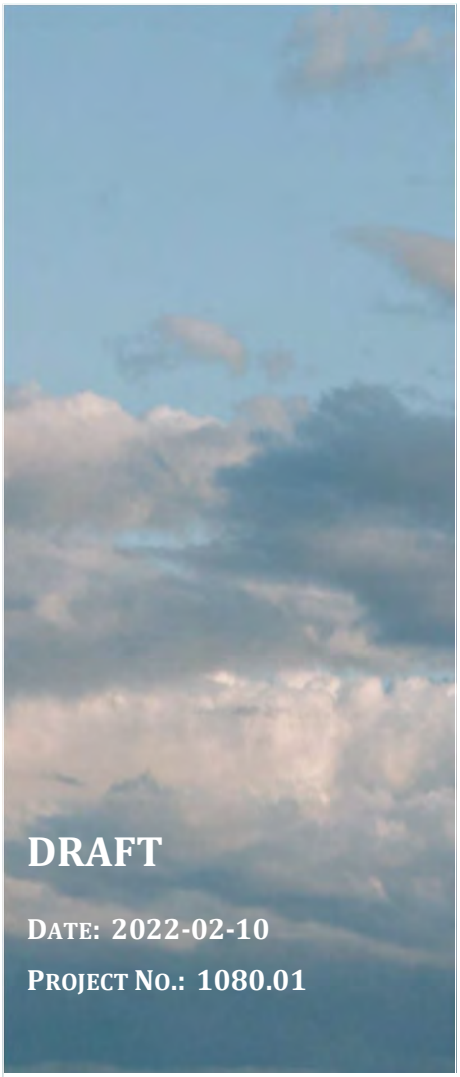
LAKE ONTARIO SHORELINE HAZARD SUMMARY, RISK ASSESSMENT AND MANAGEMENT PLAN

DRAFT TECHNICAL REPORT



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Date: 2022-02-10
Project Number: 1080.01

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EXECUTIVE SUMMARY

SJL Engineering Inc. was retained by the Central Lake Ontario Conservation Authority (CLOCA) to develop a Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan for seven (7) at risk communities within the CLOCA watershed, referred to herein as Shoreline Damage Centres (SDCs). SDCs were identified based on shoreline hazard mapping developed as a component of the recently completed Lake Ontario Shoreline Management Plan (Zuzek Inc., 2020a). Shoreline hazard mapping was produced following provincial policy and technical guidance, as outlined in Section 2.0 of this report. Identified SDCs are listed below and represent communities where one or more residential buildings were found to be located within the regulatory shoreline hazards for Lake Ontario:

- SDC #1 – Ontoro Boulevard:
- SDC #2 – Crystal Beach:
- SDC #3 – Stone Street:
- SDC #4 – Muskoka Avenue:
- SDC #5 – Port Darlington:
- SDC #6 – East Beach Road:
- SDC #7 – Wilmot Creek:

The principal objectives of the study were to complete a shoreline hazard summary and risk assessment for each of the 7 SDCs listed above, and to develop risk mitigation recommendations to address the hazards. Specifically, the following three principal tasks were completed:

1. Shoreline hazards determined and mapped as a component of the 2020 Shoreline Management Plan were reviewed and reassessed in order to confirm their accuracy at a higher spatial resolution within each of the 7 SDCs. Minor revisions to the hazard mapping were made in two locations, namely within SDC #2 and SDC #4 (refer to Section 2.0 and Appendix A).
2. A detailed risk assessment was completed for all residential buildings within the 7 SDCs with exposure to one or more of the shoreline hazards. Risk maps were produced for each SDC using the results of the risk assessment to highlight buildings of greater relative risk (refer to Section 3.0 and Appendix C).
3. A variety of risk mitigation strategies were evaluated for each SDC under four broad categories; *Avoid, Accommodate, Protect,* and *Retreat/Re-align*. Where appropriate, *Protect* and *Retreat/Re-align* strategies were recommended as "Primary Risk Mitigation Strategies", while *Accommodate* and *Avoid* strategies were provided as "Other Risk Mitigation Considerations". *Retreat/Re-align* strategies were only considered for SDCs where one or more buildings were evaluated as having *high* to *extreme risk*. High-level concept drawings and opinions of probable cost were also provided for *Protect* strategies (refer to Section 4.0).

The project included public engagement through the circulation of an online survey and a virtual, Public Information Centre (PIC) held at the mid-point of the study. Public engagement activities including responses to public feedback are presented in Section 1.2. Study conclusions and recommended next steps are presented in Section 5.0, while shoreline hazard mapping and risk maps for each SDC are provided in Appendix A and C, respectively.

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1.0 INTRODUCTION

The legal responsibility for Conservation Authorities to regulate development on hazardous lands is outlined in the Conservation Authorities Act and Ontario Regulation 97/04. Regulations specific to the Central Lake Ontario Conservation Authority (CLOCA) are outlined in Ontario Regulation 42/06 (*Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*), with supporting technical information provided in the Lake Ontario Shoreline Management Plan (the SMP), a study completed by Zuzek Inc. and SJL Engineering Inc. and published in November 2020 (Zuzek Inc., 2020a).

As a component of the 2020 SMP, natural shoreline hazards were assessed, and hazardous lands delineated and mapped for the entire CLOCA Lake Ontario shoreline based on provincial policy and the procedures outlined in the Technical Guide for Great Lakes – St. Lawrence River Shorelines (MNR, 2001), herein referred to as the Technical Guide. Specifically, the erosion, flood and dynamic beach hazards were assessed, as per provincial policy. Based on the hazard mapping produced with the SMP, seven (7) separate Shoreline Damage Centres (SDCs) were identified by CLOCA where one or more residential buildings fall within the lands susceptible to natural hazards. These areas are presented and discussed in Section 1.1.

To better understand and quantify the risks associated with these hazards and to identify potential mitigation solutions to eliminate or reduce the risks, SJL Engineering Inc. was retained to complete a Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan for each SDC. The major components of this study are summarized as follows:

1. Review shoreline hazards assessed and mapped as a component of the 2020 SMP, confirm their accuracy at a higher spatial resolution within each of the 7 SDCs, and propose revisions where it is deemed that the accuracy can be improved.
2. Complete a risk assessment for all residential buildings within the 7 SDCs and provide risk mapping for each SDC highlighting buildings of greater relative risk due to natural shoreline hazards.
3. Evaluate a variety of risk mitigation strategies for each SDC under four broad categories; Avoid, Accommodate, Protect, and Retreat/Re-align. Recommend preferred and alternative risk mitigation strategies including high-level concepts and costs for each SDC to address the risk highlighted through steps 1 and 2.

A critical component of the project was also the solicitation of feedback from landowners within each SDC, and public engagement through a Public Information Centre (PIC) that was held virtually on December 8th, 2021. The public engagement aspects of the project are discussed in Section 1.2 below.

Each SDC was also visited by SJL Engineering Inc. staff at the outset of the project in September 2021. Existing shoreline conditions were documented both through visual observations and oblique, aerial photographs captured using an unmanned aerial vehicle (UAV). Collected photos were compared to those captured in 2018 and 2019 as a component of the SMP, and major changes to shoreline conditions between the various sets of photos including areas featuring evidence of recent erosion or flooding were identified and documented.

The summary of shoreline hazards completed for each SDC is discussed in Section 2.0 of this report, with final shoreline hazard maps for each SDC provided in Appendix A. The risk assessment methodology and results are presented in Section 3.0 with supporting risk mapping provided in Appendix B. The evaluation of risk mitigation strategies and recommendations including high-level

concepts and municipal zoning considerations are provided in Section 4.0. Finally, the study conclusions and recommended next steps are presented in Section 0.

1.1 SHORELINE DAMAGE CENTRES

Seven shoreline damage centres were identified by CLOCA based on the shoreline hazard mapping produced as a component of the 2020 SMP. The location and name of each SDC is shown in Figure 1 below. Each SDC features several primary residential buildings potentially affected by the erosion, flood, or dynamic beach hazard within a 100-year planning horizon. The SDCs are defined as follows, ordered from west to east:

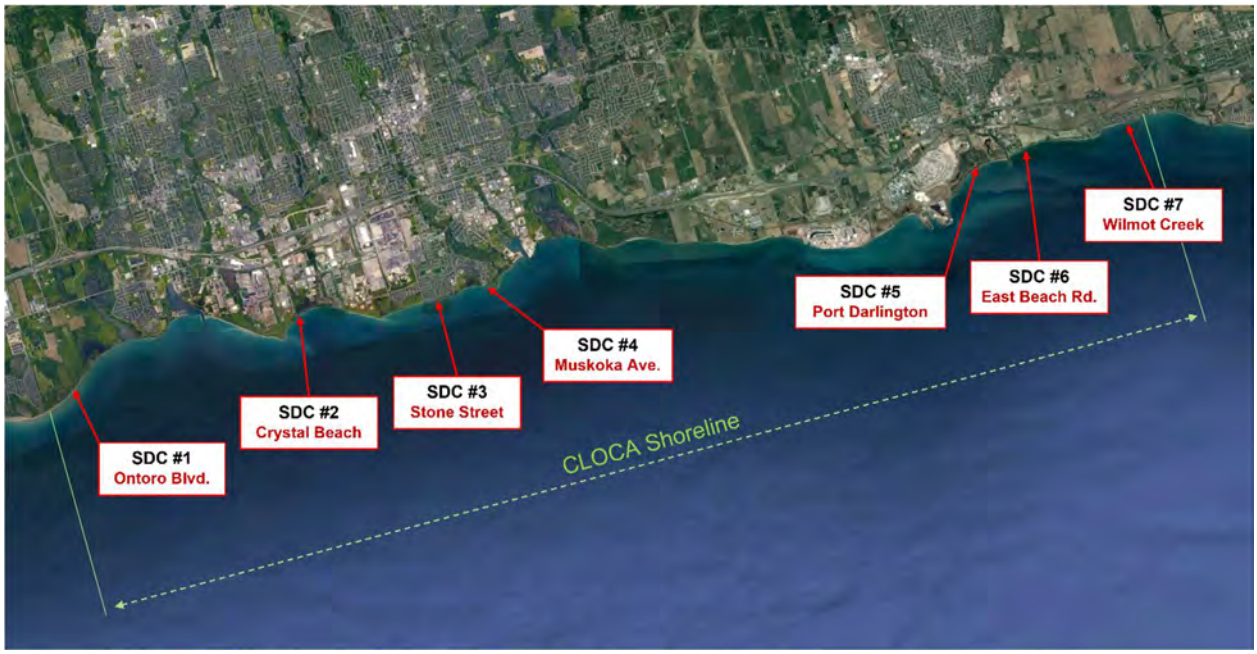


Figure 1 - CLOCA portion of the Lake Ontario shoreline showing the location and name of all 7 Shoreline Damage Centres

SDC #1 – Ontoro Boulevard: At the west end of the CLOCA jurisdiction, Ontoro Boulevard is a small residential development that includes 13 homes located on the south side of the road atop an actively eroding low-bluff shoreline. Most properties feature some form of shoreline protection, many of which were implemented in recent years. The type and condition of shoreline protection structures is highly variable. Many properties suffered significant erosion and infrastructure failures during the record-breaking water level periods on Lake Ontario in 2017 and 2019.

SDC #2 – Crystal Beach: Crystal Beach Boulevard is a private road in Whitby featuring 19 individual properties with residential buildings affected by the shoreline hazards. The western portion of the road sits on a medium-high eroding cohesive bluff, while the eastern portion of the road sits on a low-lying barrier beach that protects the Corbett Creek wetland. All three shoreline hazards including erosion, flooding, and the dynamic beach hazard are relevant in this area, particularly at the east end of the SDC where the low-lying lands, proximity of buildings to the lake and presence of highly erodible dynamic beach material result in significant combined risks to homeowners, particularly during periods of elevated lake levels. Properties at the east end of the SDC are also subject to riverine flood and erosion risks associated with Corbett Creek.

SDC #3 – Stone Street: Stone Street was densely developed several decades ago, with 53 properties presently located on the south (lake) side of the road. These properties sit atop a naturally eroding, medium-high cohesive bluff. This shoreline suffered significant and rapid erosion in multiple places during the 2017 and 2019 high water periods, triggering several landowners to have field stone revetments constructed. However, much of this SDC remains unprotected with more than half of the properties on the south side of the road featuring residential buildings within the Lake Ontario erosion hazard.

SDC#4 – Muskoka Avenue: Muskoka Avenue is fronted by a prominent headland that can be described as high glacial till bluff. A single residential property sits atop the geological feature. The headland is naturally armoured due to its high content of boulder-sized material which has accumulated on the beach and in the nearshore, reducing its erosion rate when compared to neighbouring shorelines. Land elevations immediately west of the headland drop rapidly down to a low-bank shoreline, with five homes located in very close proximity to the seasonal high water line in this transitional area. The shoreline features both erosion and flood risks.

SDC #5 – Port Darlington: The Port Darlington region has significant risk associated with natural hazards due to the prevalence and severity of all three shoreline hazard types (erosion, flooding and dynamic beach), as well as riverine flood and erosion hazards. The western portion of the SDC features 40 lakefront properties on Cedar Crest Beach Road, a development that was constructed many decades ago on a dynamic barrier beach and former inlet. The eastern portion of the SDC features 22 properties on West Beach Road which was also constructed on a low-lying barrier beach that separates Lake Ontario from Bowmanville Marsh and Harbour. The two low-lying dynamic beaches are separated by an area of higher elevation which features a further 20 lakefront properties on the south side of Cove Road. Homes on both Cedar Crest Beach Road and West Beach Road were subjected to significant flooding and impacts from wave runup during the high water level periods in 2017 and 2019, and riverine flooding from the coastal Marshes. Emergency access is also a serious consideration for these communities as both Cedar Crest Beach Road and West Beach Road feature road elevations similar to or lower than the 100-year flood elevation for this portion of Lake Ontario shoreline.

It is noted that SDC #5 is treated differently in this study, due to the fact that it has been extensively studied over the last few years. Shoreline hazards presented for this SDC are the same as those shown in the 2020 SMP, and recommendations concerning risk mitigation strategies for this community are restated from recent studies and not re-evaluated. Only the risk assessment component of this study has been completed for SDC #5, as a qualitative risk assessment had not previously been completed for the residential buildings in this area.

SDC #6 – East Beach Road: Located on the east side of the federal navigation channel and jetties at Port Darlington, East Beach Road futures a number of private properties situated atop a medium-high to high, rapidly eroding cohesive bluff. Three residential buildings are also located at the south end of South Service Road, where the land elevations are significantly lower resulting in both flood and erosion risks. Natural erosion rates along this portion of Lake Ontario shoreline are relatively high due to wave exposure and lack of sediment supply, which is in part due to the presence of the Port Darlington jetties which trap sediment on their updrift (west) side, as is evident by the fillet beach fronting West Beach Road. Several properties within this SDC face acute risks due to their close proximity to the edge of the high, actively eroding cohesive bluff.

SDC #7 – Wilmot Creek: The Wilmot Creek Retirement Community includes approximately 3 km of low, medium-high and high, naturally eroding cohesive bluffs on the shores of Lake Ontario. Seventy individual properties are potentially exposed to the shoreline hazards within the CLOCA portion of this community due to their proximity to the crest of the eroding bluff. An interim

shoreline protection structure has been implemented along the majority of the bluff toe fronting this community over the past decade. However, labelled by the design engineers as an "interim" solution, this structure is porous and under-designed to fully mitigate erosion of the bluff.

1.2 PUBLIC ENGAGEMENT

In August 2021, an online public survey was circulated to all property owners within the SDCs who were identified by the CLOCA as being potentially affected by the natural hazards. In total, 57 survey responses were received, with the distribution of respondents by SDC shown as a pie chart in Figure 2 below. Landowners were asked to rate and comment on their perceived short-term (next 5 years) and long-term (5+ years) risk due to the shoreline hazards (erosion, flooding, or dynamic beach). Their responses are also summarized in Figure 2 below, with 9 and 12% of respondents stating that their short and long-term risk, respectively, was "extreme". A further 26% of respondents felt that their short-term risk was at least high.

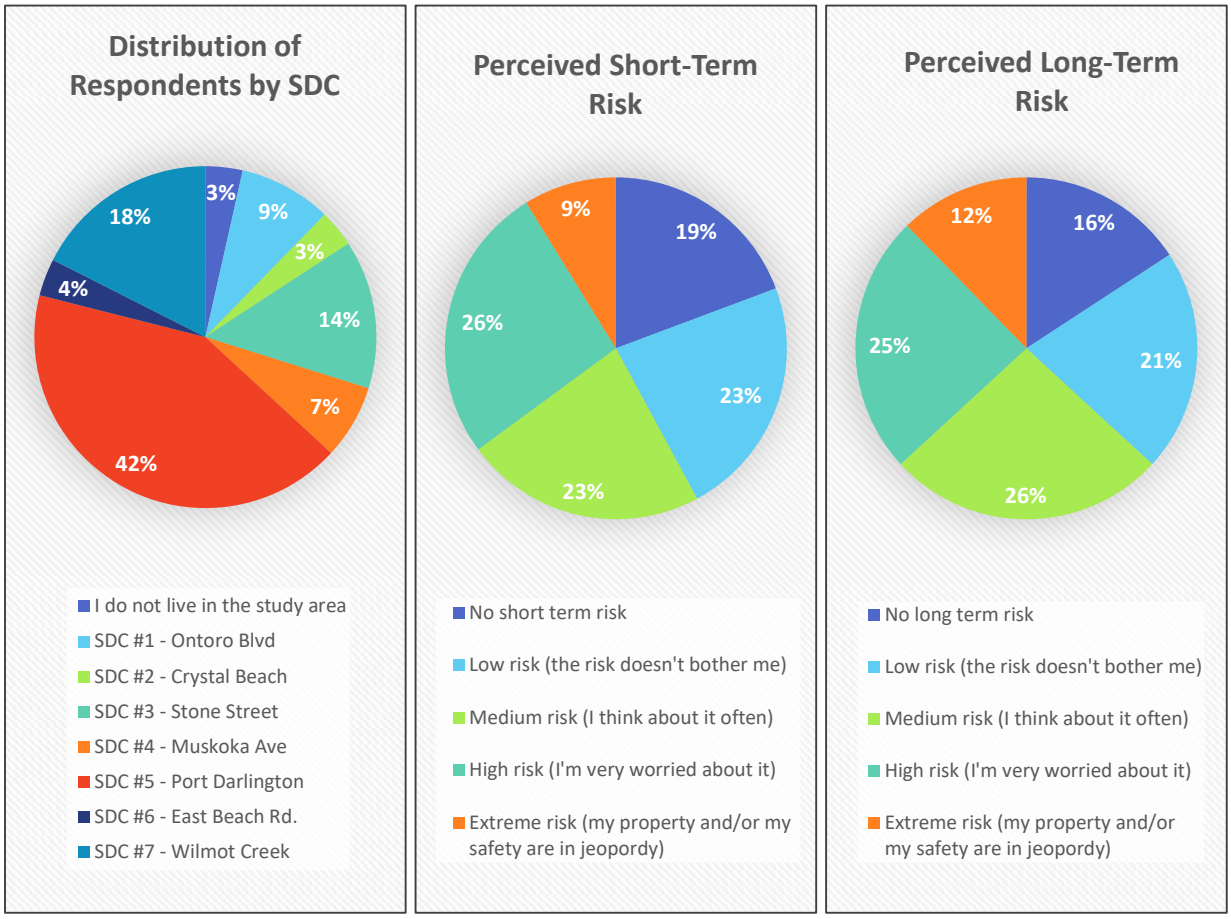


Figure 2 – Summary of public survey responses (57 respondents total)

Landowners also had the opportunity to provide comments and ask questions as a part of the online survey. Questions that were common to multiple respondents or of most relevance to the study were compiled to be addressed directly in a Public Information Centre (PIC), which was held virtually on December 8th, 2021. The PIC featured a technical presentation by members of the study team providing an overview of the study and work completed to date. A summary of responses to questions and comments received via the online survey was provided, and landowners were given another opportunity to voice their opinions and pose questions to the study team during a question

and answer period. Key questions and comments received either via the online survey or during the PIC are summarized as follows, followed by answers provided from members of the study team:

- **QUESTION/COMMENT:** What are "shoreline hazards" and how are they defined?

  RESPONSE: There are three regulated shoreline hazards for Great Lakes shorelines in Ontario; the erosion hazard, flood hazard, and dynamic beach hazard. Each hazard is described in detail in Section 2.0 of this report.

- **QUESTION/COMMENT:** Why is my home still shown as being within or affected by the shoreline hazards when I've already invested in engineered shoreline protection?

  RESPONSE: Shoreline hazards (and corresponding risk) are assessed and mapped based on the presence of a natural shoreline, as per provincial policy. The presence and condition of shoreline protection is not accounted for in the assessment or mapping.

- **QUESTION/COMMENT:** Shoreline protection is expensive, and someone should help pay for it.

  RESPONSE: Typically, private shoreline protection is not publicly funded in Ontario. If you own property along the shoreline, in general, you are responsible for mitigating the associated hazards.

- **QUESTION/COMMENT:** Why is non-engineered, lower-cost shoreline protection not permitted?

  RESPONSE: Shoreline protection that is not properly designed is likely to deteriorate or fail. Policies surrounding shoreline protection standards are meant to ensure good investment through adequate protection to human safety and private assets from the shoreline hazards. It is also necessary for the owner to mitigate negative impacts to neighbouring shorelines/properties and the coastal environment when applying for a shoreline protection permit.

- **QUESTION/COMMENT:** Erosion and flooding events in 2017 and 2019 were man-made and were the result of Plan2014.

  RESPONSE: Extreme high water levels and associated flooding and erosion experienced on Lake Ontario in 2017 and 2019 were the result of record breaking water supplies to the Great Lakes Basin. Notwithstanding this fact, the water level regulation plan that is presently in effect at the Moses-Saunders Dam, known as Plan2014, is presently under review by the International Joint Commission. This study will not evaluate the performance of Plan2014 during periods of extreme water supply nor will recommendations concerning water level regulation be made.

2.0 SUMMARY OF SHORELINE HAZARDS

Three shoreline hazards are recognized and regulated for Great Lakes shorelines in Ontario, as stipulated in the Guidelines for Developing Schedules of Regulated Areas (Conservation Ontario and MNR, 2005). These are the *erosion hazard*, the *flood hazard*, and the *dynamic beach hazard*. Definitions for each hazard and acceptable processes for establishing the hazards are outlined in the Technical Guide (MNR, 2001). Each hazard is briefly described in the sections that follow.

Shoreline hazards for the CLOCA shoreline were most recently assessed and mapped as a component of the 2020 Lake Ontario Shoreline Management Plan (SMP). This project included shoreline hazard mapping for more than 135 km of Lake Ontario shoreline and was thus done at a regional scale. For this study, shoreline hazards affecting each of the 7 SDCs were reviewed, and revisions were made to improve their spatial accuracy where appropriate. This review process is also discussed in the sections that follow.

2.1 EROSION HAZARD

The erosion hazard is defined as a 100-year erosion allowance plus a stable slope allowance measured horizontally from the future toe of the slope (CO & MNR, 2005). The 100-year erosion allowance is first established by determining the representative average annual recession rate (AARR + 1 standard deviation) for a shoreline from a comparison of historical aerial imagery or other erosion measurements (where available) and multiplying by 100-years. The stable slope is then assumed to be 3:1 (horizontal:vertical), or some other value as determined by a detailed geotechnical study. A 15 metre horizontal buffer is typically added to the erosion hazard setback to form the *regulated area*, or the area in which the local conservation authority is mandated to regulate development as per provincial policy. A graphical definition of the erosion hazard is provided in Figure 3 below.

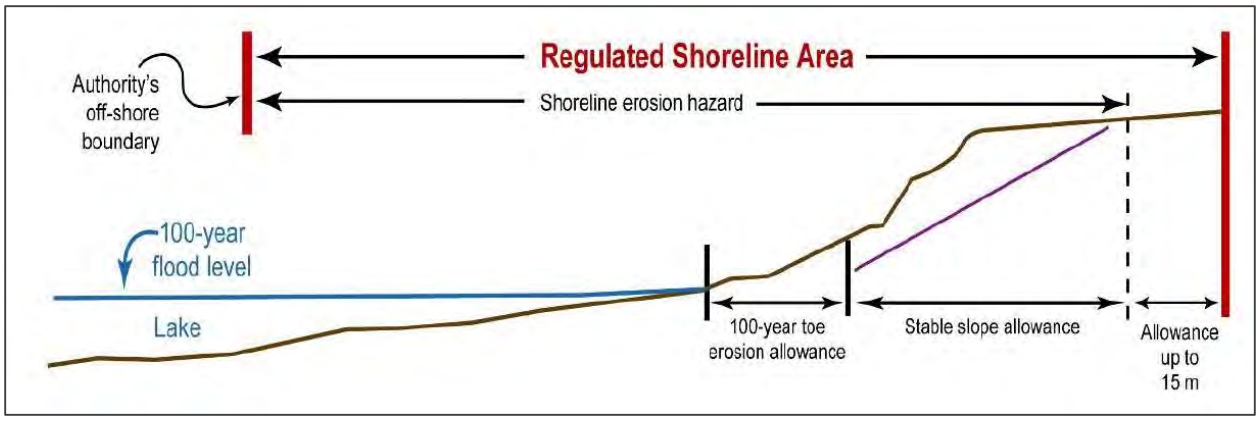


Figure 3 – Erosion Hazard definition sketch, as defined in the Guidelines for Developing Schedules of Regulated Areas (Conservation Ontario and MNR, 2005)

The stable slope setback as measured from the *existing* location of the toe of bluff/bank is often referred to as the "zone of pending failure". In a practical sense, this is the area adjacent to the bluff or bank crest that may be affected by a rapid failure of the slope. As discussed further in Section 3.0, where a building is located within the "zone of pending failure", the risk related to the *erosion hazard* is extremely high.

The erosion hazard as defined in the 2020 SMP was reviewed in detail for each SDC (except for SDC #5 – Port Darlington). Figure 4 presents an example of the analysis for SDC #3 – Stone Street. An average annual erosion rate of 0.20 metres per year was used in the SMP shoreline hazard mapping based on a comparison of historical aerial imagery for the broader region from 1954 to 2018. For the present study, recession rates between 1954 – 2018 and 1954 – 2020 were reviewed at 10 meter increments in the immediate vicinity of Stone Street only. The resulting average annual recession rates (+ 1 standard deviation) were shown to range from 0.19 – 0.20 m/year, thus confirming the accuracy of the 2020 mapping. No revisions were therefore warranted for this SDC.

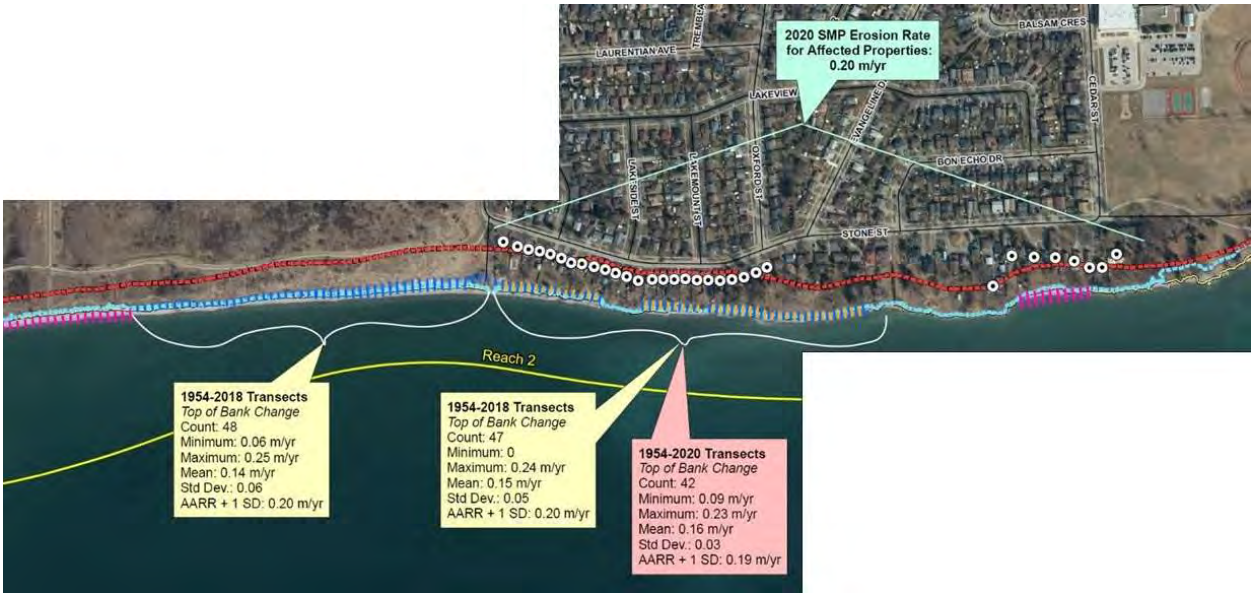


Figure 4 – Erosion rate analysis for SDC #3 (Stone Street) showing the AARR from the 2020 SMP, and the AARR as calculated from local erosion transects only, based on aerial imagery from 1954, 2018 and 2020.

A similar review of erosion rates at a high spatial resolution was completed for all 7 SDCs, with only SDC #2 – Crystal Beach resulting in a notable difference when compared to the erosion rates applied regionally in the 2020 SMP. In this area, local erosion rates for bluff shorelines to the east and west of Crystal Beach Boulevard were lower than that which was applied in the SMP. As a result, the erosion hazard from the west end of the SDC to the transition from bluff shoreline to dynamic beach was remapped using an average annual recession rate of 0.20 m/year. The revised erosion hazard for this area is shown on the updated hazard mapping provided in Appendix A. Average annual recession rates used in the delineation of the erosion hazard are provided for all 7 SDCs in Table 1 below.

Table 1 – Average annual recession rates used in the determination of the erosion hazard for affected properties within each SDC.

Shoreline Damage Centre:	Average Annual Recession Rate (+ 1 S.D.)
SDC #1 – Ontoro Blvd.	0.15 m/year
SDC #2 – Crystal Beach	0.20 m/year*
SDC #3 – Stone Street	0.20 m/year
SDC #4 – Muskoka Ave.	0.20 m/year
SDC #5 – Port Darlington	0.22 m/year
SDC #6 – East Beach	0.24 m/year
SDC #7 – Wilmot Creek	0.24 m/year

* Revised from 2020 SMP which used a regional AARR of 0.27 m/year

2.2 FLOOD HAZARD

The flood hazard is defined as the combination of the 100-year flood level and an allowance for wave uprush and other water related hazards (MNR, 2001). First the 100-year flood level must be assessed from a joint probability analysis of static lake levels and local storm surge. The 100-year flood level is the combined water level having a probability of occurrence of 1% in any given year. Next, the wave uprush elevation corresponding to at least a 20-year wave event must be assessed through the use of acceptable empirical formulas or numerical modelling (MNR, 2001). The wave uprush elevation can then be mapped on the appropriate topographic contour which determines the location of the flood hazard. Wave uprush is dependent on the offshore wave conditions, the lakebed slope and available depths in the nearshore, and the physical properties of the shoreline itself including beach slope and shoreline material (i.e. roughness). A graphical definition of the flood hazard is provided in Figure 5.

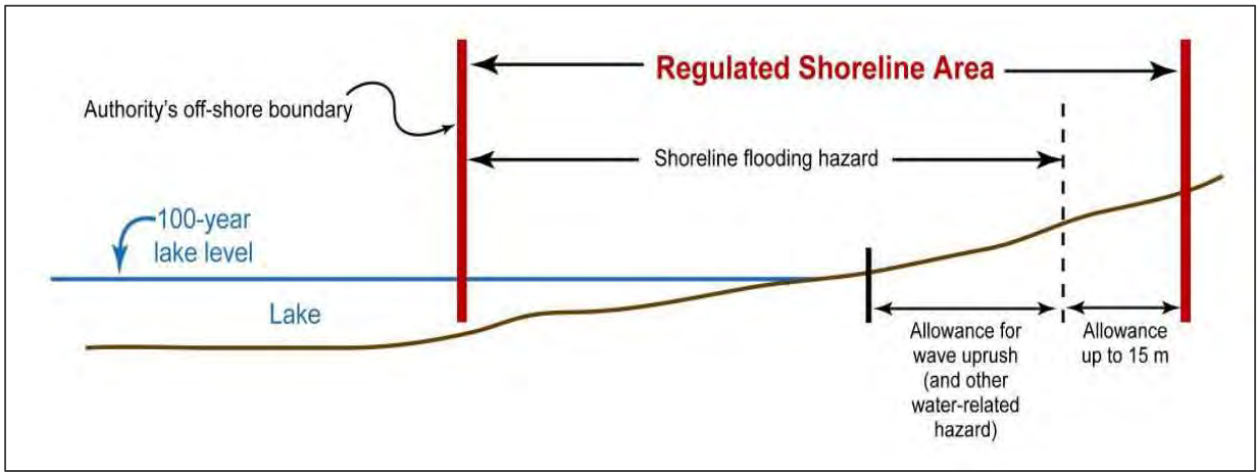


Figure 5 – Flood Hazard definition sketch, as defined in the Technical Guide (MNR, 2001) and the Guidelines for Developing Schedules of Regulated Areas (CO and MNR, 2005)

The flood hazard was assessed and mapped as a component of the 2020 SMP for the entire CLOCA shoreline. The 100-year water level is relatively consistent along the CLOCA shoreline; however, the wave uprush component of the flood hazard can vary significantly due to local wave exposures and physical shoreline characteristics. Due to the scale of the 2020 SMP, the wave uprush component was assessed regionally for various types of shorelines (bluff, sandy beach, cobble beach, etc.) using representative nearshore slopes and regional wave exposures. For the present

study, wave uprush was reassessed using our in-house composite slope wave uprush tool at multiple locations within each SDC (except for SDC #5 – Port Darlington) using local wave exposure and shoreline properties.

In general, revised wave uprush calculations resulted in wave uprush elevations within +/- 20 cm of those assessed as a component of the 2020 SMP for each of the SDCs (within the accuracy of the topography used in the hazard maps). The sole exception to this was in SDC #4 – Muskoka Avenue, where revised uprush calculations indicated that the wave uprush potential in the vicinity of the homes along Muskoka Ave. was on the order of 60 cm higher than that which was calculated for the broader region as a component of the 2020 SMP. As such, the flood hazard elevation was remapped in this area to an elevation of +78.27 m IGLD85', as is shown on the revised hazard mapping in Appendix A. Flood hazard elevations resulting from the combination of 100-year flood levels and wave uprush are provided in Table 2 below for all 7 SDCs.

Table 2 – Flood hazard elevation affecting properties within each SDC including 100-year flood level and wave uprush.

Shoreline Damage Centre:	Start (lat., long.)	End (lat., long.)	Flood Hazard Elevation (m IGLD85')
SDC #1 – Ontoro Blvd.	43.8285, -78.9792	43.8458, -78.9490	+77.68
SDC #2 – Crystal Beach	43.8481, -78.9004	43.8521, -78.8945	+77.82
	43.8521, -78.8945	43.8525, -78.8816	+77.79[1]
SDC #3 – Stone Street	43.8510, -78.8690	43.8584, -78.8331	+77.81[2]
SDC #4 – Muskoka Ave.	43.8510, -78.8690	43.8584, -78.8331	+78.27[3]
	43.8584, -78.8331	43.8593, -78.8311	+77.76
SDC #5 – Port Darlington	43.8782, -78.6843	43.8857, -78.6750	+77.74
	43.8857, -78.6750	43.8878, -78.6648	+77.64
SDC #6 – East Beach	43.8885, -78.6624	43.8895, -78.6617	+77.64
	43.8895, -78.6617	43.8967, -78.6257	+77.77
SDC #7 – Wilmot Creek	43.8895, -78.6617	43.8967, -78.6257	+78.02[4]

[1] minor revision from 2020 SMP which listed flood hazard elevation as +77.68 m – no revision to hazard map
[2] minor revision from 2020 SMP which listed flood hazard elevation as +77.68 m – no revision to hazard map
[3] revision from 2020 SMP which listed flood hazard elevation as +77.68 m – revision made to hazard map
[4] minor revision from 2020 SMP which listed flood hazard elevation as +77.77 m – no revision to hazard map

2.3 Dynamic Beach Hazard

The dynamic beach hazard is the most restrictive of the three shoreline hazards, and is generally reserved for shorelines which are comprised of dynamic beach materials with a beach profile that may evolve or erode rapidly under certain combinations of wind, wave and water level conditions. For a shoreline to be subjected to the dynamic beach hazard, the following criteria must be met (as per MNR, 2001):

- Beach or dune deposits exist landward of the water line, AND
- Beach or dune deposits overlying bedrock or cohesive material are equal to or greater than 0.3 metres in thickness, 10 metres in width, and 100 metres in length, AND
- The maximum fetch distance measured over an arc extending 60 degrees on either side of a line perpendicular to the shoreline is greater than 5 km.

For shorelines in which the above criteria apply, the dynamic beach hazard is typically defined by the landward limit of the flood hazard (100-year flood level plus wave uprush, as defined in Section 2.2 above), plus an additional allowance to account for the dynamic nature of the beach and dune system. This additional allowance is generally taken as 30 metres, or some other distance as determined by a detailed, site-specific study (MNR, 2001). A definition sketch of the dynamic beach hazard is provided in Figure 6 below.

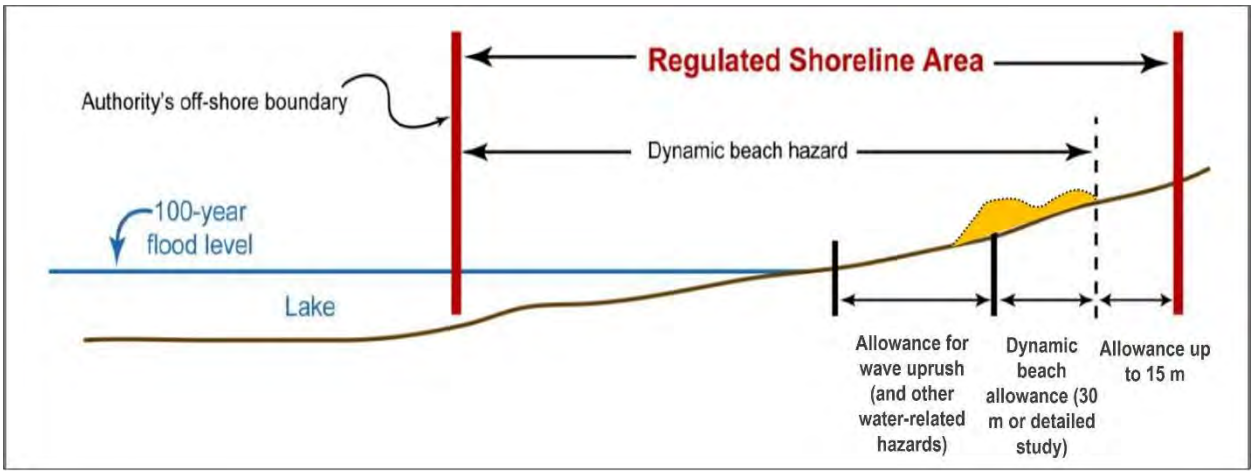


Figure 6 – Dynamic Beach Hazard definition sketch, as defined in the Technical Guide (MNR, 2001) and the Guidelines for Developing Schedules of Regulated Areas (CO and MNR, 2005)

For dynamic beaches on shorelines that also feature a long-term erosion trend, the dynamic beach hazard should also include an allowance for 100-years of erosion, based on the long-term average annual recession rate for the shoreline. This scenario is depicted in Figure 7.

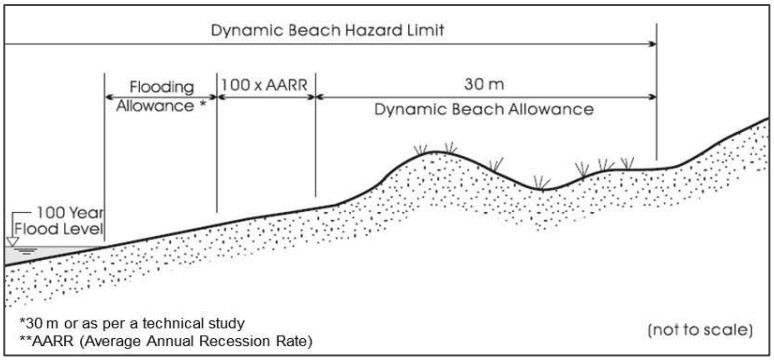


Figure 7 – Definition sketch for a dynamic beach with a long-term erosion trend, as per the Technical Guide (MNR, 2001).

There are several exceptions listed in the Technical Guide to the typical definition of a dynamic beach depicted in Figure 6 and Figure 7. One such exception that is of particular relevance to this study is for barrier beach systems. Barrier beaches are typically narrow, low-lying landforms that separate an energetic body of water (in this case Lake Ontario) from a sheltered lagoon, river outlet, marsh or coastal wetland. Barrier beaches form naturally and are comprised of dynamic sediment deposits such as sand and cobble. There are three barrier beaches within the 7 SDCs. Crystal Beach is a narrow, low lying barrier beach that separates Lake Ontario from Corbett Creek in SDC #2 (Crystal Beach). In SDC #5 (Port Darlington), Cedar Crest Beach Road and West Beach Road were constructed on barrier beaches that separate Lake Ontario from Westside Marsh and

Bowmanville Marsh, respectively. All three barrier beaches feature legacy residential developments, are low-lying, flood prone, and erodible.

Figure 8 provides a graphical representation of how the dynamic beach hazard should be defined and mapped for low-lying, barrier beach shorelines, as per the Technical Guide (MNR, 2001). In this case, the dynamic beach hazard extends across the entire width of the barrier beach system below the 100-year flood elevation (100-year water level + wave uprush), to at least the toe of the slope on the sheltered side of the landform.

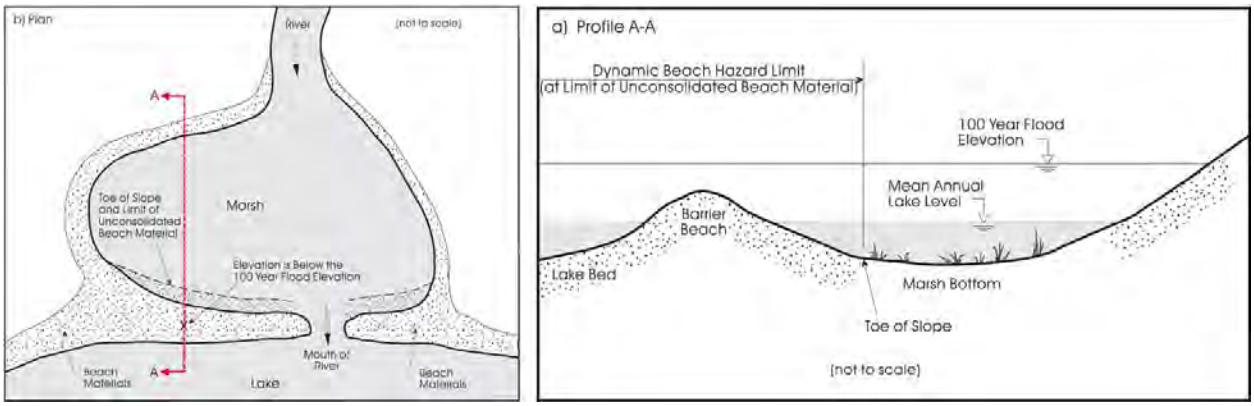


Figure 8 - Plan view (left) and cross-section (right) definition sketch of the dynamic beach hazard for a low-lying barrier beach.

The delineation of barrier beaches in the 2020 SMP hazard mapping was reviewed through each of the 7 SDCs, and it was determined that no revisions to the barrier beach hazard were warranted. For each mapped dynamic beach hazard, the criteria listed above were deemed to have been met, and the hazard mapped appropriately. Where a dynamic beach hazard is present within each SDC, it is shown on the hazard maps provided in Appendix A.

2.4 RIVERINE FLOODING & EROSION HAZARDS

Riverine hazards were not assessed as a component of the 2020 SMP, which focused on coastal hazards only. However, a number of shoreline communities within the CLOCA watershed are affected by riverine flooding and erosion hazards from streams discharging floodwaters into Lake Ontario.

Riverine flooding studies have been completed for the various tributaries that enter Lake Ontario within the CLOCA jurisdiction. These include Corbett Creek which outlets through the barrier beach in SDC #2 (Crystal Beach), Westside Marsh and Bowmanville Marsh which both outlet within SDC #5 (Port Darlington). Riverine flood hazard mapping produced as a component of those studies was leveraged in the risk assessment portion of this study, in particular where it was shown to impact properties located on narrow barrier beach complexes.

Although regulatory riverine floodplain mapping is developed under the assumption that Lake Ontario water levels will be at long term average elevation during a severe riverine flood event, recent experiences with extreme Lake Ontario water levels created conditions where communities on barrier beaches were prone to riverine flooding even during moderate rain events. The extreme lake levels backwatered the riverine stream outlets to Lake Ontario and significantly reduced the storage volume in the coastal Marshes. In these conditions, the barrier beach communities including those in SDC #2 and SDC #5 are at greater risk to riverine flooding.

Riverine flooding studies reviewed for this study are listed as follows (from newest to oldest):

- Corbett Creek Master Drainage Plan, The Municipal Infrastructure Group Ltd. (March, 2021)
- Functional Understanding of Westside Marsh, Dillon (March, 2018)
- Westside Creek Hydrologic and Hydraulic Modeling, CLOCA (March 2013)
- Bennett Creek Floodplain Mapping Update, CLOCA (April, 2013)
- Bennett Creek Hydrologic and Hydraulic Modeling, CLOCA (2012)
- Hydrologic Modeling for Bowmanville & Soper Creeks, CLOCA (July, 2011)
- Bowmanville Creek & Soper Creek Floodplain Mapping Study, Aquafor Beech Ltd. (June, 2009)
- Report on Hydrotechnical Analysis of Modifications to Westside Creek and Marsh Associated with Future Operations of Blue Circle Cement, Marshall Macklin Monaghan (April, 1998)

Barrier beaches are also prone to erosion during a riverine flood event. Barrier beaches consist of non-native, unconsolidated sediment (sand and cobble) deposited over a long period of time through littoral drift. If subjected to the flow of extreme riverine floodwater over the barrier beach, the saturated and cohesionless soils may be prone to erosion resulting in the loss of barrier beach material. The erosion of the barrier beach would have the potential to wash away road surfaces and eliminate road access to communities. Figure 9 presents a graphical representation of the evolution of a narrow, elevated landform (barrier beach) comprised of cohesionless materials due to erosion associated with constant overtopping of floodwaters.

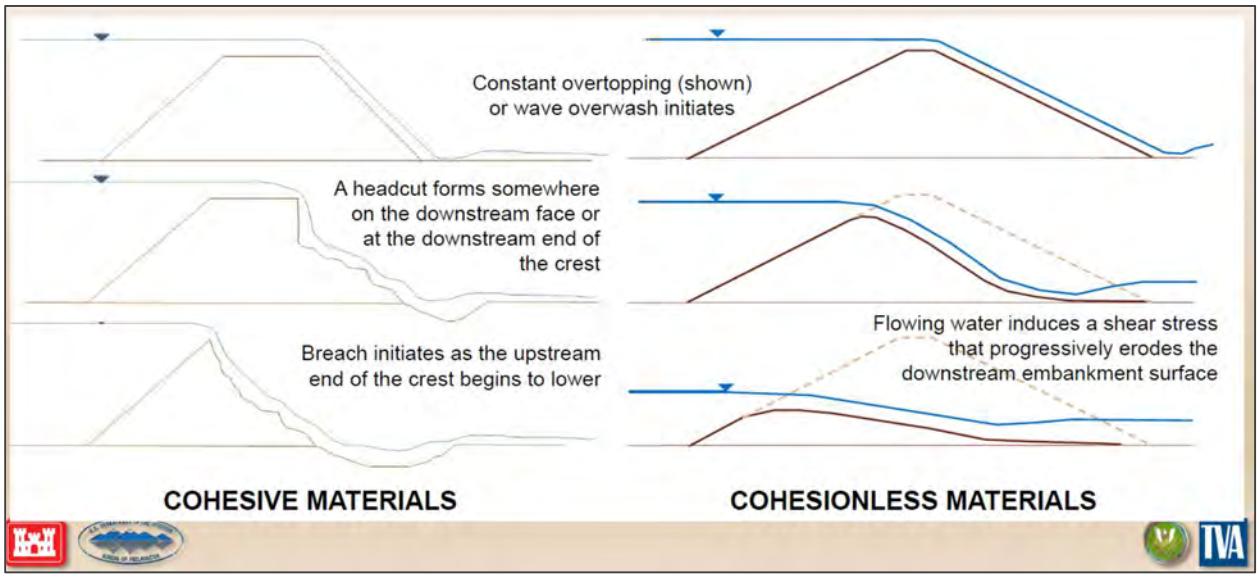


Figure 9 – Evolution of a narrow, elevated landform such as a barrier beach comprised of cohesionless materials (right) due to constant overtopping of floodwaters with erosive force (courtesy of the USACE).

3.0 RISK ASSESSMENT

A detailed risk assessment was conducted for all residential buildings affected by the shoreline hazards within each SDC. Property parcels and building footprints were provided for this assessment by the Regional Municipality of Durham through their online open data portal. Shoreline hazards were those identified and summarize in Section 2.0 of this report, and shown on the shoreline hazard maps provided in Appendix A.

3.1 RISK ASSESSMENT METHODOLOGY

A custom risk assessment template was developed for the project, loosely based on the federal National Disaster Mitigation Program's (NDMP) Hazard Identification and Risk Assessment (HIRA) and Risk Assessment Information Template (RAIT). For this type of risk assessment, risk is calculated by multiplying the likelihood or vulnerability of a building being impacted by the hazards (represented by an assigned score) by the impacts or consequences of that event actually occurring (represented by another assigned score). In general terms this approach can be summarized as follows:

(Likelihood/Vulnerability Multiplier) X *(Impacts/Consequences Score)* = *Risk*

The approach can generally be divided into two steps. First, an erosion or flooding multiplier is assigned to each residential building affected by one or more shoreline hazards, based on the building exposure to the hazard. Buildings exposed to both erosion and flooding hazards are assigned two separate multipliers (and thus receive separate erosion and flooding risk scores). Buildings affected by the dynamic beach hazard are considered to be exposed to both erosion and flood risks and were therefore scored in both categories.

Each multiplier has two scoring components which are added together to form the overall erosion or flood multiplier. The first component relates to the likelihood of the hazard event occurring or the vulnerability of the building to the hazard and is scored from 0 - 5. The second component accounts for other considerations specific to the hazard and is scored from 0 - 3. The maximum erosion or flooding multiplier a building can receive is therefore a score of 8. A summary of the criteria used to assign erosion and flood multipliers to each residential building is provided in Table 3 below, with a more detailed description provided in Appendix B.

Table 3 – Criteria used to assign erosion and flood multipliers for each primary (residential) building affected by the shoreline hazards.

	EROSION MULTIPLIERS	SCORE	BRIEF DESCRIPTION
A	Likelihood / Vulnerability - Erosion	0	Building not affected within 100-year planning horizon
		1	Building likely affected within 100-year period
		2	Building likely affected within 50-year period
		3	Building likely affected within 20-year period
		4	Building likely affected within 5-year period (portion may be within stable slope)
		5	Imminent risk to building (within stable slope)
B	Other Considerations - Erosion	0	Risk not expected to change within 100-year planning horizon
		1	Risk may change due to climate change
		2	Risk may change due to climate change and changes in geology/morphology/wave exposure
		3	Risk may be higher due to erodibility of material and/or erosion forces from both the lake and landside (i.e. dynamic barrier beaches)

	FLOOD MULTIPLIERS	SCORE	BRIEF DESCRIPTION
C	Likelihood / Vulnerability - Flooding	0	Building not affected within 100-year planning horizon
		1	Possible wet foundation during 100-year event only
		2	Flood depth < 0.5 m during 100-year event and minor flooding possible more frequently
		3	Flood depth 0.5 - 1.0 m during 100-year event and moderate flooding possible more frequently
		4	Flood depth 0.5 - 1.0 m + possible direct wave impacts during 100-year event, and major flooding possible more frequently
		5	Flood depth > 1.0 m + direct wave impacts during 100-year event, and major flooding will occur multiple times in 100-year planning horizon
D	Other Considerations - Flooding	0	Risk not expected to change within 100-year planning horizon
		1	Risk may change due to climate change
		2	Risk may change due to climate change and changes in geology/morphology/wave exposure
		3	Risk may be higher due to high exposure to riverine flooding, resulting in a higher probability of occurrence for flooding events (i.e. barrier beaches with flooding potential from sheltered side)

Erosion Multiplier = A + B

Flood Multiplier = C + D

The second component of the risk assessment is to assign impact or consequence scores across five categories based on the assumption that the associated hazard is realized. The five impact/consequence categories include (1) People & Societal Impacts, (2) Ecosystem Impacts, (3) Direct Economic Loses (based on MPAC assessed values), (4) Transportation / Emergency Access Impacts, and (5) Delivery of Energy / Utilities / IT. Table 4 below provides a summary of criteria used to assign scores within each of the impact/consequence categories, with additional details on how the scores were assigned for each hazard type provided in Appendix B.

Table 4 – Criteria used to assign impact/consequence scores across 5 categories based on the assumption that the shoreline hazard is realized.

IMPACTS / CONSEQUENCES	SCORE	BRIEF DESCRIPTION
People & Societal Impacts	1	No people & societal impacts expected
	2	Temporary displacement of occupants
	3	Permanent displacement of occupants
	4	Permanent displacement of occupants and injuries/health concerns are likely
	5	Displacement of occupants and fatalities are likely
Ecosystem Impacts	1	No ecosystem impact expected
	2	Temporary local impacts
	3	Temporary local impacts in proximity to high quality habitat (i.e. wetlands within 100 m)
	4	Temporary local impacts adjacent to high quality habitat (i.e. wetlands)
	5	Permanent local impacts
Direct Economic Losses (Buildings Only)	1	No economic loss expected
	2	Loss of 0k - 100k
	3	Loss of 100k - 500k
	4	Loss of 500k - 1M
	5	Loss of 1M +
Transportation / Emergency Access	1	No impact to transportation or emergency access expected
	3	Impacts limited to storm event
	5	Impacts extending beyond storm event
Delivery of Energy / Utilities / IT	1	No impact expected
	3	Impacts limited to storm event
	5	Impacts extending beyond storm event

The final *Erosion Risk Score* was calculated for each residential building as the sum of each impact/consequence score (5 categories) multiplied by the erosion multiplier. Similarly, the final *Flood Risk Score* was calculated as the sum of each impact consequence score (5 categories) multiplied by the flood multiplier. The final *Combined Risk Score* was then determined as the sum of the two risk scores.

3.2 Risk Assessment Results

The risk assessment methodology outlined in Section 3.1 was followed for all residential buildings within or in close proximity to the shoreline hazards, within each SDC. Risk maps were subsequently created for each SDC, illustrating the relative risk associated with each building by colour coding the individual building footprints. Three risk maps were produced for each SDC, one for the *erosion risk*, one for the *flood risk*, and a final map showing the *combined risk* which is the sum of the individual risks. *Erosion* and *flood risk* was generally deemed to be high or very high for residential buildings with individual scores of 120 and up (the dark end of the colour gradation on the risk maps in Appendix C). For the *combined risk* scoring, additional categories were added to the risk maps (shown as purple) for properties with extreme risk due to their exposure to both the erosion and flood hazards. It should be noted that even buildings with a low risk score (i.e. light yellow on the risk maps) are subjected to some level of risk due to the hazards, with impacts expected at some point during the 100-year planning horizon. The sections that follow provide a summary of the risk assessment results for each SDC, with the accompanying risk maps provided in Appendix C.

SDC#1 – Ontoro Boulevard:

The governing risk for residential buildings on Ontoro Boulevard is the *erosion risk*. Although no homes within this SDC were identified to have high risk (120 and up), a handful of residential buildings scored as having medium erosion risk (scores of 60 – 120), namely buildings at the eastern and western-most ends of the road, where setbacks from the existing shoreline are smallest.

The only homes to register a (minor) *flood risk* are those at the east end of Ontoro Blvd., and specifically those adjacent to a small creek outlet. This has a minor impact on the *combined risk* of these buildings, though the impact is small.

SDC#2 – Crystal Beach:

Properties in SDC #2 can generally be divided into three groups. The first is those properties at the west end of the road where residential buildings are close to the edge of a medium-high eroding bluff. These buildings scored medium-high to high in the erosion risk category.

The second group are those properties with residential buildings on the north side of Crystal Beach Blvd. in the transition area from the medium-high bluffs to the west and the low-lying barrier beach to the east. These homes generally have reasonable setbacks from the edge of the bluff and are not low-lying, meaning they scored relatively low in both individual and combined risk.

The third group of properties are those at the east end of Crystal Beach Blvd. which feature buildings founded on a low-lying barrier beach. These buildings scored as having both a medium erosion risk and high or very high flood risk, meaning their combined risk scores were extreme (180+).

An important aspect of the risk profile for residential buildings within SDC #2 is the presence of a municipal watermain beneath the road, which is well within the erosion hazard. This is accounted for in the risk evaluation under "delivery of energy/utilities/IT" where all residential buildings received an impact score of 5, due to the potential long-term loss of drinking water associated with a severe erosion event.

SDC#3 – Stone Street:

There are 53 individual properties on the south side of Stone Street in SDC #3, most of which sit atop a medium-high eroding bluff. Due to the elevation of the bluff there is no coastal flood risk for these properties. However, all residential buildings are subjected to some level of erosion risk, which is primarily a function of their individual setbacks from the bluff crest due to the consistent physical characterises and wave exposure along this portion of shoreline.

Most properties along Stone Street have large enough setbacks from the bluff crest that their erosion scores were low. There are two areas in which medium erosion risk scores were encountered. These include homes between the intersections with Lakefield St. and Oxford St., and those near the east end of Stone Street. Only one residential building within SDC #3 scored as high risk (refer to Risk Map in Appendix C). A portion of this building is very close to the eroding bluff and thus within the "zone of pending failure" (within the stable slope setback).

SDC#4 – Muskoka Avenue:

SDC #4 features 5 residential buildings located on the west side of a prominent headland, and a single residential building located atop the headland on Kluane Ave. This building is not subject to

a flood risk; however, its erosion risk is deemed to be high due to the combination of its high elevation (i.e. large area of potentially unstable slope) and average long-term recession rate.

The other 5 homes in this SDC are located on Muskoka Ave. in a transitional area between low-lying flood prone lands to the west and the high bluff headland to the east. As such, all five homes feature some level of both erosion and flood risk, with the homes at the west end of the grouping being more exposed to the flood hazard, while those at the east end are more exposed to the erosion hazard. The result is relatively high to extreme combined risk for all five properties.

SDC#5 – Port Darlington:

Properties within SDC #5 can be separated into three distinct groups. The first group is those properties on Cedar Crest Beach Rd. This residential development is located on a barrier beach and inlet system, that is both low-lying and features a long-term erosion trend. The road itself is below the 100-year coastal flood level and the regulatory riverine flood level, impacting the emergency accessibility of the area during severe flooding events. Virtually all residential buildings along Cedar Crest Beach Rd. have medium-high to very high erosion and flood risk scores. The combined risk score for nearly every building along this road is therefore extreme (purple).

The second group of properties are those with residential buildings located on Cove Rd., near the centre of the SDC. This area features much higher land elevations than the barrier beaches to the east and west, with the buildings being set back from the shoreline on relatively deep lots. As such, both erosion and flood risks for these homes generally scored low to medium.

The third group or properties are those at the east end of the SDC, located on West Beach Road. Similar to the first group, these properties are located on a dynamic and low-lying barrier beach that separates Bowmanville Marsh from Lake Ontario. This landform is highly flood prone from both the north (riverine) and south (coastal) and is likely comprised of highly erodible unconsolidated sediments such silts, sands, and cobbles. The existence of this landform is also predicated on the anchorage provided by the Port Darlington west jetty, which is in a state of significant disrepair. Finally, the elevation of West Beach Rd. is well below the 100-year flood level for this area (100-year water level + wave uprush) and the 100-year riverine flood level for Bowmanville Creek (Aquafor Beech Ltd., 2009), therefore posing significant ingress/egress challenges during severe flooding events. As a result of the above considerations, all residential buildings along West Beach Rd. score medium-high to very high in both erosion and flood risk, with the combined risk being extreme (purple).

SDC#6 – East Beach Road:

Properties subjected to coastal risk within SDC #6 can be divided into three distinct groups. The first group is those properties that are situated within Bowmanville Harbour on the shores of Bowmanville Marsh/Creek. This includes commercial and residential buildings at 70 and 120 Port Darlington Road. Due to their close proximity to the edge of an engineered (quay wall) shoreline, both properties are subject to some erosion risk as they would be within the stable slope should the shoreline infrastructure fail. Both properties also feature-medium high flood risk due to the low elevation of the properties compared to the 100-year riverine flood elevation for Bowmanville Creek (Aquafor Beech Ltd., 2009). The overall combined risk for these properties is therefore medium.

The second group of properties are those which feature residential buildings founded atop a medium-high to high eroding bluff fronting East Beach Rd. These include buildings at 70 – 89 East Beach Road, 188 Port Darlington Rd. and 220 Port Darlington Rd. Although these properties do not

have a flood risk due to their high elevation, the erosion risk for all properties is significant. In particular, buildings at 76, 78 and 79 East Beach Rd. and a single dwelling at 188 Port Darlington Rd. are subject to high or very high erosion risks and are all within the stable slope setback for the shoreline (i.e. the zone of pending failure).

The third group of properties are those at the south end of South Service Rd. at the east end of the SDC. Residential buildings on these properties are both low-lying and close to the eroding shoreline, meaning they are subjected to both erosion and flood risk. Of these properties, only the building at 2728 is subjected to high risk (flooding) given its extremely low land elevation. As such, its combined risk was determined to be extreme.

SDC#7 – Wilmot Creek:

Wilmot Creek is a retirement community located on the shores of Lake Ontario at the border between CLOCA and GRCA's watersheds. The portion of the development within CLOCA's jurisdiction features 70 residential buildings affected by the erosion hazard. Due to the consistent physical characteristics and wave exposure of this shoreline, the relative erosion risk for these buildings is primarily a function of their individual setbacks from the bluff crest, and the height of the bluff which impacts the width of the stable slope setback (i.e. the zone of pending failure). The majority of buildings in this SDC scored relatively low, however a number of homes on Birch Tree Ln. between the intersections with Heatherlea Dr. and Wilmot Trail featured medium to medium-high erosion risk scores due to the land elevation and their proximity to the bluff crest. None of the buildings within this SDC are subjected to flood risk due to the elevation of the table lands. As such, their combined risk is synonymous with their erosion risk.

4.0 RISK MITIGATION

Risk mitigation strategies were developed and evaluated for each SDC based on the results of the hazard mapping and risk assessment. Strategies for risk mitigation were developed and evaluated under four broad categories as follows:

AVOID (relevant for all risk levels):

The objective of *avoid* strategies are to reduce future exposure of people and property to shoreline hazards and coastal risk by ensuring that new developments do not occur on hazardous lands. This category generally refers to planning and policy decisions, including:

- Planning and regulatory restrictions to prevent new development and limit re-development and additions to existing buildings within the hazards,
- Planning and zoning amendments to incorporate natural shoreline buffers and public open spaces.

ACCOMMODATE (low – high risk):

Under the *accommodate* category, adaptive strategies are developed that permit continued occupation of hazardous lands while implementing changes to human activities or infrastructure to reduce the overall risk. This category may include the following:

- Floodproofing homes through the installation of flood gates, opening shields, backflow valves, sump pumps, etc.
- Raising a building foundation to provide greater flood protection,
- Raising road elevations to provide better access during flood events,
- Upgrades to stormwater management systems, water supply and sanitary systems,
- Relocate high-value assets to areas of highest elevation or furthest from the shoreline hazards within homes or property,
- Emergency preparedness and planning.

PROTECT (low – high risk):

The *protect* category is for strategies aimed at protecting people, property, and infrastructure from exposure to the risk, either through traditional engineering or nature-based solutions. This category may include:

- Conventional, shore-parallel shoreline protection structures including revetments, seawalls, breakwaters, etc.,
- Shore-perpendicular beach retention / shoreline stabilization structures such as groynes and artificial headlands,
- Beach nourishment,
- Dune restoration,
- Mechanical or hydraulic sediment bypassing (bypassing sediment around an obstruction such as a jetty).

RETREAT/RE-ALIGN (high - extreme risk):

Retreat/Re-align is a category that encompasses strategic decisions to change land use and relocate public and private assets exposed to significant risk. *Retreat/Re-align* strategies are typically considered only when strategies under the other three categories are either not sufficient to

mitigate the risk or can not be reasonably implemented due to constructability, permitting constraints, negative environmental impacts or most commonly, cost. Strategies in this category include:

- Relocate buildings a short distance away from the hazards where the depth/width of the lot is sufficient,
- Relocate buildings offsite to another existing or newly formed property parcel,
- Remove buildings, typically through a voluntary property disposition program (at fair market value) by the municipality on a willing seller/willing buyer basis.

4.1 Risk Mitigation Evaluation Criteria

Risk mitigation strategies listed above under the four broad categories of *avoid, accommodate, protect,* and *retreat/re-align* were evaluated for each SDC. All residential buildings within SDC #1, 3, 4 and 7 were evaluated together (i.e., one set of recommendations for each SDC), while buildings within SDC #2 and SDC #6 were split into three sub-groups based on their geographic location and governing risk (as discussed in Section 4.2 below).

Similar to the evaluation of risk presented in Section 3.0, risk mitigation strategies were evaluated using a scoring matrix. A summary of the scoring matrix is provided as Figure 10 below, with higher scores indicating better overall strategies. First, flooding and erosion multipliers were established by adding the scores describing a given strategy's ability to mitigate the risk and its adaptability to future extremes. The flooding and erosion multipliers are subsequently multiplied by scores across eight (8) evaluation categories to determine the final flood and erosion risk mitigation scores, as shown in Figure 10. For SDCs exposed to both flooding and erosion risks, the two scores were averaged to create a combined risk mitigation score for each evaluated strategy.

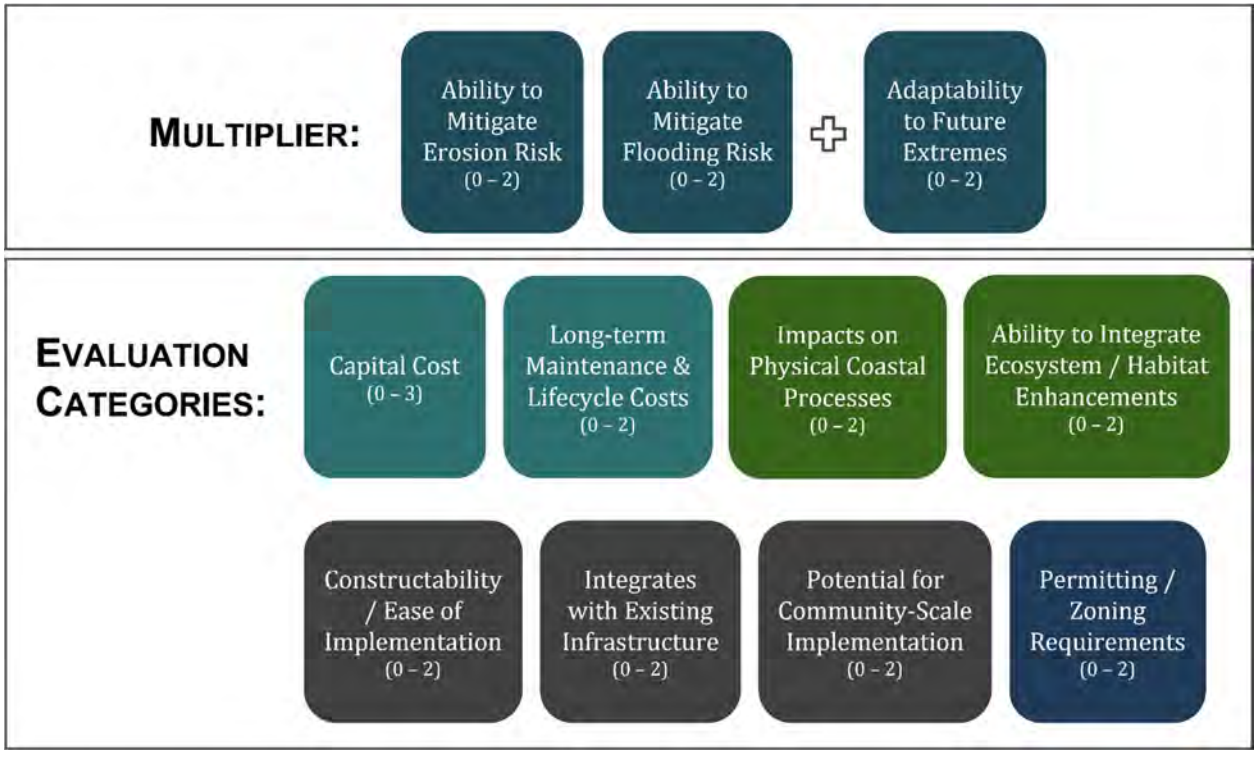


Figure 10 - Components of the risk mitigation strategy evaluation matrix.

A brief description of how each component of the risk mitigation evaluation matrix is scored is presented in Table 5 below.

Table 5 – Scoring categories and criteria for risk mitigation strategy evaluation matrix.

Multiplier / Evaluation Category	Score	Evaluation Criteria
Ability to Mitigate Erosion Risk	0	Cannot mitigate risk
	1	Can reduce risk
	2	Can mitigate risk
Ability to Mitigate Flood Risk	0	Cannot mitigate risk
	1	Can reduce risk
	2	Can mitigate risk
Adaptability to Future Extremes (i.e. climate change)	0	Low adaptability (cannot be adapted to function under future extremes)
	1	Medium adaptability (can be adapted to provide some risk mitigation under future extremes)
	2	High adaptability (can be adapted to mitigate risk under future extremes)
Capital Cost (per lot)	0	> $500,000
	1	$200,000 - $500,000
	2	$50,000 - $ $200,000
	3	$0 - $50,000
Long-Term Maintenance Requirements / Lifecycle Costs	0	Frequent maintenance requirements and cost (<10 years)
	1	Infrequent maintenance requirements and costs (>10 years)
	2	No maintenance requirements/cost
Constructability / Ease of Implementation	0	Access limitations and/or specialized construction equipment or skills required
	1	Typical medium-scale civil construction project
	2	Minor construction project / no-construction required
Integrates with Existing Shoreline Protection	0	Removal of existing shoreline infrastructure required
	1	Existing shoreline infrastructure can be reused in part
	2	Builds upon and integrates with exiting infrastructure
Applicable to Community-Scale Implementation	0	Cannot be readily scaled
	1	Scales to other properties but with considerable challenges
	2	Easily scaleable to adjacent properties or community at large
Impact on physical processes	0	May have significant negative impact on physical coastal processes
	1	May have minor negative impact on physical coastal processes
	2	Not expected to impact physical processes
Ability to Integrate Ecosystem / Habitat Enhancements	0	Negative impacts to ecosystem/habitat likely
	1	No net impacts to ecosystems/habitat expected
	2	Net positive impacts (improvements) to ecosystems / habitat possible
Regulatory / Zoning Requirements	0	Extensive regulatory / zoning requirements or considerations
	1	Regulatory / zoning investigations necessary
	2	Minor or no regulatory / zoning requirements expected

4.2 RISK MITIGATION RECOMMENDATIONS

The sections that follow provide recommended risk mitigation strategies for each SDC (and sub-group for SDC #2 and #6), based on the results of the risk mitigation strategy evaluation.

Following the evaluation process described in Section 4.1, *protect* and *retreat/re-align* strategies will generally score higher than *accommodate* strategies due to their superior ability to mitigate risk. Moreover, the scoring for *avoid* strategies is not relevant in comparison to the other three categories, as *avoid* speaks to measures that can be taken to mitigate risk exposure for future developments, while the other three categories are aimed at reducing risk for existing development. As such, recommendations are provided for each category, based on the relative scores of the various strategies within those categories. Where appropriate, *protect* and *retreat/re-align*

strategies are recommended as "Primary Risk Mitigation Strategies". *Accommodate* and *avoid* are grouped as "Other Risk Mitigation Considerations". For SDC's subject to *high* or *extreme risk* (refer to Section 3.0), recommendations are provided under all four risk mitigation categories (*avoid, accommodate, protect, retreat/re-align*). For all other SDCs, only the first three categories are considered (*avoid, accommodate, protect*).

Recommendations provided as a component of the 2020 Lake Ontario Shoreline Management Plan are also provided in the sections that follow, for reference.

SDC#1 – Ontoro Boulevard:

Ontoro Boulevard (and Halls Road) features 15 residential buildings subjected to risk associated with the shoreline hazards, ranging from *low risk* to *medium risk*. Recommended risk mitigation strategies are provided as follows:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	Conventional, engineered shoreline protection structures, preferably implemented consistently at a community-scale. Shoreline protection structures should be shore-parallel and placed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize their impact on coastal processes including littoral drift. Structures should be either conventional rubble-mound revetments, or composite revetment-seawall structures. Shoreline protection should be designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance of existing and new shoreline protection structures should be carried out [Score = 36]
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant erosion event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16]

AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06, and amendments to Ajax zoning by-law 95-200 (Ontoro Blvd.) and Whitby by-law 1784 (Halls Rd.)

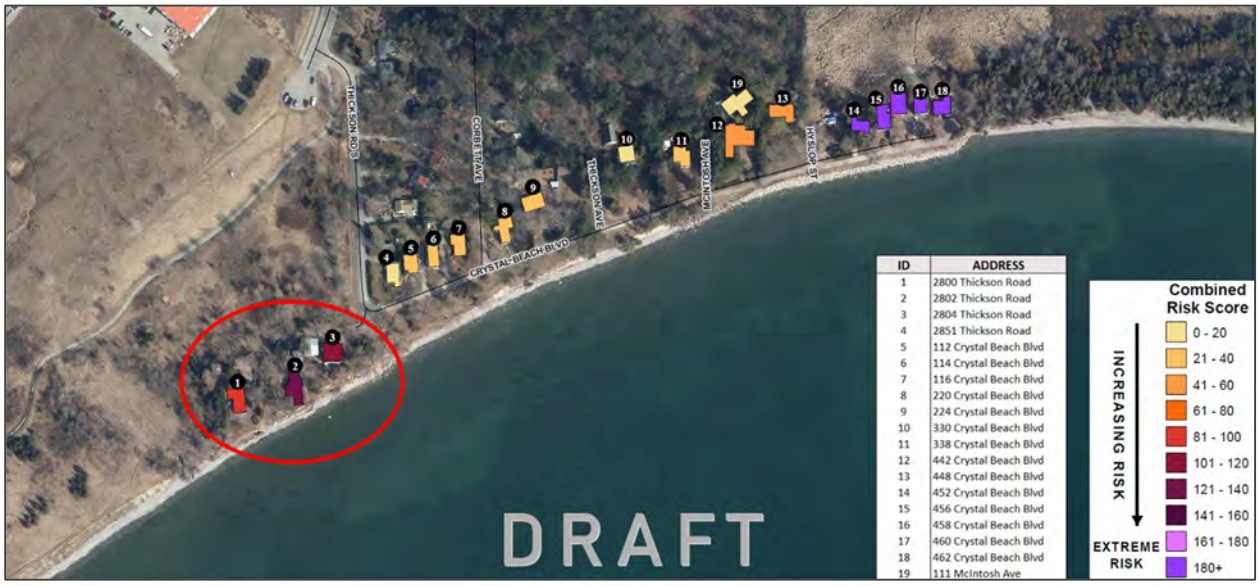
The following additional considerations are provided for SDC #1:

- Maintain natural eroding bluffs to the west and east which supplies beach building material to the shoreline and barrier beaches downdrift (i.e. Cranberry Marsh barrier beach and Lynde Creek barrier beach).
- Environmental Protection (EP) zoning east and west of Ontoro Boulevard should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazards (i.e. Ontoro Boulevard should not be extended).
- The risk is not high enough to justify a "retreat/re-align" strategy at this time. However, erosion impacts at medium risk properties including 58, 56, 52, 14 and 2 Ontoro Blvd. should be monitored regularly.
- Ajax and Whitby do not presently have shoreline emergency plans. It is recommended that shoreline emergency plans be developed, with shared resources and coordination across the Region of Durham.

The above recommendations are complimentary to those provided in the 2020 Shoreline Management Plan (Reach 1 – Lakeside Neighbourhood Park to Whitby Harbour), including:

- Monitor and maintain existing shoreline protection for damage and flanking,
- Shoreline protection structures should be engineered, and
- Additional shoreline hardening may have an impact on local beaches.

SDC#2 – Crystal Beach (West Section):



The west end of SDC#2 features three properties with *medium* to *high risk* associated with the erosion hazard. Recommended risk mitigation strategies for these properties are provided as follows:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN	Relocation of buildings further back on their lots (where possible), relocation offsite (new lot) or a voluntary property disposition program should be considered for all three properties at the west end of Crystal Beach due to their proximity to the bluff crest and the high risk associated with the erosion hazard [Score = 52].
PROTECT	If a retreat/re-align strategy is not possible or not supported by land-owners, conventional, engineered shoreline protection structures should be implement, preferably in a consistent manner across all three properties. Shoreline protection structures should be shore-parallel and placed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize their impact on coastal processes including littoral drift. Structures should be either conventional rubble-mound revetments, or composite revetment-seawall structures. Shoreline protection should be designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance of new shoreline protection structures should be carried out [Score = 36].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant erosion event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16]
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Whitby zoning by-law 1784

The following additional comments are provided for SDC #2 (West Section):

- Beach retention structures (groynes) ranks 5th in the evaluation but would have significant adverse impacts on barrier beach and wetlands to the east and are therefore not recommended.
- Beach nourishment ranks 6th in the evaluation and may help preserve the integrity of the barrier beach to the east but will not remain stable along the Crystal Beach Blvd. shoreline due to its wave exposure and orientation.
- Maintain natural eroding bluffs to the west which supplies beach building material to the shoreline and downdrift barrier beach.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands (including to the east and west of Crystal Beach Blvd.).
- Whitby does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- There are high risk houses at the western end of Crystal Beach Blvd.
- Develop long-term retreat/re-align strategy for high-risk buildings on eroding shorelines.
- Maintain natural eroding bluffs where possible.

SDC#2 – Crystal Beach (Central Section):

Properties in the central portion of SDC #2 located on the north side of Crystal Beach Blvd. were assessed to have *low* to *medium risk* associated with the shoreline hazards. Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	Existing shoreline protection should be improved and extended west to protect the entirety of Crystal Beach Blvd. Shoreline protection should be a conventional, shore-parallel rubble-mound revetment and should be placed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize its impact on littoral drift. Shoreline protection should be designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance of new and existing shoreline protection structures should be carried out [Score = 40].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that properties are impacted by erosion within the 100-year planning horizon due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16].
AVOID	Planning/re-zoning should be considered to maintain vegetated, public open space on the south side of Crystal Beach Blvd. where possible. Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Whitby zoning by-law 1784

The following additional comments are provided for the properties in the central portion of SDC #2:

- As a component of the Protect strategy, the impacts of armouring the remainder of the bluff fronting Crystal Beach Blvd. on the supply of sediment from natural bluff erosion processes should be investigated and quantified as a component of the site-specific design and permitting process. Eroding bluffs fronting Crystal Beach Blvd. provide beach building material that is transported east to the Corbett Creek barrier beach. As such, depending on

the percentage of sands/cobbles in the bluff and its percentage of the overall sediment budget for the shoreline, measurable negative impacts to the barrier beach may occur if the remainder of the Crystal Beach Blvd. shoreline is armoured.

- Beach retention structures (groynes) ranks 5th in the evaluation but would have significant adverse impacts on the Corbett Creek barrier beach and wetlands to the east and are therefore not recommended.
- Beach nourishment ranks 6th in the evaluation and may help preserve the integrity of the barrier beach to the east but will not remain stable along the Crystal Beach Blvd. shoreline due to its wave exposure and orientation.
- Maintain natural eroding bluffs to the west which supplies beach building material to the shoreline and downdrift barrier beach.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands (including to the east and west of Crystal Beach Blvd.).
- The risk is not high enough to justify a retreat/re-align strategy at this time.
- Whitby does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- Maintain natural eroding bluffs where possible.

SDC#2 – Crystal Beach (East Section):

The five properties at the east end of SDC #2 were determined to have *extreme risk* associated with both the shoreline flooding and erosion hazards (refer to Section 3.0). Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN	A voluntary property disposition program (willing buyer/willing seller) or building relocation (offsite) is recommended for properties at the east end of Crystal Beach Blvd. in order to mitigate the extreme risk associated with both the flooding and erosion hazards. The lands should be restored to natural barrier beach [Score = 52].
PROTECT	If a retreat/re-align strategy is not implemented, significant shoreline protection upgrades could mitigate some of the risk. The erosion risk can likely be reduced through significant engineered upgrades to the existing revetment fronting Crystal Beach Blvd., including extending the structure to the north immediately adjacent to 462 Crystal Beach Blvd. The flood risk, however, cannot reasonably be mitigated due the low elevations of the lands and the threat of flooding from both the lake and marsh sides. Even if flood protection was implemented on both sides (higher revetment with flood protection on lake side and flood berm or levee on marsh side), static flooding would still occur due to flood waters infiltrating the groundwater on this narrow barrier beach landform which is largely comprised of porous sediments (sands, cobbles) [Score = 23].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	A number of accommodate strategies can be implemented to marginally reduce the combined flooding and erosion risk. These include raising the elevation of Crystal Beach Blvd. [Score = 20], emergency preparedness and planning by local landowners and local government [Score = 16], floodproofing of homes through the installation of flood gates or opening shields, backflow valves, sump pumps, etc. [Score = 13] and raising the first floor elevation of homes by raising their foundations [Score = 8].
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Whitby zoning by-law 1784

The following additional comments are provided for the properties at the east end of SDC #2:

- The access standard (MNR, 2001) is not met for properties at the east end of Crystal Beach Blvd., as the east end of Crystal Beach Blvd. is below the 100-year flood level and subjected to erosion risks. This provides further support to the recommendation of a retreat/re-align strategy.
- Construction costs associated with erosion protection and flood proofing would be substantial (likely hundreds of thousands across all five properties). Landowners should consider whether the considerable cost to mitigate some, but not all of the risk through shoreline protection, has merit in relation to the value of the land.
- Beach retention structures (groynes) ranks 6th in the evaluation but would have significant adverse impacts on barrier beach and wetlands to the east and are therefore not recommended.
- Maintain natural eroding bluffs to the west which supplies beach building material to the shoreline and downdrift barrier beach. The stability of the barrier beach has a direct impact on the risk exposure for homes at the east end of Crystal Beach Blvd.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands (including to the east and west of Crystal Beach Blvd.).

- Whitby does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- There are high risk houses at the eastern end of Crystal Beach Blvd.
- Develop long-term retreat/re-align strategy for high-risk buildings on eroding shorelines.
- Maintain natural eroding bluffs where possible.

SDC#3 – Stone Street:

ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	813 Stone Street	19	721 Stone Street	37	503 Stone Street
2	807 Stone Street	20	717 Stone Street	38	499 Stone Street
3	801 Stone Street	21	709 Stone Street	39	493 Stone Street
4	795 Stone Street	22	705 Stone Street	40	489 Stone Street
5	791 Stone Street	23	701 Stone Street	41	485 Stone Street
6	787 Stone Street	24	695 Stone Street	42	481 Stone Street
7	781 Stone Street	25	689 Stone Street	43	473 Stone Street
8	775 Stone Street	26	683 Stone Street	44	477 Stone Street
9	771 Stone Street	27	677 Stone Street	45	469 Stone Street
10	765 Stone Street	28	673 Stone Street	46	465 Stone Street
11	761 Stone Street	29	671 Stone Street	47	457 Stone Street
12	755 Stone Street	30	663 Stone Street	48	449 Stone Street
13	751 Stone Street	31	657 Stone Street	49	441 Stone Street
14	745 Stone Street	32	651 Stone Street	50	437 Stone Street
15	741 Stone Street	33	515 Stone Street	51	433 Stone Street
16	737 Stone Street	34	511 Stone Street	52	429 Stone Street
17	731 Stone Street	35	507 Stone Street	53	425 Stone Street*
18	727 Stone Street	36	505 Stone Street		*no primary building

There are 52 residential buildings along the south side of Stone Street with exposure to the shoreline hazards. In general, these properties were assessed as having low to medium risk, with the exception of a single property where the risk was evaluated as *high* (refer to Section 3.0 and risk map above). Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	Conventional, engineered shoreline protection structures, preferably implemented consistently at a community scale. Shoreline protection structures should be shore-parallel and placed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize their impact on coastal processes including littoral drift. Structures should be conventional rubble-mound revetments, designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance of new shoreline protection structures should be carried out [Score = 36].
RETREAT/RE-ALIGN **(High Risk Property Only)**	If engineered shoreline protection is not implemented in front of the property evaluated as having *high risk*, a voluntary property disposition program is recommended due to the high erosion risk associated with the buildings proximity to the bluff crest. The residential building is located within the "zone of pending failure" (i.e., stable slope allowance) [Score 52].

OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant erosion event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16].
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to City of Oshawa By-law 60-94.

The following additional comments are provided for SDC #3:

- Shoreline protection schemes implemented along Stone Street should include future flanking protection (e.g., a buried boulder trench along property line) where adjacent shorelines are expected to remain unprotected (refer to Section 4.3)
- If shoreline protection is not implemented in the medium-term (< 20 years), a voluntary property disposition program could be expanded to include all *medium risk* properties on the south side of Stone Street between Lakefield St. and Oxford St.
- Risks are not high enough to recommend a retreat/re-align strategy for all other properties along Stone Street not specifically referred to above.
- Beach retention structures (groynes) ranks 5th in the evaluation but would have significant adverse impacts on the Pumphouse Marsh barrier beach and wetlands to the east and are therefore not recommended.
- Maintain natural eroding bluffs to the west which supplies beach building material to the shoreline and downdrift barrier beach at Pumphouse Marsh.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands (including to the east and west of Stone Street).
- Oshawa does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- Stone Street Residential Area – develop a long-term, community scale armouring solution or a retreat/re-align plan that re-locates homes and naturalizes the shoreline, particularly for high risk buildings on the eroding bluff shoreline.
- Existing shoreline protection fronting Stone Street is predominantly ad-hoc or under-designed (as of 2019). Structures should be monitored, and improvements should be considered.
- Flanking of protected portions of shoreline is prevalent along Stone Street where neighbouring properties are unprotected and erosion is ongoing.
- Shoreline hardening should be limited to the high density developed area. Maintain natural eroding bluffs elsewhere.
- Consider upgrades to Stone Street Park shoreline to enhance access to the waters edge.

SDC#4 – Muskoka Avenue:

There are 7 residential buildings in SDC #4 with exposure to the hazards, including 6 along Muskoka Ave. and 1 sitting atop a high bluff headland (Bonnie Brae Point). Residential buildings within this SDC were generally evaluated as having *high* to *extreme risk* associated with the shoreline hazards (refer to Section 3.0). Recommended risk mitigation strategies for properties within SDC #4 include:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN	A long-term voluntary property disposition program (willing buyer/willing seller) or building relocation offsite (new lot) is recommended for all 7 properties within SDC #4 due to the severity of the risks associated with the natural hazards [Score = 52]
PROTECT	If property re-acquisition is not supported or not possible, conventional engineered shoreline protection capable of mitigating the erosion risk and reducing the flooding risk is recommended for the 6 properties on Muskoka Ave. Shoreline protection should be engineered by a qualified coastal engineer based on site-specific design conditions, should preferably be consistent across all 6 properties, and should consist of either a conventional revetment or composite revetment-seawall structure [Score 23]. The overall protection scheme could include a small beach retention structure (stone groyne) immediately east of 61 Muskoka Ave. to anchor a beach in front of all 6 properties. The potential impacts of this structure on the downdrift headland shoreline would have to be investigated by a qualified professional [Score = 14]
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant erosion or flooding event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16]. Buildings subjected to high flood risk specifically (51 – 57 Muskoka Ave.) could be raised [Score = 9] or floodproofed including the installation of flood gates, opening shields, backflow valves, sump pumps, etc. [Score 7]

AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to City of Oshawa By-law 60-94. Planning/zoning should consider maintaining the lands atop the high bluff headland as vegetated, public open space.

The following additional comments are provided for SDC #4:

- Armouring the headland shoreline fronting 1575 Kluane Ave. (Bonnie Brae Point) is not recommended. Erosion of the headland is a critical natural process that generates beach-building material which is transported to the otherwise sediment-starved beaches to the east (Lakeview Park).
- A geotechnical study is recommended to determine the actual stable slope for 1575 Kluane Ave. The risk has been assessed using the provincial standard stable slope of 3:1 (horizontal:vertical), placing the residential building within the "zone of pending failure" (stable slope setback), but the hard glacial till bluff may actually be stable at a steeper slope resulting in a smaller "zone of pending failure".
- Oshawa does not presently have a shoreline emergency plan. It is recommended that a shoreline emergency plan be developed, with shared resources and coordination across the Region of Durham.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 2 – Whitby Harbour to Oshawa Harbour) for this area, including:

- Develop a long-term retreat/re-align strategy for high-risk buildings on eroding shorelines
- Shoreline hardening should be limited to high density development areas. Maintain natural eroding bluffs where possible.
- Lakewoods Park Lookout (Bonnie Brae Point) and Lakeview Park: monitor trails and fencing to ensure park user safety is addressed.

SDC#5 – Port Darlington:

ID	ADDRESS	ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	43 Cedar Crest Beach Rd	22	107 Cedar Crest Beach Rd	43	155 Cove Road*	64	56 West Beach Road
2	49 Cedar Crest Beach Rd*	23	109 Cedar Crest Beach Rd	44	147 Cove Road*	65	55 West Beach Road
3	55 Cedar Crest Beach Rd	24	111 Cedar Crest Beach Rd	45	145 Cove Road	66	54 West Beach Road
4	59 Cedar Crest Beach Rd	25	115 Cedar Crest Beach Rd	46	133 Cove Road	67	52 West Beach Road
5	63 Cedar Crest Beach Rd	26	119 Cedar Crest Beach Rd	47	131 Cove Road	68	51 West Beach Road
6	67 Cedar Crest Beach Rd	27	121 Cedar Crest Beach Rd	48	129 Cove Road	69	50 West Beach Road
7	69 Cedar Crest Beach Rd	28	123 Cedar Crest Beach Rd	49	127 Cove Road	70	49 West Beach Road
8	71 Cedar Crest Beach Rd	29	125 Cedar Crest Beach Rd	50	125 Cove Road	71	48 West Beach Road
9	75 Cedar Crest Beach Rd	30	127 Cedar Crest Beach Rd	51	123 Cove Road	72	47 West Beach Road*
10	79 Cedar Crest Beach Rd*	31	131 Cedar Crest Beach Rd	52	121 Cove Road	73	46 West Beach Road
11	81 Cedar Crest Beach Rd	32	133 Cedar Crest Beach Rd	53	120 Cove Road	74	45 West Beach Road
12	83 Cedar Crest Beach Rd	33	135 Cedar Crest Beach Rd	54	119 Cove Road	75	44 West Beach Road
13	87 Cedar Crest Beach Rd*	34	137 Cedar Crest Beach Rd	55	115 Cove Road	76	43 West Beach Road*
14	91 Cedar Crest Beach Rd	35	139 Cedar Crest Beach Rd	56	113 Cove Road	77	42 West Beach Road*
15	93 Cedar Crest Beach Rd	36	141 Cedar Crest Beach Rd	57	111 Cove Road	78	20 West Beach Road*
16	95 Cedar Crest Beach Rd	37	143 Cedar Crest Beach Rd	58	109 Cove Road	79	28 West Beach Road
17	97 Cedar Crest Beach Rd	38	145 Cedar Crest Beach Rd	59	107 Cove Road	80	17 West Beach Road
18	99 Cedar Crest Beach Rd	39	149 Cedar Crest Beach Rd	60	105 Cove Road	81	16 West Beach Road
19	101 Cedar Crest Beach Rd	40	151 Cedar Crest Beach Rd	61	103 West Beach Road	82	32 West Beach Road
20	103 Cedar Crest Beach Rd	41	155 Cedar Crest Beach Rd*	62	67 West Beach Road*	83	8 West Beach Road
21	105 Cedar Crest Beach Rd	42	157 Cove Road*	63	60 West Beach Road	84	6 West Beach Road

*no primary building

Port Darlington (SDC #5) has been the subject of several technical studies in recent years to evaluate the shoreline hazards and associated risk, and to recommend risk mitigation strategies. As such, this SDC is treated differently than the others in this section, with no new recommendations provided. Instead, the reader is directed to existing technical reports prepared by independent consultants in recent years with expertise in the field of coastal engineering. The following technical reports can be found on the CLOCA website:

- Port Darlington Shore Protection Concepts (W.F. Baird & Associates, 2018)
- Proposed Port Darlington (West Shore) Shoreline Management Report (Aqua Solutions 5 Inc., 2018)
- Lake Ontario Shoreline Management Plan (Zuzek Inc., 2020a)
- Cedar Crest Beach Shoreline Change Assessment (Zuzek Inc., 2020b)

SDC#6 – East Beach Road (West Section):

The west section of SDC #6 includes properties situated on the shores of Bowmanville Marsh/Creek. This includes commercial and residential buildings on Port Darlington Rd. Residential buildings at both properties were generally evaluated as having *medium risk* associated with the shoreline hazards (refer to Section 3.0). Recommended risk mitigation strategies for properties within SDC #6 – West Section include:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	A structural assessment of harbour quay walls fronting commercial and residential buildings on Port Darlington Rd. is recommended including an evaluation of their flood mitigation potential at water levels due to 100-year Lake Ontario and Bowmanville Creek flooding events. The assessment should be undertaken by a qualified coastal or structural engineer. If required, upgrades to shoreline infrastructure and regular maintenance of quay walls fronting both properties should be undertaken to improve the provided protection against flooding [Score 20]

OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in the event that a significant flooding event occurs due to the combination of high lake levels and storm waves on Lake Ontario or flooding of Bowmanville Creek [Score = 16]. High value assets within both properties should be relocated to areas of highest elevation within buildings or on properties where possible [Score = 7]. Floodproofing options should be considered including the installation of flood gates, opening shields, backflow valves, sump pumps, etc. [Score 6] and upgrades to stormwater management and landside drainage systems should be evaluated to assist in removing floodwaters from the properties and surrounding areas [Score = 4]
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Municipality of Clarington By-law 84-63.

The following additional comments are provided for SDC #6 – West Section:

- The flood-risk associated with both Lake Ontario and Bowmanville Creek should be reassessed at regular intervals based on the availability of new riverine flood modelling tools and additional historical water level, rainfall and flow rate data.

SDC#6 – East Beach Road (Central Section):

The central portion of SDC #6 includes properties along East Beach Road and two properties further to the east on Port Darlington Rd. Residential buildings within this group of properties were generally evaluated as having *medium* to *high risk* associated with the erosion hazard (refer to Section 3.0). Recommended risk mitigation strategies for properties within SDC #6 – Central Section are provided as follows:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN	A long-term voluntary property disposition program (willing buyer/willing seller) or building relocation offsite (new lot) is recommended for homes immediately east of East Beach Park, prioritized based on their relative risk scores [Score = 52]
PROTECT	If property re-acquisition is not supported or not possible, conventional engineered shoreline protection capable of mitigating the erosion risk is recommended for all properties. Shoreline protection should be engineered by a qualified coastal engineer based on site-specific design conditions, should preferably be consistent across adjacent properties, and should consist of either a conventional revetment or composite revetment-seawall structure such as that which was constructed in recent years to the west in front of East Beach Park [Score 32]. In addition to shoreline armouring, mechanical or hydraulic sediment bypassing of beach material from west beach (supported by an appropriate technical study) or the sand accumulated in the navigation channel to east beach is recommended. This sediment pathway is presently interrupted by the Port Darlington jetties resulting in long-term growth of the west filet beach and accelerated erosion of the East Beach shoreline. Sediment bypassing (or another form of beach nourishment) may reduce the long-term erosion rate for the East Beach community [Score = 26]
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in preparation for a significant and rapid erosion event [Score = 16]. A geotechnical slope stability assessment should be completed for the homes currently located in the zone of pending failure (stable slope setback).
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Municipality of Clarington By-law 84-63.

The following additional comments are provided for SDC #6 – Central Section:

- Beach retention structures (groynes) ranks 7th in the evaluation but would have significant adverse impacts on the downdrift shorelines to the east, including acceleration of erosion rates for bluff shorelines that have been recently developed with significant residential subdivisions. Beach retention structures are therefore not recommended.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within hazardous lands.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 5 – Port Darlington to Port of Newcastle) for this area, including:

- Implement a sediment bypassing program from the Port Darlington west filet beach to nourish Port Darlington East Beach shoreline.
- A long-term, community scale solution is required for the East Beach community to reduce erosion and flood hazards, such as protection or retreat/re-align. For example, a voluntary land acquisition program for lands subject to acute hazards could be implemented to return the shore lands to public open space.

- Maintain naturally eroding bluff environments where possible to preserve natural sediment supplies.

SDC#6 – East Beach Road (East Section):

The eastern end of SDC #6 includes properties at the south end of South Service Rd. This group features three residential buildings, two of which were evaluated to have *medium risk*. The third building (furthest west) was evaluated as having *extreme risk* associated with both the erosion and flooding hazard (refer to Section 3.0 and risk map presented above). Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
RETREAT/RE-ALIGN **(Extreme Risk Building Only)**	A long-term voluntary property disposition program (willing buyer/willing seller), building relocation further landward within the property, or building relocation offsite (new lot) is recommended for the residential building receiving an *extreme risk* score due to the combined risk posed by the erosion and flooding hazards [Score = 52]
PROTECT	Conventional, engineered shoreline protection capable of mitigating the erosion and flooding risk is recommended for all properties (including *extreme risk* property if *retreat/re-align* is not supported or not possible). Shoreline protection should be engineered by a qualified coastal engineer based on site-specific design conditions, should preferably be consistent across adjacent properties, and should consist of either a conventional revetment or composite revetment-seawall [Score 23]. In addition to shoreline armouring, mechanical or hydraulic sediment bypassing of beach material from west beach or the navigation channel to East Beach is recommended. This sediment pathway is presently interrupted by the Port Darlington jetties resulting in long-term growth of the west filet beach and accelerated erosion east of the jetties. Sediment bypassing (or another form of beach nourishment) may reduce the long-term erosion rate for the shoreline fronting South Service Rd. [Score = 12]

OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual landowners and local levels of government in preparation for a significant erosion or flooding event [Score = 16]. Floodproofing options should be considered for *extreme risk* building, including raising building foundation [Score = 9], and the installation of flood gates, opening shields, backflow valves, sump pumps, etc. [Score 7]. High value assets within properties should be located in areas of highest elevation within buildings or on properties where possible [Score = 7]
AVOID	Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Municipality of Clarington By-law 84-63.

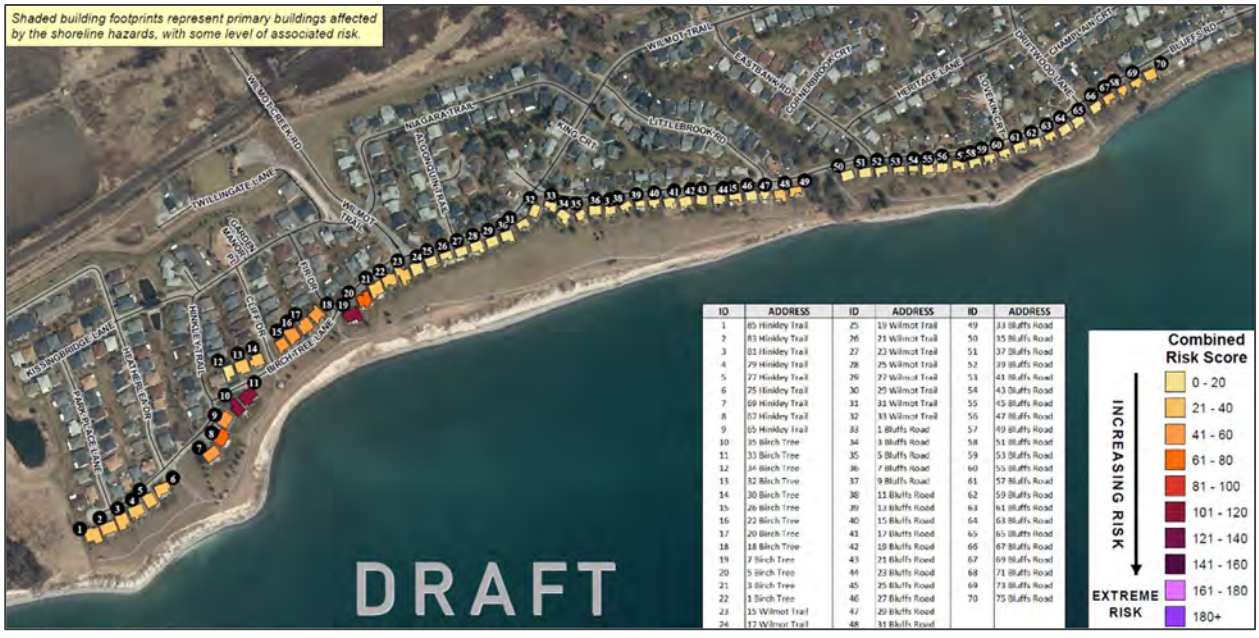
The following additional comments are provided for SDC #6 – East Section:

- Beach retention structures (groynes) ranks 5th in the evaluation but would have significant adverse impacts on the downdrift shorelines to the east, including acceleration of erosion rates for bluff shorelines that have been recently developed with significant residential subdivisions. Beach retention structures are therefore not recommended.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within the hazardous lands.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 5 – Port Darlington to Port of Newcastle) for this area, including:

- Implement a sediment bypassing program from the Port Darlington west filet beach to nourish Port Darlington East Beach shoreline.
- Maintain naturally eroding bluff environments where possible to preserve natural sediment supplies.

SDC#7 – Wilmot Creek:



There are 70 residential buildings within the CLOCA portion of the Wilmot Creek Retirement Community with exposure to the shoreline hazards. In general, these properties were assessed as having *low* to *medium risk* (refer to Section 3.0). Recommended risk mitigation strategies for these properties include:

PRIMARY RISK MITIGATION STRATEGIES:	
PROTECT	Existing "interim" shoreline protection should be redesigned and reconstructed to provide adequate, properly engineered erosion protection, starting with areas where *medium risk* buildings have been identified. Structures should be conventional rubble-mound revetments, constructed at the toe of the existing bluff (i.e. minimal lakeward projection) to minimize their impact on coastal processes. Erosion protection should be designed by a qualified coastal engineer based on site-specific design conditions. Regular monitoring and maintenance should be carried out [Score = 40].
OTHER RISK MITIGATION CONSIDERATIONS:	
ACCOMMODATE	Emergency preparedness and planning should be considered by individual residents, CAPREIT (owner of Wilmot Creek community) and local levels of government in the event that a significant erosion event occurs due to the combination of high lake levels and storm waves on Lake Ontario [Score = 16].
AVOID	Planning/re-zoning should be considered to maintain vegetated, public open space on the south side of Hinkley Trail, Birch Tree Lane, Wilmot Trail, and Bluffs Road, where possible. Development or re-development within the hazardous lands should generally be avoided in accordance with Ontario Regulation 42/06 and amendments to Clarington Zoning By-law 84-63.

The following additional comments are provided for SDC #7:

- Risks are not high enough to recommend a retreat/re-align strategy at this time, but erosion of the shoreline fronting homes on Birch Tree Lane in particular should be monitored.
- Beach retention structures (groynes) ranks 5th in the evaluation but would result in a period of accelerated erosion rates along the shoreline to the east which fronts a significant and recently constructed subdivision (Newcastle).
- Beach nourishment ranks 6th in the evaluation but is not recommended as sediment is not likely to remain stable along this portion of shoreline due to its orientation.
- Maintain natural eroding bluffs to the west, the east and in areas within the SDC where the assessed risk is negligeable or low, in order to preserve sediment supplies to downdrift shorelines.
- Municipal zoning should be amended to incorporate updated hazard limits and prohibit development or redevelopment within the hazardous lands.

The above recommendations and notes are complimentary to the summary comments provided in the 2020 Shoreline Management Plan (Reach 5 – Port Darlington to Port of Newcastle) for this area, including:

- Monitor shoreline protection and upgrade structures as required to provide the necessary protection.

4.3 CONCEPTS & ESTIMATES OF PROBABLE COST

Guidance for shoreline protection structures is provided in this section for the CLOCA shoreline. The guidance is generally based on regional coastal conditions commensurate with a 100-year planning horizon and covering the typical shoreline types encountered within the 7 SDCs. However, the design of shoreline protection is site-specific, as local shoreline conditions and wave exposure can vary significantly over short distances. Information provided herein including opinions of probable cost should be taken as a general guide only. Site specific advice and engineering should always be sought from a professional engineer specializing in coastal engineering before implementing shore protection works.

In general, sloping shore protection structures such as revetments are preferred over vertical structures due to their superior ability to dissipate wave energy. Vertical structures tend to reflect more wave energy causing increased lakebed erosion directly in front of the structure. This can lead to failures if the structure toe is not designed properly or founded deep enough. Several failures of pre-cast concrete block seawalls occurred between 2017 – 2019 in the study area for this reason, as pictured in the adjacent image.

Moreover, properly designed sloping structures tend to have gradual failure mechanisms such as displacement of structure elements (typically stones) or settlement over relatively long periods of time. By contrast, verrtical structures tend to fail abruptly and catastrophically during a major storm event. Sloping structures can be monitored and maintained more readily throughout their design life relative to their vertical counterparts.

In general, structures comprised of items such as pre-cast concrete blocks, gabion baskets, timber and scrap concrete should be avoided on Great Lakes shorelines. These forms of shoreline protection are inadequate to resist the siginfincant loads and erosive forces on Lake Ontario over the long term, and are generally poor for the aquatic and shorelands environment.

Shore protection structures should generally be shore-parallel and placed against the existing bank or bluff (i.e. minimal lakeward projection) in order to mitigate potential impacts to longshore sediment transport and other coastal processes. Shore protection structures should be constructed from natural stone materials where possible. Natural stone materials such as quarried limestone and field stone are preferred over alternative construction materials such as concrete due to their density, durability and the fact that they are better for the aquatic environment and more closely replicate natural shoreline conditions and habitat.

All SDCs for which shoreline protection is presented in Section 4.2 as a viable and recommended option can be described as medium to high bluff or low-bank shorelines. **The recommended approach to shoreline protection for these types of shorelines is a conventional stone revetment**. Stone revetments are generally comprised of an outer 'primary' stone course, and underlying courses of smaller 'filter' stone. The 'primary' stone layer can be comprised of a single layer of tightly packed, blocky armour stone (quarried stone), or multiple layers of randomly placed irregular armour (quarry stone) or field stone (natural boulders). Single-layer armour stone structures require a smaller volume of material, however the cost of blocky armour stone is

typically much higher per tonne than irregular armour stone or field stone. Ultimately the selection between the two types of revetments is typically based on the availability of materials and cost, as both structure types can be designed to effectively resist wave loading and mitigate erosion for Lake Ontario shorelines. Figure 11 presents examples of single-layer blocky armouor stone revetments, while Figure 12 presents examples of randomly placed armour or field stone revetments.

Figure 11 – Examples of single-layer, blocky armour stone revetments on Lake Ontario

Figure 12 – Examples of conventional rubble-mound revetments with multiple layers of randomly placed field stone (left) and irregular armour stone (right).

Concept-level cross sections for a single-layer armour stone revetment and multi-layer, irregular armour or field stone revetment are provided in Figure 13 and Figure 14, respectively (below). These cross-sections are typical for a medium to high-bank or bluff shoreline, where the necessary height of the revetment to limit wave overtopping to acceptable (no damage) levels is below the elevation of the top of bank or bluff. This is indicative of the shorelines encountered in the western half of SDC #1 (Ontoro Blvd.) and SDC #2 (Crystal Beach), all of SDC #3 (Stone Street), SDC #6 (East Beach) and SDC #7 (Wilmott Creek).

Figure 15 and Figure 16 below present similar cross-sections for single-layer armour stone and multi-layer irregular armour or field stone revetments fronting low-bank shorelines where the structure must be higher than the elevation of the table lands to mitigate wave overtopping to acceptable levels. Such a scenario might be encountered at the east end of SDC #1 (Ontoro Blvd.)

and SDC #2 (Crystal Beach), SDC #4 (Muskoka Ave.), SDC #5 (Port Darlington), and the east end of SDC #6 (properties on South Service Rd.).

For extremely low-elevation shorelines or where superior flood protection is necessary such as the east end of SDC #2 (Crystal Beach) or SDC #5 (Port Darlington), a composite revetment-seawall may be necessary. In these structures a near vertical, vertical or re-curved (return) wall is placed at the crest of the revetment to further mitigate wave overtopping. The vertical wall component of the structure can be comprised of stacked armour stone (refer to Figure 17), or for superior flood protection can be comprised of pre-cast concrete units (refer to Figure 18).

Finally, for shorelines with existing vertical structures or shorelines where significant space limitations exist and the structural footprint must be minimized, an armour stone or field stone berm can be placed in front of a vertical wall to improve its stability, longevity, and ability to mitigate wave overtopping. Several examples of this concept already exist within SDC #1 (Ontoro Blvd.), where existing precast block walls have been rehabilitated with the addition of stone berms (refer to inset image).

For protected properties where the adjacent lot(s) are expected to remain unprotected, flanking protection is recommended. Flanking occurs at the adjacent shoreline continues to erode, eventually progressing landward beyond the extent of protection at the property boundary between protected and unprotected properties. This can result in failure of the structure at its terminations, and ongoing and rapid recession of the shoreline in lee. Flanking protection can be provided by burying the ends of the shore protection structure some distance into the bluff or bank face at either end of the structure. Where space allows, a simple form of flanking protection can be to burry a trench of stones just below ground level parallel to the property boundary some distance inshore. As the neighbouring property continues to erode these stones will become exposed and naturally fall to the base of the bluff or bank along the property line providing some level of flanking protection. Finally, flanking of shoreline structures should always be monitored where an adjacent shoreline remains unprotected and continues to erode.

Construction costs for engineered revetments such as those discussed above and for the wave exposure encountered along the CLOCA shoreline generally range from $3,200 to $4,200 CAD per linear meter. To determine the approximate construction cost for an individual property, this number should be multiplied by the length of shoreline to be armoured. The estimated range of probable construction costs presented above is based on recent experience and quotations from a wide range of contractors across Ontario, with prices indexed to 2021. Prices may vary outside of this range depending on the specific design, material availability, location, contractor availability, construction timing, and site access, among other things. The above prices do not include contingencies, design fees or other professional costs associated with the implementation of shore protection. A minimum contingency of 20% should be added to these costs when considering the affordability of implementing shoreline protection.

The above section is presented as broad guidance for shoreline protection structures only and does not negate the requirement for site-specific engineering to be carried out by a qualified professional engineer. Moreover, all shoreline protection works will require work permits from the CLOCA, with additional permits or approvals likely required from the Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) and the Department of Fisheries and Oceans (DFO) should any portion of the structure be situated lakeward of the high water line.

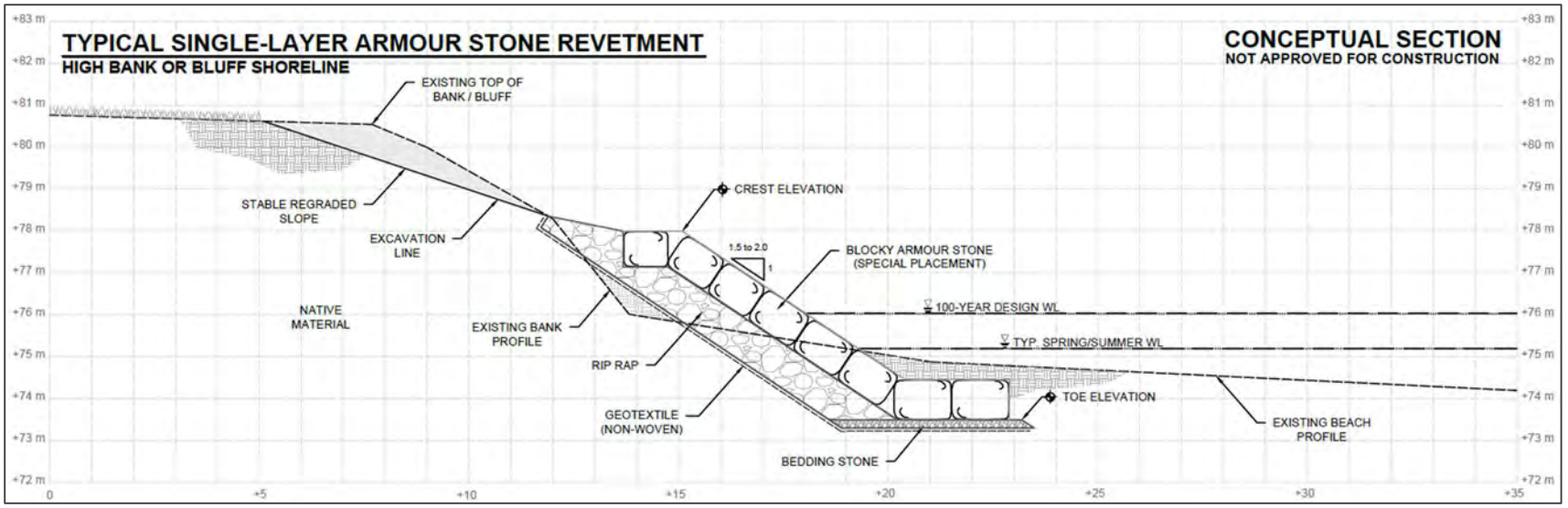


Figure 13 – Typical single-layer armour stone revetement concept for medium to high bluff/bank shoreline

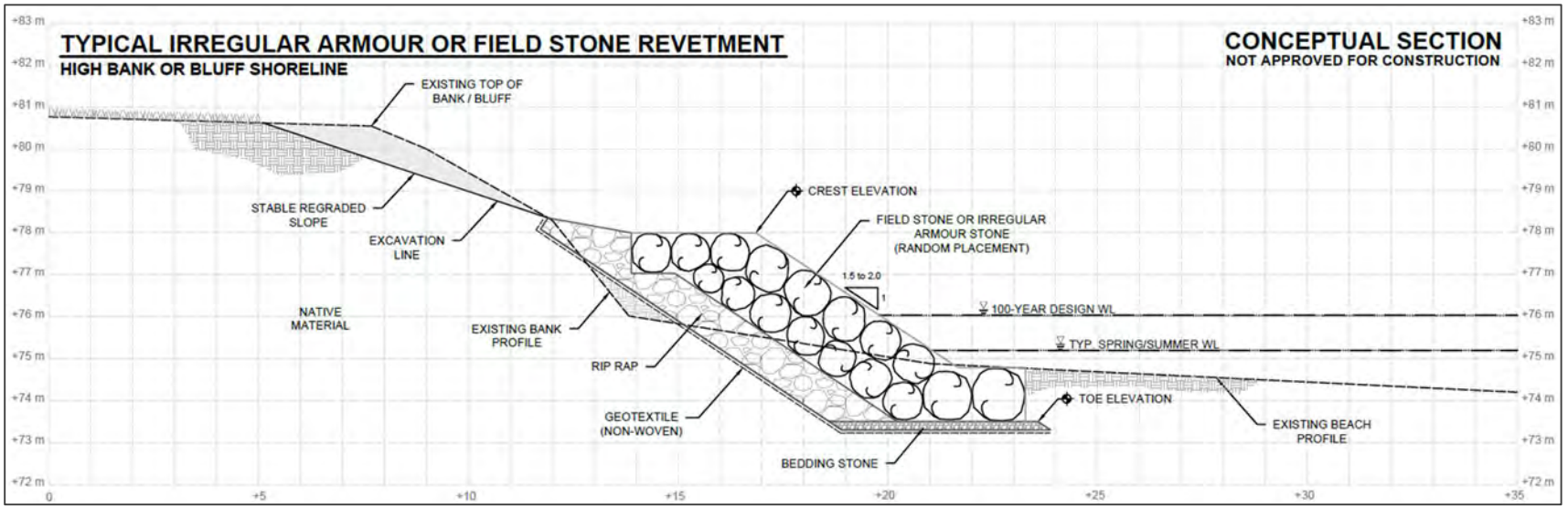


Figure 14 – Typical multi-layer, irregular armour stone or field stone revetment concept for medium to high bluff/bank shoreline

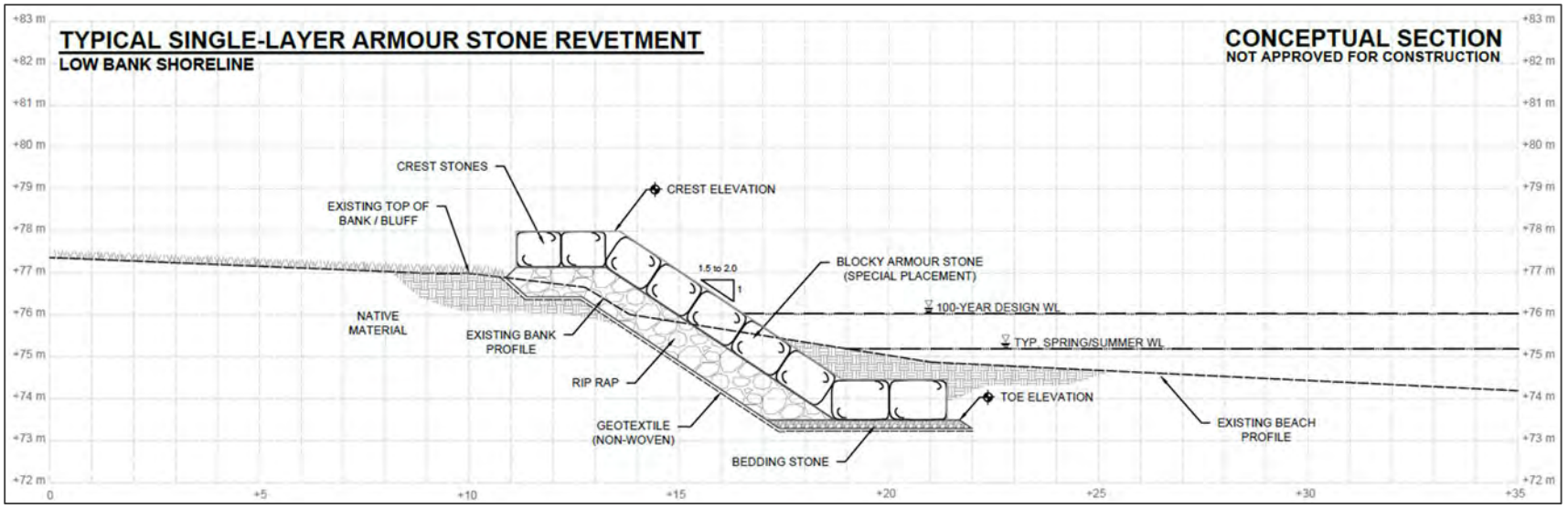


Figure 15 – Typical single-layer armour stone revetement concept for low bank shoreline

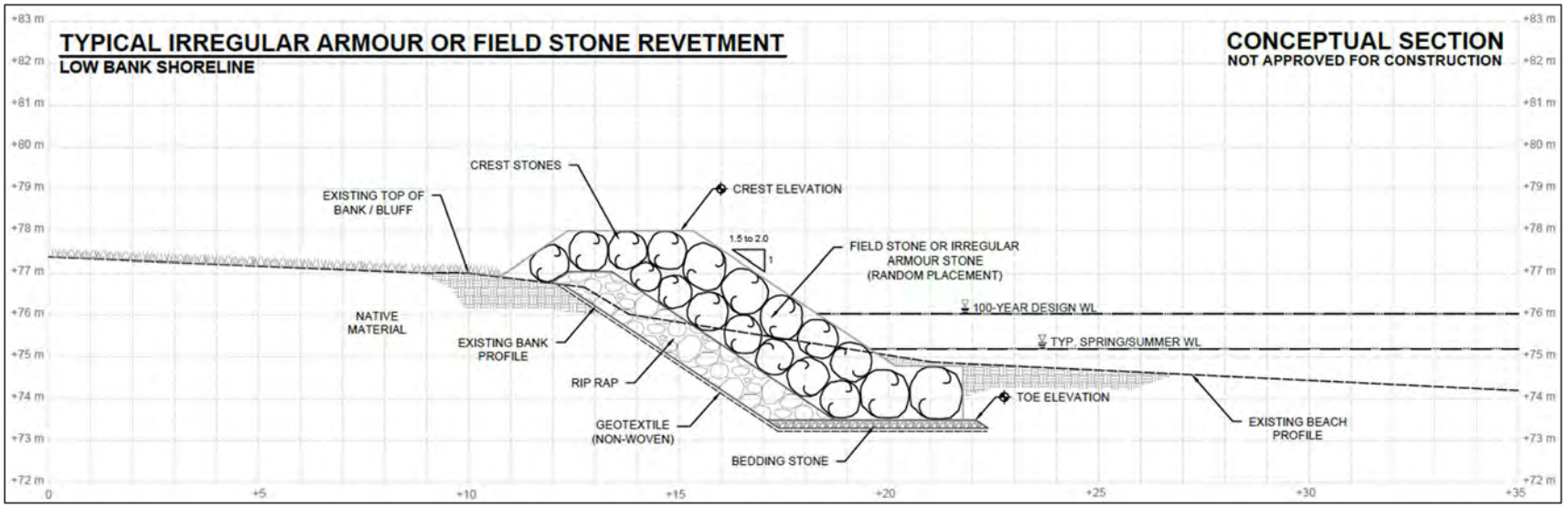


Figure 16 – Typical multi-layer, irregular armour stone or field stone revetment concept for low bank shoreline

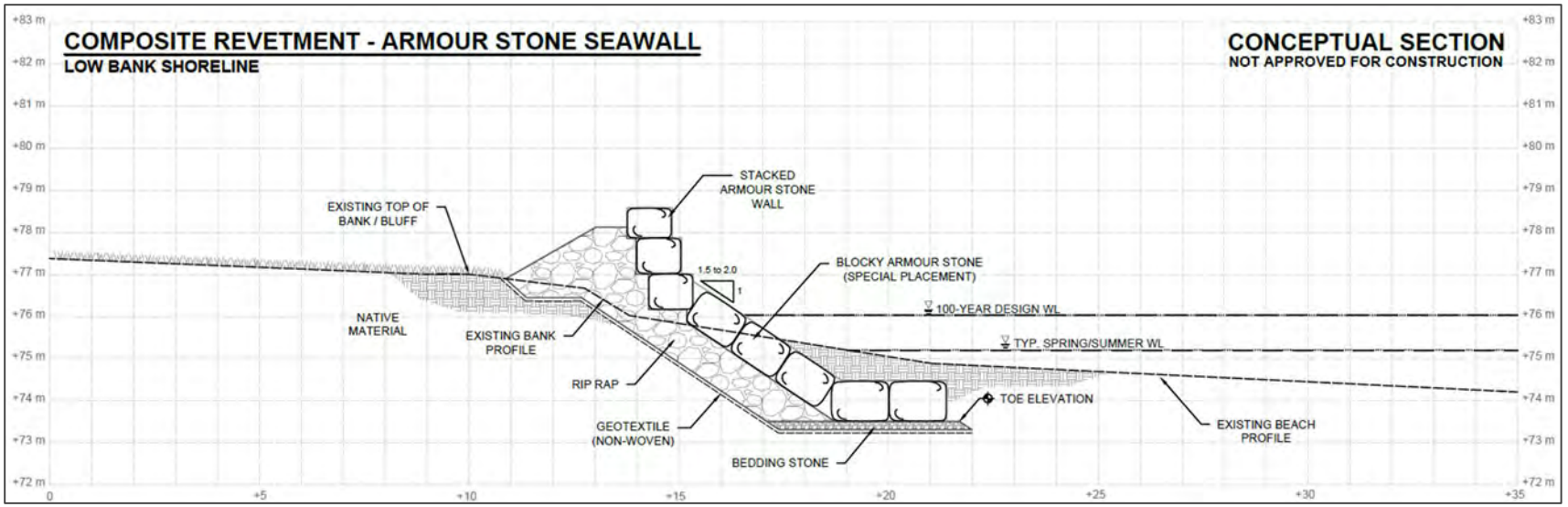


Figure 17 – Typical composite revetment – armour stone seawall concept for flood prone, low bank shoreline

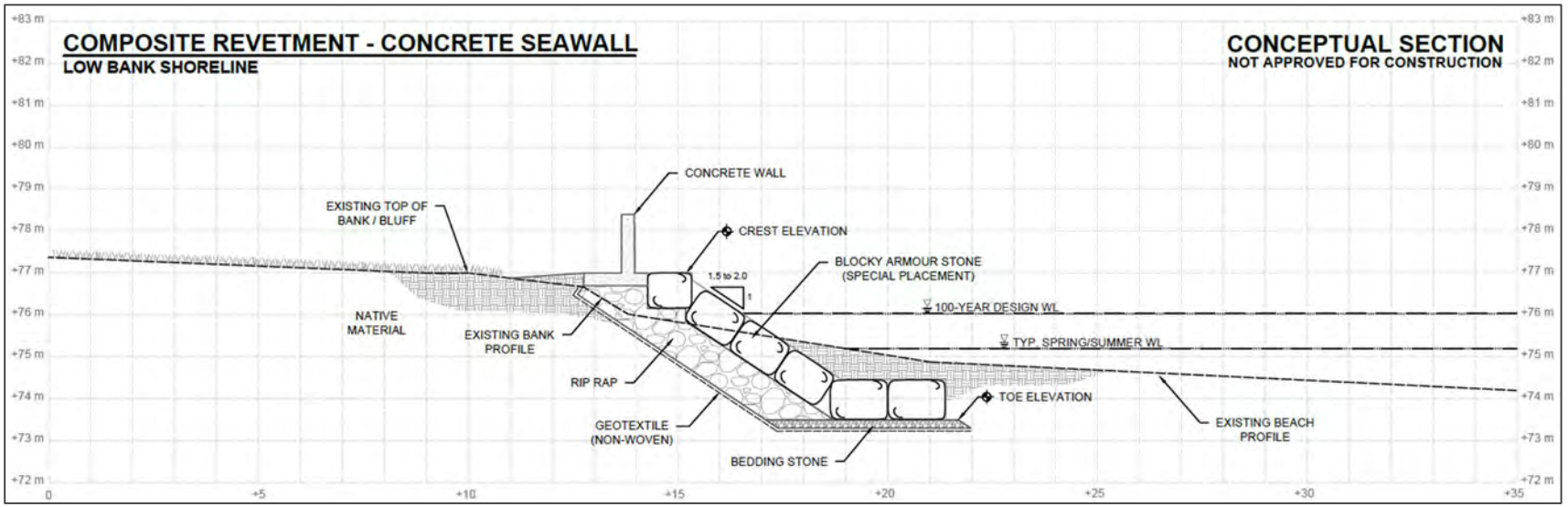


Figure 18 – Typical composite revetment – concrete seawall concept for flood prone, low bank shoreline

4.4 MONITORING & MAINTENANCE

To maximize the effective lifespan of new and existing shoreline protection structures, regular monitoring of the structure should be carried out by the owner, with less frequent monitoring (every 5 – 10 years or after a major storm event) carried out by a qualified coastal engineer. Regular monitoring should include photographs and visual observations documenting any apparent movement or displacement of stones, settlement, or loss of material. A coastal engineer should be contacted if any of these processes are observed by the owner. Less frequent, detailed monitoring to be carried out by an engineer may include surveying of the structure to look for changes in slope, toe or crest elevation, and underwater inspections where appropriate. Community-scale monitoring should be completed for community-scale shoreline protection projects, where possible.

In the event that it is required, structure maintenance should be completed in a timeline fashion by a qualified contractor. Appropriate maintenance measures should be determined by a coastal engineer. It is recommended that long-term monitoring and maintenance plans be a requirement of regulatory approvals for new shoreline protection structures.

4.5 MUNICIPAL ZONING RECOMMENDATIONS

The overall intent of the natural hazard policies provided through the Provincial Policy Statement, 2020 (PPS) under the Planning Act and the Conservation Authorities Act hazard regulation (specifically Ontario Regulation 42/06) is to direct development away from hazardous lands. Municipalities are responsible for preparing municipal policy documents and approval of applications submitted under the Planning Act, ensuring consistency with the natural hazard policies of the PPS. Additionally, municipalities are delegated the responsibility of identifying areas subject to natural hazards and to develop management plans (e.g., flood contingency plans) to limit exposure to public health and safety risks. This includes identifying flooding, erosion and dynamic beach hazards in municipal plans and incorporating policies to address new development consistent with the PPS. It is up to the municipality to determine how best to achieve this requirement, though updated municipal zoning that matches the delineation of the hazards is an essential step to ensuring the requirements of both the Planning Act and Conservation Authorities Act are met. It is therefore recommended that the revised shoreline hazards within each SDC, as delineated on hazard maps included in Appendix A, be incorporated into the relevant Zoning By-Laws, both in terms of specific zoning regulations and associated mapping. Zoning By-Laws of relevance are listed as follows, with recommended amendments to each summarized in the sections that follow, grouped by SDC.

- Town of Ajax By-Law 95-2003 (SDC #1)
- Town of Whitby By-Law 1784 (SDC #1and #2)
- City of Oshawa By-Law 60-94 (SDC #3 and #4)
- Municipality of Clarington Zoning By-Law 84-63 (SDC #5, #6 and #7)

SDC#1 – Ontoro Boulevard:

Zoning for Ontoro Blvd. is shown in Town of Ajax By-Law 95-2003, map 64. The majority of the developed properties along Ontoro Blvd. are shown as “CR” (Country Residential), with the creek floodplain and a narrow shoreline buffer both listed as “EP” (Environmental Protection). The landward extent of the shoreline “EP” buffer terminates lakeward of the governing shoreline hazard

(erosion). It is recommended that the "EP" zone be expanded to match the erosion hazard setback thereby including the entire width of hazardous lands. Refer to Figure 19 below.

Figure 19 – Shoreline hazards and municipal zoning affecting Ontoro Blvd. (SDC #1)

Lands to the west of Ontoro Blvd. are presently zoned as "EP" in By-Law 95-2003 (Town of Ajax). It is recommended that this zoning be maintained. By-Law 1784 (Town of Whitby) covers the area east of Ontoro Blvd. to Halls Road, where the shorelands are zoned as "G-4" (Greenbelt Zone, Exception 4). This zoning should also be maintained as it is restrictive and will not permit future shoreline developments within the natural hazards.

The property at 715 Halls Road and the entire barrier beach complex fronting Cranberry Marsh and Lynde Creek are zoned in By-Law 1784 as "A" (Agricultural). Although this zoning classification is restrictive, it does provide the opportunity for limited residential development. As such, it is recommended that areas within the delineated shoreline hazards (and including both barrier beaches to the east) be re-zoned as "G-4" (Greenbelt Zone, Exception 4). This would prohibit residential development within the hazards and be consistent with the shorelands zoning on the west side of Halls Road. Shoreline hazards and municipal zoning affecting the south end of Halls Road are shown in Figure 20 below.

Figure 20 – Shoreline hazards and municipal zoning affecting south end of Halls Road (SDC #1)

SDC#2 – Crystal Beach:

All residential properties within SDC #2 are presently zoned as "A" (Agricultural) as per Whitby By-Law 1784. No shoreline buffer is provided in the current zoning. Undeveloped lands to the west of the community are zoned as "OS" (Open Space). It is recommended that a shoreline buffer be introduced extending to the landward most shoreline hazard and zoned as either "EP" (Environmental Protection) or as a continuation of "OS", which should be designed to prohibit development. This shoreline buffer should extend east to include the entire barrier beach complex. Shoreline hazards and existing municipal zoning affecting SDC #2 are illustrated in Figure 21.

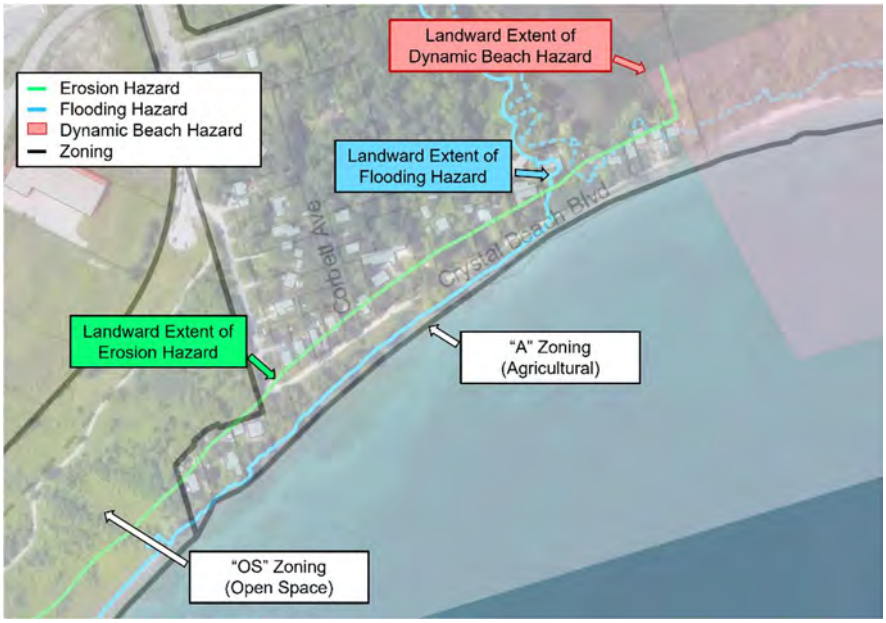


Figure 21 – Shoreline hazards and municipal zoning affecting Crystal Beach Blvd. (SDC #2)

SDC#3 – Stone Street:

The majority of the residential properties in the Stone Street community are zoned as "R2" (Residential-2), as per City of Oshawa By-Law 60-94. A narrow (~10 m wide) buffer along the shoreline is zoned as "OSW" (Waterfront Open Space), which is a development prohibitive zoning category. It is recommended that the "OSW" zone be widened such that the landward extent of the zone aligns with the erosion hazard setback, the governing shoreline hazard for this SDC. Shoreline hazards and municipal zoning affecting SDC #3 are illustrated in Figure 22 below.

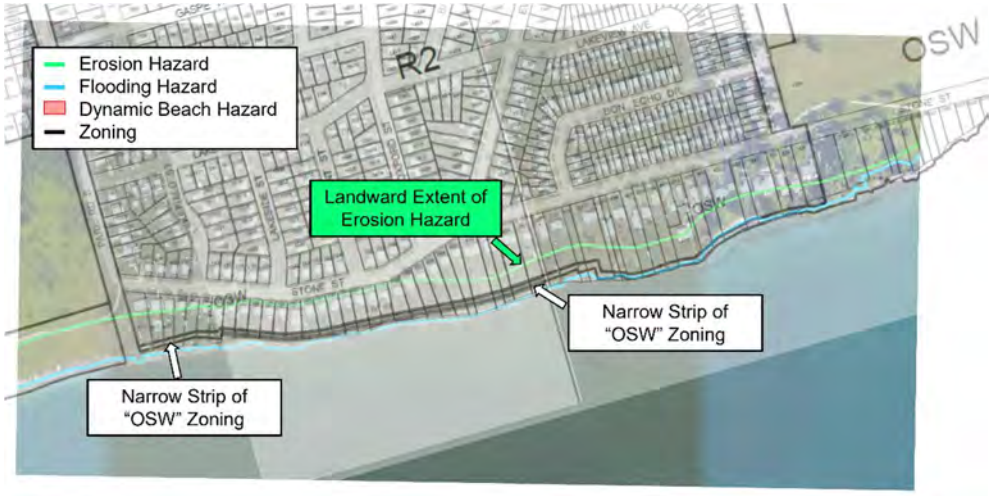


Figure 22 - Shoreline hazards and municipal zoning affecting Stone Street (SDC #3)

SDC#4 – Muskoka Avenue:

All properties affected by the shoreline hazards within SDC #4 are zones as "OSW" (Waterfront Open Space) as per City of Oshawa By-Law 60-94. This zoning category is generally residential development prohibitive. As such, the homes in this area are likely legacy developments predating the municipal zoning. There is presently no zoning buffer along the shoreline to account for shoreline hazards. It is recommended that a buffer be added to the official zoning covering the full extent of the hazardous lands (generally governed by the erosion hazard except at the west end of the SDC where it is governed by the flooding hazard). This buffer should be zoned "OSH" (Hazard Lands Open Space), as defined within By-Law 60-94. Shoreline hazards and municipal zoning affecting SDC #4 are provided in Figure 23 below.

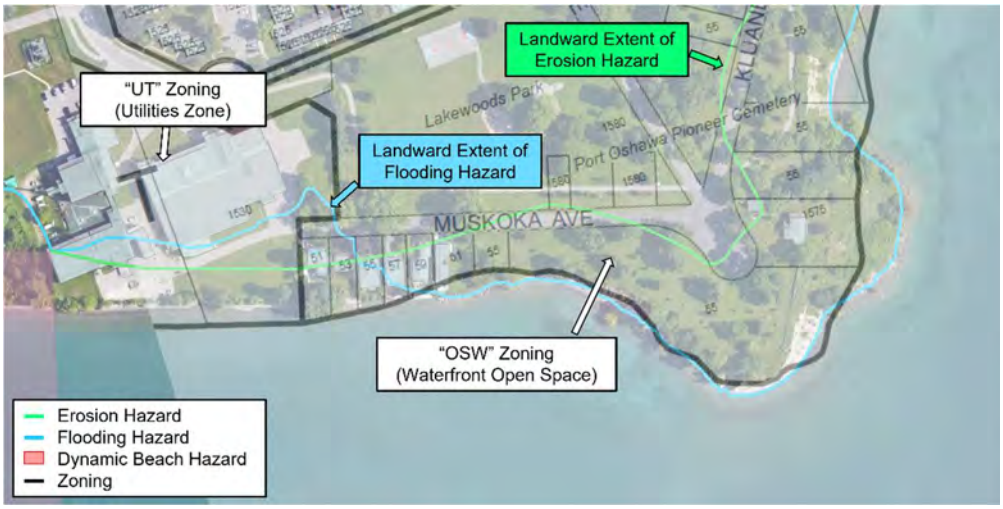


Figure 23 - Shoreline hazards and municipal zoning affecting Muskoka Ave. (SDC #4)

SDC#5 – Port Darlington:

Properties affected by the shoreline hazards along Cedar Crest Beach Rd. and Cove Rd. are zoned as "RS" (Residential Shoreline). Properties on West Beach are zoned as "RS-1" (Residential Shoreline Exception), which is more restrictive, with only seasonal dwellings or single detached dwellings constructed prior to the passing of the By-Law permitted. All three zones are presently surrounded by "EP" (Environmental Protection), including a buffer of variable width along the Lake Ontario shoreline. It is recommended that the "EP" zone be expanded to include the entirety of the dynamic beach hazard for these three areas. This would place the Cedar Crest Beach Rd. and West Beach Rd. communities within the "EP" zone (as the entire barrier beach complex is a dynamic beach), and waterfront properties along Cove Rd. up to the landward extent of the hazard. Shoreline hazards and municipal zoning affecting SDC #5 are shown in Figure 24 below.

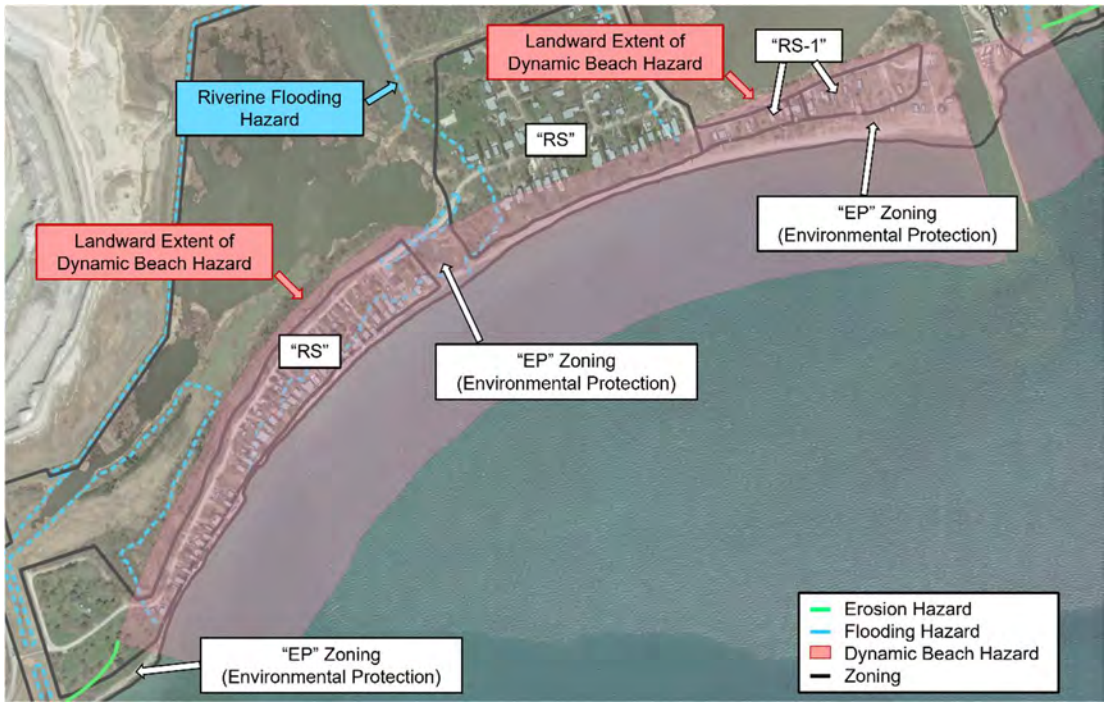


Figure 24 - Shoreline hazards and municipal zoning affecting Port Darlington (SDC #5)

SDC#6 – East Beach Road:

The property at 70 Port Darlington Rd. and the north half of 120 Port Darlington Rd. are presently zoned as "C5-2" (Special Purpose Commercial Exception). The south half of 120 Port Darlington Rd. is zoned as "RS-3" (Residential Shoreline Exception). The entirety of Bowmanville Marsh to the west is zoned as "EP" (Environmental Protection). It is recommended that the "EP" zone boundary be amended to match the landward limit of the riverine flood hazard, identified by the blue dashed line in Figure 25 below.

Two blocks of properties on East Beach are zoned as "RS-2" (Residential Shoreline Exception). A shoreline buffer is zoned as "EP" (Environmental Protection) along the entirety of the Lake Ontario shoreline within this SDC, encapsulating the properties at the east end of the SDC at the southern end of South Service Rd. It is recommended that the "EP" zone be expanded to include all present "RS-2" zoning, at least up to the landward extent of the governing shoreline hazard (erosion). Shoreline hazards and municipal zoning affecting SDC #6 are illustrated in Figure 25 below.

Figure 25 - Shoreline hazards and municipal zoning affecting East Beach (SDC #6)

SDC#7 – Wilmot Creek:

The entire Wilmot Creek development within the CLOCA's jurisdiction is zoned as either "R2" (Urban Residential Type 2) or "R4" (Urban Residential Type 4). An "EP" (Environmental Protection) buffer exists along the shoreline; however, it terminates significantly lakeward of the shoreline erosion hazard in many locations. It is recommended that the alignment of the "EP" buffer be amended such that it includes the entirety of the hazardous lands defined by the landward extent of the erosion hazard, as depicted in Figure 26 below.

Figure 26 - Shoreline hazards and municipal zoning affecting Wilmot Creek (SDC #7)

5.0 CONCLUSIONS AND NEXT STEPS

Following the issuance of the 2020 Lake Ontario Shoreline Management Plan (Zuzek Inc., 2020a), seven (7) coastal communities were identified withing the CLOCA watershed as having one or multiple residential buildings exposed to the shoreline hazards. These communities are referred to as Shoreline Damage Centres (SDCs), and include the communities of Ontoro Blvd. (Ajax), Crystal Beach (Whitby), Stone Street and Muskoka Ave. (Oshawa), Port Darlington, East Beach and Wilmot Creek (Clarington).

The objectives of the CLOCA Shoreline Hazards, Risk Assessment and Management Plan study were to (1) review, confirm and summarize the shoreline hazards affecting each SDC, (2) evaluate the relative risk of each residential building within the SDCs to the shoreline hazards, and (3) identify, evaluate, and recommend risk mitigation strategies for each community.

Section 2.0 of this report provides an overview of the three regulated shoreline hazards in Ontario, including the flooding hazard, erosion hazard, and dynamic beach hazards. Existing regulatory riverine flooding and erosion hazards were also reviewed. A site-specific and high spatial resolution review of each shoreline hazard was completed for all 7 SDCs, and two minor revisions to the hazard mapping were identified. These included the erosion hazard within SDC #2 (Crystal Beach) and the flooding hazard within SDC #4 (Muskoka Ave.). Revised hazard maps for each SDC are provided in Appendix A.

A detailed risk assessment was completed for all residential buildings within the SDCs affected by the shoreline and riverine hazards, as documented in Section 3.0 of this report. The risk assessment was performed using a risk assessment matrix whereby likelihood/vulnerability multipliers were assigned to each building for each shoreline hazard. These values were than multiplied by assigned scores across 5 impact/consequence categories. The following ranges in relative combined (flooding and erosion) risk were determined from the risk assessment:

- SDC #1 – Ontoro Blvd.: *Low to Medium Risk*
- SDC #2 – Crystal Beach (West Section): *Medium to High Risk*
- SDC #2 – Crystal Beach (Central Section): *Low to Medium Risk*
- SDC #2 – Crystal Beach (East Section): *Extreme Risk*
- SDC #3 – Stone Street: *Low to Medium Risk* (1 building rated as *High*)
- SDC #4 – Muskoka Ave.: *High to Extreme Risk*
- SDC #5 – Port Darlington (Cedar Crest Beach): *Extreme Risk*
- SDC #5 – Port Darlington (Cove Road): *Low to Medium Risk*
- SDC #5 – Port Darlington (West Beach): *Extreme Risk*
- SDC #6 – East Beach (West Section): *Medium Risk*
- SDC #6 – East Beach (Central Section): *Medium to High Risk*
- SDC #6 – East Beach (East Section): *Medium to Extreme Risk*
- SDC #7 – Wilmot Creek: *Low to Medium Risk*

Following the risk assessment, a risk mitigation strategy evaluation matrix was created to assist in developing shoreline management recommendations for each SDC. The evaluation of risk mitigation strategies is documented in Section 4.0 of this report. Risk mitigation strategies were developed under the four broad categories of *Avoid, Accommodate, Protect* and *Retreat/Re-align*. Strategies were first assigned multipliers for their ability to mitigate the risk both now and under future conditions. These values were then multiplied across 8 scoring categories and summed to determine the overall risk mitigation score for each strategy. Based on this evaluation, *Protect* and *Retreat/Re-Align* strategies were recommended, where appropriate, as "Primary Risk Mitigation

Strategies" within each SDC. *Retreat/Re-Align* strategies were only recommended where one or more buildings were shown to have *high* to *extreme risk*. *Accommodate* and *Avoid* strategies were recommended for all SDCs as "Additional Risk Mitigation Considerations" and provide ways in which risk to existing and future development can be reduced, respectively. A summary of recommended risk mitigation strategies is provided in Section 4.2 for each SDC.

For all those SDCs where "Protect" risk mitigation strategies were recommended, Section 4.3 provides an overview of preferred shoreline protection concepts for the range of shoreline types encountered within the SDCs. Concept-level cross sections and an opinion of the probable range in construction costs were provided based on 2021 unit costs. Monitoring and maintenance recommendations for new and existing shoreline protection structures is discussed in Section 4.4.

Finally, existing Municipal Zoning By-Laws were evaluated and compared to the shoreline hazards identified on the revised shoreline hazard maps for each SDC. Areas where the Municipal Zoning either contradicts or does not align with the natural hazards were identified. Recommended amendments to the municipal zoning were provided for each of these areas in accordance with the overall intent of Section 3.0 of the Provincial Policy Statement (2020), which is to direct development away from areas where there is an unacceptable risk to public health, public safety, or risk of property damage (i.e. hazardous lands).

5.1 NEXT STEPS

Following the acceptance and publication of this document, the report will be made publicly available for interested parties to:

- Engage residents and stakeholders within the communities or sub-communities of highest risk on the recommended risk mitigation strategies, including Avoid, Accommodate, Protect and Retreat/Re-align, to build consensus towards a community-scale solution.
- Seek site-specific engineering and construction cost estimates and verify lot by lot participation and interest in the preferred risk mitigation approach.
- Investigate potential funding streams to implement the recommended risk mitigation strategies beginning with the communities and buildings of highest risk. SJL Engineering Inc. is not presently aware of any such funding streams. Risk mitigation associated with shoreline hazards on private properties has historically been the responsibility of the private landowners in Ontario.
- Engage with municipal representatives to propose amendments to municipal zoning by-laws to ensure consistency between the municipal zoning, regulatory shoreline hazard mapping, and the overall intent of Section 3.0 of the PPS.

6.0 REFERENCES

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APPENDIX A

SHORELINE HAZARD MAPS

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #1
Ontoro Blvd.

Central Lake Ontario Conservation Authority (CLOCA)

LEGEND:

Hazard Mapping:

- 100 Year Flood Level
- Erosion Hazard Limit
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

Base Mapping:

- Geographical Names
- Dynamic Beach (End Pt)
- Dynamic Beach (Start Pt)
- Road Network
- Building Footprints
- Assessment Parcels
- CLOCA Administrative Boundary
- Topographic Contours (2 m interval)

INTERPRETATION OF THE HAZARD MAPS:

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100 Year Flood Level
The 100 Year Combined Flood Level considers both static lake level and storm surge, having a combined probability of being equalled or exceeded during any year of 1% (i.e., probability, P =0.01). The 100 Year Combined Flood Level elevation for CLOCA is +76.01 m IGLD85 (+75.55 m CGVD2013).

Flood Hazard Limit
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Toe of Bluff
The Toe of Bluff is the transition from the gently sloping beach to the steep portion of the bank or bluff slope.

Stable Slope Allowance
The Stable Slope Allowance is defined as a horizontal setback equivalent to 3.0 times the height of the bank or bluff.

Erosion Hazard Limit
The landward extent of the Erosion Hazard is the sum of the 100 year erosion rate plus the Stable Slope Allowance, measured horizontally from the toe of the bank or bluff.

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Dynamic Beach Hazard Limit
The Dynamic Beach Hazard Limit is defined as the sum of the Flood Hazard plus 30 metres measured horizontally. Local conditions may require a modified mapping approach if the beach is eroding and/or a barrier beach. Refer to the CLOCA Shoreline Hazards Summary, Risk Assessment and Management Plan Final Report for additional details.

DATA SOURCES:

2018 Orthophotography provided by © First Base Solutions

2018 Digital Terrain Model provided by © First Base Solutions

Geographical Names obtained from Natural Resources Canada Road Network File, 2016 Census. Statistics Canada Catalogue no. 92-500-X

Inset Map: © OpenStreetMap contributors

Datums:
Horizontal: UTM 17N NAD1983, metres.
Vertical: CGVD2013, metres

Datum Conversion:
IGLD1985 - CGVD2013 = 0.46 m (average)
To convert from IGLD85 to CGVD2013, subtract 0.46 m.
Note: There are local variations along the reaches within CLOCA. Refer to the Lake Ontario SMP for additional details.

0 50 100 m

N W E S

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Dec. 20, 2021

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Mapping prepared by SJL Engineering Inc. for the Central Lake Ontario Conservation Authority.

MAP PUBLISHED DECEMBER 20, 2021

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CLOCA
SDC #1

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #2
Crystal Beach

Central Lake Ontario Conservation Authority (CLOCA)

LEGEND:

Hazard Mapping:

- 100 Year Flood Level
- Erosion Hazard Limit
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

Base Mapping:

- Geographical Names
- Dynamic Beach (End Pt)
- Dynamic Beach (Start Pt)
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0 50 100 m

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PROFESSIONAL GEOSCIENTIST PETER J. ZUZEK PRACTISING MEMBER 1121 ONTARIO Dec. 20, 2021

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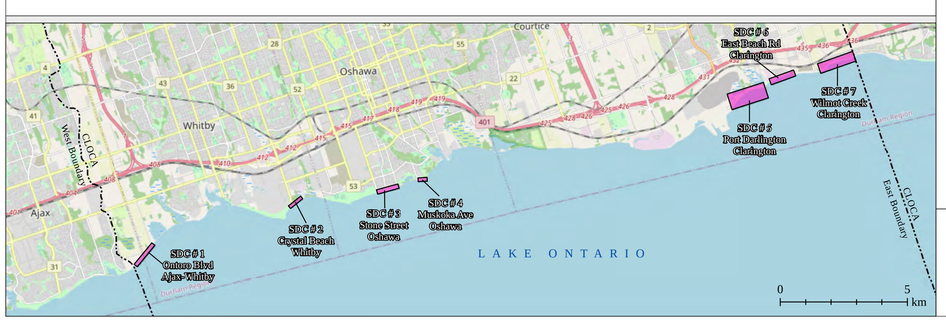

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Central Lake Ontario Conservation Authority

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CLOCA
SDC #2

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #3
Stone Street

Central Lake Ontario Conservation Authority (CLOCA)

LEGEND:

Hazard Mapping:

- 100 Year Flood Level
- Erosion Hazard Limit
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

Base Mapping:

- Geographical Names
- Dynamic Beach (End Pt)
- Dynamic Beach (Start Pt)
- Road Network
- Building Footprints
- Assessment Parcels
- CLOCA Administrative Boundary
- Topographic Contours (2 m interval)

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0 50 100 m

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CLOCA
SDC #3

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #4
Muskoka Ave.

Central Lake Ontario Conservation Authority (CLOCA)

LEGEND:

Hazard Mapping:

- 100 Year Flood Level
- Erosion Hazard Limit
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

Base Mapping:

- Geographical Names
- Dynamic Beach (End Pt)
- Dynamic Beach (Start Pt)
- Road Network
- Building Footprints
- Assessment Parcels
- CLOCA Administrative Boundary
- Topographic Contours (2 m interval)

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0 50 100 m

N W E S

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Zuzek inc. ONE WORLD

PROFESSIONAL GEOSCIENTIST PETER J. ZUZEK PRACTISING MEMBER 1121 ONTARIO P.Zuzek Dec. 20, 2021

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Central Lake Ontario Conservation Authority

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CLOCA
SDC #4

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #5
Port Darlington

Central Lake Ontario Conservation Authority (CLOCA)

LEGEND:

Hazard Mapping:

- 100 Year Flood Level
- Erosion Hazard Limit
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

Base Mapping:

- Geographical Names
- Dynamic Beach (End Pt)
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0 50 100 m

N W E S

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CLOCA SDC #5

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #6
East Beach Road

Central Lake Ontario Conservation Authority (CLOCA)

LEGEND:

Hazard Mapping:

- 100 Year Flood Level
- Erosion Hazard Limit
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

Base Mapping:

- Geographical Names
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0 50 100 m

N W E S

PREPARED BY:

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LICENSED PROFESSIONAL ENGINEER S. J. LOGAN 100189144 2021/12/20 PROVINCE OF ONTARIO

Zuzek inc. ONE WORLD

PROFESSIONAL GEOSCIENTIST PETER J. ZUZEK PRACTISING MEMBER 1121 ONTARIO Dec. 20, 2021

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MAP PUBLISHED DECEMBER 20, 2021

Central Lake Ontario Conservation Authority

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Web: www.cloca.com/

CLOCA
SDC #6

Lake Ontario Shoreline Management Plan
Shoreline Damage Centre #7
Wilmot Creek

Central Lake Ontario Conservation Authority (CLOCA)

LEGEND:

Hazard Mapping:

- 100 Year Flood Level
- Erosion Hazard Limit
- Flood Hazard Limit
- Dynamic Beach Hazard Limit

Base Mapping:

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Geographical Names obtained from Natural Resources Canada Road Network File, 2016 Census. Statistics Canada Catalogue no. 92-500-X

Inset Map: © OpenStreetMap contributors

Datums:
Horizontal: UTM 17N NAD1983, metres.
Vertical: CGVD2013, metres

Datum Conversion:
IGLD1985 - CGVD2013 = 0.46 m (average)
To convert from IGLD85 to CGVD2013, subtract 0.46 m.
Note: There are local variations along the reaches within CLOCA. Refer to the Lake Ontario SMP for additional details.

0 50 100 m

N W E S

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Dec. 20, 2021

This map was published December 20, 2021 for the Central Lake Ontario Conservation Authority (CLOCA). The mapping of hazardous lands, including erosion, flooding, and dynamic beach areas, is subject to change. The proponent of a proposed development on or adjacent to the hazardous lands should contact CLOCA to discuss permit requirements.

Every reasonable effort has been made to ensure the accuracy of this map. However, neither CLOCA, SJL Engineering, Zuzek Inc., or any other affiliated party assume any liability arising from its use. This map is provided without warranty of any kind, either expressed or implied.

Mapping prepared by SJL Engineering Inc. for the Central Lake Ontario Conservation Authority.

MAP PUBLISHED DECEMBER 20, 2021

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CLOCA
SDC #7

APPENDIX B

RISK ASSESSMENT

SDC#1 - Ontoro Blvd.				MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Property Address	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
1	1	58 Ontoro Blvd	Two Storey Dwelling	4	1	0	0	5	2	4	5	5					
1	2	56 Ontoro Blvd	Single Storey Dwelling	3	1	0	0	5	2	4	5	5					
1	3	52 Ontoro Blvd	Two Storey Dwelling	4	1	0	0	5	2	5	5	5					
1	4	48 Ontoro Blvd	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
1	5	44 Ontoro Blvd	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
1	6	40 Ontoro Blvd	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
1	7	38 Ontoro Blvd	No Building														
1	8	32 Ontoro Blvd	Two Storey Dwelling	1	1	0	0	5	2	5	5	5					
1	9	30 Ontoro Blvd	Two Storey Dwelling	1	1	0	0	5	2	4	5	5					
1	10	26 Ontoro Blvd	Two Storey Dwelling	0	1	0	0	5	2	5	5	5					
1	11	18 Ontoro Blvd	Two Storey Dwelling	1	1	0	0	5	2	5	5	5					
1	12	16 Ontoro Blvd	Single Storey Dwelling	2	1	0	1	3	2	4	5	5	1	2	1	1	1
1	13	14 Ontoro Blvd	Two Storey Dwelling	2	1	2	1	4	2	5	5	5	2	2	2	1	1
1	14	2 Ontoro Blvd	Two Storey Dwelling	3	1	2	1	4	2	5	5	5	2	2	2	1	1
1	15	7 Ontoro Blvd	Single Storey Dwelling	0	0	0	1						1	1	1	1	1
1	16	715 Halls Road	Two Storey Dwelling	2	1	0	0	5	3	5	5	5					

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
25	10	20	25	25	0	0	0	0	0	105	0	Erosion	105
20	8	16	20	20	0	0	0	0	0	84	0	Erosion	84
25	10	25	25	25	0	0	0	0	0	110	0	Erosion	110
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
										0	0	n/a	0
10	4	10	10	10	0	0	0	0	0	44	0	Erosion	44
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
5	2	5	5	5	0	0	0	0	0	22	0	Erosion	22
10	4	10	10	10	0	0	0	0	0	44	0	Erosion	44
9	6	12	15	15	1	2	1	1	1	57	6	Erosion	63
12	6	15	15	15	6	6	6	3	3	63	24	Erosion	87
16	8	20	20	20	6	6	6	3	3	84	24	Erosion	108
0	0	0	0	0	1	1	1	1	1	0	5	Flood	5
15	9	15	15	15	0	0	0	0	0	69	0	Erosion	69
										0	0	n/a	0
										0	0	n/a	0
										0	0	n/a	0

SDC#2 - Crystal Beach				MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Property Address	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
2	1	2800 Thickson Road	Single Storey Dwelling	3	1	0	0	5	2	4	5	5					
2	2	2802 Thickson Road	Single Storey Dwelling	5	1	0	0	5	2	4	5	5					
2	3	2804 Thickson Road	Two Storey Dwelling	4	1	0	0	5	2	4	5	5					
2	4	2851 Thickson Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5					
2	5	112 Crystal Beach Blvd	Two Storey Dwelling	0	1	0	0	5	2	4	5	5					
2	6	114 Crystal Beach Blvd	Two Storey Dwelling	1	1	0	0	5	2	3	5	5					
2	7	116 Crystal Beach Blvd	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
2	8	220 Crystal Beach Blvd	Two Storey Dwelling	1	1	0	0	5	2	3	5	5					
2	9	224 Crystal Beach Blvd	Single Storey Dwelling	0	1	0	0	5	2	4	5	5					
2	10	330 Crystal Beach Blvd	Two Storey Dwelling	0	0	0	0										
2	11	338 Crystal Beach Blvd	Two Storey Dwelling	0	1	0	0	5	3	4	5	5					
2	12	442 Crystal Beach Blvd	Two Storey Dwelling	1	1	0	1	5	3	3	5	5	1	3	1	1	1
3	19	111 McIntosh Ave	Two Storey Dwelling	0	0	0	1						1	3	1	1	1
2	13	448 Crystal Beach Blvd	Single Storey Dwelling	0	0	2	2						2	4	2	1	3
2	14	452 Crystal Beach Blvd	Single Storey Dwelling	1	3	4	2	3	4	4	5	5	4	4	4	5	5
2	15	456 Crystal Beach Blvd	Single Storey Dwelling	1	3	4	2	3	4	3	5	5	4	4	3	5	5
2	16	458 Crystal Beach Blvd	Single Storey Dwelling	1	3	4	2	3	4	3	5	5	4	4	3	5	5
2	17	460 Crystal Beach Blvd	Two Storey Dwelling	1	3	4	2	4	4	3	5	5	4	4	3	5	5
2	18	462 Crystal Beach Blvd	Single Storey Dwelling	1	3	5	2	3	4	3	5	5	5	4	3	5	5

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
20	8	16	20	20	0	0	0	0	0	84	0	Erosion	84
30	12	24	30	30	0	0	0	0	0	126	0	Erosion	126
25	10	20	25	25	0	0	0	0	0	105	0	Erosion	105
5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
5	3	4	5	5	0	0	0	0	0	22	0	Erosion	22
10	6	6	10	10	1	3	1	1	1	42	7	Erosion	49
0	0	0	0	0	1	3	1	1	1	0	7	Flood	7
0	0	0	0	0	8	16	8	4	12	0	48	Flood	48
12	16	16	20	20	24	24	24	30	30	84	132	Flood	216
12	16	12	20	20	24	24	18	30	30	80	126	Flood	206
12	16	12	20	20	24	24	18	30	30	80	126	Flood	206
16	16	12	20	20	24	24	18	30	30	84	126	Flood	210
12	16	12	20	20	35	28	21	35	35	80	154	Flood	234

SDC#3 - Stone Street				MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Property Address	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
3	1	813 Stone Street	Single Storey Dwelling	0	1	0	0	5	2	4	5	5					
3	2	807 Stone Street	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
3	3	801 Stone Street	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	4	795 Stone Street	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	5	791 Stone Street	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	6	787 Stone Street	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	7	781 Stone Street	Two Storey Dwelling	2	1	0	0	5	2	4	5	5					
3	8	775 Stone Street	Two Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	9	771 Stone Street	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	10	765 Stone Street	Single Storey Dwelling	3	1	0	0	5	2	3	5	5					
3	11	761 Stone Street	Single Storey Dwelling	3	1	0	0	5	2	3	5	5					
3	12	755 Stone Street	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	13	751 Stone Street	Single Storey Dwelling	5	1	0	0	5	2	5	5	5					
3	14	745 Stone Street	Two Storey Dwelling	4	1	0	0	5	2	3	5	5					
3	15	741 Stone Street	Single Storey Dwelling	3	1	0	0	5	2	3	5	5					
3	16	737 Stone Street	Single Storey Dwelling	3	1	0	0	5	2	3	5	5					
3	17	731 Stone Street	Two Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	18	727 Stone Street	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	19	721 Stone Street	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	20	717 Stone Street	Single Storey Dwelling	4	1	0	0	5	2	3	5	5					
3	21	709 Stone Street	Single Storey Dwelling	2	1	0	0	5	2	3	5	5					
3	22	705 Stone Street	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	23	701 Stone Street	Single Storey Dwelling	1	1	0	0	5	2	3	5	5					
3	24	695 Stone Street	Single Storey Dwelling	0	1	0	0	5	2	3	5	5					
3	25	689 Stone Street	Single Storey Dwelling	0	0	0	0										
3	26	683 Stone Street	Single Storey Dwelling	0	0	0	0										
3	27	677 Stone Street	Two Storey Dwelling	0	0	0	0										
3	28	673 Stone Street	Single Storey Dwelling	0	0	0	0										
3	29	671 Stone Street	Single Storey Dwelling	0	0	0	0										
3	30	663 Stone Street	Single Storey Dwelling	0	0	0	0										
3	31	657 Stone Street	Two Storey Dwelling	0	0	0	0										
3	32	651 Stone Street	Two Storey Dwelling	0	0	0	0										
3	33	515 Stone Street	Two Storey Dwelling	0	0	0	0										
3	34	511 Stone Street	Three Storey Dwelling	0	0	0	0										
3	35	507 Stone Street	Two Storey Dwelling	0	0	0	0										
3	36	505 Stone Street	Two Storey Dwelling	0	0	0	0			3	5	5					
3	37	503 Stone Street	Two Storey Dwelling	0	0	0	0			4	5	5					
3	38	499 Stone Street	Three Storey Dwelling	0	0	0	0			4	5	5					
3	39	493 Stone Street	Two Storey Dwelling	0	0	0	0			4	5	5					
3	40	489 Stone Street	Two Storey Dwelling	0	0	0	0			4	5	5					
3	41	485 Stone Street	Two Storey Dwelling	0	0	0	0			3	5	5					
3	42	481 Stone Street	Single Storey Dwelling	0	0	0	0			3	5	5					
3	43	473 Stone Street	Single Storey Dwelling	0	0	0	0			3	5	5					
3	44	477 Stone Street	Two Storey Dwelling	1	1	0	0	5	2	4	5	5					
3	45	469 Stone Street	Single Storey Dwelling	0	0	0	0										
3	46	465 Stone Street	Single Storey Dwelling	0	0	0	0										
3	47	457 Stone Street	Single Storey Dwelling	0	1	0	0	5	2	4	5	5					
3	48	449 Stone Street	Single Storey Dwelling	0	1	0	0	5	2	3	5	5					
3	49	441 Stone Street	Single Storey Dwelling	1	1	0	0	5	2	4	5	5					
3	50	437 Stone Street	Single Storey Dwelling	2	1	0	0	5	2	4	5	5					
3	51	433 Stone Street	Two Storey Dwelling	2	1	0	0	5	2	4	5	5					
3	52	429 Stone Street	Single Storey Dwelling	0	0	0	0										
3	53	425 Stone Street	No Building	0	0	0	0										

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
15	6	12	15	15	0	0	0	0	0	63	0	Erosion	63
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
30	12	30	30	30	0	0	0	0	0	132	0	Erosion	132
25	10	15	25	25	0	0	0	0	0	100	0	Erosion	100
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
25	10	15	25	25	0	0	0	0	0	100	0	Erosion	100
15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
10	4	8	10	10	0	0	0	0	0	42	0	Erosion	42
15	6	12	15	15	0	0	0	0	0	63	0	Erosion	63
15	6	12	15	15	0	0	0	0	0	63	0	Erosion	63
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
										0	0	n/a	0

SDC#4 - Muskoka Ave.				MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Property Address	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
4	1	51 Muskoka Ave	Two Storey Dwelling	1	1	4	1	5	2	3	5	5	4	2	3	3	3
4	2	53 Muskoka Ave	Two Storey Dwelling	1	1	4	1	5	2	3	5	5	4	2	3	3	3
4	3	55 Muskoka Ave	Single Storey Dwelling	4	1	4	1	4	2	3	5	5	4	2	3	3	3
4	4	57 Muskoka Ave	Two Storey Dwelling	4	1	3	1	5	2	3	5	5	2	2	2	3	3
4	5	59 Muskoka Ave	Two Storey Dwelling	4	1	0	1	5	2	3	5	5	1	1	2	1	1
4	6	61 Muskoka Ave	Two Storey Dwelling	5	1	0	1	5	2	3	5	5	1	1	2	1	1
4	7	1575 Kluane Ave	Two Storey Dwelling	5	1	0	0	5	2	4	5	5					

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
10	4	6	10	10	20	10	15	15	15	40	75	Flood	115
10	4	6	10	10	20	10	15	15	15	40	75	Flood	115
20	10	15	25	25	20	10	15	15	15	95	75	Erosion	170
25	10	15	25	25	8	8	8	12	12	100	48	Erosion	148
25	10	15	25	25	1	1	2	1	1	100	6	Erosion	106
30	12	18	30	30	1	1	2	1	1	120	6	Erosion	126
30	12	24	30	30	0	0	0	0	0	126	0	Erosion	126
										0	0	n/a	0
										0	0	n/a	0

SDC#5 - Port Darlington				MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES					EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
SDC #	ID	Property Address	Building Type:	Likelihood / Vulnerability - Erosion	Other Consideration s - Erosion	Likelihood / Vulnerability - Flooding	Other Consideration s - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportatio n / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportatio n / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
5	1	43 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	5	1	3	4	4	5	5	5	4	4	5	5	15	20	20	25	25	30	24	24	30	30	105	138	Flood	243
5	2	49 Cedar Crest Beach Rd	No Building																									0	0	n/a	0
5	3	55 Cedar Crest Beach Rd	Two Storey Dwelling	3	3	5	1	4	4	4	5	5	5	4	4	5	5	24	24	24	30	30	30	24	24	30	30	132	138	Flood	270
5	4	59 Cedar Crest Beach Rd	Single Storey Dwelling	3	3	5	1	3	4	3	5	5	5	4	3	5	5	18	24	18	30	30	30	24	18	30	30	120	132	Flood	252
5	5	63 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	5	1	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	30	24	18	30	30	100	132	Flood	232
5	6	67 Cedar Crest Beach Rd	Two Storey Dwelling	1	3	5	1	4	4	4	5	5	5	4	4	5	5	16	16	16	20	20	30	24	24	30	30	88	138	Flood	226
5	7	69 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	5	1	4	4	4	5	5	5	4	4	5	5	20	20	20	25	25	30	24	24	30	30	110	138	Flood	248
5	8	71 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	4	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	20	20	20	25	25	110	110	n/a	220
5	9	75 Cedar Crest Beach Rd	Three Storey Dwelling	2	3	4	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	20	20	20	25	25	110	110	n/a	220
5	10	79 Cedar Crest Beach Rd	No Building											4		5	5											0	0	n/a	0
5	11	81 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	4	1	4	4	3	5	5	4	4	3	5	5	20	20	15	25	25	20	20	15	25	25	105	105	n/a	210
5	12	83 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	5	1	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	30	24	18	30	30	105	132	Flood	237
5	13	87 Cedar Crest Beach Rd	No Building											4		5	5											0	0	n/a	0
5	14	91 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	5	1	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	30	24	18	30	30	100	132	Flood	232
5	15	93 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	5	1	4	4	4	5	5	5	4	4	5	5	20	20	20	25	25	30	24	24	30	30	110	138	Flood	248
5	16	95 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	5	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	24	24	24	30	30	105	132	Flood	237
5	17	97 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	5	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	24	24	24	30	30	105	132	Flood	237
5	18	99 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	4	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	20	20	20	25	25	105	110	Flood	215
5	19	101 Cedar Crest Beach Rd	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	20	103 Cedar Crest Beach Rd	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	21	105 Cedar Crest Beach Rd	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	22	107 Cedar Crest Beach Rd	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	23	109 Cedar Crest Beach Rd	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	24	111 Cedar Crest Beach Rd	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	3	4	4	5	5	16	16	16	20	20	12	16	16	20	20	88	84	Erosion	172
5	25	115 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	4	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	20	20	20	25	25	105	110	Flood	215
5	26	119 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	3	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	16	16	16	20	20	105	88	Erosion	193
5	27	121 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	3	1	3	4	3	5	5	4	4	3	5	5	15	20	15	25	25	16	16	12	20	20	100	84	Erosion	184
5	28	123 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	3	1	3	4	4	5	5	4	4	4	5	5	15	20	20	25	25	16	16	16	20	20	105	88	Erosion	193
5	29	125 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	3	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	16	16	16	20	20	110	88	Erosion	198
5	30	127 Cedar Crest Beach Rd	Single Storey Dwelling	3	3	4	1	3	4	4	5	5	4	4	4	5	5	18	24	24	30	30	20	20	20	25	25	126	110	Erosion	236
5	31	131 Cedar Crest Beach Rd	Single Storey Dwelling	3	3	4	1	3	4	4	5	5	4	4	4	5	5	18	24	24	30	30	20	20	20	25	25	126	110	Erosion	236
5	32	133 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	4	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	20	20	20	25	25	110	110	n/a	220
5	33	135 Cedar Crest Beach Rd	Single Storey Dwelling	3	3	4	1	3	4	3	5	5	4	4	3	5	5	18	24	18	30	30	20	20	15	25	25	120	105	Erosion	225
5	34	137 Cedar Crest Beach Rd	Two Storey Dwelling	1	3	3	1	4	4	4	5	5	4	4	4	5	5	16	16	16	20	20	16	16	16	20	20	88	88	n/a	176
5	35	139 Cedar Crest Beach Rd	Single Storey Dwelling	2	3	4	1	3	4	3	5	5	4	4	3	5	5	15	20	15	25	25	20	20	15	25	25	100	105	Flood	205
5	36	141 Cedar Crest Beach Rd	Single Storey Dwelling	1	3	4	1	3	4	4	5	5	4	4	4	5	5	12	16	16	20	20	20	20	20	25	25	84	110	Flood	194
5	37	143 Cedar Crest Beach Rd	Single Storey Dwelling	3	3	4	1	3	4	3	5	5	4	4	3	5	5	18	24	18	30	30	20	20	15	25	25	120	105	Erosion	225
5	38	145 Cedar Crest Beach Rd	Two Storey Dwelling	0	3	2	1	4	4	4	5	5	2	4	4	5	5	12	12	12	15	15	6	12	12	15	15	66	60	Erosion	126
5	39	149 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	3	1	4	4	4	5	5	4	4	4	5	5	20	20	20	25	25	16	16	16	20	20	110	88	Erosion	198
5	40	151 Cedar Crest Beach Rd	Two Storey Dwelling	2	3	3	1	4	4	4	5	5	3	4	4	5	5	20	20	20	25	25	12	16	16	20	20	110	84	Erosion	194
5	41	155 Cedar Crest Beach Rd	No Building																									0	0	n/a	0
5	42	157 Cove Road	No Building																									0	0	n/a	0
5	43	155 Cove Road	No Building																									0	0	n/a	0
5	44	147 Cove Road	Single Storey Dwelling	1	1	3	1	3	2	4	5	5	3	2	4	3	3	6	4	8	10	10	12	8	16	12	12	38	60	Flood	98
5	45	145 Cove Road	Two Storey Dwelling	0	0	3	1						3	2	2	3	3	0	0	0	0	0	12	8	8	12	12	0	52	Flood	52
5	46	133 Cove Road	Two Storey Dwelling	0	0	2	1						2	2	2	1	1	0	0	0	0	0	6	6	6	3	3	0	24	Flood	24
5	47	131 Cove Road	Two Storey Dwelling	0	0	1	1						1	2	2	1	1	0	0	0	0	0	2	4	4	2	2	0	14	Flood	14
5	48	129 Cove Road	Two Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
5	49	127 Cove Road	Two Storey Dwelling																									0	0	n/a	0
5	50	125 Cove Road	Two Storey Dwelling																									0	0	n/a	0
5	51	123 Cove Road	Two Storey Dwelling																									0	0	n/a	0
5	52	121 Cove Road	Two Storey Dwelling	0	1	0	0	5	2	5	5	5						5	2	5	5	5	0	0	0	0	0	22	0	Erosion	22
5	53	120 Cove Road	Single Storey Dwelling	1	1	0	0	5	2	5	5	5						10	4	10	10	10	0	0	0	0	0	44	0	Erosion	44
5	54	119 Cove Road	Two Storey Dwelling	0	1	0	0	5	2	4	5	5						5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	55	115 Cove Road	Two Storey Dwelling	0	1	0	0	5	2	4	5	5						5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	56	113 Cove Road	Two Storey Dwelling	0	1	0	0	5	2	4	5	5						5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	57	111 Cove Road	Two Storey Dwelling	0	1	0	0	5	2	4	5	5						5	2	4	5	5	0	0	0	0	0	21	0	Erosion	21
5	58	109 Cove Road	Two Storey Dwelling																									0	0	n/a	0
5	59	107 Cove Road	Two Storey Dwelling																									0	0	n/a	0
5	60	105 Cove Road	Two Storey Dwelling	1	1	1	1	3	4	4	5	5	1	3	4	3	3	6	8	8	10	10	2	6	8	6	6	42	28	Erosion	70
5	61	103 West Beach Road	Single Storey Dwelling	1	2	1	2	3	4	4	5	5	2	4	4	3	3	9	12	12	15	15	6	12	12	9	9	63	48	Erosion	111
5	62	67 West Beach Road	No Building																									0	0	n/a	0
5	63	60 West Beach Road	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	64	56 West Beach Road	Two Storey Dwelling	2	3	4	3	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	35	28	21	35	35	105	154	Flood	259
5	65	55 West Beach Road	Single Storey Dwelling	2	3	4	3	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	35	28	21	35	35	100	154	Flood	254
5	66	54 West Beach Road	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	67	52 West Beach Road	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	68	51 West Beach Road	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	69	50 West Beach Road	Two Storey Dwelling	2	3	3	3	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	30	24	18	30	30	105	132	Flood	237
5	70	49 West Beach Road	Two Storey Dwelling	2	3	3	3	4	4	4	5	5	5	4	3	5	5	20	20	20	25	25	30	24	18	30	30	110	132	Flood	242
5	71	48 West Beach Road	Single Storey Dwelling	2	3	3	3	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	30	24	18	30	30	100	132	Flood	232
5	72	47 West Beach Road	No Building																									0	0	n/a	0
5	73	46 West Beach Road	Two Storey Dwelling	2	3	3	3	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	30	24	18	30	30	105	132	Flood	237
5	74	45 West Beach Road	Two Storey Dwelling	2	3	4	3	4	4	3	5	5	5	4	3	5	5	20	20	15	25	25	35	28	21	35	35	105	154	Flood	259
5	75	44 West Beach Road	Single Storey Dwelling	2	3	3	3	3	4	3	5	5	5	4	3	5	5	15	20	15	25	25	30	24	18	30	30	100	132	Flood	232
5	76	43 West Beach Road	No Building																									0	0	n/a	0
5	77	42 West Beach Road	No Building																									0	0	n/a	0
5	78	20 West Beach Road	No Building																									0	0	n/a	0
5	79	28 West Beach Road	Single Storey Dwelling	2	3	3	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	30	18	12	30	30	90	120	Flood	210
5	80	17 West Beach Road	Single Storey Dwelling	2	3	4	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	35	21	14	35	35	90	140	Flood	230
5	81	16 West Beach Road	Single Storey Dwelling	2	3	4	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	35	21	14	35	35	90	140	Flood	230
5	82	32 West Beach Road	Single Storey Dwelling	2	3	3	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	30	18	12	30	30	90	120	Flood	210
5	83	8 West Beach Road	Two Storey Dwelling	2	3	4	3	4	3	2	5	5	5	3	2	5	5	20	15	10	25	25	35	21	14	35	35	95	140	Flood	235
5	84	6 West Beach Road	Single Storey Dwelling	2	3	4	3	3	3	2	5	5	5	3	2	5	5	15	15	10	25	25	35	21	14	35	35	90	140	Flood	230
																												0	0	n/a	0

SDC#6 - East Beach Rd				MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES				
SDC #	ID	Property Address	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT
6	1	70 Port Darlington Rd	Three Storey Commercial	0	1	3	2	5	4	5	5	5	2	4	5	3	3
6	2	120 Port Darlington Rd	Three Storey Condominiums	0	1	3	2	5	4	5	5	5	2	4	5	3	3
6	3	70 East Beach Road	Single Storey Dwelling	2	2	0	0	5	2	3	5	5					
6	4	71 East Beach Road	Two Storey Dwelling	3	2	0	0	5	2	3	5	5					
6	5	72 East Beach Road	Two Storey Dwelling	3	2	0	0	5	2	4	5	5					
6	6	73 East Beach Road	Two Storey Dwelling	4	2	0	0	5	2	3	5	5					
6	7	74 East Beach Road	Two Storey Dwelling	4	2	0	0	5	2	3	5	5					
6	8	76 East Beach Road	Two Storey Dwelling	5	2	0	0	5	2	3	5	5					
6	9	78 East Beach Road	Two Storey Dwelling	5	2	0	0	5	2	3	5	5					
6	10	79 East Beach Road	Two Storey Dwelling	5	2	0	0	5	2	4	5	5					
6	11	85 East Beach Road	No Building														
6	12	89 East Beach Road	No Building														
6	13	188 Port Darlington Rd	Two Storey Dwelling	5	2	0	0	5	2	4	5	5					
6	14	220 Port Darlington Rd	Single Storey Dwelling	2	1	0	0	5	2	4	5	5					
6	15	2728 South Service Rd	Single Storey Dwelling	3	1	4	1	3	2	3	5	5	4	2	3	5	5
6	16	2736 South Service Rd	No Building														
6	17	2738 South Service Rd	Two Storey Dwelling	1	1	2	1	4	2	4	5	5	2	2	2	3	3
6	18	2745 South Service Rd	Two Storey Dwelling	2	1	2	1	4	2	4	5	5	3	2	2	3	3

EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
5	4	5	5	5	10	20	25	15	15	24	85	Flood	109
5	4	5	5	5	10	20	25	15	15	24	85	Flood	109
20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
25	10	15	25	25	0	0	0	0	0	100	0	Erosion	100
25	10	20	25	25	0	0	0	0	0	105	0	Erosion	105
30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
35	14	21	35	35	0	0	0	0	0	140	0	Erosion	140
35	14	21	35	35	0	0	0	0	0	140	0	Erosion	140
35	14	28	35	35	0	0	0	0	0	147	0	Erosion	147
										0	0	n/a	0
										0	0	n/a	0
35	14	28	35	35	0	0	0	0	0	147	0	Erosion	147
15	6	12	15	15	0	0	0	0	0	63	0	Erosion	63
12	8	12	20	20	20	10	15	25	25	72	95	Flood	167
										0	0	n/a	0
8	4	8	10	10	6	6	6	9	9	40	36	Erosion	76
12	6	12	15	15	9	6	6	9	9	60	39	Erosion	99
										0	0	n/a	0

SDC#7 - Wilmot Creek				MULTIPLIERS				EROSION - IMPACTS / CONSEQUENCES					FLOOD - IMPACTS / CONSEQUENCES					EROSION - RISK SCORES					FLOOD - RISK SCORES					FINAL RISK SCORES			
SDC #	ID	Property Address	Building Type:	Likelihood / Vulnerability - Erosion	Other Considerations - Erosion	Likelihood / Vulnerability - Flooding	Other Considerations - Flooding	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	People & Societal Impacts	Ecosystem Impacts	Economic Losses (Buildings Only)	Transportation / Emergency Access	Delivery of Energy / Utilities / IT	EROSION RISK SCORE	FLOOD RISK SCORE	GOVERNING RISK	COMBINED RISK SCORE
7	1	85 Hinkley Trail	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	2	83 Hinkley Trail	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	3	81 Hinkley Trail	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	4	79 Hinkley Trail	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	5	77 Hinkley Trail	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	6	75 Hinkley Trail	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	7	69 Hinkley Trail	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	8	67 Hinkley Trail	Single Storey Dwelling	3	1	0	0	5	2	3	5	5						20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
7	9	65 Hinkley Trail	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	10	35 Birch Tree	Single Storey Dwelling	5	1	0	0	5	2	3	5	5						30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
7	11	33 Birch Tree	Single Storey Dwelling	5	1	0	0	5	2	3	5	5						30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
7	12	34 Birch Tree	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	13	32 Birch Tree	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	14	30 Birch Tree	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	15	26 Birch Tree	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	16	22 Birch Tree	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	17	20 Birch Tree	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	18	18 Birch Tree	Single Storey Dwelling	2	1	0	0	5	2	3	5	5						15	6	9	15	15	0	0	0	0	0	60	0	Erosion	60
7	19	7 Birch Tree	Single Storey Dwelling	5	1	0	0	5	2	3	5	5						30	12	18	30	30	0	0	0	0	0	120	0	Erosion	120
7	20	5 Birch Tree	Single Storey Dwelling	3	1	0	0	5	2	3	5	5						20	8	12	20	20	0	0	0	0	0	80	0	Erosion	80
7	21	3 Birch Tree	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	22	1 Birch Tree	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	23	15 Wilmot Trail	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	24	17 Wilmot Trail	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	25	19 Wilmot Trail	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	26	21 Wilmot Trail	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	27	23 Wilmot Trail	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	28	25 Wilmot Trail	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	29	27 Wilmot Trail	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	30	29 Wilmot Trail	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	31	31 Wilmot Trail	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	32	33 Wilmot Trail	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	33	1 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	34	3 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	35	5 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	36	7 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	37	9 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	38	11 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	39	13 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	40	15 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	41	17 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	42	19 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	43	21 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	44	23 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	45	25 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	46	27 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	47	29 Bluffs Road	Single Storey Dwelling	0	1	0	0	5	2	3	5	5						5	2	3	5	5	0	0	0	0	0	20	0	Erosion	20
7	48	31 Bluffs Road	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	49	33 Bluffs Road	Single Storey Dwelling	1	1	0	0	5	2	3	5	5						10	4	6	10	10	0	0	0	0	0	40	0	Erosion	40
7	50	35 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	51	37 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	52	39 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	53	41 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	54	43 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	55	45 Bluffs Road	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	56	47 Bluffs Road	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	57	49 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	58	51 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	59	53 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	60	55 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	61	57 Bluffs Road	Single Storey Dwelling	0	0	0	0											0	0	0	0	0	0	0	0	0	0	0	0	n/a	0
7	62	59 Bluffs Road	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	63	61 Bluffs Road	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	64	63 Bluffs Road	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	65	65 Bluffs Road	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	66	67 Bluffs Road	Single Storey Dwelling	0	1	0	0	4	2	3	5	5						4	2	3	5	5	0	0	0	0	0	19	0	Erosion	19
7	67	69 Bluffs Road	Single Storey Dwelling	1	1	0	0	4	2	3	5	5						8	4	6	10	10	0	0	0	0	0	38	0	Erosion	38
7	68	71 Bluffs Road	Single Storey Dwelling	1	1	0	0	4	2	3	5	5						8	4	6	10	10	0	0	0	0	0	38	0	Erosion	38
7	69	73 Bluffs Road	Single Storey Dwelling	1	1	0	0	4	2	3	5	5						8	4	6	10	10	0	0	0	0	0	38	0	Erosion	38
7	70	75 Bluffs Road	Single Storey Dwelling	1	1	0	0	4	2	3	5	5						8	4	6	10	10	0	0	0	0	0	38	0	Erosion	38
7	71																											0	0	n/a	0
7	72																											0	0	n/a	0

APPENDIX C

RISK MAPPING

ID	ADDRESS
1	58 Ontoro Blvd
2	56 Ontoro Blvd
3	52 Ontoro Blvd
4	48 Ontoro Blvd
5	44 Ontoro Blvd
6	40 Ontoro Blvd
7	38 Ontoro Blvd*
8	32 Ontoro Blvd
9	30 Ontoro Blvd
10	26 Ontoro Blvd
11	18 Ontoro Blvd
12	16 Ontoro Blvd
13	14 Ontoro Blvd
14	2 Ontoro Blvd
15	7 Ontoro Blvd
16	715 Halls Road

*no primary building

Erosion Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #1: Ontoro Blvd.

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

ID	ADDRESS
1	58 Ontoro Blvd
2	56 Ontoro Blvd
3	52 Ontoro Blvd
4	48 Ontoro Blvd
5	44 Ontoro Blvd
6	40 Ontoro Blvd
7	38 Ontoro Blvd*
8	32 Ontoro Blvd
9	30 Ontoro Blvd
10	26 Ontoro Blvd
11	18 Ontoro Blvd
12	16 Ontoro Blvd
13	14 Ontoro Blvd
14	2 Ontoro Blvd
15	7 Ontoro Blvd
16	715 Halls Road

*no primary building

Flood Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

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SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #1: Ontoro Blvd.

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
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0 50 100
m

ID	ADDRESS
1	58 Ontoro Blvd
2	56 Ontoro Blvd
3	52 Ontoro Blvd
4	48 Ontoro Blvd
5	44 Ontoro Blvd
6	40 Ontoro Blvd
7	38 Ontoro Blvd*
8	32 Ontoro Blvd
9	30 Ontoro Blvd
10	26 Ontoro Blvd
11	18 Ontoro Blvd
12	16 Ontoro Blvd
13	14 Ontoro Blvd
14	2 Ontoro Blvd
15	7 Ontoro Blvd
16	715 Halls Road

*no primary building

Combined Risk Score

INCREASING RISK

EXTREME RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160
- 161 - 180
- 180+

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #1: Ontoro Blvd.

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

0 50 100
m

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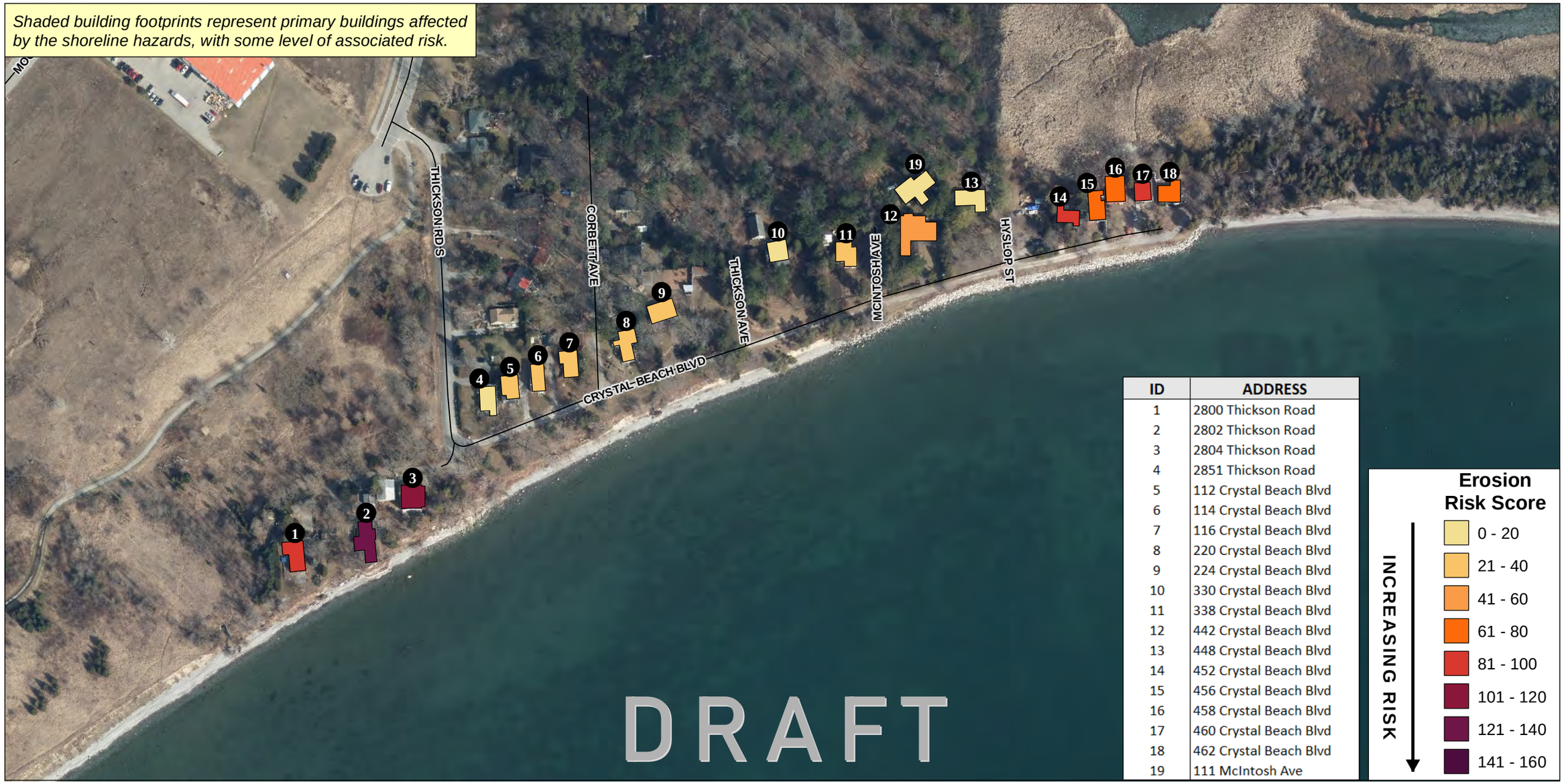


ID	ADDRESS
1	2800 Thickson Road
2	2802 Thickson Road
3	2804 Thickson Road
4	2851 Thickson Road
5	112 Crystal Beach Blvd
6	114 Crystal Beach Blvd
7	116 Crystal Beach Blvd
8	220 Crystal Beach Blvd
9	224 Crystal Beach Blvd
10	330 Crystal Beach Blvd
11	338 Crystal Beach Blvd
12	442 Crystal Beach Blvd
13	448 Crystal Beach Blvd
14	452 Crystal Beach Blvd
15	456 Crystal Beach Blvd
16	458 Crystal Beach Blvd
17	460 Crystal Beach Blvd
18	462 Crystal Beach Blvd
19	111 McIntosh Ave

Erosion Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #2: Crystal Beach

Erosion Risk Score

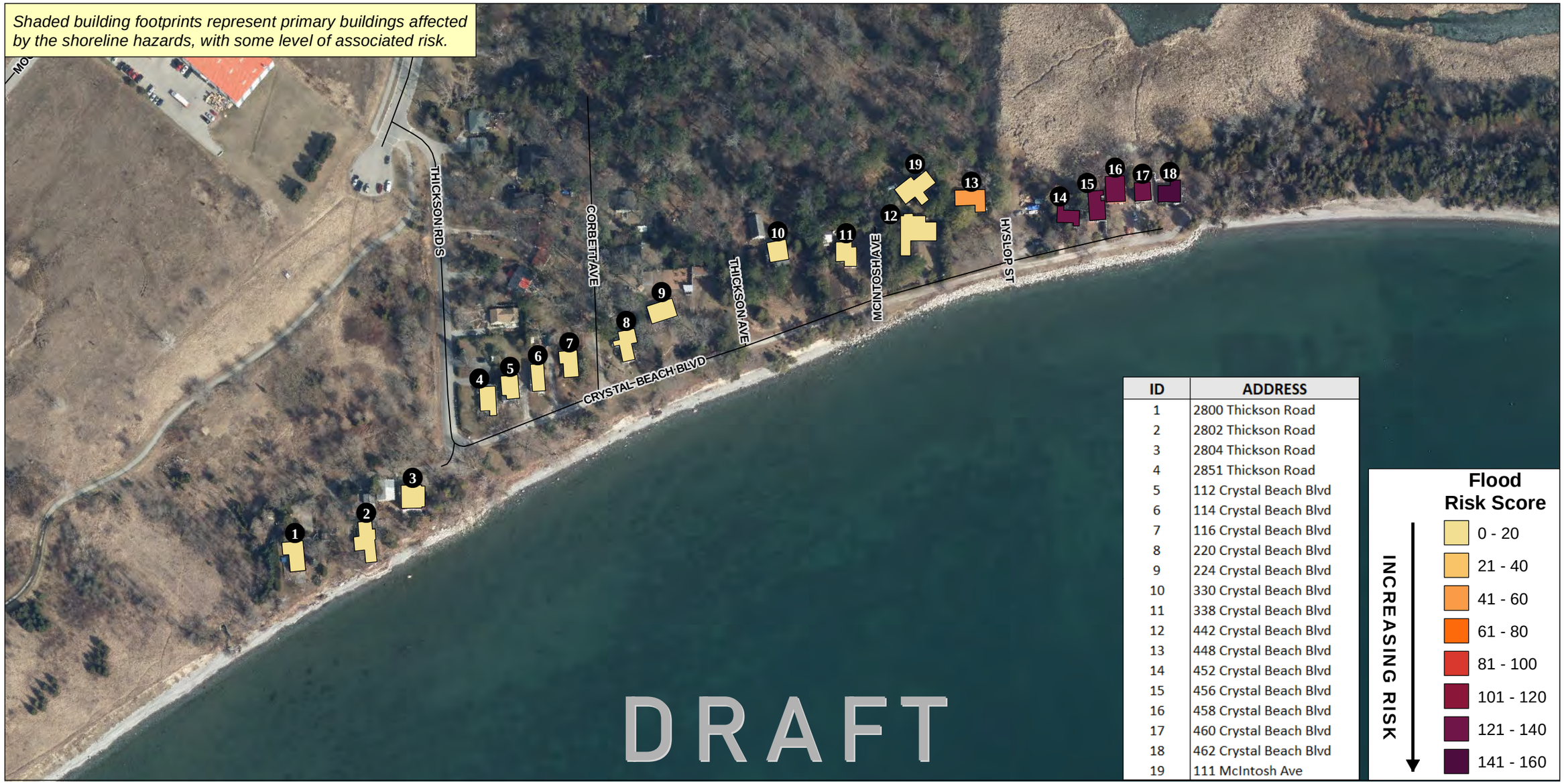
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS
1	2800 Thickson Road
2	2802 Thickson Road
3	2804 Thickson Road
4	2851 Thickson Road
5	112 Crystal Beach Blvd
6	114 Crystal Beach Blvd
7	116 Crystal Beach Blvd
8	220 Crystal Beach Blvd
9	224 Crystal Beach Blvd
10	330 Crystal Beach Blvd
11	338 Crystal Beach Blvd
12	442 Crystal Beach Blvd
13	448 Crystal Beach Blvd
14	452 Crystal Beach Blvd
15	456 Crystal Beach Blvd
16	458 Crystal Beach Blvd
17	460 Crystal Beach Blvd
18	462 Crystal Beach Blvd
19	111 McIntosh Ave

Flood Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #2: Crystal Beach

Flood Risk Score

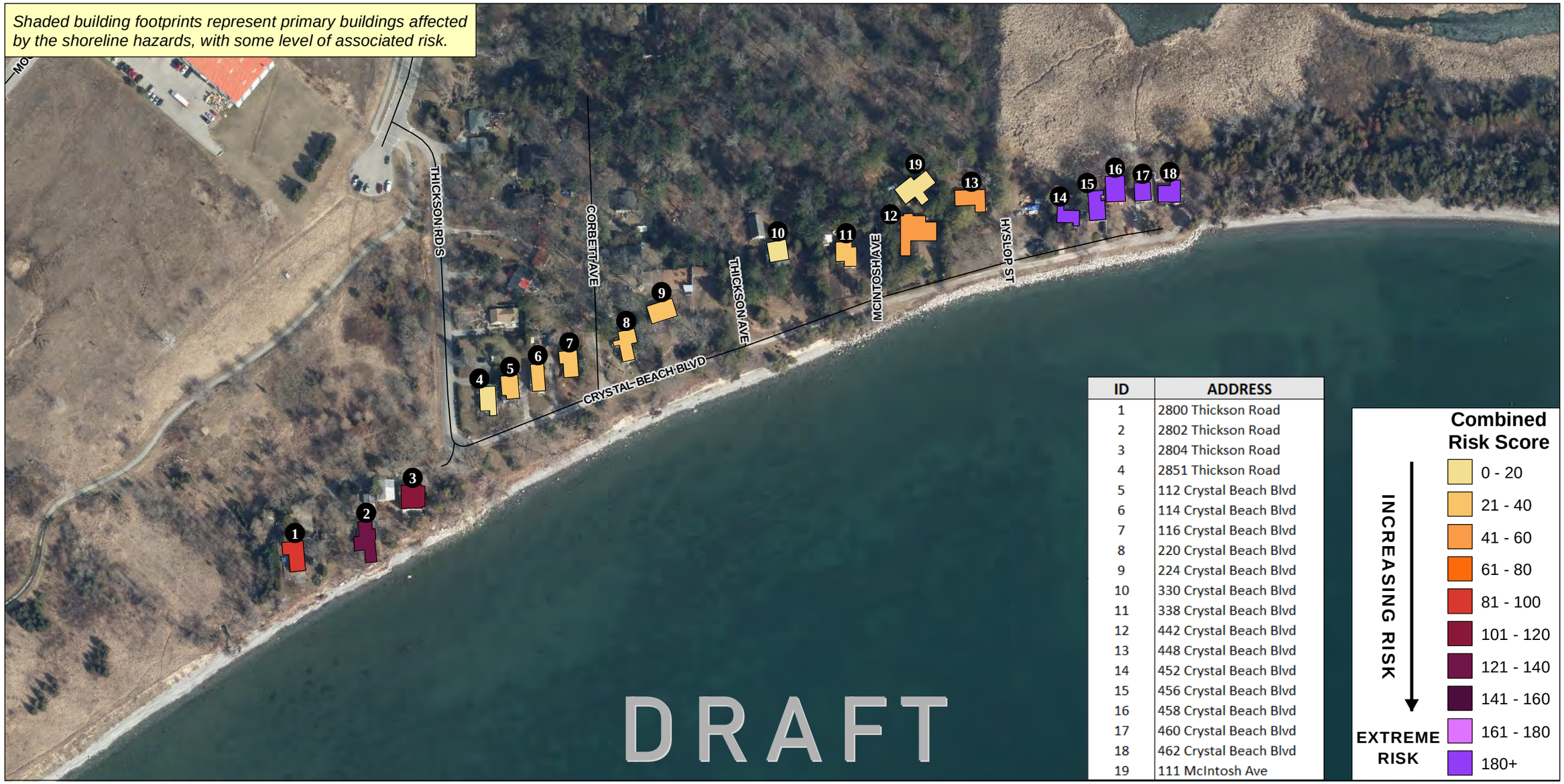
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS
1	2800 Thickson Road
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3	2804 Thickson Road
4	2851 Thickson Road
5	112 Crystal Beach Blvd
6	114 Crystal Beach Blvd
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8	220 Crystal Beach Blvd
9	224 Crystal Beach Blvd
10	330 Crystal Beach Blvd
11	338 Crystal Beach Blvd
12	442 Crystal Beach Blvd
13	448 Crystal Beach Blvd
14	452 Crystal Beach Blvd
15	456 Crystal Beach Blvd
16	458 Crystal Beach Blvd
17	460 Crystal Beach Blvd
18	462 Crystal Beach Blvd
19	111 McIntosh Ave

Combined Risk Score

INCREASING RISK

EXTREME RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160
- 161 - 180
- 180+

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #2: Crystal Beach

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	813 Stone Street	19	721 Stone Street	37	503 Stone Street
2	807 Stone Street	20	717 Stone Street	38	499 Stone Street
3	801 Stone Street	21	709 Stone Street	39	493 Stone Street
4	795 Stone Street	22	705 Stone Street	40	489 Stone Street
5	791 Stone Street	23	701 Stone Street	41	485 Stone Street
6	787 Stone Street	24	695 Stone Street	42	481 Stone Street
7	781 Stone Street	25	689 Stone Street	43	473 Stone Street
8	775 Stone Street	26	683 Stone Street	44	477 Stone Street
9	771 Stone Street	27	677 Stone Street	45	469 Stone Street
10	765 Stone Street	28	673 Stone Street	46	465 Stone Street
11	761 Stone Street	29	671 Stone Street	47	457 Stone Street
12	755 Stone Street	30	663 Stone Street	48	449 Stone Street
13	751 Stone Street	31	657 Stone Street	49	441 Stone Street
14	745 Stone Street	32	651 Stone Street	50	437 Stone Street
15	741 Stone Street	33	515 Stone Street	51	433 Stone Street
16	737 Stone Street	34	511 Stone Street	52	429 Stone Street
17	731 Stone Street	35	507 Stone Street	53	425 Stone Street*
18	727 Stone Street	36	505 Stone Street	*no primary building	

Erosion Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #3: Stone Street

Erosion Risk Score

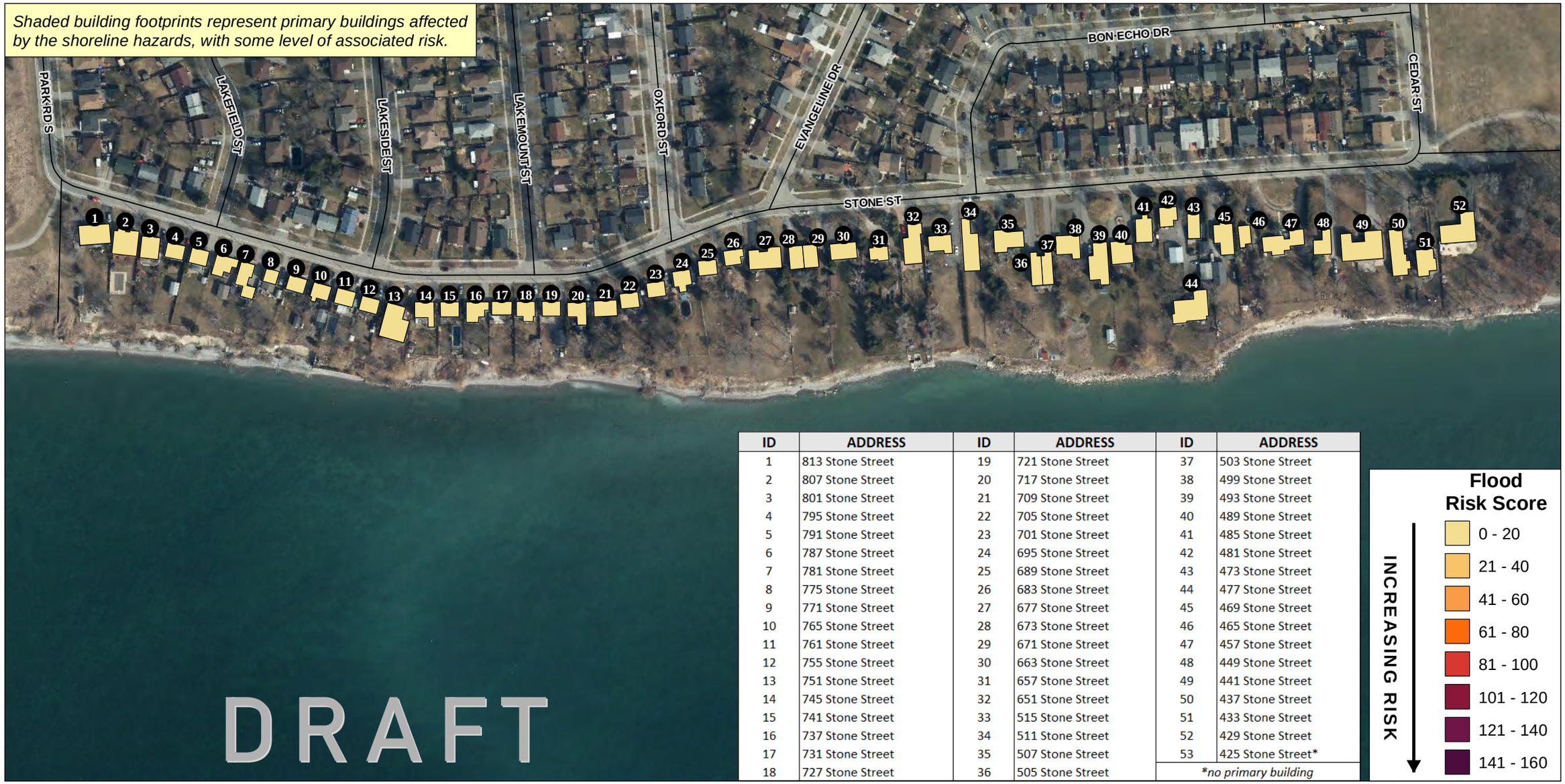
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	813 Stone Street	19	721 Stone Street	37	503 Stone Street
2	807 Stone Street	20	717 Stone Street	38	499 Stone Street
3	801 Stone Street	21	709 Stone Street	39	493 Stone Street
4	795 Stone Street	22	705 Stone Street	40	489 Stone Street
5	791 Stone Street	23	701 Stone Street	41	485 Stone Street
6	787 Stone Street	24	695 Stone Street	42	481 Stone Street
7	781 Stone Street	25	689 Stone Street	43	473 Stone Street
8	775 Stone Street	26	683 Stone Street	44	477 Stone Street
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10	765 Stone Street	28	673 Stone Street	46	465 Stone Street
11	761 Stone Street	29	671 Stone Street	47	457 Stone Street
12	755 Stone Street	30	663 Stone Street	48	449 Stone Street
13	751 Stone Street	31	657 Stone Street	49	441 Stone Street
14	745 Stone Street	32	651 Stone Street	50	437 Stone Street
15	741 Stone Street	33	515 Stone Street	51	433 Stone Street
16	737 Stone Street	34	511 Stone Street	52	429 Stone Street
17	731 Stone Street	35	507 Stone Street	53	425 Stone Street*
18	727 Stone Street	36	505 Stone Street	*no primary building	

Flood Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #3: Stone Street

Flood Risk Score

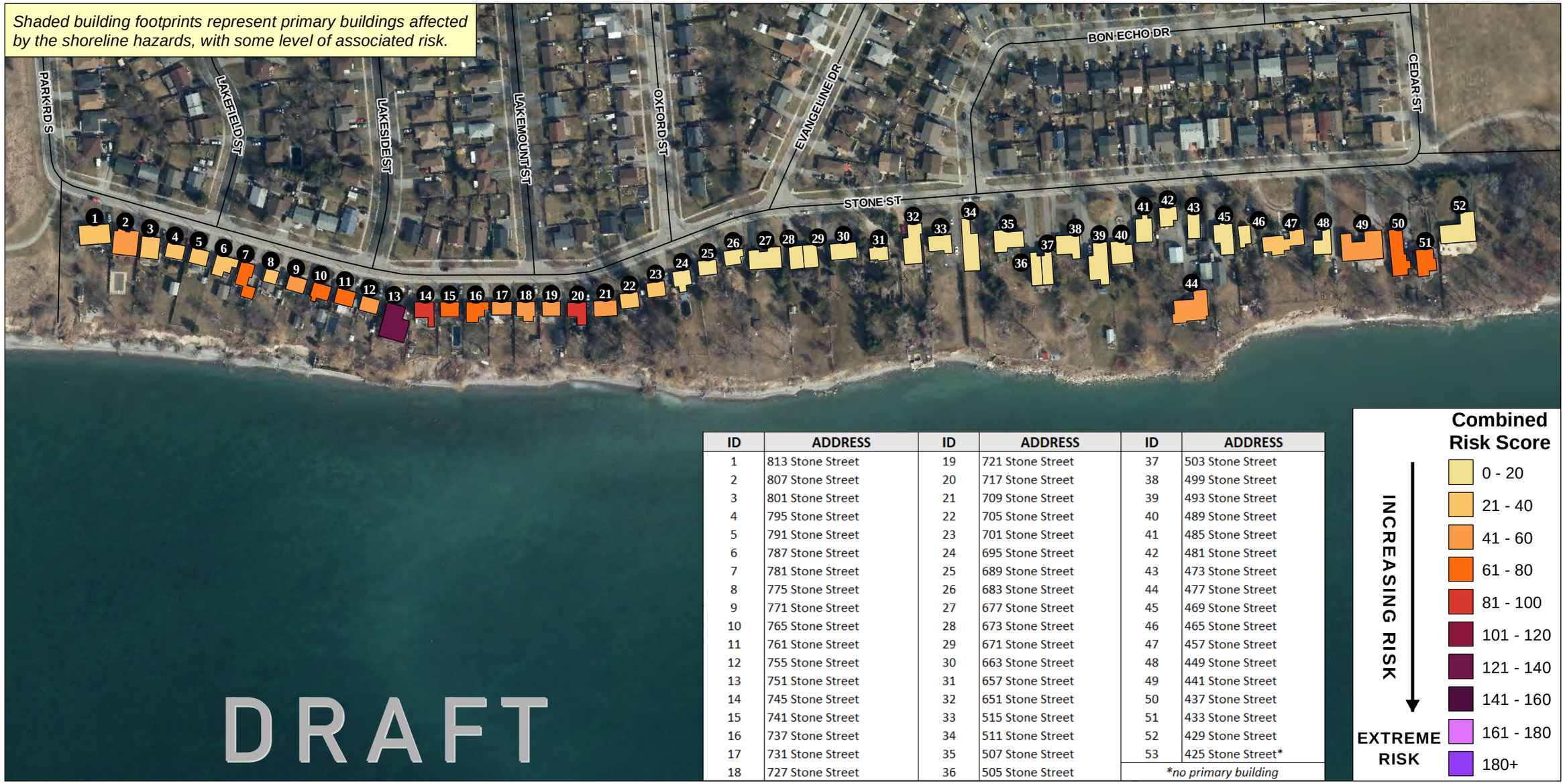
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	813 Stone Street	19	721 Stone Street	37	503 Stone Street
2	807 Stone Street	20	717 Stone Street	38	499 Stone Street
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5	791 Stone Street	23	701 Stone Street	41	485 Stone Street
6	787 Stone Street	24	695 Stone Street	42	481 Stone Street
7	781 Stone Street	25	689 Stone Street	43	473 Stone Street
8	775 Stone Street	26	683 Stone Street	44	477 Stone Street
9	771 Stone Street	27	677 Stone Street	45	469 Stone Street
10	765 Stone Street	28	673 Stone Street	46	465 Stone Street
11	761 Stone Street	29	671 Stone Street	47	457 Stone Street
12	755 Stone Street	30	663 Stone Street	48	449 Stone Street
13	751 Stone Street	31	657 Stone Street	49	441 Stone Street
14	745 Stone Street	32	651 Stone Street	50	437 Stone Street
15	741 Stone Street	33	515 Stone Street	51	433 Stone Street
16	737 Stone Street	34	511 Stone Street	52	429 Stone Street
17	731 Stone Street	35	507 Stone Street	53	425 Stone Street*
18	727 Stone Street	36	505 Stone Street	*no primary building	

Combined Risk Score

INCREASING RISK

EXTREME RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160
- 161 - 180
- 180+

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #3: Stone Street

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

ID	ADDRESS
1	51 Muskoka Ave
2	53 Muskoka Ave
3	55 Muskoka Ave
4	57 Muskoka Ave
5	59 Muskoka Ave
6	61 Muskoka Ave
7	1575 Kluane Ave

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #4: Muskoka Avenue

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

ID	ADDRESS
1	51 Muskoka Ave
2	53 Muskoka Ave
3	55 Muskoka Ave
4	57 Muskoka Ave
5	59 Muskoka Ave
6	61 Muskoka Ave
7	1575 Kluane Ave

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #4: Muskoka Avenue

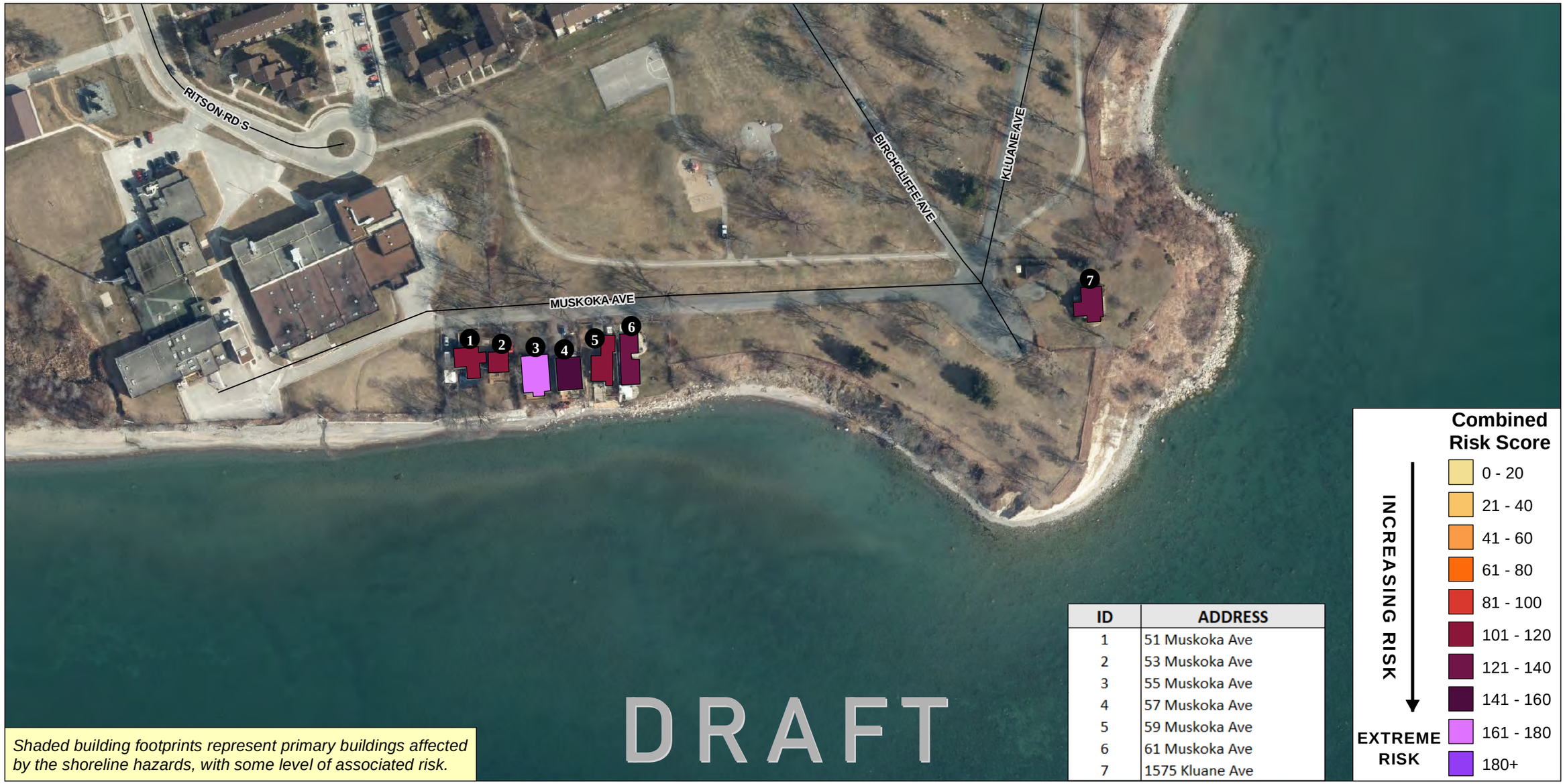
Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m



ID	ADDRESS
1	51 Muskoka Ave
2	53 Muskoka Ave
3	55 Muskoka Ave
4	57 Muskoka Ave
5	59 Muskoka Ave
6	61 Muskoka Ave
7	1575 Kluane Ave

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #4: Muskoka Avenue

Combined Risk Score

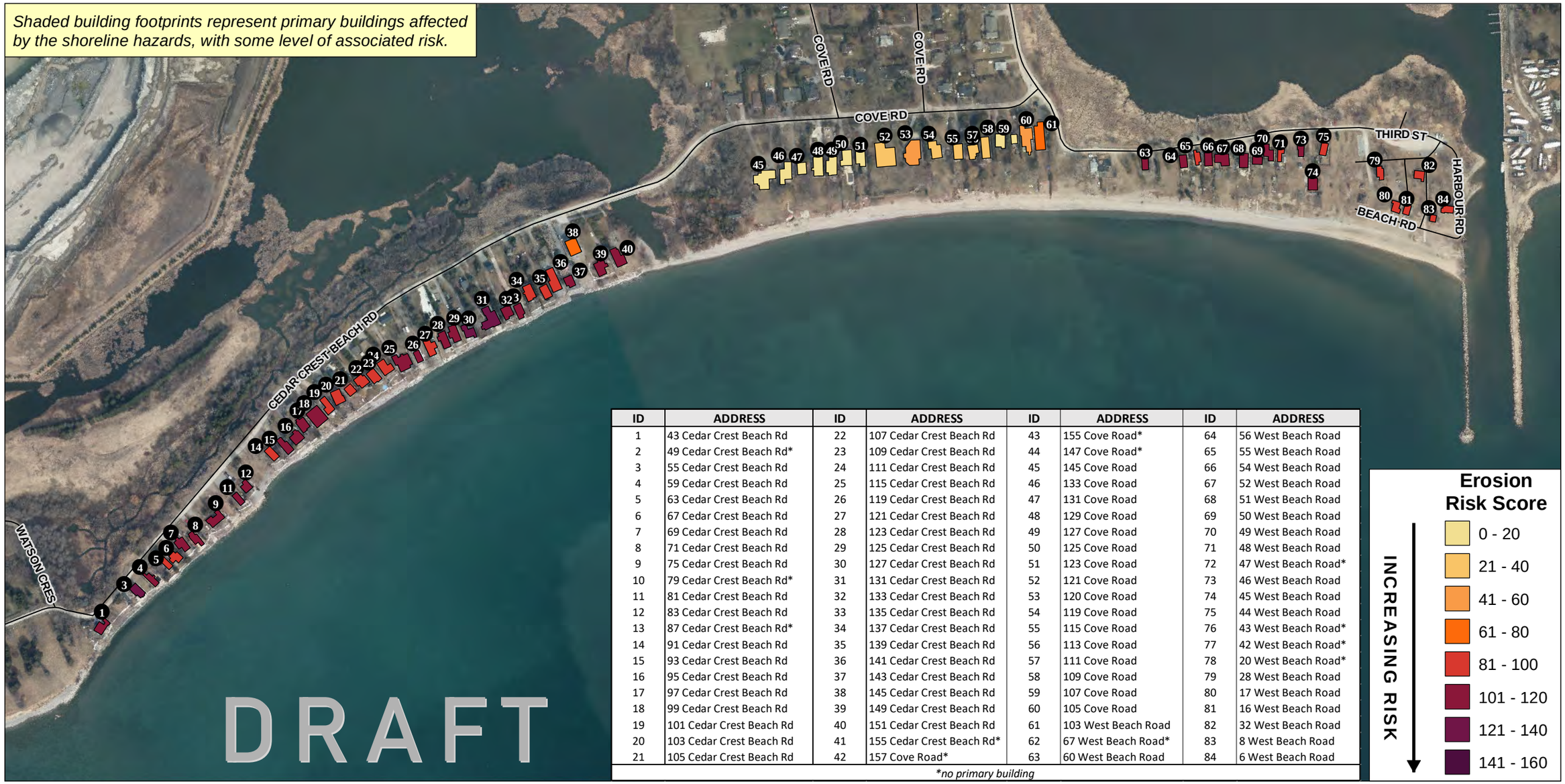
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS	ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	43 Cedar Crest Beach Rd	22	107 Cedar Crest Beach Rd	43	155 Cove Road*	64	56 West Beach Road
2	49 Cedar Crest Beach Rd*	23	109 Cedar Crest Beach Rd	44	147 Cove Road*	65	55 West Beach Road
3	55 Cedar Crest Beach Rd	24	111 Cedar Crest Beach Rd	45	145 Cove Road	66	54 West Beach Road
4	59 Cedar Crest Beach Rd	25	115 Cedar Crest Beach Rd	46	133 Cove Road	67	52 West Beach Road
5	63 Cedar Crest Beach Rd	26	119 Cedar Crest Beach Rd	47	131 Cove Road	68	51 West Beach Road
6	67 Cedar Crest Beach Rd	27	121 Cedar Crest Beach Rd	48	129 Cove Road	69	50 West Beach Road
7	69 Cedar Crest Beach Rd	28	123 Cedar Crest Beach Rd	49	127 Cove Road	70	49 West Beach Road
8	71 Cedar Crest Beach Rd	29	125 Cedar Crest Beach Rd	50	125 Cove Road	71	48 West Beach Road
9	75 Cedar Crest Beach Rd	30	127 Cedar Crest Beach Rd	51	123 Cove Road	72	47 West Beach Road*
10	79 Cedar Crest Beach Rd*	31	131 Cedar Crest Beach Rd	52	121 Cove Road	73	46 West Beach Road
11	81 Cedar Crest Beach Rd	32	133 Cedar Crest Beach Rd	53	120 Cove Road	74	45 West Beach Road
12	83 Cedar Crest Beach Rd	33	135 Cedar Crest Beach Rd	54	119 Cove Road	75	44 West Beach Road
13	87 Cedar Crest Beach Rd*	34	137 Cedar Crest Beach Rd	55	115 Cove Road	76	43 West Beach Road*
14	91 Cedar Crest Beach Rd	35	139 Cedar Crest Beach Rd	56	113 Cove Road	77	42 West Beach Road*
15	93 Cedar Crest Beach Rd	36	141 Cedar Crest Beach Rd	57	111 Cove Road	78	20 West Beach Road*
16	95 Cedar Crest Beach Rd	37	143 Cedar Crest Beach Rd	58	109 Cove Road	79	28 West Beach Road
17	97 Cedar Crest Beach Rd	38	145 Cedar Crest Beach Rd	59	107 Cove Road	80	17 West Beach Road
18	99 Cedar Crest Beach Rd	39	149 Cedar Crest Beach Rd	60	105 Cove Road	81	16 West Beach Road
19	101 Cedar Crest Beach Rd	40	151 Cedar Crest Beach Rd	61	103 West Beach Road	82	32 West Beach Road
20	103 Cedar Crest Beach Rd	41	155 Cedar Crest Beach Rd*	62	67 West Beach Road*	83	8 West Beach Road
21	105 Cedar Crest Beach Rd	42	157 Cove Road*	63	60 West Beach Road	84	6 West Beach Road

**no primary building*

Erosion Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

JL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #5: Port Darlington

Erosion Risk Score

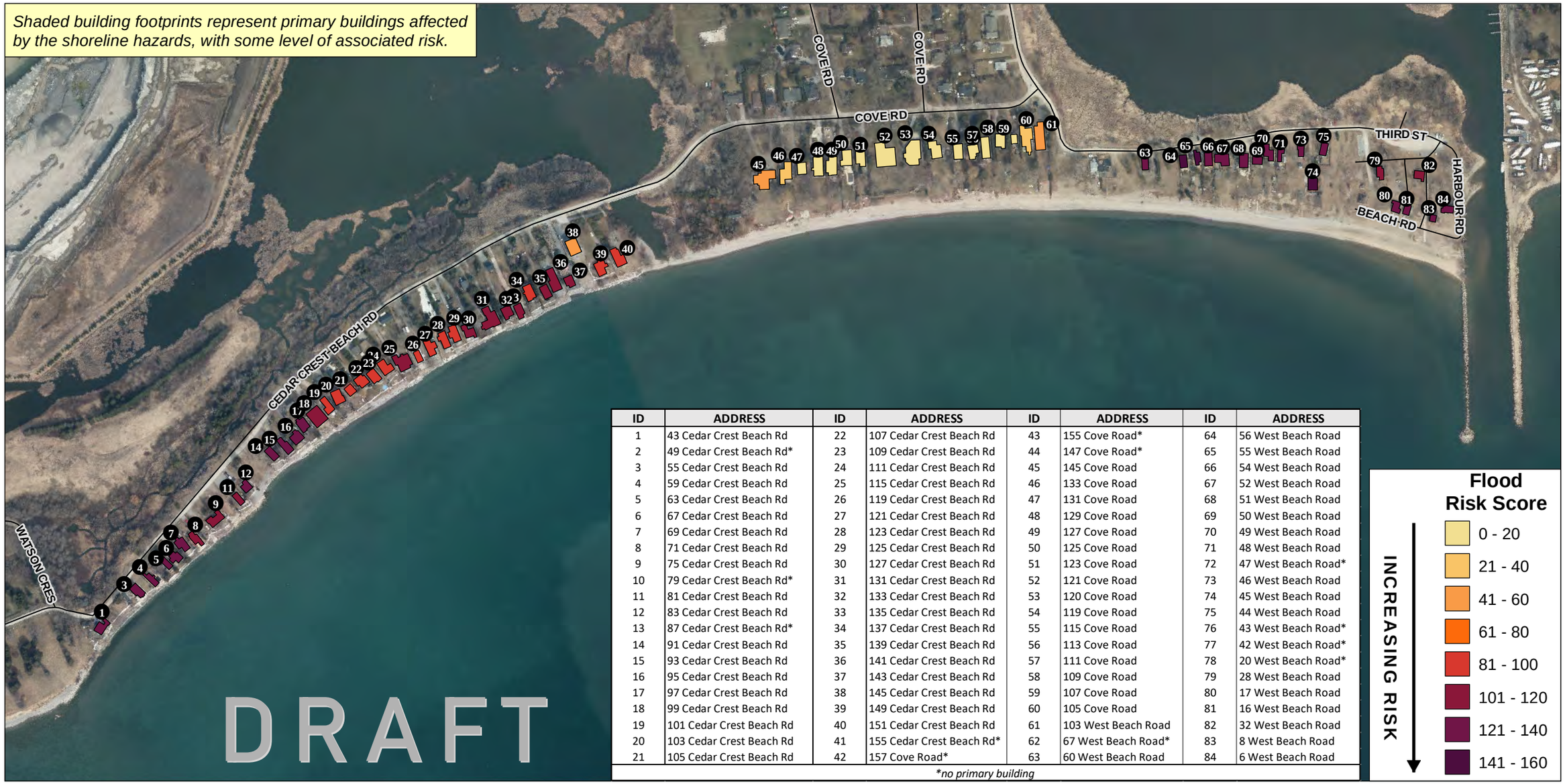
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 100 200
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS	ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	43 Cedar Crest Beach Rd	22	107 Cedar Crest Beach Rd	43	155 Cove Road*	64	56 West Beach Road
2	49 Cedar Crest Beach Rd*	23	109 Cedar Crest Beach Rd	44	147 Cove Road*	65	55 West Beach Road
3	55 Cedar Crest Beach Rd	24	111 Cedar Crest Beach Rd	45	145 Cove Road	66	54 West Beach Road
4	59 Cedar Crest Beach Rd	25	115 Cedar Crest Beach Rd	46	133 Cove Road	67	52 West Beach Road
5	63 Cedar Crest Beach Rd	26	119 Cedar Crest Beach Rd	47	131 Cove Road	68	51 West Beach Road
6	67 Cedar Crest Beach Rd	27	121 Cedar Crest Beach Rd	48	129 Cove Road	69	50 West Beach Road
7	69 Cedar Crest Beach Rd	28	123 Cedar Crest Beach Rd	49	127 Cove Road	70	49 West Beach Road
8	71 Cedar Crest Beach Rd	29	125 Cedar Crest Beach Rd	50	125 Cove Road	71	48 West Beach Road
9	75 Cedar Crest Beach Rd	30	127 Cedar Crest Beach Rd	51	123 Cove Road	72	47 West Beach Road*
10	79 Cedar Crest Beach Rd*	31	131 Cedar Crest Beach Rd	52	121 Cove Road	73	46 West Beach Road
11	81 Cedar Crest Beach Rd	32	133 Cedar Crest Beach Rd	53	120 Cove Road	74	45 West Beach Road
12	83 Cedar Crest Beach Rd	33	135 Cedar Crest Beach Rd	54	119 Cove Road	75	44 West Beach Road
13	87 Cedar Crest Beach Rd*	34	137 Cedar Crest Beach Rd	55	115 Cove Road	76	43 West Beach Road*
14	91 Cedar Crest Beach Rd	35	139 Cedar Crest Beach Rd	56	113 Cove Road	77	42 West Beach Road*
15	93 Cedar Crest Beach Rd	36	141 Cedar Crest Beach Rd	57	111 Cove Road	78	20 West Beach Road*
16	95 Cedar Crest Beach Rd	37	143 Cedar Crest Beach Rd	58	109 Cove Road	79	28 West Beach Road
17	97 Cedar Crest Beach Rd	38	145 Cedar Crest Beach Rd	59	107 Cove Road	80	17 West Beach Road
18	99 Cedar Crest Beach Rd	39	149 Cedar Crest Beach Rd	60	105 Cove Road	81	16 West Beach Road
19	101 Cedar Crest Beach Rd	40	151 Cedar Crest Beach Rd	61	103 West Beach Road	82	32 West Beach Road
20	103 Cedar Crest Beach Rd	41	155 Cedar Crest Beach Rd*	62	67 West Beach Road*	83	8 West Beach Road
21	105 Cedar Crest Beach Rd	42	157 Cove Road*	63	60 West Beach Road	84	6 West Beach Road

**no primary building*

Flood Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

JL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #5: Port Darlington

Flood Risk Score

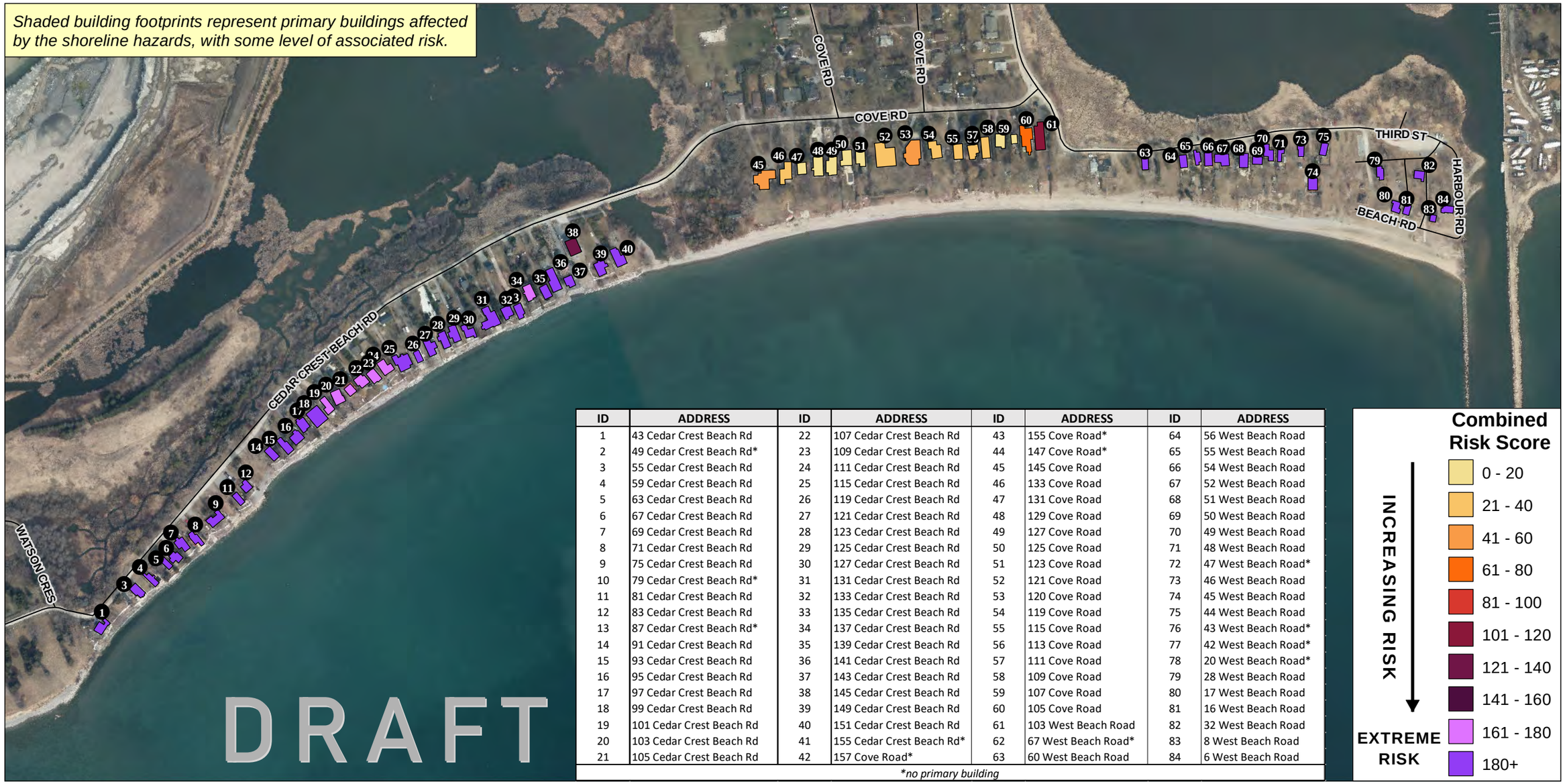
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 100 200
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS	ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	43 Cedar Crest Beach Rd	22	107 Cedar Crest Beach Rd	43	155 Cove Road*	64	56 West Beach Road
2	49 Cedar Crest Beach Rd*	23	109 Cedar Crest Beach Rd	44	147 Cove Road*	65	55 West Beach Road
3	55 Cedar Crest Beach Rd	24	111 Cedar Crest Beach Rd	45	145 Cove Road	66	54 West Beach Road
4	59 Cedar Crest Beach Rd	25	115 Cedar Crest Beach Rd	46	133 Cove Road	67	52 West Beach Road
5	63 Cedar Crest Beach Rd	26	119 Cedar Crest Beach Rd	47	131 Cove Road	68	51 West Beach Road
6	67 Cedar Crest Beach Rd	27	121 Cedar Crest Beach Rd	48	129 Cove Road	69	50 West Beach Road
7	69 Cedar Crest Beach Rd	28	123 Cedar Crest Beach Rd	49	127 Cove Road	70	49 West Beach Road
8	71 Cedar Crest Beach Rd	29	125 Cedar Crest Beach Rd	50	125 Cove Road	71	48 West Beach Road
9	75 Cedar Crest Beach Rd	30	127 Cedar Crest Beach Rd	51	123 Cove Road	72	47 West Beach Road*
10	79 Cedar Crest Beach Rd*	31	131 Cedar Crest Beach Rd	52	121 Cove Road	73	46 West Beach Road
11	81 Cedar Crest Beach Rd	32	133 Cedar Crest Beach Rd	53	120 Cove Road	74	45 West Beach Road
12	83 Cedar Crest Beach Rd	33	135 Cedar Crest Beach Rd	54	119 Cove Road	75	44 West Beach Road
13	87 Cedar Crest Beach Rd*	34	137 Cedar Crest Beach Rd	55	115 Cove Road	76	43 West Beach Road*
14	91 Cedar Crest Beach Rd	35	139 Cedar Crest Beach Rd	56	113 Cove Road	77	42 West Beach Road*
15	93 Cedar Crest Beach Rd	36	141 Cedar Crest Beach Rd	57	111 Cove Road	78	20 West Beach Road*
16	95 Cedar Crest Beach Rd	37	143 Cedar Crest Beach Rd	58	109 Cove Road	79	28 West Beach Road
17	97 Cedar Crest Beach Rd	38	145 Cedar Crest Beach Rd	59	107 Cove Road	80	17 West Beach Road
18	99 Cedar Crest Beach Rd	39	149 Cedar Crest Beach Rd	60	105 Cove Road	81	16 West Beach Road
19	101 Cedar Crest Beach Rd	40	151 Cedar Crest Beach Rd	61	103 West Beach Road	82	32 West Beach Road
20	103 Cedar Crest Beach Rd	41	155 Cedar Crest Beach Rd*	62	67 West Beach Road*	83	8 West Beach Road
21	105 Cedar Crest Beach Rd	42	157 Cove Road*	63	60 West Beach Road	84	6 West Beach Road

**no primary building*

Combined Risk Score

INCREASING RISK

EXTREME RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160
- 161 - 180
- 180+

JL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #5: Port Darlington

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 100 200
m

ID	ADDRESS
1	70 Port Darlington Rd
2	120 Port Darlington Rd
3	70 East Beach Road
4	71 East Beach Road
5	72 East Beach Road
6	73 East Beach Road
7	74 East Beach Road
8	76 East Beach Road
9	78 East Beach Road
10	79 East Beach Road
11	85 East Beach Road*
12	89 East Beach Road*
13	188 Port Darlington Rd
14	220 Port Darlington Rd
15	2728 South Service Rd
16	2736 South Service Rd*
17	2738 South Service Rd
18	2745 South Service Rd

*no primary building

Erosion Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

JL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #6: East Beach Road

Erosion Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

ID	ADDRESS
1	70 Port Darlington Rd
2	120 Port Darlington Rd
3	70 East Beach Road
4	71 East Beach Road
5	72 East Beach Road
6	73 East Beach Road
7	74 East Beach Road
8	76 East Beach Road
9	78 East Beach Road
10	79 East Beach Road
11	85 East Beach Road*
12	89 East Beach Road*
13	188 Port Darlington Rd
14	220 Port Darlington Rd
15	2728 South Service Rd
16	2736 South Service Rd*
17	2738 South Service Rd
18	2745 South Service Rd

*no primary building

Flood Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

JL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #6: East Beach Road

Flood Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

ID	ADDRESS
1	70 Port Darlington Rd
2	120 Port Darlington Rd
3	70 East Beach Road
4	71 East Beach Road
5	72 East Beach Road
6	73 East Beach Road
7	74 East Beach Road
8	76 East Beach Road
9	78 East Beach Road
10	79 East Beach Road
11	85 East Beach Road*
12	89 East Beach Road*
13	188 Port Darlington Rd
14	220 Port Darlington Rd
15	2728 South Service Rd
16	2736 South Service Rd*
17	2738 South Service Rd
18	2745 South Service Rd

*no primary building

Combined Risk Score

INCREASING RISK

EXTREME RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160
- 161 - 180
- 180+

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.

SJL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #6: East Beach Road

Combined Risk Score

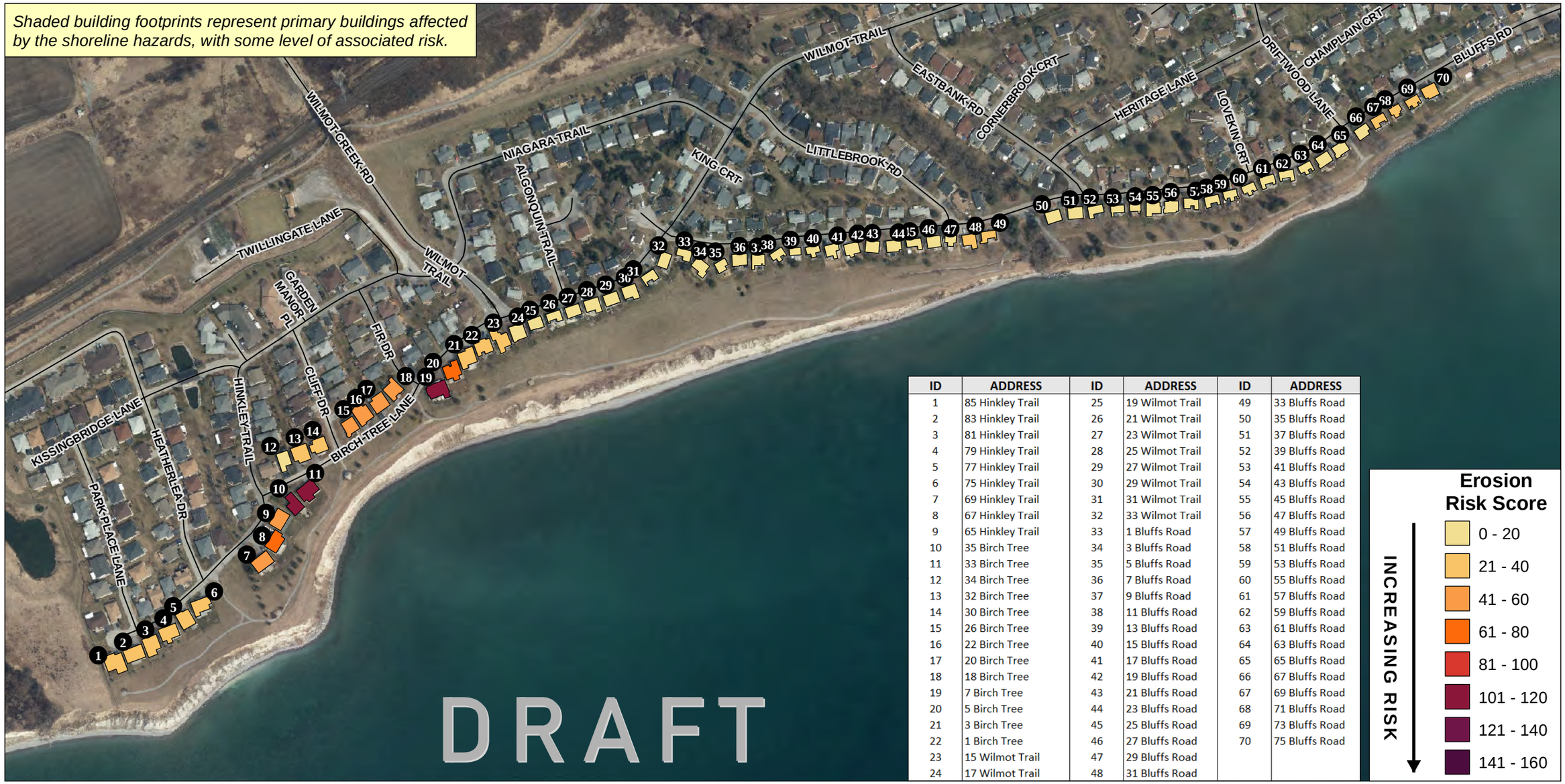
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	85 Hinkley Trail	25	19 Wilmot Trail	49	33 Bluffs Road
2	83 Hinkley Trail	26	21 Wilmot Trail	50	35 Bluffs Road
3	81 Hinkley Trail	27	23 Wilmot Trail	51	37 Bluffs Road
4	79 Hinkley Trail	28	25 Wilmot Trail	52	39 Bluffs Road
5	77 Hinkley Trail	29	27 Wilmot Trail	53	41 Bluffs Road
6	75 Hinkley Trail	30	29 Wilmot Trail	54	43 Bluffs Road
7	69 Hinkley Trail	31	31 Wilmot Trail	55	45 Bluffs Road
8	67 Hinkley Trail	32	33 Wilmot Trail	56	47 Bluffs Road
9	65 Hinkley Trail	33	1 Bluffs Road	57	49 Bluffs Road
10	35 Birch Tree	34	3 Bluffs Road	58	51 Bluffs Road
11	33 Birch Tree	35	5 Bluffs Road	59	53 Bluffs Road
12	34 Birch Tree	36	7 Bluffs Road	60	55 Bluffs Road
13	32 Birch Tree	37	9 Bluffs Road	61	57 Bluffs Road
14	30 Birch Tree	38	11 Bluffs Road	62	59 Bluffs Road
15	26 Birch Tree	39	13 Bluffs Road	63	61 Bluffs Road
16	22 Birch Tree	40	15 Bluffs Road	64	63 Bluffs Road
17	20 Birch Tree	41	17 Bluffs Road	65	65 Bluffs Road
18	18 Birch Tree	42	19 Bluffs Road	66	67 Bluffs Road
19	7 Birch Tree	43	21 Bluffs Road	67	69 Bluffs Road
20	5 Birch Tree	44	23 Bluffs Road	68	71 Bluffs Road
21	3 Birch Tree	45	25 Bluffs Road	69	73 Bluffs Road
22	1 Birch Tree	46	27 Bluffs Road	70	75 Bluffs Road
23	15 Wilmot Trail	47	29 Bluffs Road		
24	17 Wilmot Trail	48	31 Bluffs Road		

Erosion Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

JL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #7: Wilmot Creek

Erosion Risk Score

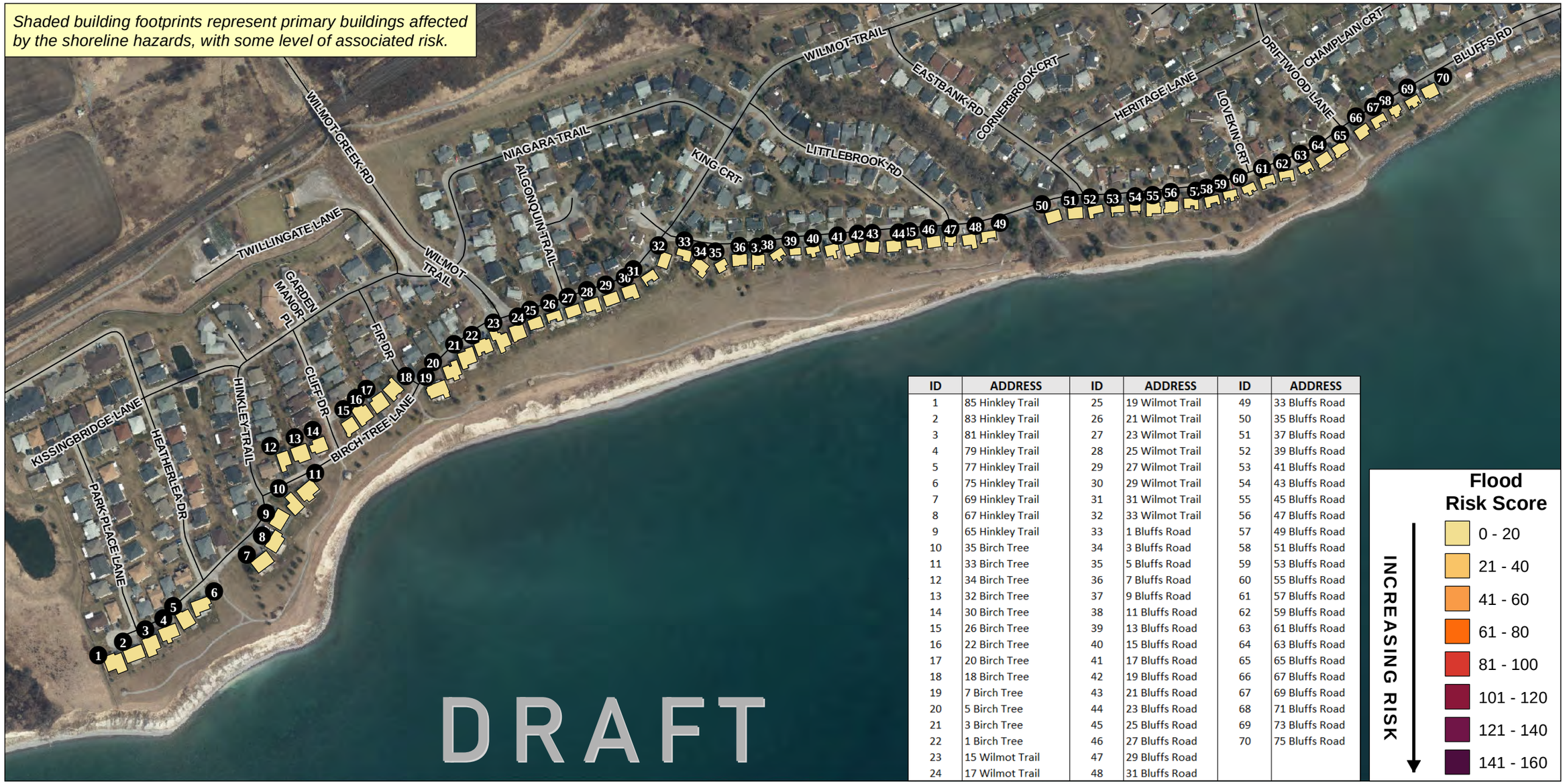
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	85 Hinkley Trail	25	19 Wilmot Trail	49	33 Bluffs Road
2	83 Hinkley Trail	26	21 Wilmot Trail	50	35 Bluffs Road
3	81 Hinkley Trail	27	23 Wilmot Trail	51	37 Bluffs Road
4	79 Hinkley Trail	28	25 Wilmot Trail	52	39 Bluffs Road
5	77 Hinkley Trail	29	27 Wilmot Trail	53	41 Bluffs Road
6	75 Hinkley Trail	30	29 Wilmot Trail	54	43 Bluffs Road
7	69 Hinkley Trail	31	31 Wilmot Trail	55	45 Bluffs Road
8	67 Hinkley Trail	32	33 Wilmot Trail	56	47 Bluffs Road
9	65 Hinkley Trail	33	1 Bluffs Road	57	49 Bluffs Road
10	35 Birch Tree	34	3 Bluffs Road	58	51 Bluffs Road
11	33 Birch Tree	35	5 Bluffs Road	59	53 Bluffs Road
12	34 Birch Tree	36	7 Bluffs Road	60	55 Bluffs Road
13	32 Birch Tree	37	9 Bluffs Road	61	57 Bluffs Road
14	30 Birch Tree	38	11 Bluffs Road	62	59 Bluffs Road
15	26 Birch Tree	39	13 Bluffs Road	63	61 Bluffs Road
16	22 Birch Tree	40	15 Bluffs Road	64	63 Bluffs Road
17	20 Birch Tree	41	17 Bluffs Road	65	65 Bluffs Road
18	18 Birch Tree	42	19 Bluffs Road	66	67 Bluffs Road
19	7 Birch Tree	43	21 Bluffs Road	67	69 Bluffs Road
20	5 Birch Tree	44	23 Bluffs Road	68	71 Bluffs Road
21	3 Birch Tree	45	25 Bluffs Road	69	73 Bluffs Road
22	1 Birch Tree	46	27 Bluffs Road	70	75 Bluffs Road
23	15 Wilmot Trail	47	29 Bluffs Road		
24	17 Wilmot Trail	48	31 Bluffs Road		

Flood Risk Score

INCREASING RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160

JL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #7: Wilmot Creek

Flood Risk Score

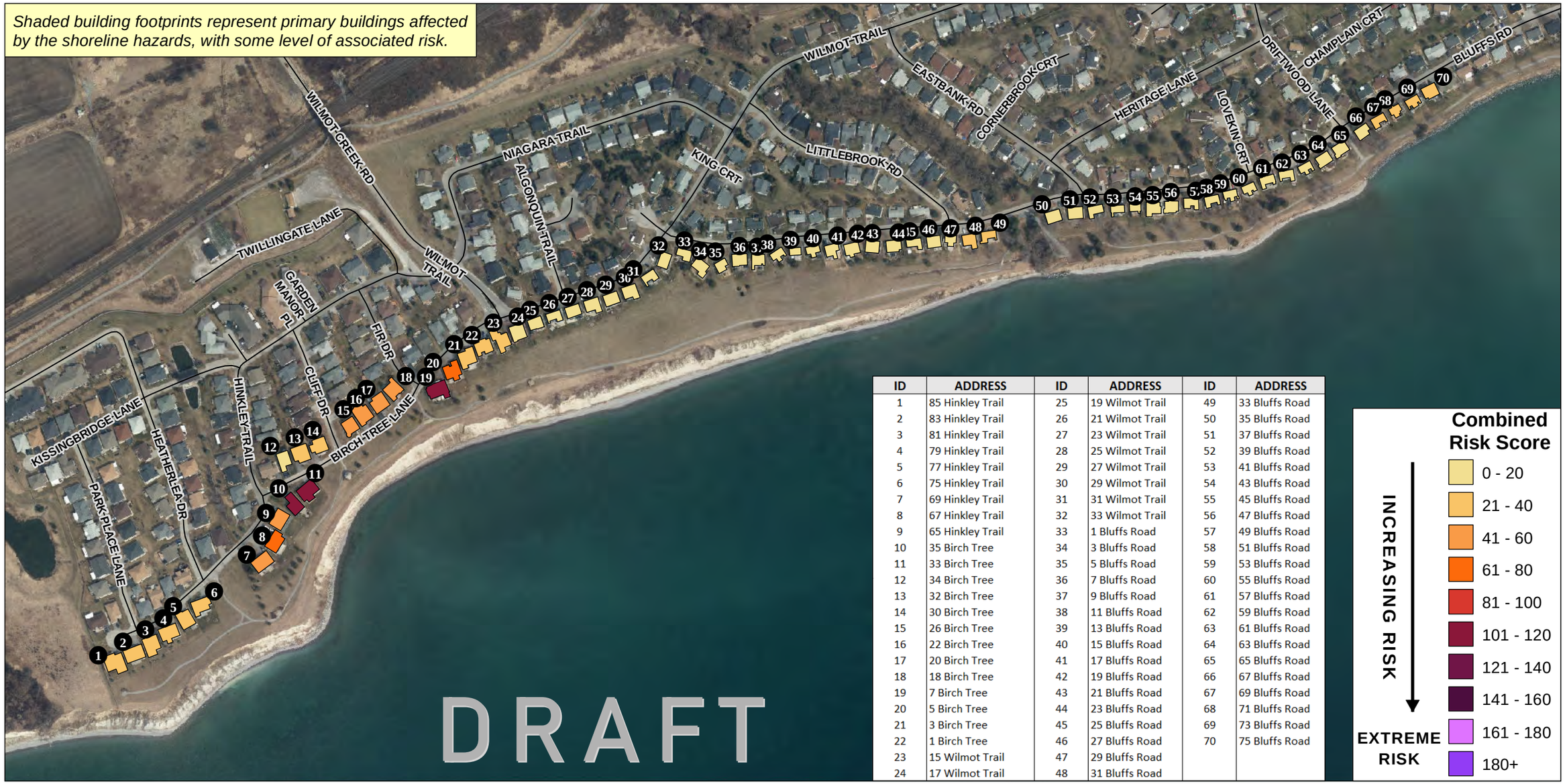
Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

Shaded building footprints represent primary buildings affected by the shoreline hazards, with some level of associated risk.



ID	ADDRESS	ID	ADDRESS	ID	ADDRESS
1	85 Hinkley Trail	25	19 Wilmot Trail	49	33 Bluffs Road
2	83 Hinkley Trail	26	21 Wilmot Trail	50	35 Bluffs Road
3	81 Hinkley Trail	27	23 Wilmot Trail	51	37 Bluffs Road
4	79 Hinkley Trail	28	25 Wilmot Trail	52	39 Bluffs Road
5	77 Hinkley Trail	29	27 Wilmot Trail	53	41 Bluffs Road
6	75 Hinkley Trail	30	29 Wilmot Trail	54	43 Bluffs Road
7	69 Hinkley Trail	31	31 Wilmot Trail	55	45 Bluffs Road
8	67 Hinkley Trail	32	33 Wilmot Trail	56	47 Bluffs Road
9	65 Hinkley Trail	33	1 Bluffs Road	57	49 Bluffs Road
10	35 Birch Tree	34	3 Bluffs Road	58	51 Bluffs Road
11	33 Birch Tree	35	5 Bluffs Road	59	53 Bluffs Road
12	34 Birch Tree	36	7 Bluffs Road	60	55 Bluffs Road
13	32 Birch Tree	37	9 Bluffs Road	61	57 Bluffs Road
14	30 Birch Tree	38	11 Bluffs Road	62	59 Bluffs Road
15	26 Birch Tree	39	13 Bluffs Road	63	61 Bluffs Road
16	22 Birch Tree	40	15 Bluffs Road	64	63 Bluffs Road
17	20 Birch Tree	41	17 Bluffs Road	65	65 Bluffs Road
18	18 Birch Tree	42	19 Bluffs Road	66	67 Bluffs Road
19	7 Birch Tree	43	21 Bluffs Road	67	69 Bluffs Road
20	5 Birch Tree	44	23 Bluffs Road	68	71 Bluffs Road
21	3 Birch Tree	45	25 Bluffs Road	69	73 Bluffs Road
22	1 Birch Tree	46	27 Bluffs Road	70	75 Bluffs Road
23	15 Wilmot Trail	47	29 Bluffs Road		
24	17 Wilmot Trail	48	31 Bluffs Road		

Combined Risk Score

INCREASING RISK

EXTREME RISK

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100
- 101 - 120
- 121 - 140
- 141 - 160
- 161 - 180
- 180+

JL ENGINEERING

Zuzek inc. ONE WORLD

Shoreline Damage Centre #7: Wilmot Creek

Combined Risk Score

Lake Ontario Shoreline Hazard Summary, Risk Assessment and Management Plan

Notes:
1) 2018 orthos provided by CLOCA.
2) Building footprints provided by Durham Region

N W E S

0 50 100
m

APPENDIX D

RISK MITIGATION STRATEGY EVALUATION

SDC #1 - Ontoro Blvd. (all at risk properties)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	Long-Term Maintenance Requirements / Lifecycle Costs	Constructability / Ease of Implementation	Integrates with Existing Shoreline Protection	Applicable to Community-Scale Implementation	Impact on physical processes	Ability to Integrate Ecosystem / Habitat Enhancements	Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	0	3	0	2	2	0	2	1	2
			2	Raising a building foundation	1		1	1	2	1	0	1	0	2	1	1
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	2	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2	1	2	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1	1	1	2	1	0	1	2	0	0	0
			3	Beach nourishment	1	1	0	0	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1	1	0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2	2	2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	12	6	
			2	Raising a building foundation	0	16	8	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	16	8	
			6	Emergency preparedness and planning	16	16	16	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	36	27	32	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	12	12	12	6
			3	Beach nourishment	13	0	7	5
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	10	10	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	44	44	2
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #2 - Crystal Beach A (2800, 2802, 2804 Thickson Road)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	2	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	36	0	18	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	5
			3	Beach nourishment	12	0	6	6
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

SDC #2 - Crystal Beach B (2851 Thickson Road, 112 - 442 Crystal Beach Blvd., 111 McIntosh Road)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	Long-Term Maintenance Requirements / Lifecycle Costs	Constructability / Ease of Implementation	Integrates with Existing Shoreline Protection	Applicable to Community-Scale Implementation	Impact on physical processes	Ability to Integrate Ecosystem / Habitat Enhancements	Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	1	1		0	3	2	2	2	2	2	2	0
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	1	2	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	15	0	8	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	40	0	20	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	5
			3	Beach nourishment	13	0	7	6
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

SDC #2 - Crystal Beach C (448 - 462 Crystal Beach Blvd)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	1	3	1	2	2	0	2	1	2
			2	Raising a building foundation	1		1	1	2	1	0	1	0	2	1	1
			3	Raise road elevations	1	1	1	1	1	1	0	1	2	2	1	2
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	0	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2	1	1	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1	1	1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	2	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0											
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2	2	2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	26	13	7
			2	Raising a building foundation	0	16	8	8
			3	Raise road elevations	20	20	20	4
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	14	7	9
			6	Emergency preparedness and planning	16	16	16	5
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	27	18	23	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	14	14	6
			3	Beach nourishment	14	0	7	9
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	0	0	
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	44	44	2
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #3 - Stone Street (all at risk properties)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	36	0	18	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	5
			3	Beach nourishment	13	0	7	6
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

SDC #4 - Muskoka Ave

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	Long-Term Maintenance Requirements / Lifecycle Costs	Constructability / Ease of Implementation	Integrates with Existing Shoreline Protection	Applicable to Community-Scale Implementation	Impact on physical processes	Ability to Integrate Ecosystem / Habitat Enhancements	Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	1	1		0	3	2	2	2	2	2	2	0
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	0	3	1	2	2	0	2	1	2
			2	Raising a building foundation	1		1	1	2	1	0	2	0	2	1	1
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	0	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2	1	1	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1	1	1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	2	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0											
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2	2	2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	15	0	8	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	13	7	9
			2	Raising a building foundation	0	18	9	6
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	14	7	7
			6	Emergency preparedness and planning	16	16	16	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	27	18	23	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	14	14	5
			3	Beach nourishment	14	0	7	7
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	0	0	
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	44	44	2
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #6 - East Beach Road A (70 & 120 Port Darlington Road)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	0	3	1	1	2	0	2	1	2
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	1		1	0	1	1	1	2	0	2	1	
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	0	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	1	1	1	1	1	0	2	2	2	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	0											
			3	Beach nourishment	0											
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0											
			2	Relocate buildings offsite (i.e. different or new property parcel)	0											
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	12	6	5
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	8	4	6
			5	Locate high value assets in areas of highest elevation within home or property	0	14	7	4
			6	Emergency preparedness and planning	16	16	16	3
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	20	20	20	2
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	0	0	0	
			3	Beach nourishment	0	0	0	
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	0	0	
			2	Relocate buildings offsite (i.e. different or new property parcel)	0	0	0	
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #6 - East Beach Road B (70 - 89 East Beach Rd., 188 - 220 Port Darlington Rd.)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	0	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		1	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	1	1		1	3	0	0	2	2	2	2	1
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1											
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	6
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	32	0	16	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	7
			3	Beach nourishment	26	0	13	4
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	24	0	12	5
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	0	0	
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1

SDC #6 - East Beach Road C (2728 - 2745 South Service Rd.)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	Long-Term Maintenance Requirements / Lifecycle Costs	Constructability / Ease of Implementation	Integrates with Existing Shoreline Protection	Applicable to Community-Scale Implementation	Impact on physical processes	Ability to Integrate Ecosystem / Habitat Enhancements	Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1	1	0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0											
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	1		1	0	3	1	2	2	0	2	1	2
			2	Raising a building foundation	1		1	1	2	1	0	2	0	2	1	1
			3	Raise road elevations	1											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	1		1	0	3	2	2	2	0	2	1	2
			6	Emergency preparedness and planning	1	1	1	0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2	1	1	2	1	1	1	1	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1	1	1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	2	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	1	1		1	3	0	0	2	2	2	2	1
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	0	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2	2	2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2	2	2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	15	15	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	0	0	0	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	13	7	10
			2	Raising a building foundation	0	18	9	7
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	14	7	8
			6	Emergency preparedness and planning	16	16	16	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	27	18	23	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	14	14	5
			3	Beach nourishment	14	0	7	8
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	24	0	12	6
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	11
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	44	44	2
			3	Property buyback program (willing seller / willing buyer)	52	52	52	1

SDC #7 - Wilmot Creek (all at risk properties)

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Applicable to SDC?	MULTIPLIERS: Ability to mitigate erosion risk*	MULTIPLIERS: Ability to mitigate flood risk*	MULTIPLIERS: Adaptability to Future Extremes (i.e. climate change)	EVALUATION CATEGORIES: Capital Cost	EVALUATION CATEGORIES: Long-Term Maintenance Requirements / Lifecycle Costs	EVALUATION CATEGORIES: Constructability / Ease of Implementation	EVALUATION CATEGORIES: Integrates with Existing Shoreline Protection	EVALUATION CATEGORIES: Applicable to Community-Scale Implementation	EVALUATION CATEGORIES: Impact on physical processes	EVALUATION CATEGORIES: Ability to Integrate Ecosystem / Habitat Enhancements	EVALUATION CATEGORIES: Regulatory / Zoning Requirements
					0 - No 1 - Yes	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Cannot mitigate risk 1 - Can reduce risk 2 - Can mitigate risk	0 - Low adaptability 1 - Med. Adaptability 2 - High. Adaptability	0 - >500k 1 - 200k to 500k 2 - 50k - 200k 3 - 0 to 50k	0 - Frequent maintenance requirements and cost (<10 years) 1 - Infrequent maintenance requirements and costs (>10 years) 2 - No maintenance requirements/cost	0 - Access limitations, specialized or large scale construction 1 - Typical medium-scale construction project 2 - Minor construction project / no construction	0 - Existing infrastructure requires removal 1 - Existing infrastructure can be reused in part 2 - Builds upon existing infrastructure (i.e. no change required)	0 - Cannot be scaled 1 - Scales but with challenges 2 - Easily scaleable	0 - May have significant negative impact on physical processes 1 - May have minor negative impact on physical processes 2 - Not expected to negatively impact physical processes	0 - Negative impacts to ecosystems / habitat likely 1 - No net impacts to ecosystems / habitat 2 - Net improvement to ecosystems / habitat possible	0 - Extensive regulatory / zoning requirements 1 - Regulatory / zoning investigations necessary 2 - Minor or no regulatory / zoning requirements
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	1	1		0	3	2	2	2	2	2	1	1
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	1	1		0	3	2	2	2	2	2	2	0
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0											
			2	Raising a building foundation	0											
			3	Raise road elevations	0											
			4	Upgrades to stormwater management systems	0											
			5	Locate high value assets in areas of highest elevation within home or property	0											
			6	Emergency preparedness and planning	1	1		0	3	2	2	2	2	2	1	2
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	1	2		2	2	1	1	1	2	1	1	1
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	1	1		1	2	1	0	2	2	0	0	0
			3	Beach nourishment	1	1		0	3	0	1	2	2	2	2	1
			4	Dune restoration	0											
			5	Mechanical or hydraulic sediment bypassing	0											
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	1	1		0	2	2	0	2	0	2	1	1
			2	Relocate buildings offsite (i.e. different or new property parcel)	1	2		2	1	2	0	2	1	2	2	1
			3	Property buyback program (willing seller / willing buyer)	1	2		2	0	2	2	2	2	2	2	1

*If properly designed

	Description	Appropriate Risk Level	#	Examples of Strategy Implementation	Erosion Score	Flood Score	Combined Score	RANK
AVOID	Reduce future exposure to risk by ensuring new development doesn't occur on hazardous land	All levels	1	Planning and regulatory changes to limit re-development/additions within the hazards	15	0	8	
			2	Planning/zoning to incorporate natural shoreline buffers and public open space	15	0	8	
ACCOMMODATE	Adaptive strategy that permits continued occupation of hazardous lands while changes to human activities or infrastructure are made to reduce the risk	Low - High	1	Floodproofing a home through the installation of flood gates, opening shields, backflow valves, sump pumps etc.	0	0	0	
			2	Raising a building foundation	0	0	0	
			3	Raise road elevations	0	0	0	
			4	Upgrades to stormwater management systems	0	0	0	
			5	Locate high value assets in areas of highest elevation within home or property	0	0	0	
			6	Emergency preparedness and planning	16	0	8	4
PROTECT	A reactive strategy to protect people, property and infrastructure from exposure to the risk (traditional engineering or nature based)	Low - High	1	Conventional shoreline protection structures (shore-parallel structures - seawall, revetment)	40	0	20	3
			2	Beach retention / shoreline stabilization structures (shore-perpendicular structures - groynes, jetties)	14	0	7	5
			3	Beach nourishment	13	0	7	6
			4	Dune restoration	0	0	0	
			5	Mechanical or hydraulic sediment bypassing	0	0	0	
RETREAT	Strategic decision to change land use or relocate public and private assets exposed to significant risk due to coastal hazards	High - Extreme	1	Relocate buildings a short distance (i.e. deep lots)	10	0	5	7
			2	Relocate buildings offsite (i.e. different or new property parcel)	44	0	22	2
			3	Property buyback program (willing seller / willing buyer)	52	0	26	1