar Point and Hanlan’s Point Beach, as the sediment is transported west and northward (Toronto and Region Conservation Authority, 2018).

Figure 2-1: Location of Hardened Shorelines Within the Inner Harbour



Recent changes to the shoreline morphology within the vicinity of the marine physical study area include the recently completed (Fall of 2024) reconstruction of the Don River Mouth. Although the constructed and original locations of the Don River Mouth are in the same general area, the new design incorporates improvements to sediment management. According to the 100% Design Documents Package for the Port Lands Flood Protection and Enabling Infrastructure project, the area downstream (south) of the Canadian National Railway tracks will be dredged and serve as a sediment trap. A sediment and debris management area will also be located on the west bank of the Don River, north to Lake Shore Boulevard (see **Figure 2-2** taken from the Don Mouth Naturalization Project Environmental Assessment (Toronto and Region Conservation Authority, 2014)). Furthermore, the width of the channel at Lake Shore Boulevard will be widened to approximately 120 m from the current 40 m (Michael Van Valkenburgh Associates, 2021). However, a coastal study by Baird and Associates (2012) affirmed that the naturalization of the Don River Mouth will not significantly change the sediment sources and no obvious impacts on sediment processes in the Toronto Harbour will result from the proposed lake filling associated with the Don Mouth Naturalization Project.

Most relevant near to the marine physical study area, is the recently constructed Gibraltar Point Erosion and Sediment Control Project along the west shoreline. The goal of the Gibraltar Point Erosion Control Project was to develop a long-term solution to address the shoreline erosion around Gibraltar Point (Baird & Associates, 2018). Most of the shoreline erosion occurs during southwesterly storm events at Gibraltar Point (Baird & Associates, 2018). The alongshore transport system at Gibraltar Point typically flows northward, especially during easterly storm events (Baird & Associates, 2018). Therefore, the erosion control solutions for this project aim to reduce both the impact of southwesterly waves and the transport potential of the northward currents (Baird & Associates, 2018). The preferred design included a nearshore reef concept that mimics natural coastal features. The proposed reef involved an exterior perimeter submerged breakwater; the reef is then formed by rock filling on the shoreward side of the perimeter of progressively smaller materials as the shoreline approaches, see **Figure 2-3** (Baird & Associates, 2018). A groyne is also a key component of the proposed structures as shown in **Figure 2-3**, to reduce sand loss at the west of Manitou Beach (Baird & Associates, 2018). The design also included a sand management program, where sand will be placed strategically to protect Gibraltar Point and nourish Hanlan’s Point Beach (Baird & Associates, 2018), however, the sand management plan has not yet been formalized (Shoreplan, 2024). The beach is being monitored for three years to determine the nourishment volumes and frequency as well as placement locations, with the initial management plan to be developed following the third monitoring survey slated to be completed in 2025 (Shoreplan, 2024). The construction of the nearshore reef and groyne structure was completed in June of 2021.

Figure 2-2: Lower Don River Proposed Conditions

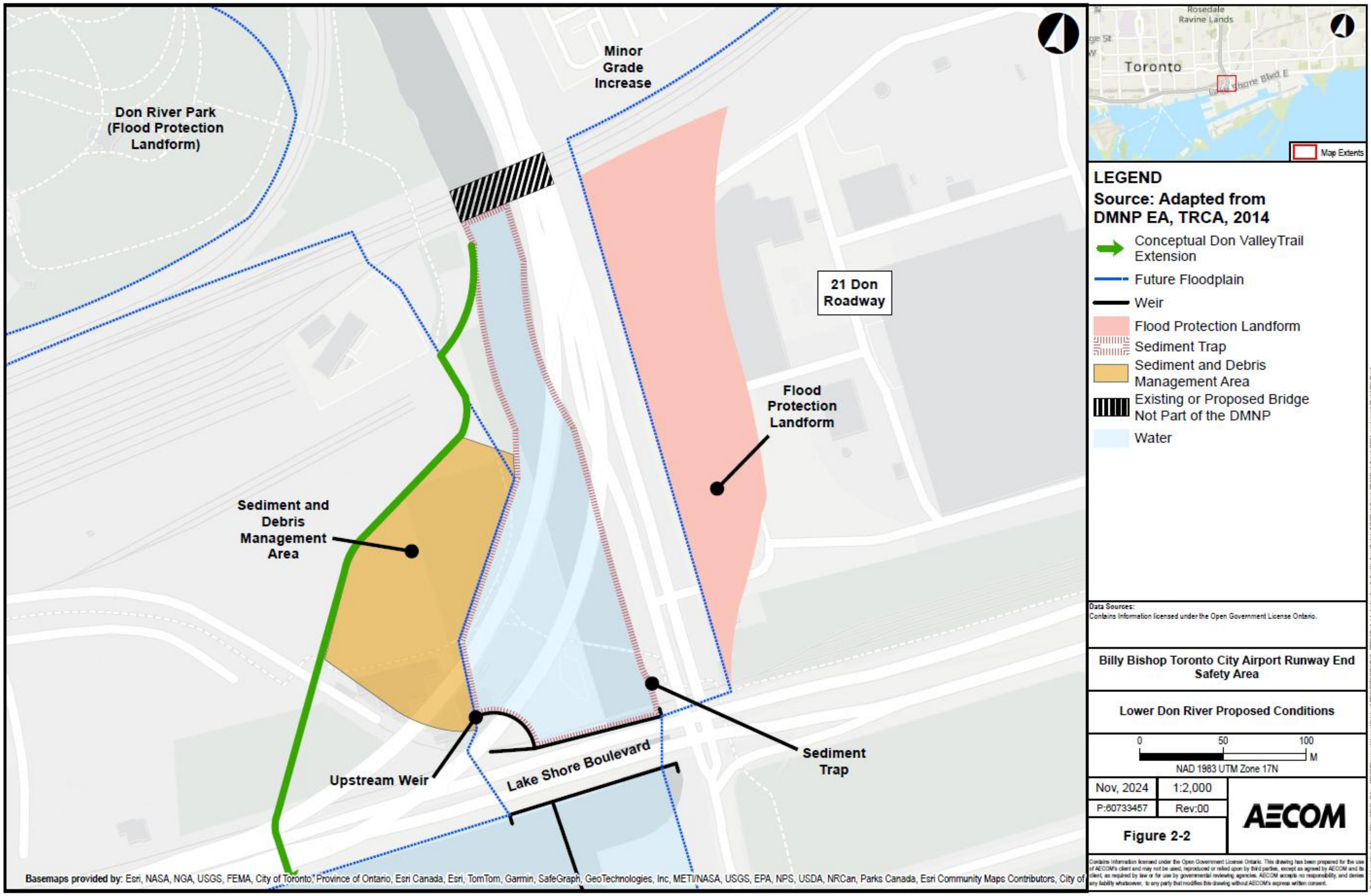
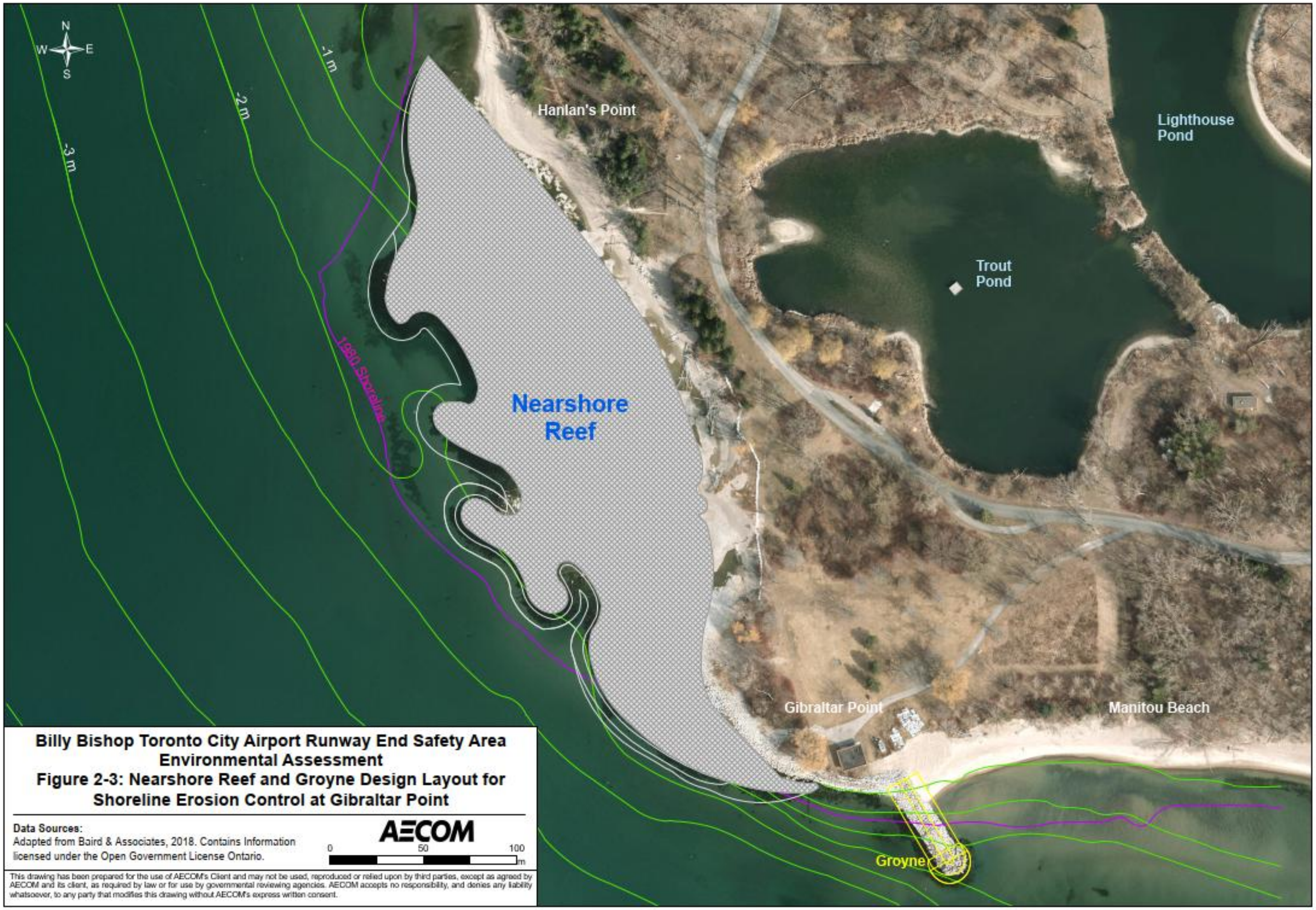


Figure 2-3: Nearshore Reef and Groyne Design Layout for Shoreline Erosion Control at Gibraltar Point



2.2 Sediment

Sediment sources within the marine physical study area are limited due to the heavily engineered shorelines, the regular dredging of the Keating Channel by PortsToronto and limited sediment transport through the Eastern and Western Channels, except along the Hanlan's Point Beach and western extension area. The shorelands within the marine physical study area are composed of Lake Iroquois deposits, which contain shallow water deposits of sand and silty sand (Toronto and Region Conservation Authority, 2008). The Leslie Street Spit, constructed in the 1950s, now forms a major barrier to littoral transport from the east and is an area of deposition (Baird and Associates, 2012). Results from the previous air photo assessment (2015), which analyzed aerial imagery from 1950 to 2015, shows that sediment eroding from the southern end of the Hanlan's Point Beach and Gibraltar Point is likely being transported northward along the western shoreline (AECOM, 2017). Confirming the results of the previous air photo analysis, Baird & Associates has noted that most of the shoreline erosion occurs during southwesterly storm events at Gibraltar Point (2018) and that the alongshore transport system at Gibraltar Point typically flows northward, especially during easterly storm events (Baird & Associates, 2018).

Descriptive modelling to understand nearshore sediment transport for the Gibraltar Point Erosion Control Project was updated by Baird (2015) and results showed that under existing conditions, the growth of Hanlan's Point Beach against the existing airport structure would likely finish in approximately 25 years or earlier. As mentioned by Shoreplan (2024) the shoreline will grow along the airport structure and when it nears the end of the structure, sediment will bypass into the Western Channel and the growth of Hanlan's Beach will slow down until it eventually stops growing.

The Runway 08/26 RESA Alternatives Study for PortsToronto (Avia NG, Rev.1, April 2024) notes that the landmass expansion for the west RESA could impact sediment movement along the adjacent sand beach (Hanlan's Point Beach), and minimal impacts are expected relating to sediment transport for the east extension. Additionally, Shoreplan's recent review on littoral transport indicates that due to the lack of beaches and the water depth, there is no littoral sediment transport in the vicinity of the east RESA (Runway 08 extension) (Shoreplan, 2024).

Furthermore, as part of the coastal and shoreline design considerations, the Avia NG 2024 Report noted that the impacts on currents and sediment transport are anticipated to be greater for landmass expansion compared to a pile-supported deck extension.

2.3 Currents

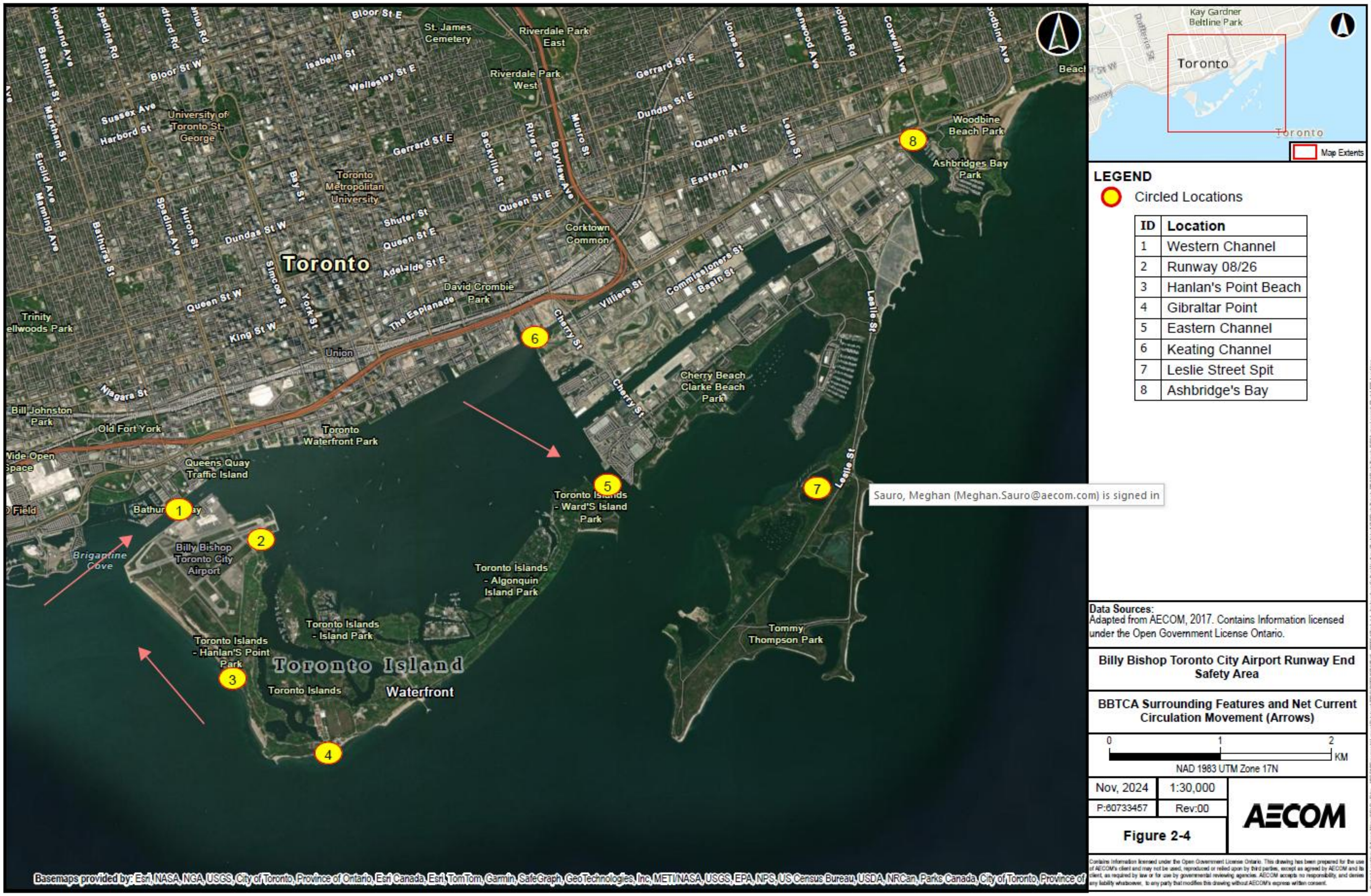
Maximum current velocities in the Western Channel were measured at 0.52 m/s (AECOM, 2017, App C-6). On a seasonal basis, the net circulation is from the Western Beaches through the Western Channel into the Inner Harbour and out the Eastern Channel, depicted in **Figure 2-4** below, adapted from the 2017 AECOM Environmental Assessment . The 2012 coastal environment study led by Baird & Associates, indicates that a strong current comes from the Don River, and this was considered in the AECOM 2018 water quality modelling study (AECOM, 2018). Results of the AECOM 2018 study identified that, for the Western Channel, there is a measurable constriction created which results in elevated velocities.

2.4 Design Wave Conditions

As part of the coastal and shoreline design considerations, Avia NG (2024) confirmed that wind generated waves dominate over ship/boat waves at both east and west runway ends. Using bathymetry from 2015, the Avia NG (2024) study identified that the 100-year return period design wave at the west end has a significant wave height of 3.5 m and a peak wave period of 8.3 s, generated by a 107 km/h south-southwesterly wind. The 100-year return period design wave at the east end has a significant wave height of 1.2 m with a peak wave period of 3.5 s. Additionally, WSP Canada’s 2015 coastal environment study, which included an analysis of wave conditions, determined that the wave height is most frequently between 0.05 m to 0.2 m. The total wave power in the vicinity of the west end RESA was previously calculated (Shoreplan, 2007), identifying that the majority (approximately 85%) of the total wave power is produced by southwesterly waves, with limited wave power produced by the easterly waves (approximately 15%). The strong southwesterly waves cause sediment to be transported northward toward the airport (Shoreplan, 2007).

The landmass expansion will have some impact to wave formation at the west end due to the restrictions at the entry of the Western Channel. Any influence at the east end is assumed to be negligible due to the limited wave activity of the Inner Harbour.

Figure 2-4: Billy Bishop Toronto City Airport Surrounding Features and Net Current Circulation Movement (Arrows)



2.5 Ice

Ice forces acting on the structures are as described in the Canadian Highway Bridge Design Code (CAN/CSA S6-06), which are summarized as:

- Dynamic ice forces from moving sheets or floes driven by wind or currents.
- Static ice forces due to thermal movement of continuous stationary ice sheets.
- Lateral thrust due to arching action resulting from ice dams or ice jams.
- Static or dynamic vertical forces because of fluctuating water levels or dynamic effects of colliding ice floes.

Ice loads exerted on shoreline structures are directly related to the ice thickness and the ice strength. Design loads are typically required for piled structures, including steel sheet pile walls, but not for sloped revetments. Ice that rides up sloped structures typically bends and breaks without exerting design loads on the revetment, although that process can lead to ice inundation. The mechanisms of ice inundation can be broken into shoving, jamming, pile-up and ride-up, although events typically consist of combinations of these mechanisms. There are no specific calculations that can be carried out to accurately determine a particular site's vulnerability to ice inundation. The potential for ice inundation is site specific and is best assessed using site specific observations.

Ice pile-ups of 1 m to 2 m in height have been reported at the steel sheet pile wall on the west end of Runway 08/26. Ice inundation has not been reported for the east end of the runway. Freezing spray can also be an issue for airport operations. Spray has been reported to produce ice up to 0.3 m thick extending onto the pre-threshold pavement on the exposed western shore. This is a common annual occurrence (Avia NG, 2024).

2.6 Water Levels

The AECOM 2019 Climate Change Vulnerability Assessment highlights the uncertainty surrounding future water levels. Baird & Associates (2019) completed the most recent assessment of water levels at Toronto Island and recommended that 76.2 m International Great Lakes Datum 1985 be the 100-year instantaneous water level used for design. This has been informally adopted by the Toronto and Region Conservation Authority, who is the approving agency for shoreline works along most of Toronto's waterfront. While the Toronto and Region Conservation Authority does not have jurisdiction on this Federal project, using a design water level of 76.2 m is consistent with other work recently completed in this area.

This design water level is the result of a combined probability analysis of Lake Ontario mean water levels and wind setup (storm surge) heights at Toronto. It includes an additional 0.07 m allowance for the potential impacts associated with the most recent International Joint Commission water level regulation (IJC Plan 2014).

2.7 Air Photo Analysis

In addition to the review of relevant background information, an updated high-level aerial photograph assessment was completed to identify any changes to the shorelines between 2015 and 2022, the most recent available aerial imagery. The two historical aerial images can be found in **Appendix A**. Historical changes that have previously been analyzed for the marine physical study area by AECOM are summarized below. **Table 2-1** below provides a summary of the results of any notable changes to the marine physical study area as well as to patterns of erosion and deposition along the shoreline. The results of this analysis are discussed below.

Table 2-1: Recent Sediment Characteristics (2015-2022) within the Marine Physical Study Area

Date of Imagery	Summary of Sediment Characteristics Identified in Aerial Photographs (2015 and 2022)
2015	■ Evidence of submerged sediment movement includes the presence of bars that can be seen under the water along the western shore at Hanlan's Point Beach. ■ Evidence of sediment deposition includes the vegetated dunes along the shoreline at Hanlan's Point Beach; it is likely that the dunes were formed prior to the cut off of sediment supply by the eastern gap and Leslie Street spit. ■ Steep and/or narrowed beach profile can be seen at the south end of Hanlan's Point Beach. ■ Turbid water can be seen offshore of Hanlan's Point Beach, around the existing runway, within the Western Channel, as well as within the Inner Harbour (AECOM, 2017).
2022	■ Evidence of submerged sediment movement includes the presence of bars that can be seen under the water along the western shore at Hanlan's Point Beach; evidence of nearshore bars remains the same between 2015 and 2022 imagery. ■ Evidence of sediment deposition includes the vegetated dunes along the shoreline at Hanlan's Point Beach, with some erosion visible in this area. It is likely that the dunes were formed prior to the cut off of sediment supply by the eastern gap and Leslie Street Spit. ■ Recently constructed nearshore reef and shoreline deposition at Gibraltar's Point evident in 2022 imagery, recently constructed groyne structure also visible. ■ Steep beach profile east of Gibraltar Point near service road and at the southeast end of Hanlan's Point Beach just north of recently constructed nearshore reef and sand placement, indicates some shoreline erosion in these areas between 2015 and 2022. However, this observation should be interpreted with caution, as water levels may vary on the date each photo was taken, and higher water levels will appear as erosion along the beach.

While this analysis provides valuable insights, limitations in aerial photo quality and variation of the water levels when each photo was taken means that results should be interpreted with some caution.

Notable historical differences prior to 2015 include a much narrower beach at Hanlan's Point in the 1950s and the construction of Runway 08/26 circa 1960, leading to sediment deposition in this area (AECOM, 2017). Evidence of sediment movement off the coast of Hanlan's Point Beach in the form of bars identified in the previous aerial imagery study (AECOM, 2017), is still present in the 2022 imagery. Additionally, the turbid areas previously identified, which includes the western shoreline, within the Western Channel, and within the Inner Harbour were also observed in the 2022 imagery. There are no significant changes to sediment transport patterns, other than the limited movement of sediment at the southern point of Gibraltar Point due to the newly constructed groyne structure. As previously observed and identified (AECOM, 2017; Toronto and Region Conservation Authority, 2007), sediment continues to move west along the Centre Island and Gibraltar Point Beach shoreline and is transported northward along the western shoreline (Hanlan's Point Beach), eventually joining the Western Channel. The evidence of sediment deposition includes the vegetated dunes along the shoreline at Hanlan's Point beach, visible in all photos, through from 1950 to 2022. It is likely that the dunes were formed prior to the cutoff of sediment supply by the eastern gap and Leslie Street Spit. Recently the area of vegetated dunes has been eroding.

In the 2022 aerial image, the recent construction of the nearshore reef and groyne structure at Gibraltar Point is visible (constructed in 2021). There is evidence of sediment deposition on the east side of the groyne structure, as the purpose of the groyne is to hold back sediment and reduce sand loss along Manitou Beach (Baird & Associates, 2018). East of Gibraltar Point near Service Road, there is a steep beach profile, relative to 2015, suggesting some erosion may have occurred in this area between 2015 and 2022, however, this cannot be for certain as water level variation on the date taken for the 2015 and 2022 photo will skew results, as higher water levels will appear as erosion along the beach. On the north side of Gibraltar Point, the recently constructed (2021) nearshore reef is visible in the 2022 imagery, as well as sand placed during the 2021 Gibraltar Point construction project. This will most likely continue to be an erosional area, hence the need for the sand management program for the Gibraltar Point project, to continue to nourish Hanlan's Point Beach (Baird & Associates, 2018).

At the southeast end of Hanlan's Point Beach, north of the recently constructed nearshore reef, there is a steep beach profile relative to the 2015 imagery, suggesting Hanlan's Point Beach continues to be an erosional area. If the sand management plan and nearshore reef are successful, this area should begin to experience stabilization of erosional areas.

2.8 Description of Future Conditions

The assessment of potential environmental effects from the future RESA expansion is conducted in consideration of the future environmental conditions. To document future environmental conditions, other past, present and predictable future effects from other active projects within the same geographic and temporal boundaries of this assessment are considered.

The naturalization of the Don River Mouth, recently completed in 2024, as previously stated by Baird and Associates (2012), will not significantly change the sediment sources in the vicinity of the marine physical study area. The recently constructed Gibraltar Point nearshore reef and groyne structure have some impact on sediment movement in this area. Specifically, the groyne structure will limit the sediment supply that moves along the southern tip and is transported northwesterly. However, the nearshore reef will help to limit erosion (sediment loss) on the west side of the groyne structure and a sand management plan will nourish Hanlan's Point Beach with sediment that can be transported northwesterly. The plan, however, has not yet been established (Shoreplan, 2024). The impacts of the groyne structure and nearshore reef as well as the sand management plan, once established, will not change the overall transport processes that occur in the vicinity of the west end RESA, however it could impact the timing of when Hanlan's Point Beach ceases to grow, estimated at approximately 25 years based on the 2015 Baird Study (see **Section 2.2**). As such, it is anticipated that future environmental conditions pertaining to the marine physical environment will be similar to present day conditions.

3. Effects Assessment

3.1 Runway End Safety Area at Billy Bishop Toronto City Airport

The project involves the implementation of RESAs at Billy Bishop Toronto City Airport, which requires expanding the landmass at both the east and west ends of Runway 08/26. To meet the requirements for RESA implementation, three alternatives were developed, each progressively building on the previous one with increased landmass expansion and additional features. The following outlines the three RESA alternatives.

RESA 1 – Minimum Landmass

RESA 1 proposes the minimum landmass expansion to meet RESA requirements, extending 54 m from the seawall on the west end (7,850 m^2), and 52 m on the east end (6,100 m^2). On the west end, the breakwater structure will be raised to 81 m above sea level, about 4.5 m above the threshold at Runway 08/26, to prevent wave overtopping and water spray. The breakwater at the east end (Inner Harbour) will be raised to 77 m above sea levels, about 1 to 1.5 m above the threshold, since there is no need to control any waves or water spray.

The proposed layout includes perimeter airfield roads around the RESA ends, providing restricted access across the runway, similar to current access conditions. The road will be managed by the control tower to avoid conflicts with aircraft landing or taking off, as this landmass configuration does not provide sufficient airspace clearance for unrestricted vehicle passage (does not meet Obstacle Limitation Surface requirements). An Obstacle Limitation Surface is an imaginary surface or series of surfaces that define the limits to which objects may project into airspace, to protect the airspace for the safe operation of aircraft during takeoff, landing and emergency operations.

RESA 2 – Taxiway Improvements

This alternative builds on RESA 1 – Minimum Landmass by incorporating additional airfield improvements in conjunction with the RESA work at both runway ends. Specifically, it proposes upgrades to Taxiway B at the west end and Taxiway D at the east end to enhance operational efficiency and safety at the airport.

For Taxiway B, the relocation of the Localizer 26 antenna to the new western RESA increases the landmass expansion to the west, reaching 82 m^2 from the seawall (11,800 m^2). The relocation of Taxiway D requires additional landmass to the northeast, bringing the total landmass on the east end to 11,300 m^2. This relocation enables the airport to upgrade its visual approach guidance system for aircraft landing on Runway 26, which is intended to improve aviation safety with a more precise system. All other features from RESA 1- Minimum Landmass remain the same in this alternative.

RESA 3 – Noise Wall and East Utility Conduit

This alternative builds on RESA 2 – Taxiway Improvements by incorporating additional elements. The key new features of RESA 3 include: 1) unrestricted airfield perimeter roads connecting the north and south sides of the airport, 2) a noise wall at the east end along with an extension of the existing noise wall at the west end, and 3) a reserved utility conduit for future hydro, water, and telecommunication services to the Toronto Islands community.

To accommodate these new components and ensure aeronautical airspace clearances over the new roads, security fences, and noise walls, a landmass expansion is required; 73 m from the seawall (29,980 m²) on the east end and 82 m from the seawall (12,600 m²) on the west end. All other features from RESA 2 are included in this alternative.

3.2 Net Effects Analysis

The net effects analysis for the three RESA alternatives 1, 2, and 3 was conducted using professional judgement in reviewing existing background information and a qualitative assessment of aerial imagery to identify trends in sediment movement, deposition, and erosion.

This analysis was completed based on the preliminary design of RESA alternatives 1, 2 and 3 available during the Environmental Assessment study, and identified key mitigation measures and effects management strategies to minimize or avoid potential impacts. The analysis summarizes the net effects remaining after the application of these measures.

3.2.1 Net Effects Analysis – Construction

Table 3-1 outlines the potential effects, proposed mitigation measures, and net effects of RESA 1, RESA 2, and RESA 3 within the marine physical study area, during construction.

3.2.2 Net Effects Analysis – Operation

Table 3-2 outlines the potential effects, proposed mitigation measures, and net effects of RESA 1, RESA 2, and RESA 3 within the marine physical study area, during operation.

Table 3-1: Net Effects Analysis of RESA 1, RESA 2, and RESA 3 for Marine Physical – Construction

Factor	Criteria	Potential Effects	Mitigation Measures	Net Effects
■ **Sedimentation and Erosion during Construction.**	■ Footprint and impact of in-water works within the vicinity of both west and east RESAs.	**RESA 1, RESA 2, RESA 3** ■ Placing stone material in the water will cause turbidity due to the fine sediments mixing with larger stone. ■ Rain, overtopping waves, and wave spray may cause surface erosion of fine materials within a construction site. ■ Risk of revetment core material being damaged by wave action after it has been placed and before it has been armoured.	**RESA 1, RESA 2, RESA 3** ■ An Erosion and Sediment Control Plan for the work site should be developed and implemented prior to the start of construction and should be inspected and maintained during all phases of construction and especially following precipitation. ■ The Erosion and Sediment Control Plan should be tailored to meet construction requirements following identification of risks. Key objectives will include limiting soil disturbance, minimizing exposure, stabilizing surfaces, and controlling sediment displacement through adaptive measures to weather and site conditions. The Erosion and Sediment Control Plan should include the following primary components. – Silt fences and straw wattles: Placed strategically along the perimeter of active construction zones, these barriers will intercept and filter overland flow, slowing water movement to encourage sediment settling. – Sediment basins and traps: Sediment basins should be installed at low points and on existing catch basins to capture sediment-heavy runoff, allowing particles to settle before the water exits the construction area. These basins should be regularly inspected and maintained to ensure efficient operation throughout the Project. – Runoff management and contaminant control: Overland flow, which may carry sediments and potential contaminants, should be managed within the Erosion and Sediment Control Plan by containing and treating runoff on-site. Techniques may include the use of containment berms and filter media around sensitive zones, especially near lake boundaries. ■ Erosion and sediment control measures should be maintained until all disturbed ground has been permanently stabilized, or any suspended sediment has resettled to the bed of the waterbody and/or settling basin and runoff water is clear. ■ Refer to **Table 6-12** for additional mitigation measures on soil and sedimentation during construction.	**RESA 1, RESA 2, RESA 3** ■ No Net Effect. ■ Effects on erosion and sedimentation are temporary, short-term and localized. ■ Provided that the erosion and sediment control plan is adhered to and adjusted when necessary, and proper control measures are in place at all times, no net effects are anticipated.

Table 3-2: Net Effects Analysis of RESA 1, RESA 2, and RESA 3 for Marine Physical – Operations

Factor	Criteria	Potential Effects	Mitigation Measures	Net Effects
■ **Sediment Transport.**	■ Sediment deposition / accumulation along West Island, Western Channel and in immediate vicinity of landmass. ■ Longshore sedimentation patterns (whether sediment moves along the shoreline). ■ Sediment deposition / accumulation in the Inner harbour.	**RESA 1, RESA 2, RESA 3** ■ Seawall expansion at west end is expected to positively impact sediment transport due to sediment deposition at the northern end of Hanlan's Point Beach on the southern side of landmass expansion. ■ Over time, sediment transport processes will generate a lakeshore morphology that has adapted to the barrier and sediment will continue to be transported into the Western Channel. ■ Negative effects on sediment erosion and deposition within the Inner Harbour are likely to be minor and negligible. **RESA 1** ■ RESA 1 will have the smallest positive impacts as provides shorter RESA extension on the west (54 m). **RESA 2 and RESA 3** ■ RESA 2 and RESA 3 will have moderate positive impacts as they both have a longer extension than RESA 1 on the west end (82 m).	**RESA 1, RESA 2, RESA 3** ■ No mitigation measures required.	**RESA 1** ■ Low Net Positive Effect. ■ Minimal sediment deposition is expected due to the shorter RESA extension on the west end, having less of an effect on sediment transport in this area. ■ Effects to sediment transport are considered beneficial, as it reduces sedimentation in the Western Channel and provides a source for nourishment of Hanlan's Point Beach under the Gibraltar Point Sediment Management Plan. ■ Over time, sediment transport processes will generate a lakeshore morphology that has adapted to the barrier and sediment will continue to be transported into the Western Channel (Shoreplan, 2024). **RESA 2, RESA 3** ■ Moderate Net Positive Effect. ■ The longer landmass extensions for both RESA 2 and RESA 3 mean a greater influence on sediment transport, creating a barrier for the sediment and leading to deposition along Hanlan's Point Beach. ■ Effects to sediment transport are considered beneficial, as it reduces sedimentation in the Western Channel and provides a source for nourishment of Hanlan's Point Beach under the Gibraltar Point Sediment Management Plan. ■ Over time, sediment transport processes will generate a lakeshore morphology that has adapted to the barrier and sediment will continue to be transported into the Western Channel (Shoreplan, 2024).
■ **Wave Formation**	■ Changes in wave height, wave period (i.e., time between waves) and wave direction.	**RESA 1, RESA 2, RESA 3** ■ Small, localized changes to wave height, wave period and wave direction will occur as a result of the RESA. ■ Minor changes to the waves entering into the Western Channel in the vicinity of the west end RESA is anticipated due to the constriction of the wave energy window for the southwesterly waves by the expansion. ■ No impacts to the east end RESA area are anticipated due to the limited wave activity in the inner harbour.	**RESA 1, RESA 2, RESA 3** ■ No mitigation measures required.	**RESA 1. RESA 2, RESA 3** ■ Negligible Net Negative Effect. ■ Overall extension on the west end will lead to minimal and localized changes to wave formation in the area, effects are anticipated to be minor and localized.
■ **Water Levels**	■ Changes in water levels in the Western Channel and nearby marina.	**RESA 1, RESA 2, RESA 3** ■ No changes in water levels in the Western Channel and nearby marina are anticipated as the water depths are at a minimum 10 m under typical water levels (Shoreplan, 2024).	**RESA 1, RESA 2, RESA 3** ■ No mitigation measures required.	**RESA 1, RESA 2, RESA 3** ■ No Net Effect. ■ No net effects are anticipated on the water levels in the Western Channel and nearby marina.

Factor	Criteria	Potential Effects	Mitigation Measures	Net Effects
■ **Currents**	■ Changes in flow patterns and current speed.	**RESA 1, RESA 2, RESA 3** ■ Areas where velocity is lowered due to fill used to create extension will see areas of sediment accumulation. ■ There is a measurable constriction created at the Western Channel due to the landmass expansion reducing channel size, resulting in increased velocities. However, the effects are anticipated to be minor and localized. ■ The east end has limited currents, therefore there will be negligible impact to flow patterns and currents at the east end.	**RESA 1, RESA 2, RESA 3** ■ No mitigation measures required.	**RESA 1, RESA 2, RESA 3** ■ Negligible Net Negative Effect. ■ Localized changes to currents resulting in potential sediment deposition or erosion will be minimal.

4. Natural Hazards

Natural hazards refer to natural, physical environmental processes that occur near or at the earth's surface, which can trigger unexpected events of extraordinary magnitude or severity (MNR, 2001). Together, the Natural Hazard Policy in the Provincial Policy Statement (2024) as well as the Ministry of Natural Resources Technical Guidelines (MNR, 2001) outline the policy requirements related to Natural Hazards in Ontario. More specifically, the marine physical study area is part of the Great Lakes – St. Lawrence system and under Section 6.0 of the Ministry of Natural Resources Technical Guidelines, the potential natural hazards within this system may include flooding hazards, erosion hazards, and dynamic beach hazards.

Key policy requirements within the Provincial Policy Statement (2024) and Ministry of Natural Resources Technical Guidelines relevant to the marine physical study area are as follows:

Natural Hazard Policy in the Provincial Policy Statement (2024)

1. Planning authorities, in collaboration with conservation authorities, must identify hazardous lands and sites, and manage development in these areas according to provincial guidelines.

2. Development should generally avoid hazardous lands, including those along the Great Lakes-St. Lawrence River System impacted by flooding, erosion, or dynamic beach hazards.

3. Development and site alteration are prohibited in areas such as dynamic beach hazards, and areas that would be inaccessible during flooding, erosion, and/or dynamic beach hazards, unless it has been demonstrated that the site has safe access appropriate for the nature of the development and the natural hazard.

4. Planning authorities shall prepare for the impacts of a changing climate that may increase the risk associated with natural hazards.

Ministry of Natural Resources Technical Guidelines (2001)

1. Hazardous lands on the Great Lakes – St. Lawrence River system and large inland lakes are defined by delineating the farthest combined landward extent of the three key shoreline natural hazards: flooding hazards, erosion hazards, and dynamic beach hazards.

2. The seven step procedure for hazard identification and management include:

   a) Identifying the hazard and their boundaries.

   b) Identify the type of development within the hazardous lands.

   c) Identify appropriate hazard management responses. Development within the least hazardous areas should be undertaken according to established standards and procedures with respect to floodproofing, protection works, and access.

   d) Determine the potential impacts to the physical processes and characteristics. Will the development create new hazards or aggravate existing hazards.

   e) Assess off-site physical impacts.

   f) Assess biological or environmental impacts.

   g) Mitigate minor impacts of preferred hazard management response. Impacts are mitigated by alterations to the design and/or to the timing and method of installation.

Additionally, according to Policy 3.4.17 of the City of Toronto Official Plan (2024), lakefilling projects in Lake Ontario will be supported only if they meet specific conditions. These include ensuring that the land created is used for natural habitat, public recreation, or essential public works. The project should undergo an Environmental Assessment to confirm that water quality, quantity, and habitat will be protected or enhanced. Additionally, the project must not create or worsen existing natural hazards.

The three potential natural hazards within the marine physical study area (flooding, erosion, and dynamic beach hazard) are discussed in detail in sections below.

4.1 Dynamic Beach Hazard

A dynamic beach can be described as a beach that moves (MNR, 2001). The hazard limit of a dynamic beach is not possible to be defined in terms of a single elevation. The dynamic beach hazard limit is the combined flooding hazard limit (the 100-year flood level plus an allowance for wave uprush and other water related hazards), plus the dynamic beach allowance of 30 metres on the Great Lakes St. Lawrence River System. If the dynamic beach is subject to erosion or is receding, the 100-year erosion rate is added to the flooding hazard limit and dynamic beach allowance of 30 metres.

The Lake Ontario shoreline within the marine physical study area has been significantly reinforced through traditional engineering structures (timber cribs, concrete walls, steel sheet piling, revetments and seawalls, etc.), see **Figure 2-1** (Baird & Associates, 2012). The shoreline at both the west and east end RESAs are already hardened as well as the shoreline of the East Island that is protected by a large rock, located approximately 500 metres to the west of the west end RESA. Therefore, the dynamic beach hazard does not apply at this site as the shoreline is an artificial shoreline that is protected by existing structures that addresses the erosion hazard.

4.2 Erosion Hazard

Erosion hazards can be defined as the loss of lands, due to human or natural processes, that pose a threat to life and property (MNR, 2001). RESA 3 will address the erosion hazard as both the east and west end RESAs will be hardened. The design of RESA 3 will not create any new erosion hazards, nor will it exacerbate existing erosion hazards as the design does not lead to any significant increases in velocities or shear stresses that could lead to increased erosion within the marine physical study area. Furthermore, the only area that may see small increases in velocities is the Western Channel, which has a hardened shoreline.

4.3 Flooding Hazard

Flooding Hazards can be defined as the risk of land inundated with water due to natural or man-made causes. It typically occurs when water levels rise beyond the normal flow of lakes, leading to the overflow of water onto adjacent land. The flooding hazard limit is defined as the 100-year flood level plus an allowance for wave uprush and other water-related hazards. Toronto and Region Conservation Authority has adopted a 100-year flood level of 76.2 m International Great Lakes Datum 1985 for Toronto Harbour (see **Section 2.6** for more information on water levels). The existing shore walls at either end of the runway have a low free board (approximate elevation of 76.5 m) and will be significantly overtopped by wave action at the 100-year flood level. RESA 3 will raise the crest elevation of the shore protection reducing the impact of wave action or overtopping water flooding the site. As for the shorelines in the vicinity of the marine physical study area, it is not expected that the RESA 3 design will create any new flooding hazards, nor exacerbate existing flooding hazards as the design will not increase the water levels.

5. Conclusion and Recommendations

The following provides a summary of the overall net effects of the RESA 1, RESA 2, and RESA 3 related to sediment transport, currents, water levels, wave formation, as well as erosion and sedimentation during RESA construction and operation:

- As stated by Shoreplan from their recent sediment transport assessment (2024), any landmass expansion at the west end RESA is predicted to have a beneficial impact on sediment transport in the vicinity, reducing sedimentation in the Western Channel and potentially supporting the Gibraltar Point Sediment Management Plan, including trapping sediment along Hanlan's Point Beach which will help to sustain the beach.
- Effects on sediment erosion and deposition within the Inner Harbour are likely to be minor and negligible.
- Over time, sediment transport processes will generate a lakeshore morphology that has adapted to the barrier and sediment will continue to be transported into the Western Channel.
- No net effects on the water levels within the marine physical study area have been identified.
- Minor and localized changes related to wave formation and currents is expected, specifically in the vicinity of the west end RESA and Western Channel.
- Erosion and sedimentation as well as accidental spills risk should be managed with appropriate construction means and methods, to reduce the temporary and localized impacts from construction.
- In compliance with provincial policies on natural hazards, the RESA designs are not expected to cause any new flooding or erosion hazards, nor is it expected to exacerbate existing hazards. It was also determined that the dynamic beach hazard does not apply to the study area.

The above net effects assessment and results of the marine physical environment investigation is based on a completed background review of relevant studies as well as an updated high-level air photo analysis, which has provided sufficient information, resulting in the above conclusions relating to the net effects of RESA 1, RESA 2, and RESA 3.

6. References

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AECOM

Appendix A

Historical Aerial Imagery

LEGEND

1. Steep Beach Profile
2. Submerged Dunes
3. Vegetated Dunes
4. Turbid Water

Data Sources:
Contains Information licensed under the Open Government License Ontario.

Billy Bishop Toronto City Airport Runway End Safety Area

2015 Aerial Imagery

0 250 500 Meters
NAD 1983 UTM Zone 17N

Nov, 2024	1:11,000
P:60733457	Rev:00

Figure 1

AECOM

LEGEND

- (1) Steep Beach Profile
- (2) Submerged Dunes
- (3) Vegetated Dunes
- (4) Turbid Water
- (5) Nearshore Reef
- (6) Groyne Structure

Data Sources:
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Billy Bishop Toronto City Airport Runway End Safety Area

2022 Aerial Imagery

0 250 500 Meters

NAD 1983 UTM Zone 17N

Nov, 2024	1:11,000
P:60733457	Rev:00

Figure 2

AECOM