Toronto and Region Conservation Authority

Marine Engineering Services to Develop Preliminary Designs for Land Creation Works Surrounding Essroc Quay

PRELIMINARY DESIGN REPORT

Photo © Bing Maps

Submitted by:

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March 14, 2016
(Appendices Finalized June 2016)

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Executive Summary

Riggs Engineering Ltd., in association with Peto MacCallum (geotechnical) and Natural Resource Solutions Inc. (natural heritage), was retained by Toronto Region Conservation Authority (TRCA) to provide preliminary marine engineering design services associated with the development of an infill area around the existing Essroc Quay. These design services are in support of the Port Lands Due Diligence works, further progressing work completed in the Don Mouth Naturalization Project Environmental Assessment (DMNP EA) and the Lower Don Lands Master Plan Class EA (LDLMP EA). These larger projects represent the components of the Due Diligence and Enabling Infrastructure Project. The basis of the Essroc Quay land creation project is documented in the EA documents.

The preliminary engineering services provided under this Project include:

(i) review of existing conditions and available information to support the preliminary design, and

(ii) the development of preliminary designs, phasing strategy and costs for land creation around Essroc Quay which are consistent with the Villier's Island's development concepts.

The design provides for the creation of new land surrounding Essroc Quay to an elevation above the 100 year flood level (including wave uprush considerations) and includes provision of fish habitat and public realm features taking into consideration geoenvironmental, hydrogeological, geotechnical, river hydraulics, civil, and future land use inputs as part of the design.

The existing conditions review established much of the generic information relating to environmental conditions which will govern design requirements and existing structures and landforms which must be considered. The site is subject to moderate wave action and ice conditions due the semi-protected location within the Toronto Harbour. Sedimentation does occur within the Keating Channel and in the Study area where flow velocities are typically small due to lake backwater impacts; this material has historically been dredged as necessary to maintain commercial navigation needs.

Existing structures within the project area are typical of aging dock walls designed for commercial vessel berthing and industrial uses. Shorelines structures around Essroc Quay and Cousins Quay include timber sheet pile walls and steel sheet pile walls with concrete cope beams. These structures will be buried by the Essroc land creation project. Servicing of the quay areas is limited; the only existing servicing issue identified is a 900 mm diameter storm sewer along the north wall of Cousins Quay.

There is limited information on the lake bed conditions within the project area. Dated borehole logs for the lakebed area and recent borehole logs for the upland areas indicate that the lakebed is comprised soft silty clays, muck and sands overlying bedrock. The depth of sediments is typically on the order of 5 m with bedrock elevations typically 12 m to 14 m below low water datum.

The development of a land creation concept involved the consideration of local physical and environmental conditions and constraints as well as the intended future land uses for the land to be created and the nature of fill materials available to make that land. Provincial guidance for a land creation project using fill material of the quality expected to be available requires the creation of a containment berm to prevent the fill materials from washing into the lake. Through

an integrated advancement of the various design team members work, it was determined that the land creation approach should include the staged filling of three defined containment cells. The general nature of the perimeter confinement structures was determined based on considerations of future land uses, space constraints and naturalization requirements, such that a rock fill berm is proposed for the western end of the project area consistent with the proposed parkland use and naturalized upland areas and a vertical structural wall is proposed for the northeast portion of the project are to optimize the balance of upland space needs and hydraulic capacity constraints in the Keating Channel. Interior confinement structures required to create the separate fill cells were located to maximize the benefit of existing shoreline structures while remaining generally consistent with the delineation between upland urban development and upland parklands.

The preliminary design of the land creation works and containment structures has been developed on the basis of the best available information. It is anticipated that the first stage of filling will bring the land grade to an elevation of 76.2 m ± (approximately 1 m above normal spring water levels). The specified criteria for protection of the containment structure to an elevation of 1 m above the 100 year water level plus maximum wave uprush is expected to require armouring of the rock containment berm and overlying fill to a maximum elevation of 78.75 m. Where vertical structural containment walls are overtopped, fill should be protected to the limits of the 100 year water level plus maximum overtopping wave action on the land surface beyond the wall.

Foundation conditions for the berm and vertical wall containment structures will require further investigation of lakebed geotechnical conditions in order to confirm requirements to improve sediment conditions below the proposed berm structures and to define structural needs for the toe anchoring of steel sheet pile or H-pile and panel walls. Design of structural anchoring for vertical walls within the back fill area will require additional details of the backfill and lakebed materials as well as final grading plans. The design of filling operations for the three containment cells will require additional details of the fill materials and the method and scheduling of delivery to the site.

Naturalization of the shoreline area is required to provide aquatic habitat in an effort to offset some of the loss of habitat area associated with the land creation works. Typical habitat enhancement features and limits of proposed habitat creation have been discussed with Aquatic Habitat Toronto (AHT) and are presented. The preliminary design of the specific features has been developed based on recommended materials and naturalized geometries consistent with the physical constraints of areas of application. It is expected that the design of habitat features will be further refined through the detailed design stage in order to maximize their intended benefit.

1 Introduction

The purpose of this Preliminary Design report is to present the preliminary design of Essroc Quay land creation based on information developed through the Port Lands due diligence work and in accordance with the associated intended function of this area of the development.

The current project focuses on the preliminary design for creation of a land base in the area of the Essroc Quay. This is an important early aspect of the overall DMNP as it provides the land base required to accommodate the relocation of the Cherry Street Bridge. This relocation will permit increased flood capacity and thereby permit increased grades to be achieved within the western Villier's Island's Precinct and Promontory Park without offsite impacts. The land mass must provide the required conditions for construction of new footings for the bridge crossing. Furthermore, the construction of the land mass provides a potential opportunity for management of excess soils from various sources providing that the design of the land development process is consistent with both the excess soils for land creation and the existing local quay area geotechnical and hydrogeological conditions.

The design of the new land base must give due consideration to a wide range of existing constraints and opportunities while achieving the various design objectives which include provision of design hydraulic capacity, secure containment of the land fill materials, accommodation of existing and future infrastructure needs, accommodation of geotechnical considerations, stable shoreline protection to design flood conditions, natural habitat enhancements including integration of aquatic habitat features into the shoreline structure design, accommodation of future commercial navigation needs through tight control of shoreline structure footprint, functional space needs for designated use of upland areas and a staging plan that is consistent with overall project needs.

The schedule for this preliminary design project is based on timely requirements for submissions to various authorities and partners within the overall Port Lands Flood Protection and Related Infrastructure Project context, and similarly relies on information provided by other consultants working simultaneously. It is important that the design tasks are advanced to the greatest degree possible based on available information in order to best satisfy the target dates and project integration objectives.

Progress to date relating to the various Preliminary Design tasks for the Essroc Quay land creation is discussed in the following sections, which include:

- Compilation of existing conditions for Essroc Quay
- Development of land creation methodology
- Preliminary design of in-water confinement structures
- Preliminary design of fill operations
- Estimation of fill volumes
- Preliminary design of shoreline protection structures
- Support to design costing.

The Project Area for the preliminary design is depicted in Figure 1.1.

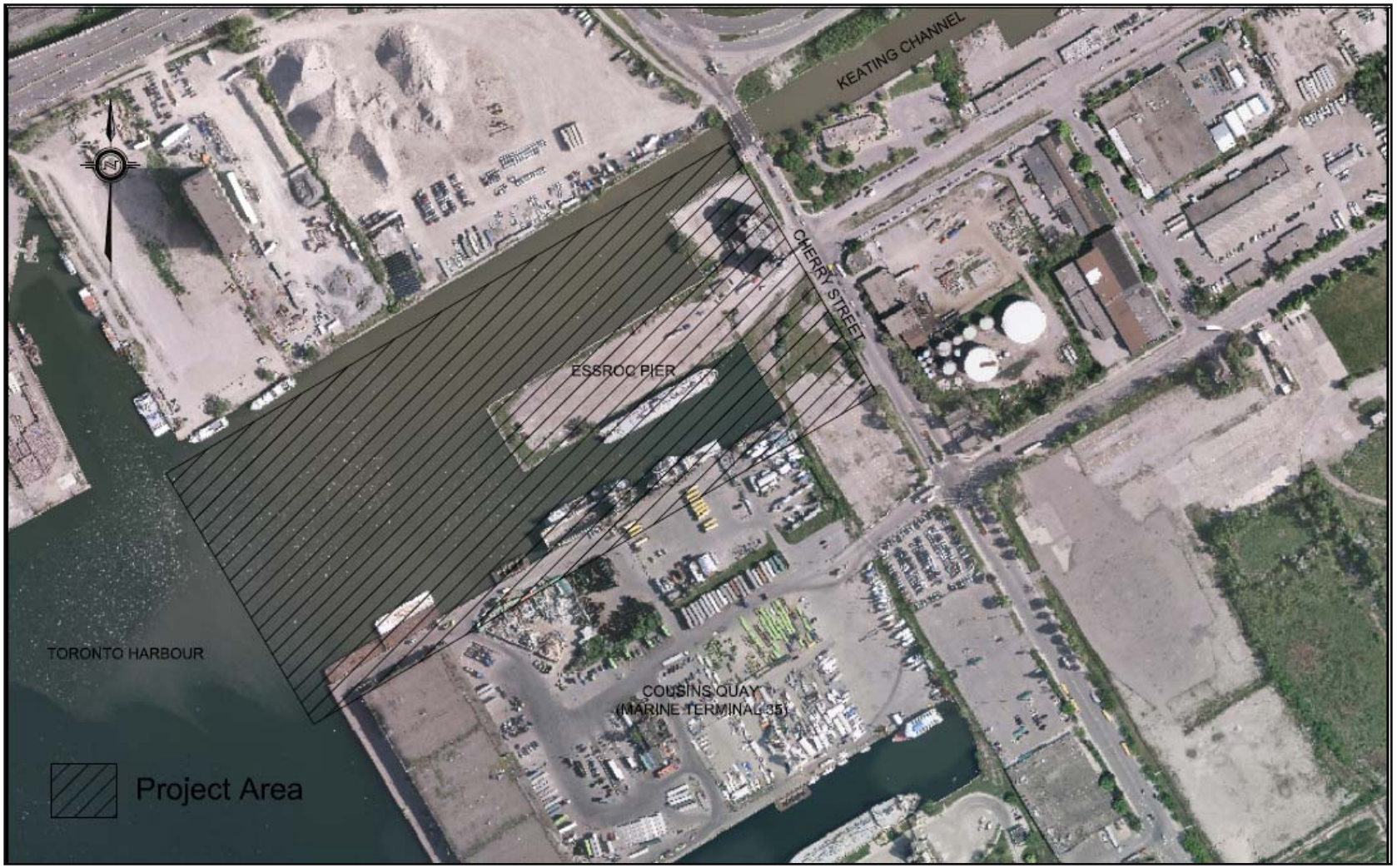


Figure 1-1 : Project Area

2 Basis of Design Assumptions

There are a large number of factors that are integral to the development of a preliminary design for the Essroc Quay land creation. These factors include conditions of bed sediments under the proposed land creation containment, characteristics of soils and sediments to be placed within the confinement area, timing of various aspects of the works and proposed shoreline and infrastructure designs. Many of these factors are presently under consideration as the design for the broader Port Lands area moves forward.

However, there are two key conditions that have been assumed to be necessary for the purpose of this preliminary design exercise. Those conditions are:

- the proposed fill materials will be consistent with the confined fill material criteria as presented in the Fill Quality Guide and Good Management Practices for Shore Infilling in Ontario (MOECC, 2011), and
- the preliminary design of the fill and containment works must not create any adverse hydraulic impacts within the Keating Channel.

It is important to note that this basis of design does not eliminate the potential to consider fill materials which are not consistent with the confined fill material criteria (i.e. more contaminated) nor does it preclude future placement of additional rock materials within the Keating Channel. Both considerations remain active in the overall planning aspect of this project. However, consideration of more contaminated fill would require additional investigations and possible adjustments to the containment design, and placement of additional rock materials in the Keating Channel would require that additional offsetting hydraulic capacity is provided within the system prior to adjustment of the shoreline footprint proposed herein. The implications of the basis of design assumptions and potential considerations beyond this basis are discussed further where relevant to the various components of the preliminary design exercise.

An overview of the project area elements and overall infill area is presented in Figure 2-1.

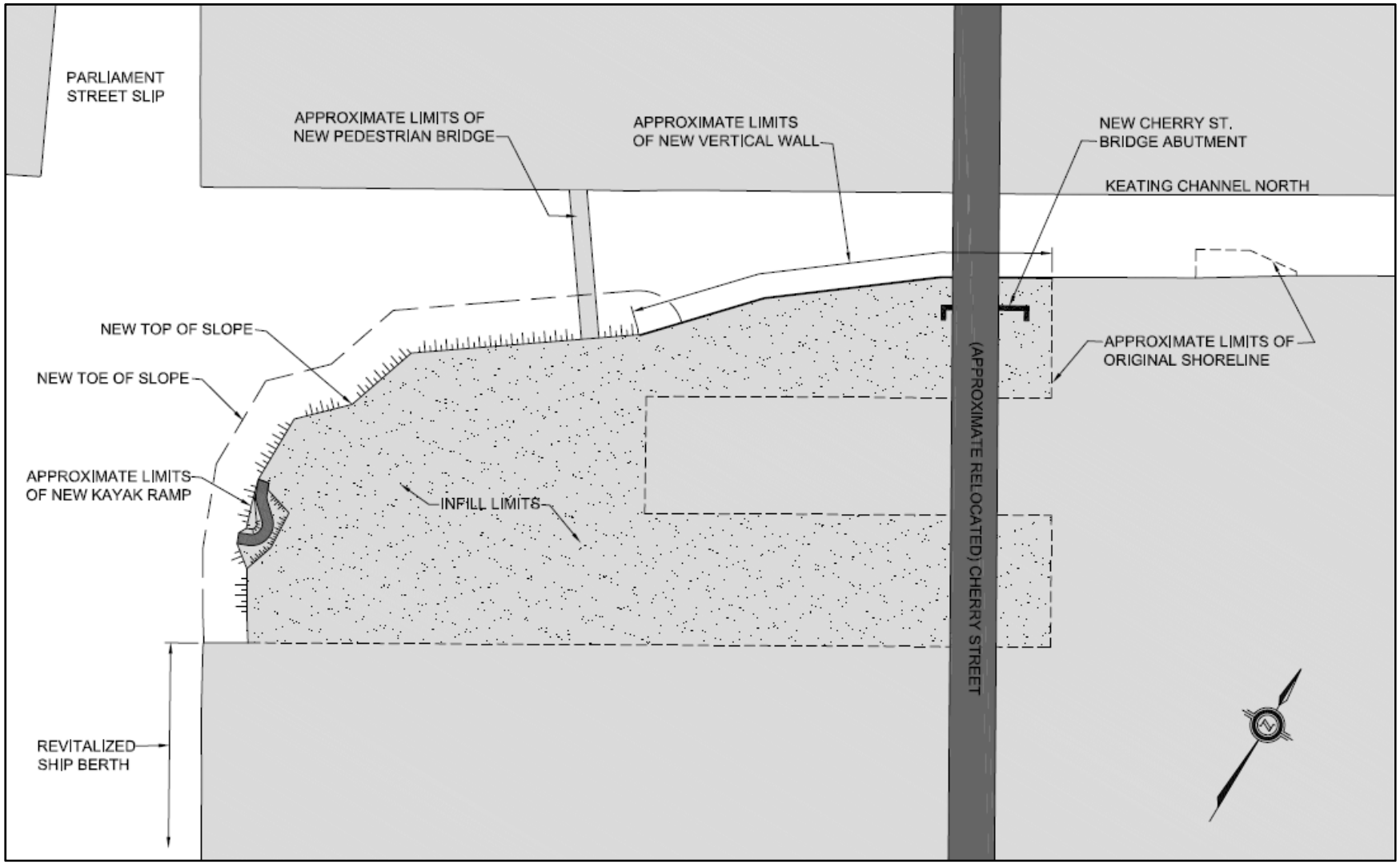


Figure 2-1 : Project Components Overview

3 Compilation of Existing Conditions for Essroc Quay

Existing conditions at Essroc Quay were detailed in the Existing Conditions Summary Report (Riggs, 2014). This documentation included available details for existing structures, services topography, bathymetry and soils.

Limited additional local information has been advanced since that report, with the exception of some additional geotechnical information along the northern side of Cousin's Quay. Select information from this updated geotechnical investigation is presented in Appendix B.

A composite profile across the Essroc Quay and Cousins Quay which depicts the variation in structure condition, bed elevation and bedrock elevations based on available information is presented in Figure 3-1.

It is noted that an existing 900 mm diameter storm sewer discharges through the north wall of Cousin's Quay at the east end of the wall. It will be necessary to relocate this outfall or provide for interception of the drainage to this point within another system prior to completion of the local containment berm and filling in this area.

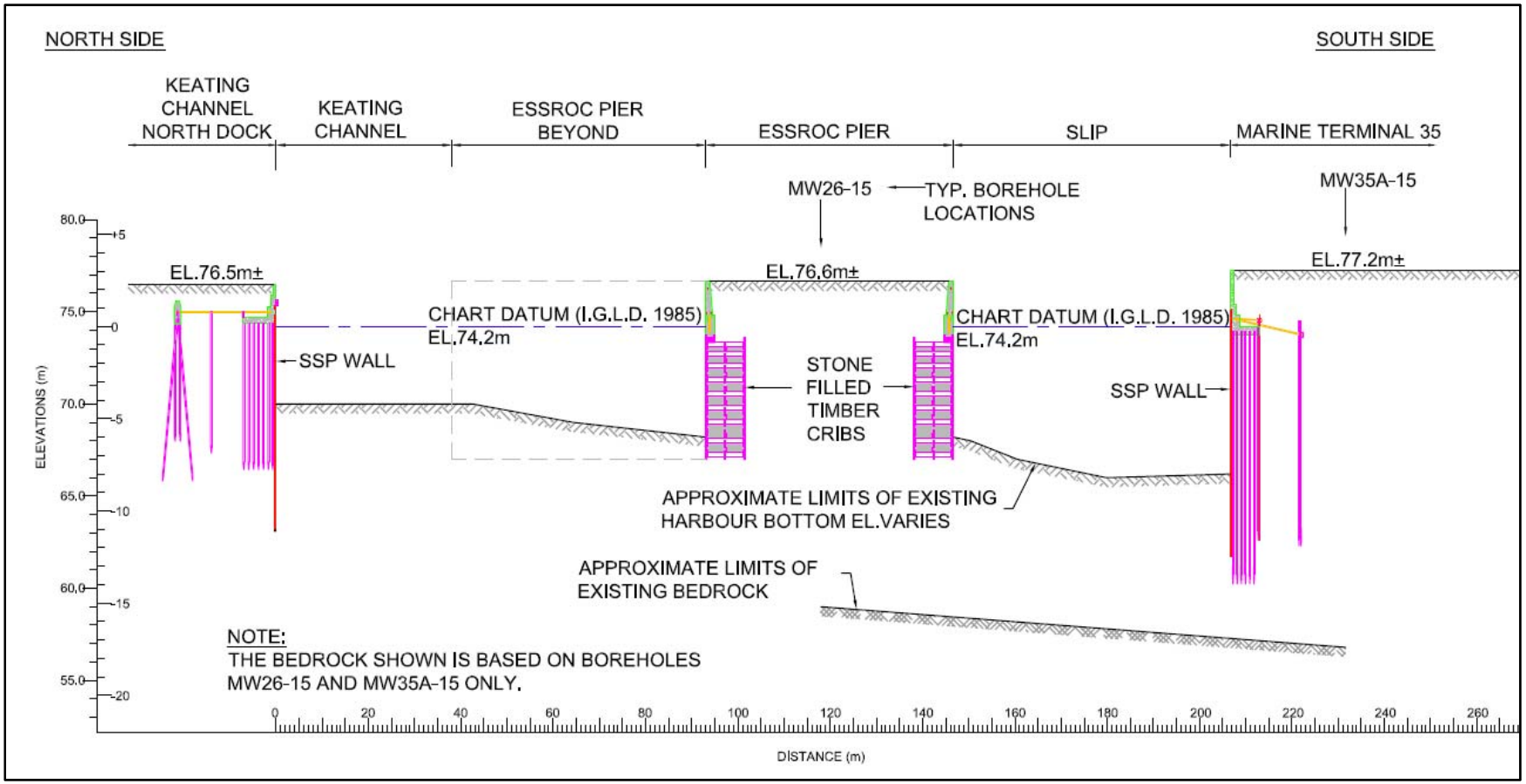


Figure 3-1 : Existing Section Through Proposed Fill Area

4 Development of Land Creation Methodology

The design of the Land Creation Methodology approach requires consideration of a range of factors. Many of these factors are not yet fully defined and are subject of ongoing field investigations and design efforts. Furthermore, permitting issues may influence decisions with respect to fill sources and staging needs.

The factors which have been considered to date in the development of a preliminary design for the land creation methodology are briefly discussed below.

4.1 Staging of Fill Operations

The staging of fill operations could provide a benefit to the Essroc Quay land creation project due to the associated ability to:

- schedule filling operations to accommodate project funding timelines,
- accommodate variability in the timing of available fill materials should excavation works scheduling be delayed, or higher priority areas are defined to receive available materials, or
- accommodate staged development of upland areas and/or extended consolidation periods for specific areas to accommodate development, with pre-load soils to assist consolidation of fill in initial cells to be placed at a later date in subsequent cells.

While final direction is not yet available with regard to staging of fill operations, there is general support for the concept to accommodate staged excavation works. As a result, the development of the landfill creation to date assumes three potential cells to be constructed in a geometry that is expected to best utilize the existing quay walls while accommodating the proposed delineation of urban and parkland upland developments. This cell definition is presented in a conceptual manner in Figure 4.1.

4.2 Employment of Alternative Confinement Structure Materials

The potential utilization of alternative confinement structure materials and configurations could provide a benefit to the Essroc Quay land creation project due to the associated ability to:

- maximize potential fill volumes within the containment area through the minimization of berm volumes,
- accommodate site specific shoreline function needs which include dissipation of wave runup on harbour exposed shorelines and reduced hydraulic footprint within the Keating Channel area.

Cut and fill balance calculations for the Port Lands area have not been finalized, and therefore, consideration has been given to the development of confinement structures which maximize fill volumes. This is discussed in more detail in Section 4 and will require input from the broader design team in order to finalize details.

The need to accommodate site specific shoreline functions accepted. Design considerations associated with this need are discussed further in Sections 5 and 8.

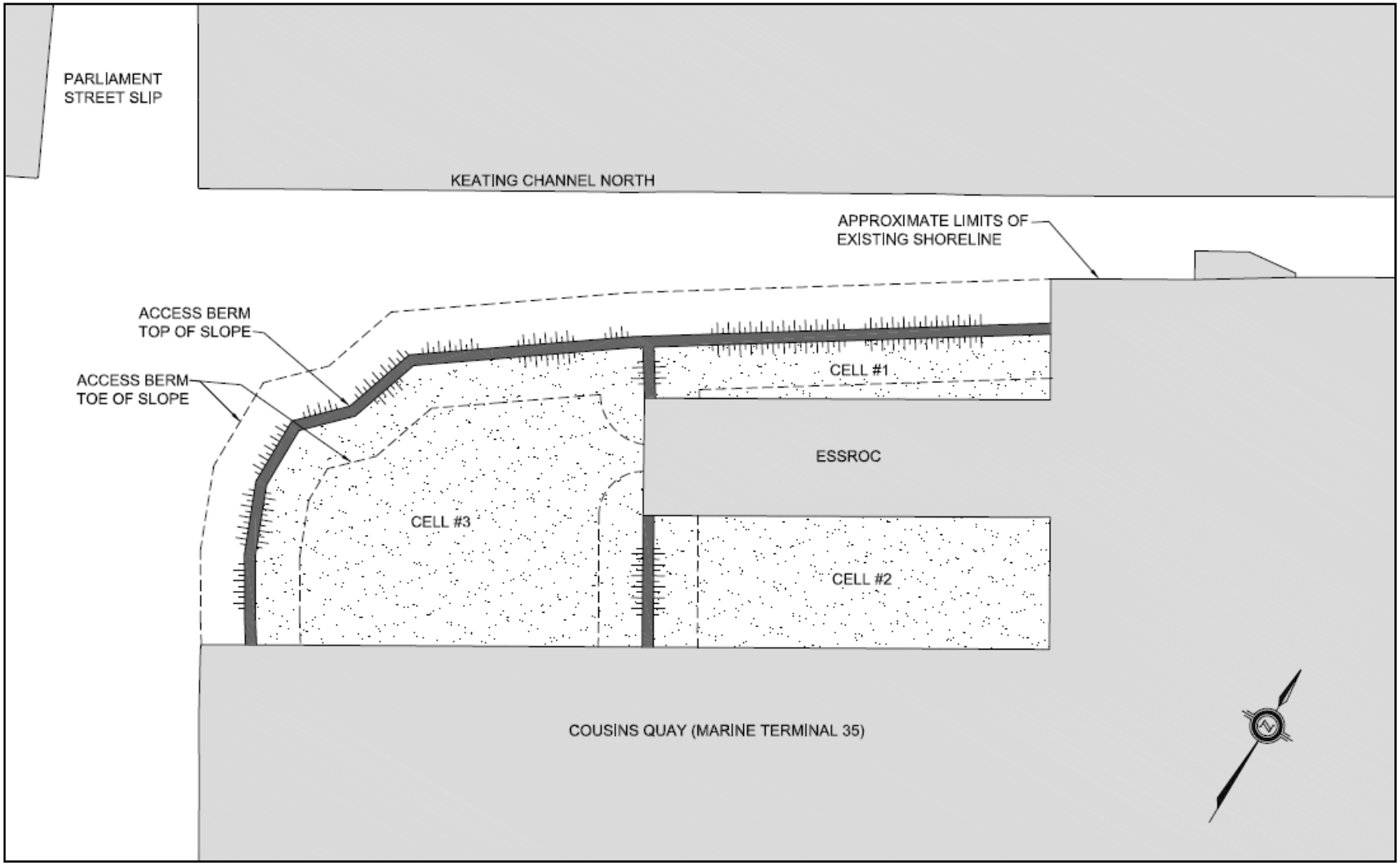


Figure 4-1 : Conceptual Multi-Cell Approach

4.3 Flexibility to accept a range of potential fill materials

The design of the fill containment structures and the land creation methodology to accommodate a range of fill materials would provide considerable flexibility for the design of excavation works and could minimize excavation and dredging management costs. As noted in Section 2, the preliminary design to date assumes that fill materials will meet the confined fill material criteria. However, potential project benefits could be realized through the accommodation of:

- dredged sediment materials
- excavated materials not meeting the Confined Fill Material Criteria (dirty soils)

The desire to accommodate "dirty" fill material is an issue that would require consideration of potential impacts to project timelines due to permitting issues. An amendment to the original Environmental Assessment (EA) would be required to accommodate fill materials that significantly exceed the confined fill material criteria; the length of time required to amend the DMNP EA approvals and achieve MOECC approvals is a significant factor in the consideration to place contaminated fill as part of the Essroc land creation project. Additional considerations associated with the ability to accommodate significantly contaminated fill material include:

- clean soil cover requirements,
- construction of footings and foundations within contaminated fill
- installation of municipal services with contaminated fill areas.

A design to accommodate dirty fill will require detailed evaluation of the specific contaminants and their transport mechanisms. Sealed pile walls with appropriate bed penetration and / or low conductivity liners could be considered to contain contaminated sediments if cost analysis warrants such expenditures.

The accommodation of dredged sediment materials may not require any significant design considerations if the dredged sediment meets the confined fill material criteria, is dewatered and trucked to the site. The ability to accommodate hydraulically dredged materials pumped to the facility may require improved wastewater handling capabilities near Essroc Quay to accommodate management of wastewater from local dredgeate dewatering processes or to manage displaced water from the active fill area should the dredge slurry be pumped directly to a fill cell. Dredged sediments could also be offloaded from a barge to a transfer area near the active fill cell; this would require provision of a transfer and re-handling area. The potential to dump dredge materials directly within a cell from a barge of dump-scow would require water access to the cell and therefore would require an incomplete barrier structure to permit vessel passage. A complete barrier must be in place before placement of "confined" fill, and therefore this approach would be expected to require that fill materials meet "unconfined" criteria.

At this time, it is assumed that materials will satisfy the Confined Fill Material Criteria, and would be dumped or pumped into the containment area. Furthermore, it is suggested that the material used as in-water lake fill will meet the requirements of "structural fill" with no more than 15% fines (74 μm) content, less than 0.5% organic content and shall have a maximum grain size of 67 mm (CH2M, 2015). By contrast, a 2015 infill project in Port Stanley, proposed for parkland use, has accepted material with up to 75% fines and up to 2% organics. Typical sections presented herein could accommodate soils of this physical nature, and therefore criteria could be revisited during detailed design should increased flexibility in soils accommodation be required.

5 Preliminary Design of In-Water Confinement Structure

The function of the confinement structure is to protect the proposed fill material from coastal and fluvial processes and to provide a structural confinement. Good management practices for shore infilling indicate that "fill may be placed within the confines of a structure which is capable of withstanding the waves of a 1:100 year storm" (MOECC, 2011). Furthermore, design guidance presented in MOECC 2011 includes recommendations to:

- ensure that the confining structure will withstand the most significant wave that could occur in storms over a 25-year period during the active filling phase; and
- protect the confining structure at the end of the filling season or upon completion of the project, to withstand the estimated 100-year storm significant wave prior to the end of the calm period or low flow period during which confined fill was first deposited.

The Don Mouth Naturalization and Port Lands Flood Protection Project EA indicated that the containment berm would extend approximately 1 m above normal water level. This berm and fill placed above it to achieve design grades will require protection against erosion due to coastal and hydraulic processes. Toronto and Region Conservation Authority has requested protection to an elevation of 1 m above the 100 year water level plus maximum wave uprush.

Initial design efforts focused on the development of two separate options for a viable in-water confinement structure. As the preliminary design has developed, the requirement for two fully distinct confinement structure cross sections has become less relevant. Instead, the ability to provide flexibility in the development of the detailed design has become a more important issue. In order to provide such flexibility, the provision of design options has been addressed through the definition of alternatives for single and multi-cell containments and through the definition of alternative cross sections for confinement structures. Alternative methods of constructing the confinement cell perimeter have been considered as required to accommodate the ultimate shoreline and upland functions and to address the various site constraints.

In general, the perimeter confinement structure alternatives include:

- a granular berm section option which would be expected to maximize the re-use of available demolition and excavation materials from regional development while providing significant flexibility with regard to shoreline naturalization; and
- a vertical wall structural option including driven piles (steel sheet piles or H piles with concrete panels) with pile footing and anchor conditions to be defined based on native lakebed conditions.

The primary consideration in the assignment of appropriate perimeter confinement structure cross sections is the desired function and geometry of the shoreline configuration. There are two primary areas of consideration in this regard. They are:

- the shoreline exposed to the west and associated inner harbour wave conditions which is associated with upland park use and related public functions, and
- the shoreline along the Keating channel under the new Cherry Street bridge realignment which is associated with upland urban use and is subject to stringent criteria with regard to hydraulic impact mitigation.

Internal confinement structures should be designed based on economic considerations and structural needs as they will ultimately be buried.

The proposed layout of confinement structure is presented in Figure 5-1.

Each of the two perimeter confinement geometries and the internal confinement geometry are discussed briefly in the following sections.

5.1 Berm Perimeter Confinement

A berm confinement structure is proposed for the western portion of the shoreline exposed to the Inner Harbour, extending into the Keating Channel to the approximate limits of the proposed upland parklands. This confinement geometry is most appropriate for this section of shoreline as it provides a compatible foundation for the natural rock shoreline that is envisioned to accommodate the intended public function. It is anticipated that the berm confinement structure would be a cost-effective structure where materials can be procured at reasonable costs.

Furthermore, the construction of the berm cross section is relatively simple, by end-dumping materials, working progressively offshore from a shoreline base. Depending on the bed conditions and bearing capacities, the berm materials could be placed directly on the lake bed. Should significant depths of soft clays or organic materials be present in the bed profile, excavation of a portion of this layer would be recommended in order to minimize potential for settlement of the berm.

As there is no recent borehole information for the lakebed within the area of the proposed confinement structures or land creation, boreholes and monitoring wells on adjacent Portland areas have been reviewed. While there are areas of concern identified in some of the local borehole information, the conditions are not consistent, and it is not possible to draw definitive conclusions at this time. Monitoring well MW27A-25 from the recent geotechnical investigations (GHD, 2015) shows approximately 1.5 m of very weak clay within the profile. The presence of organic materials has been documented in boreholes within the Study area (Peto MacCallum, 2016) but it is suggested that organics are predominantly found in soils to the east of Cherry Street (GHD, 2015). Dumping of stone on the lakebed where there is a significant thickness of poor quality materials, with the expectation that the material settle to a stable foundation is not recommended. Given the potential for organic material within the Study Area, it is recommended that an allowance be carried for excavation of bed materials to accommodate potential poor soils conditions.

The cost of removal of poor quality materials will depend on the depth and cover of such materials, as well as any potential chemistry concerns. Where the cost of removing the poor quality bed sediments is prohibitive, opportunities to strengthen the bed sediments could be considered during detailed design. One such alternative may be to install wick drains during berm construction.

One disadvantage of the berm confinement is that it consumes a significant volume of potential fill area. Should the cost of the berm be more considerable than anticipated, and the financial benefit to increasing fill volumes more than offsets such costs, a refined berm design could be considered.

A typical cross section of the berm confinement structure is provided in Figure 5-2. It is anticipated that the berm core would be constructed as an initial working surface with a minimum

crest elevation of 75.2 m. Armouring of the structure and an increase of the core elevation to 76.2 m would be completed as the second stage of the berm construction. The selection of core materials would require consideration of the wave exposure and risk of reshaping prior to placement of the filter and armour stone. Should the core material be a coarse and angular material, it is anticipated that a clearstone layer would be required on the lee side of the berm prior to placement of geotextile. Alternatively, a full granular filter design could be implemented to eliminate the need for geotextile if advantageous to the project schedule and budget.

The berm would be constructed to above the 100 year water level and would require protection with armour. The shoreline protection requirements are discussed further in Section 8.

5.2 Vertical Wall Perimeter Confinement

A vertical wall perimeter confinement is proposed for the eastern end of the Project Area along the Keating Channel, extending under the new Cherry Street bridge, westerly to the approximate proposed limits of the upland urban boundary. The rational for a vertical wall structure in this location is primarily related to the need to maintain functional upland space while ensuring no hydraulic impacts following construction of the Essroc land creation and prior to the availability of the new river mouth channel and ship channel overflow.

While the ultimate cross section at the new Cherry Street bridge includes a rock slope below water within the Keating Channel, the interim condition where Cherry Street has been moved but new floodway capacity has not yet been realized will be sensitive to any restriction of the channel beyond the limits of the existing south vertical Keating Channel wall. As a result, it is necessary that any toe of slope be placed south of this wall alignment. A sloping revetment with this toe location would result in a loss of upland area in the vicinity of the Cherry Street bridge.

In order to accommodate hydraulic requirements while maintaining upland property, a vertical wall is proposed. The proposed vertical confinement wall is carried to the west to the approximate limits of the upland urban area which coincides with the approximate westerly end of the Essroc Quay. This transition point to a berm confinement is consistent with the development of an internal confinement cell wall and a point where the Keating Channel has widened sufficiently to accommodate the encroachment of a rock slope.

A typical cross section of the vertical perimeter confinement wall is presented in Figure 5-3 in relation to the proposed Cherry Street bridge. The top of wall in this location is designed at an elevation of approximately 75.7 m. The vertical wall in this location could be constructed as a steel sheet pile (SSP) or H-pile and concrete panel structure. The primary differences in design would largely relate to the treatment of the pile footing and the design of the concrete panel integration with the bed. Both of these issues would be confirmed at the detailed design stage.

Typically in depths such as those present at the site, anchor walls are favoured over cantilevered walls from an economic perspective. Further, bedrock elevations at the site may eliminate the potential for a cantilevered SSP wall. The design and construction of an anchor wall will require that tie-backs are protected during first stage filling processes if fill is placed between the working berm and the SSP wall. A socketed soldier pile wall could be investigated as an alternative to the anchored SSP wall once geotechnical conditions are confirmed during detailed design.

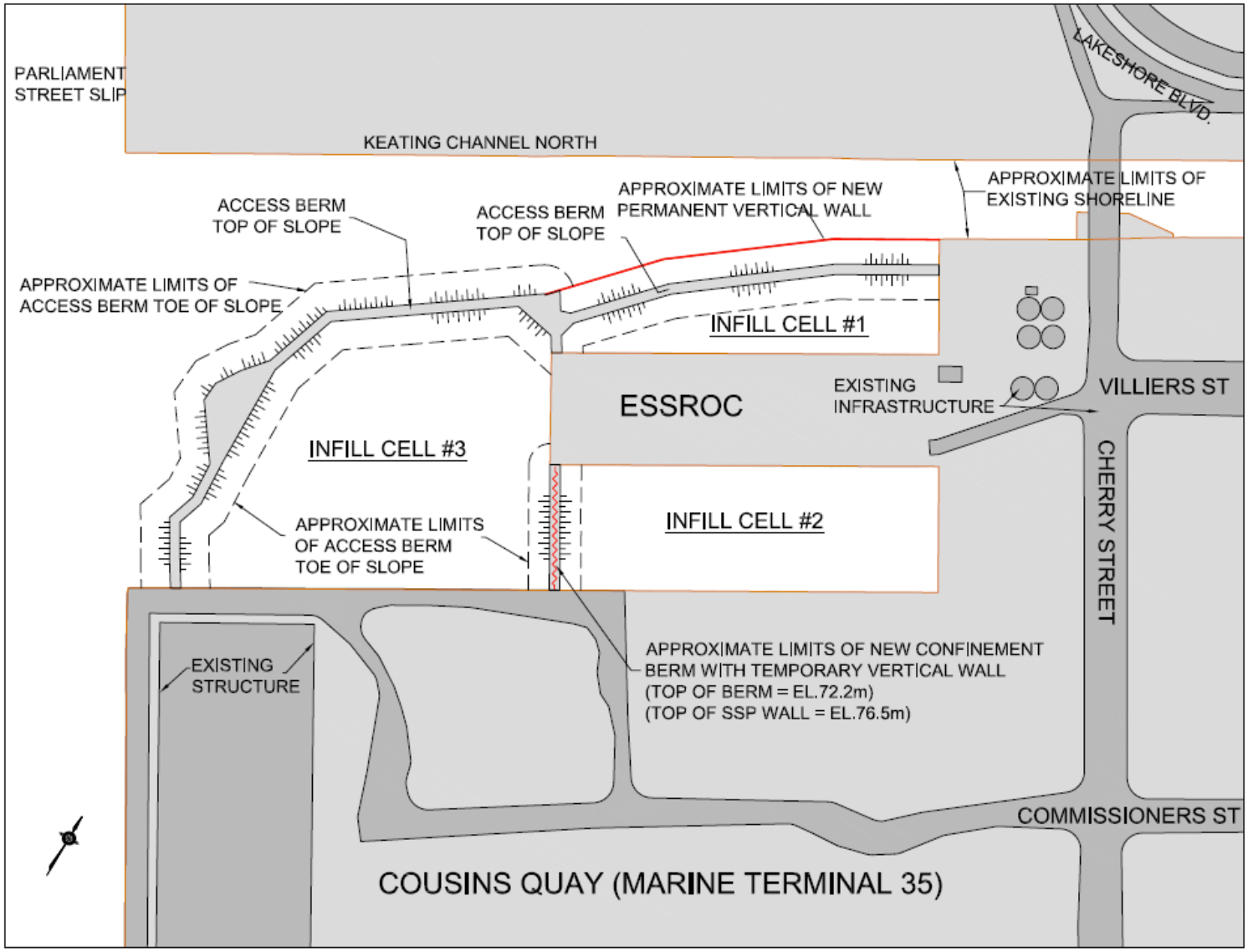


Figure 5-1 : Proposed Layout and Type of Confinement Structures

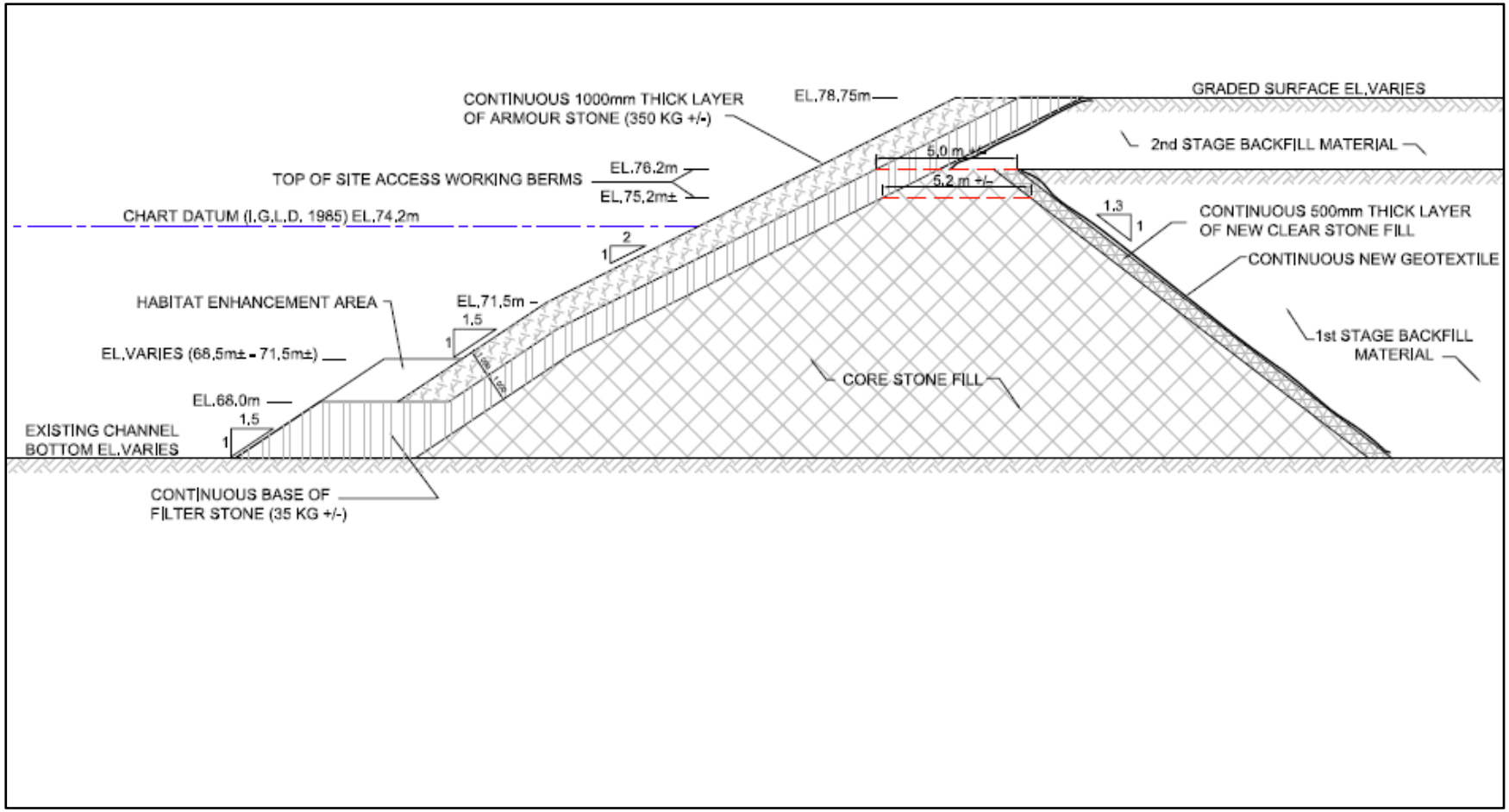


Figure 5-2 : Proposed Berm Confinement Cross Section

The SSP wall option is presented in Figure 5-4.

The vertical wall section will tie to the existing Keating channel wall structure at the east end of the Essroc land creation project, and will integrate with the proposed berm section at the westerly limits of the vertical wall section. It is anticipated that the termination of the west end of the vertical wall will not require a return wall section, but will simply be buried within the confinement berm as required to accommodate proposed local landscaping grades. This detail will be developed during the final design stage.

5.3 Internal Confinement Structures

Confinement structures which may be required to provide for a multi-cell configuration to accommodate advanced fill placement in certain areas will ultimately be buried upon completion of all phases of filling operations, and as a result, they must provide adequate protection to the interim fill areas but have no long-term functional constraints. As a result, these structures may be of a berm configuration, a vertical wall configuration or a hybrid.

A berm section would be similar to that presented for the perimeter confinement case. Given that a berm cross section may occupy a significant volume which could otherwise be used for fill disposal and would still be expected to require some interim protection of the offshore face, there may be justification for consideration of a smaller cross sectional profile, as may be provided by a vertical wall or hybrid configuration. While both of these sections would require structural capacity to accommodate the fill, protection of the offshore side of the structure would not be a significant concern and it may be possible to remove a portion of any associated rock fill during final filling operations to maximize fill disposal volumes.

The design of the internal confinement structures should consider the ultimate upland configuration to as great a degree as possible. These confinement structures may be advantageous in terms of geotechnical capabilities providing a more structural base for roadways, or may be impediments to upland development where footings to bedrock are required. The alignment of these containment berms, choice of construction materials and possible design measures to accommodate future structures and servicing should be considered within the context of the proposed upland functions where possible.

A typical conceptual section of a potential hybrid internal confinement structure is presented in Figure 5-5. As noted above, this internal confinement structure could also be constructed simply as a granular berm or potentially a vertical wall. Detailed design considerations will determine the preferred approach to constructing the internal confinement structures, providing they are deemed necessary and economically beneficial. For the purposes of budget estimating and volume calculations, a simple berm cross section to elevation 76.2 m has been assumed.

Should contaminant levels in proposed fill materials exceed the confined fill material criteria, the design of internal containment structures must be reviewed with respect to ability to control the transport of contaminants from a given cell. This review would need to include perimeter structures as well, either new or existing, with respect to contaminant transport in order to provide adequate support for required permitting processes.

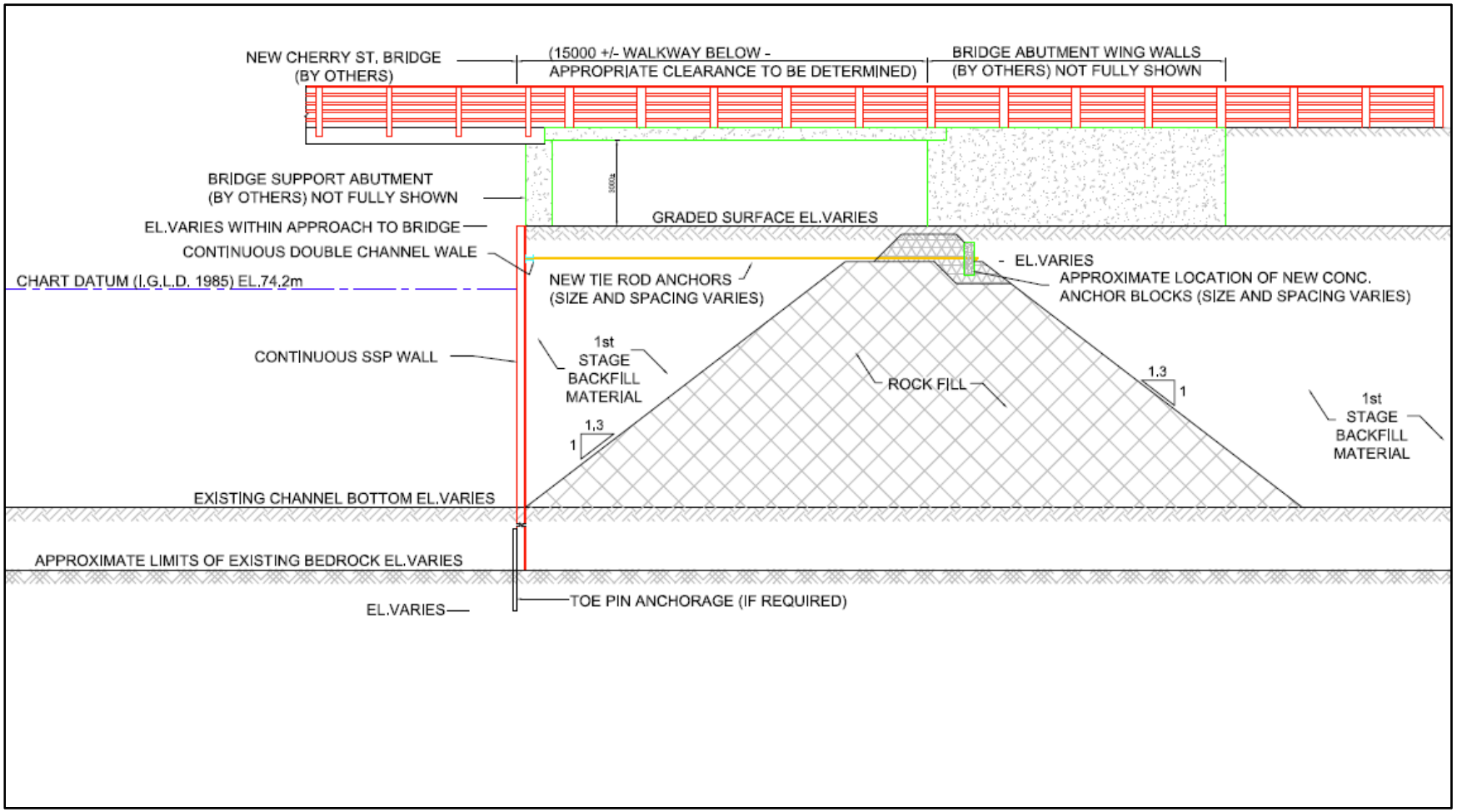


Figure 5-3 : Proposed Vertical Confinement Cross Section at Cherry Street Bridge

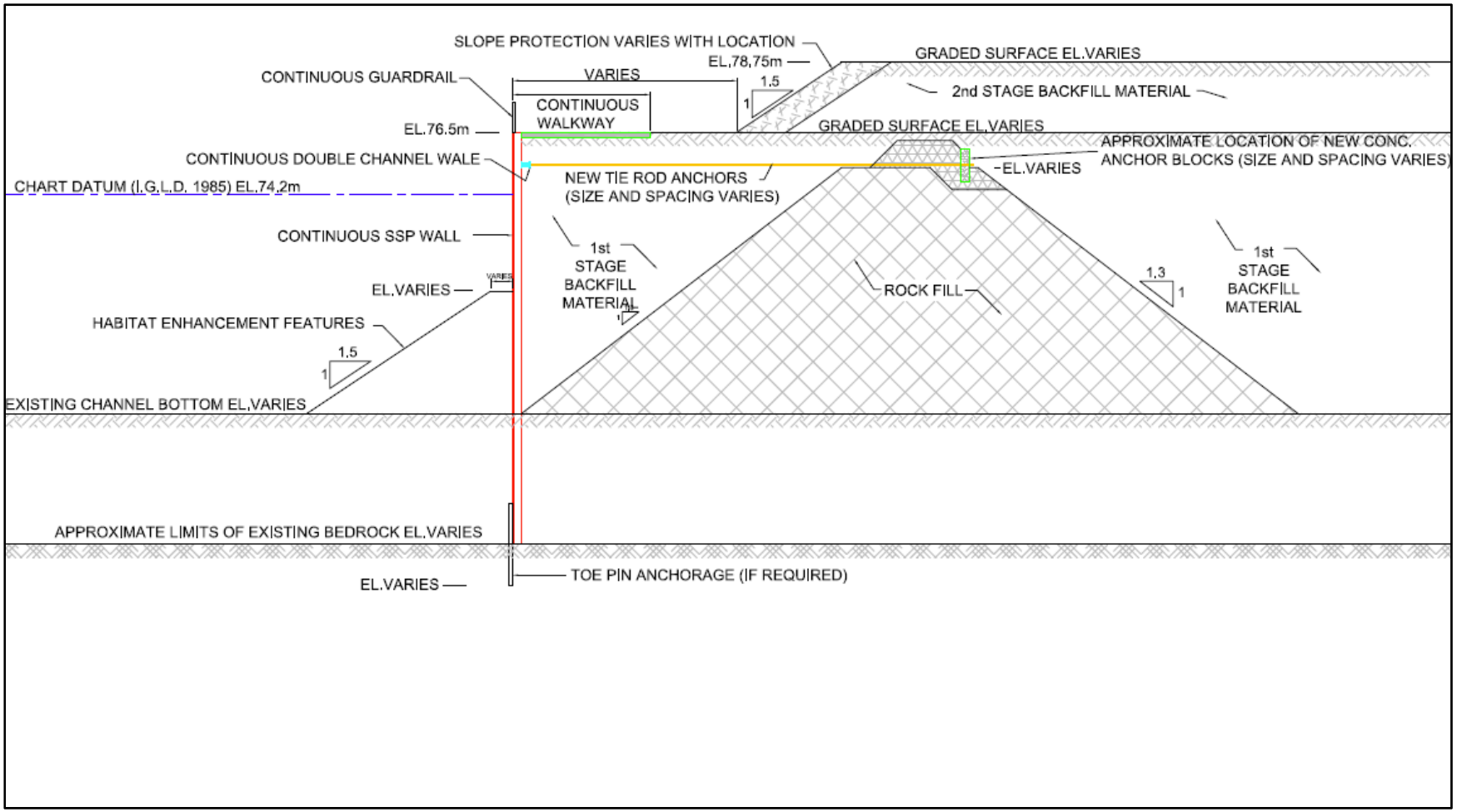


Figure 5-4 : Proposed Vertical Confinement Cross Section - Generic SSP

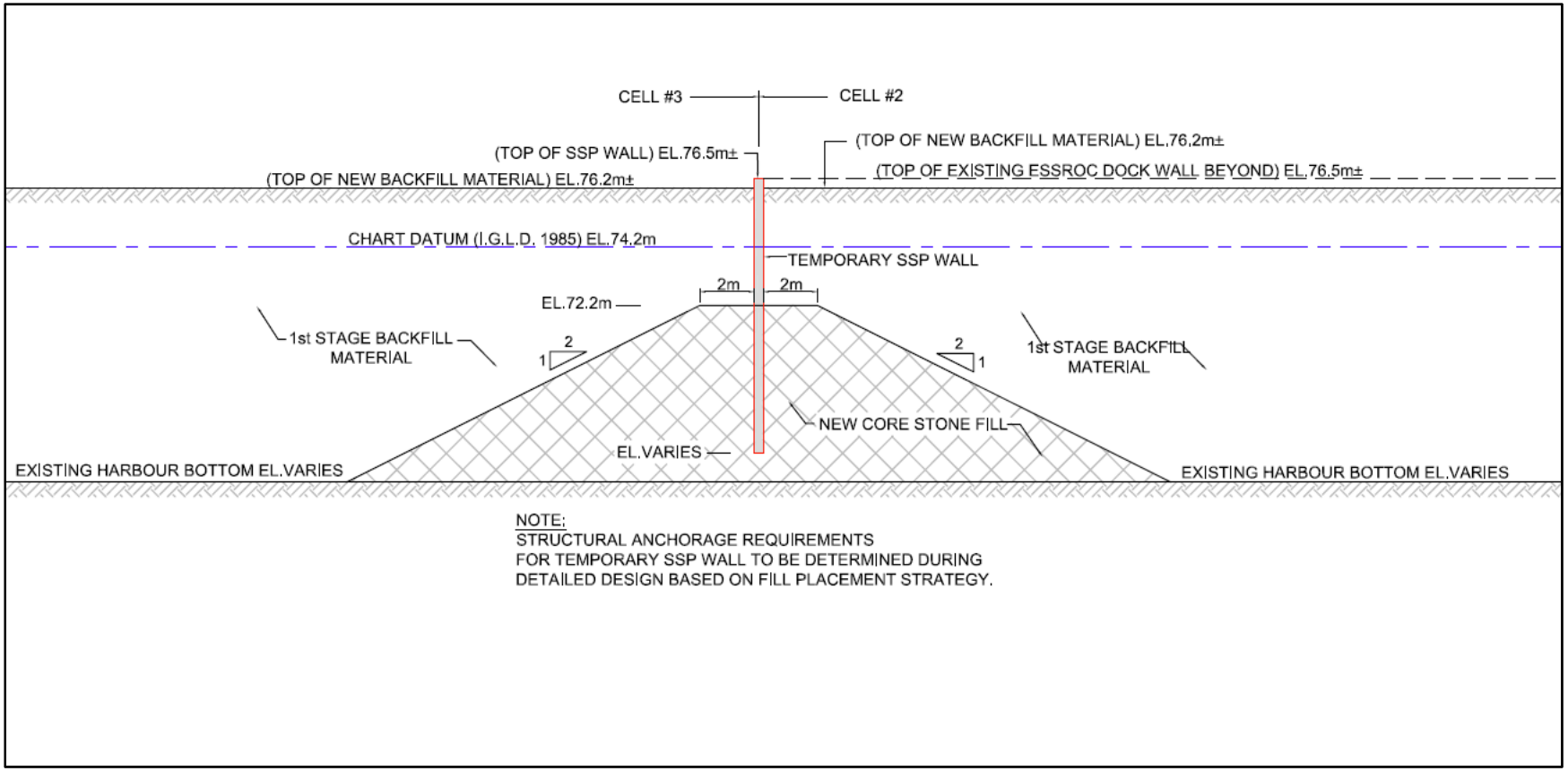


Figure 5-5 : Hybrid Internal Confinement Cross Section

6 Preliminary Design of Filling Operations

Assuming that fill material is consistent with the Confined Fill Material Criteria, the approach to filling operations will depend to a large extent on the source of the fill material, its physical characteristics, the characteristics of the confinement perimeter and the rate of delivery. These factors are not yet fully determined, and therefore, it is not yet possible to provide significant detail on the design of filling operations. A conceptual schematic for the land creation works is presented in Figure 6-1.

A number of generic points can be made with regard to the potential filling operations and related design factors which should be considered further as detailed information becomes available.

- Placement of fill is anticipated to be largely by end-dumping from a truck with subsequent rehandling (grading) of fill placed above water. Consideration should be given to methods of limiting the need for significant rehandling (regrading) of these materials. Options such as hydraulic redistribution of dumped materials (where fill conditions permit) and strategic development of defined haul routes within a given fill area may serve this end.
- Management of water from active fill areas may be partially accommodated by filtration through the granular component of the berm or rock fill anchorage associated with the confinement structure. Permittivity of geotextiles is expected to be reduced in time and allowance for supplementary management measures for displaced water should be provided. Such measures may include settling basins, or active filtering technologies. Graded granular filters may be employed in place of geotextiles but their design would require knowledge of the containment berm core materials. Cost implications of materials and cell volume needs would likely dictate the viability of geotextiles Degree and rate of consolidation of fill materials will vary with the physical characteristics of the fill. Allowance should be made for measures to enhance the natural consolidation processes. The degree of settlement and rate of consolidation of the bed sediments once lake fill material is placed will be dependent on bed sediment profiles which must be determined during detailed design. Consideration of conservative sediment profiles (Peto MacCallum, 2016) suggests that pre-loading may not be sufficient to achieve design grades within an acceptable period of time. Surcharge fill loads would reduce the consolidation times and provide for possible fill staging areas if required. Additional measures such as wick drainage and in place densification may warrant further consideration where fill soils are of poorer geotechnical capacity and footings will not be founded on bedrock.
- Consideration of future infrastructure requirements and conflicts with existing structures and future fill conditions may require special design considerations in order to facilitate development. It is noted that the preliminary design profiles for Cherry Street servicing maintain storm sewer inverts on the order of 75 m within the proposed fill area. It is expected however that there will be some conflicts between proposed local services and existing structures. Potential considerations to address such conflicts include:
    - partial demolition of existing crib and/or SSP walls on Essroc Quay and Cousins Quay to facilitate future installation of Cherry Street servicing,
    - installation of structural conduit to accommodate future Cherry Street services through fill areas where future disturbance of fill would be problematic.

Staging of fill operations is anticipated to accommodate staged excavation works. A multi-cell approach is proposed at this preliminary design stage; detailed design of fill sequencing will require coordination with detailed design of proposed excavation areas by other members of the Project Team. Preliminary staging plans for the filling operations are presented in Appendix A.

Based on available information and preliminary design considerations, typical tasks associated with the land creation project would include:

- secure permits and confirm work windows
- install environmental and site controls
    - secure site access points
    - install upland environmental site controls
    - install turbidity controls
    - install navigation controls
- prepare lakebed and upland areas as required for berm placement and access respectively
    - pre-dredging of significant organic deposits along berm alignment if deemed necessary by detailed geotechnical investigations
    - construct upland access roads and material management areas
    - relocate existing services as required
- construct working berms for construction of confinement structures
    - berm material to be free from fines and placed during permitted in-water work windows
    - working periods will be sensitive to environmental conditions
- construct confinement structures to provide protection above 25 yr wave action (76.2 m +/-)
    - schedule work sequencing to maximize potential for construction during winter periods (e.g. pile driving),
    - construct berm armour and filter layers
    - construct fisheries habitat enhancements
- prepare upland areas for filling operations
    - selective partial demolition of existing shorewall structures as required to facilitate future utility construction
    - construct aggregate piles
    - establish decant water management facilities
- place 1st stage of confined fill
    - working from defined discharge locations place 1st stage of fill within completed confinement areas
- Complete fill placement and protection to level of 100 year wave action
    - place 2nd stage of fill materials to design grades
    - concurrently, complete armouring to level of 100 year wave action (78.75 m +/-) or as defined locally along Keating Channel based on detailed hydraulic investigations
- implement measures to assist consolidation as required throughout filling process

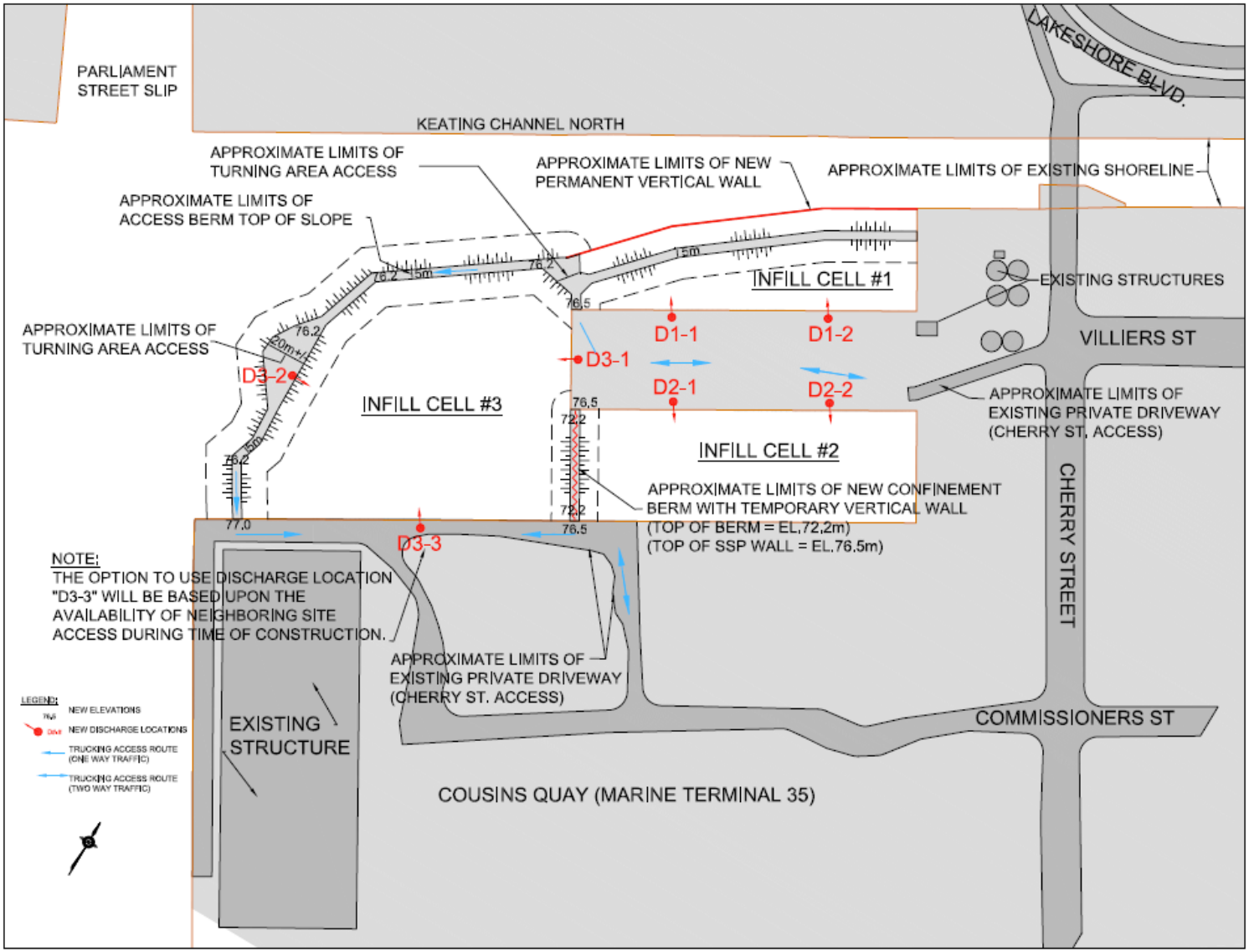


Figure 6-1 : Conceptual Schematic for Land Creation

7 Assessment of Fill Volumes

The assessment of fill volumes has been based on expected fill elevations to the elevation of the 100 year water level plus wave uprush plus 1.0 m freeboard allowance. This elevation equates to approximately 78.75 m, and is in excess of ultimate design grades over a portion of the site. This is not anticipated to be an issue given the desire to pre-load the fill areas, and in fact, it is anticipated that fill will be placed above 78.75 m elevation to achieve such pre-loading.

Gross volumes available within the defined confinement areas are provided below without consideration of soil bulking on excavation and consolidation in place. The estimates in the following table do not include settlement of the underlying materials.

Table 7-1 : Approximate Structure Material and Fill Capacity Volumes

Location	Cell #1	Cell #2	Cell #3	Existing Upland
Confinement Structure Materials	40,500	14,400	67,200	Nil
Fill Capacity Volume to 76.2 m	38,000	97,500	159,500	Nil
Fill Capacity between 76.2 m - 78.75 m	17,000	27,500	53,500	46,500

Following placement of fill within the proposed confinement areas, settlement of the underlying soils will take place under natural and imposed conditions. The rate and extent of settlement will depend on the lakebed materials (primarily loose silts and organics) and any efforts employed to enhance and expedite such settlement. Given the lack of local information with regard to geotechnical conditions of the lakebed within the Essroc Quay area, settlement estimates have been completed based on assumed depths of compressible materials. Primary settlements of 950 mm, 625 mm and 300 mm are estimated for potential compressible bed materials with thickness of 5m, 3m and 1, respectively. The estimated time for 90% of this settlement to occur is estimated to be up to 24 - 30 months (Peto MacCallum, 2016).

The fill capacity volumes noted above should be increased in accordance with settlement estimates developed on the basis of more detailed geotechnical investigations during the detailed design stage of the project.

8 Preliminary Design of Shoreline Structures

The design of shoreline protection measures will serve to stabilize the proposed confinement structures against coastal and fluvial processes and must be compatible with the proposed development functions of the site. Furthermore, some aspects of the shoreline protection measures provide an improvement to fish habitat conditions through the provision of large rock slopes and associated voids. Additional enhancement opportunities will be implemented in conjunction with these slopes, integrating more formally designed offset features in the toe of slope region.

Key aspects of the design of the rock armour shoreline and the vertical wall shoreline sections are presented in Sections 8.1 and 8.2 respectively. The integration of fish habitat enhancement features is discussed in Section 8.3. The proposed shoreline structures and associated landscape and habitat enhancement features are shown in Figure 8-1.

8.1 Rock Armour Shoreline

The primary design criteria for the shoreline protection works as per the project terms of reference is to provide protection to the level of the 100 year water level plus wave uprush plus 1.0 m. Wave uprush will vary with wave exposure and structure characteristics. For the purpose of this investigation, it is assumed that the local wave climate as defined based on a more regional investigation is relevant to the revetment slope overall, and that the revetment slope will be constructed at 2H:1V. These assumptions should be revisited during detailed design in order to assess potential for savings or additional requirements. The resulting upper elevation estimated for slope protection based on estimated 100 year wave uprush with 100 year water level and 1.0 m additional freeboard is 78.75 m ±. This is based on a wave uprush of approximately 1.77 m.

Wave uprush for other design conditions and structure slopes has been estimated to assist in interpretation of design options and required protection levels. Results are provided in Table 8.1

Table 8.1: Wave Runup Matrix - Assuming 2% Wave Exceedence

T	Hs	Tp	1.5:1	2:1	2.5:1	3:1
2	0.7	3.5	1.33	1.17	1.06	0.97
25	1.0	3.5	1.76	1.54	1.39	1.16
50	1.1	3.5	1.89	1.66	1.46	1.22
100	1.2	3.5	2.02	1.77	1.53	1.27
Wake/200	1.3	3.5	2.15	1.88	1.59	1.32

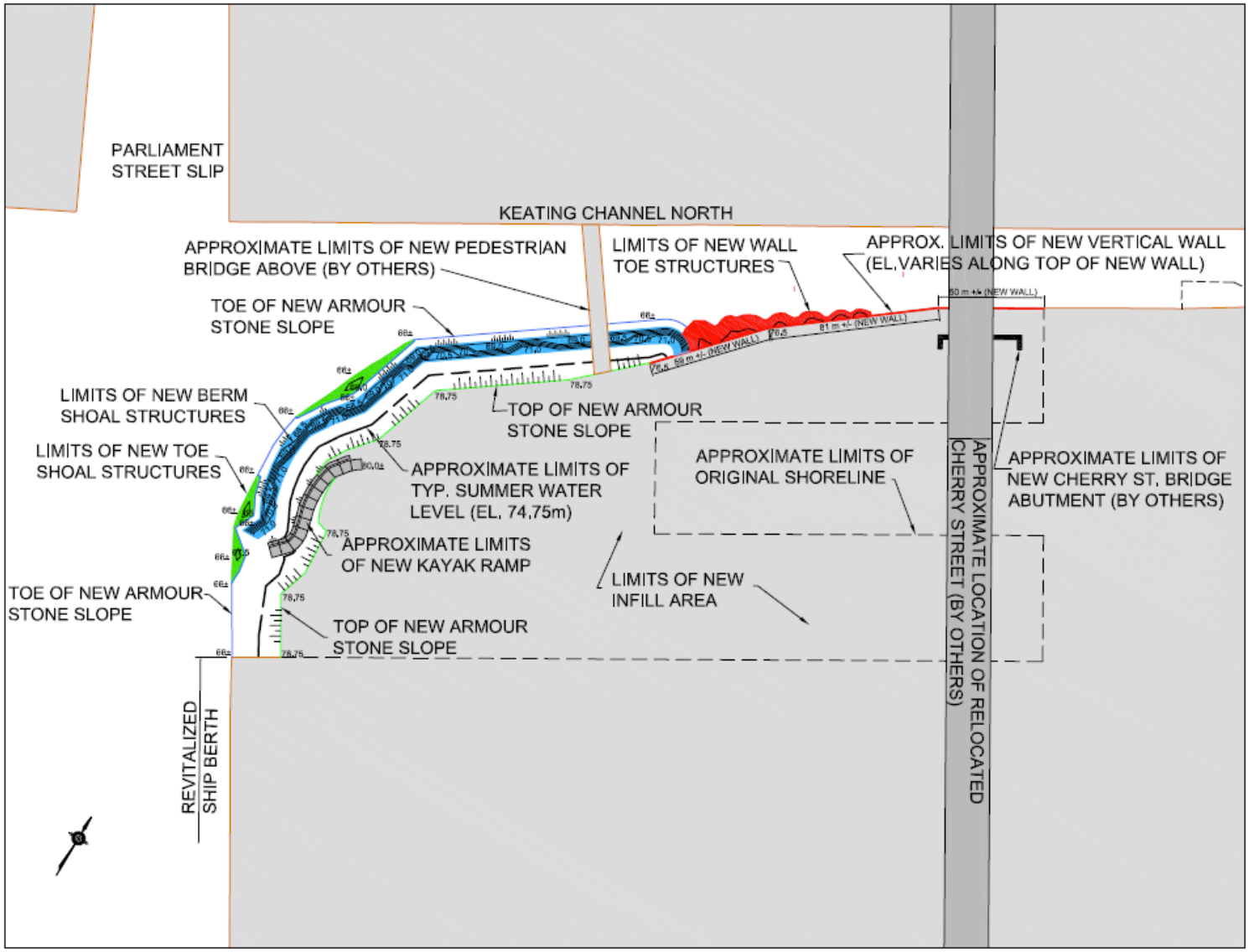


Figure 8-1 : Proposed Shoreline Features

Required armour sizing for the slope protection has been estimated based on two empirical approaches to armour stability under wave attack. As with runup, the calculation is sensitive to structure slope, and therefore a matrix of requirements has been provide in Table 8.2. The results suggest that for a 100 year wave condition on a 2:1 slope, a typical armour of approximately 0.46 m diameter would be stable. Given the potential for large boat wakes, the 0.5 m armour stone requirement is recommended for this project. This equates to a stone mass of approximately 350 kg.

Table 8.2: Stability Matrix - D_{50} (m)

T	Hs	Tp	1.5:1	2:1	2.5:1	3:1
2	0.7	3.5	0.31	0.27	0.25	0.23
25	1.0	3.5	0.42	0.38	0.35	0.33
50	1.1	3.5	0.46	0.42	0.39	0.37
100	1.2	3.5	0.50	0.46	0.43	0.40
Wake/200	1.3	3.5	0.55	0.50	0.46	0.43

The ability of rubble slopes to manage ice forces is a complex issue. The revetment is a flexible structure and the irregular nature of the surface typically does not permit ice sheets to develop to their maximum potential. Armour of 350 kg mass has proven stable in semi-sheltered great lakes environments to date, and is carried for costing purposes in this exercise.

Continued development of the shoreline protection design elements through the detailed design process should focus in greater detail on the integration of the required public function and localized hydraulic considerations.

A kayak launch is presently proposed along the western shoreline of the proposed fill area; the proposed location of this feature is expected to be revisited as the detailed design progresses to address preliminary comments from review agencies (AHT) and consideration of potential local commercial vessel navigation. Furthermore, specific design parameters for the launch ramp are yet to be developed in accordance with the landscape plan. A possible integration of such a ramp into the shoreline structure where presently proposed is depicted in Figure 8-1 with typical section presented in Figure 8-2. Upland site grading will be sensitive to the location of the ramp.

8.2 Vertical Wall Shoreline

The vertical wall component of the shoreline along the Keating Channel is shown geometrically at this time with assumed requirements for pinning or socketing of pile elements into bedrock. The ultimate design of the toe detail and tiebacks will manage the structural loads imposed by the fill and hydraulic conditions. Because the elevation of the shoreline drops under the new Cherry Street bridge to accommodate a pedestrian walkway, the elevation of the top of wall is expected to be below wave crest elevations in this area. While some anticipated reduction in wave height is expected in this area due to the reduced exposure, reflection of waves from the north Keating Channel wall would tend to reduce the influence of this protection.

Without detailed wave analysis, the design progressive wave height has been considered relevant in this location. The vertical wall structure will not support formal wave runup processes, but instead will permit overtopping. Empirical techniques used to estimate the extent of excursion of a wave crest onto a low bluff shoreline suggest that the extent of wave action could extend on the order of 5 m inland from the wall. As this would be the extent of the 100 year flood limit, proposed fill would require protection against this wave action. It is anticipated that granular capping protected by concrete walkways would provide this protection.

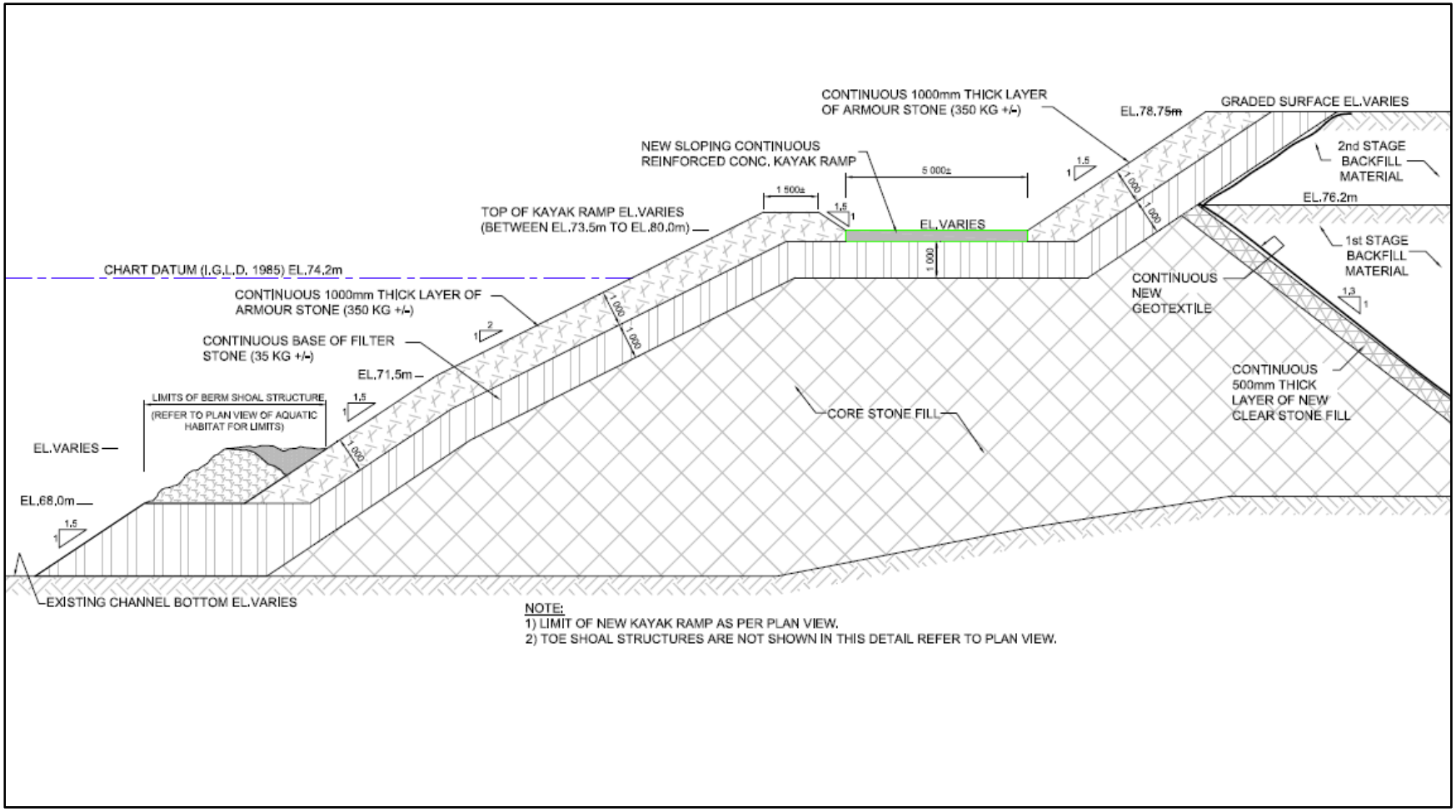


Figure 8-2 : Typical Section at Proposed Kayak Ramp

Should proposed site grading result in secondary slopes within the overtopping region, protection of upland slopes and fill areas would be required up to the maximum elevation of the 100 year water level plus maximum wave uprush plus 1 m freeboard. Analysis of local wave runup processes should be completed during detailed design with final shoreline geometries to finalize the height and location of the protection required. For the purposes of the preliminary design is should be expected that the sloping grade along the south edge of the walkway at the vertical wall require protection to a height of 1 m above the walk way surface. Such protection is depicted in Figure 5-4. Fill material should not be placed lakeward of the toe of this protected slope.

8.3 Fish Habitat Enhancement

Two meetings were held with Aquatic Habitat Toronto (AHT) during the preliminary design stage of the project. At the initial meeting, discussions focused on feasible habitat enhancement opportunities given the proposed general shoreline layout and geometry. At the second meeting, preliminary design of fish habitat enhancements were presented for comment and discussion.

While it is understood that the broader Don Mouth naturalization project will result in the generation of significant high-quality habitat area, that work will follow the Essroc Quay land creation project and therefore, opportunities to create habitat function in conjunction with the construction of the confinement structures must be realized. Habitat enhancement opportunities identified to be compatible with the proposed confinement structure geometries include:

- berm shoals to be developed along the slope of the proposed rock berm,
- toe shoals (nearshore reefs) to be developed in recessed areas along the toe of the proposed rock berm, and
- toe shoals to be developed along the toe of the proposed vertical wall section.

The area available for the implementation of these features is constrained to some extent by local commercial navigation requirements in the region and by hydraulic capacity constraints within the Keating Channel until additional floodway capacity is provided through the new Don River outlet and spillway.

The potential for the development of shoals along the slope of the rock containment berm has been maximized, with the placement of shoals extending from the proposed kayak ramp to the berm's intersection with the new vertical wall. These shoals are developed at a range of elevations between 68.5 m and 71.5 m using a variety of stone sizes to provide appealing conditions for a range of species. Development of shoals above 71.5 m is not proposed due to the potential for increased wave generated stresses above this elevation. The location of habitat enhancement features along the proposed containment berm is depicted in Figure 8-1 with typical cross sections presented in Figures 8-3 through 8-5.

The potential to locate reef structures offshore of the toe of the rock armoured shoreline was investigated, but due to navigation requirements it was determined that enhancement opportunities should remain within the general alignment of the toe of berm slope. Opportunities do exist in select locations where the toe pulls back locally to form a small embayment area. These opportunities will be taken advantage of by placing toe shoals (small connected reefs) where space allowed. The elevation of the structures was maximized for the space available.

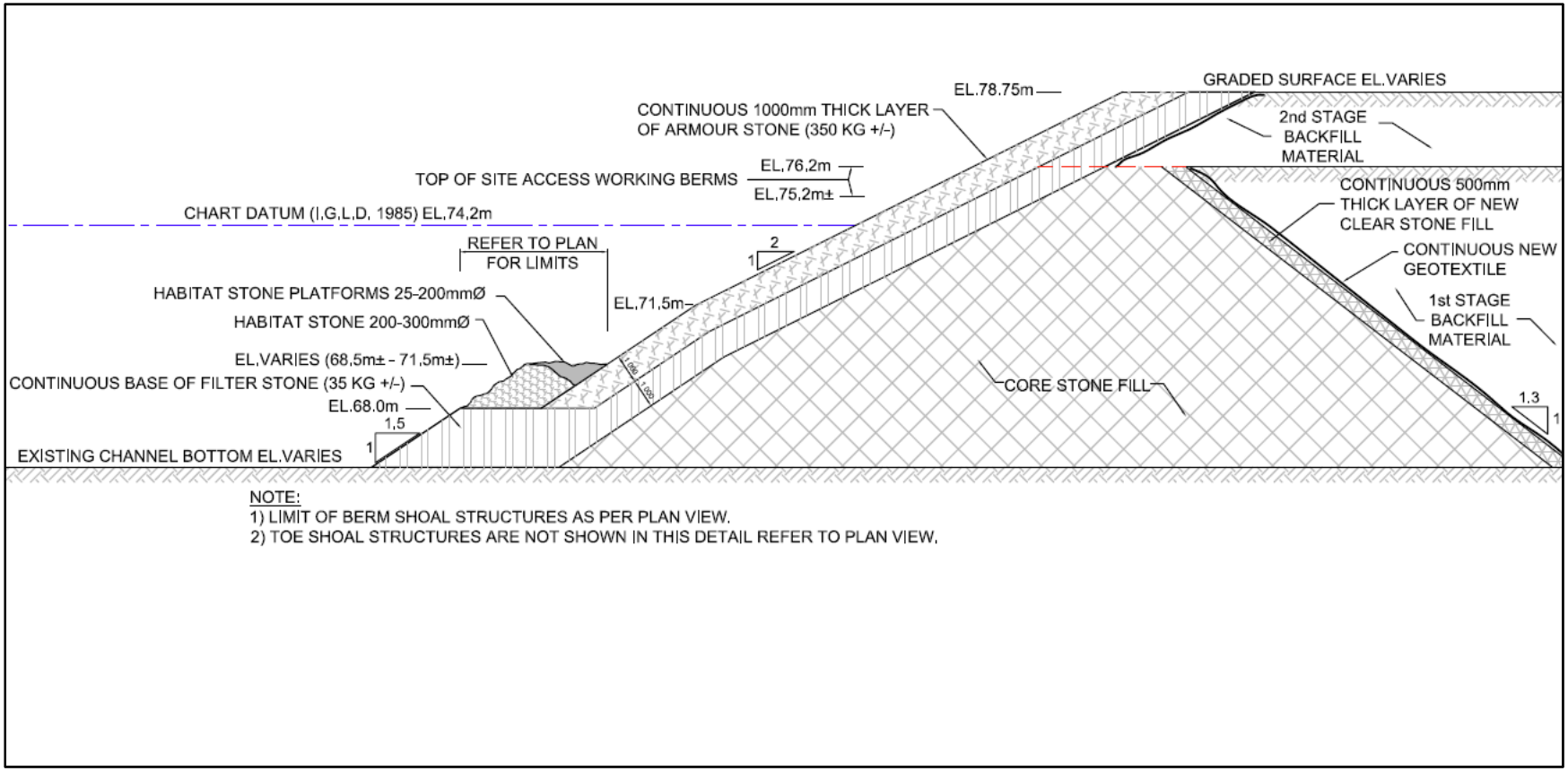


Figure 8-3 : Typical Berm Shoal Section on Confinement Berm

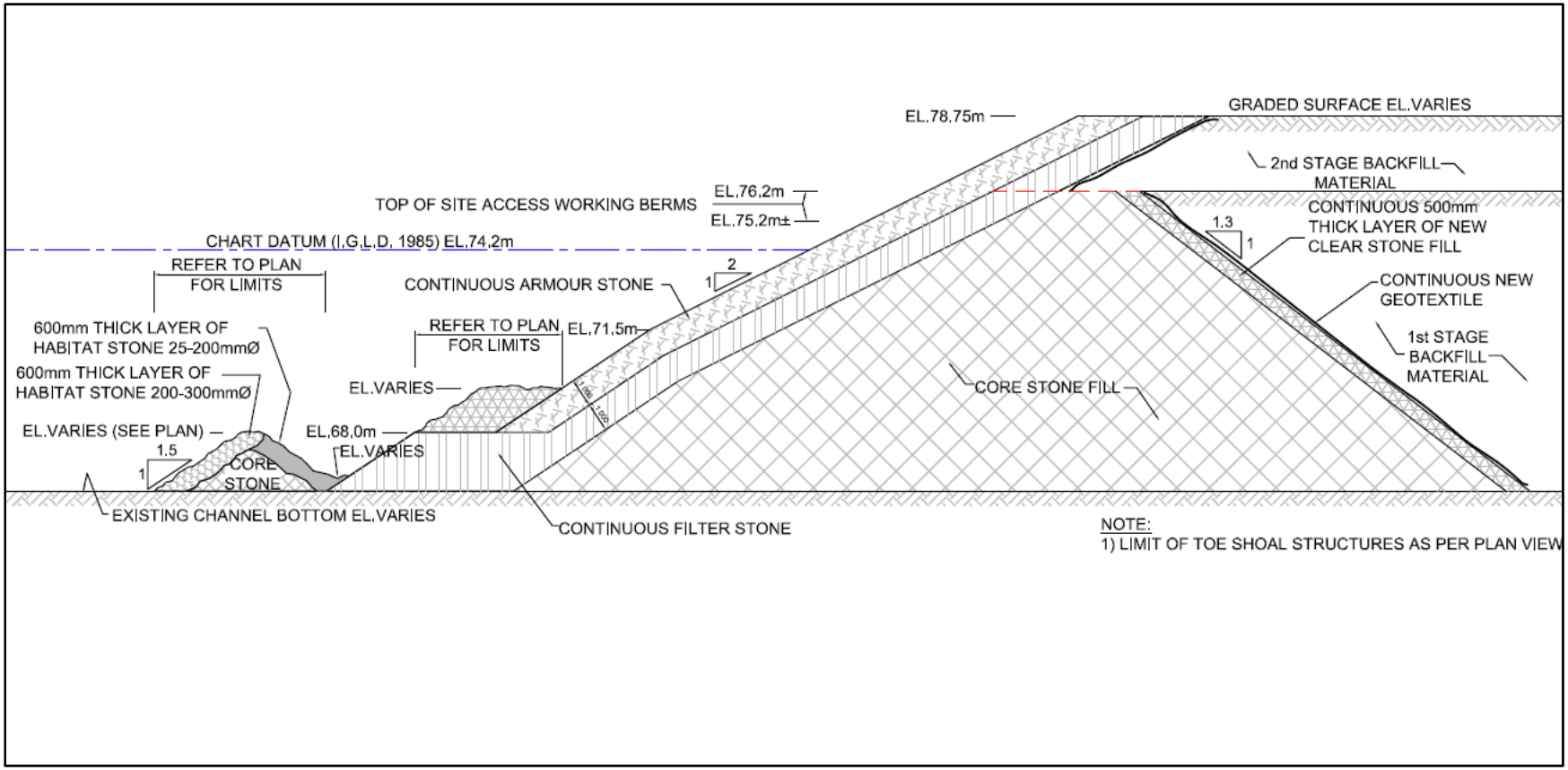


Figure 8-4 : Typical Toe Shoal Section on Confinement Berm

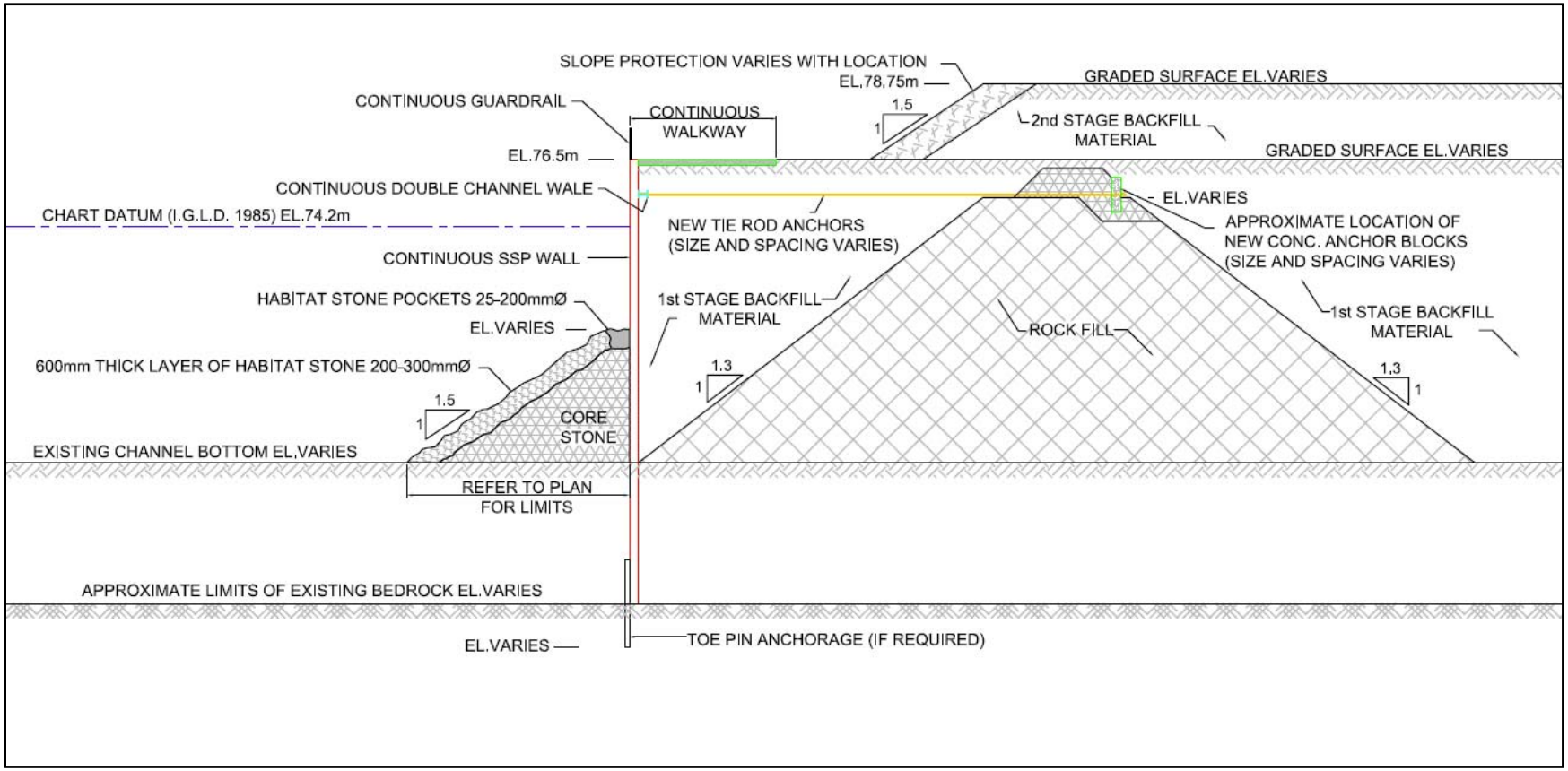


Figure 8-5 : Typical Wall Toe Structure on SSP Wall

Due to hydraulic capacity constraints, it is not anticipated that fish habitat offsets are immediately possible along the new vertical wall within the narrowest portion of the Keating Channel near Cherry Street. As the proposed vertical wall alignment changes towards the west, creating a wider channel, increasing opportunity exists for implementation of habitat offset measures. From this point of channel widening westerly to the integration with the proposed rock armoured shoreline, toe shelter structures will be constructed along the toe of the vertical wall. The proposed design in this area will provide for variability in the slopes, elevations and material characteristics associated with these toe shelter features in order to provide a naturalized variety of shelter areas.

The potential may exist to incorporate small localized areas of woody material (log tangles) between toe shoals and the toe of berm slope and at the transition between the vertical wall and containment berm, and to provide shoal materials which may support the natural development of vegetation. Such opportunities should be explored more fully during detailed design.

Once the full naturalized river outlet and floodplain build-out has been completed to offset hydraulic capacity constraints, additional habitat offset opportunities may be feasible along the Keating Channel wall in the vicinity of Cherry Street.

9 Support to Design Costing

Concept level costing efforts are presently based on coarse estimates of volumes, and are presented as bulk costs per linear meter for shoreline structures, and as lump sum items for generic works. More detailed breakdown of costing will be possible as design parameters are refined through the detailed design.

The bulk costs of the proposed confinement structures assume market values for rock materials for berm construction. Should local waste rubble materials be available at reduced costs, significant savings may be realized due to the volume of material required. Should market value berm materials be necessary to carry in the project budget, further evaluation of cross sections may be warranted.

Table 9-1: Concept Level Cost Estimate

Cell #	Item	Unit	Unit Cost	Units	Extended
1	Perimeter Berm	Lin. m	$32,500	300	$9,750,000
2	Internal Confinement Berm	Lin. m	$29,000	60	$1,740,000
3	Perimeter Wall	Lin. m	$36,500	190	$6,935,000
3	Internal Confinement Berm	Lin. m	$29,000	30	$870,000
All	Fill Management Allowance	L.S.	$500,000	1	$500,000
Total					**$19,795,000**

10 References

CH2M, 2015. Stage 1: Draft Preliminary Environmental Assessment and Geotechnical and Earthworks Report. September 30, 2015.

GHD, 2015. Port Lands Environmental, Geotechnical and Hydrogeological Investigation : Stage 1 and Stage 2 Port Lands Toronto. Report No. 2, December 31, 2015.

Ontario Ministry of Environment (MOE), 2011. Fill Quality Guide and Good Management Practices for Shore Infilling in Ontario. Revised 2011.

Peto MacCallum Consulting Engineerrs, 2016. Revised Draft Preliminary Geotechnical Comments - Essroc Quay Cherry Street, Toronto Ontario. January 22, 2016.

Riggs Engineering Ltd., 2015 Marine Engineering Services to Develop Preliminary Designs for Land Creation Works Surrounding Essroc Quay - Existing Conditions Summary Report. Draft Report, September 4, 2015

APPENDICES

Appendix A: Preliminary Proposed Excavation and Fill Staging
(Source: CH2M, 2015. Stage 1: Draft Preliminary Environmental Assessment and Geotechnical and Earthworks Report.)

PHASE I

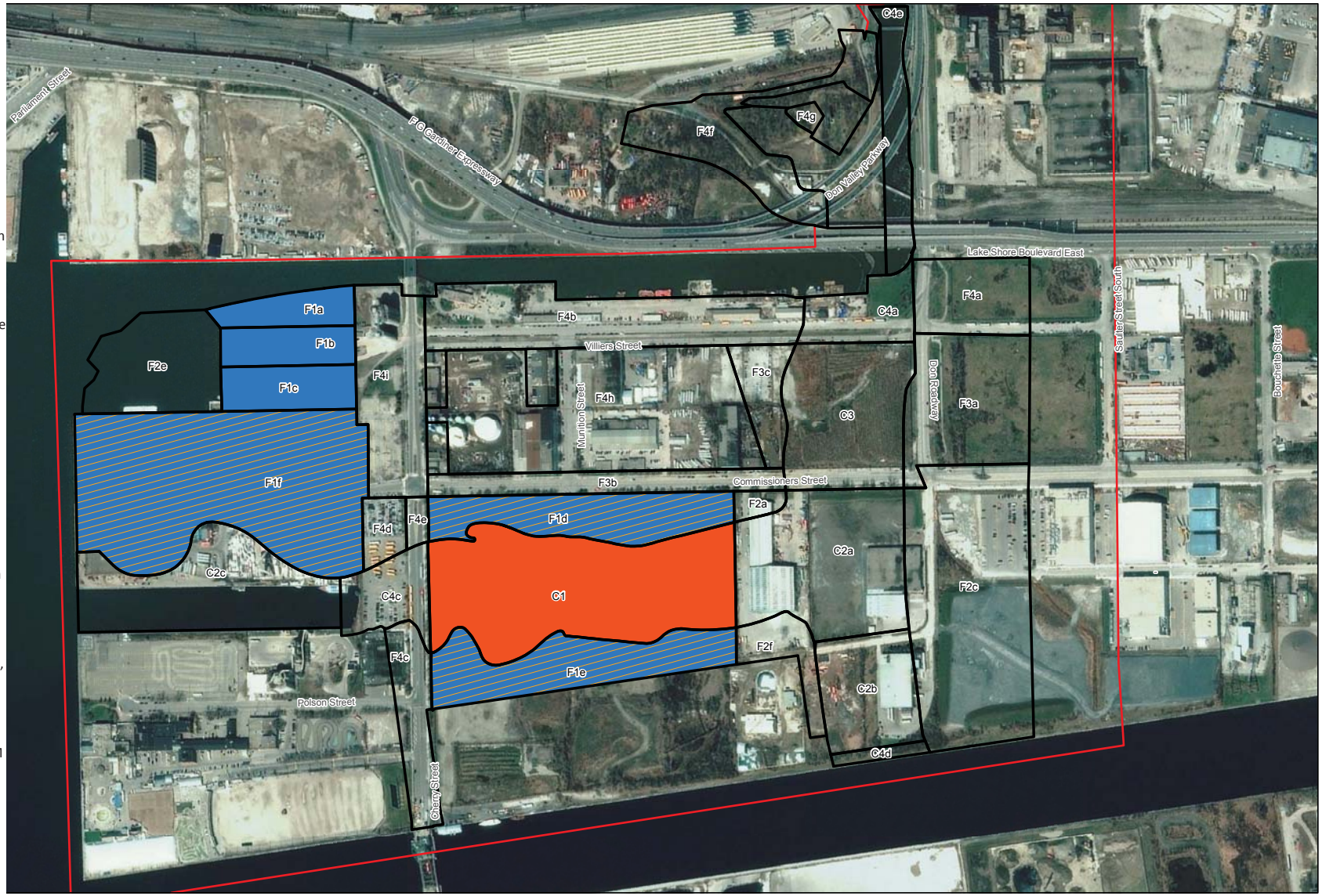
Construct Sequence Activities:

River Valley Activities

1)Construct Western Greenway Area C1
a)Demolish designated structures, utilities, and monitoring wells
b)Strip asphalt, concrete, granular materials, and top soil
c)Construct Soil Processing Facility at Excavation
d)Start river valley excavation at west limit of work progressing east. The western limit of work is approx. 50 m east of existing Cherry Street. No work on Cherry Street. The unexcavated area will stay in place to isolate the river valley from Lake Ontario. Begin excavating dry soil down to the water table and clear enough material for positioning of dredge equipment. Then begin dredging soil below the water table. Dredging and dry soil excavation will progress to the east.
e)Segregate soil during excavation and complete soil processing.
f)Manage groundwater in the open excavation.
g)Start the river valley restoration and landscape construction at the western limit of the completed excavation, progressing east behind excavation activities.

Upland activities

1)Construct Essroc Quay lake fill cells F1a and F1c.
2)Begin filling cells F1a and F1c.
3)Begin the construction of New Cherry Street Bridge, north side.
4)Demolish the building on Cherry Street, Cousins Quay.
5) Construct/set up the Long-term the Soil Processing Facility on Cousins Quay in Area 1Ff.
6) Cut Areas to accommodate the RA/RM barrier.



N

0 20 40 60 80
Metres

Stage 1 Study Boundary
RA/RM Cut and Border Cut Areas
Area to Cut
Area To Fill

Notes:
1. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

DRAFT

Figure 32A
Excavation and Fill Sequencing - Phase 1
Preliminary Environmental Assessment and Geotechnical and Earthworks Report
Waterfront Toronto
Toronto, Ontario

ch2m

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PHASE II

Construct Sequence Activities:

River Valley Activities

1) Construct Central and Lower Greenway Areas C2a and C2b

a) Demolish designated structures, utilities, and monitoring wells.

b) Strip asphalt, concrete, granular materials, and top soil.

c) Continue the excavation west to east.

d) Start the river valley excavation at the southern limit of Area C2b, progressing north.

i) The southern limit of work is approx. 50m north of the existing Ship Channel marine wall.

ii) The dock wall and soil in C4d will stay in place until the subsequent phase.

e) Segregate soil during excavation and complete soil processing.

f) Manage groundwater in the open excavation.

g) Start the river valley restoration and landscape construction behind excavation activities.

2) Construct south Cousins Quay, north Polson slip Area C2c.

a) Demolish designated structures, utilities, and monitoring wells.

b) Strip asphalt, concrete, granular materials, and top soil.

c) Start the river valley excavation at the southeastern limit of area C2c, progressing north and west.

d) Segregate soil during excavation and complete soil processing.

e) Manage lake/groundwater in the open excavation.

Upland activities

1) Compete filling Essroc Quay lake fill cell F1a and F1c.

2) Begin filling areas F2a,F2c, F2e, F2f

a) Area F2c fill geometry will be designed with flood model simulation to avoid increasing interim flood risk.

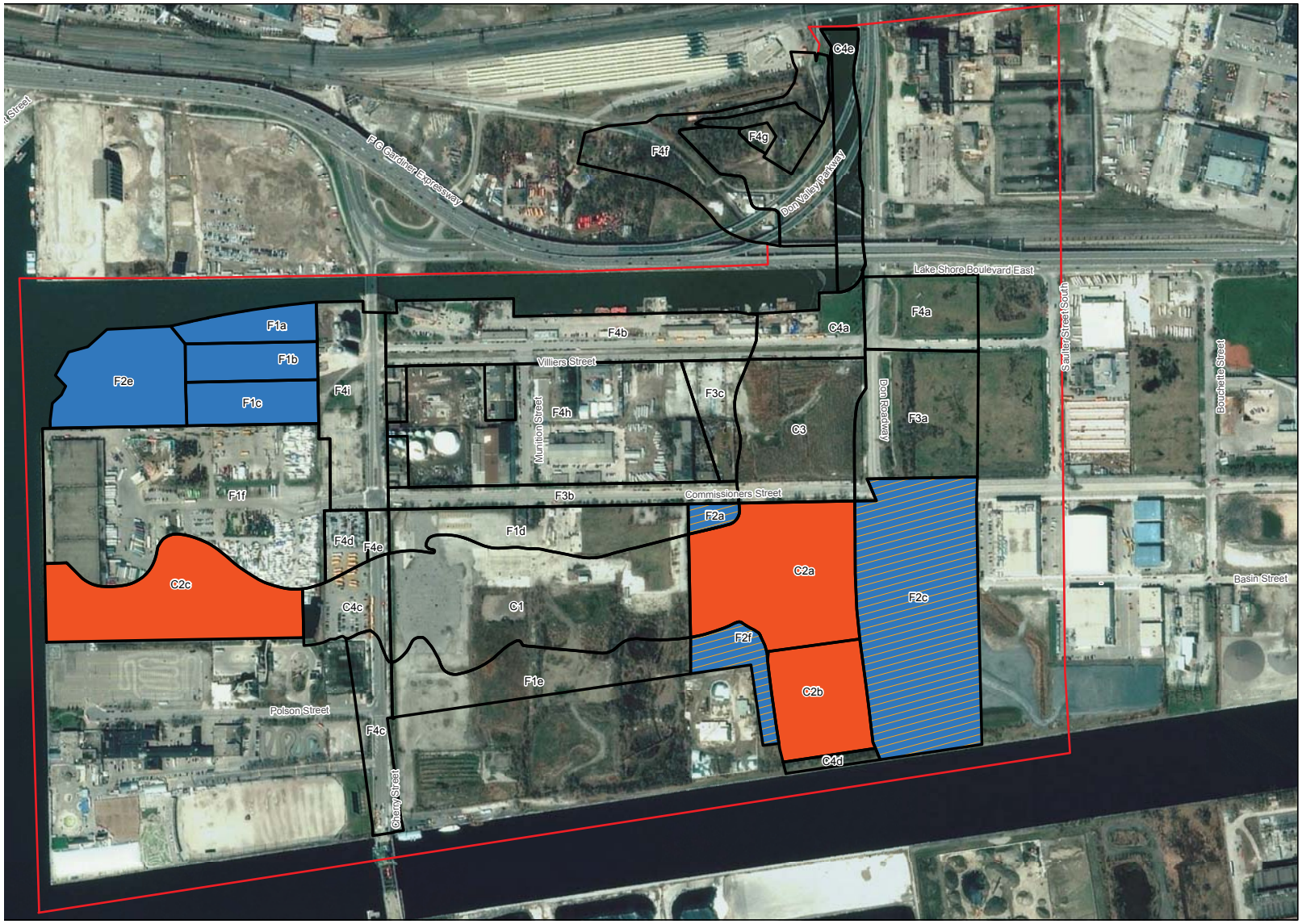
b) Fill F2e by end-dumping north to south, east to west.

3) Complete the construction of New Cherry Street Bridge.

4) Construct the new Cherry Street alignment from Keating Channel to Commissioners Street.

5) Construct temporary infrastructure along Cherry Street and reroute the storm sewer from the Essroc Quay discharge area.

6) Cut Areas to accommodate the RA/RM barrier.



Notes:
1. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

DRAFT

Figure 32B
Excavation and Fill Sequencing - Phase 2
Preliminary Environmental Assessment and Geotechnical and Earthworks Report
Waterfront Toronto
Toronto, Ontario

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Appendix B: Select Geotechnical Information for Essroc Pier and Cousins Quay (Source: GHD, 2015: Port Lands Environmental, Geotechnical and Hydrogeological Investigation : Stage 1 and Stage 2 Port Lands Toronto)

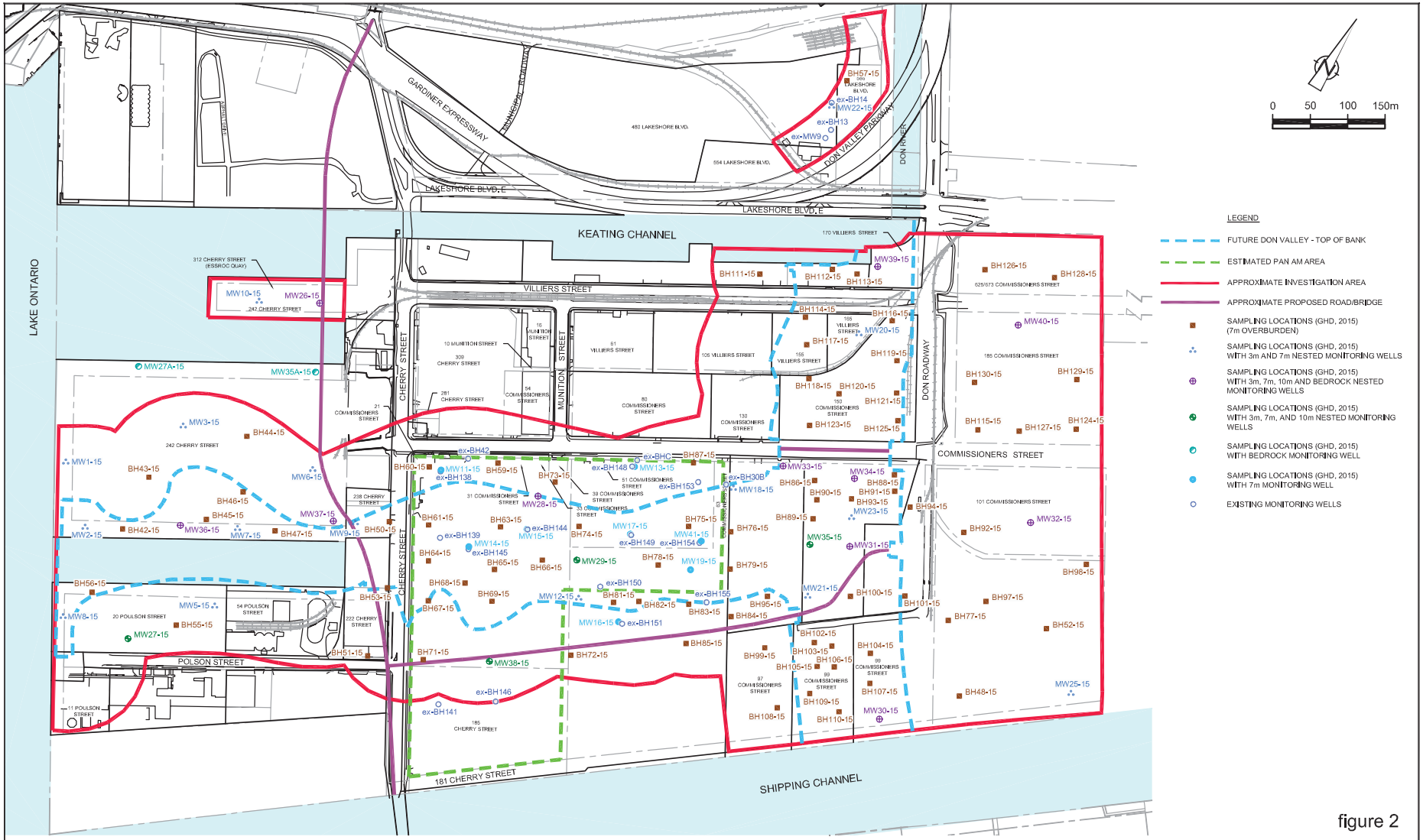

figure 2

SITE PLAN AND INVESTIGATIVE LOCATIONS
PORT LANDS - ENVIRONMENTAL, GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
CONTRACT No. 1042.R2
Waterfront Toronto

SOURCES:
1. J. D. BARNES SOURCE: 1820 AND 1912 SHORELINE SOURCE, THE ACHEOLOGICAL MASTER PLAN OF THE CENTRAL WATERFRONT, CITY OF TORONTO.

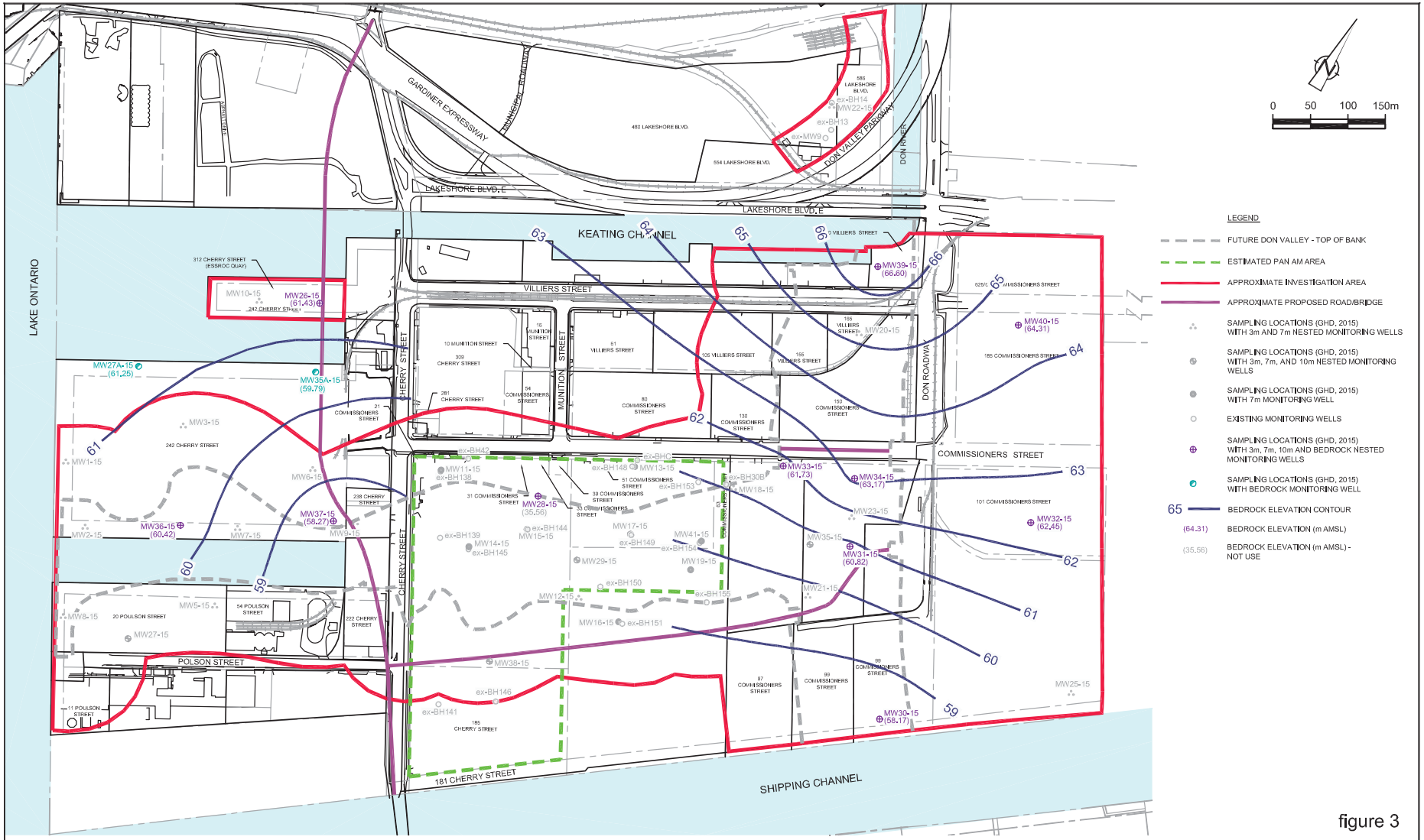

figure 3

BEDROCK ELEVATION CONTOURS
PORT LANDS - ENVIRONMENTAL, GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
CONTRACT No. 1042.R2
Waterfront Toronto

SOURCES:
1. J. D. BARNES SOURCE: 1820 AND 1912 SHORELINE SOURCE, THE ACHEOLOGICAL MASTER PLAN OF THE CENTRAL WATERFRONT, CITY OF TORONTO.

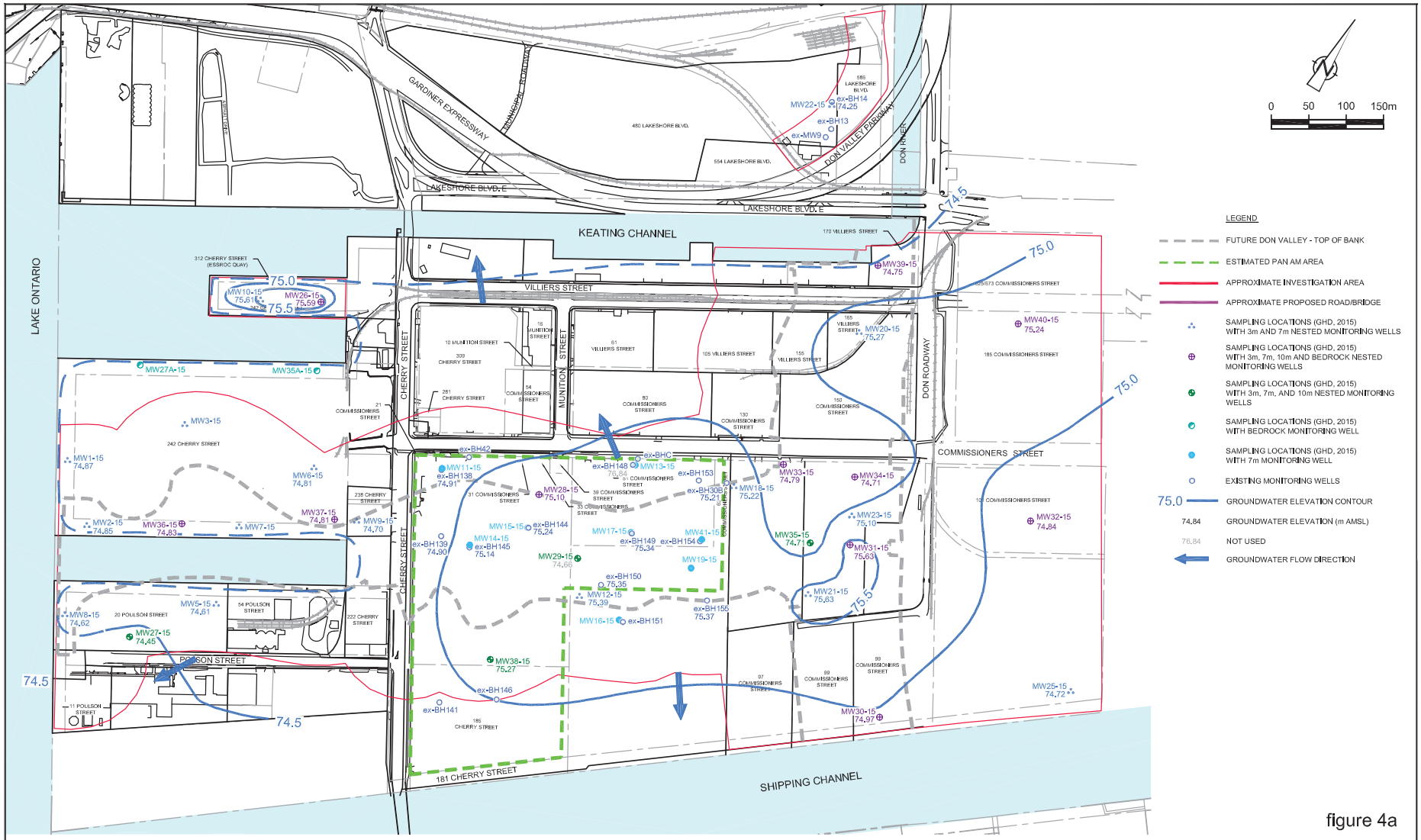

figure 4a

OVERBURDEN GROUNDWATER ELEVATION CONTOURS (DECEMBER 8, 2015)
PORT LANDS - ENVIRONMENTAL, GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
CONTRACT No. 1042.R2
Waterfront Toronto

SOURCES:
1. J. D. BARNES SOURCE: 1820 AND 1912 SHORELINE SOURCE, THE ACHEOLOGICAL MASTER PLAN OF THE CENTRAL WATERFRONT, CITY OF TORONTO.

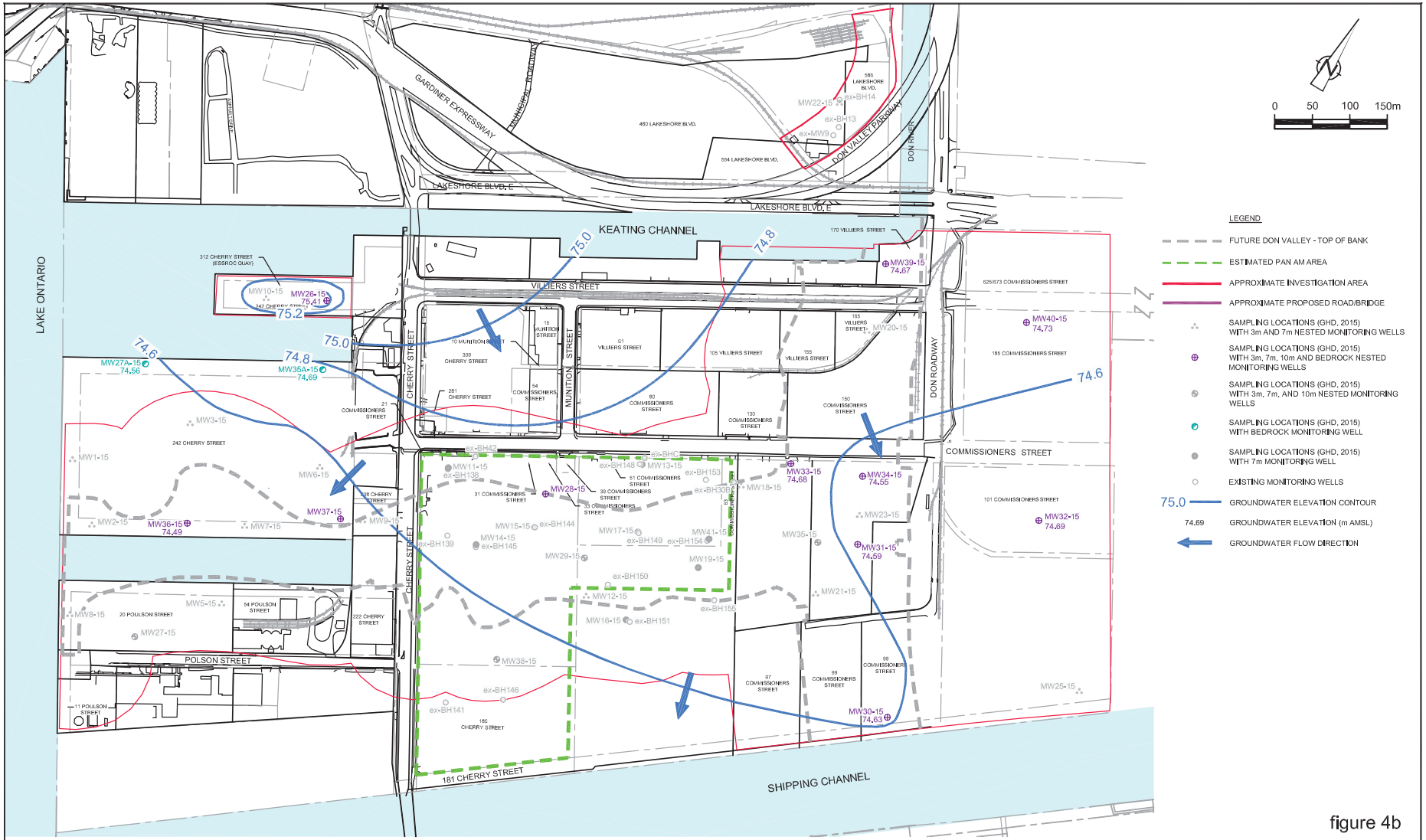

figure 4b

BEDROCK GROUNDWATER ELEVATION CONTOURS (DECEMBER 8, 2015)
PORT LANDS - ENVIRONMENTAL, GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
CONTRACT No. 1042.R2
Waterfront Toronto

SOURCES:
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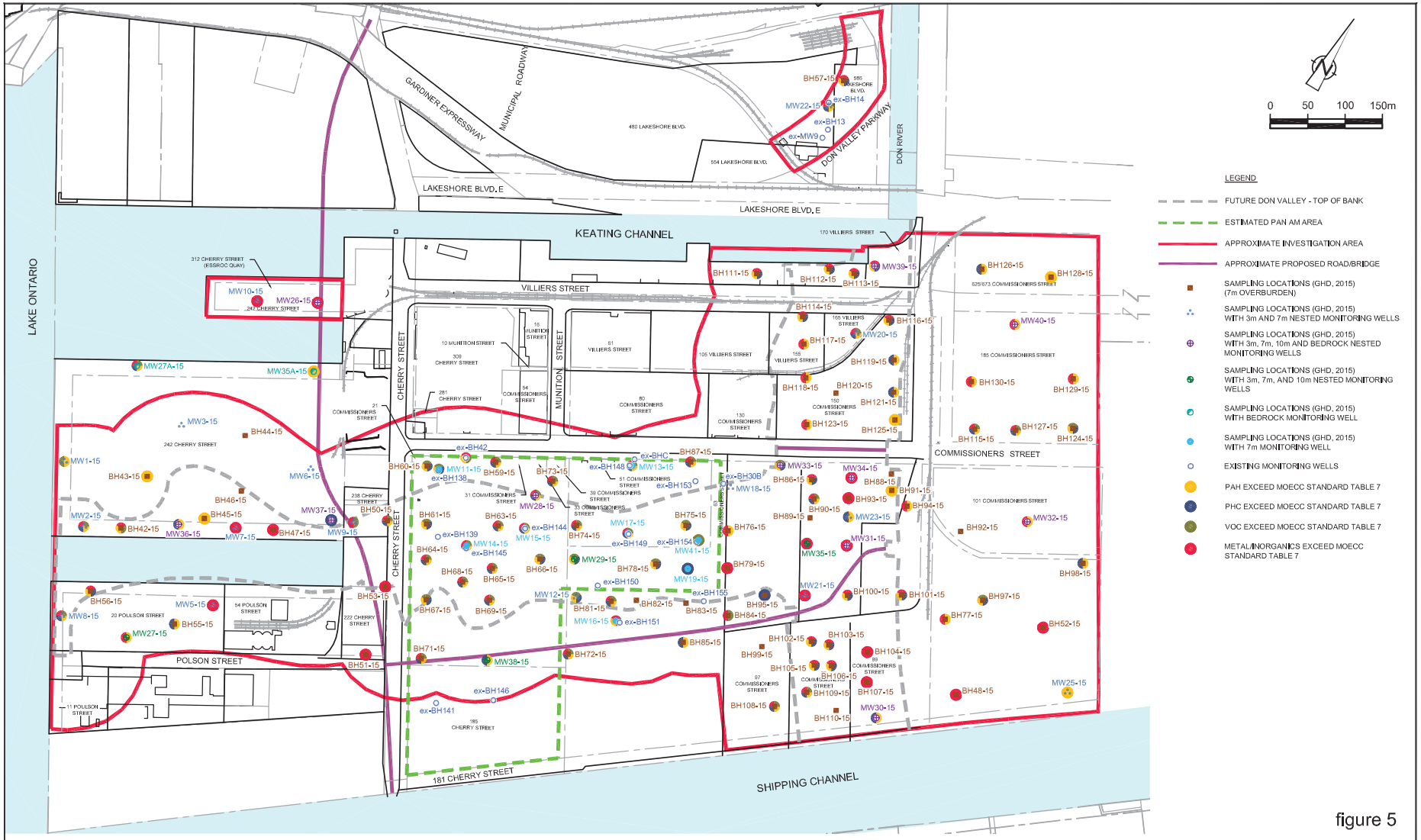

figure 5

SUMMARY OF SOIL CONCENTRATIONS ABOVE MOECC STANDARD
PORT LANDS - ENVIRONMENTAL, GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
CONTRACT No. 1042.R2
Waterfront Toronto

SOURCES:
1. J. D. BARNES SOURCE: 1820 AND 1912 SHORELINE SOURCE, THE ACHEOLOGICAL MASTER PLAN OF THE CENTRAL WATERFRONT, CITY OF TORONTO.

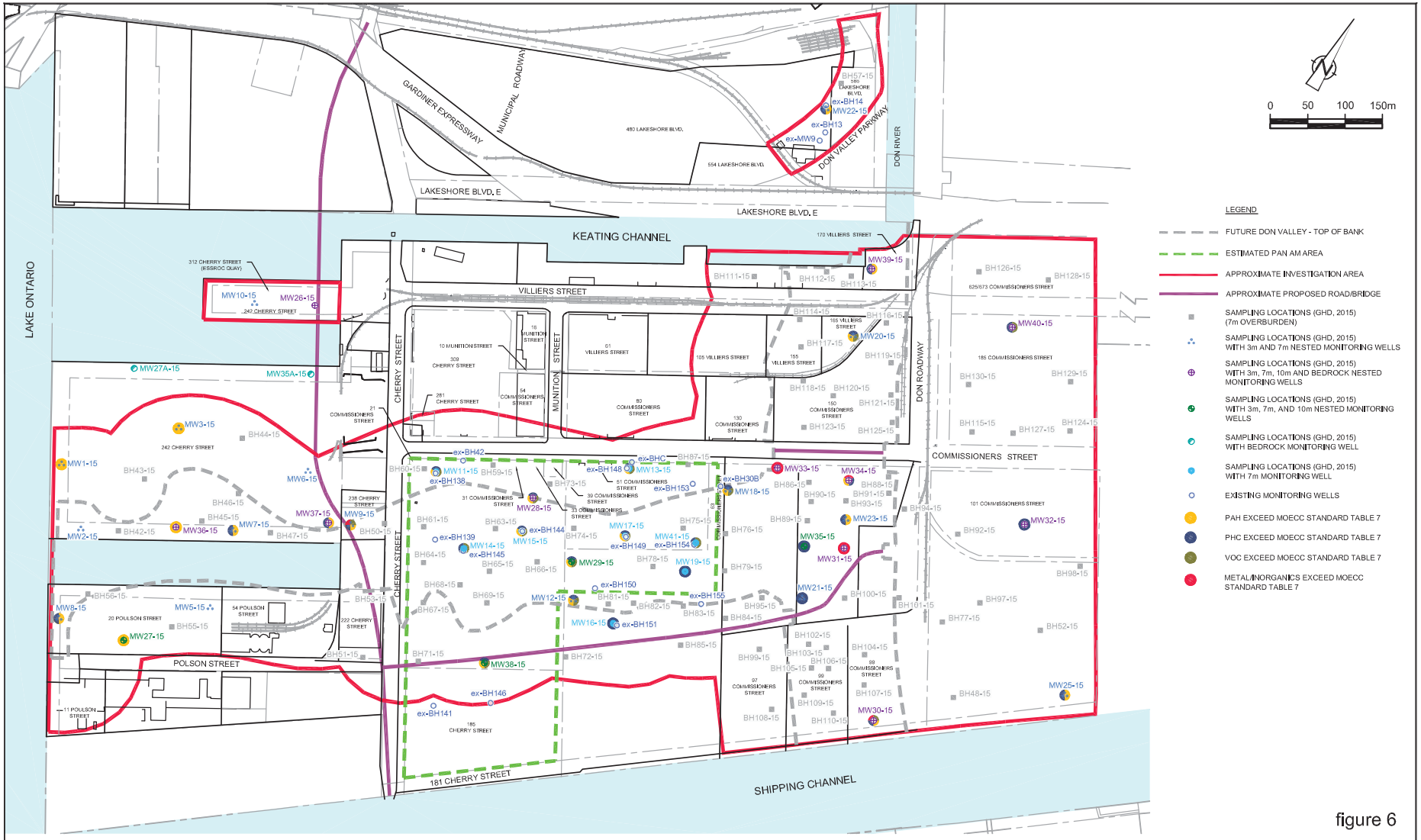

figure 6

SUMMARY OF GROUNDWATER CONCENTRATIONS ABOVE MOECC STANDARD
PORT LANDS - ENVIRONMENTAL, GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
CONTRACT No. 1042.R2
Waterfront Toronto

SOURCES:
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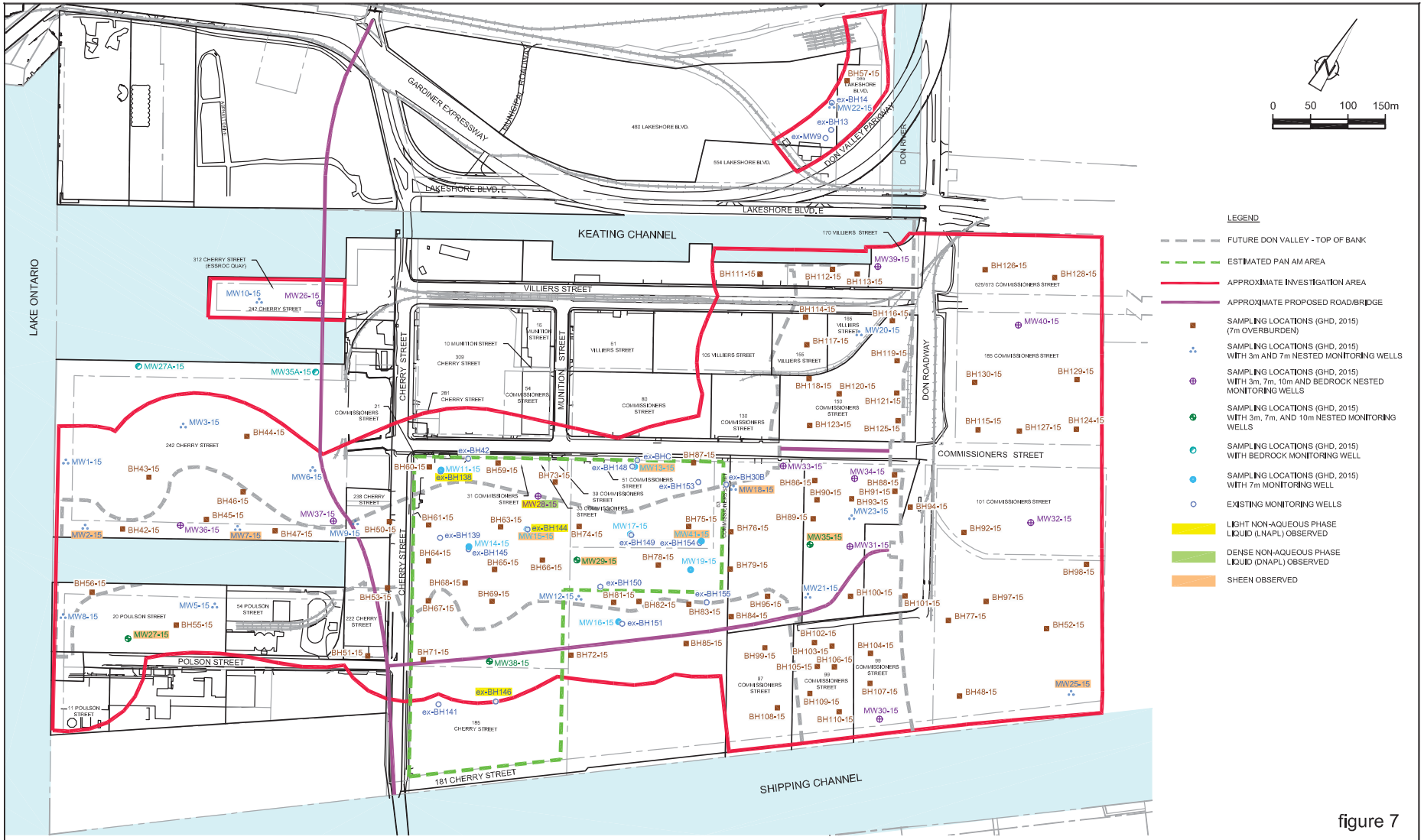


figure 7

MONITORING WELLS WITH EVIDENCE OF NAPL
PORT LANDS - ENVIRONMENTAL, GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION
CONTRACT No. 1042.R2
Waterfront Toronto

SOURCES:
1. J. D. BARNES SOURCE: 1820 AND 1912 SHORELINE SOURCE, THE ACHEOLOGICAL MASTER PLAN OF THE CENTRAL WATERFRONT, CITY OF TORONTO.

REFERENCE No.: 11102463 ENCLOSURE No.: 10

BOREHOLE No.: MW10A-15
ELEVATION: 76.35 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: L. Griffith CHECKED BY: F. Gergis
DATE (START): 28 July 2015 DATE (FINISH): 28 July 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

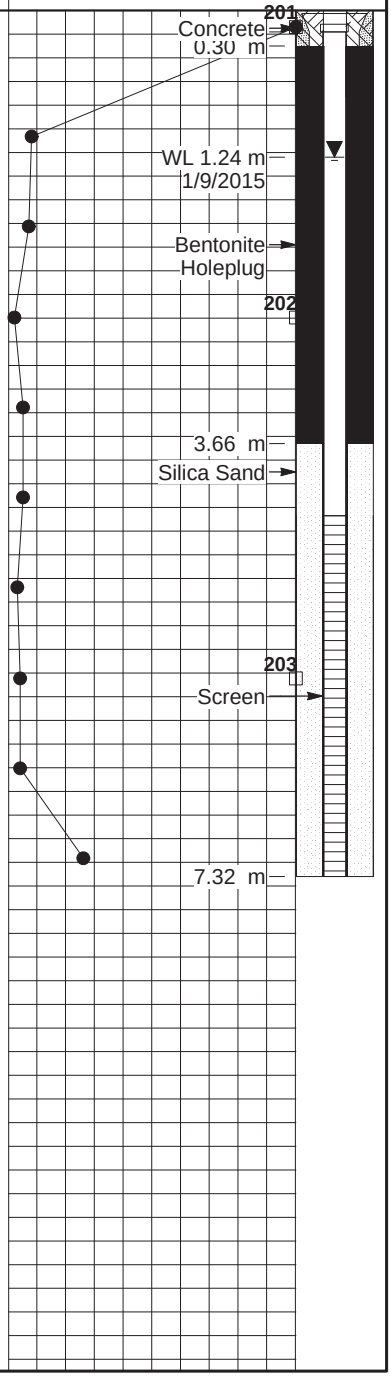
Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		76.35		GROUND SURFACE						
1	0.30	76.05		GRANULAR BASE : 300 mm		SS-1	50	5.0	31-50/ 125mm	100
2				FILL : SAND, some gravel, fine grained, trace red brick fragments, trace wood pieces, brown, moist, very dense; (SP)						
3	1.0					SS-2	0	--	6-5-3-4	8
4										
5										
6	1.68	74.67		SAND with SILT, slight odour, black stains, grey, loose; (SW-SM)		SS-3	75	3.0	2-3-4-6	7
7	1.98 2.0	74.37		SAND and GRAVEL, coarse grained, slight odour, grey, wet, loose; (SW-GW) trace rootlets						
8						SS-4	75	2.0	2-1-1-2	2
9										
10	3.0									
11				25 mm black seam, trace rootlets		SS-5	75	2.0	1-2-3-3	5
12										
13	4.0					SS-6	100	2.0	1-2-3-4	5
14										
15										
16	5.0					SS-7	50	1.0	1-1-2-2	3
17										
18										
19	5.79	70.56		SAND, some silt, grey, wet, very loose; (SP)		SS-8	75	1.0	2-2-2-2	4
20	6.0			very loose						
21						SS-9	50	3.0	2-2-2-3	4
22										
23	7.0									
24	7.47	68.88		trace clay, compact trace wood fragments, organic odour, dark brown		SS-10		1.0	2-12-14-16	26
25										
26	8.0			**END OF BOREHOLE:**						
27										
28				NOTE : End of Borehole at 7.47 m bgs 50 mm diameter monitoring well installed at 7.32 m bgs in the sampled borehole Heaving sand condition observed at 2.3 m bgs A balancing pressure head of clean water or mud was used in the open borehole during drilling to stabilize the uplift pressure bgs denotes 'below ground surface'						
29	9.0									
30										
31										
32										
33	10.0									
34										
35										
36	11.0									
37										

Water Level :

Date	Depth (m)	Elev (m)
01/09/2015	1.24	75.11

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 10

BOREHOLE No.: MW10B-15
ELEVATION: 76.34 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: L. Griffith CHECKED BY: F. Gergis
DATE (START): 28 July 2015 DATE (FINISH): 28 July 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	PID	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR%
		76.34		GROUND SURFACE			%	ppm		N
1	0.30	76.04		FILL : SAND and GRAVEL, well graded, grey, moist, very dense; (SW-GW)		SS-1		--		--
3	1.0			SAND, some gravel, fine grained, trace red brick fragments, trace wood pieces, brown, moist, very dense; (SP)		SS-2		--		--
6	1.68	74.66		SAND with SILT, slight odour, black stains, grey, loose		SS-3		--		--
7	1.98 2.0	74.36		SAND and GRAVEL, coarse grained, slight odour, grey, wet, loose; (SW-GW) trace rootlets		SS-4		--		--
10	3.0 3.05	73.29				SS-5		--		--
13	4.0									
16	5.0									
20	6.0									
23	7.0									
26	8.0									
30	9.0									
33	10.0									
36	11.0									

END OF BOREHOLE:

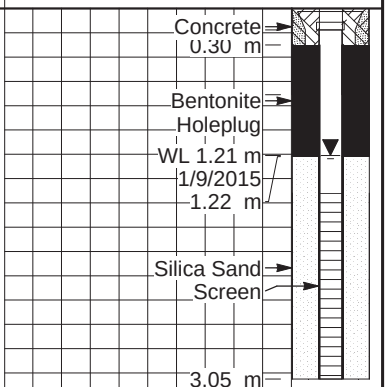
NOTE :
End of Borehole at 3.05 m bgs
50 mm diameter monitoring well installed at 3.05 m bgs in the sampled borehole
bgs denotes 'below ground surface'

Water Level :

Date	Depth (m)	Elev (m)
01/09/2015	1.21	75.13

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 26

BOREHOLE REPORT

BOREHOLE No.: MW26A-15
ELEVATION: 76.75 m
Page: 1 of 3

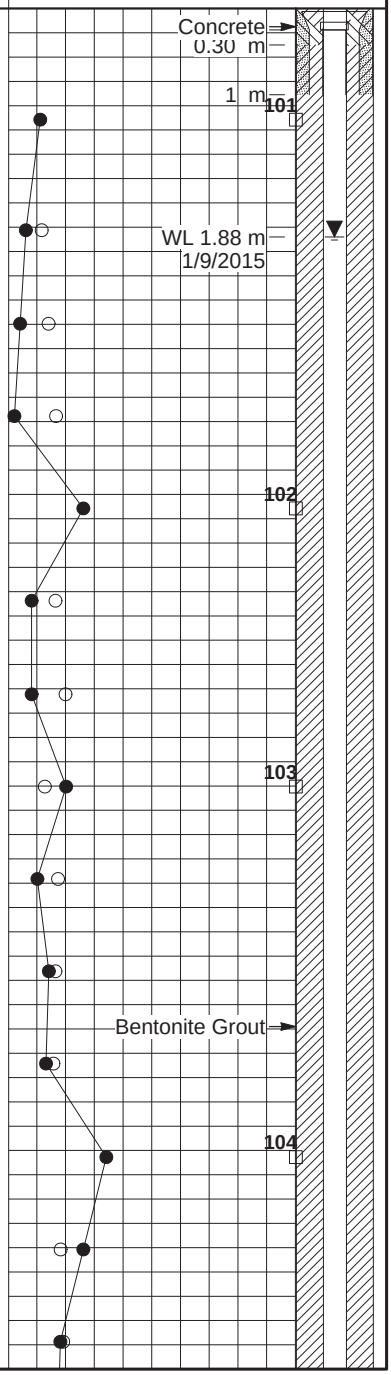
CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 28 July 2015 DATE (FINISH): 29 July 2015

LEGEND
SS - SPLIT SPOON
ST - SHELBY TUBE
RC - ROCK CORE
▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		76.75		GROUND SURFACE						
	0.61	76.14		FILL : SAND and GRAVEL, fine to medium grained, well graded, brown, moist; (SW-GW)						
	1.0			SAND, trace gravel, fine grained, brown, moist, compact; (SP)		SS-1	100	0.0	7-6-5-6	11
	1.52	75.23		trace silt and peat, loose		SS-2	58	0.0	2-3-3-5	6
	2.0			SILTY SAND, trace clay and gravel, medium to coarse grained, well graded, grey to brown, moist to very moist, loose; (SM)		SS-3	100	0.0	1-1-3-4	4
	3.0			heaving sands, very loose Gravel : 16%, Sand : 74%, Clay : 0%, Silt : 10%		SS-4	100	0.0	2-1-1-2	2
	3.81	72.94		SAND, some gravel, trace peat, cobble fragments, compact; (SP)		SS-5	100	0.0	2-10-16-9	26
	4.0									
	4.73	72.02		NATIVE : SAND, trace gravel and silt, fine to medium grained, well graded, trace organics, sand heavings, brown, wet, loose; (SW)		SS-6	100	0.0	2-3-5-6	8
	5.0					SS-7	100	0.0	1-2-6-10	8
	6.0			compact Gravel : 1%, Sand : 96%, Clay : 0%, Silt : 3%		SS-8	100	0.0	3-7-13-14	20
	7.0					SS-9	100	0.0	2-4-6-7	10
	8.0			fine to coarse grained		SS-10	100	0.0	2-6-8-9	14
	9.0					SS-11	100	0.0	4-5-8-14	13
	9.91	66.84		grey, wet, dense		SS-12	100	0.0	8-15-19-23	34
	10.0			compact		SS-13	100	2.0	5-10-16-24	26
	11.0			sand, trace silt Gravel : 0%, Sand : 95%, Clay : 0%, Silt :		SS-14	100	0.0	3-5-13-16	18

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 26

BOREHOLE No.: MW26A-15
ELEVATION: 76.75 m

BOREHOLE REPORT

Page: 2 of 3

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 28 July 2015 DATE (FINISH): 29 July 2015

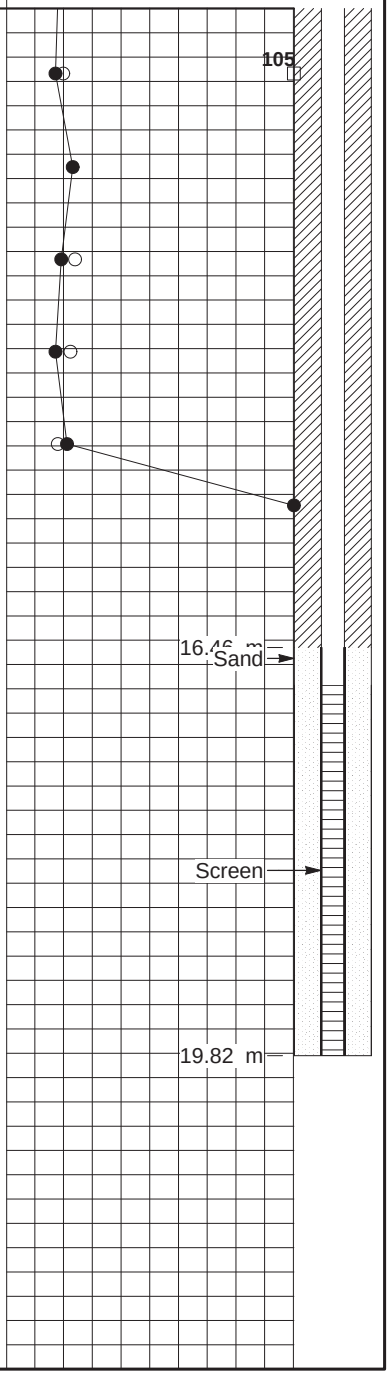
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) 76.75	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
				GROUND SURFACE						
				5%						
	12.0					SS-15	100	1.0	3-6-11-13	17
						SS-16	100	0.0	8-10-13-14	23
	12.96	63.79								
	13.0			SANDY SILT, trace clay, very fine grained, poorly graded, grey, wet, dilatant, compact; (SM)		SS-17	100	0.0	7-9-10-14	19
	14.0					SS-18		0.0	3-7-10-10	17
						SS-19		0.0	6-8-13-17	21
	15.0									
	15.32	61.43				SS-20		--	50/ 50mm	100
	15.70	61.05		SHALE-BEDROCK (GEORGIAN BAY FORMATION), trace clay, friable, thinly bedded, soft, grey						
	16.0			BEDROCK, highly wethered, clay content, grey						
	16.46	60.29		highly fractured		RC-1	100	--	60	--
	17.0									
	17.38	59.37		highly weathered						
	17.68	59.07		trace limestone, light grey						
	18.0			highly weathered		RC-2	100	--	60	--
	18.17	58.58								
	18.98									
	19.0	57.77		vertical and horizontal fracture highly fractured (vertical and horizontal)		RC-3	100	--	70	--
	20.0									
	20.20	56.55								
	21.0			**END OF BOREHOLE:** NOTE : End of Borehole at 20.20 m bgs 50 mm diameter monitoring well installed at 19.82 m depth in the sampled borehole Rock coring from 15.70 m bgs Heaving sand condition observed at 2.35 m bgs						
	22.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 26

BOREHOLE No.: MW26A-15
ELEVATION: 76.75 m

BOREHOLE REPORT

Page: 3 of 3

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 28 July 2015 DATE (FINISH): 29 July 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	PID	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR%
		76.75		GROUND SURFACE			%	ppm		N
74				A balancing pressure head of clean water or mud was used in the open borehole during drilling to stabilize the uplift pressure bgs denotes 'below ground surface' Water Level : Date Depth (m) Elev (m) 01/09/2015 1.88 74.88						
75	23.0									
76										
77										
78										
79	24.0									
80										
81										
82	25.0									
83										
84										
85	26.0									
86										
87										
88	27.0									
89										
90										
91	28.0									
92										
93										
94	29.0									
95										
96										
97	30.0									
98										
99										
100	31.0									
101										
102										
103	32.0									
104										
105										
106	33.0									
107										
108										
109										
110										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 26

BOREHOLE No.: MW26B-15
ELEVATION: 76.73 m

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 28 July 2015 DATE (FINISH): 28 July 2015

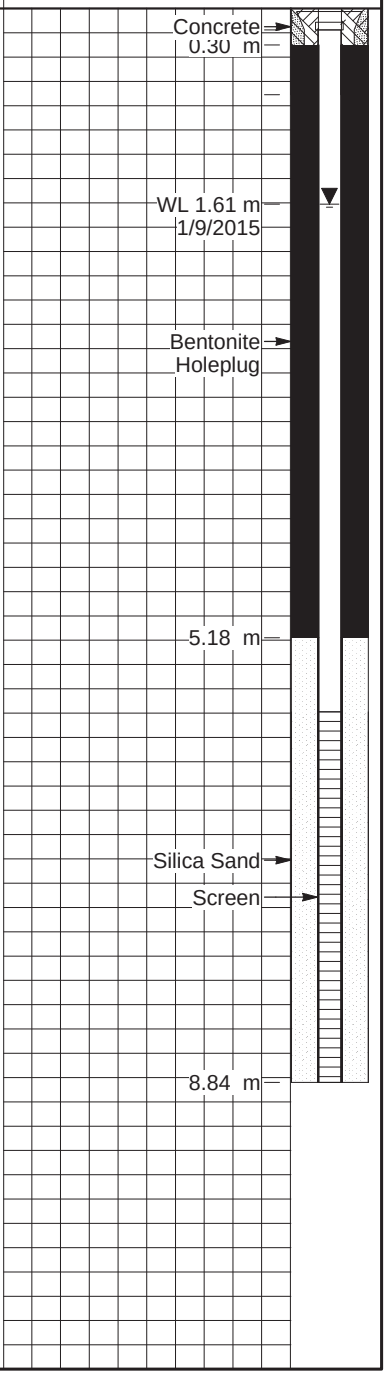
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		76.73		GROUND SURFACE						
	0.61	76.12		FILL : SAND and GRAVEL, fine to medium grained, well graded, brown, moist; (SW-GW)						
	1.0			SAND, trace gravel, fine grained, brown, moist, compact; (SP)		SS-1	--	--		--
	1.52	75.21		trace silt and peat; loose		SS-2	--	--		--
	2.0			SILTY SAND, trace clay and gravel, medium to coarse grained, well graded, grey to brown, moist to very moist, loose; (SM)		SS-3	--	--		--
	3.0			heaving sands, very loose Gravel : 16%, Sand : 74%, Clay : 0%, Silt : 10%		SS-4	--	--		--
	3.81	72.92		SAND, some gravel, trace peat, cobble fragments, compact; (SP)		SS-5	--	--		--
	4.0									
	4.73	72.00		NATIVE : SAND, trace gravel and silt, fine to medium grained, well graded, trace organics, sand heavings, brown, wet, loose; (SW)		SS-6	--	--		--
	5.0					SS-7	--	--		--
	6.0									
	6.10	70.63		compact Gravel : 1%, Sand : 96%, Clay : 0%, Silt : 3%		SS-8	--	--		--
	7.0					SS-9	--	--		--
	8.0			fine to coarse grained		SS-10	--	--		--
	8.84	67.89				SS-11	--	--		--
	9.0			**END OF BOREHOLE:** NOTE : End of Borehole at 8.84 m bgs 50 mm diameter monitoring well installed at 8.84 m depth in the sampled borehole Heaving sand condition observed at 2.35 m bgs A balancing pressure head of clean water or mud was used in the open borehole during drilling to stabilize the						
	10.0									
	11.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 26

BOREHOLE No.: MW26B-15
ELEVATION: 76.73 m

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 28 July 2015 DATE (FINISH): 28 July 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	PID	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR%
		76.73		GROUND SURFACE			%	ppm		N
37				uplift pressure bgs denotes 'below ground surface'						
38										
39	12.0			Water Level : Date Depth (m) Elev (m) 01/09/2015 1.61 75.12						
40										
41										
42										
43	13.0									
44										
45										
46	14.0									
47										
48										
49	15.0									
50										
51										
52	16.0									
53										
54										
55	17.0									
56										
57										
58	18.0									
59										
60										
61	19.0									
62										
63										
64	20.0									
65										
66										
67	21.0									
68										
69										
70	22.0									
71										
72										
73										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 26

BOREHOLE No.: MW26C-15
ELEVATION: 76.66 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 28 July 2015 DATE (FINISH): 28 July 2015

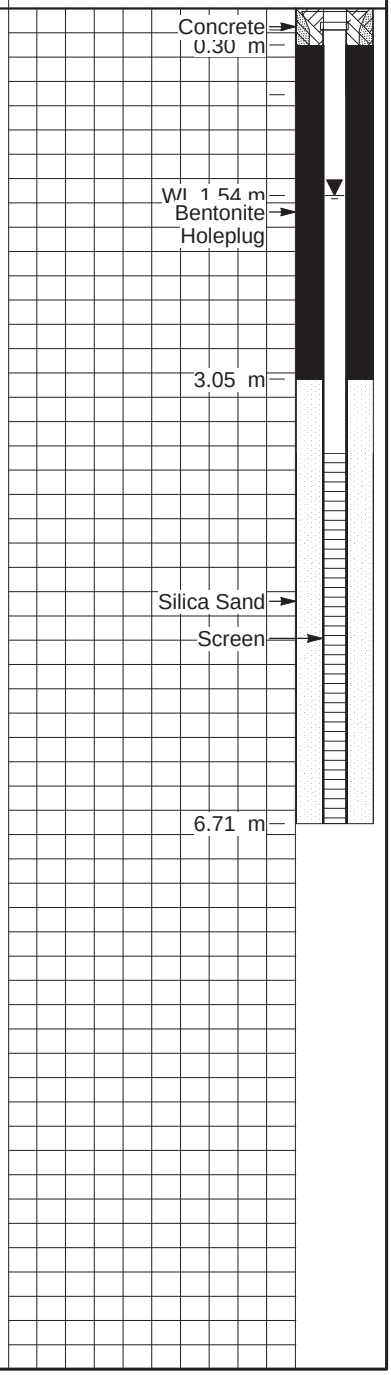
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		76.66		GROUND SURFACE						
	0.61	76.05		FILL : SAND and GRAVEL, fine to medium grained, well graded, brown, moist; (SW-GW)						
	1.0			SAND, trace gravel, fine grained, brown, moist, compact; (SP)		SS-1		--		--
	1.52	75.14		trace silt and peat; loose		SS-2		--		--
	2.0			SILTY SAND, trace clay and gravel, medium to coarse grained, well graded, grey to brown, moist to very moist, loose; (SM)		SS-3		--		--
	3.0			heaving sands, very loose Gravel : 16%, Sand : 74%, Clay : 0%, Silt : 10%		SS-4		--		--
	3.81	72.85		SAND, some gravel, trace peat, cobble fragments, compact; (SP)		SS-5		--		--
	4.0									
	4.73	71.93		NATIVE : SAND, trace gravel and silt, fine to medium grained, well graded, trace organics, sand heavings, brown, wet, loose; (SW)		SS-6		--		--
	5.0									
						SS-7		--		--
	6.0			compact Gravel : 1%, Sand : 96%, Clay : 0%, Silt : 3%		SS-8		--		--
	6.71	69.95		**END OF BOREHOLE:**						
	7.0			NOTE : End of Borehole at 6.71 m bgs 50 mm diameter monitoring well installed at 6.71 m depth in the sampled borehole Heaving sand condition observed at 2.40 m bgs A balancing pressure head of clean water or mud was used in the open borehole during drilling to stabilize the uplift pressure bgs denotes 'below ground surface'						
	8.0			Water Level : Date 01/09/2015 Depth (m) 1.54 Elev (m) 75.12						
	9.0									
	10.0									
	11.0									

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 26

BOREHOLE No.: MW26D-15
ELEVATION: 76.65 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 29 July 2015 DATE (FINISH): 29 July 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		76.65		GROUND SURFACE						
2	0.61	76.04		FILL : SAND and GRAVEL, fine to medium grained, well graded, brown, moist; (SW-GW)						
3	1.0			SAND, trace gravel, fine grained, brown, moist, compact; (SP)		SS-1		--		--
5	1.52	75.13		trace silt and peat; loose		SS-2		--		--
8				SILTY SAND, trace clay and gravel, medium to coarse grained, well graded, grey to brown, moist to very moist, loose; (SM)		SS-3		--		--
10	3.0 3.05	73.60				SS-4		--		--

END OF BOREHOLE:

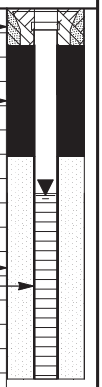
NOTE :
End of Borehole at 3.05 m bgs
50 mm diameter monitoring well installed at 3.05 m depth
bgs denotes 'below ground surface'

Water Level :

Date	Depth (m)	Elev (m)
01/09/2015	1.54	75.11

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 27

BOREHOLE No.: MW27A-15
ELEVATION: 77.41 m

BOREHOLE REPORT

Page: 1 of 3

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: R. Khabbaznia/K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 10 August 2015 DATE (FINISH): 10 August 2015

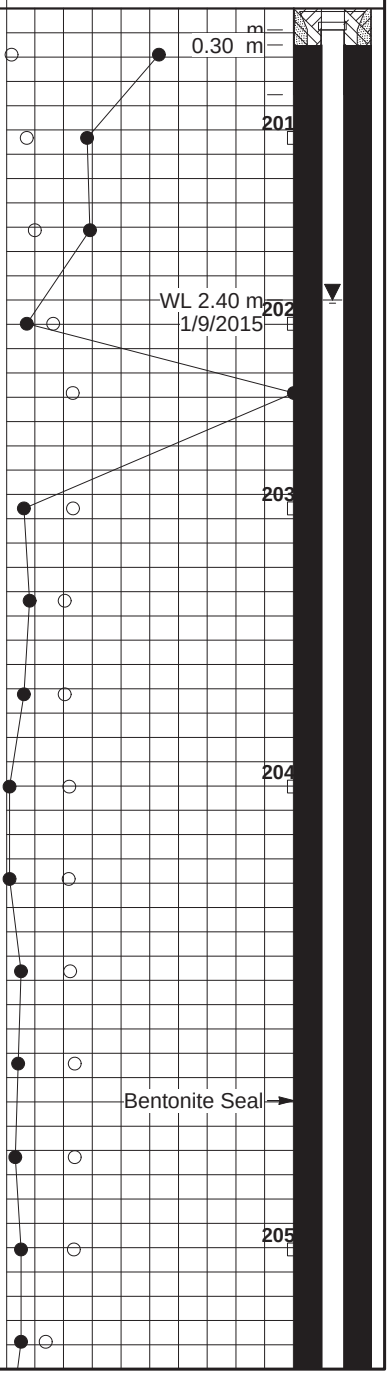
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		77.41		GROUND SURFACE						
1				GRANULAR FILL : CRUSHER RUN LIMESTONE, SAND and GRAVEL		SS-1	33	1.0	26-27-31	53
2	0.76	76.65								
3	1.0			FILL : GRAVELLY SAND, trace silt, asphalt debris, grey, moist, compact; (SW-GW)		SS-2	58	1.0	10-9-19-23	28
4										
5				brick and concrete fragments						
6				Gravel : 26%, Sand : 64%, Silt : 10%, Clay : 0%		SS-3	83	1.0	20-17-12-12	29
7	2.0									
8	2.29	75.12		NATIVE : SAND, medium to fine grained, trace gravel, grey, wet, loose; (SP)		SS-4	25	0.0	3-4-3-2	7
9										
10	3.0			very dense		SS-5	100	0.0	3-50/ 150mm	100
11										
12	3.81	73.60								
13	4.0			loose		SS-6	33	1.0	1-2-4-3	6
14										
15										
16	5.0					SS-7	42	1.0	4-3-5-4	8
17										
18						SS-8	25	1.0	4-4-2-1	6
19										
20	6.0 6.10	71.31								
21				very loose		SS-9	33	1.0	0-1-0-2	1
22										
23	7.0					SS-10	8	0.0	1-0-1-1	1
24										
25				trace silt, loose						
26				Gravel : 0%, Sand : 95%, Silt : 5%, Clay : 0%		SS-11	58	0.0	2-3-2-1	5
27	8.0									
28						SS-12	67	0.0	3-2-2-3	4
29										
30	9.0									
31						SS-13	33	0.0	1-2-1-2	3
32										
33	10.0					SS-14	58	0.0	2-3-2-2	5
34										
35										
36	11.0					SS-15	67	0.0	2-3-2-2	5

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 27

BOREHOLE No.: MW27A-15
ELEVATION: 77.41 m

BOREHOLE REPORT

Page: 2 of 3

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: R. Khabbaznia/K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 10 August 2015 DATE (FINISH): 10 August 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		77.41		GROUND SURFACE						
	12.0			very loose		SS-16	33	0.0	1-1-0-4	1
	12.20	65.21		SAND and GRAVEL, grey, very moist, loose to compact; (SW-GW)		SS-17	67	0.0	2-3-7-8	10
	12.96	64.45		CLAYEY SILT, some sand, trace gravel, medium plasticity, brown to grey, very moist, firm; (CL-ML) Gravel : 1%, Sand : 12%, Silt : 66%, Clay : 21%		SS-18	33	0.0	2-2-3-3	5
	13.0					SS-19A		--		--
	14.0			soft		SS-19B	25	0.0	1-1-2-4	3
	14.48	62.93		SILTY SAND, brown, wet, compact; (SM) Gravel : 1%, Sand : 71%, Silt : 28%, Clay : 0%		SS-20	58	0.0	7-10-14-14	24
	15.0			trace clay		SS-21	58	0.0	5-10-14-14	24
	16.0	61.40				SS-22	40	0.0	9-50/ 100mm	100
	16.01	61.25		SILT, some sand and clay, very dense; (ML)						
	16.16									
	16.46	60.95		SHALE-BEDROCK, silt content, friable, thinly bedded, dark grey, soft		RC-1	100	--	67	--
	17.0			BEDROCK, highly fractured horizontal fractures dark clay seams interbedded in shale		RC-2	100	--	30	--
	18.0									
	18.45	58.96		vertical fracture						
				clay bands						
	19.0					RC-3	100	--	30	--
	20.0									
	20.43	56.98				RC-4	100	--	35	--
	21.0									
	21.49	55.92								
	22.0			**END OF BOREHOLE:** NOTE :						

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

17.68 m — Sand →
Screen →
21.49 m —

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 27

BOREHOLE No.: MW27A-15
ELEVATION: 77.41 m

BOREHOLE REPORT

Page: 3 of 3

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: R. Khabbaznia/K. Vander Meulen CHECKED BY: F. Gergis
DATE (START): 10 August 2015 DATE (FINISH): 10 August 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	PID	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR%
		77.41		GROUND SURFACE			%	ppm		N
74				End of Borehole at 21.49 m bgs Rock coring from 16.46 m bgs 50 mm diameter monitoring well installed at 21.49 m bgs in the sampled borehole Heaving sand condition observed at 2.40 m bgs A balancing pressure head of clean water or mud was used in the open borehole during drilling to stabilize the uplift pressure bgs denotes 'below ground surface' Water Level : Date Depth (m) Elev (m) 01/09/2015 2.40 75.02						
75	23.0									
76										
77										
78	24.0									
79										
80										
81	25.0									
82										
83										
84	26.0									
85										
86										
87	27.0									
88										
89										
90	28.0									
91										
92										
93	29.0									
94										
95										
96	30.0									
97										
98										
99	31.0									
100										
101										
102	32.0									
103										
104										
105	33.0									
106										
107										
108										
109										
110										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 27

BOREHOLE No.: MW27B-15
ELEVATION: 76.85 m

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Gergis
DATE (START): 11 August 2015 DATE (FINISH): 11 August 2015

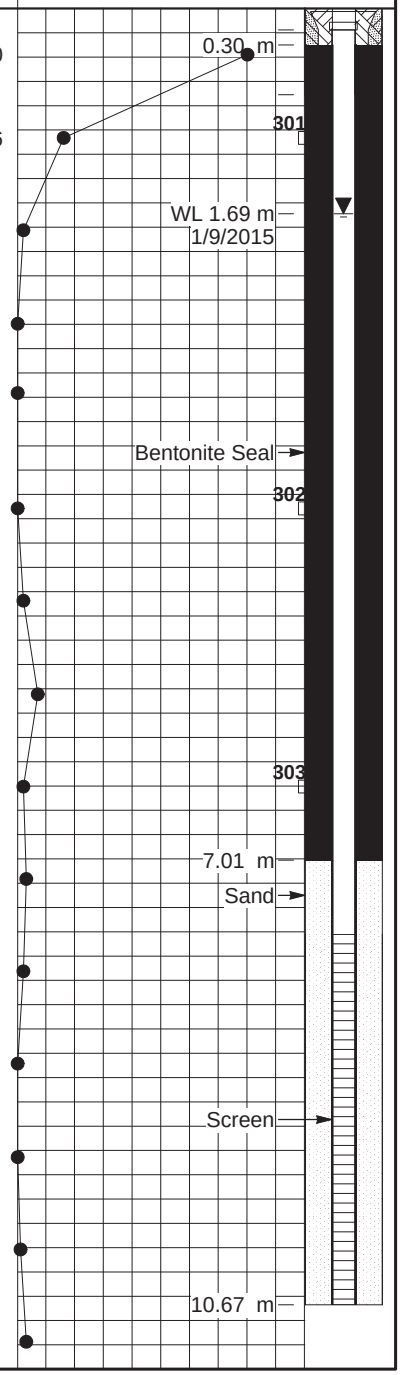
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		76.85		GROUND SURFACE						
1				GRANULAR FILL : CRUSHER RUN LIMESTONE, SAND and GRAVEL		SS-1	33	0.0	23-30-50/ 150mm	80
2	0.76	76.09								
3	1.0			FILL : GRAVELLY SAND, trace silt, asphalt debris, grey, moist, compact; (SW-GW)		SS-2	83	0.0	11-8-8-10	16
4										
5				brick and concrete fragments						
6				Gravel : 26%, Sand : 64%, Silt : 10%, Clay : 0%		SS-3	100	0.0	2-1-1-1	2
7	2.0									
8	2.29	74.56		NATIVE : SAND, medium to fine grained, trace gravel, grey, wet, loose; (SP)		SS-4	100	0.0	0-0-0-0	0
9										
10	3.0			very dense		SS-5	100	0.0	0-0-0-0	0
11										
12	3.81	73.04		loose						
13	4.0					SS-6	100	0.0	0-0-0-0	0
14										
15										
16	5.0					SS-7	75	0.0	0-1-1-1	2
17										
18						SS-8	67	0.0	2-4-3-2	7
19										
20	6.0 6.10	70.75		very loose						
21						SS-9	100	0.0	0-0-2-5	2
22										
23	7.0					SS-10	83	0.0	1-2-1-2	3
24										
25	7.62	69.23		trace silt, loose						
26	8.0			Gravel : 0%, Sand : 95%, Silt : 5%, Clay : 0%		SS-11	83	0.0	1-1-1-1	2
27										
28						SS-12	100	0.0	0-0-0-0	0
29										
30	9.0									
31						SS-13	100	0.0	0-0-0-1	0
32										
33	10.0					SS-14	100	0.0	1-0-1-0	1
34										
35										
36	11.0					SS-15	100	0.0	1-2-1-2	3

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 27

BOREHOLE REPORT

BOREHOLE No.: MW27B-15
ELEVATION: 76.85 m
Page: 2 of 2

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Gergis
DATE (START): 11 August 2015 DATE (FINISH): 11 August 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		76.85		GROUND SURFACE						
37	11.28	65.57		**END OF BOREHOLE:**						
38				NOTE :						
39	12.0			End of Borehole at 11.28 m bgs						
40				Groundwater level measured at 2.14 m bgs upon completion						
41				50 mm diameter monitoring well installed at 11.28 m bgs in the sampled borehole						
42				Heaving sand condition observed at 2.50 m bgs						
43	13.0			A balancing pressure head of clean water or mud was used in the open borehole during drilling to stabilize the uplift pressure						
44				bgs denotes 'below ground surface'						
45										
46	14.0			Water Level :						
47										
48				Date Depth (m) Elev (m)						
49	15.0			01/09/2015 1.69 75.16						
50										
51										
52	16.0									
53										
54										
55										
56	17.0									
57										
58										
59	18.0									
60										
61										
62	19.0									
63										
64										
65										
66	20.0									
67										
68										
69	21.0									
70										
71										
72	22.0									
73										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 27

BOREHOLE No.: MW27C-15
ELEVATION: 76.85 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Gergis
DATE (START): 11 August 2015 DATE (FINISH): 11 August 2015

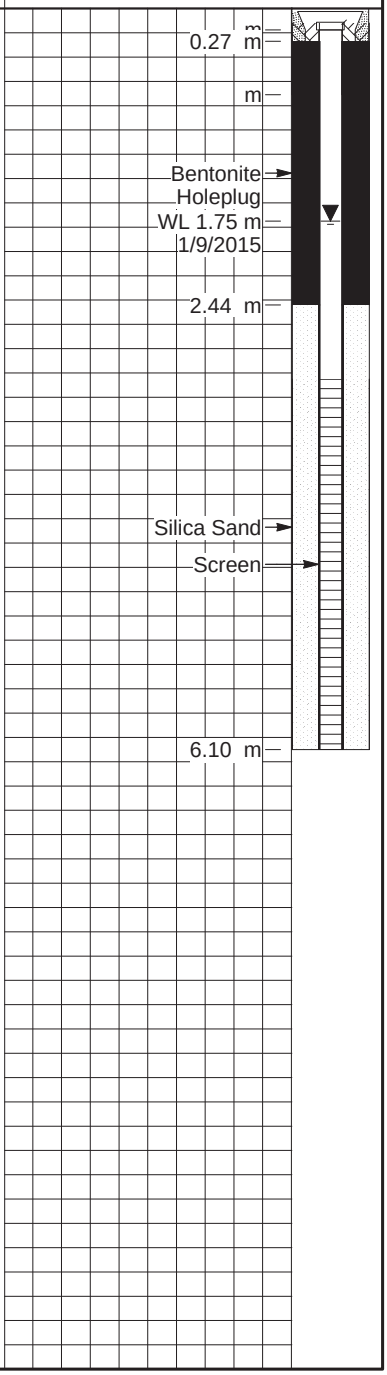
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) 76.85	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
				GROUND SURFACE						
	0.15	76.70		ASPHALT : 150 mm						
1				GRANULAR BASE : 400 mm		SS-1		--		--
2	0.55	76.30		FILL : GRAVELLY SAND, trace silt, asphalt debris, grey, moist, compact; (SW-GW)						
3	1.0					SS-2		--		--
4										
5	1.52	75.33		SILTY CLAY, trace gravel, trace organics, grey, very moist, very soft; (CL)						
6						SS-3		--		--
7	2.0									
8	2.29	74.56		SILT to CLAYEY SILT, trace sand, grey, very moist, very soft; (CL-ML)						
9						SS-4		--		--
10	3.0									
11						SS-5		--		--
12										
13	3.81	73.04		dark grey NATIVE : SILTY CLAY, grey, moist, very soft; (CL)		SS-6		--		--
14	4.0									
15										
16						SS-7		--		--
17	5.0									
18	5.34	71.51		SAND, some gravel, grey, wet, loose; (SP)		SS-8		--		--
19										
20	6.0 6.10	70.75				SS-9		--		--
21				**END OF BOREHOLE:**						
22				NOTE :						
23	7.0			End of Borehole at 6.1 m bgs						
24				50 mm diameter monitoring well installed at 6.10 m bgs in the sampled borehole						
25				bgs denotes 'below ground surface'						
26	8.0			Water Level :						
27				Date Depth (m) Elev (m)						
28				01/09/2015 1.75 75.11						
29										
30	9.0									
31										
32										
33	10.0									
34										
35										
36	11.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 27

BOREHOLE No.: MW27D-15
ELEVATION: 76.88 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: R. Khabbaznia CHECKED BY: F. Gergis
DATE (START): 11 August 2015 DATE (FINISH): 11 August 2015

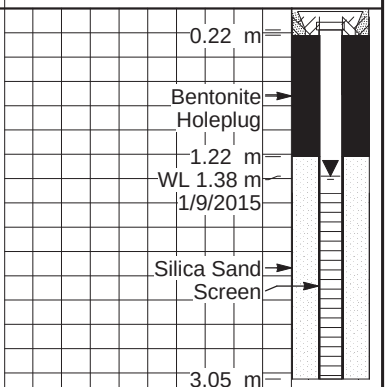
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	PID	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR%
		76.88		GROUND SURFACE			%	ppm		N
1	0.15	76.73		ASPHALT : 150 mm GRANULAR BASE : 400 mm		SS-1		--		--
2	0.55	76.33		FILL : GRAVELLY SAND, trace silt, asphalt debris, grey, moist, compact; (SW-GW)						
3	1.0					SS-2		--		--
4										
5	1.52	75.36		SILTY CLAY, trace gravel, trace organics, grey, very moist, very soft; (CL)						
6	2.0					SS-3		--		--
7	2.29	74.59		SILT to CLAYEY SILT, trace sand, grey, very moist, very soft; (CL-ML)						
8						SS-4		--		--
9										
10	3.0 3.05	73.83				SS-5		--		--
11				**END OF BOREHOLE:**						
12										
13	4.0			NOTE : End of Borehole at 3.05 m bgs 50 mm diameter monitoring well installed at 3.05 m bgs in the sampled borehole bgs denotes 'below ground surface'						
14										
15										
16	5.0			Water Level :						
17										
18				Date Depth (m) Elev (m) 01/09/2015 1.38 75.50						
19										
20	6.0									
21										
22										
23	7.0									
24										
25										
26	8.0									
27										
28										
29	9.0									
30										
31										
32										
33	10.0									
34										
35										
36	11.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 35

BOREHOLE No.: MW35A-15
ELEVATION: 77.17 m

BOREHOLE REPORT

Page: 1 of 3

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen/P. Hardcastle CHECKED BY: F. Gergis
DATE (START): 12 August 2015 DATE (FINISH): 12 August 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) 77.17	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
				GROUND SURFACE						
	0.13	77.04		ASPHALT : 125 mm						
1				GRANULAR FILL : GRANULAR MATERIAL mixed with asphalt debris, wood fragments, black, moist, dense		SS-1	100	0.4	13-15-16-14	31
2	0.76	76.41								
3	1.0			FILL : SAND and GRAVEL mixed with crusher run limestone, trace silt, brown, moist, very dense; (SW-GW) Gravel : 38%, Sand : 53%, Silt : 9%, Clay : 0%		SS-2	25	0.1	7-25-30-22	55
4										
5						SS-3	50	0.9	8-9-10-12	19
6										
7	2.0									
	2.29	74.88								
8				NATIVE : SAND, trace silt and gravel, fine grained, brown, very moist, compact; (SP) Gravel : 6%, Sand : 85%, Silt : 9%, Clay : 0%		SS-4	100	0.6	4-10-18-16	28
9										
10	3.0					SS-5	100	0.3	7-8-8-7	16
11				trace clay seam						
12				medium to fine grained						
13	4.0			loose		SS-6	25	0.6	1-2-3-2	5
14										
15				very loose						
16						SS-7	50	1.3	1-0-1-1	1
17	5.0									
	5.34	71.83								
18				grey, loose		SS-8	25	1.2	3-2-3-4	5
19										
20	6.0									
21						SS-9	100	1.1	2-1-2-3	3
22										
23	7.0					SS-10	100	1.1	0-1-2-2	3
24										
25				wet						
26						SS-11	50	0.9	3-2-4-5	6
27	8.0									
28				very loose		SS-12	50	1.6	1-1-1-1	2
29										
30	9.0									
31				loose		SS-13	50	0.9	3-2-5-10	7
32										
	9.91	67.26								
33	10.0			fine sand, trace silt, compact Gravel : 0%, Sand : 92%, Silt : 8%, Clay : 0%		SS-14	100	0.2	5-11-17-21	28
34										
35										
36	11.0					SS-15	50	0.8	2-8-10-14	18

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

0.30 m
119
WL 2.03 m
1/9/2015
Bentonite
Holeplug
120
122

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 14/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 35

BOREHOLE No.: MW35A-15
ELEVATION: 77.17 m

BOREHOLE REPORT

Page: 2 of 3

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen/P. Hardcastle CHECKED BY: F. Gergis
DATE (START): 12 August 2015 DATE (FINISH): 12 August 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m) 77.17	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
				GROUND SURFACE						
37										
38				loose		SS-16	50	0.2	1-1-8-10	9
39	12.0									
40				compact		SS-17	100	2.2	2-7-11-15	18
41										
42						SS-18	100	0.4	12-10-15-29	25
43	13.0									
44										
45				wet		SS-19	100	0.5	5-8-11-14	19
46	14.0									
47						SS-20	100	0.3	4-7-9-12	16
48										
49	15.0									
50						SS-21	100	0.6	10-8-9-9	17
51										
52						SS-22	100	0.6	4-6-9-14	15
53	16.0									
54										
55				very dense		SS-23	100	1.0	4-10-50	60
56	17.0									
57	17.38	59.79		SHALE-BEDROCK (GEORGIAN BAY FORMATION), trace clay, highly fractured, friable, thinly bedded, soft, dark grey						
58										
59	17.99									
60	18.0	59.18		BEDROCK, thinly bedded, light grey		RC-1	79	--	0	--
61										
62	18.95			50 mm clay seams						
63	19.0	58.22		horizontal fractures		RC-2	100	--	70	--
64	19.21	57.96		highly fractured vertical fractures						
65										
66	20.0			clay seam highly fractured						
67	20.43	56.74								
68						RC-3	100	--	80	--
69	21.0									
70										
71										
72	22.0									
73						RC-4	100	--	80	--

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

Bentonite Holeplug
19.36 m
Silica Sand
Screen

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 14/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 35

BOREHOLE No.: MW35A-15
ELEVATION: 77.17 m

BOREHOLE REPORT

Page: 3 of 3

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: K. Vander Meulen/P. Hardcastle CHECKED BY: F. Gergis
DATE (START): 12 August 2015 DATE (FINISH): 12 August 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	PID	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR%
		77.17		GROUND SURFACE			%	ppm		N
75	23.0	54.15		**END OF BOREHOLE:**						
	23.02			NOTE : End of Borehole at 23.02 m bgs Rock coring from 17.99 m bgs 50 mm diameter monitoring well installed at 23.02 m bgs in the sampled borehole Heaving sand condition observed at 2.10 m bgs A balancing pressure head of clean water or mud was used in the open borehole during drilling to stabilize the uplift pressure bgs denotes 'below ground surface'						
78	24.0			Water Level : Date Depth (m) Elev (m) 01/09/2015 2.03 75.14						
82	25.0									
85	26.0									
88	27.0									
92	28.0									
95	29.0									
98	30.0									
102	31.0									
105	32.0									
108	33.0									

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

23.02 m

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 14/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 35

BOREHOLE No.: MW35B-15
ELEVATION: 80.07 m

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: L. Griffith CHECKED BY: F. Gergis
DATE (START): 13 August 2015 DATE (FINISH): 13 August 2015

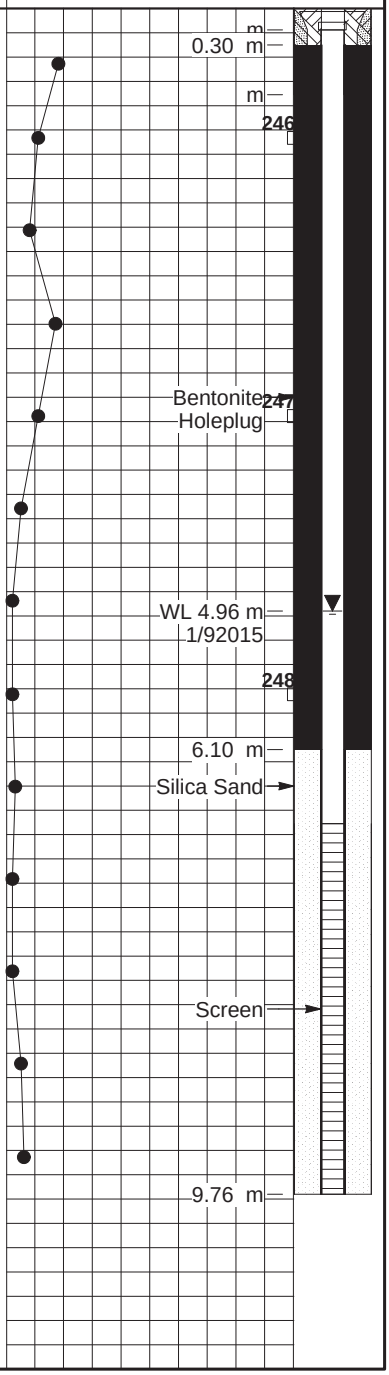
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		80.07		GROUND SURFACE						
	0.61	79.46		FILL : SAND and GRAVEL, medium to fine grained, well graded, brown, moist, very dense; (SW-GW)		SS-1	25	0.0	4-8-10-8	18
	1.0			SILT, trace gravel, brown, moist, compact; (ML)		SS-2	50	0.0	4-7-4-3	11
	2.0					SS-3	50	0.0	3-3-5-9	8
	2.29	77.78		SAND and GRAVEL, fine to medium grained, well graded, grey, moist, compact; (SW-GW)		SS-4	75	0.0	5-9-8-11	17
	3.0			trace red crushed brick fragments, black staining wood fragments		SS-5	75	0.0	5-6-5-5	11
	4.0					SS-6	33	0.0	2-3-2-2	5
	4.57	75.50		NATIVE : PEAT, brown, moist, soft; (PT)		SS-7		0.0	1-1-1-2	2
	5.0					SS-8	100	0.0	1-0-2-1	2
	6.0					SS-9	100	0.0	1-1-2-3	3
	6.86	73.21		SILTY CLAY, low plasticity, grey, wet, soft; (CL)		SS-10	100	0.0	0-1-1-2	2
	7.0					SS-11	0	0.0	1-0-2-3	2
	8.0					SS-12	100	0.0	2-2-3-4	5
	9.0					SS-13		0.0	1-2-4-5	6
	9.76	70.31		**END OF BOREHOLE:** NOTE : End of Borehole at 9.76 m bgs 50 mm diameter monitoring well installed at 9.76 m bgs in the sampled borehole						
	10.0									
	11.0									

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 35

BOREHOLE No.: MW35B-15
ELEVATION: 80.07 m

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: L. Griffith CHECKED BY: F. Gergis
DATE (START): 13 August 2015 DATE (FINISH): 13 August 2015

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	PID	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR%
		80.07		GROUND SURFACE			%	ppm		N
37				bgs denotes 'below ground surface'						
38										
39	12.0			Water Level :						
40				Date Depth (m) Elev (m)						
41				01/09/2015 4.96 75.12						
42										
43	13.0									
44										
45										
46	14.0									
47										
48										
49	15.0									
50										
51										
52	16.0									
53										
54										
55	17.0									
56										
57										
58	18.0									
59										
60										
61	19.0									
62										
63										
64	20.0									
65										
66										
67	21.0									
68										
69										
70	22.0									
71										
72										
73										

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 35

BOREHOLE No.: MW35C-15
ELEVATION: 80.07 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: L. Griffith CHECKED BY: F. Gergis
DATE (START): 14 August 2015 DATE (FINISH): 14 August 2015

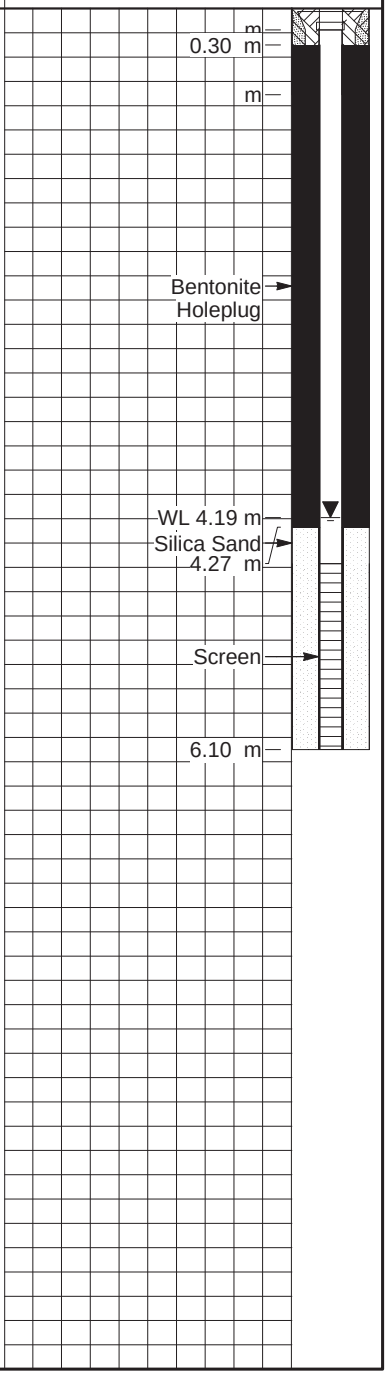
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		80.07		GROUND SURFACE						
	0.61	79.46		FILL : SAND and GRAVEL, medium to fine grained, well graded, brown, moist, very dense; (SW-GW)		SS-1	--	--		--
	1.0			SILT, trace gravel, brown, moist, compact; (ML)		SS-2	--	--		--
	2.0					SS-3	--	--		--
	2.29	77.78		SAND and GRAVEL, fine to medium grained, well graded, grey, moist, compact; (SW-GW)		SS-4	--	--		--
	3.0			trace red crushed brick fragments, black staining wood fragments		SS-5	--	--		--
	4.0					SS-6	--	--		--
	4.57	75.50		SILTY CLAY, trace organics, low plasticity, grey, moist to very moist, very soft; (CL)		SS-7	--	--		--
	5.0					SS-8	--	--		--
	6.0									
	6.10	73.97				SS-9	--	--		--
	7.0			**END OF BOREHOLE:** NOTE : End of Borehole at 6.10 m bgs 50 mm diameter monitoring well installed at 6.10 m bgs in the sampled borehole bgs denotes 'below ground surface' Water Level : Date Depth (m) Elev (m) 01/09/2015 4.19 75.88						
	8.0									
	9.0									
	10.0									
	11.0									

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 35

BOREHOLE No.: MW35D-15
ELEVATION: 80.07 m

BOREHOLE REPORT

Page: 1 of 2

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: L. Griffith CHECKED BY: F. Gergis
DATE (START): 21 August 2015 DATE (FINISH): 21 August 2015

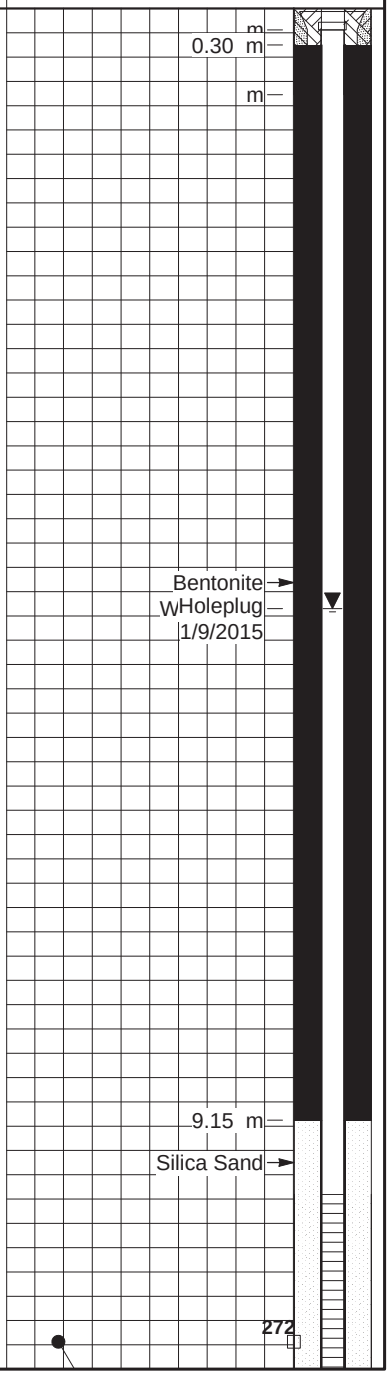
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	PID	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR%
		80.07		GROUND SURFACE			%	ppm		N
				No sampling/Augered to 10.67 m bgs						
10.67	11.0	69.40		NATIVE : SAND, fine grained, brown, moist, wet;		SS-1	50	0.0	2-3-15-11	18

Shear test (Cu) △ Field
Sensitivity (S) □ Env. Sample
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

REFERENCE No.: 11102463 ENCLOSURE No.: 35

BOREHOLE No.: MW35D-15
ELEVATION: 80.07 m

BOREHOLE REPORT

Page: 2 of 2

CLIENT: Waterfront Toronto
PROJECT: Environmental, Geotechnical and Hydrogeological Investigation
LOCATION: Port Lands, Toronto, Ontario
DESCRIBED BY: L. Griffith CHECKED BY: F. Gergis
DATE (START): 21 August 2015 DATE (FINISH): 21 August 2015

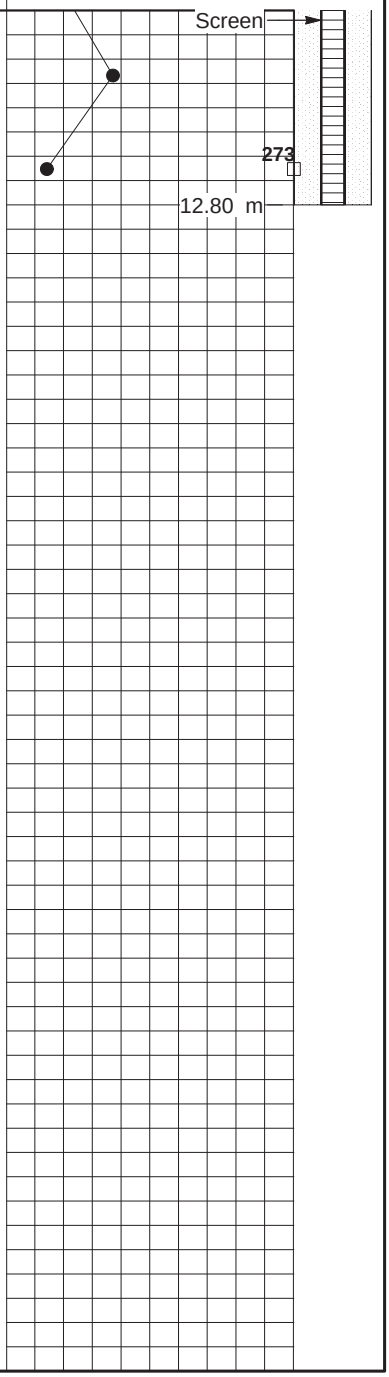
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	PID ppm	Blows per 6 in. / 15 cm or RQD	Penetration Index/SCR% N
		80.07		GROUND SURFACE						
37				(SP)						
38				dense						
39	12.0					SS-2	50	0.0	4-9-28-16	37
40										
41						SS-3		0.0	4-6-8-14	14
42	12.80	67.27								
43	13.0			**END OF BOREHOLE:**						
44										
45				NOTE :						
46	14.0			End of Borehole at 12.80 m bgs						
47				50 mm diameter monitoring well installed						
48				at 12.8 m bgs in the sampled borehole						
49	15.0			bgs denotes 'below ground surface'						
50										
51				Water Level :						
52										
53	16.0			Date Depth (m) Elev (m)						
54				01/09/2015 4.94 75.12						
55										
56	17.0									
57										
58										
59	18.0									
60										
61										
62	19.0									
63										
64										
65										
66	20.0									
67										
68										
69	21.0									
70										
71										
72	22.0									
73										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Env. Sample
○ Water content (%)
w_p w_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL 11102463.GPJ INSPEC_SOL.GDT 11/9/15

Appendix C: Geotechnical Review for Essroc Quay
(Source: Peto MacCallum Consulting Engineers, 2016. Preliminary Geotechnical Comments - Essroc Quay Cherry Street, Toronto Ontario)

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PRELIMINARY GEOTECHNICAL COMMENTS
ESSROC QUAY
CHERRY STREET
TORONTO, ONTARIO

for

RIGGS ENGINEERING LTD.

PETO MacCALLUM LTD.
45 BURFORD ROAD
HAMILTON, ONTARIO
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Distribution:
1 cc: Riggs Engineering Ltd. (plus PDF)
1 cc: PML Hamilton

PML Ref.: 15HF040
Report: 1
June 2016

Peto MacCallum Ltd.
CONSULTING ENGINEERS

June 9, 2016

PML Ref.: 15HF040
Report: 1

Mr. Stuart Seabrook, P.Eng.
Senior Hydrotechnical Engineer
Riggs Engineering Ltd.
205 - 1240 Commissioners Road West
London, Ontario
N6K 1C7

Dear Mr. Seabrook

Preliminary Geotechnical Comments
Essroc Quay
Cherry Street
Toronto, Ontario

Peto MacCallum Ltd. (PML) is pleased to present an assessment and provide preliminary geotechnical comments for this project. Authorization to proceed with this assignment was provided by Mr. Stuart Seabrook in an email dated October 21, 2015.

It is understood that the Essroc Quay land creation works are a component of the Don River Mouth Naturalization and Lower Don River West Flood Protection Projects. The Essroc Quay project provides the land base for the Cherry Street bridge relocation and location for placement of a portion of the materials excavated in conjunction with the river mouth alignment.

The current design concept provided by Riggs Engineering Ltd. (Riggs) calls for the construction of containment structures constructed of structural walls and granular berms and infilled to provide for future commercial, residential and parkland land uses.

It is understood that the anticipated thickness of lake infill will be in the order of 11 m. Additional fill of about 2 m on the existing pier will also be required to achieve local topographic landscape features. Infill materials will satisfy the confined fill material criteria as presented in the Fill Quality Guide and Good Management Practices for Shore Infilling in Ontario (MOECC, 2011).

The purpose of this preliminary assessment is to review available background information and provide preliminary comments on design, construction and settlement of the berms and cells.

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BARRIE, HAMILTON, KITCHENER, TORONTO

Literature Review

The literature review for this preliminary geotechnical assessment included review of provided documents, various reference data and information from PML's database of subsurface investigations in the general area.

The compiled data was used to develop background data of the probable/inferred soils profile, bedrock lithology and groundwater regime near and at the site under consideration. A list of the relevant reports reviewed to obtain the information used in this report is included in Appendix A. Relevant boreholes are shown on Drawing 1 and Figures 1 and 2, appended.

A reference is made to boreholes completed in-water by Alston Associates in 2009 at Waterfront Toronto's Bayside Development in the report by Golder (2015) which notes a "very soft, silty clay, lake bed deposit (up to about 5 m thick)". PML has requested a copy of this report for review, however, it was not provided at the time of this report.

It is noted that the Ontario borehole database, known as the Urban Geology Analysis Information System (UGAIS), was reviewed for applicability and was considered during the modelling of the soil; however the information is generally dated and inconsistent and was not relied upon for accuracy of soil layer thicknesses for the purposes of this report.

Limited reliable data is available that documents the existing conditions of the lakebed sediments and organic layers. In this regard, it is considered that man-made fill deposits were likely placed over sediment and organic layers. Therefore, for the purposes of this report, the organic layers contacted in boreholes completed through existing man-made fill deposits are considered representative of the lakebed layer thicknesses and were used for modelling the lakebed sediment and organic thicknesses. Additional investigations and/or detail design investigations must be carried out to further define the soil layer thicknesses and parameters in the settlement model.

The previous subsurface investigations were carried out up to 50 years ago and site conditions may have since been altered. In particular, surficial subsoil and the upper zones of the previously encountered soils may have been removed or covered with fill as part of site grading from previous and/or ongoing development. This limitation should be considered when referring to the compiled data in this report.

Geology

The project area is situated within the physiographic region known as the Iroquois Plain. The Iroquois Plain was formed in the late Pleistocene times by a body of water known as Lake Iroquois, which emptied eastward at Rome, New York. (Chapman and Putnam, 1984). Lake Iroquois was characterized by higher water levels than the present day Lake Ontario, caused by an ice sheet blocking the present day St. Lawrence River valley. When the St. Lawrence valley became free of ice, the water level dropped to a level much lower than the present Lake Ontario levels (Karrow, 1959).

Based on Quaternary Geology Map M2204, the surficial deposits on the site are man-made fill deposits underlain by lacustrine sand. According to Bedrock Geology of Ontario Map M2554, the bedrock geology consists of grey shale of the Georgian Bay Formation.

Summarized Subsurface Conditions

The subsurface data in this report is preliminary only and is based on a literature review of available data.

Based on a review of relevant information, the subsurface stratigraphy general consists of lake bed sediments overlying organic silt and/or peat, underlain by sand, mantling shale bedrock. Reference is made to Drawing 1 and Figures 1 and 2, appended, for the stratigraphy of boreholes near the site. For the purposes of modelling settlement, the following details were considered:

Water

The water level in Lake Ontario generally averages near elevation 74.8; the chart datum is elevation 74.2. The average lake water elevation was obtained from The Canadian Hydrographic Service water level gauging station located in Toronto, Ontario. The elevation is referenced to the International Great Lakes Datum, 1985.

Based on Bathymetric mapping provided by Riggs, the elevation of the lake bed typically ranges from 67 to 70 m with localized zones of 65 m and 72 m in the south and north east, respectively. In general, the lake bed elevation slopes down in a southerly direction within the project area.

Recent Sediment

Based on a review of the information provided, very little information is known about the thickness or physical properties of recent sediment deposits. It is understood that the Toronto Region Conservation Authority (TRCA) has provided a description as sand to silty sand and records for dredging which indicated that the area near Essroc Quay has not been dredged in recent years. It is anticipated that sediment thickness will range from 0.5 to 1.0 m.

Organic Silt

The recent sediment is underlain by loose, organic silt with variable organic content including shells, peat and rootlets and interbedded with clayey and sandy layers. Records indicate the thickness of the organic layer on and within the vicinity of the site ranges from 0.6 to 5.5 m, typically 3.0 to 5.0 m as shown on Drawing 1, appended. It is anticipated that the thickness of the organic silt layer will increase towards the extents of the former Don River mouth. No records of consolidation testing results were made available at the time of this report.

Sand

Sand ranging in thickness from 6 to 7 m is encountered below the organic silt. The sand is generally compact becoming dense with depth.

Bedrock

Shale bedrock is typically encountered at depths 12 to 14 m, near elevation 60 to 63. Locally, shale was encountered near elevation 64 near Cherry Street. The shale bedrock is grey shale of the Georgian Bay Formation. It is anticipated that the bedrock contact elevation slopes down in a southerly direction within the project area.

Engineering Discussion and Recommendations

Settlement

Berm and Infill Material

It is understood that the berm construction will consist of granular materials.

Based on the design model presented by Riggs, it is assumed the material planned to be used to infill cells will be soils meeting the confined fill material criteria; however, it is noted by Riggs that there is the potential to accommodate dredged sediments or “dirty soils” not meeting the confined fill material guidelines. For the purposes of this report, it is considered that the soils will be meeting the confined fill material and will generally consist of granular material.

Assuming granular materials are used, consolidation settlement of the berm and infill materials will generally be completed during the construction phase. This should be reassessed once fill materials are known.

Organics

Settlement induced by infilling the lake and construction of the berms will occur primarily due to consolidation of the underlying organic soils.

Neither site specific subsurface investigations nor geotechnical laboratory testing programs have been carried out for this study. In this regard, review of the literature and local experience were used to select the parameters to estimate the settlement.

The following parameters were assumed for modelling settlement:

Assumed Geotechnical Parameters of Compressible Layer (Organic Silt)	
Unit Weight, γ (kN/m^3)	15.0
Void Ratio , e_o	1.7
Compression Index, C_c	1
Vertical Coefficient of Consolidation, C_v (m^2/min)	1.8 x 10^{-5}
Secondary Compression Index, C_α	0.08

A preliminary estimate of the magnitude of the settlement of the organic silt based on a conservative soil model using the maximum thickness of compressible (5 m) soil is as follows:

Soil	**Estimated Magnitude of Settlement**			**Estimated Time for 90% (t_{90}) Completion of Settlement (months)[1]**
	Primary Consolidation (mm)	**Secondary (Creep) Consolidation (mm)**	**Total (mm)**	
Organic Silt	950	50	1000	24 to 30

Notes: 1. Without mitigation measures

It is noted that preliminary calculations were conducted for various soil layer thicknesses and parameters to provide a lower limit for the magnitude of the settlement. In this regard, total settlement for compressible thickness layers of 1 m and 3 m were 300 and 625 mm, respectively.

It is anticipated that placement of about 2 m of additional fill is planned on the existing pier to achieve local topographic landscape features. It is considered that the magnitude of primary consolidation settlement of the underlying organic (assuming 3 to 5 m thickness) within the existing pier area is expected to be less than calculated above.

The magnitude of settlement should be considered preliminary and used for planning purposes only. The settlement calculations should be reassessed when site specific borehole information becomes available.

Mitigation Measures

It is understood that options for mitigation measures are required to minimize the magnitude and estimated time for completion of the settlement. The following sections provide a brief overview of various mitigation measures and their applicability. Consideration for combining the mitigation options should be considered to provide the most efficient and cost effective solution. Further comments in this regard can be provided when site specific details on the characteristics (thickness and consolidation properties) of the compressible soil are known.

Preloading

Preloading refers to placement of fill to the proposed finished grades and requires a delay period after construction to monitor and assess the magnitude of settlement prior to placing finished surfaces (pavement structure, landscaping), utilities and/or structures. Preloading is considered suitable for soils in which the primary consolidation is anticipated to be completed within the construction period and secondary (creep) consolidation is anticipated to be minimal.

Based on the information complied for this study, preloading may not considered a viable mitigation measure due to the calculated consolidation time and magnitude of creep that would continue after preloading period.

Surcharge

Surcharging requires placement of a surcharge load (generally fill placed above proposed finished grades) to increase the stress imposed on the compressible soil and increase the rate of consolidation.

Surcharging is considered a viable option to reduce the estimated time of settlement for infilled cells; however this would not reduce the magnitude or creep. Surcharging the berms before infilling of the cells is not considered practical.

Based on our experience with comparable projects with similar soil conditions, it is anticipated that a 150 kPa surcharge, or about 7 m of granular fill, will increase the strength of the underlying organics and reduce the estimated time of settlement to 12 to 18 months; however laboratory and in situ testing of the soil will be required to confirm the surcharge required and to refine the estimated time and degree of settlement.

Wick Drains

The purpose of wick drains, when used in conjunction with surcharging, is to accelerate the consolidation settlement by reducing the length of the drainage path and allowing water to drain more quickly in the consolidation process. It is anticipated that wick drains and surcharging would reduce the settlement time to less than one year.

Subexcavation

Excavation of the compressible soils is considered an effective means of reducing the magnitude and estimated completion time for the settlement; however, in consideration of the estimated 5 m thickness of compressible soils, it may not be practical. The practicality of the this option should be reassessed once a site specific geotechnical investigation to establish soil conditions has been completed.

Ground Improvement

Ground improvement techniques may be considered to reduce the settlement and increase the stability of compressible soils. Ground improvement methods such as soil mixing, rammed aggregate piers or densification (impact or vibration compaction) are considered viable options for increasing the strength and mitigating the settlement of the compressible soil beneath the berms

and in the cell areas, particularly in areas of proposed buildings. Further comments in this regard can be provided when site specific details on the characteristics (thickness and consolidation properties) of the compressible soil are known.

Additional Studies

The subsurface data in this report is preliminary only and is based on a literature review of available data. Additional investigations and/or detail design investigations must be carried out to further define the parameters in the settlement model and for design of the berms and steel sheet pile or H-Pile and panel walls.

The interpretation and recommendations are provided only for planning and feasibility studies and should not be used for detail design purposes. The following items should be considered for the additional studies:

- Boreholes to assess the subsurface soil conditions within the limits of the berms and cells to establish boundary limits of the soil strata thicknesses and bedrock contact
- Laboratory and in situ testing of the soil encountered during the above noted geotechnical investigation to determine index properties and soil classification (moisture content, organic content, grain size, Atterberg Limits and specific gravity), settlement properties (consolidation) and strength parameters (unconfined uniaxial compression, undrained triaxial and consolidated undrained triaxial).
- Refinement of the settlement model based on the soil strata thicknesses and laboratory and in situ testing
- Assess the bearing capacity to evaluate the feasibility of supporting the berm on in situ organic layers and sediment.

Closure

Neither site specific subsurface investigations nor laboratory testing programs have been carried out for this study. The preliminary data has been taken from previous investigations carried out in

the general area of the site and is considered adequate for planning purposes only. The magnitude of the settlement and measures to mitigate the settlement should be reassessed when site specific borehole information becomes available.

We trust that the information presented in this report is sufficient for your present purposes. Please do not hesitate to contact our office should you have any question regarding the information submitted.

Sincerely

Peto MacCallum Ltd.

Karel Furbacher, P.Eng.
Project Engineer

Matthew St. Denis, P.Eng.
Senior Engineer, Geotechnical Services

KF:lad

Enclosures:
References
Figures 1 and 2 – Section A-A and B-B
Drawing 1 – Site Plan
Appendix A – Literature Review Documents

References

Chapman, L.J., and Putnam, D.F., 1984: The Physiography of Southern Ontario; Ontario. Ontario Research Foundation.

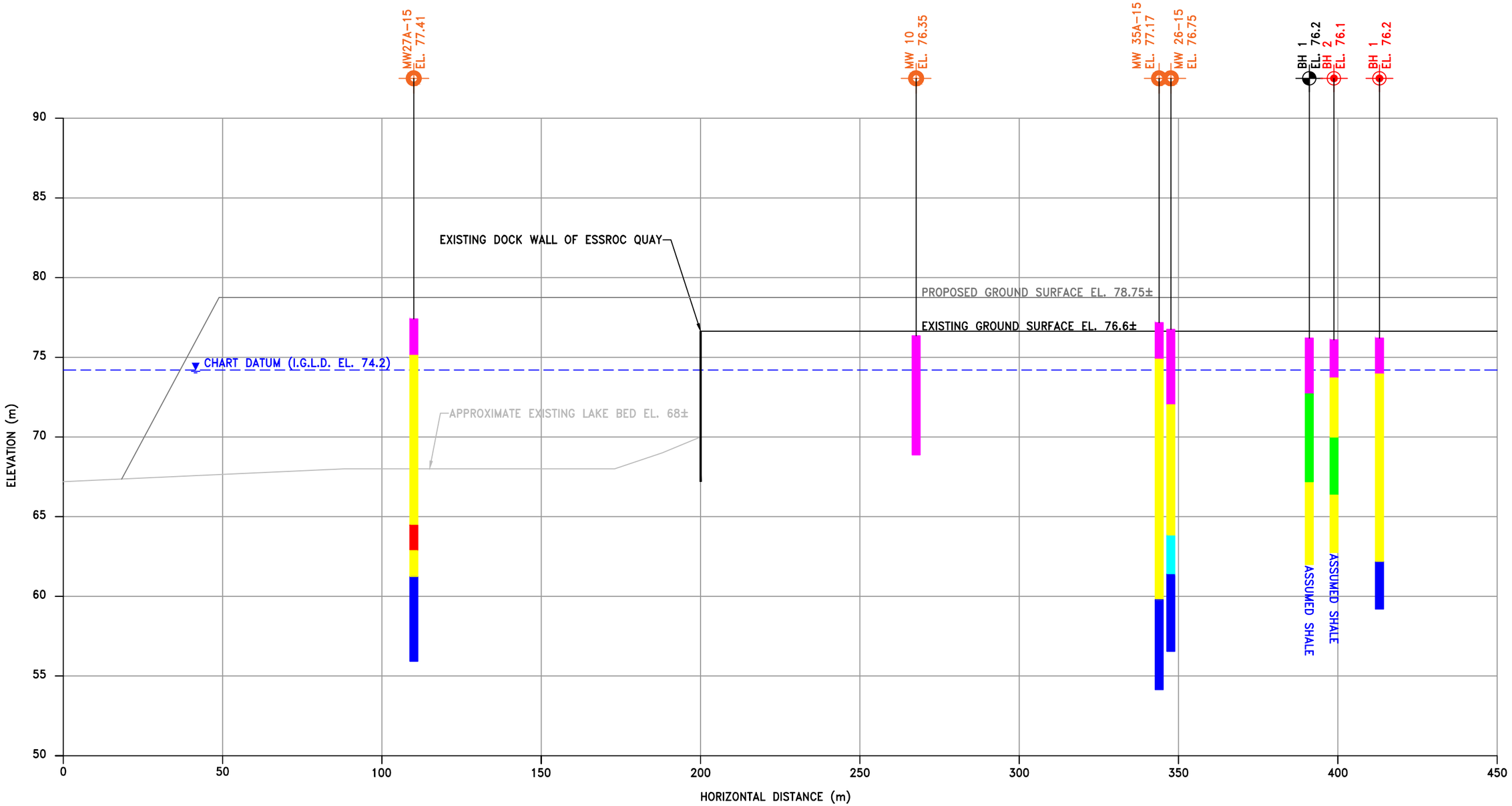
Karrow, P. F., 1959; Pleistocene Geology of the Hamilton Map-Area. Ontario; Toronto, Ontario. Ontario Department of Mines

M2204; Quaternary Geology, Toronto and Surrounding Area, Southern Ontario; Ministry of Natural Resources; 1980; Scale: 1:100,000.

M2544; Bedrock geology of Ontario, southern sheet; Ontario Geological Survey, 1991; Scale: 1:1,000,000.

Fill Quality Guide and Good Management Practices for Shore Infilling in Ontario; Ontario Ministry of Environment (MOE), 2011. Revised 2011.

SECTION A–A



LEGEND:

- FILL
- ORGANICS
- SAND
- SILT
- CLAY
- SHALE

NOTES:

1. REFER TO DRAWING 1 FOR SECTION LOCATION
2. THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

0m 2.5 5 7.5 10 15
VERTICAL SCALE
(1:250)

0m 10 20 30 40 50
HORIZONTAL SCALE
(1:1250)

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PRELIMINARY GEOTECHNICAL COMMENTS
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CHERRY STREET, TORONTO

SECTION A–A

Peto MacCallum Ltd.
CONSULTING ENGINEERS

		DATE	SCALE	PML REF.	FIGURE NO.
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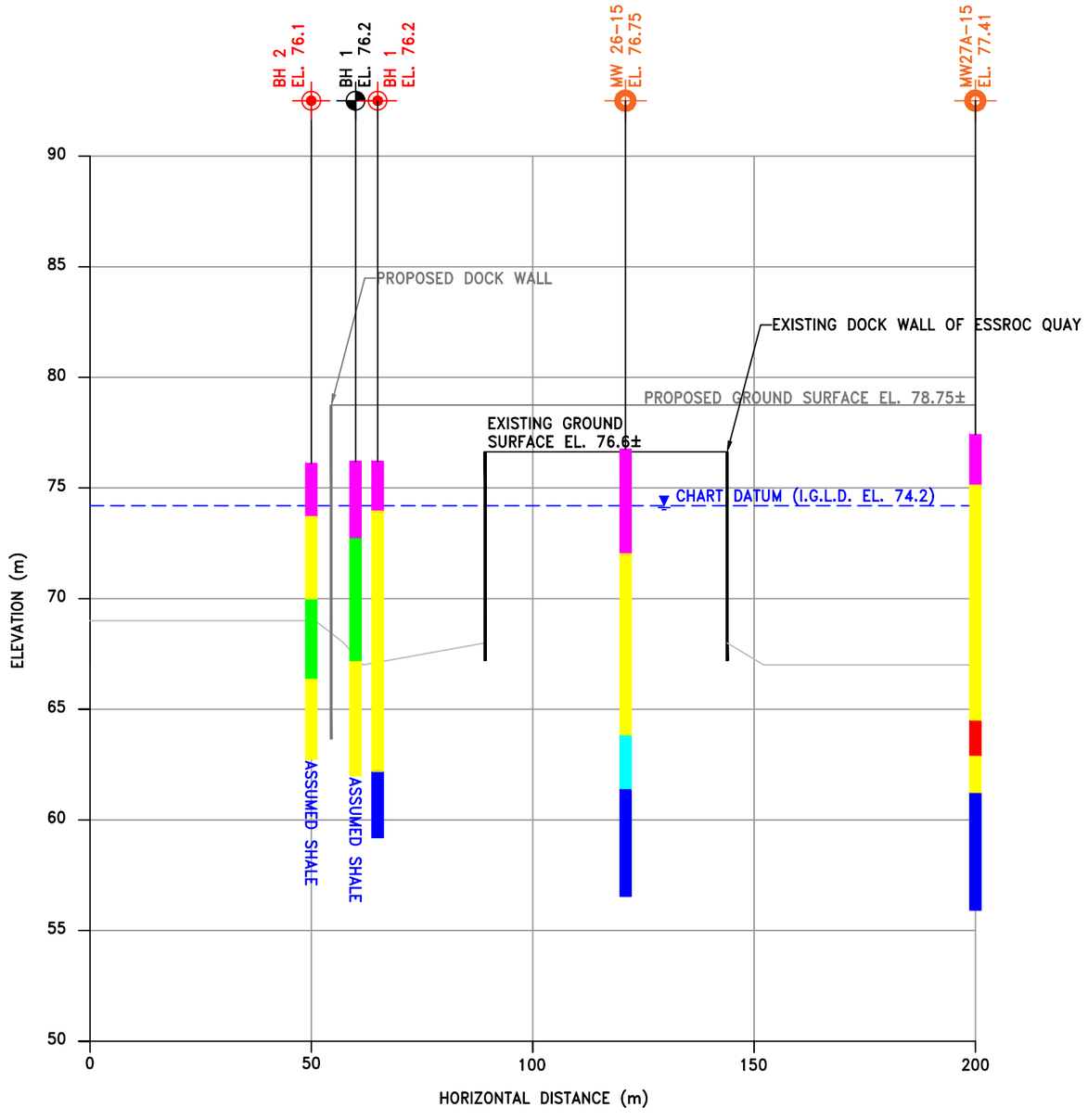
CHECKED	KF				
APPROVED	MDS				

SECTION B–B



LEGEND:

- FILL
- ORGANICS
- SAND
- SILT
- CLAY
- SHALE

NOTES:

1. REFER TO DRAWING 1 FOR SECTION LOCATION
2. THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE BOREHOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE BOREHOLES MAY VARY.

0m 2.5 5 7.5 10 15
VERTICAL SCALE
(1:250)

0m 10 20 30 40 50
HORIZONTAL SCALE
(1:1250)

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PRELIMINARY GEOTECHNICAL COMMENTS
ESSROC QUAY
CHERRY STREET, TORONTO

SECTION B–B

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	KF	DATE	SCALE	PML REF.	FIGURE NO.
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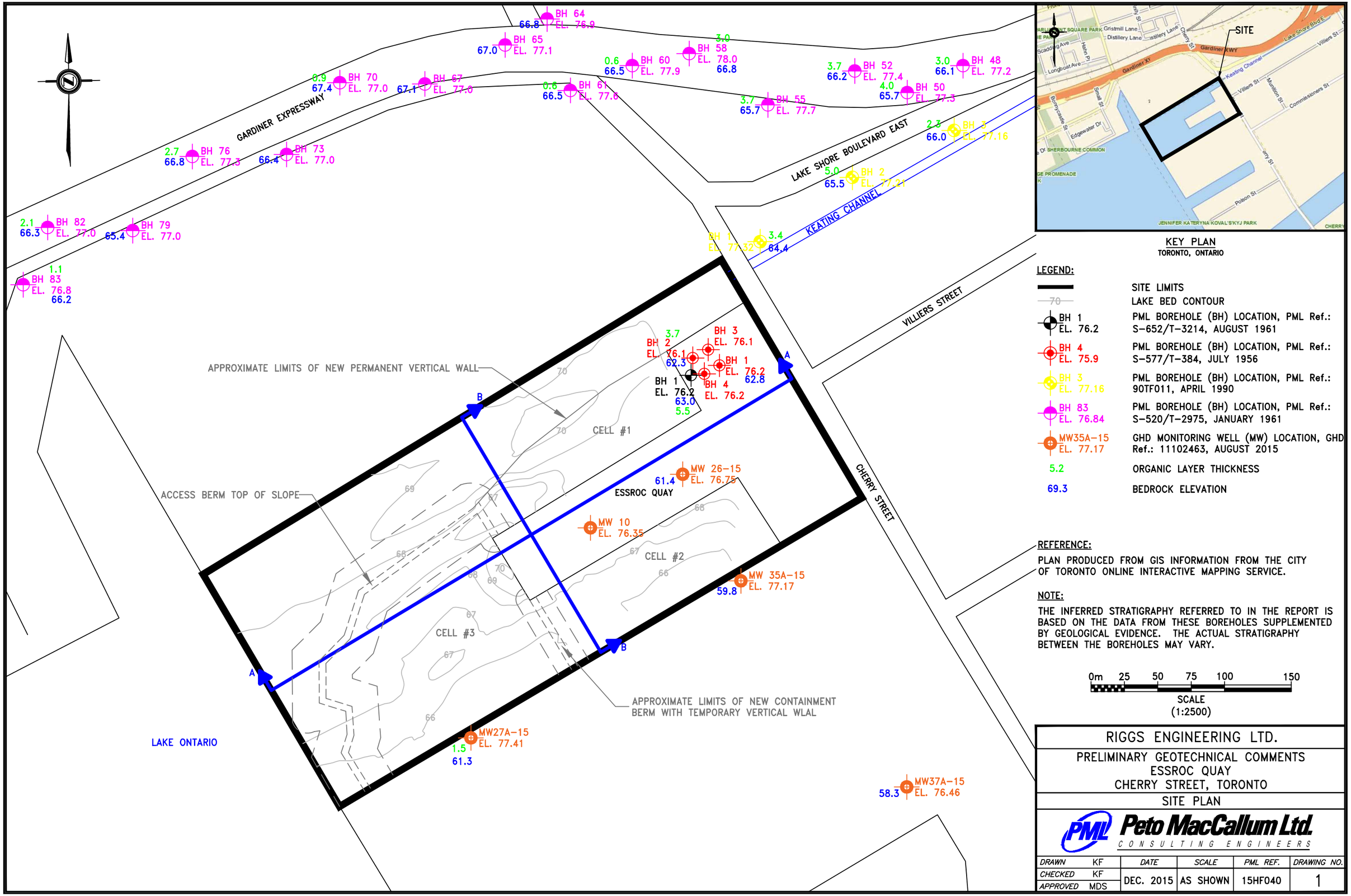
APPROVED	MDS				



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PRELIMINARY GEOTECHNICAL COMMENTS
ESSROC QUAY
CHERRY STREET, TORONTO

SITE PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	KF	DATE	SCALE	PML REF.	DRAWING NO.
CHECKED	KF	DEC. 2015	AS SHOWN	15HF040	1
APPROVED	MDS				

Appendix A

Literature Review Documents

Appendix A

Riggs Document List

- Marine Engineering Services to Develop Preliminary Designs for Land Creation Works Surrounding Essroc Quay – Draft Existing Conditions Summary Report for Toronto and Region Conservation Authority submitted by Riggs Engineering Ltd., dated September 4, 2015;
- Marine Engineering Services to Develop Preliminary Designs for Land Creation Works Surrounding Essroc Quay – Preliminary Design Update Report for Toronto and Region Conservation Authority submitted by Riggs Engineering Ltd., dated September 30, 2015;
- Organic Layer Surface Elevation, Figure 5, from Preliminary Environmental Assessment and Geotechnical Earthworks Report for Waterfront Toronto by CH2M dated September 30, 2015;
- Organic Layer Thickness, Figure 6, from Preliminary Environmental Assessment and Geotechnical Earthworks Report for Waterfront Toronto by CH2M dated September 30, 2015;
- Bedrock Surface Elevation, Figure 7, from Preliminary Environmental Assessment and Geotechnical Earthworks Report for Waterfront Toronto by CH2M dated September 30, 2015;
- Cross-section Locations, Figure 8, from Preliminary Environmental Assessment and Geotechnical Earthworks Report for Waterfront Toronto by CH2M dated September 30, 2015;
- Geologic Cross-section D-D', Figure 9D, from Preliminary Environmental Assessment and Geotechnical Earthworks Report for Waterfront Toronto by CH2M dated September 30, 2015;
- Geologic Cross-section I-I', Figure 9I, from Preliminary Environmental Assessment and Geotechnical Earthworks Report for Waterfront Toronto by CH2M dated September 30, 2015;
- Lower Don River – 2015 Due Diligence and Validation Report – Draft, by Golder Associates Ltd, pages 58 to 77;
- Tab D. Geotechnical Conditions by CH2M Hill Canada Limited;
- Tab H. Earthworks Methodology by CH2M Hill Canada Limited;
- Port Lands Environmental, Geotechnical, and Hydrogeological Investigation, Draft Report No 2 for Waterfront Toronto by GHD dated September 15, 2015;

PML Reports

- Foundation Investigation for a Concrete Silo Site, Keating Channel and Cherry Street, Toronto, Ontario, PML Ref.: S-577/T-384, Report: 1, dated July 19, 1956;
- Soil Investigation, Cherry Street Plant, Lake Ontario Portland Cement Company, Toronto, Ontario, PML Ref.: S-652/T-3214, Report: 1, dated August 24, 1961;
- Soil Investigation for Gardiner Expressway, Don Channel to Parliament Street, Lakeshore Boulevard East and Cherry Street South, Toronto, Ontario, PML Ref.: S-520/T-2795, Reports A to C, dated January to February 1961;
- Geotechnical Investigation and Phytotoxicological Testing, Keating Channel Entry Park, Keating Channel and Cherry Street, Toronto, Ontario, PML Ref.: 90TF011, Report 1, dated May 2, 1990.