City of Kingston
Information Report to Council
Report Number 19-220

To:	**Mayor and Members of Council**
From:	**Lanie Hurdle, Interim Chief Administrative Officer**
Resource Staff:	**Same**
Date of Meeting:	**August 13, 2019**
Subject:	**Deep Water Dock and Cruise Ship Potential Alternative Location**

Executive Summary:

As per the previous and current council strategic priorities as well as the recent Integrated Destination Strategy endorsed by Council, City staff have been working on options to enable a deep water dock to support growth in the tourism industry.

In November 2017, Council endorsed a report that provided a high level engineering analysis, produced by Riggs Engineering, of four (4) potential locations for a deep water dock to accommodate large cruise ships. Three (3) of the four (4) locations reviewed (Crawford Wharf, 1 Queen Street and 55 Ontario Street) are located in the downtown area. Based on the analysis, the only downtown location that has sufficient water depth to accommodate larger cruise ships of about 400 passengers is 55 Ontario; however it has limitations to mooring due to the condition of the infrastructure.

Since 2017, City staff provided a couple of information updates with the most recent being in July 2019. In this last update, City staff raised additional concerns related to the 1 Queen Street location including an increased estimated cost of about $4.5M as well as potential disruption to cruise ship service of two (2) to three (3) years should the property owner develop the property due to its limited footprint. In this same report, City staff indicated that review of additional options would be considered and staff would report back to Council at a later time.

City staff were recently approached by the new owner of 55 Ontario Street and 5 Lower Union Street to discuss the possibility of partnering on implementing a public waterfront project as per the Waterfront Master Plan in conjunction with the relocation of the Marine Museum of the Great Lakes. The potential for a deep water dock was identified as an option that could be considered as part of a waterfront redevelopment at this location.

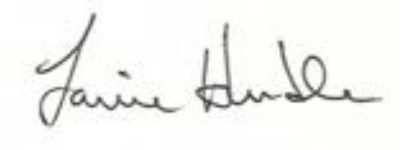
As per Report 19-150, staff indicated that it was important to review and consider all options available for the development of a deep water dock for cruise ships. Although not as centrally located as 1 Queen Street (4 minute walk to City Hall), 55 Ontario Street (7 minute walk to City Hall) does provide other waterfront opportunities for public access, higher potential for partnerships with the Marine Museum of the Great Lakes, as well as greater water depth which could accommodate larger cruise ships with minimal dredging as per the engineering analysis completed by Riggs Engineering and attached to this report as Exhibit B.

Recommendation:

That Council direct staff to advance discussions with the property owner of 55 Ontario and 5 Lower Union Street for the purpose of a potential partnership that could include public access to the waterfront, a deep water dock and programs with the Marine Museum of the Great Lakes; and

That Council direct staff to report back when more information is available on potential partnerships for both options at 1 Queen Street as well as 55 Ontario and 5 Lower Union Street for the potential development of a deep water dock and public waterfront project.

Authorizing Signatures:



Lanie Hurdle, Acting Chief Administrative Officer

Consultation with the following Members of the Corporate Management Team:

Deanne Roberge, Acting Commissioner, Corporate Services	Not required
Peter Huigenbos, Acting Commissioner, Community Services	
Jim Keech, President & CEO, Utilities Kingston	Not required
Desirée Kennedy, Chief Financial Officer & City Treasurer	Not required
Sheila Kidd, Commissioner, Transportation & Public Works	Not required

Options/Discussion:

Council strategic priorities from 2015-2018 included the creation of a deep water docking facility for larger cruise ships as opportunities unfold at key waterfront sites. The current Council strategic priorities (2019-2022) include the facilitation of a deep water dock for cruise ships. Furthermore, the facilitation of a deep water dock to accommodate larger cruise ships was included in the Integrated Destination Strategy developed and endorsed in partnership with Tourism Kingston (TK) and Kingston Accommodation partners (KAP).

Since 2017, staff have been working with TK on short-term cruise ship options to market Crawford Wharf. Efforts over the last couple of years to market Kingston as a cruise ship port have already shown some increase in the number of cruise ships visiting Kingston. The passengers of the medium size cruise ships have to be tendered to shore as the City currently does not have the appropriate deep water dock facility with the necessary water depth. This approach has prevented some cruise ships from docking in Kingston (including in 2019) and a permanent deep water dock is necessary if the City is interested in truly growing this market in Kingston. Otherwise, the cruise ship market growth will be very minimal in future years.

In addition to marketing Crawford Wharf, staff have been reviewing options for a long term solution related to a deep water dock for cruise ships. A report was presented to Council in November 2017 which reviewed four (4) locations (Crawford Wharf, 1 Queen Street, 55 Ontario Street and the Coal Dock) for a future deep water dock (Report Number 17-282). There were three (3) potential downtown locations (Crawford Wharf, 1 Queen Street and 55 Ontario Street). Crawford Wharf is under municipal ownership but it is anticipated that the development of a deep water dock at that location would have higher costs related to both the amount of dredging and structural extension required to accommodate the depth and the length of medium cruise ships. The 55 Ontario Street location was identified as a location that could accommodate larger cruise ships, such as the Hamburg, with some dredging, but the issue was the costs to renovate and stabilize the actual dock structure. The 55 Ontario Street location has an estimated 7 minute walk to City Hall. The property located at 1 Queen Street was identified as a preferred option due to the anticipated lower costs of renovation and its more central location (estimated 4 minute walk to City Hall), even if the location would not be able to accommodate the larger cruise ships such as the Hamburg.

In July 2019, Report 19-150 was presented to Council to advise Council that based on additional assessment of the structure, required dredging as well as improvements to provide a quality customer experience, the deep water dock at 1 Queen Street had an estimated cost of $4.5M assuming that the City could partner with the Ministry of Transportation on their dredging contract for the expansion of the MTO ferry dock expansion. Furthermore, City staff raised a concern of potential service interruption for cruise ships when the property owner decides to proceed with the redevelopment of its property due to the limited footprint available. The redevelopment period could take two (2) to three (3) years. Based on this update, staff indicated that they would be reviewing all options and opportunities to advance this Council strategic priority.

Recently, City staff were approached by the new owner of 55 Ontario and 5 Lower Union Street to discuss the potential of a partnership that could include a public waterfront project, a partnership with the Marine Museum of the Great Lakes (Marine Museum) to be relocated at its former location on 55 Ontario Street as well as a deep water dock. The new owner indicated that it would be ideal to have a waterfront public space in conjunction with the Marine Museum and a deep water dock to support the increased of tourism to the City.

In the past, staff pursued this location for a pathway and public open space along the waterfront as part of the previous owner's development plans for the property. A deep water dock was not pursued with the previous owner.

The dock at 55 Ontario Street is presently not used for any intensive marine function. The condition of the structure is uncertain. The engineering analysis conducted by Riggs Engineering identified that although the water depth was sufficient to attract the medium and larger size cruise ships there were concerns with the condition of the structure. Riggs Engineering did advise that the concrete parapet structures that historically formed the surface perimeter of the wharf are in a state of considerable disrepair and it is expected that relatively significant structural works would be necessary at this site to provide a suitable mooring space and infrastructure improvements to provide for safe passenger loading and unloading. The costs of structural measures to accommodate mooring at 55 Ontario Street have not been estimated at this time and would require site specific investigations to provide conceptual designs for budgetary considerations.

From a Waterfront Master Plan perspective, both properties (55 Ontario Street and 5 Lower Union Street) were identified as projects for future consideration at the time of property redevelopment. Access to public open space and pathway along the waterfront were identified in the concepts included within the Waterfront Master Plan.

Based on the information contained in this report and as per Report 19-150, staff believe that the City should consider options of a potential partnership with the property owner at 55 Ontario and 5 Lower Union and report back to council with more details for both 1 Queen Street and 55 Ontario Street/5 Lower Union Street.

As per the previous staff report, staff will continue to explore the option of a Municipal Accommodation Tax (MAT) contribution in order to reduce the impact on local taxpayers and invest those funds in attracting and welcoming cruise ship tourism. This will be further discussed when a more detailed plan and costing will be available for both options. Decisions on the allocation of MAT funds are made jointly by TK, Kingston Accommodation Partners (KAP) and the City.

Existing Policy/By-Law:

Not applicable

Notice Provisions:

Not applicable

Accessibility Considerations:

Not applicable

Financial Considerations:

Not applicable

Contacts:

Lanie Hurdle, Acting Chief Administrative Officer 613-546-4291 extension 1231

Other City of Kingston Staff Consulted:

Julie Salter-Keane, Community Projects Manager

Exhibits Attached:

Exhibit A 55 Ontario and 5 Lower Union Street Key Map

Exhibit B Riggs Engineering Memorandum

CLOSED SESSION REPORT

NEIGHBOURHOOD CONTEXT (2015)

Applicant: IBI Group Incorporated
Owner: 2502410 Ontario Incorporated
File Number: D35-003-2017
Address: 55 Ontario Street & 5 Lower Union Street

LEGEND

- Subject Property
- Property Boundaries

0 10 20 30 40 Metres

1:2,000

Planning, Building & Licensing Services

a department of Community Services

PREPARED BY: J.Partridge
DATE: 9/1/2017

RIGGS ENGINEERING

To: Ms. Julie Salter-Keane
City of Kingston.

MEMORANDUM

From: Stu Seabrook, P.Eng.

Date: 2017-10-27 (Revision 2)

Re: **City of Kingston - Cruise Ship Mooring Potential**

This memorandum provides a review of 4 locations along the Kingston waterfront with regard to potential for mooring of various cruise ships which sail through the Kingston region. The review is based on the following tasks and analyses:

- bathymetric survey of the sites by Riggs Engineering
- review of historic water levels at Kingston for cruise ship season
- review of vessel characteristics and minimum draft requirements
- assessment of percentage of time that mooring depth requirements can be met without dredging
- review of site characteristics and opportunities to improve mooring potential

Bathymetric Survey

Bathymetry of 4 potential mooring sites was surveyed by Riggs Engineering on September 5, 2017. The sites surveyed were:

a) Queen Street Wharf
b) Crawford Wharf
c) 55 Ontario Street Wharf
d) Coal Dock

Surveyed depths were reduced to Chart Datum (IGLD 1985) for Lake Ontario and are presented in Appendix A to this memorandum. As these depths represent the depth below a constant still water level of 74.2 m IGLD 1985 they do not adequately represent the expected available depth at the docks under typical summer water levels during the cruise sailing season. The south side of the Queen Street Wharf was surveyed subsequent to the majority of the sites using different equipment and involved fewer soundings and is therefore expected to produce slightly more variability in results; the difference is not expected to impact the findings presented herein.

In order to better represent the available depths for cruise ship mooring under variable water level conditions, an analysis of historic water levels was completed as discussed in the following section.

Review of Historic Water Levels

Water levels at Kingston are variable from season to season and from day to day. The seasonal and long term variations are due to the hydrologic inputs to the lake from the broader Great Lakes system and the regional contributing catchments. Water levels in Lake Ontario are controlled at the hydro dam near Cornwall, Ontario. Shorter term water

level variations are due to oscillations within Lake Ontario and more locally, within the regional Kingston basin. These oscillations are largely due to wind effects which can vary considerably on a short-term basis.

As a result of this water level variability, the available depth (vessel draft) at any given location is constantly changing, and a site may be viable some of the time, but not others. Long-term Lake Ontario Water Levels are presented in Appendix B to this memorandum. The first figure in Appendix B shows long-term historic trends in average Lake Ontario levels. As mentioned however, there are regional and short-term variations which are not reflected in these average trends.

The Canadian Hydrographic Service of the Department of Fisheries and Oceans measures water levels at Kingston on an ongoing basis. Water levels from recent years are available at 6 minute intervals; older local historic water level information is generally available on an hourly basis. Hourly water level data between 1962 and 2017 have been collected and assessed for the windowed periods of interest (cruise ship sailing season).

City of Kingston staff have advised that the sailing season is typically June 1 to September 20 for most vessels of interest. One vessel (Hamburg) sails only between August 1 and September 20. Therefore, historic water level data for these periods have been assessed to determine the percentage of time within the record, the water level has been above (or below) any given value.

Plots representing this assessment are presented in Appendix B to this memorandum. The viability of mooring at any given site depends on the depth (dictated by the water level and local bed elevations discussed in the previous two sections) and the depth requirements of the vessel. These depth requirements are discussed in the following section.

Review of Vessel Characteristics

A total of 5 vessels have been considered for potential mooring at Kingston. A summary of the vessel characteristics is presented in the table below.

Cruise Ships Considered : Vessel Characteristics

Vessel Name	Length (m)	Breadth (m)	Draft (m) (nominal)[1]
M/V Victory 1	91.44	15.24	4.12
Pearl Mist	99.05	16.8	3.5
Hamburg	145.00	21.5	5.75
Grand Caribe	54.10	11.91	2.10
Grand Mariner	56.64	11.91	2.00

1. Vessel draft is reported here as the actual depth to keel as per information provided. Additional clearance requirements not included here.

The draft of a vessel is a variable that is affected by the nature of the vessel loading, the vessel ballast and dynamics when under power. Vessel draft relevant to the mooring requirements for the vessels discussed herein were reviewed with Richard Winnel of the Canadian Marine Pilots Association. Mr. Winnel confirmed the nominal draft

requirements for the vessels and advised that insurance requirements generally include a 10% allowance above the nominal draft for under-keel clearance.

For the purpose of this investigation. a minimum under-keel allowance of 0.5 m or 10% of the nominal draft (whichever is larger) has been assumed. For example, adequate draft for mooring of the MV Victory 1 would be 4.52 m (0.5 m clearance above nominal draft), while adequate draft for mooring the Hamburg would be 6.32 m (0.57 m clearance above nominal draft).

The vessel length and beam are also relevant considerations with regard to space constraints at the wharf. For the purpose of this analysis, it is assumed that no more than 10% of the vessel length may overhang at either end of a mooring wall without consideration of additional mooring structures (such as dolphins). This assumption would be subject to vessel specific considerations but is consistent with comments from Mr. Winnel and considered appropriate for this level of review.

The assumed vessel alignment while moored is presented in the Figures in Appendix C to this memorandum. Where physical dock wall length is insufficient to limit overhang to 10% of the vessel length, the vessel is placed as far forward along the wharf wall as considered practical. In some cases, the limiting of overhang length would require dredging of the mooring area. Such considerations are discussed in the following sections.

Review of Mooring Potential

The potential for mooring each of the vessels noted above at each of the 4 sites surveyed has been considered on the basis of the percentage of time during the sailing season that the water depth is sufficient to provide the nominal draft + specified allowance. The results are presented graphically in Appendix C to this memorandum, and are discussed briefly below.

a) Queen Street Wharf:

The Queen Street Wharf is situated immediately south of the present Wolf Islander Ferry dock. The pier is not utilized and is overgrown; a parking lot is situated at the inshore end of the pier. While there are no obvious signs of significant deterioration of the steel sheet pile, the condition of the structure has not been investigated in detail. Local depths generally vary between approximately 3.0 m and 4.5 m below datum. The suitability of the south face of the Queen Street Wharf for each of the vessels considered is summarised below:

- The M/V Victory I typically would not have sufficient draft clearance throughout the majority of the berthing area and therefore, dredging would be required if this location is considered further for this vessel. The wharf does appear to provide sufficient length for mooring with minimal vessel overhang.
- The Pearl Mist would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season over much of the mooring area but it is still expected that some localized dredging would be required along the wharf wall and potentially near the inshore (west)end of the mooring area. The wharf does appear to provide sufficient length for mooring with minimal vessel overhang.

- The practicality of mooring the Hamburg at the Queen Street Wharf is limited. There would not be sufficient draft clearance in this location without considerable dredging efforts in the mooring area and the approach. Furthermore, the wharf does not provide sufficient length for this vessel and it is expected that supplementary structural considerations such as dolphins would be required to provide mooring support beyond the east of the end of the wharf.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 m clearance more than 95% of the time within the mooring area during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang.

Dredging costs will depend on the sediment characteristics and quality. Dredge design would need to consider the structural characteristics of the wharf wall and would be constrained by the natural shoreline near the southwest limits of the mooring area.

It is not possible to estimate the dredging requirements necessary to accommodate the Hamburg at this location based on the information available and due to uncertainty in approach conditions. It is anticipated that costs for dredging and structural modifications as well as permitting implications could make this site an impractical location for the Hamburg.

Dredging requirements to accommodate the M/V Victory 1 along the south wall of the Queen Street Wharf are roughly estimated at 1500 m^3; assuming an allowance of \$50/m^3 for dredging and \$50/m^3 for disposal, the approximate cost of dredging would be expected to be on the order of \$150,000. It is possible that dredging costs could be offset to some extent if the vessel mooring location is shifted to the east; this would require additional structural measures such as mooring dolphin(s) constructed off the east end of the pier. Dredging to accommodate the M/V Victory 1 would accommodate the Pearl Mist as well.

Additional costs for structural review, dredge design and any structural modifications which may be necessary to accommodate mooring of the cruise ships considered herein have not been estimated at this time. Navigation charts indicate depth limitations over a portion of the approach to this location for the M/V Victory 1 and the Pearl Mist which would also require dredging. The costs of such efforts have not been addressed at this time and require detailed survey of this region of the approach route.

b) Crawford Wharf

The Crawford Wharf is presently the loading/unloading dock for a number of small local cruise boats. While the capability of the site for smaller vessel mooring is generally accepted and approach routes are understood, the site is more challenging for larger vessels with increased draft requirements. The local depths are somewhat variable with depths of 4 m +/- below datum along approximately half of the length of the north face, but with diminishing depths moving west along the wharf wall. There is also a marginal reduction in depth immediately east of the end of the wharf which may be a pose some restrictions on vessel approach. The suitability of the Crawford Wharf for each of the vessels considered is summarised below:

- The M/V Victory I typically would not have sufficient draft clearance throughout the majority of the berthing area and therefore, dredging would be required if this

location is considered further for this vessel. The north face of the wharf would require a dredging to be focused at the western end of the berth with some dredging along the wharf wall. The south face would require dredging throughout, with most efforts to be focused along the south edge of the mooring area and in the approach channel. It is expected that the vessel overhang at this location would be unacceptable for the M/V Victory 1 on the north side of the wharf due to space constraints (local shoreline structure) for the vessel bow. Mooring on the south side of the wharf with this size of vessel may result in conflicts with recreational vessels using the northern entrance to Confederation Basin. Therefore, it is expected that mooring dolphin(s) would be required to make this a viable location.

- The Pearl Mist would have nominal draft + 0.5 m clearance more than 95% of the time over much of the required mooring length along the south wall but some dredging would be required at the west end of the berth and in isolated areas along the berth length. Similar concerns expressed for the M/V Victory 1 would apply to the Pearl Mist, including proximity of structures near the bow on the north side of the wharf and potential conflicts with local recreational boating activity on the south side of the wharf. Therefore, it is expected that mooring dolphin(s) would be required to make this a viable location. As with the Queen Street wharf, reduced dredging requirements could be achieved through shifting the mooring location to the east through the use of dolphins.
- The practicality of mooring the Hamburg at the Crawford wharf is limited. Extensive dredging would be required throughout the mooring area and in the approach in order to provide draft clearance. Furthermore, supplementary structures (e.g. dolphins) would be necessary to provide suitable berth length.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang.

Dredging costs will depend on the sediment characteristics and quality. Dredge design would need to consider the structural characteristics of the wharf wall and local adjacent structures.

It is not possible to estimate the dredging requirements necessary to accommodate the Hamburg at this location based on the information available and due to uncertainty in approach conditions. It is anticipated that costs for dredging and structural modifications as well as permitting implications could make this site an impractical location for the Hamburg.

Dredging requirements to accommodate the M/V Victory 1 along the north wall of the Crawford Wharf are roughly estimated at 2000 m^3; assuming an allowance of \$50/m^3 for dredging and \$50/m^3 for disposal, the approximate cost of dredging would be expected to be on the order of \$200,000. Dredging to accommodate the M/V Victory 1 would accommodate the Pearl Mist as well.

Additional costs for structural review, dredge design and any structural modifications which may be necessary to accommodate mooring of the cruise ships considered herein have not been estimated at this time. Navigation charts indicate depth limitations over a portion of the approach to this location for the M/V Victory 1 and the Pearl Mist which

would also require dredging. The costs of such efforts have not been addressed at this time and require detailed survey of this region of the approach route.

c) 55 Ontario Street Wharf:

The Wharf at 55 Ontario Street is presently not used for any intensive marine function. The condition of the underwater portions of the structure in general is uncertain, but casual observation does indicate that the concrete parapet structures that historically formed the surface perimeter of the wharf are in a state of considerable disrepair and it is expected that relatively significant structural works would be necessary at this site to provide a suitable mooring space. The local depths are somewhat variable in the area with depths of 6 m +/- to 7 m +/- below datum along the east end of the wharf, decreasing to 5 m +/- below datum and less along the north and south sides of the wharf. The suitability of the Wharf at 55 Ontario Street for mooring each of the vessels considered is summarised below:

- The M/V Victory I would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. This depth would be available along the east end of the Wharf, but it is expected that mooring would require consideration of supplementary structures such as dolphins or reconstruction of the wharf walls to ensure a suitable berth space as well as infrastructure improvements to provide for safe passenger loading and unloading. Suitable depths are also available along the south face of the 55 Ontario Street Wharf wall but this wharf wall and upland area is also in a state of considerable disrepair.
- The Pearl Mist would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. This depth would be available along the east end of the 55 Ontario Street location, but it is expected that mooring would require consideration of supplementary structures such as dolphins or reconstruction of the wharf walls to ensure a suitable berth space as well as infrastructure improvements to provide for safe passenger loading and unloading.. Suitable depths are also available along the south face of the 55 Ontario Street Wharf wall but as previously noted, the wharf wall upland area is in a state of considerable disrepair.
- While the Hamburg would have nominal draft + 0.57 m clearance more than 95% of the time during the sailing season over most of the potential mooring space along the east end of the 55 Ontario Street Wharf, the geometry of this vessel is somewhat challenging due to the proximity of the pier at the end of Gore Street. It is expected that supplementary mooring structures and reconstruction of the wharf walls would be required to ensure a suitable berth space as well as infrastructure improvements to provide for safe passenger loading and unloading.. The vessel is expected to be too long to practically moor along the south side of the 55 Ontario Street Wharf.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 m clearance more r than 95% of the time during the sailing season based on the historic water level record. It is anticipated that supplementary mooring structures or wharf wall reconstruction would be required to permit mooring on the east end or south side of the 55 Ontario Street Wharf. Additional infrastructure improvements would be required to permit safe passenger loading and unloading.

The cost of structural measures to accommodate mooring at this site have not been estimated at this time and would require site specific investigations to provide conceptual designs for budgetary considerations. Of the sites considered, it is expected that this site would require the most intensive shoreline improvements to provide for a suitable mooring location. A small lake bed area just off the northeast corner of the wharf requires further investigation to define the nature of a local high point in the bed and potential local dredge requirement.

d) Coal Dock:

The Coal Dock at the former Psychiatric Hospital is presently not used for any intensive marine function. The structure is subject to some deterioration and is presently fenced off to the public. The local depths are generally uniform in the area and on the order of 6 m +/- below datum near the wharf wall, increasing offshore. The suitability of the Coal Dock for mooring each of the vessels considered is summarised below:

- The M/V Victory I would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. It is expected that there would be minimal vessel overhang at this location, but it is anticipated that some structural improvements would be required to provide a competent mooring structure.
- The Pearl Mist would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. There would be approximately 20 m of vessel overhang at this location for the Pearl Mist and it is anticipated that some structural improvements would be required to provide a competent mooring structure..
- The Hamburg would have nominal draft + 0.57 m clearance over much of the wharf length more than 95% of the time during the sailing season based on the historic water level record. There are, however some depth limiting areas along the edge of the wharf where dredging is expected to be necessary if this site was to be considered. The Hamburg would overhang the end of the wharf by about 30 m +/- at both ends and therefore, it is expected that additional structural measures would be required to accommodate the vessel length and it is anticipated that some structural improvements would be required to the existing dock wall to provide a competent mooring face.
- The Grand Caribe and Grand Mariner would have nominal draft + 0.5 m clearance more than 95% of the time during the sailing season based on the historic water level record. The wharf provides sufficient length for mooring without overhang but it is anticipated that some structural improvements would be required to provide a competent mooring structure..

The cost of structural measures to accommodate mooring at this site have not been estimated at this time and would require site specific investigations to provide conceptual designs for budgetary considerations. The nature of bed materials along the dock wall requires further investigation to assess dredging requirements or potential to address the through structural modifications.

Closing Comments

Based on the level of review completed in support of this memorandum, the Queen Street Wharf would appear to be the most suitable location for a potential Cruise Ship mooring site for all vessels considered except the Hamburg. While some moderate dredging is expected to be required, the visible portions of the structure appear to be in relatively good condition, the geometry of the wharf is expected to be adequate and there is presently no intensive marine function at this location. A structural review of the wharf is recommended to identify any potential deficiencies and to provide guidance with regard to dredging constraints. Potential to reduce dredging requirements through provision of mooring dolphins (or other means to extend the mooring area to the east) could be considered at this site. Based on the information presented herein, it is expected that this site is not a practical option for mooring the Hamburg due to geometric and depth considerations. Navigation charts indicate depth limitations in the approach to this location for the M/V Victory 1 and the Pearl Mist which would also require dredging; quantification of these dredging needs requires detailed local investigations of the approach.

The Crawford Wharf presently serves as mooring facility for smaller cruise boats and as such has some level of proven capacity. However, there are depth limitations along the western end of the wharf on the north side and some additional depth constraints along the south side of the wharf which constrain the berth width and approach. With a combination of dredging and structural works to extend the mooring area to the east, it is anticipated that the Crawford Wharf could be a viable mooring location for all vessels considered with the exception of the Hamburg. The proximity of the site to Confederation basin could result in some conflict with recreational vessels. Based on the information presented herein, it is expected that this site is not a practical option for mooring the Hamburg due to geometric and depth considerations. Navigation charts indicate depth limitations in the approach to this location for the M/V Victory 1 and the Pearl Mist which would also require dredging; quantification of these dredging needs requires detailed local investigations of the approach.

The Wharf at 55 Ontario Street has limited accessible contiguous wharf wall length and therefore, it is anticipated that supplementary mooring structures would be required to accommodate a berth in this location. Furthermore, much of the wharf wall in this location is in a state of considerable disrepair and would require structural rehabilitation of the wall and the upland area to provide a competent mooring area and safe passenger handling. As the local depths appear to be suitable for all vessels considered (with minor accommodations required for the Hamburg) this location could be a viable site for all vessels with investment to rehabilitate the shoreline infrastructure. This site is more exposed than the Queen Street and Crawford Wharf locations which could present more challenging docking conditions.

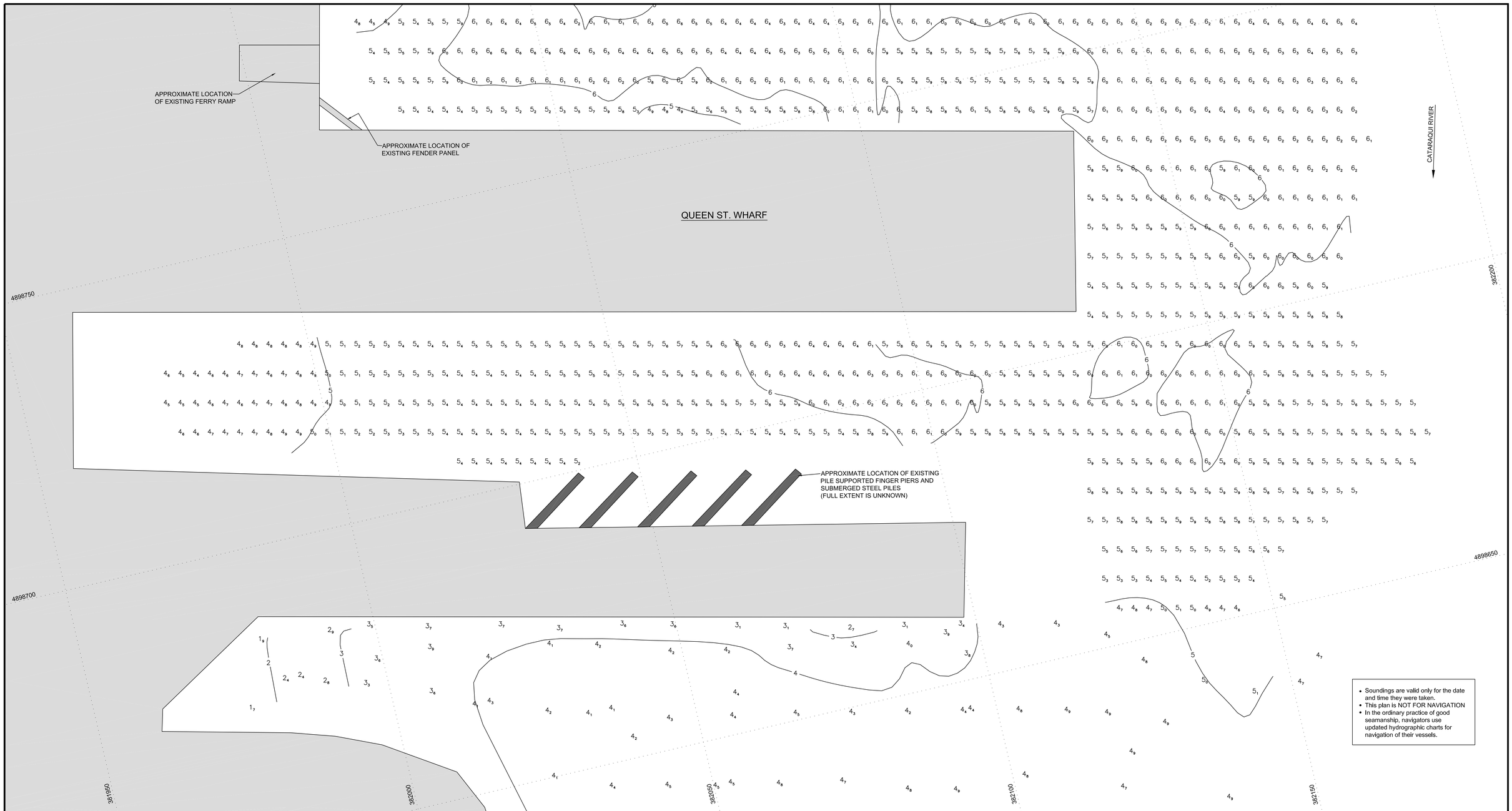
The Coal Dock provides sufficient depths for all vessels considered with the exception of the Hamburg for which some localized dredging would be required. The is some deterioration of the existing dock wall which would require investigation and rehabilitation as may be required to provide a competent mooring structure and safe passenger handling. This site is more exposed than the Queen Street and Crawford Wharf locations which could present more challenging docking conditions.

The review provided herein is preliminary in nature. It does not include consideration of the following:

- Structural integrity of the various wharf and dock walls - an assessment of structures would be required to determine what works may be required to adequately accommodate mooring of the vessels considered herein.
- Navigation approach lines - Approaches to each of these sites have not been investigated in detail at this time. It will be important to delineate safe approach lines to any viable mooring site and identify dredging requirements and any other navigation issues to be addressed in this regard.
- Detailed review of hydrodyanamics - a detailed review of hydrodynamic conditions affecting vessel motion and associated depth and dredge requirements is recommended to finalize site design parameters. It is noted that the Queen Street and Crawford Dock sites do provide more sheltered locations for mooring.
- Sea Pilot Consultation - It is also recommended that further consultation with the Canadian Marine Pilots Association and their U.S. counterparts is undertaken during any detailed review of a particular site to ensure that all relevant operational issues are resolved..

Per: Stu Seabrook, P.Eng.

APPENDIX A
BATHYMETRIC SURVEYS



- Soundings are valid only for the date and time they were taken.
- This plan is NOT FOR NAVIGATION
- In the ordinary practice of good seamanship, navigators use updated hydrographic charts for navigation of their vessels.

Firm:

RIGGS ENGINEERING

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N6K 1C7
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1 Detail No.
2 drawing no. – where detail required refers to MA–
3 drawing no. – where detailed refers to MA–

No.	Revision	Date
1	REVISED SURVEY LIMITS	OCT/24/2017

LEGEND:

3 — MAJOR SUBMERGED DEPTH CONTOUR BELOW CHART DATUM

3_7 — SOUNDING DEPTH 3.7 METERS BELOW CHART DATUM

0 7.5 15 22.5 30m

SCALE: 1:300

NOTES:
1. SOUNDINGS WERE TAKEN ON SEPTEMBER 5, 2017 AND OCTOBER 16, 2017.
2. SOUNDINGS ARE SHOWN IN METERS BELOW CHART DATUM.
3. CHART DATUM FOR LAKE ONTARIO IS 74.2 METERS ABOVE SEA LEVEL (I.G.L.D. 1985).
4. WATER LEVEL AT THE TIME OF THE SURVEY ON SEPTEMBER 5 WAS 0.97 METERS ABOVE CHART DATUM, AND THE WATER LEVEL AT THE TIME OF SURVEY ON OCTOBER 16 WAS 0.64 METERS ABOVE CHART DATUM.
5. VERTICAL CONTROL ESTABLISHED FROM CHS GAUGE KINGSTON.
6. COORDINATE GRID REFERS TO UTM NAD83 ZONE 18.
7. POSITIONING SYSTEM - HEMISPHERE R320
8. SOUNDER - RESON NAVISOUND 110

* THE SOUNDING INFORMATION REPRESENTS RESULTS OF THE SURVEY MADE ON THE DATES SPECIFIED AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THAT TIME.

Stamp:

DRAWING IS IN METRIC UNITS
DO NOT SCALE DRAWINGS

Client:

CITY OF KINGSTON
216 ONTARIO ST.
KINGSTON, Ontario
K7L 2Z3

Project Name:

2017 SOUNDINGS FOR CRUISE SHIP BERTHING

Drawing Title:

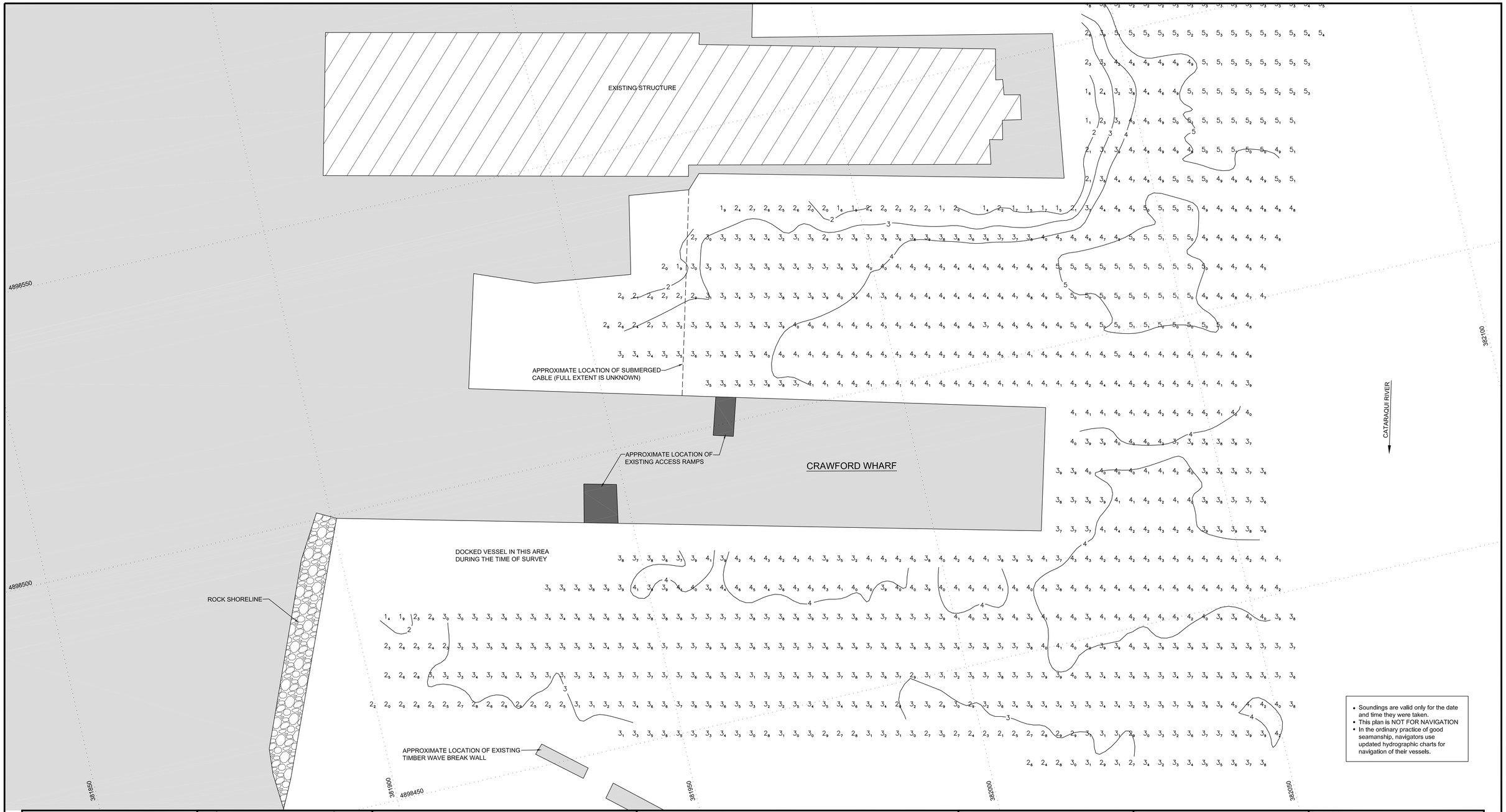
QUEEN ST. WHARF SOUNDING SURVEY 2017

Date:	Drawn by:	Checked by:
SEPT. 7, 2017	AM	BR

Scale: AS NOTED:

Project No. 17-1326

Drawing No. MA-01



- Soundings are valid only for the date and time they were taken.
- This plan is NOT FOR NAVIGATION
- In the ordinary practice of good seamanship, navigators use updated hydrographic charts for navigation of their vessels.

Firm:
RIGGS ENGINEERING
Riggs Engineering Ltd.
1240 Commissioners Rd. W, Suite 205
London, Ontario,
N6K 1C7
Tel: (519) 657-1040
Fax: (519) 657 8631
Website: www.riggsengineering.com

1 Detail No.
2 drawing no. – where detail required refers to MA–
3 drawing no. – where detailed refers to MA–

No.	Revision	Date

LEGEND:

3 — MAJOR SUBMERGED DEPTH CONTOUR BELOW CHART DATUM

3_7 — SOUNDING DEPTH 3.7 METERS BELOW CHART DATUM

0 7.5 15 22.5 30m

SCALE: 1:300

NOTES:

1. SOUNDINGS WERE TAKEN ON SEPTEMBER 5, 2017.
2. SOUNDINGS ARE SHOWN IN METERS BELOW CHART DATUM.
3. CHART DATUM FOR LAKE ONTARIO IS 74.2 METERS ABOVE SEA LEVEL (I.G.L.D. 1985).
4. WATER LEVEL AT THE TIME OF THE SURVEY WAS 0.96 METERS ABOVE CHART DATUM.
5. VERTICAL CONTROL ESTABLISHED FROM CHS GAUGE KINGSTON.
6. COORDINATE GRID REFERS TO UTM NAD83 ZONE 18.
7. POSITIONING SYSTEM - HEMISPHERE R320
8. SOUNDER - RESON NAVISOUND 110

* THE SOUNDING INFORMATION REPRESENTS RESULTS OF THE SURVEY MADE ON THE DATES SPECIFIED AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THAT TIME.

Stamp:

DRAWING IS IN METRIC UNITS
DO NOT SCALE DRAWINGS

Client:
CITY OF KINGSTON
216 ONTARIO ST.
KINGSTON, Ontario
K7L 2Z3

Project Name:
2017 SOUNDINGS FOR CRUISE SHIP BERTHING

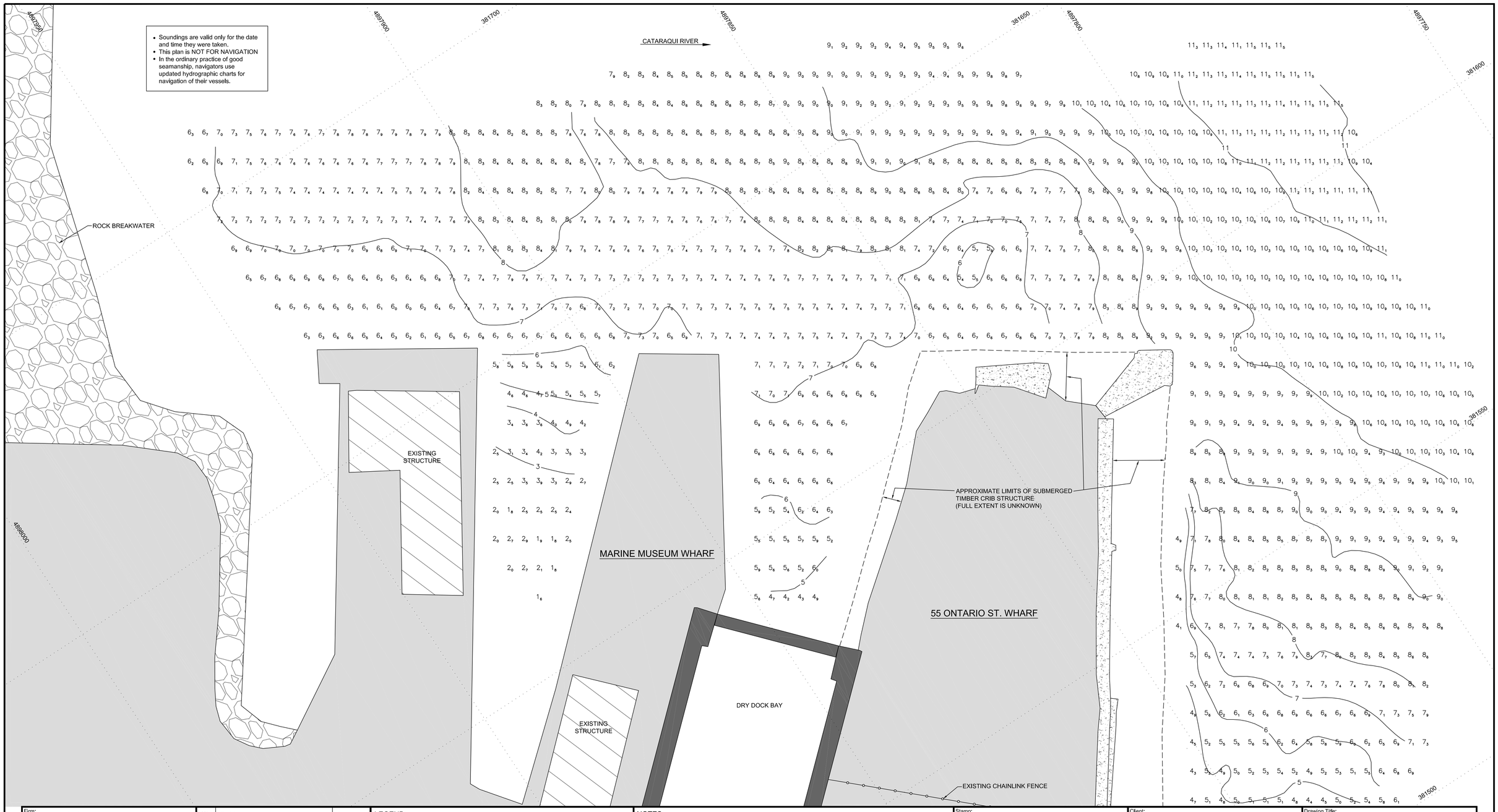
Drawing Title:
CRAWFORD WHARF SOUNDING SURVEY 2017

Date:	Drawn by:	Checked by:
SEPT. 7, 2017	AM	BR

Scale: AS NOTED:

Project No. 17-1326

Drawing No. MA-02



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- This plan is NOT FOR NAVIGATION
- In the ordinary practice of good seamanship, navigators use updated hydrographic charts for navigation of their vessels.

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Website: www.riggsengineering.com

1 Detail No.
2 drawing no. – where detail required refers to MA–
3 drawing no. – where detailed refers to MA–

No.	Revision	Date

LEGEND:

3 — MAJOR SUBMERGED DEPTH CONTOUR BELOW CHART DATUM

3.7 — SOUNDING DEPTH 3.7 METERS BELOW CHART DATUM

0 7.5 15 22.5 30m

SCALE: 1:300

NOTES:
1. SOUNDINGS WERE TAKEN ON SEPTEMBER 5, 2017.
2. SOUNDINGS ARE SHOWN IN METERS BELOW CHART DATUM.
3. CHART DATUM FOR LAKE ONTARIO IS 74.2 METERS ABOVE SEA LEVEL (I.G.L.D. 1985).
4. WATER LEVEL AT THE TIME OF THE SURVEY WAS 0.95 METERS ABOVE CHART DATUM.
5. VERTICAL CONTROL ESTABLISHED FROM CHS GAUGE KINGSTON.
6. COORDINATE GRID REFERS TO UTM NAD83 ZONE 18.
7. POSITIONING SYSTEM - HEMISPHERE R320
8. SOUNDER - RESON NAVISOUND 110

* THE SOUNDING INFORMATION REPRESENTS RESULTS OF THE SURVEY MADE ON THE DATES SPECIFIED AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THAT TIME.

Stamp:

DRAWING IS IN METRIC UNITS
DO NOT SCALE DRAWINGS

Client:
CITY OF KINGSTON
216 ONTARIO ST.
KINGSTON, Ontario
K7L 2Z3

Project Name:
2017 SOUNDINGS FOR CRUISE SHIP BERTHING

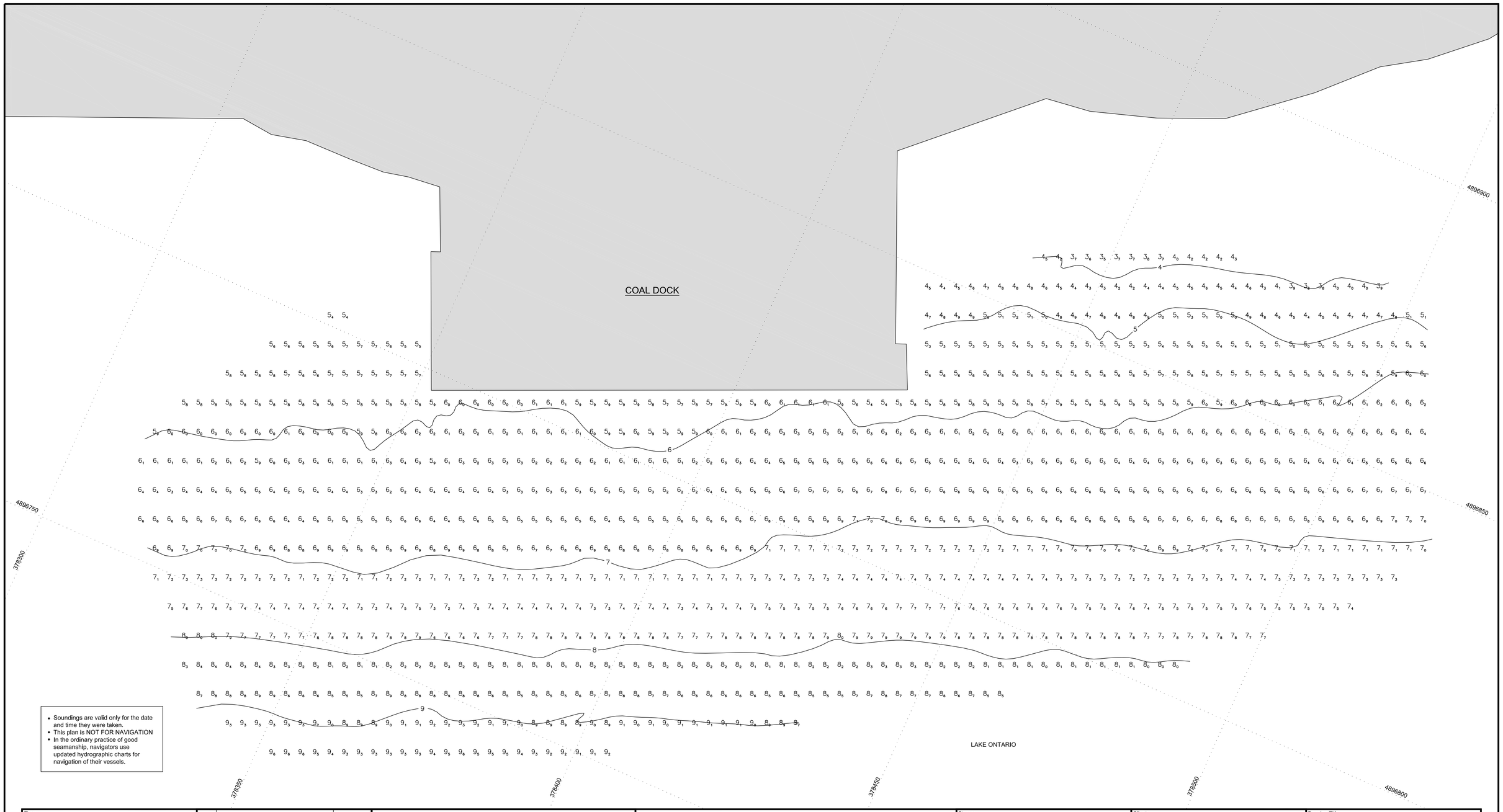
Drawing Title:
MUSEUM DOCK SOUNDING SURVEY 2017

Date:	Drawn by:	Checked by:
SEPT. 7, 2017	AM	BR

Scale: AS NOTED:

Drawing No. MA-03

Project No. 17-1326



- Soundings are valid only for the date and time they were taken.
- This plan is NOT FOR NAVIGATION
- In the ordinary practice of good seamanship, navigators use updated hydrographic charts for navigation of their vessels.

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1 Detail No.
2 drawing no. – where detail required refers to MA–
3 drawing no. – where detailed refers to MA–

No.	Revision	Date

LEGEND:

3 MAJOR SUBMERGED DEPTH CONTOUR BELOW CHART DATUM

3.7 SOUNDING DEPTH 3.7 METERS BELOW CHART DATUM

0 7.5 15 22.5 30m

SCALE: 1:300

NOTES:
1. SOUNDINGS WERE TAKEN ON SEPTEMBER 5, 2017.
2. SOUNDINGS ARE SHOWN IN METERS BELOW CHART DATUM.
3. CHART DATUM FOR LAKE ONTARIO IS 74.2 METERS ABOVE SEA LEVEL (I.G.L.D. 1985).
4. WATER LEVEL AT THE TIME OF THE SURVEY WAS 0.96 METERS ABOVE CHART DATUM.
5. VERTICAL CONTROL ESTABLISHED FROM CHS GAUGE KINGSTON.
6. COORDINATE GRID REFERS TO UTM NAD83 ZONE 18.
7. POSITIONING SYSTEM - HEMISPHERE R320
8. SOUNDER - RESON NAVISOUND 110

* THE SOUNDING INFORMATION REPRESENTS RESULTS OF THE SURVEY MADE ON THE DATES SPECIFIED AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THAT TIME.

Stamp:

DRAWING IS IN METRIC UNITS
DO NOT SCALE DRAWINGS

Client:

CITY OF KINGSTON
216 ONTARIO ST.
KINGSTON, Ontario
K7L 2Z3

Project Name:

2017 SOUNDINGS FOR CRUISE SHIP BERTHING

Drawing Title:

COAL DOCK
SOUNDING SURVEY
2017

Date:	Drawn by:	Checked by:
SEPT. 7, 2017	AM	BR

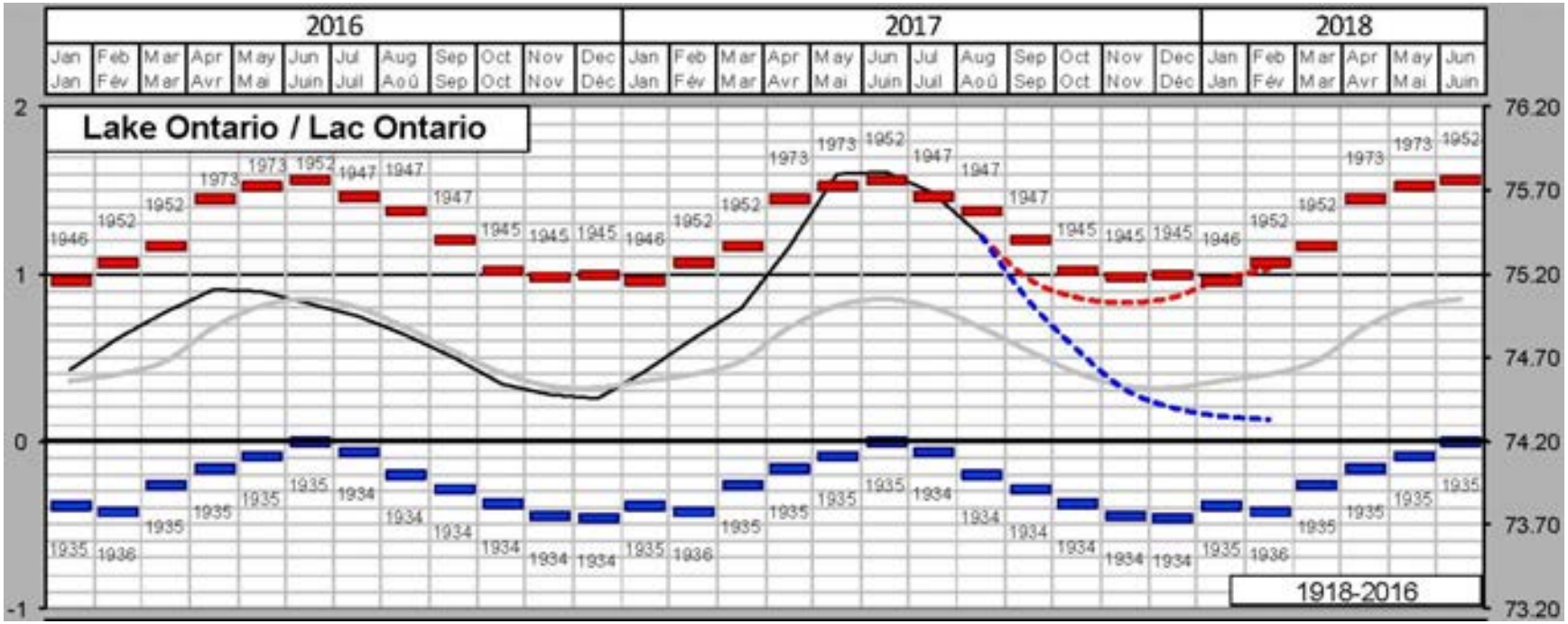
Scale: AS NOTED:

Project No. 17-1326

Drawing No. MA-04

APPENDIX B
WATER LEVEL INFORMATION

Lake Ontario - Long Term Water Level Trends
Average Lake Levels



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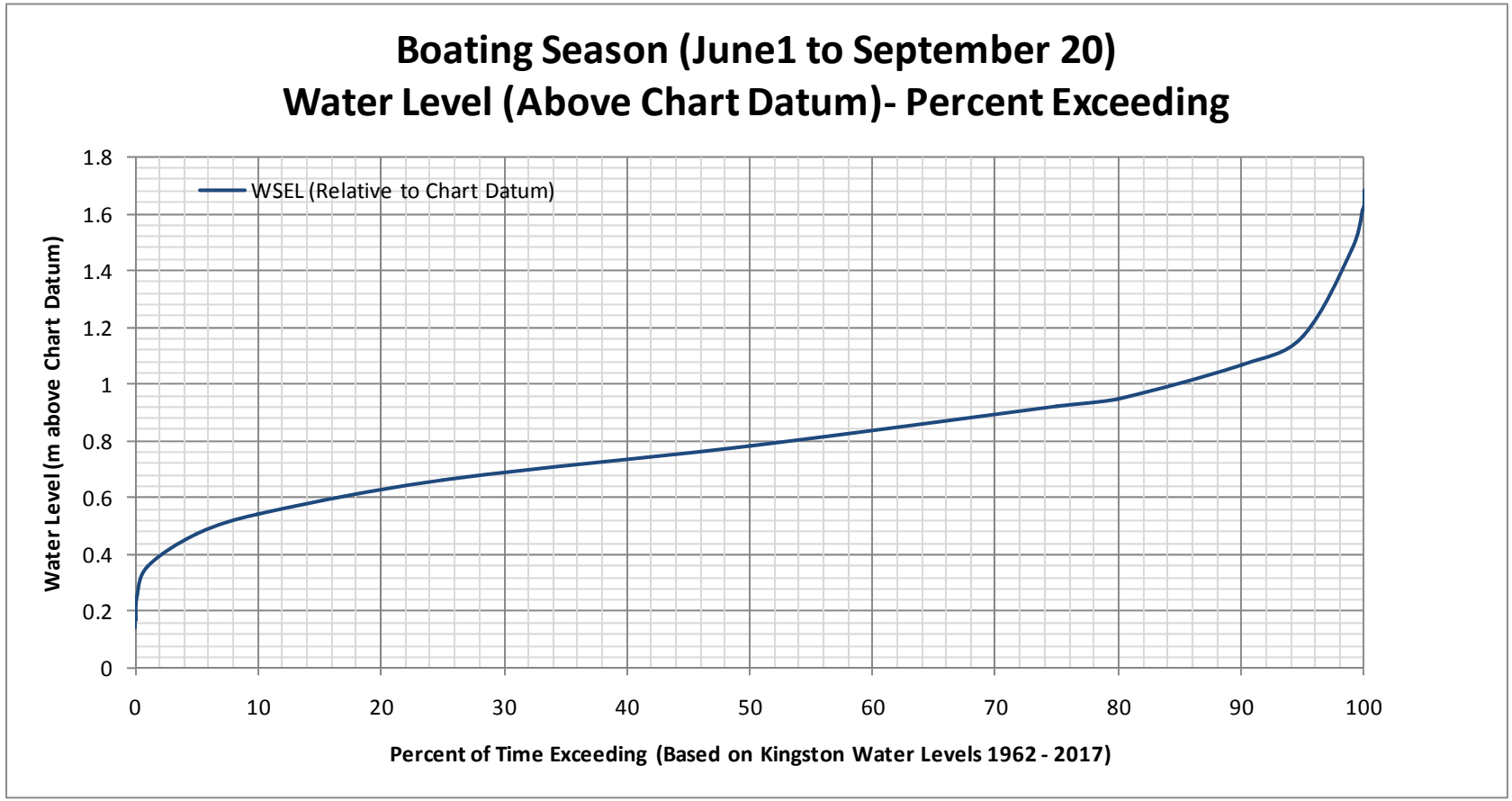

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tel: (519) 657-1040 fax: (519) 657-8631 www.riggsengineering.com

APPENDIX C
MOORING POTENTIAL FIGURES

Exhibit A

QUEEN ST. WHARF

CATARAQUI RIVER

APPROXIMATE LOCATION OF EXISTING PILE SUPPORTED FINGER PIERS AND SUBMERGED STEEL PILES (FULL EXTENT IS UNKNOWN)

PEARL MIST

LENGTH = 99.05m
BEAM = 16.8m
DRAFT = 3.5m

LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

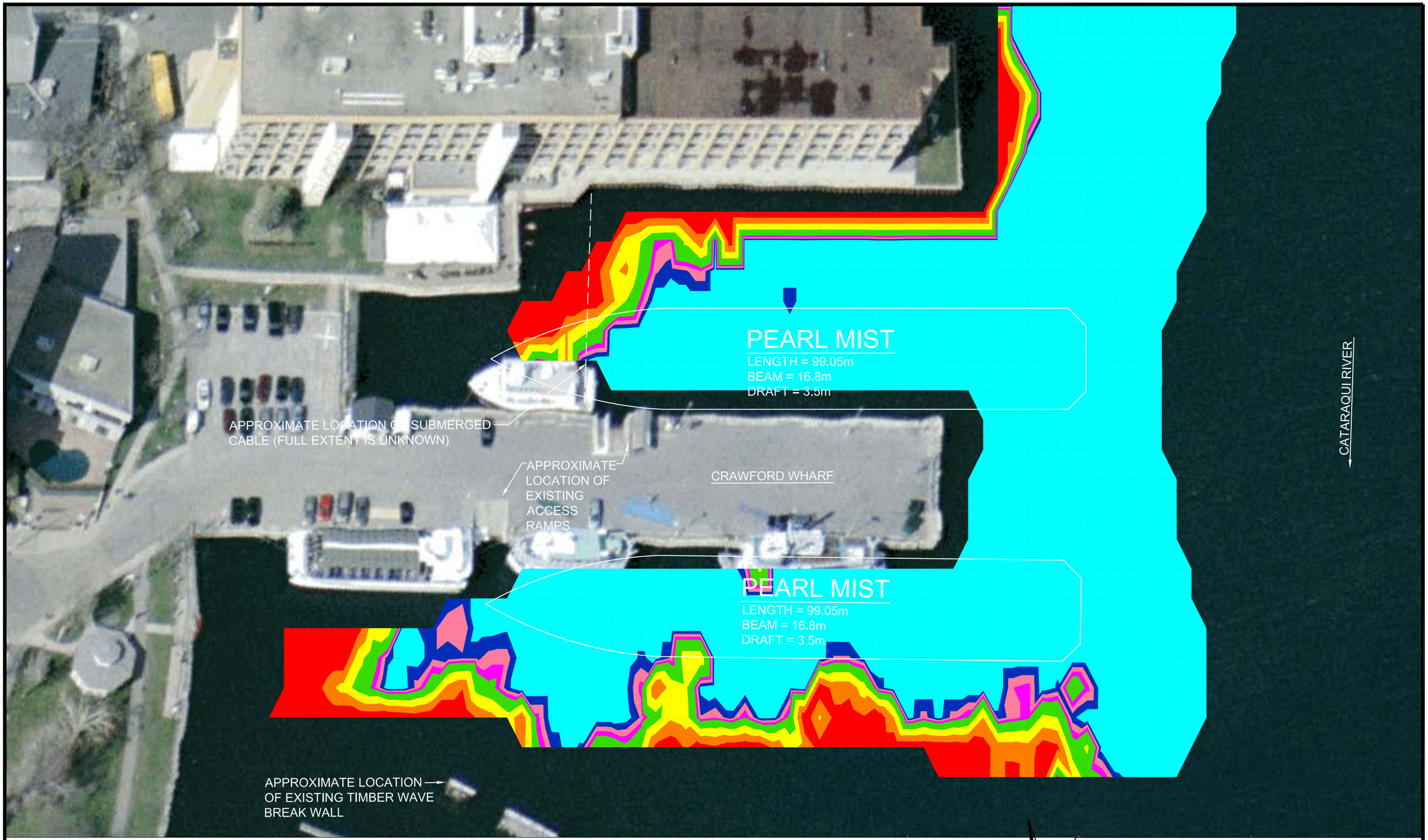
FIGURE 1.1
QUEEN ST. WHARF BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



LEGEND:

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- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

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- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

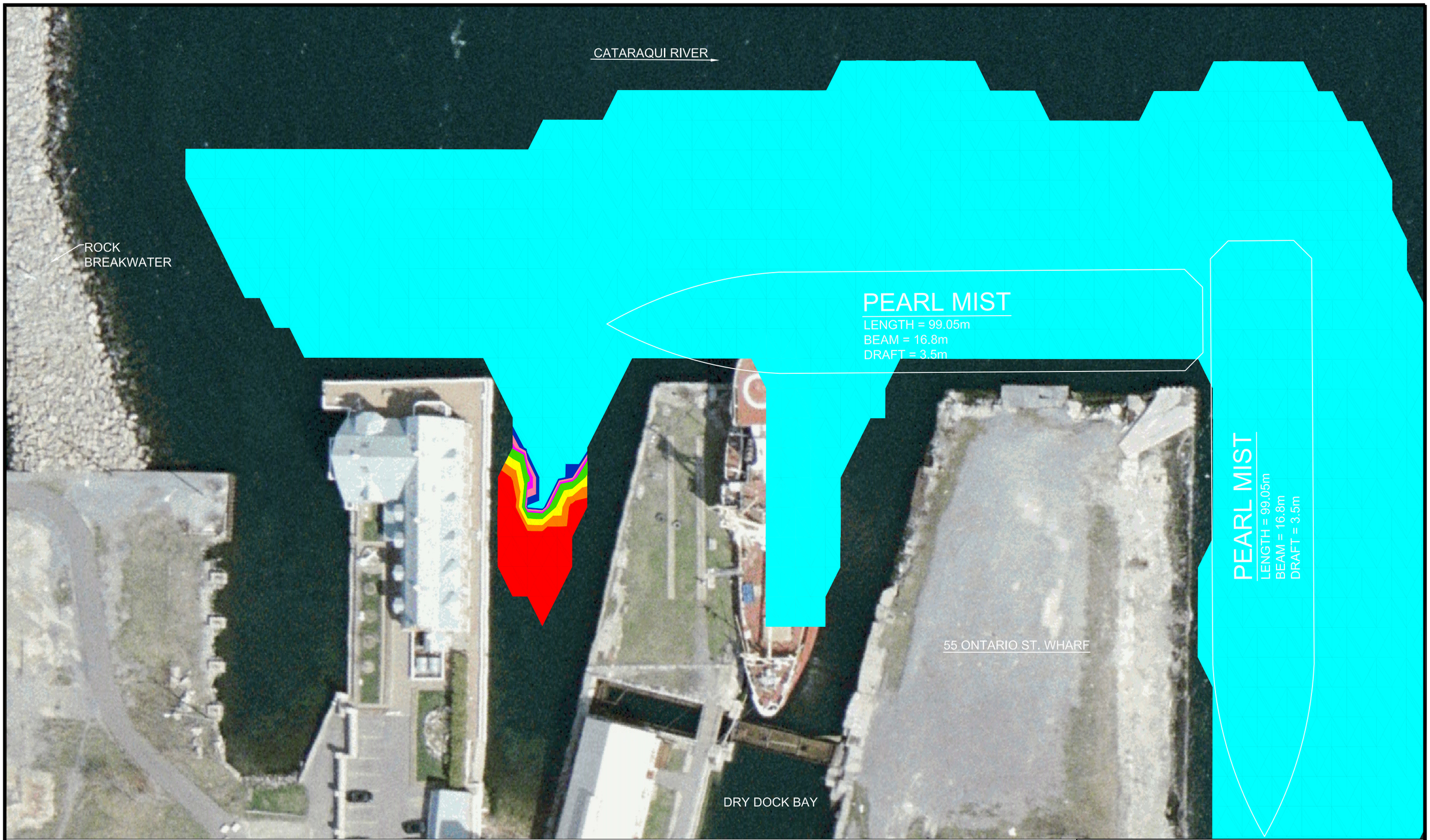
FIGURE 1.2
CRAWFORD WHARF BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



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- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

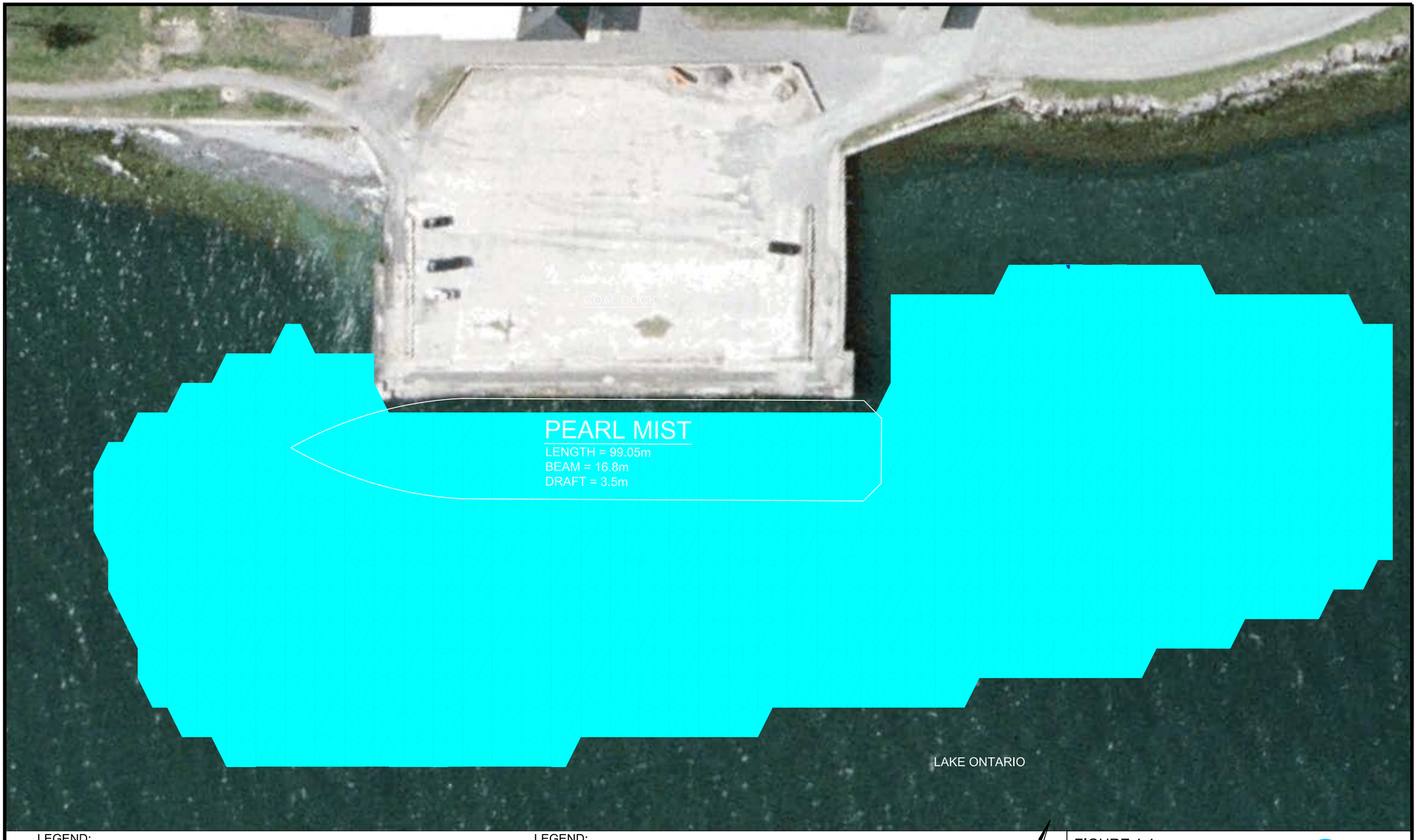
FIGURE 1.3
55 ONTARIO ST BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



LEGEND:
- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
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LEGEND:
- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
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- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

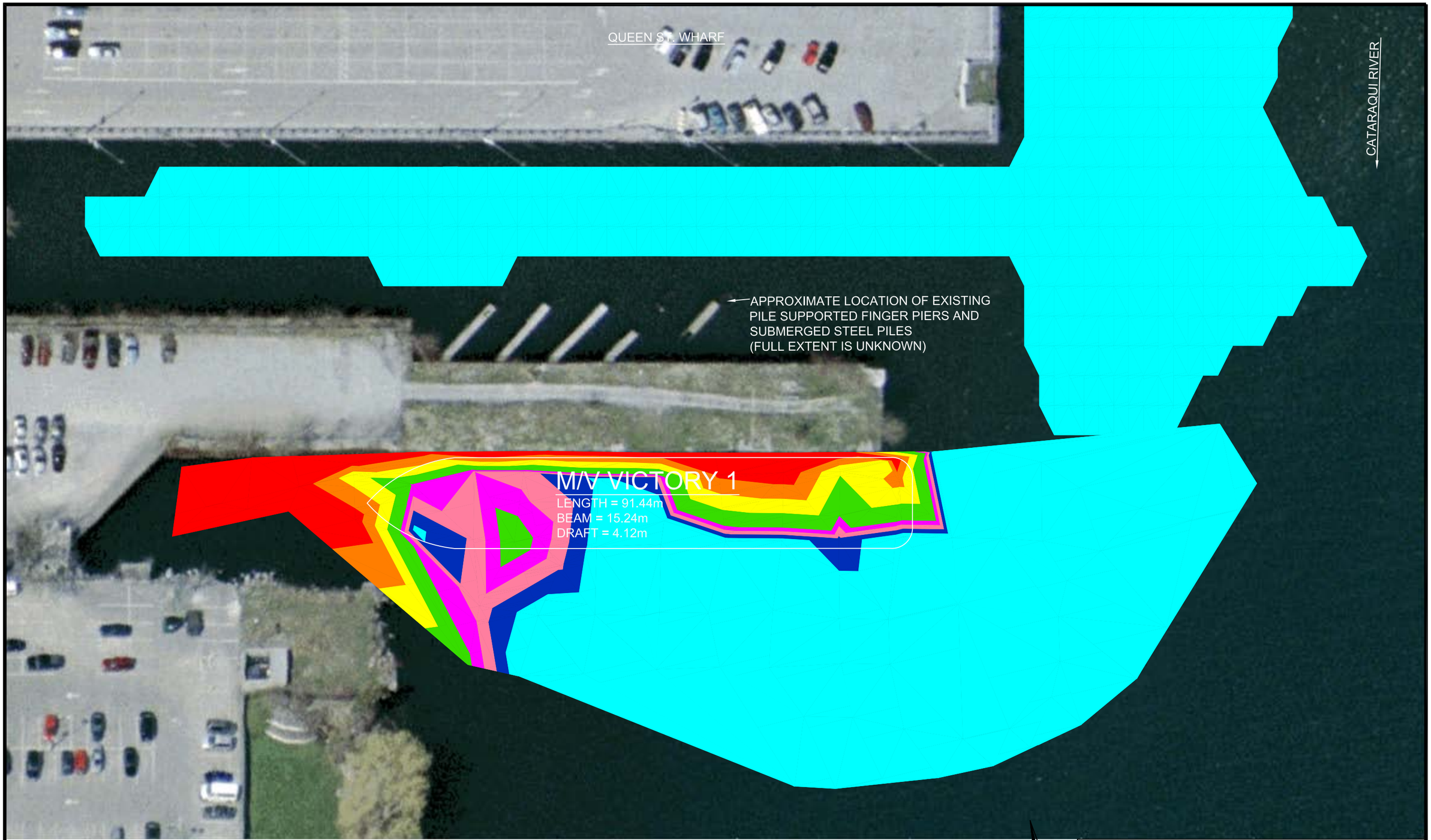
FIGURE 1.4
COAL DOCK BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m
1:600

Exhibit A



LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

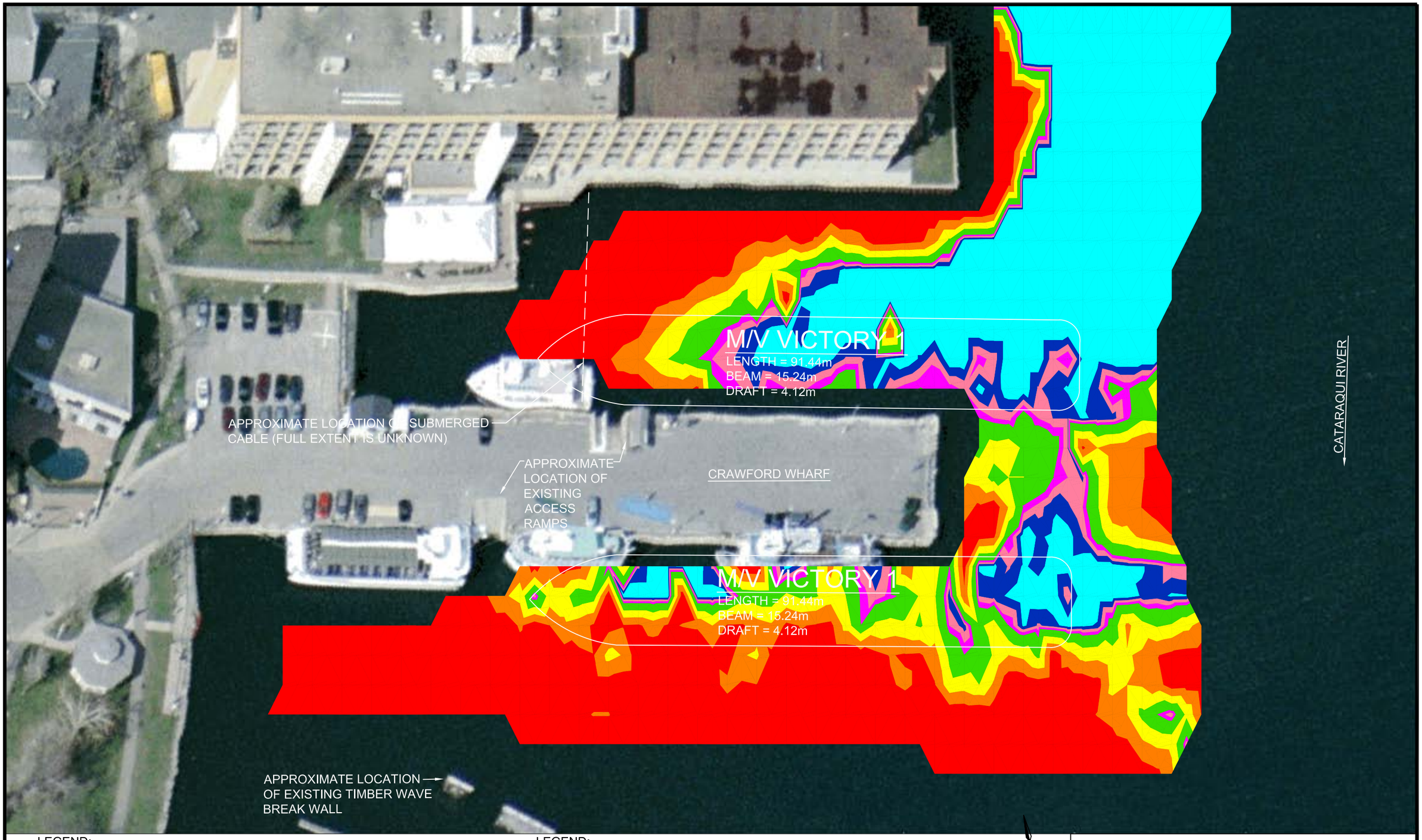
FIGURE 2.1
QUEEN ST. WHARF BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

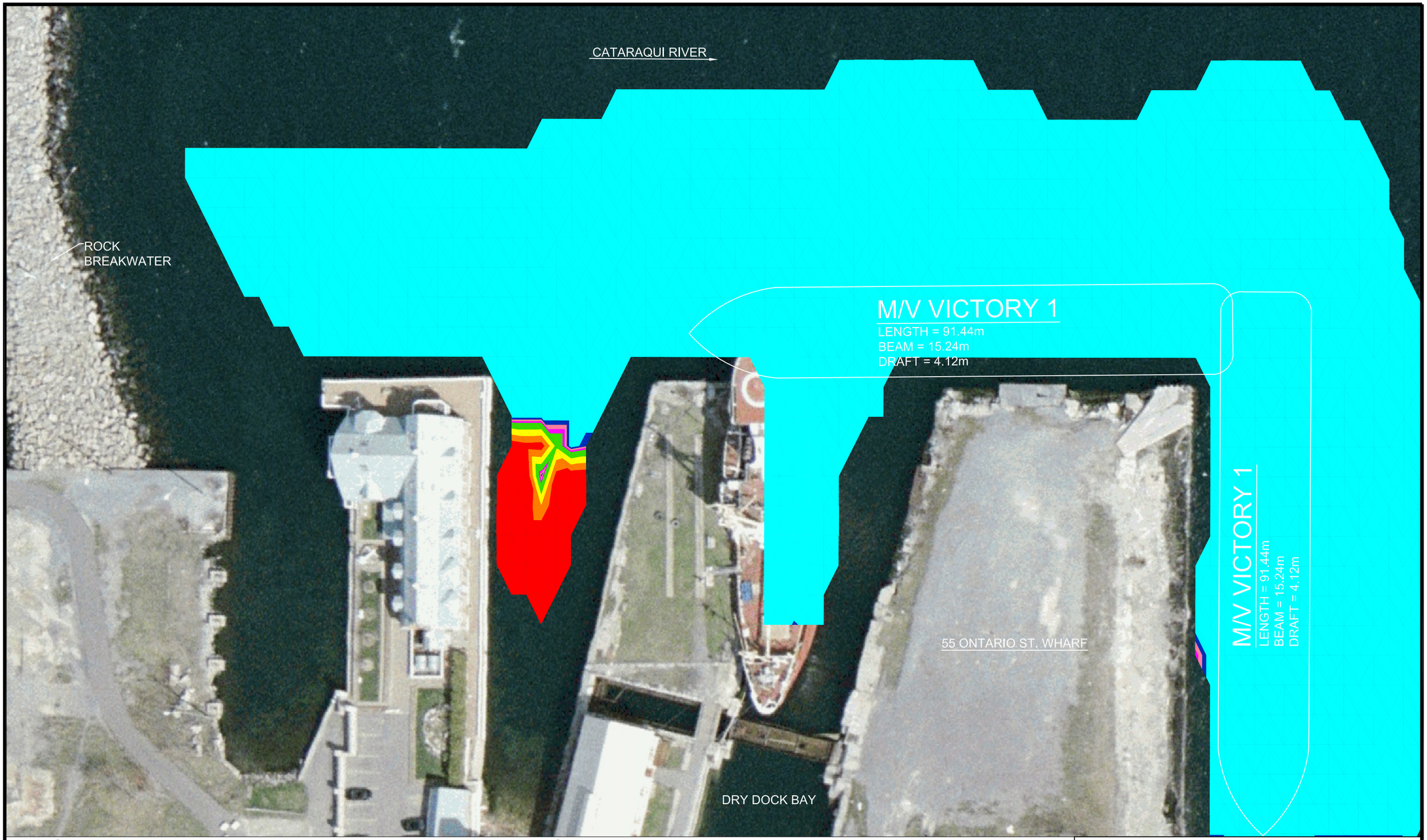
FIGURE 2.2
CRAWFORD WHARF BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

FIGURE 2.3
55 ONTARIO ST BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A

LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

FIGURE 2.4
COAL DOCK BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A

LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

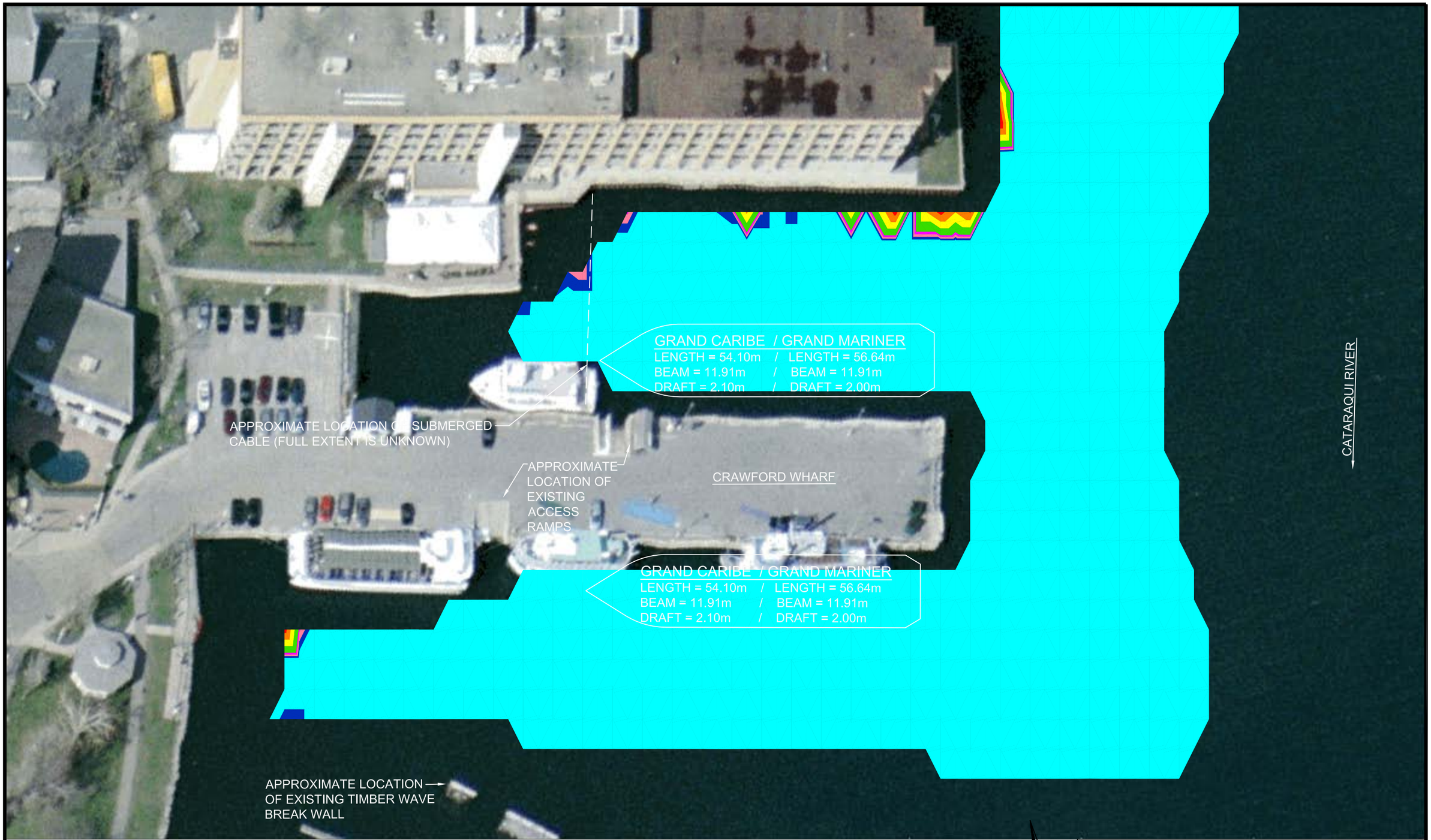
FIGURE 3.1
QUEEN ST. WHARF BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

FIGURE 3.2
CRAWFORD WHARF BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A

LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

FIGURE 3.3
55 ONTARIO ST BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A

LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.5m DRAFT CLEARANCE)

FIGURE 3.4
COAL DOCK BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A

LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

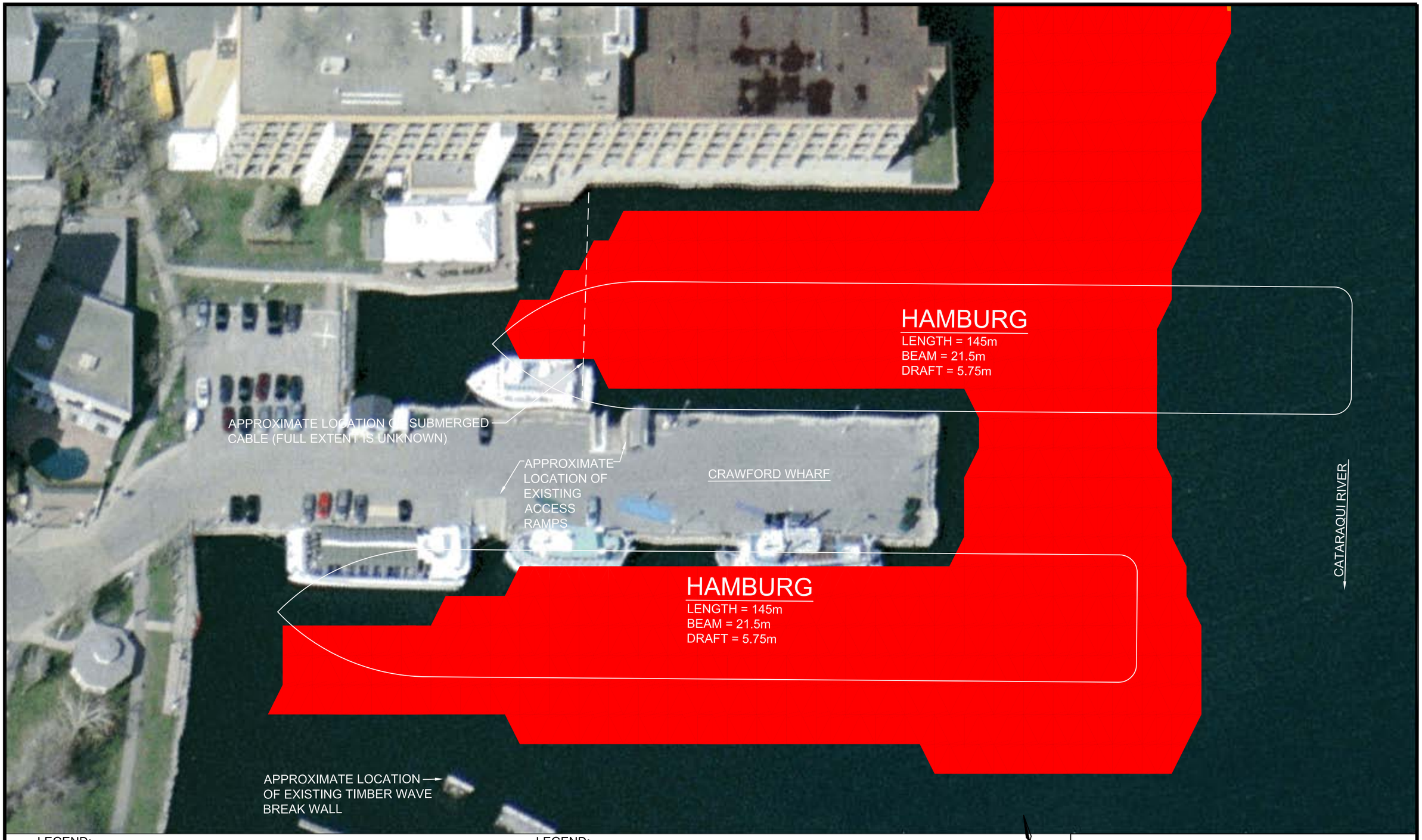
FIGURE 4.1
QUEEN ST. WHARF BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

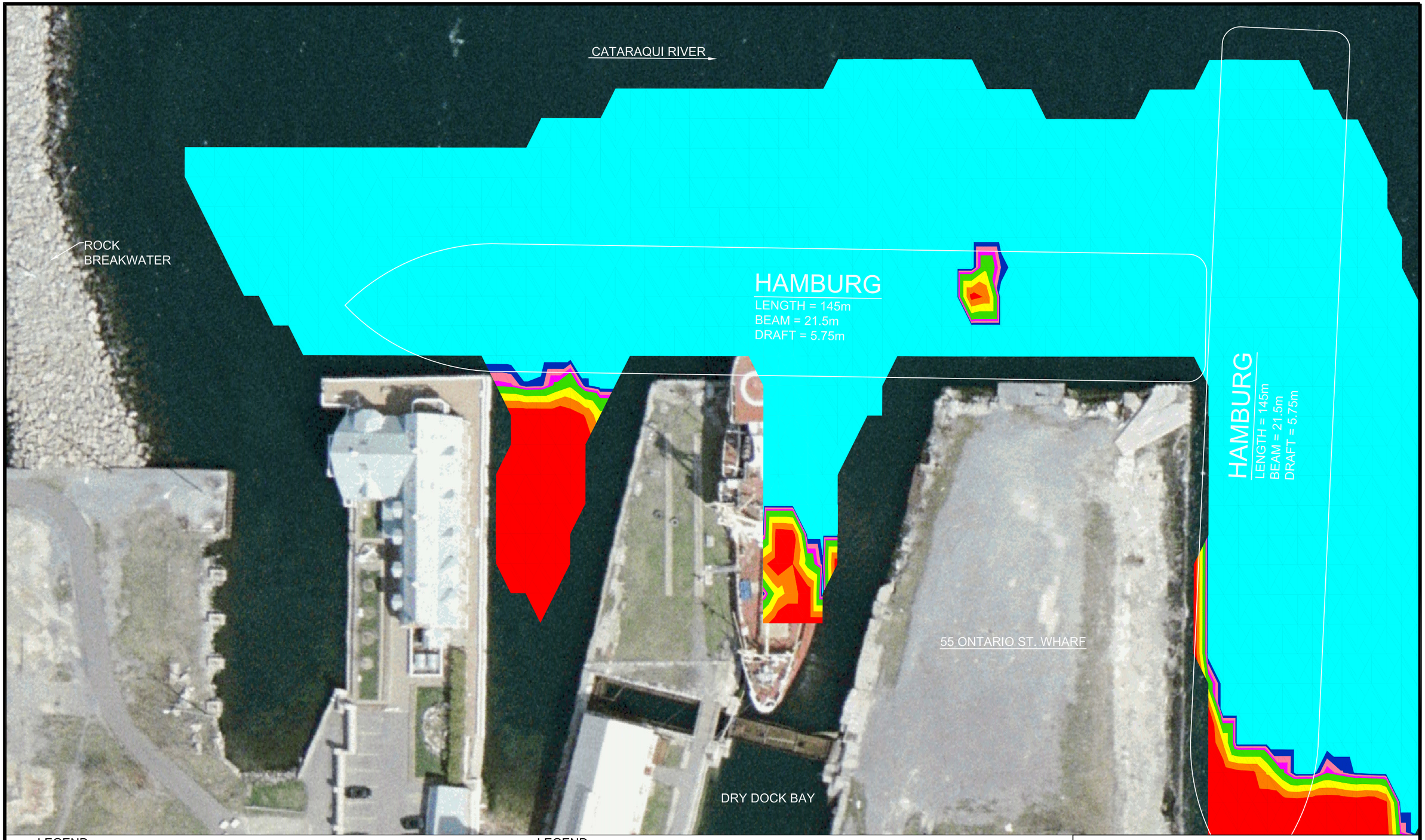
FIGURE 4.2
CRAWFORD WHARF BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



LEGEND:

- 0% to 20% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

LEGEND:

- 80% to 85% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

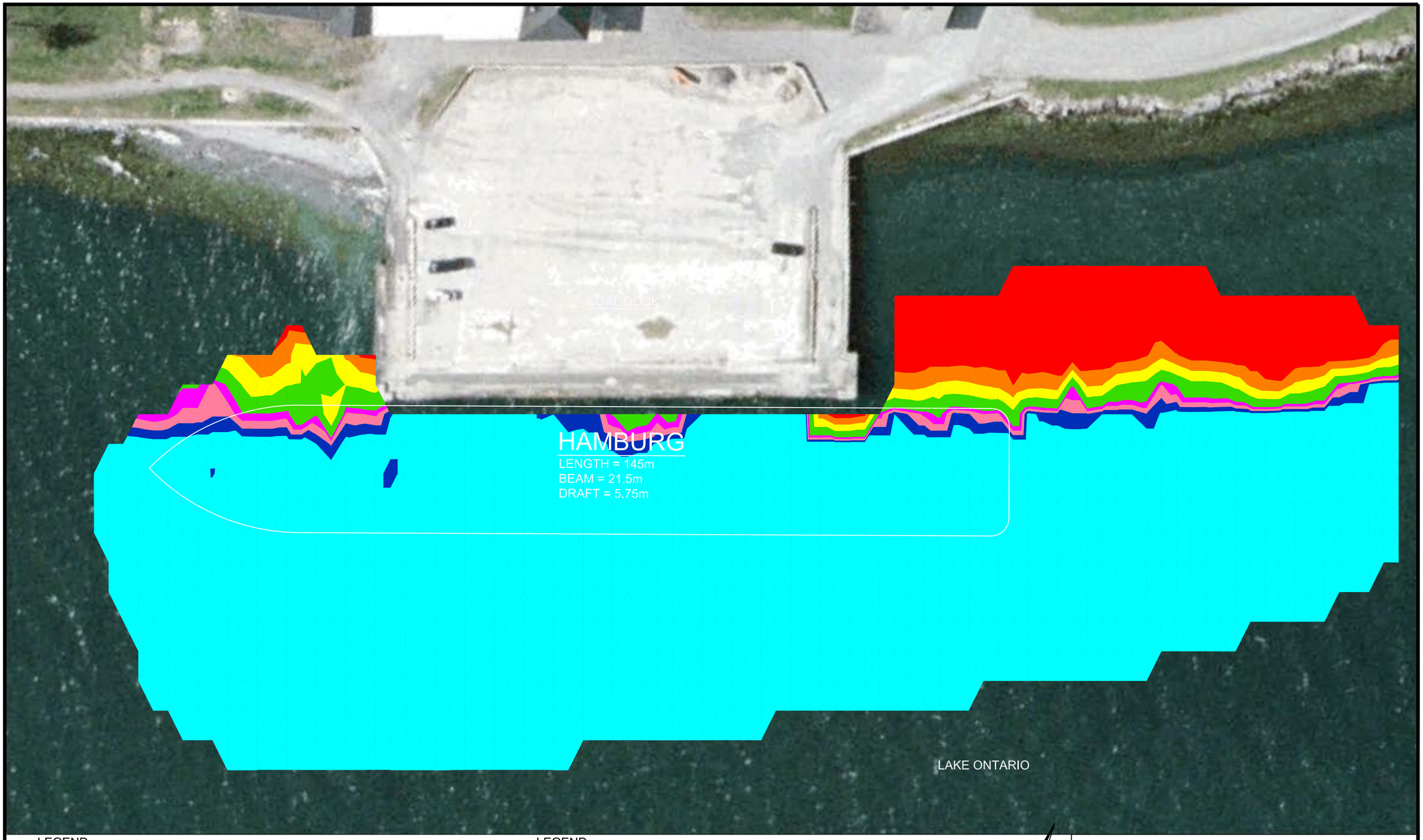
FIGURE 4.3
55 ONTARIO ST BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600

Exhibit A



LEGEND:
- 0% to 20% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 20% to 40% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 40% to 60% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 60% to 80% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

LEGEND:
- 80% to 85% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 85% to 90% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 90% to 95% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)
- 95% to 100% (PERCENTAGE OF TIME WITH 0.57m DRAFT CLEARANCE)

FIGURE 4.4
COAL DOCK BERTHING

RIGGS ENGINEERING

CLIENT
CITY OF KINGSTON

0 3 9 18m 1:600