6. Description of the Preferred Alternative

This chapter describes the conceptual design of the preferred alternative and the phasing plan and techniques proposed to construct the undertaking.

6.1 Overview of the Conceptual Design

The conceptual design for the DMNP includes the following components:

- Flood protection features;
- Sediment, debris, and ice management;
- Naturalization;
- Public realm and open space; and
- Integration with the Lower Don Lands planning and servicing.

The various components are described in their built-out state in the following sections. Minimum design requirements for these components are described throughout **Section 6.1** in ***italicized bold*** text; these minimum requirements reflect approximate dimensions (including area) that were developed during conceptual design and must be maintained (or enhanced) during functional and detailed design. The minimum design requirements are summarized at the end of this section in **Table 6-4**, along with the technical issues and constraints that have influenced the design, including: existing conditions; the fixed components of the design; and opportunities for flexibility.

All components of the design have been developed with Waterfront Toronto's Sustainability Framework in mind. As described in **Chapter 2**, the Sustainability Framework provides the overarching corporate policy for the integration of sustainability principles into all facets of decision making and project delivery. **Table 6-1** identifies how the objectives of the Sustainability Framework have been incorporated into the design.

Table 6-1 How Sustainability is Addressed in the Design

Waterfront Toronto Sustainability Framework Objectives	How the Objective is Addressed in the Conceptual Design
Recapture Value of Abandoned and Underused Sites • Redevelop abandoned sites	• Creation of a new valley system will involve redevelopment of contaminated sites that are either abandoned or underused and allow for reuse of adjacent lands that are currently underused due to flooding constraints
State-of-the-Art Integrated Soil Management • Safe and effective management of contaminated soils.	• Treatment of contaminated soils at a nearby Soil Recycling Facility is one option being considered for how to manage soils that are excavated from the site
Protect Groundwater from Contamination • Minimize risks from contaminated sites. • Implementation of Waterfront Toronto's Integrated Groundwater Management Soil Strategy.	• The design of the river valley includes a selectively permeable or impermeable barrier to isolate contaminated groundwater from clean soils and water • Construction techniques have also been identified to ensure that clean stormwater does not intercept contaminated groundwater during excavation

Table 6-1 How Sustainability is Addressed in the Design

Waterfront Toronto Sustainability Framework Objectives	How the Objective is Addressed in the Conceptual Design
Enhanced Terrestrial and Aquatic Habitat • Site design that accommodates animal and aquatic habitat. • Habitat enhancement along the water's edge and more wetland. • Create and maintain networks of natural systems both within the site and beyond its boundaries including linking the Don River corridor, Cherry Beach, Lake Ontario Park and the Leslie Street Spit. • Infrastructure creation that facilitates understanding, appreciation, and use of fish and wildlife resources	• Over 33 ha of terrestrial and aquatic habitat are being created, including 13 ha of wetland habitat, 12 ha of permanent aquatic habitat, and 8 ha of terrestrial habitat • All 33 ha are either in-water or along the water's edge and contribute to improved connectivity between the site and adjacent natural systems • Existing infrastructure within the Keating Channel will be redesigned to provide for enhanced fish habitat
Extensive Habitat Improvement • Restoration and enhancement of natural communities in accordance with soil, topographic and hydrologic conditions. • Protect and restore habitat for all wildlife, including migratory birds. • Create and maintain networks of green space throughout the waterfront as identified in the Toronto and Region Terrestrial Natural Heritage System Strategy	• Refer to bullet points above
Strengthen Native Biodiversity • Ground cover with a diversity of indigenous plant species. • Identify native plants most suitable for waterfront revitalization	• Although a planting plan is not included in this EA, it is intended that plants used to establish the naturalized communities will be indigenous
Increase Walking, Cycling and Public Transit Use • Create trail system, bike paths and pedestrian linkages with and between waterfront neighbourhoods and the rest of the City.	• A cycling and pedestrian trail system has been provided for adjacent to the river within the river floodplain. It will be a major connecting link between the Don Valley trail system, the Don Greenway, and the Martin Goodman Trail, as well as the various natural communities in the Lower Don Lands
Waterfront Communities that Attract People Year Round • Enhance recreational features. • Create and maintain green and open spaces that are suitable for a wide range of recreational activities and park land. • Develop winter recreational programs across the Toronto waterfront • Create extensive year-round walking, biking, fishing, and boating opportunities	• The conceptual design includes over 13 ha of open space, which is intended to accommodate a range of passive and active recreational uses while providing some habitat value • Recreational boating opportunities will be enhanced by the creation of a new low flow channel
Protect and Enhance Existing Cultural and Heritage Resources, Including Built Heritage • Understand the nature and extent of existing waterfront built and cultural heritage and archaeological resources and how they can be integrated as part of sustainable community development. • Develop an operational strategy for integrating cultural heritage resources into planning and design for site, buildings and infrastructure using approaches such as restoration, adaptive re-use and public art.	• The location of the new valley system allows for the continued existence of the Keating Channel in a modified form, and avoids many existing built and cultural heritage resources within the Project Study Area. • Those resources that are within or adjacent to the floodplain, including the Marine Terminal building and the easternmost Harbour Commissioners storage building will be relocated where feasible or otherwise commemorated.

6.1.1 Flood Protection Features

The conceptual design is comprised of a number of flood protection features, which include:

- River valley formation;
- East bank flood protection landform;
- Modifications to grades surrounding Eastern Avenue at the Kingston Subdivision grade separation (near the BMW site);
- Keating Channel weirs; and
- Grading and setbacks of development areas.

The primary technical issue influencing the design of the flood protection features, especially the valley system, is conveyance of the Regulatory Flood. As required by TRCA, the design will provide for an additional ***0.5 metre vertical freeboard*** where physically possible to allow for the potential of increasing frequency and/or intensity of flood events associated with climate change.

Standard engineering practice related to flood protection features, such as channels, dykes, and flood diversion structures, is that the features are typically designed to a specific flood rate set by either frequency based flow rates or historically based flow rates or water levels. In doing so, it has been common practice to address the varying levels of uncertainty that exist by including a freeboard to any design height developed. This freeboard is a similar approach to that of applying factors of safety common in assessing uncertainties in other engineering designs. For flood control structures, this freeboard has normally been set at a minimum additional height of 0.3 metres above that defined for the flood design.

In the case of the Lower Don flood control river projects, the stressor of climate change is an additional requirement to be included. Inclusion of climate change impacts at a local scale poses many technical and scientific challenges given the current uncertainty within climate change science. To address these uncertainties, a flow sensitivity analysis was undertaken on the Don River to look at impacts that could occur should climate change result in a 10 to 15 percent increase in the design flood being used to size the flood control structures. This analysis was based upon the limited understanding of the projected future science and input from external expertise. The resulting sensitivity analysis defined that up to an additional 20 centimetres of flood levels may be anticipated within this reach of the Don River under future climates. This factor of safety was added to the 0.3 metre standard freeboard to define an ***overall freeboard of 0.5 metres***. It is acknowledged that the 0.5 metre vertical freeboard may not be achievable at the Lake Shore Boulevard crossing and at Eastern Avenue with the Kingston Subdivision grade separation.

6.1.1.1 River Valley Formation

Creation of a new river valley is the primary means of conveying flood events up to the Regulatory Flood. For the purpose of describing different areas of the river, the river design has been broken into four reaches and two sub-reaches (the latter depicted by the two spillways), as illustrated in **Figure 6-1**.

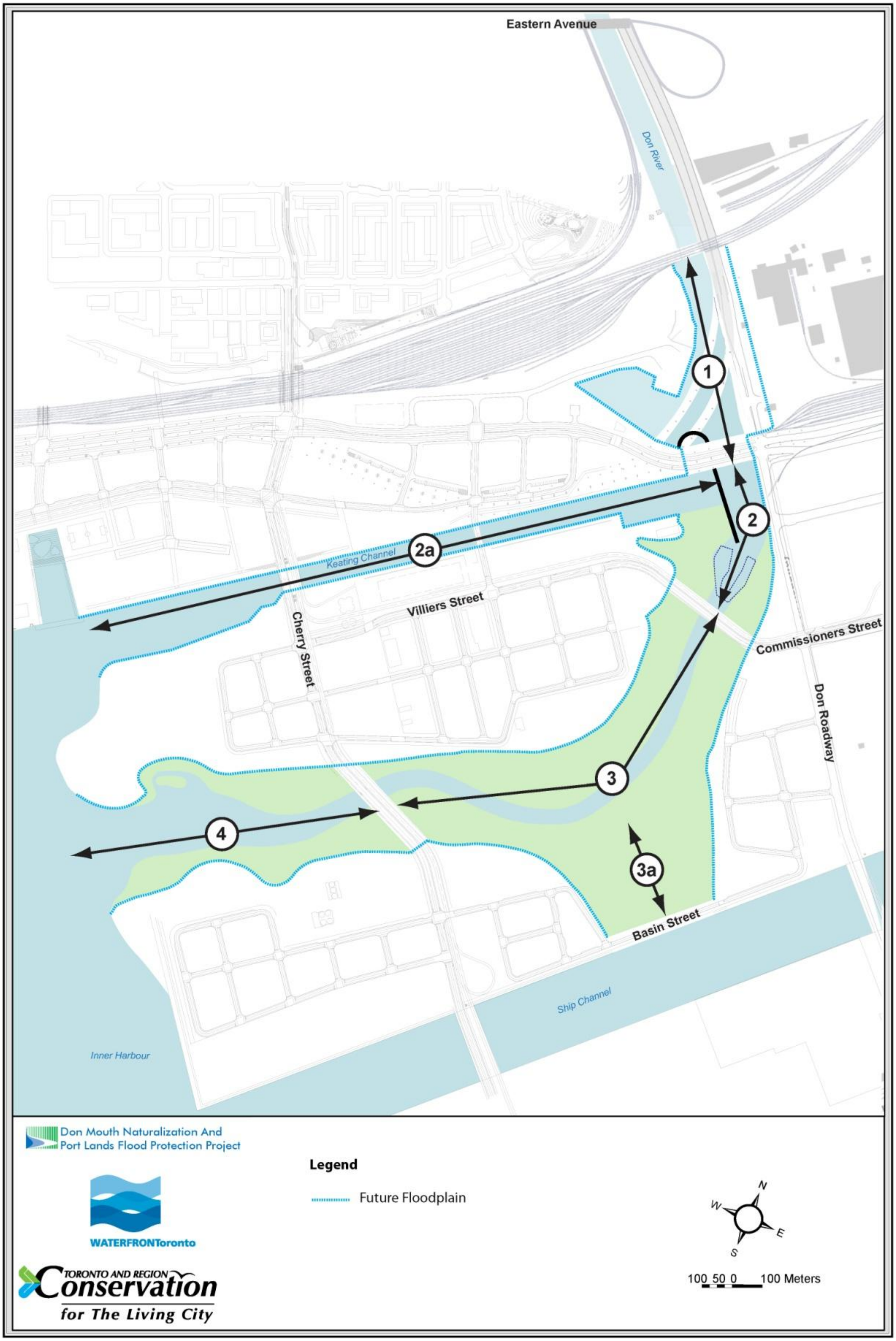

Figure 6-1 Don River Reaches

Common to all reaches is the need for underlying stabilization of the river bed, valley walls, and levees to limit or prevent movement. Specifically, stabilization will ensure that most flood events and the associated shear stresses do not erode into the underlying contaminated soils, undermine adjacent development blocks, nor result in the destruction of the lake-connected wetlands. Under major flooding (e.g., Regional flood) events it is anticipated that the lake-connected wetlands and levee systems will experience some degree of damage while contaminated soils will remain protected. The overall type and extent of stabilization works will be defined through detailed hydraulic modelling. These stabilization features will be overtopped with a clean layer of fill and soil with vegetation (if applicable) to prevent the movement of contaminated soil and groundwater into the naturalized areas. The depth of clean fill and soil cover will be determined through a separate risk assessment and risk management (RA/RM) process, to be conducted in accordance with O. Reg. 153/04.

Stabilization and subsurface erosion control methods will be designed for the valley feature where considerable shear stresses are expected. Stone is also proposed for bridge footings to provide scour protection, within the Keating Channel to stabilize the dockwalls, and for large levees to ensure stability. The river bottom will be heavily stabilized along most of its length in all reaches of the river using a combination of gravel, sand, and cobble to prevent downcutting and to stabilize the levees as well.

For the detailed assessment of the preferred alternative, it has been assumed that a barrier will be installed beneath the river channel and the wetlands to prevent the migration of contaminated groundwater into surface water. We have further assumed that this will require over-excavation of the river channel footprint and wetlands by 1.0 to 1.5 metres to facilitate the installation of such a barrier. This depth will be confirmed through the RA/RM to accommodate whatever form of barrier is adopted. The flexibility and maximum degree to which downcutting is permissible will be set by the depth of cover over contaminated soils as defined by the RA/RM.

Don River Reach 1

Reach 1 extends from upstream of the CN Rail bridge south to Lake Shore Boulevard East, as shown in **Figure 6-2**. This will remain a fully engineered channel with no low flow channel and floodplain features. ***The length of this reach is approximately 290 metres and the channel width ranges from approximately 60 to 80 metres within the sediment trap area. To address the requirements for sediment management, the sediment trap will be deepened to approximately 70 metres above sea level* (mASL). *The area that is not used for the sediment trap will be situated at an elevation of approximately 72 metres.***

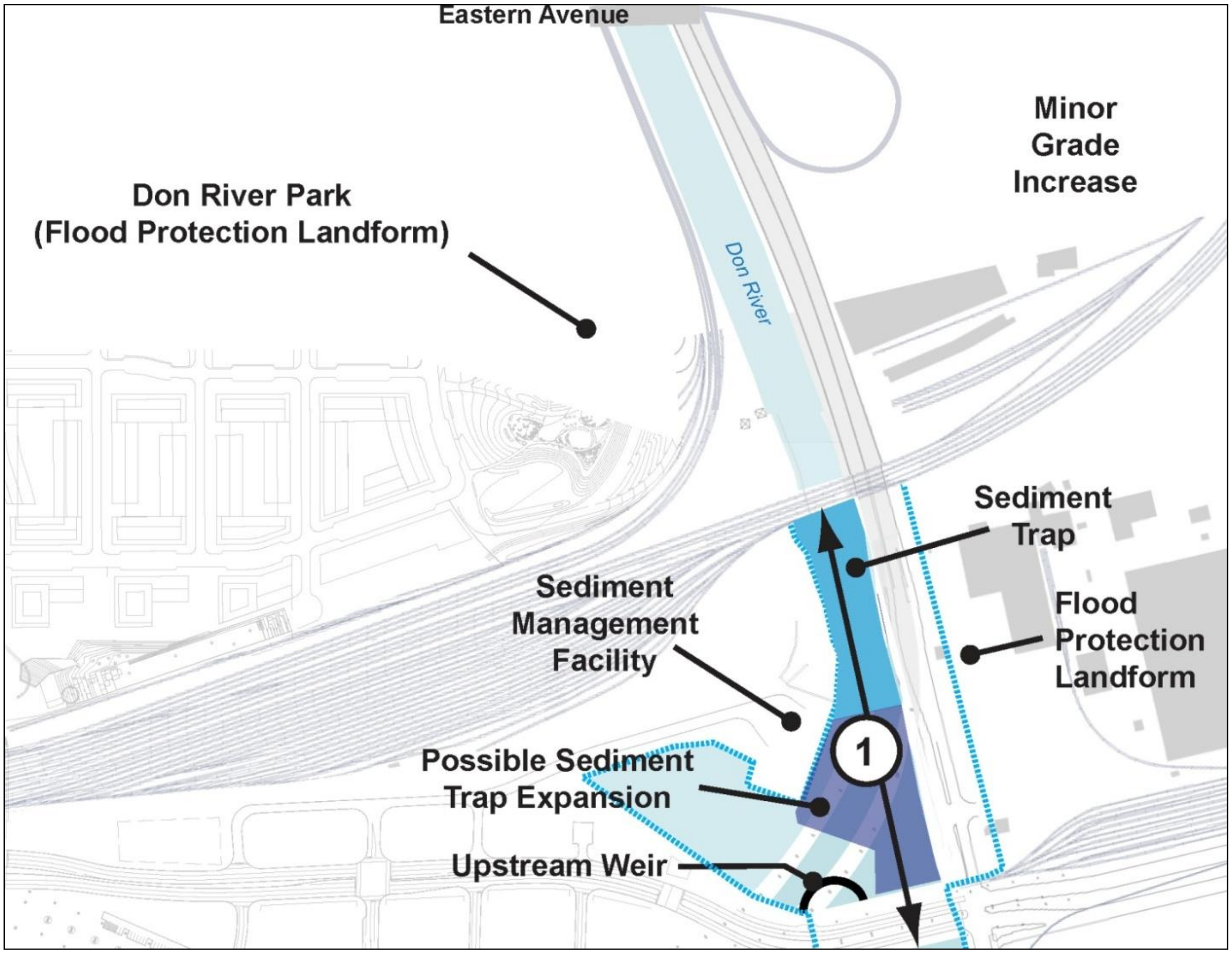

Figure 6-2 Reach 1

A sediment and debris management facility is also planned for the west bank of Reach 1, as described in **Section 6.1.2.4.** In addition, a flood protection feature on the east bank of the Don River will be located between the CN Rail bridge and the Keating Yard to permanently eliminate the risk of flooding to the east. ***This feature will require a minimum crest elevation of approximately 80 metres at the upstream end, which will drop by approximately 1.5 metres at the downstream end***. The west side slope (wet side) of the landform will possess a maximum 10 percent grade, while the east side slope (dry side) will possess a maximum 5 percent grade. These grades will allow for some continued use and occupation of the existing operations on the property, though it will necessitate establishing a new roadway access from the Don Roadway or Lake Shore Boulevard, modifying the existing loading bays and parking area, and relocating the hydro station infrastructure on the northwest corner of the property. No development or deep rooted plantings will be permitted on the entire footprint of the landform. The landform will need to be keyed in appropriately to the height of land near Lake Shore Boulevard in the south and the elevated railway embankment in the north.

On the east bank of Reach 1 south of the CN Rail line crossing, existing drainage services are likely to remain and will need to pass under the proposed flood protection landform (FPL) protecting the Unilever site and lands to the east. To ensure that flood protection to lands east of this FPL is maintained, back flow prevention devices will be required on existing storm drainage outlets. The design of these backflow prevention systems will need to allow for future access for maintenance and replacement and be designed to be as maintenance free as is technically feasible.

In the event that the site undergoes redevelopment, additional alternatives to provide necessary flood protection will be sought through a future site planning process.

Current hydraulic modelling has identified a spill related to minor flooding depths through the Eastern Avenue underpass of the CN Rail line (Kingston Subdivision) east of the Don River during the regulatory event. While flood depths at this location are shallow, some minor grade modifications may be required to the area southeast of Eastern Avenue in the vicinity of the CN Rail line (east of the Don River) to eliminate this potential spill of flood waters on the BMW site.

Reach 1 will have a completely armoured edge along the entire channel using sheet piling, with the exception of the backwater area adjacent to the sediment and debris management facility. Other modifications within this reach that are required to improve flood conveyance include removal of the Hydro One utility bridge that is approximately 40 metres south of the CN Rail bridge.

Given the constraints associated with conveying the Regulatory Flood through Reach 1, there is no flexibility for modifying the dimensions of the channel unless modifications allow for additional conveyance capacity. Given the hydraulic influence of the Gardiner Expressway ramps (to the Don Valley Parkway) there is an opportunity to provide additional conveyance capacity should the Gardiner Expressway (currently subject to its own Environmental Assessment) be reconfigured or removed.

6.1.1.2 Don River Reach 2 and Keating Channel (Reach 2a)

Reach 2 extends from the Lake Shore Boulevard crossing south to the realigned Commissioners Street, as shown in **Figure 6-3**. This reach is a transitional area from the heavily managed reach upstream of the Lake Shore bridge to the new naturalized valley south of the new Commissioners Street bridge. Reach 2 will consist of a river channel and a connected and functioning floodplain within the new valley system. ***The length of Reach 2 is approximately 260 metres. The width of the valley is approximately 185 metres, measured from the top of the valley slope. The width of the low flow channel is approximately 52 metres at its widest point and transitions to a width of approximately 25 metres north of the future Commissioners Street bridge.***

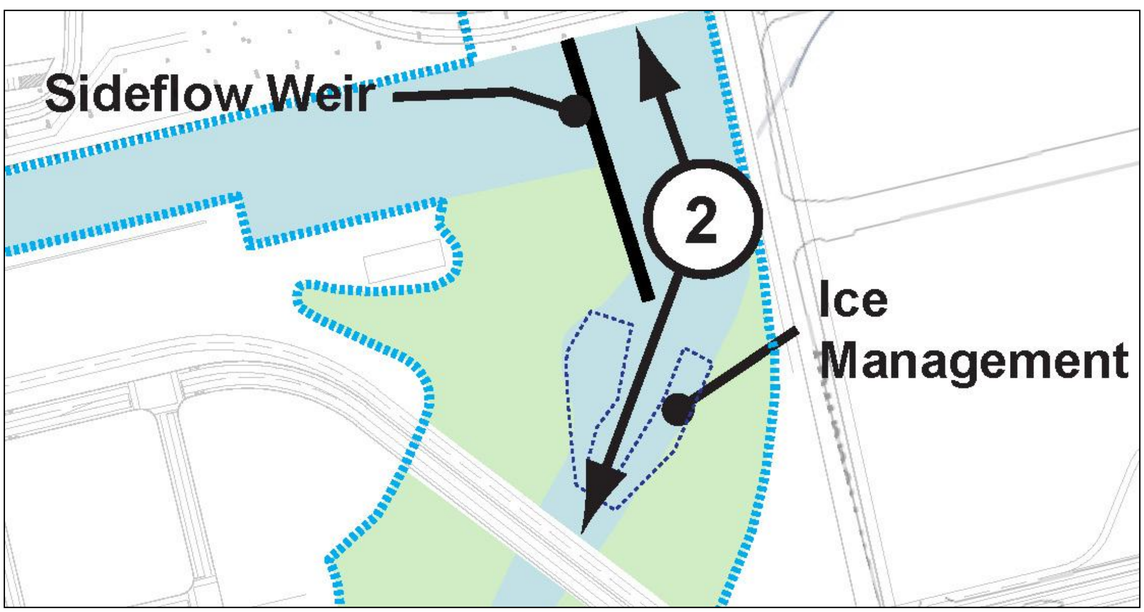

Figure 6-3 Reach 2

To mediate the transition between Reach 1 and Reach 2, there will be walls or riprap on the east and west sides, likely built with large rock to manage the high stresses associated with the transition. This type of stabilization will likely be covered with a naturalized veneer to support habitat functions. This transition will also provide a required ice management function by providing a place for ice to collect and break up, with capacity for overflow into the Keating Channel if an ice jam should occur. At the downstream end of the reach, stabilization will also be provided to protect the Commissioners Street bridge footings. Stabilization for the valley wall will consist of engineering edge (e.g., sheetpile) on the eastern side underlain by soil and vegetation.

This reach has limited flexibility in alignment or configuration as it is set by the location of the Lake Shore Boulevard crossing, the Commissioners crossing (including the associated ice management function), and the elevations/function of the sideflow weir in the Keating Channel.

The existing Keating Channel, referred to as Reach 2a, is retained and continues to provide a flow conveyance function, shown in **Figure 6-4**. Reach 2a ***is approximately 1,150 metres long***, including the edge bounding the northern promontory***.*** Approximately 4,700 square metres of the Keating Channel will be filled in on the south side to facilitate additional development. As a result, ***the width of Reach 2a varies from approximately 55 metres at the east end, to approximately 34 metres between River Park Bridge to the east and Cherry Street Bridge to the west, and to approximately 90 metres where it meets the lake.***

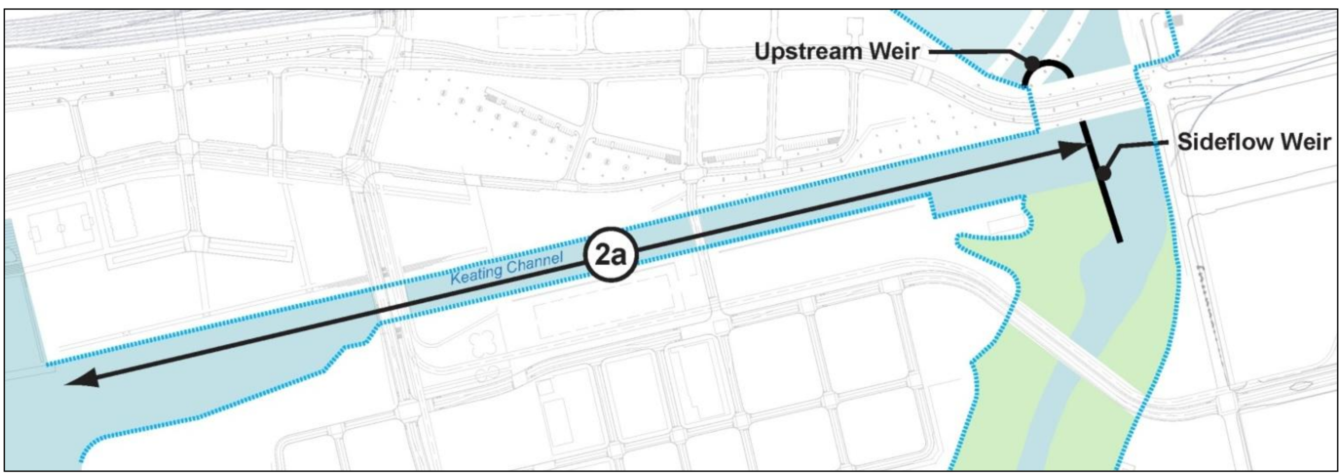

Figure 6-4 Reach 2a

In addition, the Keating Channel will be narrowed though placement of stone revetments that will act to stabilize the existing Keating Channel dockwall and provide fish habitat structure (see **Figure 6-5**). The revetments will extend at a 2:1 slope from a platform created at the dockwall edge to the channel bottom. The bottom elevation of the channel will be lowered to match the bathymetry of the Inner Harbour where it abuts the Keating Channel (anticipated to be approximately 2 metres).

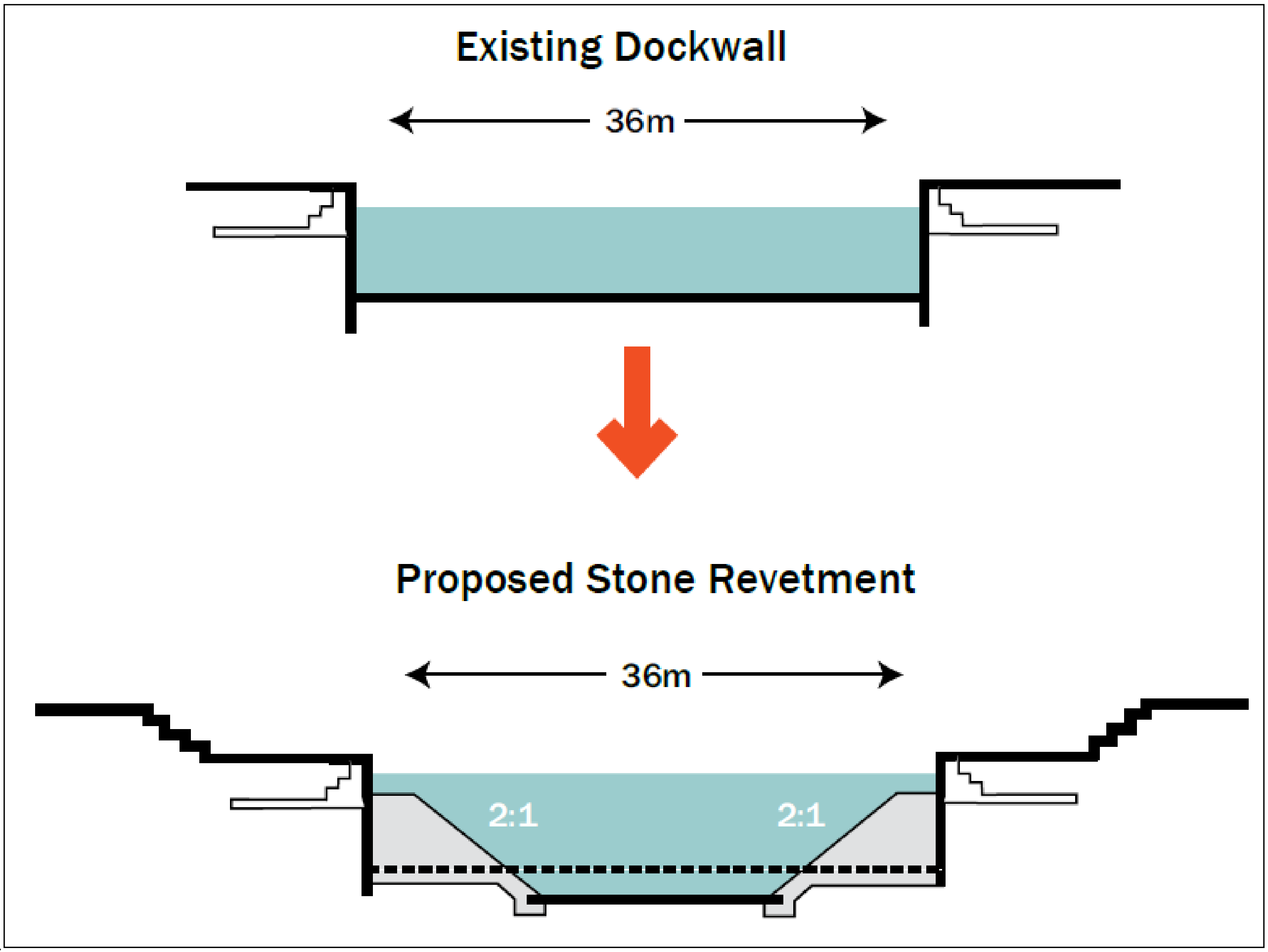

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Figure 6-5 Existing Dockwall and Proposed Stone Revetment

6.1.1.3 Don River Reach 3 and Ship Channel Wetland (Reach 3a)

Reach 3 extends from the new Commissioners Street to the new Cherry Street. ***The length of Reach 3 is approximately 680 metres. The width of the valley within Reach 3 ranges from approximately 185 metres at the upstream end to approximately 190 metres at the downstream end measured from the top of the valley slope. The width of the low flow channel ranges between approximately 24 metres upstream to 33 metres downstream.*** This reach will have softer river edges and will allow lateral migration of the low flow channel of several metres. As described above, some subsurface stabilization measures may be undertaken to control the dynamics of the river at locations where migration may be of concern. Stabilization and/or armouring of the low flow channel could be composed of materials ranging from coarse substrate layers to heavy large stone.

Reach 3a is a sub-reach that includes the new spillway to the Ship Channel, as shown in **Figure 6-6.** The Ship Channel spillway is a wide floodway that will only be used during large flood events. ***Reach 3a extends approximately 180 metres in length between the valley and the Ship Channel. The width of Reach 3a is approximately 165 metres, measured from the top of the valley slope.*** Reach 3a will include a lake-connected wetland that is hydraulically connected to the Ship Channel, with protections against invasive species migration. A constructed levee emulating a natural levee will separate Reach 3 from Reach 3a and will be set to overtop when flood events reach the 25 to 50 year flood elevations. Actively operating the upstream weir in Reach 1 could further reduce the frequency of overtopping from Reach 3 to 3a as desired/required. Flood waters will then flow into the Ship Channel through openings under the Basin Street causeway. The spillway will require stabilization along the valley sides, at the Ship Channel, and under the overflow levee**.**

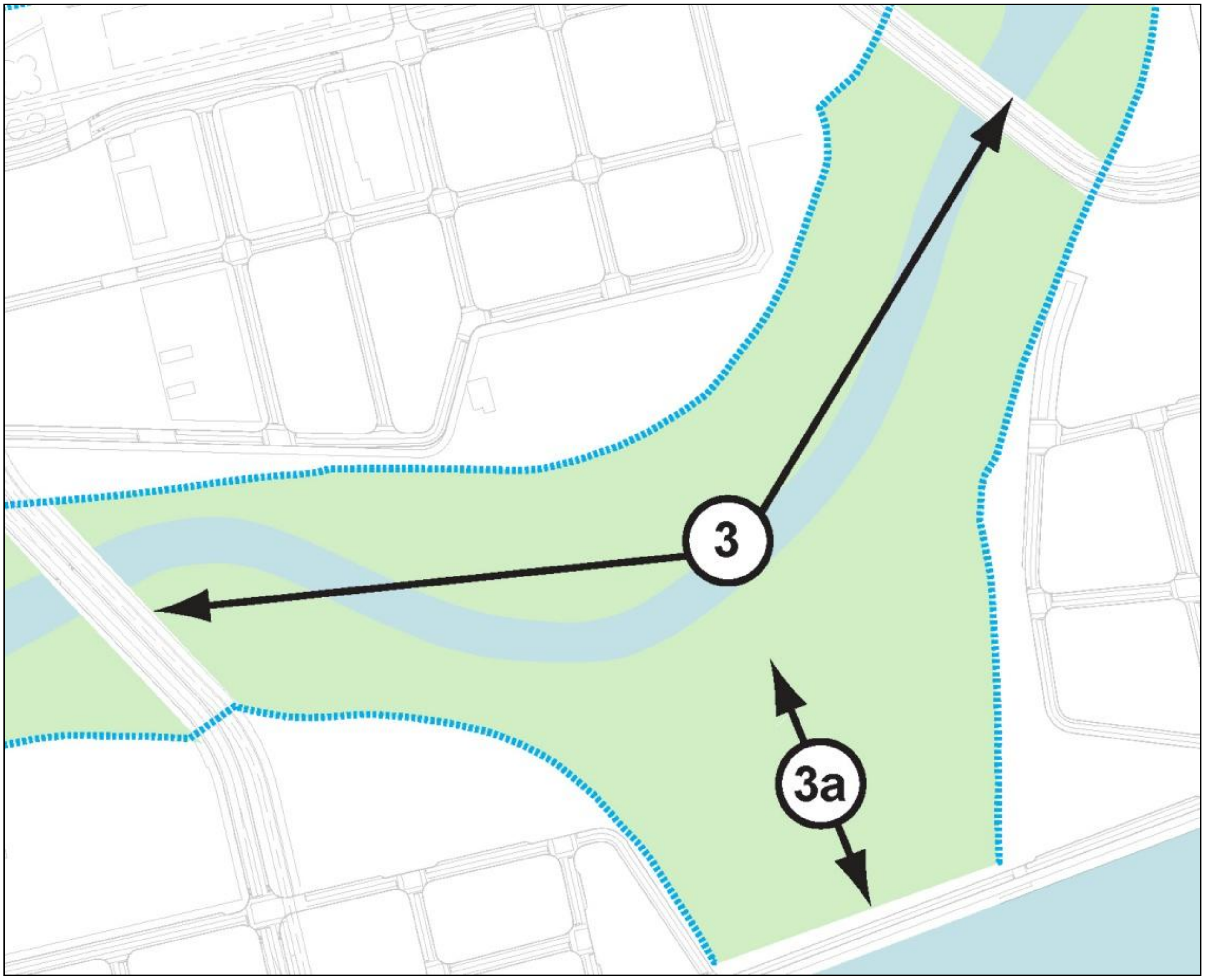

Figure 6-6 Reach 3 and 3a

6.1.1.4 Don River Reach 4

Reach 4 is the mouth of the river, shown in **Figure 6-7**. ***The length of Reach 4 is approximately 490 metres. At the downstream end, where the river mouth opens to the Inner Harbour and serves as the main outlet to the lake, the low flow channel encompasses nearly the entire width of the floodplain, equal to approximately 220 metres. Upstream, the low flow channel narrows to a width of approximately 33 metres where it connects to Reach 3***. There will be minimal or no stabilization in Reach 4 along the river channel edges, with tolerance for migration of the channel. This minimal level of stabilization will transition to a higher degree of stabilization at the harbour-exposed edges.

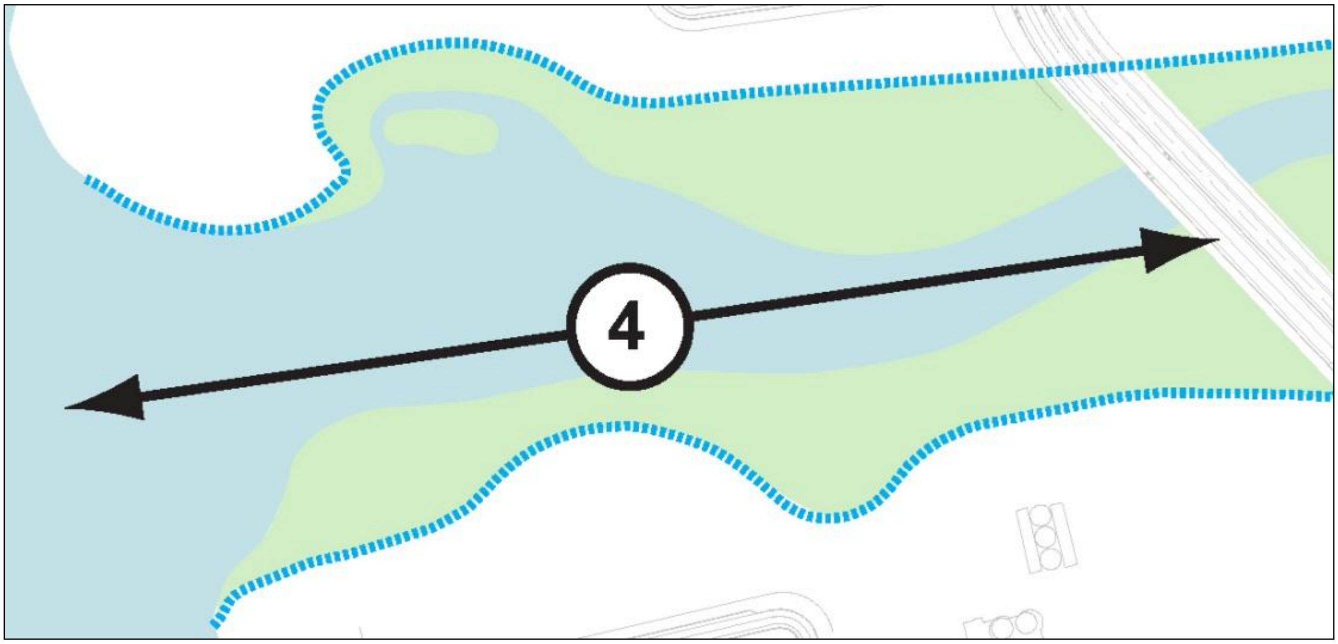

Figure 6-7 Reach 4

The channel bottom of the river will be graded down gradually (approximately a 1 percent slope) in this reach from 72 to 73 mASL upstream to 68 mASL at the downstream end of Reach 4 (at or before the most westerly extent of the new promontories constructed at the river mouth).

As part of Reach 4, two promontories north and south of new river mouth will be constructed off of Polson Quay and Cousins Quay. The promontory at Cousins Quay (north of the new river mouth) will be substantially larger than the southern promontory. The promontories will be stabilized to an elevation of a couple of metres above mean lake level.

The size of the promontories, specifically their footprint within Lake Ontario, is limited by the navigation requirements of the vessels that use the Inner Harbour. A navigation risk assessment, completed by Baird and Associates, concluded that the promontories would not preclude vessels from navigating the Inner Harbour, provided that they do not extend any further west into the lake than the proposed manoeuvring circle, as shown in **Figure 6-8**. The complete Navigation Risk Report is included in **Appendix F.** ***The crest of the containment berms are shown as extending a maximum of 200 metres from the existing dock wall at the average lake level.***

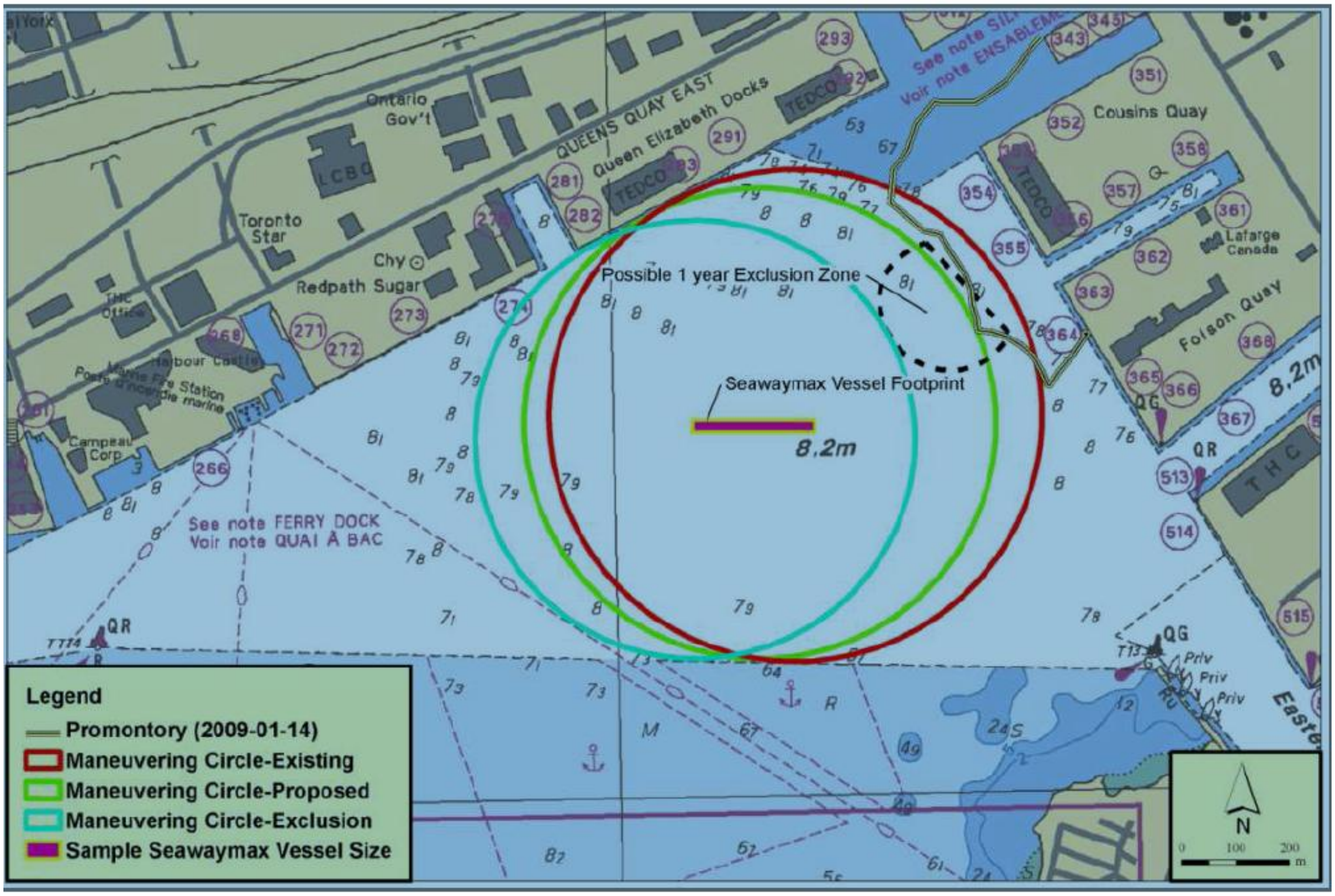

Figure 6-8 Manoeuvring Circles Associated with Promontories

6.1.1.5 Operation of Keating Channel Weirs

To improve flood conveyance, the existing Lake Shore Boulevard and Harbour Lead bridges will be lengthened from the two bays that currently exist to include a total of five bays, for a total length of approximately 120 metres. The soffit heights for the lengthened portions of the bridges will range between approximately 77 and 78 metres. The design plans for the proposed extension of the roadway (Lake Shore Boulevard) and the railway (Harbour Lead) bridges, which originate from the Lower Don Lands Infrastructure Municipal Class EA, are shown in **Appendix G.**

The three eastern bays will provide conveyance for river flows continuing straight south into the new primary river outlet. A weir structure will be placed just north of the Lake Shore Boulevard / Harbour Lead crossing and will regulate water to allow the passage of flood events through the Keating channel. It is proposed that an adjustable weir will be installed to allow for flexibility in operation. ***The maximum height of the new weir structure will be set at approximately 76 metres and a bed elevation of approximately 71 metres, which will provide conveyance of flood events greater than the two-year event.***

A sideflow weir will be installed to the south of the Lake Shore Boulevard crossing to permit flows greater than the two-year event to pass into the Keating Channel from the east, with a bed elevation of approximately 71 metres and a crest height of approximately 75 to 76 metres. It will likely feature a fixed crest with a drop inlet to allow for decanting of some of the surface water from the main channel during flow events in the range of 15 to 25 cubic metres per second up to the two-year flood to help with circulation in the Keating Channel and prevent stagnation. The functional or detailed design of the river will confirm the configuration, type, and operation of the weirs.

6.1.1.6 Grading and Setbacks of Development Areas

To permanently remove flood risk from future development areas, the lands on either side of the river will be elevated approximately 1 to 2 metres above existing elevations. ***New development areas, as defined within the Provincial Policy Statement (PPS, 2005), will be required to be set back from the top of valley slope of the new river valley by 10 metres horizontally***. **Figure 6-9** shows the setbacks associated with the adjacent development areas and the approximate grading relative to this new regulatory floodplain. A detailed grading plan is included in **Appendix H.**

Figure 6-9 Regulatory Event Level and Setbacks from Floodplain