CATARAQUI REGION CONSERVATION AUTHORITY

MINUTES OF THE FULL AUTHORITY BOARD

WEDNESDAY, JUNE 26, 2019

CRCA ADMINISTRATION OFFICE BOARDROOM

Present: Alan Revill (Chair), Alan Barton, Rhonda Ferguson, Claire Gunnewiek, Al Hanes, Bert Herfst, Garry Hewett, Robert Kiley, Gordon Ohlke, Lisa Osanic, Ross Sutherland (Vice Chair)

Regrets: Leigh Bursey, Matt Harper, Wayne Hill, Paul McAuley, Gary Oosterhof, Terry Richardson

Staff Present: Geoff Rae, General Manager; Tom Beaubiah, Manager, Conservation Lands; Donna Campbell, Assistant, Chair & General Manager; Michael Dakin, Resource Planner; Krista Fazackerley, Supervisor, Communications & Education; Katrina Furlanetto, Manager, Watershed Planning & Engineering; Steve Knapton, Coordinator, Operations Planning; Rob McRae, Manager, Corporate Services; Cheryl Rider, Supervisor, Finance; Rhonda Roantree, Receptionist/Clerk; Andrew Schmidt, Supervisor, Development Review; Janice Teare, Engineer, Water Resources

Delegation: Roddy Bolivar, Bolivar≈Phillips

The meeting commenced at 6:30 P.M.

1. ROLL CALL

There were eleven (11) members present.

2. ADOPTION OF AGENDA

There was an addition to the agenda under 7.5, Report from the Open Session of the Personnel Committee Meeting of June 26, 2019 (report IR-051-19).

Moved by: Bert Herfst
Seconded by: Claire Gunnewiek

THAT the agenda BE ADOPTED, AS AMENDED.

CARRIED

3. DECLARATION OF CONFLICT OF INTEREST

There were none.

4. DELEGATION / PRESENTATION

4.1. Roddy Bolivar, Bolivar≈Phillips

- Presentation – Asset Management for Conservation Authorities (Attachment #1)

Resolution: **053-19**
Moved by: Robert Kiley
Seconded by: Lisa Osanic

THAT the presentation by Roddy Bolivar, Bolivar≈Phillips, on Asset Management for Conservation Authorities, BE RECEIVED.

CARRIED

4.2. Waterfront Development Guidance for Eastern Lake Ontario & Upper St. Lawrence River

- Presentation – Katrina Furlanetto, Manager, Watershed Planning & Engineering (Attachment #2)

Resolution: **054-19**
Moved by: Gordon Ohlke
Seconded by: Bert Herfst

THAT the presentation on Waterfront Development Guidance for Eastern Lake Ontario & Upper St. Lawrence River, BE RECEIVED.

CARRIED

5. APPROVAL OF PREVIOUS MINUTES

5.1. Minutes of May 22, 2019

Moved by: Bert Herfst
Seconded by: Lisa Osanic

THAT the minutes of the May 22, 2019 meeting of the Cataraqui Region Conservation Authority, BE APPROVED, AS AMENDED.

CARRIED

6. BUSINESS ARISING

There was none.

7. ITEMS FOR CONSIDERATION

7.1. Waterfront Development Guidance for Eastern Lake Ontario and Upper St. Lawrence River (PR00168) – Final Report (report IR-044-19)

It was noted that the Waterfront Development Guidance for Eastern Lake Ontario & Upper St. Lawrence River final report (dated June 26, 2019) had been received from the consultant since the agenda was issued and would be distributed with the Minutes. (Attachment #3)

Resolution: **055-19**
Moved by: Bert Herfst
Seconded by: Al Hanes

THAT report IR-044-19, Waterfront Development Guidance for Eastern Lake Ontario and Upper St. Lawrence River (PR00168) – Final Report, BE RECEIVED.

CARRIED

7.2. Buell's and Butler's Creeks Flood Plain Mapping Update - Canarm Site Expansion (report IR-045-19)

Resolution: **056-19**
Moved by: Al Barton
Seconded by: Garry Hewett

THAT report IR-045-19, Buell's and Butler's Creeks Flood Plain Mapping Update - Canarm Site Expansion, BE RECEIVED; and,

THAT the Full Authority Board approve the use of the flood plain elevation information received and reviewed by Cataraqui Region Conservation Authority staff as part of project PR00169, Buell's and Butler's Creek Flood Plain Mapping Update to facilitate development review for the proposed Canarm site expansion in Brockville.

CARRIED

7.3. Operating Variance Report to end of May 2019 (report IR-046-19)

Resolution: **057-19**
Moved by: Bert Herfst
Seconded by: Rhonda Ferguson

THAT Report IR-046-19, Operating Variance Report to end of May 2019, BE RECEIVED.

CARRIED

7.4. Capital Variance and Closure Report to end of May 2019 (report IR-047-19)

Resolution: **058-19**
Moved by: Al Hanes
Seconded by: Claire Gunnewiek

THAT Report IR-047-19, Capital Variance and Closure Report to end of May 2019, BE RECEIVED; and,

THAT 2019 and prior years capital projects, as indicated in Section 9.0 Financial Implications of the Capital Variance and Closure Report to end of May 2019, BE CLOSED, and any remaining balances BE RETURNED to the appropriate reserves.

CARRIED

7.5. Report from the Open Session of Personnel Committee Meeting of June 26, 2019 (report IR-051-19) – circulated at the meeting (Attachment #4)

Resolution: **059-19**
Moved by: Bert Herfst
Seconded by: Al Hanes

THAT Report IR-051-19, Report from Open Session of Personnel Committee meeting of June 26, 2019, BE APPROVED.

CARRIED

7.6. Information Technology Services (report IR-048-19)

Resolution: **060-19**
Moved by: Bert Herfst
Seconded by: Rhonda Ferguson

THAT Report IR-048-19, Information Technology Services, BE RECEIVED; and,

THAT staff BE AUTHORIZED to negotiate a shared services agreement through which the County of Frontenac would provide information technology services to the Cataraqui Region Conservation Authority (CRCA); and,

THAT staff BE DIRECTED to present the final draft agreement to the CRCA Board, along with final cost estimates, prior to authorization.

CARRIED

8. MINUTES

8.1. Cataraqui Trail Management Board

Resolution: **061-19**
Moved by: Ross Sutherland
Seconded by: Claire Gunnewiek

THAT Cataraqui Trail Management Board minutes of March 28 and April 25, 2019, BE RECEIVED.

CARRIED

8.1.1. Appointment to Friends of the Cataraqui Trail

Resolution: 062-19
Moved by: Bert Herfst
Seconded by: Al Hanes

THAT the Cataraqui Region Conservation Authority APPROVE the appointment of Ross Sutherland as a CRCA representative to the Friends of the Cataraqui Trail.

CARRIED

9. COMMITTEE REPORTS

9.1. Report from Budget Review Committee meeting of June 17, 2019 (IR-049-19)

Resolution: 063-19
Moved by: Bert Herfst
Seconded by: Lisa Osanic

THAT the report from the Budget Review Committee meeting of June 17, 2019 (IR-049-19) BE APPROVED.

CARRIED

10. ANNOUNCEMENTS OR INQUIRIES/INFORMATION

10.1. Report on Communications (report IR-050-19)

The Board acknowledged the achievement of Michael Dakin, Resource Planner, in becoming a Full Member of the Canadian Institute of Planners and a Registered Professional Planner in Ontario, per Item 1 of the report.

Krista Fazackerley, Supervisor, Communications & Education, indicated that surveys regarding CRCA's brand and signage system, as described in Item 3 of the report, would be initiated by the end of June, and that an invitation to participate would be shared with the Board.

There was an addition of a letter from the City of Kingston dated June 24, 2019 regarding City Council Meeting – June 18, 2019 – New Motion 1 (Attachment #5)

Resolution: **064-19**
Moved by: Garry Hewett
Seconded by: Robert Kiley

THAT the Report on Communications (IR-050-19), BE RECEIVED.

CARRIED

11. MOTIONS / NOTICES OF MOTIONS

There were none.

12. IN CAMERA SESSION

Resolution: **065-19**
Moved by: Bert Herfst
Seconded by: Claire Gunnewiek

THAT the Full Authority move **IN CAMERA.**

CARRIED

Resolution: **066-19**
Moved by: Al Hanes
Seconded by: Lisa Osanic

THAT the Full Authority move out of **IN CAMERA** and report**.**

CARRIED

13. RETURN TO OPEN SESSION

Resolution: **067-19**
Moved by: Bert Herfst
Seconded by: Claire Gunnewiek

THAT Cataraqui Region Conservation Authority AUTHORIZE staff to pursue items of action as discussed at the **IN CAMERA** session on June 26, 2019.

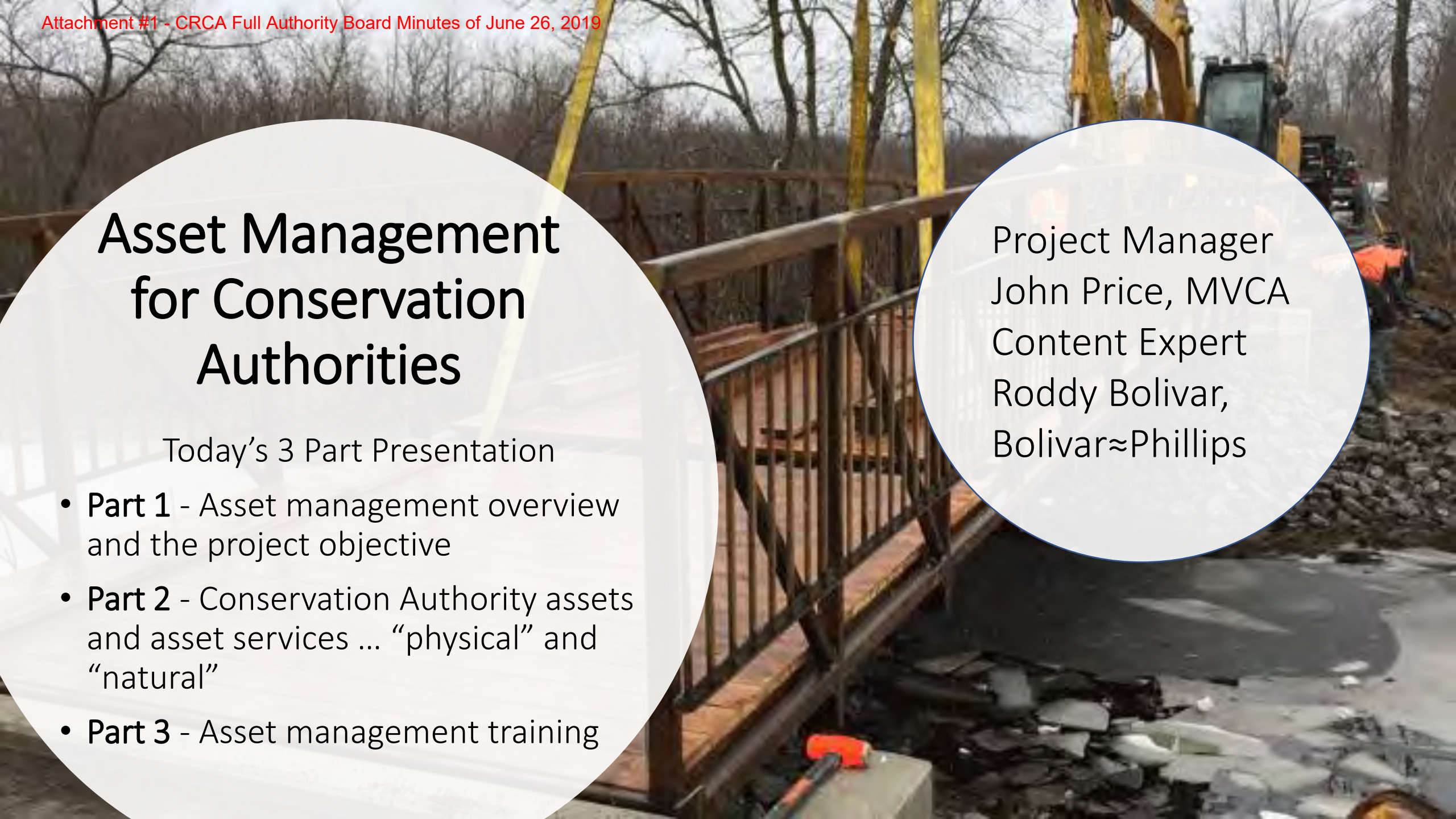
CARRIED

14. ADJOURNMENT

The meeting adjourned at 7:21 P.M. on a motion by Al Hanes, seconded by Bert Herfst.

Geoff Rae, MBA, P.Eng.
General Manager

Alan Revill
Chair



Asset Management for Conservation Authorities

Today's 3 Part Presentation

- **Part 1** - Asset management overview and the project objective
- **Part 2** - Conservation Authority assets and asset services … "physical" and "natural"
- **Part 3** - Asset management training

Project Manager
John Price, MVCA
Content Expert
Roddy Bolivar,
Bolivar≈Phillips

FCM FEDERATION OF CANADIAN MUNICIPALITIES FÉDÉRATION CANADIENNE DES MUNICIPALITÉS

Government of Canada Gouvernement du Canada

This initiative is offered through the Municipal Asset Management Program, which is delivered by the Federation of Canadian Municipalities, and funded by the Government of Canada.

Improve asset management knowledge and skills to help address:

- Aging infrastructure
- Demand for expanding services and systems
- Impacts of climate change
- Limited financial resources
- Need to balance social, environmental and financial needs and risks.

Today's briefing is the **first part** of a **two-part program** approved for Eastern Ontario Conservation Authorities for delivery in 2019.

- **Part A – Briefing** of nine Eastern Ontario CA Boards
- **Part B – Training sessions** delivered to CA (and municipal) staff followed by coaching

Part 1 …what is Asset Management?

FCM Asset Management Competencies Framework

("Competencies" = knowledge and skills on a 1 – 5 scale)

A too simple answer is - "It's managing our assets".

The process to do that varies widely between organizations and in particular on the resources of the organization and the types of assets they own.

One of the activities in the planned training program is for each Conservation Authority to consider their own answer to this question.

A goal of the Board briefings and the training is to improve knowledge and skills related to asset management among the Conservation Authorities and their member municipalities.

How is it different?

Managing Assets*	Asset Management*
"Siloed" decisions at departmental level	Strategic asset decisions leveraging information and minimizing acceptable risk
Departmentally driven levels of service	Increased collaboration across departments
Immediate cost; focus on operating budget	Long-term value and purpose
Current performance by Department	Long-term Impact
Responding to failures	Business risks articulated and mitigated

Compliance with PS3150 ≠ Asset Management

What does it “cost” (time and/or money)?

Identify and consolidate existing practises
Build a complete asset register
Establish a capital reserve process

Staff training to increase capacity
Automated data collection and management
Incorporate levels of service into capital planning
Continuous improvement plan

Corporate asset management policies and strategies
Asset management plans for all asset classes
Current data for all assets
Integration of asset management into strategic planning

Each CA is at a different place on the AM journey

- Significant progress has been made over past two years:
  - completed assessments of all water control structures
  - developed long-term capital forecast
  - implemented special levy for water control structures
  - started to rebuild reserves
- Next steps, 2019:
  - develop a Conservation Lands Strategy
  - complete condition assessment of CA offices and other facilities
  - conduct engineering assessments of bridges along the Cataraqui Trail
- participate in the E. Ontario AM training initiative and address gaps in AM system

The FCM sponsored Board presentations and the training are aimed at helping participants advance in their AM journey

Part 2 … CA Assets: The Municipal Connection

Conservation Authority Assets

"Physical" assets like water control structures have a capital value, need for maintenance and eventual replacement.

Some CA assets such as conservation areas and some of the services provided by physical assets are sometimes called "natural" assets.

Natural assets provide services which have value:

- Flood risk reduction
- Preservation of heritage
- Recreational opportunities
- Education opportunities
- Ecological services

How do we place a value on these and then manage the assets to deliver on that value.

The Municipal Connection

The CA role in river and lake water levels, quality and flow affect:

- The quantity and quality of water entering the municipal intake pipes.
- The discharge criteria, design, and operations of municipal wastewater lagoons and treatment plants.
- Tax assessment from waterfront properties.

The CA role in management woods and wetlands:

- Provide drinking water and recreational water storage and purification.
- Mitigate erosion and damage to roadway structures.

Conservation Authorities moving forward with asset management will provide benefits to member municipalities.

Representatives from Comox Valley Regional District, City of Courtenay, Town of Comox and Village of Cumberland and K'ómoks First Nation initiating the first watershed scale natural asset plan

How do we Value Natural Infrastructure

New tools and approaches are evolving to recognize and bring an asset management approach to natural infrastructure. These will provide new tools for Conservation Authority asset management.

The Provincial Policy Statement has new direction:

Planning authorities should promote green infrastructure to complement infrastructure.

Canada's first watershed-scale municipal natural asset management initiative kicked off only recently (March 21) in the Comox Lake watershed in BC. The goal is to recognize provision of safe, reliable drinking water, as well as other social, environmental, cultural and economic benefits from natural assets.

In 2017, a pilot study was initiated by Credit Valley Conservation for the Region of Peel to assess the monetary value of stormwater services provided by natural assets in Peel's jurisdiction.

Part 3 - Asset Management Training

Session 1:

Designed for those at the early stages of asset management experience. Will provide attendees with the principles and tools needed to get started and move forward.

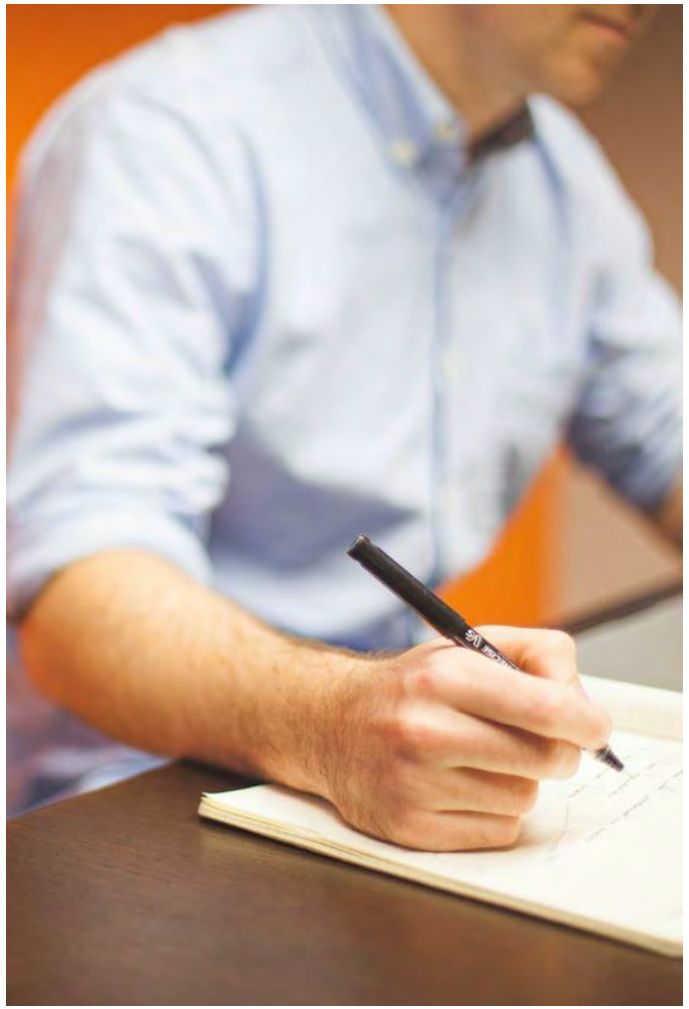
Session 2:

Designed to improve awareness of specific AM tools and processes used for policy and governance, data and data management and role of service levels in AM.

Session 3:

Designed to facilitate a community of practice amongst Eastern Ontario Authorities where AM practitioners share tools, approaches, and lessons learned.

Progress and Next Steps



- AM Readiness self-assessments by each CA
- Training AM 101 and AM 201 completed
- Practical assignments following sessions
- Follow-up coaching
- Reporting back to Board by CA management

Thanks … Questions?

- John Price
  jprice@mvc.on.ca

- Roddy Bolivar
  Roddy.Bolivar@BolivarPhillips.ca

IAM Asset Management Competencies Framework – Certification is achieved after 300 hours of training

Waterfront Development Guidance Study

CRCA Full Authority Board Meeting June 26, 2019

Credit: Realty Source

CATARAQUI REGION
CONSERVATION AUTHORITY

Project Purpose

Aim: To develop an Eastern Lake Ontario – Upper St. Lawrence River Waterfront Development Guidance document.

- It will assist & encourage responsible management of flood & erosion risks associated with (large-scale) shoreline development

The purpose of the project is to help CRCA to clarify its approach to the flood and erosion risks associated with waterfront development in the study area

CATARAQUI REGION CONSERVATION AUTHORITY

Background

Study Area:

Lake Ontario and St. Lawrence River shoreline of the region within 8 municipalities

CATARAQUI REGION CONSERVATION AUTHORITY

Project Description

Scope of Work

- Review relevant sections of listed guidance documents
- Address seven (7) technical questions
- Prepare draft recommendations for CRCA policies and guidelines with Technical Advisory Group (TAG)
- Prepare a draft report (for TAG review)
- Prepare a final report (for TAG and CRCA)

CATARAQUI REGION CONSERVATION AUTHORITY

Project Process & Value

Report Deliverable

- Final report received June 26, 2019 addressing many comments provided by CRCA and City of Kingston staff
- Good effort provided by the sub-consultant to finalize the project

Value

- Policy review confirms CRCA's policy approach to natural hazards avoidance
- Recommendations for future technical work and consideration to address challenging development

Next Steps

Next Steps

- Review CRCA policies to determine areas of clarification
- Develop scope of work for future projects with suggested aspects to include:
  - Legal review
  - Policy development
  - Terms of Reference for:
    - flow modeling to delineate "defined areas" of the St. Lawrence River
    - determining whether a property can be an "artificial shoreline"
    - assessing impacts for proposed fill projects and necessary requirements and level of compensation

Waterfront Development Guidance For Eastern Lake Ontario & Upper St. Lawrence River

Final Report

Document Version 1.0

26 June 2019

Prepared by:

Aqua Solutions 5 Inc. &

Coldwater Consulting Ltd.

Prepared For:

Cataraqui Region Conservation Authority

This report was prepared by Aqua Solutions 5 Inc., and Coldwater Consulting Ltd., for the Cataraqui Region Conservation Authority (CRCA). The material in this document reflects the best advice and judgment of the authors in light of the data and information available at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on its contents, are the sole responsibility of any Third Parties. The authors accept no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions taken based on the contents of this document. Please note, photos included in this document have been sourced from either CRCA, M. Davies of Coldwater Consulting Ltd., or J. Sullivan, Aqua Solutions 5 Inc.

Information Highlights:

This document has been developed to provide important contextual information at the beginning with more detailed site-specific response to the technical questions provided in Section 5 of the document.

This document has been formatted to allow the reader to obtain important information quickly. Several highlighted features appear throughout the document as follows:

Denotes highlights of key policy, regulatory responsibilities, legislation or mandates.

R# Denotes key recommendations of the study.

Acknowledgements

Aqua Solutions 5 Inc., and Coldwater Consulting Ltd. would like to extend sincere thanks to the Cataraqui Region Conservation Authority (CRCA) for the opportunity to study these issues. The range of subject matter provided a unique opportunity to assess a wide range of technical and policy-based issues.

We also wish to acknowledge the contributions of members of the CRCA Staff and Technical Advisory Group (TAG) without whose assistance and support, this document would not have been possible. Members of the Technical Advisory Group offered many insightful and thought-provoking comments on the Draft Report. Where possible these have been addressed in this Final Report.

TAG Members:

Leon Boegman	Queen's University
Michael Dakin	Cataraqui Region Conservation Authority
Tamara Dolan	Ministry of Natural Resources and Forestry
Katrina Furlanetto	Cataraqui Region Conservation Authority
Teresa Labuda	Conservation Halton
Ryan Mulligan	Queen's University
Greg Newman	City of Kingston
Jon Orpana	Ministry of the Environment, Conservation and Parks
Andrew Schmidt	Cataraqui Region Conservation Authority
Mike Shantz	Environment and Climate Change Canada
Russell Wiginton	Cataraqui Region Conservation Authority

Executive Summary

This report reviews the regulatory framework within which the Cataraqui Region Conservation Authority (CRCA) makes decisions regarding waterfront development related specifically to a series of specific technical issues raised by the CRCA (referred to herein as the 'Technical Questions'). A series of recommendations are presented for CRCA's consideration to aid them in addressing waterfront development along the Lake Ontario and St. Lawrence River shorelines.

Through responding to these Technical Questions, a series of recommendations for consideration regarding hazard delineation and the interpretation of natural hazard policy in response to development applications. The key findings of this study include:

Updated flood hazard mapping: Existing standards for flood hazards along the Lake Ontario and St. Lawrence River shorelines are based on analysis techniques developed in the 1980s. New approaches and computational techniques are now available to allow development of CRCA-wide coastal hazard mapping using a combination of wave and inundation models to provide detailed mapping of water levels and wave effects (hazard risk, inundation depths, etc.) at various risk levels along the Lake Ontario and St. Lawrence River shorelines (effectively an update to existing flood hazard guidance found in the Anthony, 1993 study). The availability of high-resolution LiDAR-derived DEMs and efficient 2D hydrodynamic modelling tools makes this a tractable problem and offers the ability to provide/use consistent and uniform analysis techniques throughout the CRCA's domain rather than relying on individual hazard assessment prepared by consultants under contract to individual property owners.

Erosion hazards: The erosion hazard guidelines in use by CRCA were developed in 1995. This approach should be re-visited to improve the fidelity and consistency of the erosion standards used by CRCA. Since the 1990s, satellite imagery, aerial photography and LiDAR terrain mapping have led to a dramatic improvement in the accuracy and detail of shoreline mapping that is available. Items to address include refinement of the guidance for mapping out the erosion hazard (particularly with respect to establishing toe of slope and stable slope allowance), and refinement of the shore classification scheme for low coastal plains and bedrock shores.

Shoreline management plans: Updated flood and erosion hazard mapping could be undertaken within the context of developing shoreline management plans for the Great Lakes and St. Lawrence River shorelines under CRCA jurisdiction.

Artificial shorelines: The MNR Technical Guides characterize large-scale industrial or post-industrial waterfronts as 'artificial shorelines'. This is a distinct shore type that tends to lack the physical features and natural processes that control and define natural shores. Consequently, a different approach is needed for regulating and managing these lands. Flood hazards need to be addressed in much the same manner as all shores, but the concepts of erosion hazard and stable slope allowance are not directly applicable. The Provincial guidance on dealing with artificial shorelines is limited. In this report we introduce the term 'docklands' to refer to historical waterfronts developed in the 1800s that could qualify as 'artificial shorelines' from a natural hazards perspective. The CRCA should conduct site-specific assessments of potential artificial shoreline areas (e.g. Elevator Bay, the City of Kingston waterfront from, say Breakwater Park through to the La Salle Causeway, the Brockville waterfront from, say, Home St. to Orchard St.) in order to determine the extents of qualifying artificial shorelines and to establish appropriate permitting criteria to ensure that the intent of the Provincial hazardous lands policy is properly addressed in a meaningful and consistent manner. Some suggestions on the criteria that could be used for such an assessment are provided herein.

Delineated Portions: Delineation of 'defined portions' of the river that would constitute a concern with respect to flood hazards would need to be based on a detailed technical study of flood conditions in the river. This study could use an accepted, calibrated model of the upper St. Lawrence River (preferably a 2D model, possibly available through Environment Canada) to determine hydraulic conditions at cross-sections of the river. At each cross-section, cross-sectional areas and velocities could be extracted. These hydraulic conditions could be used to compute the impacts of a theoretical infilling on the conveyance of the channel. Part of the technical challenge here would be to define a useful and relevant threshold value.

TABLE OF CONTENTS

1. Introduction

The natural beauty of the waterfront tends to form a key focal point for communities, providing access to the water, as well as an opportunity to engage with nature. Urban waterfront redevelopment, the need for public access to waterfront areas, environmental conservation, and increasing flooding and erosion concerns are placing increasing demands on the regulatory and permitting roles of the CRCA and local governments.

The extreme high water levels that occurred along Lake Ontario and the St. Lawrence River in the spring of 2017 (and which are recurring now in 2019) amplified a number of concerns related to natural hazards (i.e. flooding, erosion and dynamic beaches) along the Cataraqui Region Conservation Authority (CRCA) jurisdiction and the urgent need to address these issues.

This document examines waterfront regulation issues facing the Cataraqui region from the perspective of several specific development challenges.

1.1. Purpose

The purpose of this project is to support the CRCA and local municipalities by providing guidance, and clarifying where possible, approaches to managing flooding and erosion hazards. This is accomplished by providing independent advice on how to reliably manage waterfront resources related to a set of specific technical questions concerning development issues.

The study involved a review of influencing factors of climate change, the recent historic high-water levels, flooding and erosion hazards and complex development considerations. This work included an assessment of these development issues from the perspectives of Provincial natural hazard management policy directives, CRCA Regulatory and Planning requirements, and municipal and regional guidance documents and legislative responsibilities. Within the City of Kingston there is pressure for large-scale development along the waterfront and this document is also intended to assist in addressing the flood and erosion risks associated with potential future large-scale shoreline development.

The study reviewed the CRCA's Environmental Planning Policies (CRCA, 2015) and the CRCA Guidelines for Implementing Ontario Regulation 148/06 (CRCA, 2017) to identify potential changes or revisions, that could be undertaken by CRCA staff.

1.2. Context

The study area for this project consists of the Lake Ontario and St. Lawrence River shoreline of the CRCA region within the following eight municipalities:

- City of Brockville,
- Township of Elizabethtown-Kitley,

- Township of Front of Yonge,
- Town of Gananoque,
- Town of Greater Napanee,
- City of Kingston,
- Township of Leeds and the Thousand Islands, and
- Loyalist Township

The study area extends 140 km from Greater Napanee in the Bay of Quinte to the City of Brockville to the east and includes Amherst Island and an additional 1,800 islands as shown in Figure 1.

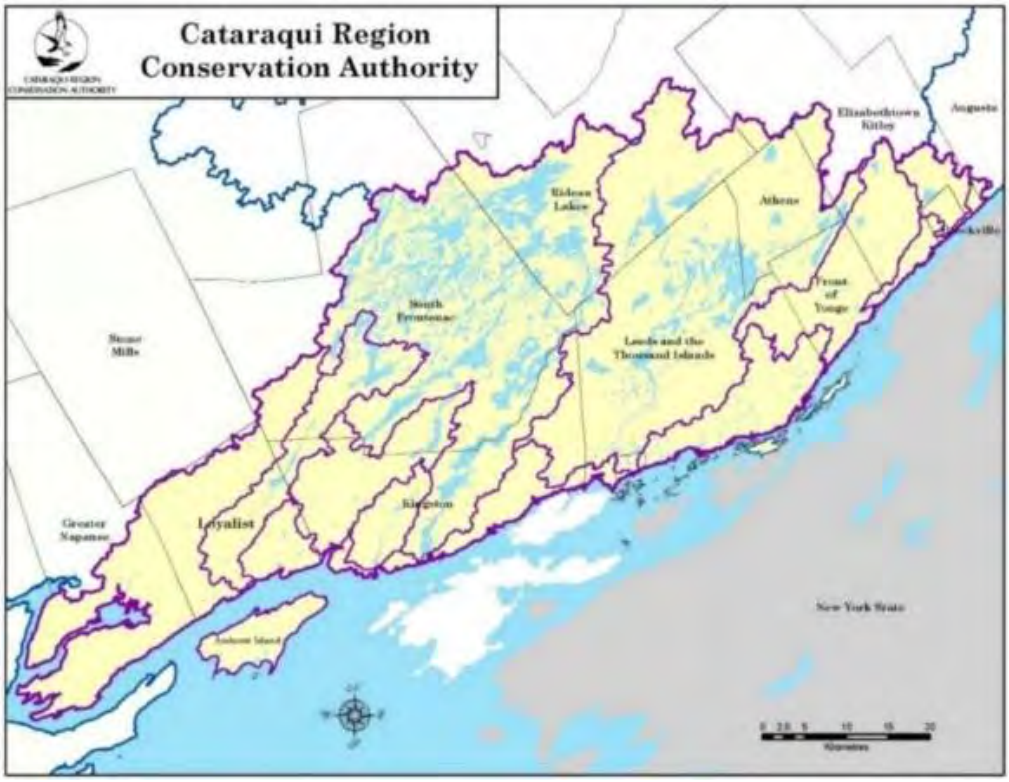


Figure 1 Cataraqui Region Conservation Authority Jurisdiction

Within Kingston, the study area includes the mouth of the Cataraqui River, extending from the LaSalle Causeway upstream to Highway 401 (Figure 2).

Figure 2 Cataraqui River mouth, Kingston

When considering any recommendations, the key objectives and legislative requirements of the CRCA, applicable Provincial Legislation and the Municipalities must be taken into consideration.

> "*CRCA has a watershed-based mandate to conserve and manage natural resources across its jurisdiction. The Authority has important roles as a trustee for the environment, as an advocate for the public open spaces, and as a manager of its natural resources."* (CRCA Website Jan 2019)

In order for development to be approved by the CRCA, the applicant must demonstrate, at a minimum, to the satisfaction of the CRCA that the proposed works will not adversely affect:

- flooding,
- erosion,
- dynamic beaches,
- pollution or
- the conservation of land.

Throughout the evaluation process an Integrated Shoreline Management perspective has also been taken into consideration and these objectives are discussed in Section 4 of the report.

2. Regulations & Policy

Provincial legislation (the *Conservation Authorities Act* and the *Planning Act*) and policy (the *Provincial Policy Statement*, 2014 and associated technical guidance) places a responsibility on Ontario's conservation authorities to deliver on established provincial hazard policy. The Conservation Authorities also administer regulations issued under *Section 28 of the Conservation Authorities Act* and provide advice and guidance to municipalities in keeping with their legislatively-assigned responsibilities as an advisory agency under the *Planning Act*. This is done with a goal of furthering the conservation, restoration, development and management of natural resources, while ensuring that:

- no new hazards are created;
- existing hazards are not aggravated;
- adverse environmental impacts do not result; and
- vehicles and people have a way of safely entering and exiting the area during times of flooding, erosion and other emergencies.

The following provides a brief discussion of the provincial legislation and regulations guiding conservation authority activities.

2.1. Provincial Legislation

The Ministry of Municipal Affairs and Housing (MMAH) and the Ministry of Natural Resources and Forestry (MNRF) are the principal provincial agencies responsible for formulating provincial policy for the protection of the public from natural hazards (including Flooding, Erosion and Dynamic Beach Hazards). While these responsibilities extend to all Ontario lands and waters, specific guidance has been developed for the shorelines of the Great Lakes and the St. Lawrence River.

The following highlights some relevant legislation related to natural hazards for this study.

Ministry of Municipal Affairs and Housing (MMAH)

The Planning Act and Provincial Policy Statement (PPS)

MMAH administers the *Planning Act* which sets out the ground rules for land use planning in Ontario. It sets the policy foundation for regulating the development and use of land. The *Provincial Policy Statement (PPS)* (Province of Ontario, 2014) is issued under the authority of Section 3 of the *Planning Act* and provides policy direction on matters of provincial interest related to land use planning and development, including matters related to hazardous lands. The *PPS* was first issued in 1996, and revised in 1997, 2005 and 2014.

Excerpts from the PPS highlighting key directives with respect the natural heritage and hazards read as follows.

> *"The Province's **natural heritage resources, water resources, including the Great Lakes**, agricultural resources, mineral resources, and cultural heritage and archaeological resources provide important environmental, economic and social benefits. The **wise use and management of these resources** over the long term is a key provincial interest. The Province must ensure that its resources are managed in a sustainable way to **conserve biodiversity, protect essential ecological processes and public health and safety,** provide for the production of food and fibre, **minimize environmental and social impacts, and meet its long-term needs**.*
>
> *It is **equally important to protect the overall health and safety of the population**. The Provincial Policy Statement **directs development away from areas of natural and human made hazards**. This **preventative approach supports provincial and municipal financial wellbeing over the long term, protects public health and safety, and minimizes cost, risk and social disruption.** Taking action to **conserve land and resources** avoids the need for **costly remedial measures to correct problems** and **supports economic and environmental principles**."* (PPS 2014. Page 4-5)

The balance between the appropriate type of intensification or redevelopment, and the level of development allowed, should be determined keeping in mind the wise use and management of resources and additionally the requirements under the Protecting Public Health and Safety section of the *PPS* and the involvement of the various communities affected where appropriate. The protection and health of the natural water systems, natural and cultural heritage, minerals, agricultural and archaeological resources while conserving biodiversity for their economic, environmental and social benefits must also be addressed.

The diversity and connectivity of natural heritage features and areas are also key considerations for any development to be considered along Lake Ontario or the St. Lawrence River in order to protect the biodiversity and maintain their long-term ecological function. They should be maintained, restored, improved and provide additional linkages wherever possible.

Section 1.5 of the *PPS* recognizes the importance of Public Spaces, Recreation, Parks, Trails and Open Space. Future developments along the shoreline should consider, where applicable, public access and ownership for the following; natural recreation areas, conservation reserves and environmentally protected areas, parklands and their supporting facilities, public spaces, open space areas, trails, linkages, water-based resources where appropriate.

Section 2.2 addresses the quality and quantity of water resources, including surface water features, municipal drinking water supplies and vulnerable areas. These areas should also be protected by considering the cumulative impacts of development on a watershed scale where appropriate. This may include providing restrictions on development and site alterations by identifying, maintaining linkages and water

resource systems consisting of sensitive surface and ground water features, hydrologic functions, natural heritage features and areas, including shoreline areas, as these are necessary for the ecological and hydrological integrity of the watershed.

Section 3.1.2 of the *PPS* stipulates that "Planning authorities shall consider the potential impacts of climate change that may increase the risk associated with natural hazards."

As stated in the *PPS*, there should also be:

> *"planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality; ensuring consideration of environmental lake capacity, where applicable; and ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces". (PPS 2.2.1 f,g,h)*

Ministry of Natural Resources and Forestry

The Ontario Ministry of Natural Resources and Forestry (MNRF) has developed two key documents to support the natural hazards policies of the *PPS* that are relevant to the present study, namely:

- Understanding Natural Hazards. Great Lakes – St. Lawrence River System and large inland lakes, river and stream systems and hazardous sites (MNRF, 2001) which is an introductory guide for the public health and safety policies 3.1 Provincial Policy Statement; and

- *Great Lakes — St. Lawrence River System and Large Inland Lakes Technical Guides for flooding, erosion and dynamic beaches* (MNRF, 2001) which provides detailed technical guidance for application of the natural hazard policies of Section 3.1 of the *PPS* including supplemental technical guidance on hazardous sites and the geotechnical principles for stable slopes .

The MNRF administers the *Public Lands Act* which regulates the use of Crown land and shore lands in Ontario, including the beds of most lakes and rivers. Any works on or near crown land which deposit materials in Lake Ontario or the St. Lawrence River may need permission from MNRF.

MNRF also administers the *Lakes and Rivers Improvement Act*, which regulates works to construct, alter, improve or repair dam infrastructure in Ontario, including temporary dams and other works (e.g. water crossings, channelizations, enclosures, cables and pipelines).

2.2. CRCA

Conservation Authorities (CAs) in Ontario were established in 1946 to ensure the conservation, restoration, development and management of Ontario's natural resources through programs that balance human, environmental and economic needs. CAs are responsible for implementation of the natural hazard policies of the PPS. Since 2001, MNRF has delegated to the *CAs* the responsibility to represent the provincial interest for the natural hazard policies in the *PPS* (Section 3.1 *PPS*). This requires that the CAs review and provide comment on municipal planning documents and site-specific applications submitted under the *Planning Act*. They must ensure that these plans and applications are consistent with the natural hazard policies of the *PPS*.

On May 4, 2006 "*Ontario Regulation 148/06, Cataraqui Region Conservation Authority: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses,"* was enacted. This regulation identifies the area regulated by the CRCA, generally prohibits development in that area, and provides the authority to issue permits for development within the regulated area.

CRCA has developed an internal planning policy document, *Environmental Planning Policies* (*EPP*) (CRCA, 2015). The *EPP* provides specific policy direction where the *PPS* and municipal Official Plans are silent or where CRCA expertise warrants additional policy for matters specific to the Cataraqui Region.

The CRCA developed *Guidelines for Implementing Ontario Regulation 148/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* (CRCA, 2017). This document is largely based on Province-wide approaches as presented in the MNR Technical Guides and adapts them to local conditions by incorporating jurisdiction-specific guidance on flood and erosion hazards.

2.3. Municipal Planning and Regulation Policy

In accordance with the *PPS*, all municipalities include provisions for natural hazards, heritage and the environment within their Official Plans (OPs) and zoning by-laws. The CRCA reviews and comments on all of the OP's that are within their jurisdiction. Of the eleven municipalities and townships under the CRCA's jurisdiction, the following eight border the waters of Lake Ontario and/or the St. Lawrence River:

- City of Brockville,
- Township of Elizabethtown-Kitley,
- Township of Front of Yonge,
- Town of Gananoque,
- Town of Greater Napanee,
- City of Kingston,
- Township of Leeds and the Thousand Islands, and
- Loyalist Township.

Some municipalities within the study area specifically identify and recognize the importance of their waterfront areas through the creation of waterfront master plans, trails and park systems to support the protection of these natural features and to provide vital recreational opportunities for the community. As discussed in the following, opportunities exist to get natural hazard policies more fully embedded in some of these planning and policy documents. Sections 2.3.1, 2.3.2, and 2.3.2.1 are provided as a review of municipal land use planning documents as they relate to natural hazards. Recommendations are provided as a way to improve natural hazards content in these documents. These recommendations are general in nature and are supplementary to the recommendations provided in sections 5 and 6 which pertain to the specific technical questions of the study.

2.3.1. City of Kingston

The City of Kingston recognizes the importance of their waterfront areas throughout their Official Plan (City of Kingston, 2017) and Waterfront Master Plan (City of Kingston, 2016) documents.

The various sections within the OP that discuss the waterfront and natural hazards are; Section 3.9 Waterfront Protection, Section 3.10 Waterfront Protection and Section 5 Protection of Health and Safety, and Section 6 The Environment and Energy. The OP has designated a 30 m setback from the shoreline as 'Environmental Protection' Area (2018. Kingston OP, Schedule 3-A, see Figure 3 below).

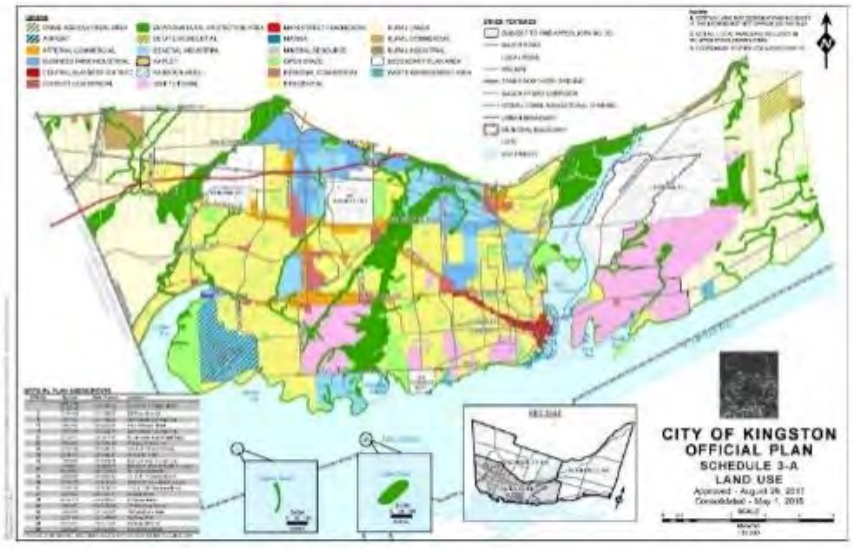


Figure 3 Schedule 3-A Land Use Map

Ribbon of Life Policy

Kingston's Official Plan has adopted a "Ribbon of Life" policy to enhance and protect the City's waterfront (Sect. 2.8.3). This policy seeks to establish a 30m naturalized buffer along the waterfront. Section 3.9 of the Official Plan entitled "Waterfront Protection" outlines the goals and general policies of this Ribbon of Life strategy.

> ***Protection of Waterfront Areas***
>
> *2.8.3 The City recognizes the importance of its waterfront areas along Lake Ontario, the St. Lawrence River, the Great Cataraqui River and the many inland lakes and water bodies that define the landscape character. As further outlined in Section 3.9 of this Plan, the City seeks to protect and enhance a 30 metre naturalized buffer, also known as a 'ribbon of life', along the waterfront. The continued acquisition of waterfront lands will accordingly be pursued by the City to ensure the long term protection of the resource and the amenity that it brings to residents and visitors alike.*
>
> *(Amended by By-Law Number 2017-57, OPA Number 50)*

The focus of this policy is on landscape, recreation, and natural heritage rather than hazard lands (which are handled through the CRCA as noted in, for example, Section 5.10 of the Official Plan). Key elements of the Ribbon of Life policies are:

> *3.9.2: The protection of a 30 metre naturalized buffer along the waterfront, also referred to as a "ribbon of life", can help to enhance water quality, minimize soil erosion, provide plant and animal habitat, establish connectivity and wildlife corridors, and contribute to the overall health of shoreline ecosystems, particularly fish habitat. The buffer may also be used to screen views of development from the water, and to create natural spaces for passive recreation.*
>
> *3.9.3: Zoning controls will be used to establish a minimum 30 metre water setback from the high water mark to implement the objectives of the "ribbon of life" policy, as expressed in Section 3.9.2 above. A zoning bylaw amendment or minor variance, as appropriate, will be required in support of any relief from the 30 metre water setback, subject to the policies of Section 3.9.8 and other applicable policies of this Plan.*
>
> *3.9.4: An Official Plan amendment will be required in support of any requested relief from the 30 metre "ribbon of life" unless one of the exceptions listed in Section 3.9.5 or 3.9.6 applies [which specify exclusions for parks, trails, marinas, shore protection and the like].*
>
> *3.9.6 On lots existing as of the date of adoption of this Plan, new development must be located outside of the 30 metre "ribbon of life" unless one of the following two circumstances applies:*
>
> *a. where the depth of a lot, existing as of the date of adoption of this Plan, is insufficient to accommodate a modest amount of development and any related servicing outside of the 30 metre water setback, subject to Section 3.9.8; and*
>
> *b. for the enlargement of a building, structure, or facility which existed on the date of adoption of this Plan, provided the enlargement does not further encroach into the existing water setback, subject to Section 3.9.8.*

The key definition of the Ribbon of Life is that it is a buffer extending 30m landward from the 'high water mark'. The Official Plan defines the high-water mark as follows:

> ***High Water Mark***
>
> *The highest water level that has been maintained for a sufficient duration (on an annual basis) as to leave physical evidence upon the landscape marking the boundary between that water level and upland areas.*
>
> *The boundary may be identified by:*
>
> *a. An examination of the bed and bank of the waterbody, to determine where the presence and action of water has been so common and usual and long continued in all ordinary years to mark upon the bed or bank a character distinct from that of the abutting upland; and/or*
>
> *b. A distinction between either open water or dominant aquatic/wetland vegetation, and dominant upland vegetation.*
>
> *(Added by By-Law Number 2017-57, OPA Number 50)*

It is the professional opinion of the author (M. Davies) that this definition of high-water mark is ambiguous. The phrasing "The highest water level that has been maintained for a sufficient duration (on an annual basis) as to leave physical evidence upon the landscape" suggests a water level such as, say the highest average monthly water level. But static water levels tend not to leave much of a mark on the landscape. In open water bodies such as Lake Ontario, the 'physical evidence upon the landscape' can be the upper bounds of a beach – typically defined by the limit of wave runup under 'typical conditions' but this can, naturally, vary based on storm conditions and extreme events. Similarly, for Great Lakes shorelines, the band between aquatic/wetland vegetation and upland vegetation can be vast – in many beach areas aquatic vegetation is not found in depths less than 1m, while upland vegetation might be 1m or more above the ordinary water line – with the band between (the active shore zone) being largely free of vegetation. The horizontal distance between the end of aquatic vegetation and the start of upland; or from the static water level to the upper beach limit can be tens of meters. A more rigorous definition of the water-side boundary for the 'Ribbon of Life' is needed.

A federal government report on water boundaries (Ballantyne, 2016) explores the distinctions between water marks and water levels, noting that in Ontario, non-tidal water boundaries are established as the water's edge under non-extreme, non-freshet conditions (p. 11, Ballantyne, 2016). This is in contrast to some other territories and provinces which use the Ordinary High Water Mark (OHWM) as the edge of limit of a body of water. The report goes on to note that the Ordinary High Water Mark (OHWM) as a label is discontinued in jurisdictions [such as Ontario] where OHWM in not used.

A statistically-derived water level such as the mean water level during May-June on Lake Ontario (typically the highest levels of the year) would form a more robust delineation for the shoreward boundary of the Ribbon of Life.

For consistency with CRCA regulations and policies regarding hazard lands, it is recommended that the City of Kingston's 30m "Ribbon of Life" buffer use the water's edge during typical high-water conditions as its shoreward boundary.

For the Kingston area, the 'typical high-water' level is 75.1m (IGLD85) – based on the average (50th %ile) daily water level during June. This level is based on the long-term water level data for CHS Gauge 13988 at Portsmouth Harbour for the time period 1962-2018 (see Figure 4, below).

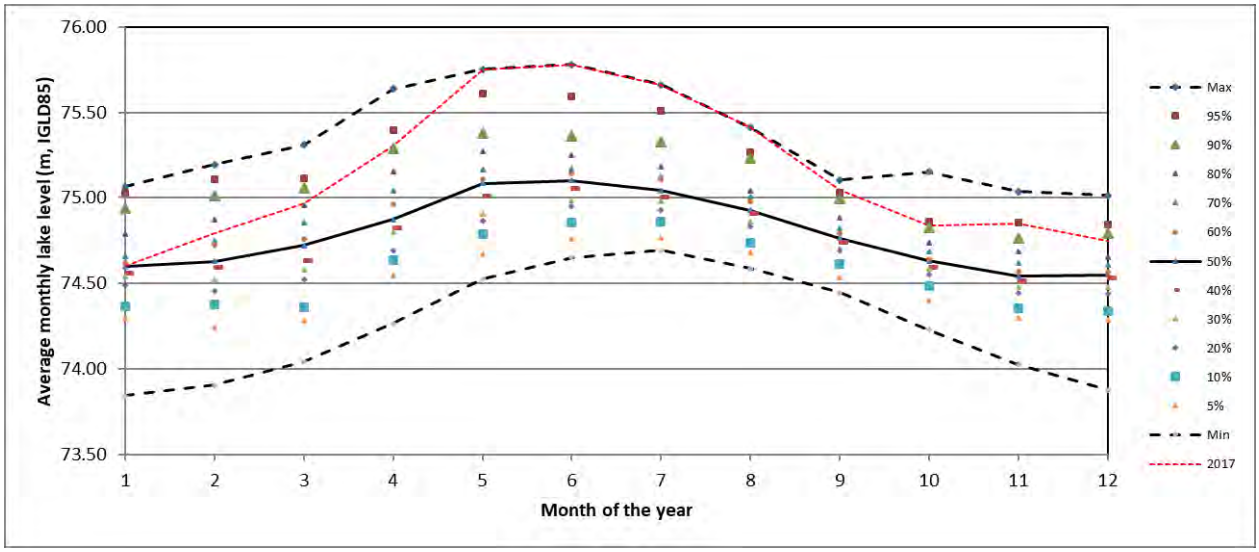


Figure 4 Lake Ontario water levels @ Kingston 1962-2018 (Stn 13988)

R1 - The City of Kingston should consider amending the 'Ribbon of Life' buffer to use a statistically-derived definition for its shoreward boundary, such as the 75.1m IGLD85 lake level noted herein. (Note that this is equivalent to 74.80m CGG2013 and 75.14m CGVD28 – see Section 3.3.1 for more details).

2.3.2. Municipal Maps and Official Plan Schedules

The City of Kingston's trail and community park linkages and trail system have been identified in their plan and are located along their entire waterfront (Figure 5). The City of Kingston's Schedule 11-A Constraint Mapping identifies regions marked as 'Natural Hazards' (see Figure 6 below, 2018. Kingston OP, Schedule 11-A). It is our understanding (G. Newman, p. comm.) that this hazard includes a 30m buffer to capture the erosion hazard along Lake Ontario. It may be beneficial to refine this buffer in accordance with an updated erosion hazard assessment.

Figure 5 Waterfront Trail and Park Linkages

R2 - Inclusion of an updated erosion hazard should be a priority in updating this Schedule 11-A mapping – this could have significant implications for potential future planning for not only identifying the hazard areas but also the implications for the environmental and open space areas which are key components of the City's Waterfront Master Plan and Natural Heritage Areas.

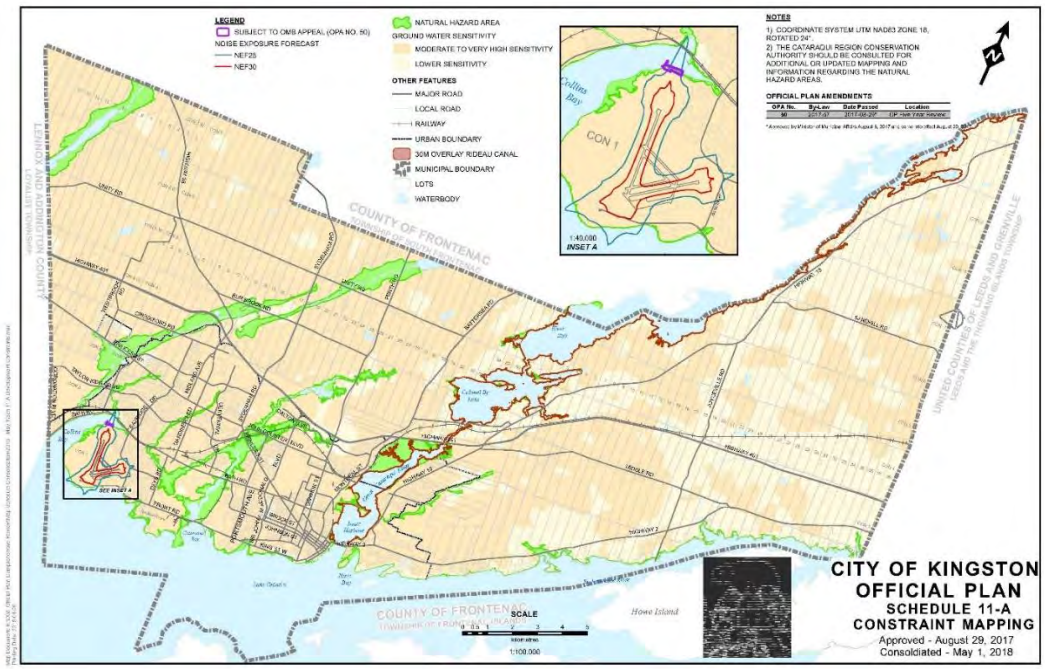


Figure 6 Schedule 11-A Constraint Map

The City of Kingston has produced mapping for both the Environmental Protection and Natural Heritage areas. Additional details on the implementation of site specific policy areas such as the 'Harbour Area' have been identified separately with corresponding site specific policies outlined in Schedule 3-D (see Figure 7).

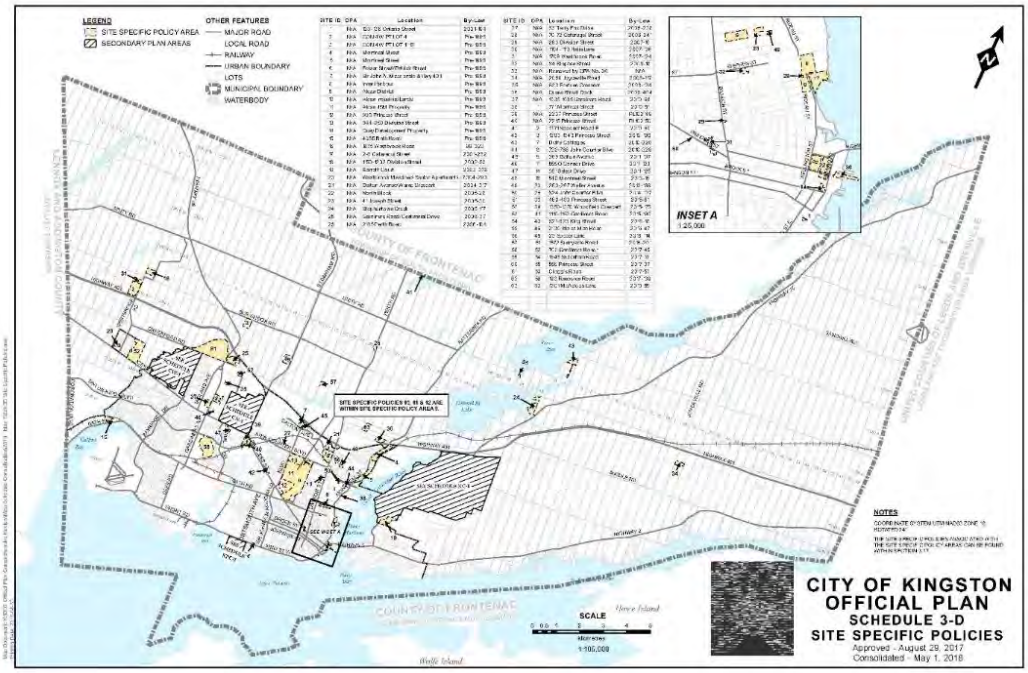


Figure 7 Schedule 3-D Site Specific Policies Map

The following sections provide general recommendations for the City of Kingston to consider when carrying out future updates of their OP, zoning by-laws and supporting planning and policy documents for natural hazards. Various sections from these documents have been identified in the following comments, where the hazards or associated public waterfront land ownership, future trail system etc. could enhance and support both the environmental and hazard programs as they are often interconnected. Protection of these types of lands could be assimilated or supported throughout the OP, zoning by-laws, waterfront documents etc. in order to provide mutual support for both of these programs since they are naturally integrated within one another. The comments and policy sections that have been highlighted, would need to be further reviewed and assessed, in accordance with how the City would like to support their overall approach to achieving their waterfront goals and objectives. A more detailed assessment would be required in order to ensure integration of the appropriate recommendations within the applicable sections throughout the City's OP, zoning by-laws and other supporting policy and planning documentation.

City of Kingston Official Plan Recommendations

The subsequent recommendations have been provided to highlight areas within the OP and specific zoning by-laws with respect to natural hazards in order to strengthen the direction and implementation of these directives throughout the various documents. Inherently, additional areas along the waterfront (e.g. environment, waterfront trail system etc.) will also be supported as a result of these recommendations and will ultimately assist the City in achieving their waterfront policy, planning and management goals.

One of the key issues related to natural hazards is that the OP does not always recognize or highlight the natural hazards (and the erosion hazard in particular), throughout the OP and as mentioned previously, is not included in the 'Natural Hazard" Schedule 11-A Constraint mapping. The OP does have requirements for flooding hazards and unstable soils (the latter not being related to water) referenced throughout the document, however it does not highlight the riverine, St. Lawrence River and Lake Ontario related erosion and slope stability issues other than in Section 5. There are a number of areas within the OP where changes could be made to highlight and support and reinforce issues related to natural hazards, namely:

R3 - Recommended changes to Kingston OP:

a) Section 3.9., Waterfront Protection (Discussion and Goals) should provide a discussion on the natural hazards (Flooding, and Erosion) and the need to allow for these setbacks in accordance with the CRCA regulations (i.e. Section 5, and 5.5 to 5.9 of the OP). This could further be outlined in the Goals and General Policies.

b) Development of Existing Lots Section 3.9.6. should reference natural hazards.

c) New Lot Creation Along the Waterfront Section 3.9.7should reference natural hazards.

d) Hazard Lands Section 3.9.10 needs a better description of the main hazards that this includes, (i.e.; flooding, erosion and unstable soils hazards) for river and stream systems, the St. Lawrence River and Lake Ontario. This should perhaps also reference Section 5, and 5.5 to 5.9 of the OP.

e) CRCA Regulations Section 3.9.21 should highlight what hazards those regulations apply to (i.e.; flooding, erosion and unstable soils hazards), so the concept of the total Erosion Hazard (i.e. the Stable Slope allowance plus Erosion setback allowance plus a 6 m access allowance) is understood. The same thing for the Flood Allowance consisting of a 100-year flood allowance plus wave uprush, over-topping and other water-related hazards. This would clarify that the total setbacks typically required can be quite significant. This section could also reference Section 5, and 5.5 to 5.9 of the OP.

f) Harbour Areas Section 3.9 A should highlight that the shorelines may also be substantially affected by Natural Hazards (i.e.; flooding, erosion and unstable soils hazards) and that the CRCA regulations and *PPS* requirements for these hazards should be adhered to.

g) Environmental Impact Assessment, Section 3.9.A.5 should also discuss the requirements of the CRCA regulations and *PPS* legislation related to natural hazards (i.e.; flooding, erosion and unstable soils hazards) since the later Environmental Protection Areas (EPA) section makes reference to some of these hazards (i.e. flood protection in Section 3.10.2).

h) Marina Area, Section 3.9.B.3(b) should outline the flooding and erosion hazards and the CRCA and *PPS* regulatory requirements since only floodproofing is mentioned here.

i) Marina Area, Section 3.9.B.5. should include discussion of the erosion and slope stability hazards and allowances in the discussion of stable slopes. Alternatively, this section could remain only including the unstable soils not associated with water, in which case, the erosion and slope stability hazards discussion should then be placed in the previous Section 3.9.B.3.

j) Environmental Protection Areas Section 3.10., should have reference to the natural hazards also included in the opening paragraph since the requirements are part of some of the other subsequent sections. This could also reference Section 5, and 5.5 to 5.9 of the OP.

k) Setbacks Section 3.10.7., may want to consider putting the hazard setback explanation in this section.

l) CRCA Regulations Section 3.10.8., should highlight what hazards those regulations are for (i.e.; flooding, erosion and unstable soils hazards), so that the concept of the total Erosion Hazard (i.e. stable slope allowance plus and erosion setback allowance, plus a 6m access allowance) is understood. The same thing for the 100 year flood allowance plus the wave uprush, over topping and other water related allowances for the Flooding Hazard. This provides a much clearer picture for the reader of the fact that these may not be small setback distances that will be required. This could also reference Sections 5, and 5.5 to 5.9 of the OP.

m) Protection of Health and Safety Section 5 should include the erosion hazard in opening paragraph as an additional natural hazard.

n) *Regulatory Floodplain*, Section 5.5 could more appropriately be reworded to include all of the required Flooding Hazards. The *Regulatory Floodplain* definitions describing the three different types (a, b, and c) along the shoreline could be provided from page 30 of the OP in order to emphasize the distinct shoreline types that are within the City of Kingston jurisdiction.

o) Natural Hazard Mapping, Section 5.9. The reference to only the 'regulatory floodplain' does not include the erosion hazards which should be part of the hazard mapping. This relates to the earlier recommendation that a study should be carried out in collaboration with the CRCA and the City of Kingston to determine the erosion hazards and incorporate them into the hazard mapping. The full description for river and stream systems, St. Lawrence River systems and Lake Ontario Flooding should also be included in the description paragraph of Section 5.5 as noted previously.

p) The waterfront lands could have a specific OP designation of "Natural Hazards" (in accordance with the CRCA mapping, including the addition of the erosion hazards) in order to further support and emphasize the importance and restrictions associated with these lands up front, in a very clear immediate visual format. Although there is provision for the hazards in the Schedule 11A constraint mapping, the scale is difficult to see and if there was a separate designation for these lands it would highlight much more clearly that these are not just environmental or open space lands, but unique areas with specific hazard issues which need to be addressed. This would need to be assessed and reviewed in more detail with the City in order to ensure the appropriate approach is recommended and whether or not it would be additionally useful to see if there would be other specific opportunities to strengthen the natural hazards areas and designations.

Waterfront Master Plan

The Waterfront Master Plan is supportive of the further development of waterfront parks and pathways and improvements to connections providing access to the waterfront.

R4 - A recommendation for future input to the Waterfront Master Plan document would be for the natural hazard waterfront lands to also be included. The inclusion of these lands would assist in highlighting further potential future linkages along the Lake Ontario and St. Lawrence River waterfront, and river and stream systems. The natural hazards also indicate areas which may potentially be considered for future acquisition because of their associated hazards. The natural hazard lands often work well with the overall concepts being considered for a waterfront plan related to environmental and open space lands and waterfront trails.

City of Kingston By-Law # 96-259- Downtown and Harbour

The following is extracted from the City of Kingston Downtown and Harbour *By-Law # 96-259* which was updated to include last amending *By-law # 2018-50* which was passed on February 6, 2018:

Under Section 5 – General Provisions, Sub-Section 5.37 WATER'S EDGE FLOODPROOFING AND EROSION CONTROL

Adjacent to or in Lake Ontario any building or structure which requires floodproofing, as determined by the appropriate approval authority, shall be flood proofed to the regulatory flood level and protected to the regulatory erosion limit." (Page 103).

R5 - The Downtown and Harbour By-Law # 96-259 (includes last amending By-law # 2018-50) does not make reference to the full requirements of the Flooding Hazard, and the Erosion Hazard requirements for either the *CRCA Regulation* or the *PPS*. It is recommended that the Flood and Erosion hazards should be included in future updates to more accurately reflect the requirements of the *PPS* and *CRCA regulation* regarding the flood and erosion hazard allowances.

Throughout several sections of this By-Law for the various areas there is reference to the 'Minimum Required Building or Structure Distance from Water's Edge'. For these sections the accompanying descriptions; "*Notwithstanding any provisions of this By-Law to the contrary, within the …Zone the minimum required distance between the* ***water's edge and the nearest part of any land-based building or structure shall be 10.0 metres (33 feet)****."* (the preceding was from the Park (P) Zone, Page 177).

R6 - It is recommended that additional descriptions be added in future revisions of the By-Law # 96-259 (includes last amending By-law # 2018-50) such as, 'OR a distance determined by the CRCA satisfying all the Natural Hazard CRCA Regulation and PPS Requirements'.

City of Kingston By-Law #8499 'Restricted Area Zoning By-Law'

Preliminary recommendations within the following sections of the *By-Law #8499* , Part VI: Part, Open Space and Environmental, Protection Area Zones, are as follows.

The description states; "The following regulations shall apply to lands, buildings or structures erected in…" the following Zones;
Section 32: "P" – General Recreation Park
Section 33: "P1" – Recreational building
Section 34: "P2" – Water-Area
Section 35: "OS1" – Public Open Space
Section 36: "OS2" – Private Open Space
Section 37: "OS3" – Harbour Open Space
Section 38: '"EPA" – Environmental Protection Area and
Part V: Industrial Zones, Section 28: "M5" – Waterfront Industrial.

Subsequently in each of these sections there is a description of side, rear lots, etc. provisions.

R7 - It is recommended that an additional description to include the Hazard Setbacks (Flooding and Erosion Hazards) requirements be added in each of the sections (i.e. Section 32: "P" – General Recreation Park, Section 33: "P1" – Recreational building, Section 34: "P2" – Water-Area, Section 35: "OS1" – Public Open Space, Section 36: "OS2" – Private Open Space, Section 37: "OS3" – Harbour Open Space, Section 38: '"EPA" – Environmental Protection Area and Part V: Industrial Zones, Section 28: "M5"– Waterfront Industrial), outlined in of the By-Law #8499 'Restricted Area Zoning By-Law' to strengthen the natural hazards.

2.3.3. City of Brockville

The City of Brockville Official Plan (City of Brockville, 2012) is supportive of the *CRCA regulation* and provides detailed description of the requirements for all of the natural hazards and identifies that if there are any discrepancies then it is the *CRCA Regulation* that will prevail as outlined in the following excerpt from the OP.

OP, Section 3.7.1.1 Flood Hazards #9. All lands within the Screening Area for the CRCA, as generally identified on Schedule 3, may be subject to the Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulations (the "CRCA Regulation"), which is administered by the CRCA under the Conservation Authorities Act. ***In the event of a discrepancy between the geographic application of the CRCA Regulation and the CRCA Screening Area*** *identified on Schedule 3 to this Plan, the geographic application of the* ***CRCA Regulation shall prevail in this regard.*** (OP, 2012. Page 84-85)

The Schedule 3 Natural Heritage System, Open Spaces and Constraints Map also includes the CRCA hazard mapping delineation (Figure 8).

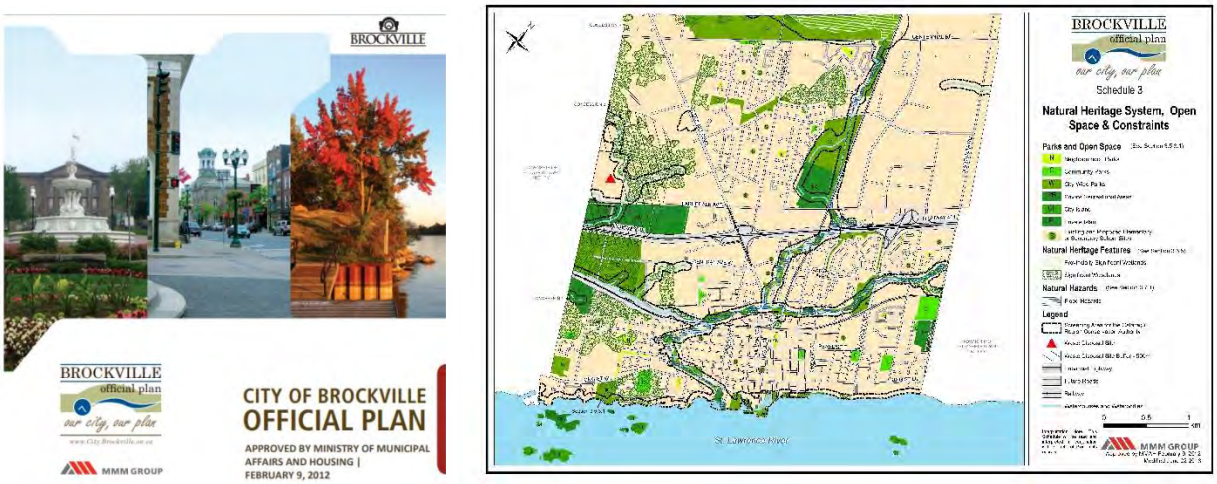


Figure 8 Official Plan & Schedule 3, Natural Heritage System, Open Space & Constraints Map

Additionally the City of Brockville had adopted a 'Downtown & Waterfront Master Plan & Urban Design Strategy' (City of Brockville, 2009) (Figure 9) with a goal of establishing "community planning and urban design principles to maintain the downtown and waterfront as a healthy, liveable and sustainable destination in the City"[1].

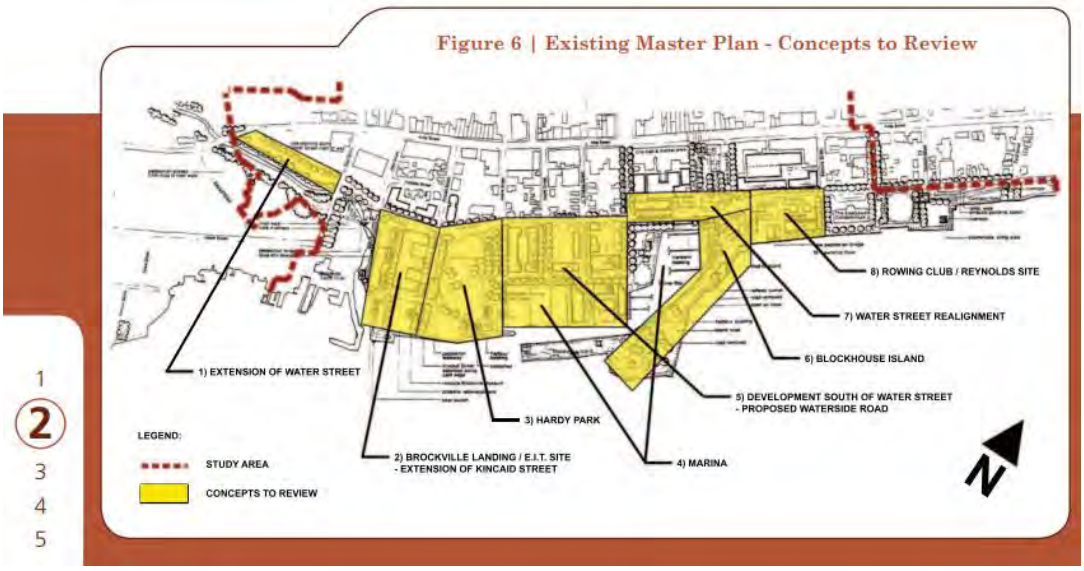


Figure 9 Downtown & Waterfront Master Plan & Urban Design Strategy

Since this document was produced in 2009, updates provided in the 2012 Official Plan document and the Schedule 3 Natural Heritage System, Open Spaces and Constraints Map, better indicate the CRCA hazard setback allowances along the shoreline. It would be beneficial to update the Waterfront Master Plan to reflect these changes.

[1] City of Brockville Downtown Waterfront Management Plan, page 1.

R8 - Any updates to the City of Brockville Waterfront Master Plan should reflect the current OP and CRCA hazard mapping requirements.
R9 - Additionally it is recommended that the development of an integrated shoreline management planning document be considered in the future for the City of Brockville.

2.3.4. Town of Gananoque

The Town of Gananoque Official Plan identifies a 'Recreational Pathway' along sections of their waterfront trail areas as shown in Schedule "A" of their Official Plan (Stantec, 2009) (Figure 10).

Figure 10 Schedule A, Lowertown District Policy Area

The Official Plan identifies Public Health and Safety in 'Section 3.7 Development Constraints – Planning for Public Health and Safety' and in 'Section 3.7.3 General' discusses the Hazardous areas which were mapped on Schedule G (Figure 11) from information provided by both the MNRF and the CRCA.

Figure 11 Schedule G, Development Constraints

It appears that the erosion hazards were not mapped on the shoreline nor were the erosion hazard requirements outlined for both the components of the stable slope

allowance and erosion allowance in the requirements within 'Section 3.7.4.1 Defining Areas Subject to Floods and Erosion', and 'Section 3.7.4.2 Permitted Uses' descriptions.

R10 - The Town of Gananoque erosion hazard requirements should be reviewed and should be included, along with the Access, Flooding and Protection Works Standards, in subsequent revisions of the Official Plan.

The Town of Gananoque has also identified Open Space (OS), Environmental Constraints (EC) and Waterfront Overlay (W), within their Development Permit By-Law (By-Law No. 2010-65) system. However, these designations have their "Waterfront Setback" requirements set at 30 metres (98.7 feet) and do not make provision in the By-Law descriptions for either the 100-year and/or regulatory flood plain elevation requirements or flood hazard setbacks, or the erosion setback consisting of both the slope stability and erosion allowance components. Both of these hazards, which have not been included in the By-Law descriptions, could potentially be further back than 30 metres. As a result, many of the natural hazard sites are not being initially flagged or addressed through the current Development Permit By-Law (DPBL).

The DPBL system, "*differs from traditional land use regulations by **allowing discretionary uses, conditional approvals, variations to standard requirements**, control of exterior design elements and control over the removal of vegetation in specific areas. This provides staff and Council with flexibility within the context of the By-Law to review development proposals and **provide approvals without further site specific amendments to this By-Law**.*" (Town of Gananoque DPBL report, 2010, Page 2).

In not fully delineating hazards at the DPBL stage, the risk arises that conditional approvals may be issued by the municipality prior to CRCA being given the opportunity to review the issue with respect to natural hazards. Full inclusion of hazards within the DPBL and its supporting mapping is therefore recommended.

R11 - Further review of Ganaoque's Development Permit By-Law (DPBL) system issue related to natural hazards would be required in order to make any specific recommendations, however a future consideration for the addition of the prerequisite for the CRCA to carry out an assessment before any conditional approvals, variations to standard requirements could be inserted into the DPBL as a requirement for any waterfront property. This, along with additions to the OP related to the erosion hazards as noted above, should be considered in subsequent revisions of these documents.

R12 – Additionally, the Schedule mapping could also be updated to include the entire CRCA regulatory area, so that any properties that are within this area would automatically flagged and go to the CRCA for review before any conditional approvals and/or variations to standard requirements could be issued for an application.

In section '3.7.2 Identifying Hazard Areas' of the Official plan the hazards are outlined. It appears that the waterfront erosion hazards were not included in the Official Plan Schedule "G" DEVELOPMENT CONSTRAINTS Mapping. Unstable soils were included but the erosion aspects of the natural hazards were not included.

3. Natural Hazards

The main natural hazard considerations for this study are erosion and flooding. Dynamic beaches, while an important component of Provincial hazard lands policies are not a dominant feature on the CRCA shorelines. This section reviews some of the technical aspects of flood and erosion conditions affecting the study areas.

3.1. Recent Lake Ontario Record High Water Levels

Record high water levels for Lake Ontario were experienced in the spring of 2017 (and again in 2019). In 2017, the daily average lake level at Kingston reached a record level of 75.81m (CGVD28) on June 1st, 2017. Levels in 2019 have been slightly higher with a peak daily mean level of 75.87m on June 14th, 2019. Shoreline owners along Lake Ontario and the St. Lawrence River experienced severe flooding, erosion, and damage to protection works as a result of the 2017 high water levels (see Figure 12 through Figure 15 below) and again in 2019.

The fact that record high levels (≈1% annual chance of exceedance) were reached in 1952 and again in 2017 and 2019 suggests that perhaps the '100-yr level' has something more like a 25-year return period. The statistics of Lake Ontario levels are complicated by ongoing changes to the regulation of the lake as well as a possible lack of stationarity in the record[2]. While a comprehensive review of lake levels may be warranted, it may also be worthwhile to bear in mind that the 'regulatory flood level' is not the highest possible level, but instead a level deemed sufficiently high to aid in hazard delineation and land use planning.

Figure 12 Shoreline erosion at Kingston's Breakwater Park, June 2017

[2] A stationary time series is one where statistical properties do not vary over time. A lack of stationarity means that statistics are changing with time, possibly due to climate change, or due to changes in water level regulation or overall system hydrology.

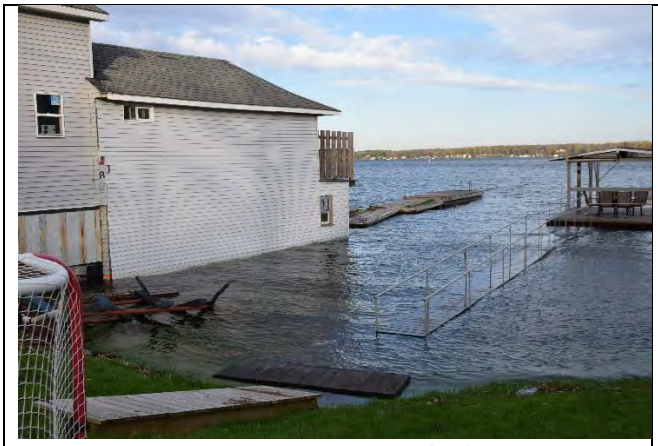


Figure 13 Flood waters in Brockville, May 2017

Figure 14 High lake levels near Amherst, May 2017

Figure 15 Wave runup -– Kingston area, June 2017 (left). Shoreline damage in 2019 (right)

The effects of recent flood levels on our understanding of the 1% Annual Exceedance Probability (AEP) Flood is illustrated by the following analysis of flood levels in the Ottawa River below the Chaudiere Falls (in downtown Ottawa). Figure 16 shows measured annual maximum river levels and the resulting estimate of the 100-yr (1%AEP) flood. Using available data up to 2016 gives a flood level of 45.25m. Including data up to 2019 increases the 1%AEP flood level by 35cm to 45.6m. This effectively gives a 35cm rise in the 100-yr flood level at Ottawa over the past 3 years.

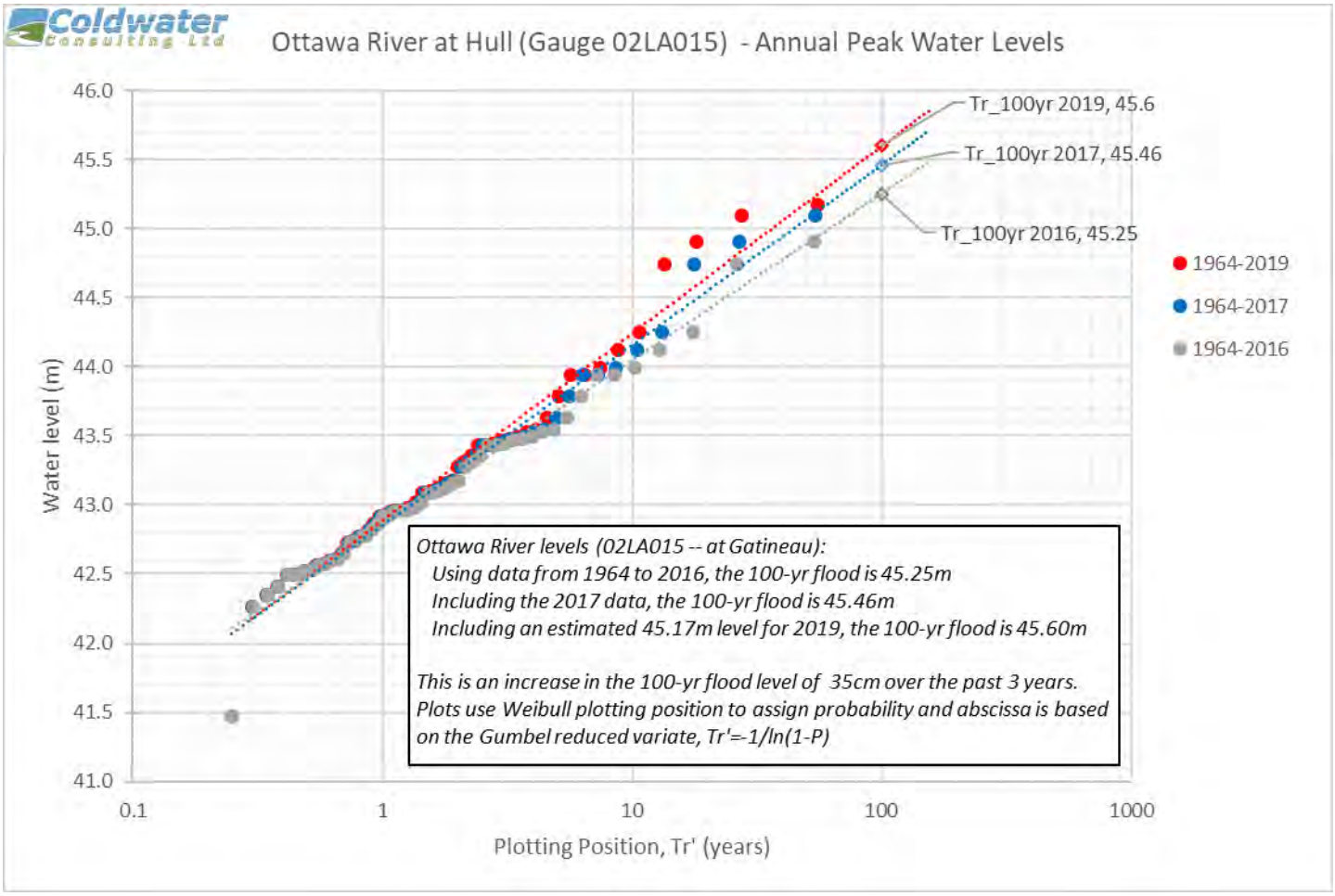


Figure 16 Flood levels in the Ottawa River

For Lake Ontario and the upper St. Lawrence River peak flood levels result from a combination of the mean lake level and storm-induced surge. The statistics of extremes in the mean lake level (using the daily average water level measured at Portsmouth Harbour in Kingston) have been influenced by the recent high water events of 2017 and 2019 as shown in Figure 17[3]. This preliminary analysis suggests that the 1% AEP mean water level at Kingston has increased by 0.19m (from 75.89 to 76.08m). Assuming that the statistics of surge events remain unchanged, it is reasonable to expect that the 100-yr flood level has similarly increased by about 20cm. Clearly there is a pressing need to re-examine water level statistics and the definition of acceptable flood risk levels. This could be an indicator of the effects of climate change, or merely a reminder of the uncertainties involved in predicting extreme events using relatively short measurement records.

[3] This plot shows the results of preliminary extreme value analysis on mean daily lake levels at Kingston using the Weibull plotting position and the L-moments method of parameter estimation for a best-fit GEV distribution.

R13 - A statistical re-evaluation should be undertaken for extreme water levels along the CRCA's Lake Ontario and St. Lawrence River shorelines including the most recent water level data (i.e. 2017 through 2019). This analysis should examine the joint probabilities of storm surge and mean water levels. For the Lake Ontario shoreline, it would be useful to also examine the joint probabilities of waves and storm water levels since the largest storm waves typically occur in late autumn, when lake levels are relatively low.

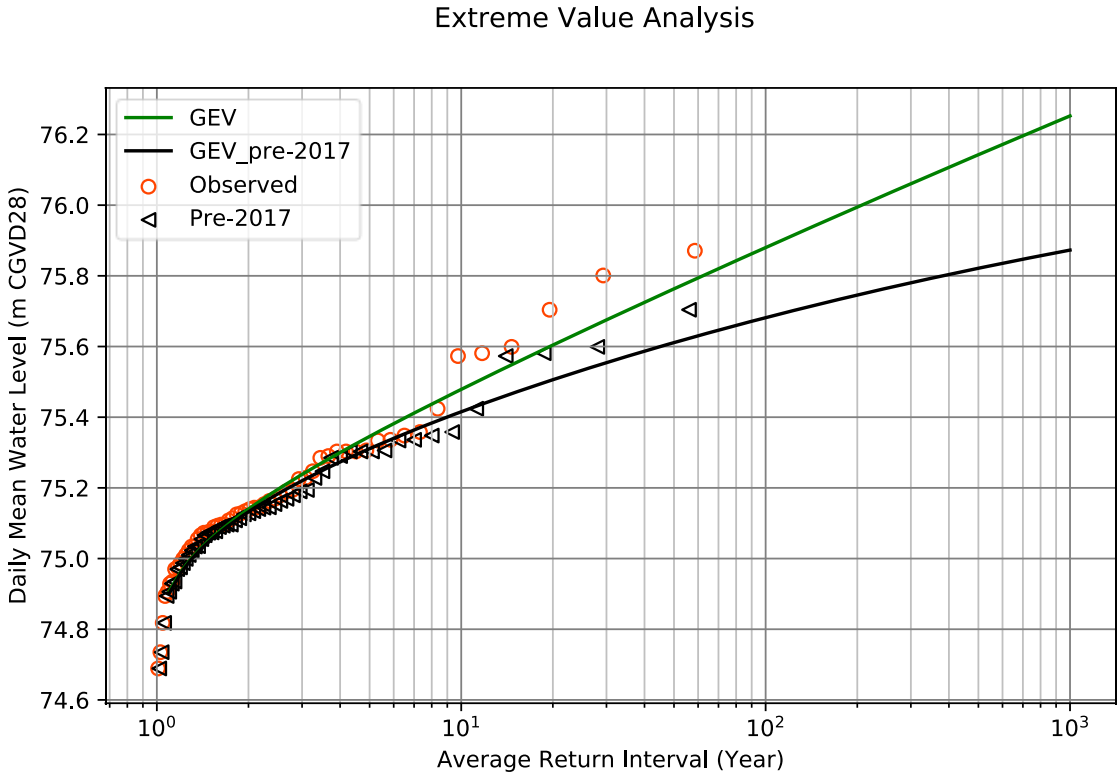


Figure 17 Changes in extreme value statistics of daily mean lake level at Kingston.

3.2. Climate Change Impacts

Climate change is expected to generally lead to increased temperatures, changes in weather patterns and increased sea levels. While the Great Lakes won't be directly affected by sea level change, changes to precipitation and evaporation could either increase or reduce lake levels. Warmer temperatures are expected to lead to reduced ice cover which will, in turn, lead to worsening winter storm conditions and increased erosion.

Along the Great Lakes the following impacts are expected; *"The most important impact of this longer ice-free season on coastal processes will be an increase in the number of storms associated with large waves and large storm surges. This effect is enhanced by the fact that storms during the winter months are generally more frequent and more*

intensive than spring and summer. In turn, the greater frequency of storms and increased number of intense storms will drive larger volumes of longshore sediment transport and an increase in the rate of downcutting of the nearshore and erosion of the bluff toe along cohesive shorelines." (Davidson-Arnott, 2016)

At present, our understanding of the effects of climate changes on the Great Lakes follows the adage that we have reached 'the end of stationarity'. While we fully expect climate change to manifest itself through changes in storm patterns, ice cover and overall precipitation and evapo-transpiration patterns, there is no clear consensus as to whether this will result in rising or falling lake levels. As such, the present MNRF lake level guidance, as presented in the Technical Guides, continues to be followed. The effects of climate change are generally being addressed through sensitivity analyses that explore the potential effects of changing climate conditions. With little clear guidance on the probabilities associated with future climate scenarios, it remains a challenge to incorporate the results of such analyses into quantitative hazard assessments.

3.3. Flood Hazard

Flooding within the CRCA jurisdiction is of particular concern along the St. Lawrence River where large areas of land are within the flooding hazard. Development in these areas could potentially cause adverse environmental impacts, upstream and/or downstream impacts.

The CRCA regulation limit for the flooding hazard consists of the 1%AEP flood level, plus an allowance for wave uprush and other water related hazards, plus a 15m allowance. In the CRCA jurisdiction, wave uprush has been calculated for individual profiles throughout the Lake Ontario and St. Lawrence River shorelines (Anthony, 1993) and as updated by CRCA (CRCA, 2015). The wave uprush calculations are provided in Appendix B of CRCA EPP 2015 document and are reproduced in Appendix B of this document.

To account for wave uprush and other water related hazards, in the absence of site-specific technical studies, the provincial standard requires a flood allowance of 15 metres for Lake Ontario and 5 m for the St. Lawrence River. This is measured horizontally from the 100-year flood level (Figure 18). The CRCA applies this standard in those areas not covered by the Anthony (1993) study (such as Amherst Island and the islands within the St. Lawrence River).

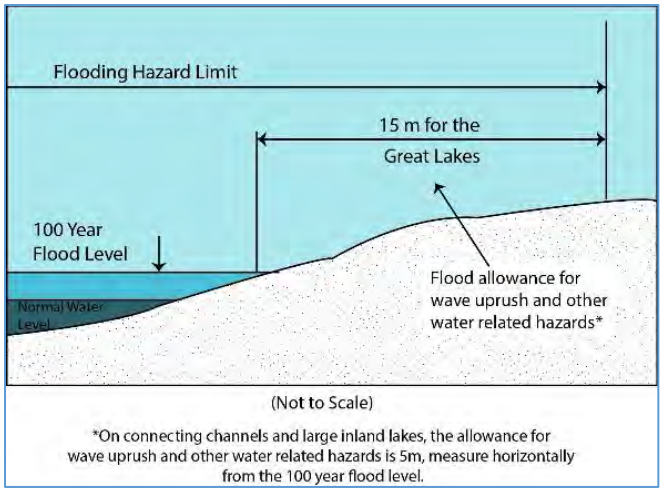


Figure 18 Flooding Hazard (Source: MNRF, Understanding Natural Hazards, 2001)

The use of a fixed, and somewhat arbitrary, horizontal setback to account for the effects of wave uprush ignores the effects of wave climate, nearshore bathymetry, beach slope, shore composition and overall shore profile on runup. It is our understanding that 15m was selected as being considered a relatively generous setback and that in most cases runup would be expected to be no greater than 15m. Provincial and CRCA guidelines both allow for detailed technical studies to be undertaken should a more accurate estimate of wave runup be desired.

One of the technical challenges in accurate delineation of the flood hazard is the evaluation of wave runup. The 2001 MNR Technical Guides provide a range of analysis techniques with guidance for calculation of nearshore wave conditions and the calculation of wave runup and overtopping. This guidance is, however, now somewhat outdated. Practising engineers commonly look to more recent methodologies available in the literature (for example advanced computer wave modelling techniques and the EU-CIRIA wave overtopping guidance). Even with more advanced approaches, wave runup estimates can vary significantly and wave overtopping estimates, in particular, can vary by an order of magnitude. As a result, there is a wide range of analysis techniques available, and there are varying levels of engineering expertise and often limited resources available to an individual property owner to fund such analysis. This can result in an uneven and inconsistent estimate of wave-driven flood hazards along a single reach of shoreline. While uncertainty in runup and overtopping estimates cannot be eliminated, the CRCA (as regulator) and the community in general, would benefit from a detailed regional assessment of flood hazards that would map the hazard at a sufficiently fine scale to ensure a uniform and defensible application of flood standards. Such as study would require a critical review of available analysis techniques, a careful review and compilation of available topographic and bathymetric data as well as a comprehensive peer review process. Effectively this would be an update to the existing Anthony (1993) and CRCA (2014) studies with a goal of providing uniform, equitable flood guidance for all riparian areas.

R14 One of the key recommendations of this study is that the wave uprush calculations for the flooding hazard component of the CRCA regulation be updated, for further information please see Section 6 with the Summary of Recommendations and the individual technical questions in Section 5 which will outline the detailed recommendations.

The flooding policies are consistent with the *PPS* in that development and site alteration are directed to areas that are outside of the flooding hazards. The CRCA Flooding Hazard policies are provided in Section 4.1 of the CRCA Environmental Planning Policy (EPP) 2015 document and highlights have been provided in Appendix B of this document. Additional detailed information and specific recommendations for the Technical Questions can be consulted in Section 5 of this document and the Appendices of the CRCA Guidelines for Implementing Ontario Regulation 148/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, November 2017 document.

3.3.1. Flood Levels and Vertical Datums

Water levels in the Great Lakes and the St. Lawrence River are typically reported in reference to either Chart Datum, or the International Great Lakes Datum of 1985 (IGLD85). Flood hazards and most land-based infrastructure typically refer to geodetic datum. Until 2013, the term 'geodetic datum' in Canada generally referred to the Canadian Geodetic Vertical Datum of 1928 (CGVD28) which was an approximation of mean sea level circa 1928. In 2013, Natural Resources Canada released a new national geodetic datum, CGG2013, which is a much more sophisticated, detailed and up-to-date estimation of mean sea level. It is, in fact, an equipotential gravitational surface which best represents mean sea level around the coastline of North America. Flood levels presented in the MNRF Technical Guides and reproduced widely through CRCA documentation are presented relative to 'GSC' datum, meaning CGVD28. The vertical difference between CGVD28 and CGVD2013 varies by location, in downtown Kingston, for example, the new CGVD2013 datum is 34cm above CGVD28 meaning that the 76.0m (CGVD28) flood level is now 75.66m in the new CGVD2013 datum. In Adolphuston, the difference in datums is 35cm, while in Brockville the difference is 33cm. Care must be taken in ensuring that the appropriate datums are being used in considering flood hazards and that the correct datum conversions are being applied. This is compounded by the fact that in casual terms both CGVD28 and CGG2013 are referred to as 'geodetic datum' or even 'mean sea level'.

R15 The CRCA and local municipalities should develop clear guidance on the use and applicability of vertical datums when dealing with flood hazards and should provide clear guidance on applying the flood hazard using the new CGVD2013 datum.

3.4. Erosion Hazard

The Provincial Policy Statement (PPS) defines the erosion hazard as follows:

> **Erosion hazard:** means the loss of land, due to human or natural processes, that poses a threat to life and property. The *erosion hazard* limit is determined using considerations that include the 100 year erosion rate (the average annual rate of recession extended over a one hundred year time span), an allowance for slope stability, and an erosion/erosion access allowance.

The MNR Technical Guides (MNRF, 2001) state:

> In defining the landward limit of the *erosion hazard*, it is recognized that there are three components to be calculated;
>
> - **stable slope allowance,**
> - **average annual recession rate**, and
> - **an erosion allowance.**

The following diagram from the technical guides suggests that a bank/slope is first delineated by determining its toe. A stable slope is drawn landward from the toe of the existing slope. The resulting 'top of bank' (which is un-named here) is then migrated landward to reflect the effects of 100 years of recession.

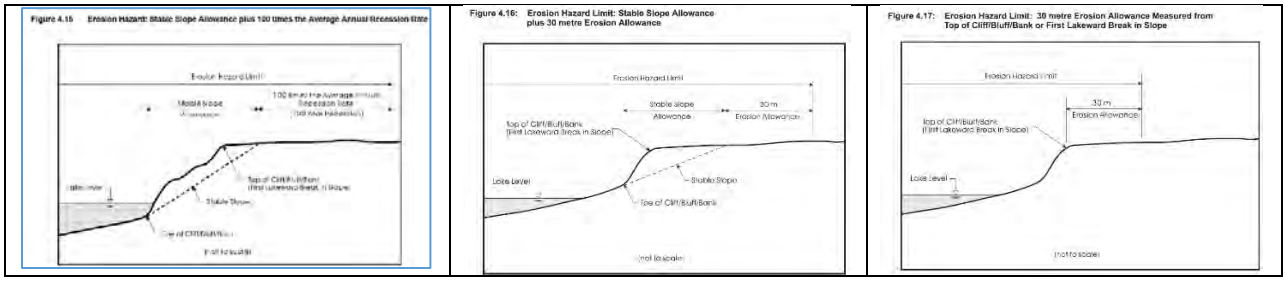


Figure 19 Erosion hazard from ON-MNR

The approach of applying the Stable Slope Allowance first and then the recession allowance is similarly shown in the Understanding the Natural Hazards (MNR 2001) document (Figure 20).

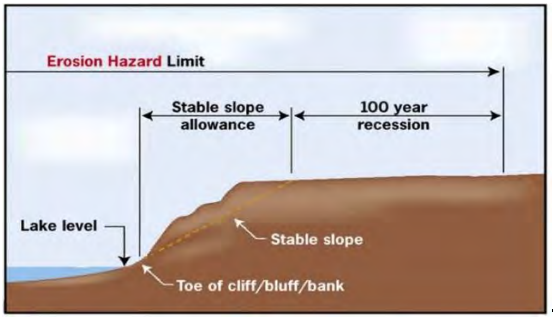


Figure 20 Erosion Hazard Limit – (Source: MNRF, Understanding Natural Hazards, 2001).

The MNR Technical Guides states that "[t]he first step in determining the erosion hazard is to identify and calculate the stable slope allowance measured landward from the toe

of the shoreline cliff/bluff/bank" (Item 4.4, p. 4-23). Throughout the text of the Technical Guides, the approach to shoreline erosion is dominated by the assumption that there is a defined toe of cliff/bluff/bank unless it is a dynamic shoreline. Section 4.4.1 of the Technical Guides provides the following guidance for determining the toe of cliff/bluff/bank:

> Three common sources of information used in defining the location of the toe and top of cliff/bluff/bank positions and the vertical height of the cliff, bluff or bank shore type are:
>
> - topographic maps with one metre contour intervals or less
> - detailed aerial photographs, or
> - field surveys
>
> Toe and top of the cliff, bluff, or bank positions usually correspond with contour lines on topographic maps, with visible changes, often in slope, on aerial photographs, and in terms of recognized and measured changes in slope as recorded in field surveys.
>
> **a) Submerged Toe**
>
> For shore forms having a submerged toe, for ease of application, the toe of the cliff, bluff, or bank shall be taken as the waterline. Use of the waterline is considered appropriate in these locations since in many cases the submerged toe of the cliff, bluff, or bank is usually very close to the waterline.
>
> When a more precise definition of the toe of the cliff, bluff, or bank is required, the submerged toe of the bluff can generally be located by simply wading offshore until a rapid change in underwater geometry is detected. This change is then considered to be representative of the transition from the vertical shore form into the nearshore. In situations where the toe of cliff, bluff, or bank is located at a depth that cannot be reached by safely wading, a sounding survey of the nearshore from a boat is recommended.
>
> **b) Covered Toe**
>
> There are two natural situations when a covered toe can exist. The first is where the toe is covered by a beach, the second is where the toe is covered by slumped material. In the case of a beach covering the toe of a cliff, bluff, or bank, the toe position is to be defined by the intersection point between the top of the beach and the base of the cliff, bluff, or bank (Figure 4.20a).
>
> Where slumped material covers the toe, the toe position of the cliff, bluff, or bank is to be defined by the extrapolation of the toe of the cliff, bluff, or bank from an adjacent uncovered cliff, bluff, or bank location (Figure 4.20b). Where the option of location extrapolation from an adjacent uncovered toe of the cliff, bluff, or bank is not feasible or appropriate, the best option is to core through the slumped material to find the transition point between the slumped and cohesive shore material.
>
> **c) Emerged Toe**
>
> The easiest situation is when an emerged toe exists. The exact location of an emerged toe is the point where the vertical face of the cliff, bluff, or bank profile changes to a shallow slope (Figure 4.21).

From this guidance, it is assumed that for ambiguous shore forms which do not demonstrate a clearly defined cliff/bluff/bank face, the 'waterline' should be used as a proxy for toe of slope. This guidance does not, however, specify how that waterline it to be defined.

The CRCA's Ontario Reg 148/06 defines the erosion allowance as follows (suggesting that the erosion setback is applied before the stable slope allowance):

> (ii) the predicted long term stable slope projected from the existing stable toe of the slope or from the predicted location of the toe of the slope as that location may have shifted as a result of shoreline erosion over a 100-year period,

Highlights from the CRCA Erosion Hazard Policies from Section 4.2 of the Environmental Planning Policy 2015 document have been provided in Appendix C.

The present CRCA technical guidance (CRCA, 2017) is shown in Figure 21. The erosion hazard extends to the top of the stable slope following 100-yrs of recession at the annual average recession rate (AARR).

The text in Figure 21 states that the erosion hazard is computed as the toe of slope after 100 years of recession plus the horizontal width of the stable slope. The diagram implies that the 100-yr flood level is used to define the toe of the stable slope but there is no explanation of how or why this would be done. Using the 100-yr flood level would become problematic in low-lying areas that are prone to inundation. Typical practice is to define long-term recession using 'typical' water levels and to use the 100-yr water level for flood risk. This is important in Lake Ontario since the most severe storms tend to occur in the fall when water levels have dropped from their late-spring peaks. As noted in Section 2.3.1, a level of 75.1m corresponding to mean July water levels may be a suitable reference level.

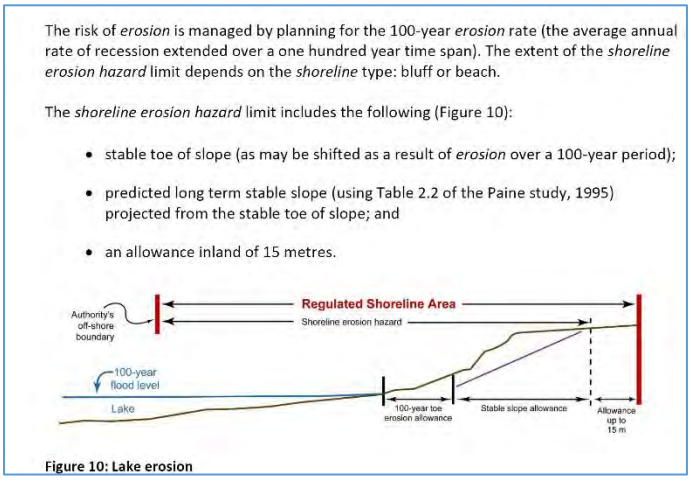


Figure 21 Excerpt from CRCA Technical Guidelines (2017) p.57

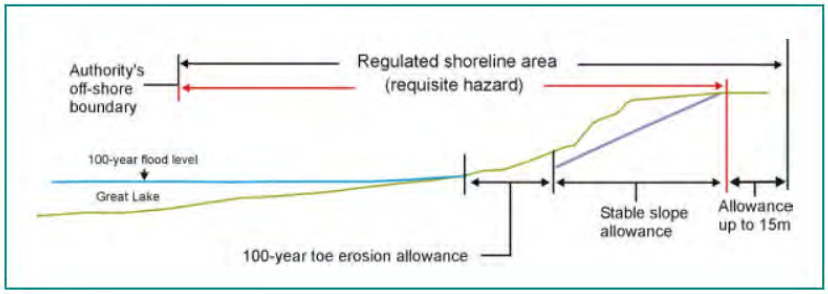


Figure 22 Guidelines for developing schedules of regulated areas, (CRCA 2005 EPP)

The stable slope allowance should be applied to any significant slope, bluff or cliff regardless of erosional state. Some debate has arisen regarding whether the slope allowance should be applied before, or after, applying the erosion allowance. The 'stable slope first' approach provides the following advantages:

- It recognizes that existing slopes may not be stable and need to be assessed for stability regardless of recession rates;
- It allows the geotechnical analysis for slope stability to be conducted using available information from the exposed (readily visible and accessible) face; and
- This approach is consistent with the ON-MNRF Technical Guides and the 2001 'Understanding the Hazards' document.

There are the following disadvantages:

- If the slope/bank/bluff/cliff is not well-defined, the slope and its toe become ambiguous. This is particularly the case when dealing with sheltered areas and small, low lying shore features.
- The alternative definition of the 'first lakeward break in slope" is also ambiguous.
- It assumes that all shorelines (except dynamic beaches) have a characteristic slope/face.
- Recession is typically based on past history (land that has already been lost). If backshore lands vary in geometry and/or composition, the stable slope analysis of the existing face may not be representative of long-term conditions and the erosion rate may also change over time.

If the lands shoreward of the top of bank are horizontal, then these two approaches result in identical setbacks. If, however, the land slopes upward (as is often the case), the application of the stable slope allowance further inland (after translation landward by the 100-yr recession distance) results in a larger horizontal slope allowance.

R16 - The stable slope allowance should be considered and applied at all stages in the evolution of the shoreline. This means that the stable slope allowance applies to the present-day shore position, as it does to the assumed future shore position (e.g. after 100 yrs x the Annual Average Recession Rate). In determining hazard limits, the approach of applying the recession allowance and subsequently applying the stable slope allowance landward from the toe of the future shoreline position as presented in existing CRCA guidance documents is appropriate. Using the stability of the existing slope as a proxy for the stability of the future slope should be based on the judgement of the Professional Engineer conducting the hazard assessment.
The existing technical guidance in the CRCA EPP documentation should be modified to clarify the water level used for definition of toe of slope (shoreline) for low-lying and sheltered shorelines.

3.4.1. CRCA-specific erosion guidance

The CRCA's erosion hazard guidelines (Paine, 1995) adopted a simplified shore classification approach for CRCA wherein shorelines are either dynamic beaches or are defined by a cliff, bluff or scarp face. Composition is either till or bedrock. Shores are either high (greater than 2m), or low (<2m). Shorelines are either exposed or in 'connecting channels'.

SHORELINE TYPE	REGULATORY EROSION STANDARD		
	Stability Allowance	Erosion Allowance	
		Open Lake	Connecting Channel
High Bedrock[2] (> 2m)	1:1 on rock portion 3:1 on till portion	5 m if till covered 0m if exposed rock	5 m if till covered 0m if exposed rock
Low Bedrock[2] (< 2 m)	1:1 from toe of slope	10 m	5 m
High Till (> 2 m)	3:1 from toe of slope	30 m	15 m
Low Till (< 2 m)	3:1 from toe of slope	30 m	10 m
Marsh (fringe ≥ 100 m)	0 m	30 m	seasonal high water level shoreline +10m
Beach (> 100 m long, 0.3 m deep, 10 m wide)	0 m	Reg. Flood Standard + 30 m	Reg. Flood Standard + 30 m

[1] To be used in conjunction with Figure 2.2.

[2] For a composite till on bedrock shoreline to be classified as bedrock shoreline, the elevation of the top of rock must exceed the seasonal high water level by a minimum of 1.0 metres.

Table 3-1 CRCA shore classification system and related erosion allowances.

The erosion allowances set out in the Paine report vary by site exposure with 'connecting channels' having erosion allowances of between ½ to ⅓ of that for 'open lake' exposure. While this is consistent with the idea that more exposed sites tend to see higher erosion rates, this approach leads to a marked and abrupt variation in the erosion hazard based on a somewhat arbitrary assessment of exposure.

The CRCA EPP guidance (CRCA, 2015), for example, provides guidance for which reaches of Lake Ontario shoreline are to be considered exposed or sheltered.

Figure 23 Shoreline exposure guidance from CRCA EPP Policy (2015)

Drawn at a scale of 1:450,000, this mapping is not capable of identifying sheltered bays, nor headlands, within the 'open lake' reaches. It lumps the sheltered waters of the Bay of Quinte with the relatively open shore between Bath and Amherstview while similarly treating relatively exposed headlands such as Everett Point the same as the inner shore adjacent to the La Salle Causeway. A more refined delineation of shoreline hazards (both for flooding and erosion) is needed.

R17 - It is recommended that the City of Kingston, in collaboration with the CRCA, carry out a study where the erosion hazard setback be determined and delineated along the Lake Ontario and St. Lawrence River shorelines throughout the City of Kingston jurisdiction. The results of this study could then be incorporated into both the City of Kingston and the CRCA Hazard mapping. This work would ideally be part of a re-analysis of the flood and erosion hazards for Kingston and the CRCA jurisdiction, providing updated hazard guidance at a finer spatial scale and could be undertaken as an integral part of a general shoreline management plan. This work would effectively replace the existing Paine (1995) and Anthony (1993) reports which are both now over 20 years old.

3.5. Recent Developments

The MNR Technical Guides that form the core of the Provincial toolkit for defining and addressing flooding and erosion hazards were written in the late 1990s and are a

substantial and comprehensive approach to the problem. Given that they are now over 20 years old, it is perhaps time to consider a re-evaluation of the guidance in light of ongoing developments in the field.

Aside from developments in available data and analysis techniques, approaches to flood hazard delineation have evolved considerably since the Technical Guides were first produced. Severe coastal flooding and erosion in the US, for example, has led to a substantial evolution in the flood mapping approaches used by the US government's Federal Emergency Management Agency (FEMA). The latest FEMA guidance provides a broad and up-to-date methodology for addressing coastal erosion and flood hazards both oceanic and Great Lakes shorelines (e.g. "Guidance for Flood Risk Analysis and Mapping – Coastal Erosion, (FEMA, 2018)).

3.6. Standards

Public Safety is paramount, and any alteration and development works must be carried out in accordance with the 'Protection Works Standard', 'Floodproofing Standards' and 'Access Standards'. The hazard policies and regulations have been highlighted in the following section however the detailed application and assessment for each of the individual Technical Questions is covered in Section 5 of this report.

3.6.1. Floodproofing Standard

The "*Floodproofing standard: means the combination of measures incorporated into the basic design and/or construction of buildings, structures, or properties to reduce or eliminate flooding hazards, wave uprush and other water-related hazards along the shorelines of the Great Lakes - St. Lawrence River System and large inland lakes, and flooding hazards along river, stream and small inland lake systems."* (PPS 2014)

Details of the provincial direction for the floodproofing standards are outlined in the *PPS* (2014) and MNR Technical Guides. Relevant sections from these documents have been provided in Appendix A and the individual recommendations for the technical questions (i.e.: TQ1 through to TQ6) have been provided in Section 5.

3.6.2. Access Standard

The purpose of the 'Access Standard' is to provide an area for safe access (ingress and egress) during times of flooding, and erosion hazards, and includes access for both emergency and regular maintenance equipment for regular maintenance, repairs, future rehabilitation or replacement of slope stability or shoreline protection works. The access allowance should also include being able to travel through the property to the lake and along the shoreline. The standard access allowance in the CRCA area is 6m and is recommended to be applied for all hazards.

Supporting this standard is the *Ontario's Emergency Management and Civil Protection Act* which defines an emergency as *"a situation or an impending situation caused by the forces of nature, an accident, and an intentional act or otherwise that constitutes a danger of major proportions to life and property."* It is a mandatory requirement for all

Ontario municipalities to have Emergency Management Programs based on local hazards and risks which are regulated by Emergency Management Ontario.

3.6.3. Protection Works Standard

The *"Protection works standards: means the combination of non-structural or structural works and allowances for slope stability and flooding/erosion to reduce the damage caused by flooding hazards, erosion hazards and other water- related hazards, and to allow access for their maintenance and repair."* (PPS 2014)

These requirements under Section 3.1.7 provide flexibility to recognize local shoreline conditions (Technical Guide, MNR 2001, Appendix A7.2, and Existing Development within the Hazardous Lands). The Technical Guide (MNR 2001a) provides specific guidelines for the protection works standard and includes the protection works themselves, the stable slope allowance and the erosion hazard allowance.

The protection works standard consists of the aggregate of the following components:

- The protection works structure
- The stable slope allowance
- The erosion hazard setback.

The MNRF Technical Guides recommend that an erosion allowance be maintained even with the installation of the Protection Works as a result of the ongoing natural erosive process which may continue to occur regardless of the existence of the protection works (e.g. undercutting of protection works): *"Some provision can be made for reductions to the overall allowances depending on the expected life of the erosion structures provided the design has been carried out according to "accepted scientific and engineering practices" with the expected life of the structure timeframe. For example if the design life expectancy of the structure is 30 years (provided the design of the structure is stamped by a professional engineer specializing in coastal engineering), then the erosion allowance portion of the setback could be reduced to 70 years x Average Annual Recession Rate PLUS the Stable Slope Allowance."* (Technical Guide, MNR 2001, Appendix A7.2, Existing Development Within the Hazardous Lands).

4. Comprehensive Approach to Planning and Policy

In order for all of the agencies to be able to work together so that the directions taken can be mutually beneficial, regulations, planning and policy tools to achieve common goals should be included when management options are being considered.

The Natural Heritage, Water Resources and Open Space Policies from Section 5, 6 and 7 of the CRCA Environmental Planning Policies should be taken into consideration for any shoreline development when applicable.

> *"The policies are organized by topic, but are intended to be considered concurrently. Thus, for example, consideration for the avoidance of natural hazards must also include an assessment of potential impacts on natural features and ecological functions, the quality and quantity of surface water, and other policy topics. By adopting a holistic, ecological approach, this Conservation Authority will make and encourage decisions that recognize the connectivity of issues relating to the natural environment of the Cataraqui Region."* (CRCA Environmental Planning Policy 2015)

When developing waterfront policy or planning issues, the following elements should be considered:

1. Natural and man-made hazards (flooding, erosion, dynamic beach)
2. Protection of natural heritage and/or rehabilitation/restoration
3. Historical and cultural heritage protection and/or rehabilitation/restoration
4. Archeology protection & restoration
5. Public access and open space
6. Continuous and connected trail system along shoreline and water's edge
7. System of linked scenic landscapes along the water's edge that provide a safe and accessible waterfront
8. Recreational opportunities
9. Economic (commercial/residential)

4.1. Integrated Watershed Management Approach

Conservation Authorities manage water resources using an integrated watershed approach that addresses human activities and natural resources on a watershed basis, taking into account social, economic and environmental issues, as well as community interests.

> *"What we do in Ontario's watersheds impacts the health and sustainability of the Great Lakes and St. Lawrence River basin. Upstream activities and conditions such as urbanization, increased water uses, pollution and stormwater runoff affect water quantity and water quality downstream. The benefit of using an integrated watershed management approach is that it allows us to address a wide variety of connected issues with strategies and*

plans that are developed in relation to each other." (Conservation Ontario web site fact sheet https://conservationontario.ca/policy-priorities/great-lakes/integrated-watershed-management-and-the-great-lakes/). An analogous approach can be used for shorelines through Integrated Coastal Zone Management.

On an international scale, Integrated Coastal Zone Management (ICZM) is described as "a resource management system following an integrative, holistic approach and an interactive planning process in addressing the complex management issues in the coastal area… A dynamic, multi-disciplinary and iterative process to promote sustainable management of coastal zones. It covers the full cycle of information collection, planning (in its broadest sense), decision making, management and monitoring of implementation. ICZM uses the informed participation and cooperation of all stakeholders to assess the societal goals in a given coastal area, and to take actions towards meeting these objectives. ICZM seeks, over the long-term, to balance environmental, economic, social, cultural and recreational objectives, all within the limits set by natural dynamics. 'Integrated' in ICZM refers to the integration of objectives and also to the integration of the many instruments needed to meet these objectives. It means integration of all relevant policy areas, sectors, and levels of administration. It means integration of the terrestrial and marine components of the target territory, in both time and space." (coastalwiki.org, 2019).

The Toronto Region Conservation Authority, for example, adopted an Integrated Shoreline Management approach for the Lake Ontario shoreline with a goal 'to provide an ecosystem-based framework to ensure that shoreline management activities result in a clean, green accessible, diverse, connected, open, affordable, attractive, and useable waterfront from Tommy Thompson Park to Frenchman's Bay" (Toronto Region Conservation Authority, 1996).

There are in fact several types of shoreline management approaches undertaken within Ontario. Some shoreline management plans are designed to implement integrated coastal zone management strategies (e.g Elgin County, 2015), while others regions have developed shoreline management plans focussed specifically on coastal natural hazards (e.g. the Central Lake Ontario, Ganaraska and Lower Trent Conservation Authorities jointly funded development of a Shoreline Hazards Management Plan in 2018.).

The CRCA's Lake Ontario and St. Lawrence River shorelines face a wide range of challenges ranging from development pressure, to public access and environmental preservation/restoration. An integrated shoreline

management plan would provide the opportunity to develop a coherent platform with which to address these inter-related and often competing perspectives. A shoreline management plan could be developed for the entire CRCA region, or possibly broken down into smaller units, for example, treating the Lake Ontario shoreline and the St. Lawrence River shorelines separately.

An integrated shoreline management plan might consider the following possible principles:

- Adopt an IZCM approach to balancing environmental, economic, social, cultural and recreational objectives, all within the limits set by natural dynamics.
- Take into consideration the natural inter-connections that exist between watersheds, shoreline zones and offshore areas when making shoreline management decisions.
- Make preservation and restoration of natural coastal ecosystems and landscapes a universal consideration in shoreline management.
- Give preference to locating development away from the shore and encourage any development activities at the shore to incorporate 'green development principles' that include natural habitat features and improved public access.

Objectives might include:

- Preserve and protect natural physical processes along the shore such as shoreline erosion, sediment transport and depositional processes.
- Protect and restore coastal habitat.
- Fully support for the Provincial Natural Hazards policies as expressed in the *PPS*.
- The open sharing and dissemination of shoreline data to inform and engage other agencies and the public in improving and protecting shorelines.

R18- It is recommended that CRCA and local municipalities consider developing and adopting integrated shoreline management plans as a means to develop a more comprehensive approach to shoreline land use planning, natural hazards and environmental protection.

4.2. Waterfront Regeneration Trust, Draft Waterfront Land Use Planning Survey

The Great Lakes Waterfront Trail organization undertook a waterfront land use planning of communities along the Lake Ontario and St. Lawrence River waterfronts to document and improve understanding of the current policy framework shaping the management and enhancement of our shared waterfront (Waterfront Regeneration Trust; Brook-McIlroy, 2014). This study solicited input from 46 community partner planning departments and included four case studies (Oshawa, Mississauga, Grimsby and Prescott). The outcomes of this survey are still applicable today and the section below highlights relevant findings from the report which could be considered when moving forward on the future management of the shorelines.

4.2.1. Planning and Policy Tools, and Processes

The survey found that communities use a wide range of planning and policy tools for waterfront enhancement. The most common tools used were the Official Plan, the Council's Strategic Plan or Priorities and Zoning.

The key findings of the study include;

- That embedding waterfront enhancement in high level planning documents and policies has been critical to action on waterfront enhancement. These documents are endorsed at the highest level of municipal government and provide direction for more specific policy development and implementation, as well as the assignment of funding to related studies and projects.
- That most municipalities use a range of policies and tools to encourage and regulate waterfront investment and enhancement.
- A clear, high-level vision helps to ensure that all of these policies are mutually supportive and ensures that resources are directed coherently.
- That many respondents described the importance of private development in realizing goals for waterfront enhancement, public access and trail development.
- Most communities face the challenge of balancing community goals for preserving waterfront access and natural heritage with goals for investment and development to promote waterfront vitality. The experience of many communities shows that these two objectives can be mutually supportive.
- It is important to establish development controls ahead of time to ensure that access will be guaranteed when this redevelopment occurs.
- Development controls also help to encourage investment, as they provide more certainty and predictability in the development approvals process.

Other planning and policy tools used to achieve shoreline management goals included:

- Secondary Plans
- Shoreline Management Plans
- Precinct Plans
- Urban Design Guidelines
- Policies on land acquisition
- Transportation/Active Transportation Plans

- Policies on parkland dedication
- City/town-wide policies related to parks and trails
- Development controls, design guidelines and public access/easement requirements
- Strategic partnerships
- Policies on downtown revitalization or special character areas
- Creation of land trusts for parkland reserves
- Lease agreements for public access/park use on lands not owned by the municipality

4.2.2. Private Development Support

The survey found that it was often important to provide for the inclusion of private land ownership as part of a waterfront development strategy. Methods to ensure that private development supports overall waterfront objectives included:

- Various types of studies such as waterfront studies, environmental studies, master plans/district plans, precinct plans, etc.
- Providing urban design guidelines that outline such things as; residential density considerations, visual structural impacts, lighting considerations, commercial uses and opportunity along the waterfront, tourism-oriented opportunities.
- Inclusion of the Waterfront Trail and public access in zoning or other development controls (eg. setback requirements, easements, parkland dedication requirements for public road allowances) and implementation through the site plan approval process.
- Integrating waterfront planning with other initiatives (eg. parks, downtown revitalization, protection of 'character areas', etc.).

4.3. Economic Considerations

A vital consideration for a successful Integrated Shoreline Management Plan (ISMP) is economic viability. Depending on the scale of the plan, some financial and acquisition strategies that could be considered to assist with the economic viability are:

- Use of development charges to fund trail extensions
- Dedication of waterfront lands or requirements for public access as a condition of land development approvals
- Land transfers from federal/provincial government
- Long-term allocation of municipal budgets to build up adequate resources
- Establishment of a community improvement plan to fund waterfront enhancements, especially on brownfield sites
- Establishment of long-term acquisition plans for private property
- Linking waterfront enhancement with other community development goals to share funding - investment in community services and facilities, downtown revitalization, etc.
- Creation of land trusts for parkland/wildlife reserves
- Lease agreements for public access/park use

Depending on the unique issues and considerations of the individual shorelines, these can bring about significant differences in ISMP approaches and preservation or

restoration of existing areas can vary substantially. There are many locations along the CRCA shoreline where the protection of natural areas, revitalization or restoration principals may be a desired criteria and it is vital that all of the governing agencies work together with the NGO's, shoreline communities and stakeholders to determine what is appropriate for their individual areas.

5. Technical Questions

Some of the challenges faced by the CRCA and local government agencies in waterfront development issues along the Lake Ontario and St. Lawrence River shorelines have been formulated as a series of technical questions that explore the application of the *PPS* and the associated guidance found in the MNRF Technical Guides.

5.1. Defined Portions of the Regulatory Floodplain (TQ1)

Question: Which areas of the St. Lawrence River and its regulatory floodplain should be included as "defined portions"?

Context: There is a need to interpret the definition of "defined portions of the flooding hazard along connecting channels" for the upper St. Lawrence River in the Cataraqui Region. The 'defined portions' are those which are "*critical to the conveyance of the flows associated with the one hundred year flood level... where development or site alteration will create flooding hazards, cause updrift and/or downdrift impacts and/or cause adverse environmental impacts*" (Ontario Ministry of Municipal Affairs and Housing PPS 2014, 3.1.2 and in *Definitions*, p. 40).

Discussion:

Infilling activities may have the following adverse effects:

1. Reduction in conveyance, leading to increased water levels upstream.
2. Reduction in storage, leading to increased flows and higher water levels both up- and downstream.
3. Increased risk of ice jamming.
4. Changes to velocity patterns that may adversely affect water quality and erosion/sedimentation patterns.
5. Environmental degradation and loss of diversity through habitat disruption and loss of natural shore features.

The technical challenge is how to evaluate what conditions would constitute 'no impact'. In terms of conveyance, the capacity of the river to pass the 100-year flood condition is highly influenced by discharge conditions at the Moses-Saunders Generating Station and the adjacent emergency spillway. The dam and its regulation form the main constriction on flow in the upper St. Lawrence River. Regardless of this, the St. Lawrence River does have a mild and spatially-varying slope between Kingston and Brockville – any proposed works that would measurably interfere with that slope would be of concern with respect to affecting the flood hazards upstream.

Section 3.1.2(b) of the PPS stipulates that development and site alteration shall not be permitted within defined portions of the flooding hazard in the St. Lawrence River, thereby allowing the consideration of development outside of 'defined portions'. The Technical Guides (Section 3.43) presents guidance on how determination of 'defined

portions' is to be based on studies using accepted engineering principles. The MNR Technical Guide 'River and Stream Systems: Flooding Hazard Limit' (Ontario Ministry of Natural Resources, 2002) provides details on methodologies for accepted engineering principles for determining flows and levels. Effectively, the consideration of development outside of 'defined portions' is somewhat analogous to the 'two-zone flood concept' wherein development is conditionally allowable in the 'flood fringe'.

Connecting channels of the Great Lakes, including the St. Lawrence River, bear the additional complexity of being trans-boundary waters. Particular attention must be paid to ensure that any consideration of works in 'non-defined' portions of the flood hazard will not adversely affect conditions along U.S. shores.

3.1 Natural Hazards

3.1.1 Development shall generally be directed to areas outside of:

a) hazardous lands adjacent to the shorelines of the Great Lakes - St. Lawrence River System and large inland lakes which are impacted by flooding hazards, erosion hazards and/or dynamic beach hazards;

b) hazardous lands adjacent to river, stream and small inland lake systems which are impacted by flooding hazards and/or erosion hazards; and

c) hazardous sites.

3.1.2 Development and site alteration shall not be permitted within:

a) the dynamic beach hazard;

b) defined portions of the flooding hazard along connecting channels (the St. Marys, St. Clair, Detroit, Niagara and St. Lawrence Rivers);

c) areas that would be rendered inaccessible to people and vehicles during times of flooding hazards, erosion hazards and/or dynamic beach hazards, unless it has been demonstrated that the site has safe access appropriate for the nature of the development and the natural hazard; and

d) a floodway regardless of whether the area of inundation contains high points of land not subject to flooding.

6.0 Definitions…

Defined portions of the flooding hazard along connecting channels: means those areas which are critical to the conveyance of the flows associated with the one hundred year flood level along the St. Marys, St. Clair, Detroit, Niagara and St. Lawrence Rivers, where development or site alteration will create flooding hazards, cause updrift and/or downdrift impacts and/or cause adverse environmental impacts.

Inset 1 Excerpts from PPS (2014) referencing 'defined portions' of connecting channels

3.4.3 Conveyance of Critical Flow in Connecting Channels

As a general rule, development within the 100 year flood level along connecting channels reduces the cross-sectional area of the waterway, so the corresponding flood level increases at the site and immediately upstream. General encroachment within the 100 year flood level also reduces the storage capacity of the channel and results in an increase in flood flows and the flood levels along the downstream reaches of the connecting channel. There may be specific locations along the connecting channels, at the outer limits of the 100 year flood level, that could potentially be safely developed with no adverse impacts. Due to the specific hydraulic conditions, including very shallow flood depth and minimal flood flow velocity, these outer portions of the flooding hazard limit within the 100 year flood level are generally not critical to the conveyance of flow associated with the 100 year flood level. The inner portions of the flooding hazard limit within the 100 year flood level along connecting channels which are critical to the conveyance of the flow associated with the 100 year flood level are those portions where development will not be permitted as it would result in a significant and unacceptable increase in the 100 year flood level.

Inset 2 Excerpt from Great Lakes Technical Guides regarding connecting channels

The Technical Guides for Rivers and Streams do not specifically refer to 'defined portions' of Great Lakes connecting channels. Neither the Great Lakes, nor the Rivers and Streams Technical Guides give criteria for delineation of 'defined portions'.

The CRCA Guidelines for Implementing Reg. 148/06 provide details on permissible development within regulated areas. In the 'notwithstanding' clauses of the CRCA Guidelines related to the *shoreline regulatory flood plain* (Section 6.3.3.2), subject to various constraints and considerations, the following activities/developments may be permitted within the *regulatory flood plain*:

- Fill placement within the wave uprush allowance
- Public infrastructure and utilities
- Public parks
- Shoreline, bank and slope stabilization works
- New buildings or structures on constrained lots
- Minor additions, landscaping and lot grading
- Reconstruction or relocation of existing buildings
- Structural repairs to existing buildings or structures
- Construction of driveways or access ways
- Removal and/or placement of small quantities of fill and site grading
- Replacement of sewage disposal systems and associated fill work
- Above-ground parking lots
- Marine facilities, erosion control measures and other such developments that, by their nature, are located within the hazard
- Dredging

The CRCA allows for the issuance of a letter of permission in lieu of a permit for activities considered to be relatively minor in nature. This, for example, includes "placement, excavation and/or grade modifications (including topdressing) that involve small quantities of fill in regulated areas"(4.2d). *Small quantities of fill* is defined within the CRCA guidance to be "a volumetric amount of fill not exceeding 12m^3 (one tandem truck load)", while a large quantity of fill is deemed to exceed 500m^3.

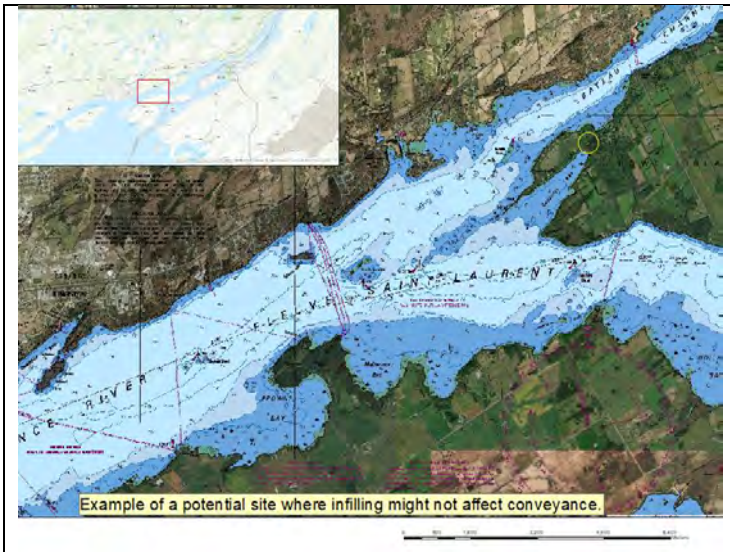
Broadly speaking, in Ontario when development is considered within the fringes of the floodplain, it is within the context of the 'two-zone' concept, wherein development is strictly prohibited within the main course of the flood channel (the floodway), but may be considered permissible within the 'flood fringe'. Definition of the flood fringe is based on hydraulic conditions. Appendix 4 of the River and Stream Flood Hazard technical guide summarizes the factors to be considered in assessing the suitability of applying the two-zone concept.

Permitting of development in defined areas of the St. Lawrence River might best be based on the concept of *no adverse impact*. Any development should prove to a reasonable level of certainty that infringement on the floodway or flood fringe is designed and/or mitigated in such a manner as to ensure no increase in flood levels will result.

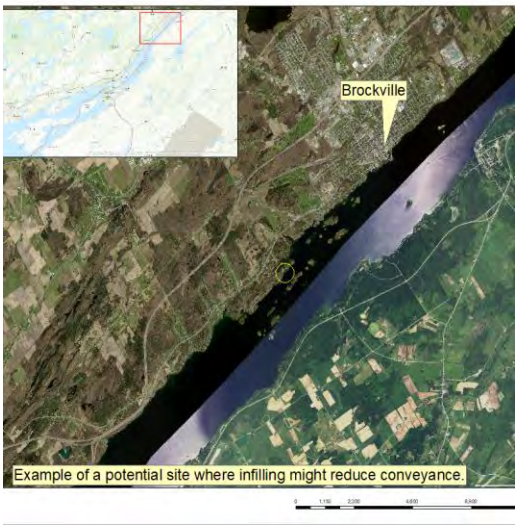
> The extent of the floodway is to be determined based on local watershed conditions, such as critical flood depth and velocity, existing and proposed development, and the potential for upstream or downstream impacts. Generally, flow depth in excess of 1 m and/or flow velocities above 1 m/s can create significant hazards for developments.

Inset 3 Flood fringe criteria - MNRF Technical Guides, Rivers and Streams, Flood Hazard

Detailed one- or two-dimensional flow modelling is recommended for any proposed infilling works in or near controlling channel sections. Such work would have to reliably and accurately demonstrate that the proposed works would result in no net increase in upstream water levels.



1) Infilling within the 100-yr flood plain that is unlikely to change conveyance. An example of this might be the construction of a secondary building or land grading in the St. Lawrence River in lands of elevation between the Ordinary High Water Mark and the 100-yr flood hazard. (e.g. Cassidy's Bay at the southern tip of Howe Island).



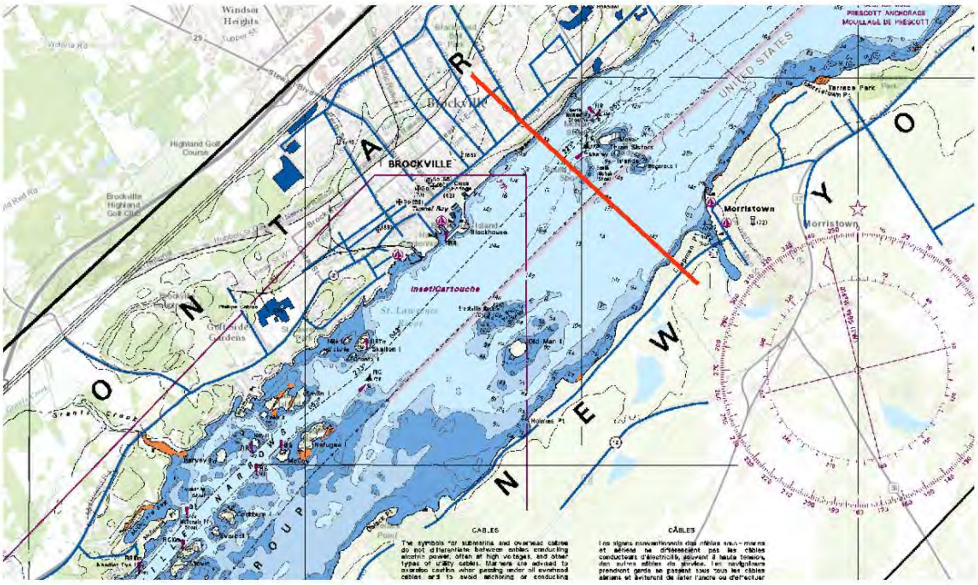
2) Infilling within a portion of the 100yr flood plain that may change conveyance.
An example of this might be in-filling along the shore of the St. Lawrence River near Brockville.

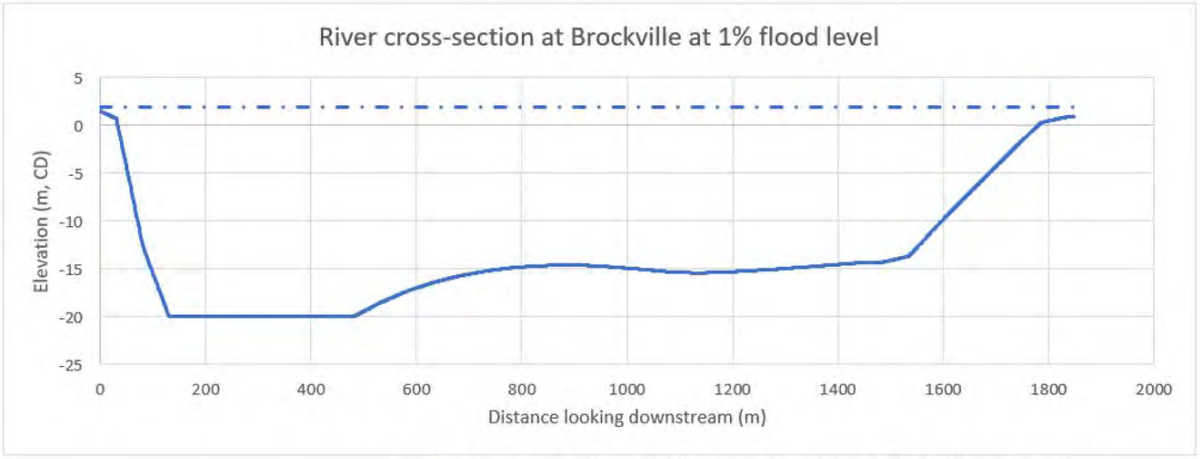
Figure 24 Two hypothetical scenarios for infilling

To put the scale of the problem in perspective, the following discussion considers two hypothetical infilling scenarios in the upper St. Lawrence River (Figure 24).

First let us consider conditions at Brockville (Figure 25). The cross-sectional area at chart datum is 26,000 m^2 and peak discharge at Cornwall is 9,870 m^3/s.

Figure 25 shows that a fill 5m wide (in the cross-shore direction) by 1m high would change the average flow velocity in the channel by just 0.06 mm/s or 0.02% - virtually undetectable in terms of changes to the average flow velocities. There would, however, be an increase in depth associated with any infilling within the active (controlling) flow channel. As this simplistic analysis shows, a $5m^2$ infill would increase upstream water levels by roughly 3mm. Using the principle of 'equal degree of encroachment' as employed by FEMA in the US., this fill is considered to be distributed as $2.5m^2$ of fill on each side of the channel. A $2.5m^2$ fill, if applied uniformly across the width of a 30m lot, would be $75m^3$ of infilling (this is much greater than the present CRCA 'small fill' limit of $12m^3$). This analysis is an upper bound on fill effects, since channel roughness is typically much higher in the flood fringe than in the main channel, the effect of infilling in the fringe is generally much less than that of the same quantity of infilling within the floodway.





Increase in average channel velocity and depth under peak flood conditions

Simplified cross-sectional analysis using Manning's equation to compute normal flow conditions

Flood level: 75.9 m IGLD85 (1.95m CD)

Record outflow LOSLR: 9,870 m^3/s Cross-sectional Area 29,385 m^2

Fill Area (m^2)	0	1	2	5	10	100	200
Modified Area (m^2)	29,385	29,384	29,383	29,380	29,375	29,285	29,185
Average Vel (m/s)	0.336	0.336	0.336	0.336	0.336	0.337	0.338
V Change (mm/s)		0.01	0.02	0.06	0.11	1.15	2.30
V Change (%)		0.00%	0.01%	0.02%	0.03%	0.34%	0.69%
Mean flow depth (m)	16.294	16.295	16.295	16.296	16.300	16.329	16.388
SWL change (mm) from normal flow assumption		0.4	0.9	2.3	5.3	34.5	93.5
SWL change from continuity assumption (mm)		0.4	1.2	3.2	7.3	48.0	130.2

Figure 25 Simplified infilling effect analysis

In a backwater area such as the Howe Island site, there is no flow through this area that affects conveyance. In the terminology of the HEC-RAS flow model, for example, this area would be characterized as an *ineffective flow area*. The effect on storage (and consequently on overall flow rates) is almost infinitesimal when one considers the

possible areal footprint of a development (say 100m^2) compared to the surface area of the Lake Ontario-St. Lawrence River system (roughly 19,000km^2 or 1.9x10^{10}m^2).

From a planning perspective, the challenge then becomes how to define which areas of the river are close enough to controlling channel sections to require a stringent analytic treatment. The Howe Island example mentioned previously is likely to have no significant effect of river conveyance and flood levels, while the Brockville example does have the potential to generate an afflux and to adversely affect flood levels.

The MNR Technical Guide for the Flooding Hazard Limit (MNR, 2002) describes the planning and technical aspects of defining and evaluating a two-zone concept to address potential development in the fringe of a floodway as follows:

> A rigorous approach based on the present hydraulic criterion to identify the floodway and flood fringe boundary was developed by Moin and Shaw (1989) using the DWOPER model. Multiple regression equations are used to undertake a sensitivity analysis to tests the changes in flood levels, flows and velocities caused by various degrees of flood fringe encroachment. The method is based on equations which relate the topographic features and degree of encroachment to the hydraulic changes in the flood plain. Generally, five different levels of encroachment are modelled for at least three different flows ranging from a 25 year to the Hazel or Timmins floods. The final selection is based on the proposed development scenario with the least upstream and downstream impacts. New development that may be permitted in the flood fringe should be protected to the level of the flood standard. (ON-MNR TG Flooding Hazard Limit, 2002 p. 14).

Inset 4 Analysis guidelines for flood fringe development

DWOPER – the Dynamic Wave Operational Forecast Program (Fread, 1976) is a 1-dimensional unsteady flow model developed by NOAA. It has subsequently been replaced by HEC-RAS. The approach taken in Environment Canada's Floodway and Flood Fringe Analysis Guidelines (Moin & Shaw, 1991) is broadly consistent with standard hydraulic engineering practice which would employ 1- and/or 2-dimensional flow models to evaluate pre- and post-project flow conditions.

Delineation of 'defined portions' of the river that would constitute a concern with respect to flood hazards would need to be based on a detailed technical study of flood conditions in the river. This study could use an accepted, calibrated model of the upper St. Lawrence River (preferably a 2D model, possibly available through Environment Canada) to determine hydraulic conditions at cross-sections of the river. At each cross-section (nominally, say at 100m spacing), the cross-sectional area at flood stage and velocities could be extracted. These hydraulic conditions could be used to identify 'controlling channel sections' where no consideration of infilling would be made without a detailed, site-specific modelling study.

In determining permissible infilling activities outside of these 'controlling channel sections' a calibrated 2D steady flow model could be used to simulate conditions at the 1% annual exceedance flood level and to simulate the effects of nominal infillings (say, 10 to 100 m^3) in selected backwaters and embayments in order to develop a basis for selecting 'defined portions' of the river where minimal infilling works could be

considered. Criteria for which may be nearshore depth, site alignment, depth of existing embayment, etc. It is quite likely that an assessment based on this type of hydraulic analysis would find that infilling within backwater bays could be extensively undertaken without significant changes to flood levels. This, however, may not be acceptable from environmental or other planning perspectives.

Finding:

Currently, there are no definitive answers when it comes to the questions of which areas of the St. Lawrence River and its regulatory floodplain should be included as the "defined portions", significant additional technical analysis would be required to determine where these types of areas could be considered. At this stage the recommendation is to carry out a detailed hydraulic analysis such as the one outlined above in order to provide further technical clarification. Permitting of development in defined areas of the St. Lawrence River should be based on the concept of no adverse impact. Any development should prove to a reasonable level of certainty that infringement on the floodway or flood fringe is designed and/or mitigated in such a manner as to ensure no increase in flood levels will result. Detailed 2-dimensional flow modelling is recommended for any proposed infilling works in or near controlling channel sections. Such work would have to reliably and accurately demonstrate that any proposed works would result in no net increase in upstream water levels.

R19 The CRCA and/or interested municipalities should develop a Terms of Reference for a flow modelling study to a) delineate 'defined portions' of the St. Lawrence River which are critical to the conveyance of the flows associated with the one hundred year flood level, and b) to establish the necessary criteria for site-specific studies of proposed activities outside of the 'defined portions'. This second part of the study (part b) might also provide guidance for establishing negligible/permissible 'minor activities'. The guidance for this approach may possibly be based on previous work by Moin & Shaw (1991). It is suggested that flow modelling be undertaken using a two-dimensional hydrodynamic model. Coldwater Consulting would be willing to assist in the development of these Terms of Reference if so desired.

5.2. Wharfs, Piers and Filled Land (TQ2)

Question: *What are the relevant considerations regarding flooding and erosion hazards for development proposals* ***on highly modified shorelines such as former wharves, piers, and historically filled lands*** *that extend into Lake Ontario and the upper St. Lawrence River?*

Context: There is no specific guidance in the PPS for these types of sites wharves, piers, and historically filled lands that extend into the lake or river. In general, development is to be directed outside of the stable slope, erosion and access allowances. Protection

works may reduce the erosion allowance in some circumstances but do not eliminate the requirement for erosion and flooding hazard setbacks.

Discussion: The typical review of these types of sites would require the erosion and flooding hazards both be addressed, as well as access, ingress/egress standards and setbacks. Under most conditions, the width and depth of the setbacks typically would not allow for development on the remaining narrow pieces of property such as old piers, and wharfs. This is, however, likely to often be complicated by pre-existing / historical development rights.

The waterfront interface with the land is often owned by the public and with this comes the responsibility for the maintenance of the shoreline structures by a public agency who will ensure the safety and long-term maintenance of shoreline structures.

In other locales, ownership and control of the urban waterfront often lies in the hands of a public agency, and the adjacent areas are developed with commercial and/or residential developments (e.g. City of Toronto working with Waterfront Toronto, the Hamilton Port Authority, Port of Vancouver, etc.). Developments are often set back from the waterfront with a public component for a waterfront trail adhering to the natural hazard setbacks and often additional public recreational and/or cultural components are included in the development. Examples from other shoreline jurisdictions have been provided in Appendix D.

While not explicitly mentioned in the PPS, the Great Lakes Technical Guides provide some details on identifying and defining 'artificial shorelines' (Section 2, Item iv). Artificial shorelines are not, however, mentioned in sections on the delineation of erosion and flood hazards, nor in sections on 'addressing the hazard'.

2(iv) Artificial

For the majority of Great Lakes - St Lawrence River System, the physiographic characteristics of the shoreline provide the basis for the identification of the shore type in the recommended shoreline classification scheme. There are a few shoreline locations, however, where the physiographic characteristics have been significantly altered and as such, do not meet any of the recommended shoreline classification scheme criteria identified to this point. For the purposes of this Technical Guide and the recommended shoreline classification scheme, the significantly altered shorelines will be defined as artificial shore types_ The criteria used to define the artificial shore type includes those shorelines that:

- cannot be classified on the basis of their physiographic characteristics due to human activities and/or alterations to the shoreline;
- involve structural changes that extend inland (i_e., well into the onshore zone);
- involve protection works that exist above and below the waterline and that extend continuously alongshore for about 1 km;
- have the protection works under public ownership and/or are maintained by a public agency (e.g., Conservation Authority, municipality, harbour commission) or a significant private concern; and
- have shoreline processes and flood, erosion and dynamic beach hazards which have been significantly altered by the protection works

The artificial shore type is predominately found along the waterfronts of major metropolitan centres such as Toronto, Sarnia and Sault Ste. Marie and at many major harbour developments (see Figure 2_9). Understanding the local flood, erosion and/or dynamic beach hazards along artificial shorelines often requires site specific studies. In addition, these site specific investigations must examine the functional longevity of the protection works and assess their potential impacts on the physical and biological environment should the protection works fail.

The artificial shore classification does not apply to shorelines where small scale and/or uncoordinated protection works have been installed by individual property owners, even where the protection works continuously extend over long distances alongshore. The primary rationale is that the natural shoreline type can still be determined and many of the shoreline processes are still taking place. Also, small scale protection works are generally placed on a individual basis and provide different lifespans and differing levels of flood and erosion protection and tend not to have consistent maintenance and repair activities. Collectively, this tends to lead to inconsistent, short-term design life protection and with it, a variety of associated problems. For a more detailed discussion on the functional design life, associated problems, and the applicability of various small-scale protection works, Part 7: Addressing the Hazards, of this Technical Guide, should be consulted."

Inset 5 MNR Technical Guide on "Artificial Shorelines"

In this sense, portions of the historic Kingston and Brockville waterfronts, for example, would likely qualify as *artificial*. It might be worth considering here a different nomenclature for this type of shoreline. Industrial / Post-industrial, dockland, harbourland come to mind as possible terms to better describe these areas. For now, we will refer to them as docklands.

In considering waterfront developments in dockland areas, prudent planning is unquestionably essential. Measures such as setbacks for flood hazards, public access, viewscapes, etc. are all valid, one should not, however, misappropriate the erosion allowance as a proxy for other setback requirements. If the coastal processes that drive shoreline recession are not in existence, then the erosion allowances should not be applied.

One consideration in assessing dockland areas is the extent to which natural hazard criteria should be applied based on present-day condition and usage versus potential future conditions. If such an area was to be re-developed, one would anticipate inclusion of some re-naturalization efforts. At certain scales, these re-naturalized areas may re-

introduce natural coastal processes, and with that re-establish the need for erosion hazard assessments and allowances.

Site	Key Attributes	'Artificial Shoreline'?
Shoreline at Elevator Bay / Cataraqui Bay	Post-industrial wharves dating to 1880s (grain elevators). Wharves extend up to 400m offshore. Mostly surface-piercing sheet piling. 1.6km of artificial shoreline extending 600m alongshore. No beach materials. Entire bay sheltered by 720m long offshore breakwater.	Yes While relatively small in scale, this seems to meet the criteria for an artificial shoreline. Erosion potential (downcutting at toe of shoreline structure) still needs to be addressed. Flood hazards unaffected by artificial shoreline status.
Portsmouth marina / Kingston Penn.	Long-standing docks and post-industrial waterfront. No visible beach features. Alongshore length of 600m Developed in early 1800s	Yes While relatively small in scale, this seems to meet the criteria for an artificial shoreline. Erosion potential (downcutting at toe of shoreline structures) still needs to be addressed. Flood hazards unaffected by artificial shoreline status.
Utilities Kingston Pier to KYC	1km reach. Developed as dock and seawall in the mid 1800s. Consists of wharves, seawall and rubble infilling (1970s). Now re-generated as recreational park space.	No While no 'natural' shore features exist, shoreline has developed pocket beaches and behaves in large measure as a natural shore – Not 'Artificial'. Illustrates the potential for 're-naturalization' of urbanized waterfronts.
Downtown shore KYC to La Salle Causeway and Anglin Bay	Almost 2km of anthropomorphic shoreline dating from early 1800s. Wharves, piers and seawalls. No natural shorelines. Low-lying lawns at Confederation Park have revetment shoreline with potential for erosion if not maintained. No evidence of large-scale littoral processes.	Yes Qualifies as 'artificial shoreline'. Continuous extent of docklands all dating back to 1800s. No evidence of natural coastal processes.

Table 5-1 Preliminary Artificial Shoreline Assessment - Kingston

To identify and delineate artificial shorelines, a set of criteria would need to be satisfie. While establishing a definitive quantitative characterization might prove challenging, the applicability of the artificial shoreline concept can be examined by looking at some specific examples within the CRCA's jurisdiction (Table 5-1).

From this cursory overview it seems that the history and extent of contiguous development combined with the absence of natural coastal processes does support the evaluation of docklands as 'artificial shorelines'. Additional efforts are needed to codify this approach. How large of a pocket beach between two headlands would be needed to disqualify a reach? Is there a minimum typical nearshore water depth that could be applied? How best to quantify updrift and downdrift coastal processes? Would determination of a coastal sediment budget be useful/necessary?

If a dockland area were deemed to qualify as artificial, the following considerations would need to be addressed with respect to natural hazards:

- Geotechnical and structural stability would need to be addressed for waterfront structures, including careful consideration of the effects of ice, waves, currents and extreme water levels.
- Scour and down-cutting could still occur and would need to be addressed through the use of either structural controls and/or setbacks.
- The flood hazard and access allowances would need to be addressed similarly to any other development.
- Ownership and long-term liability for structural stability and maintenance is a major concern because once the shoreline protection structures are built and approved by the CRCA, there is no legislative authority available to enable CRCA to require property owners to regularly inspect and maintain the existing shoreline protection structures. The regulatory framework for identifying critical coastal infrastructure and the means from monitoring and maintaining would need to be established (see 5.7 for more detail).
- The size (i.e. width/depth) of the available wharf/pier area is often a major factor of consideration for future development of dockland sites - the original design intent of marine structures such as wharves and docks may not provide an adequate footprint for residential or commercial development.
- Development controls, design guidelines and public access/easement requirements are important consideration to be included.

Issues regarding the design and maintenance of many dockland structures (wharves, piers, jetties, bulkheads, etc.) are covered through the *Ontario Building Code* (as 'designated structures' under *Section 4 of the Ontario Building Code*). Other municipal, provincial and federal standards may also be applicable. The *Residential Tenancies Act*, for example in *ON Reg 517/06 Section 8* stipulates that retaining walls are to be maintained in a structurally sound condition and free from hazards. Kingston property standards - *By-Law 2005-100:2015-15 Sect. 4.3* stipulates that retaining walls shall be kept in good repair.

If a waterfront development is a condominium, the *Condominiums Act of 1998* would apply to retaining walls, bulkheads and similar protection works that are considered 'common elements' of the development. In such cases, the condominium corporation would be responsible for setting aside, or raising, funds required for ongoing maintenance and/or repair. The technical nature of waterfront structures would require

the retention of qualified civil engineers specializing in coastal and geotechnical engineering to assist in the evaluation of the condition of waterfront structures such as retaining walls, bulkheads and associated revetments. Development approvals could conceivably include express requirements for regularly scheduled engineering assessments of waterfront structures in much the same way as is done for bridges and for other condominium common elements. Given the specialized nature of waterfront/coastal engineering, independent peer review of these components of a development may be advisable.

The concept of an erosion hazard setback (100 times the annual average recession rate) and an associated stable slope allowance are not readily applicable to artificial shorelines. For one thing, if there is clear evidence that these shorelines form a fixed and stable waterfront and are not receding then there is by definition no average recession rate. Furthermore, such shorelines do not demonstrate the alongshore, nor cross-shore, coastal processes that affect and control natural shorelines. Flood hazards and structural stability are the controlling criteria for these artificial shorelines. Detailed site-specific studies should be undertaken of proposed development works to ensure a proper understanding of the long-term coastal response of the shoreline and its bordering waters. A strong, defendable case would need to be made for exclusion from the erosion and related stable slope allowances. This would have to be based on detailed process analysis by qualified and experienced coastal specialists. Again, peer review may be advisable for large-scale or sensitive developments.

For example, to assess the Kingston waterfront one would need to evaluate the movement of littoral drift (wave- and current-borne sediments) throughout the candidate sites as well as along adjacent up-drift and down-drift shorelines. The nearshore river-/lake-bed should be characterized in terms of the abundance and composition of surficial sediments and the presence of any morphologically-controlling features in the bathymetry. The potential for nearshore erosion and/or sedimentation along any existing structures should be evaluated using both existing site conditions and available historical information concerning the site and its past development. This information may be useful in guiding requirements for toe protection against scour. Nearshore wave climate, circulation and sediment transport modelling and analysis may be required to create a comprehensive site characterization. A regional sediment budget could be developed at this stage which would characterize, and quantify, the flow of sediments through the study area. This would aid in identifying and delimiting a dockland area as well as in understanding coastal processes in the area.

A key consideration that is more of a land-use planning issue than it is a natural hazards issue, is the question of whether a dockland artificial shoreline should remain in that state or should it be restored to its pre-development (natural) state. Generally, the mix of public and private land ownership and mixture of ongoing land uses precludes the wholesale reversion of the shoreline back to its ‘pre-industrialization’ character. Re-

naturalization, however, is a valued and integral part of most waterfront regeneration strategies. The development of green public spaces within dockland areas is seen as an essential element of urban waterfront landscapes as evidenced by recent works in Toronto (Port Lands), Brooklyn Bridge Park (NYC), as well as Kingston's Breakwater Park.

Condition assessments of existing structures are a key consideration in assessing a potential dockland artificial waterfront area. In some instances, a long-established working waterfront may, through a combination of decay and changing commercial needs, gradually become abandoned, derelict and return to a more natural form. In some cases, it may be desirable to actively restore a working waterfront to a naturalized shoreline. It is generally assumed herein that shorelines that qualify as 'dockland artificial waterfront' would be of a large enough spatial extent and be sufficiently integrated into the adjacent urban landscape that large-scale re-naturalization is not a practical consideration (although 'softening' and introduction of valued ecological components might well be considered as part of the long-term shoreline management strategy).

From a hazard avoidance perspective, as well as from a broader desire for shore 'naturalization', the best use for such lands might be for public access, parkland, habitat, greenspace, water access, and recreational use. In many cases, the ideal urban waterfront development involves placing trails and greenspace along the water's edge with any residential development being set back as far as possible within the subject lands. A key element of a Shoreline Management Plan could be evaluation of artificial/dockland shorelines and the development of strategies for their long-term treatment.

Given the tight footprints and limited setback space associated with many historical waterfront properties, it may be desirable to establish stricter guidelines for flood hazard and structural stability. Careful attention should be paid to both the frequency of occurrence of hazardous flood conditions (e.g. the joint probability of wave-water level scenarios) as well as the potential for events more extreme than the 1% annual exceedance flood event such as the 0.2% event, as well as possible climate change-related scenarios. Given the potential sensitivity of these sites to wave runup and overtopping, consideration should be given to the application of more recent coastal flood hazard analysis techniques such as those described in FEMA (2018).

Finding:

The key consideration here is the treatment of dockland sites as *artificial shorelines* within the context of the 2001 MNR Technical Guides. Such sites require site-specific studies to assess erosion, flood and stable slope hazards and to establish suitable allowances as appropriate. The nature and extent of these hazards tends, however, to be fundamentally different from those on natural and residential shorelines. For a

dockland artificial shoreline as described above, the recession allowance and associated stable slope allowance are typically not applicable or inappropriate. The potential for erosion processes leading to downcutting of the lake/river-bed and subsequent structural hazards should be addressed. Stability, access, and flood hazards need to be addressed for these 'artificial shoreline' sites in much the same way as for any shoreline development. A risk-based approach should be used for this analysis, taking into account the consequences of damage/failure from a wide range of flood and erosion scenarios.

It should be noted that the recession allowance and associated stable slope allowance must still apply to those properties where protection works (e.g. shorewalls) have been added to an otherwise natural shoreline since these type of shorelines are not truly artificial and are subject to the same erosion and slope stability issues despite the presence of protection works.

Ownership and long-term liability for maintenance are major concerns for urban waterfront development. As noted above, provisions of the Ontario Building Code, the Condominiums Act and municipal property standards (by-laws) capture many aspects of the need for structures to be appropriately designed and maintained. Care needs to be taken in the planning and approvals process to ensure that any and all shoreline infrastructure that is critical to the stability and safety of a proposed development is properly identified and characterized in a manner such that the responsibility for design, construction and maintenance is clearly identified and attributed. In some cases, this will be better handled by keeping/placing the waterfront in public ownership, maintained by public agencies.

R20 Planning and/or regulatory decisions that could affect permitting and development of historic waterfront properties should be undertaken within the context of an integrated shoreline management plan that considers all aspects of present and future land use as well as ecological services and natural hazards. A technical study should be undertaken on candidate dockland artificial shoreline areas as part of, or supplemental to, an integrated shoreline management plan. This study would assess the candidate areas in terms of the coastal processes described herein and establish appropriate criteria for ensuring that natural hazards are appropriately addressed. A probabilistic, risk-based analysis should be used for this work. The establishment of technical criteria for acceptance as a dockland artificial shore should be undertaken in consultation with urban planning and legal advice.

5.3. New Fill on the Lake or Riverbed (TQ 3)

Question: *Are there circumstances in which it may be appropriate for CRCA to grant permission under Ontario Regulation 148/06 for the placement of fill on the bed of the Lake and/or River?*

If so, then are there typical conditions that should be placed on such permissions by CRCA? Ecological impact, cumulative impacts, off-site impacts / coastal processes (erosion, sediment transport, etc.).

Context: A request or need for fill placement on the lake and/or river bed could arise from many possible situations:

- To create development envelope
- To improve property for use, aesthetic or environmental purposes
- For safe access / private roads
- For public infrastructure
- As part of shoreline protection works and/or related habitat mitigations/restoration.

The placement of fill on a lake/river bed is covered by various other governmental agencies (federal and provincial environment ministries, the provincial Public Lands Act, the Lakes and Rivers Improvement Act, and the Federal Fisheries Act, to name a few). Within the context of Ontario Reg. 148/06, fill on the Lake/River bed may be considered a permissible activity if undertaken in relation to either the construction of shore protection and/or flood hazard reduction works, or for environmental reasons (habitat creation, cap-and-cover of contaminated soils, etc.).

The existing regulatory environment generally discourages intrusions into the lake/floodway with the perhaps unanticipated negative consequence that protection works tend to be designed with the smallest practical footprint, often resulting in steep, reflective structures that can dramatically alter shoreline characteristics.

The current trend in shore protection works is sometimes described as 'designing with nature', the idea being to mimic and enhance natural coastal processes and features while providing the necessary flood and erosion protection. Examples of this type of work involves, beach restoration, beach-headland shore protection schemes, the use of boulder clusters and habitat features along the shore. This type of work often requires lake/river fill placement – particularly with the use of sand, gravel, cobble and boulder features. If properly designed and with due consideration of environmental and hazard implications of any such works, this type of fill seems appropriate for permitting under Reg. 148/06.

Fill placement for the sake of improving a property for development could, under certain circumstances, be permissible within flood fringes of rivers and streams and, on one level, it seems reasonable to afford the same latitude for coastal properties along Lake Ontario. The risk of unintended up-drift and down-drift consequences in terms of water quality, beach sediments and erosion-deposition patterns is considerable in any situation where alterations are made to the shoreline and/or the adjacent lake bed. Any consideration of new fill placement related to property development should be undertaken within the context of a detailed shoreline management plan that prescribes reach-wide shoreline processes and hazard management strategies.

Decisions on placement or removal of material along the shore and in adjacent waters should be approached with great care and attention to detail. It is not practical to consider a minimum threshold fill amount that could be considered benign. The geometry, positioning and design of any potential fill activities would have to be carefully addressed on a case-by-case basis to ensure that the environmental, public safety and coastal hazard implications of any such works are well-understood.

Finding:

There are some circumstances in which it may be appropriate for CRCA to grant permission under Ontario Regulation 148/06 for the placement of fill on the bed of the Lake and/or River, particularly if such works were aimed to improve public safety or for environmental enhancement/restoration. In order to permit such development, assessments would need to be made of:

- Ecological impacts,
- Natural Heritage impacts,
- Cumulative impacts and off-site impacts,
- Coastal processes (erosion, sediment transport, etc.), and
- Public safety (e.g. access during emergency events).

Some filling may be allowable to support the construction of marinas, docks, wharves, and swim areas, etc. subject to typical constraints and also to avoid any adverse coastal processes or environmental impacts.

Any such fill applications may be considered a net benefit if they result in an improvement in substrate conditions (e.g. replacing brown-field detritus with clean sands and gravels). This may include consideration of public access to the water, public safety, or environmental enhancement.

The filling must not have any adverse impacts on environmental conditions and coastal processes.

Any works or fill must be tied into addressing the questions of conveyance/storage/flood hazards.

Additionally, any such works would have to conform with the Public Lands Act, the Lakes and Rivers Improvement Act and, where applicable, the Fisheries Act.

R21 A new section outlining when the 'placement of fill on the bed of the Lake and/or River', could be considered as an addition to the CRCA documents (i.e. CRCA Environmental Planning Policies and CRCA Guidelines for Implementing Ontario Regulation 148/06) whereby the above discussion is provided. There are no clear answers when it comes to the questions of conveyance/storage/flood hazards to specifically determine with set technical criteria when this would be applicable, so individual studies could be considered on a site by site basis.

5.4. Flood Storage & Compensation (TQ 4)

Question: *If permission is granted to place fill into the Lake and/or River, or the associated regulatory floodplain, then should compensating flood storage volume be granted elsewhere?*

Should the approach vary between Lake Ontario and the St. Lawrence River?

Context:

The concept of compensation for any changes to flood storage is technically sound and is widely accepted as a flood management strategy. The challenge in the Lake Ontario – St. Lawrence River system is one of scale. Upstream of the Moses-Saunders dam, the surface area of Lake Ontario and the St. Lawrence River is approximately 19,000 km^2 ($1.9x10^{10}m^2$). As discussed in Section 5.3, the size of this water body relative to any likely fill volumes is such that compensatory excavation to create a balanced cut/fill scenario is not of any physical significance. The key issues here relate to shoreline preservation, habitat and ecosystems which are handled through other policies and regulations. Compensatory works to preserve and enhance overall shoreline characteristics should be considered for all major fill undertakings, but for what are largely environmental reasons rather than for ones of storage. The situation is somewhat different on the River, where conveyance can be an issue (particularly in the *defined portions* of the River). This should be addressed through an evaluation of the hydraulic impacts of any proposed works and the need for mitigation measures in order to reach a *no adverse impact* condition.

Finding:

While any development activities that would reduce flood storage are generally prohibited, the scale of the Lake Ontario – St. Lawrence River system is so vast that many potential infilling activities related to individual properties would have an infinitesimal effect on flood storage/conveyance – except for works within the *defined areas* of the Upper St. Lawrence as addressed in TQ1.

Inner bays and river mouths need to be addressed differently. In these cases (such as, for example, the mouth of the Cataraqui River) a rigorous hydraulic analysis would be required to ensure that infilling does not adversely affect river flows or water levels.

Rather than making a broad statement regarding the suitability of infilling and/or compensation works, decisions relating to such matters should be based on impact to the littoral system (updrift/downdrift effect, sediment budgets, etc.) and on environmental, and public safety grounds.

R22 - At this stage the recommendation is to carry out the site-specific detailed studies of any candidate infilling projects in order to provide further technical clarification. No specific changes to the CRCA existing documentation (i.e. CRCA Environmental Planning Policies and CRCA Guidelines for Implementing Ontario Regulation 148/06) are recommended at this time.

5.5. Development on Piles (TQ 5)

Question: *Are there circumstances in which it is appropriate for CRCA to grant permission under Ontario Regulation 148/06 for development on vertical piles over the bed of the Lake and/or River, and if so, then are there conditions that should be placed on such permissions?*

Context:

Neither the CRCA Guidelines for Implementing O. Reg. 148/06, nor Provincial Policy support this type of development (nor do they explicitly address it). Any new development is to be directed away from hazardous areas.

For the most part, the Ontario Public Lands Act and the Lakes and Rivers Improvement Act should control development on the lake/river-bed. The Fisheries Act is expected to also have an important role in the permitting of such works.

In the case of dockland 'artificial' shorelines, decisions on pile-supported developments may well avoid the erosion hazard issue. Flood hazard concerns could be addressed through appropriate engineering design (particularly under-deck clearances). While piled developments might raise concerns in terms of urban planning, environmental concerns and waterfront usage, there are many examples throughout Canada and internationally where such developments have been shown to be technically achievable (e.g. Canada Place on Burrard Inlet in Vancouver).

Discussion:

Generally, piling is preferable to a fill/armourstone or steel sheet piling structure – open pilings allow circulation, don't obstruct sediment pathways, and they have a much smaller 'footprint' on the lake-/river-bed.

US FEMA discussion of coastal foundations and best practices (FEMA, 2009), for example, notes that open, deep pile foundations are well-suited to coastal applications:

"Buildings founded and supported by driven piles or caissons in deep soil strata generally offer the greatest resistance to coastal hazards. When supported by foundations deep enough to retain sufficient strength to resist flood loads after scour and erosion have removed soils around the foundation, properly constructed buildings can fare well, even when exposed to wind loads. Post-event assessments have revealed

success stories, even when buildings have been exposed to conditions greater than those anticipated during a design event (FEMA, 2009 Section 6.4.3.1).”

If the development in question was a marine terminal, for example. The Atikokan Pier, Lake Erie (Figure 26) is an open piled structure in the nearshore, that presents no erosion/accretion problems.

Figure 26 Atikokan Pier (Google Earth)

In contrast, a large fill--type structure such as the breakwater built for the Fifty Point Marina in Stoney Creek, Ontario (Figure 27) created a large barrier to longshore sediment transport resulting in beach accretion on one side, and substantial erosion on the other.

Figure 27 Fifty Point Marina (Google Earth)

On a residential scale, consider an existing residential property (Figure 28).

Figure 28 3 Existing waterfront home on St. Lawrence River

IF reconstruction on the existing footprint were to be allowed, piling could be preferable to rockfill (Figure 29) through offering a smaller river-bed footprint and avoiding flood hazards by providing adequate under-deck clearance.

Figure 29 Piled over-water residential development.

If the issue under consideration is an existing dockland (artificial) shoreline, piling could be preferable to existing sheet pile structures, allowing circulation and sediment movement. Consider Elevator Bay in Cataraqui Bay (Figure 30). If the existing steel sheet pile structure were redeveloped as a pile-supported structure allowing open flow beneath it, it could be considered preferable to the existing steel-sheet piled pier. If, however, the development proposal was an open-water, undeveloped 'water-lot'; while

a high, pile-supported (open beneath) structure might be preferable to other alternatives, the main issue would be that it is an open-water development. Whether the proposed development was a fill/armour-stone structure or an open-piled over-water structure, neither should be desirable due to the provisions of the PPS Section 3 that development should be directed away from the hazard zone. Surrounding the development with armour stone, or raising it high above the waves on piles are both means of working within the hazard zone, not eliminating the hazard zone. Arguments can be made that the pile alternative might be in some ways preferable to the armour stone fill, but both alternatives are forms of development within the natural hazard zone, and both are to be discouraged.

This does not apply to all piling applications. Open piling may in, certain instances, be preferable to lake- or river-bed infilling due to the resulting reduced footprint, reduced loading on the structure and reduced environmental impacts.

Figure 30 Elevator Bay, Kingston

Finding:

New development on un-encumbered lake/river-bed does not fit with the CA's nor the PPS's natural hazard requirements of staying out of hazardous areas, nor with their 'naturalization' mandate. Allowance is made for marine-related infrastructure which by its very nature needs to be built on/over the water such as wharves, docks and marinas. There seems to be no justification for extending this usage to non-essential activities such as residential or commercial development.

R23 - Unless directly related to marine-related infrastructure, it is recommended that CRCA not approve new over-water piled developments since they are generally inconsistent with the natural hazard requirements of the PPS (i.e. "The Provincial Policy Statement directs development away from areas of natural and human-made hazards." Section 3.0).

5.6. Floodplain Setback and Freeboard (TQ 6)

Question: *What horizontal setback from the regulatory floodplain is appropriate for new buildings and structures in the study area, and what vertical freeboard value is appropriate for building openings and first floor elevations?*

Context:

Existing Provincial Natural Hazards Policy and the MNR Technical Guides for the Great Lakes (notably Section 7) provide the following setback criteria:

- 15 m allowance (for wave uprush and Overtopping) on top of the 100 year flood level for Lake Ontario
- 5 m allowance (for wave uprush and Overtopping) on top of the 100 year flood level for connecting channels
- 6 m for safe access
- Floodproofing Standard
- Must have no adverse impacts on environmental conditions and coastal processes.

:

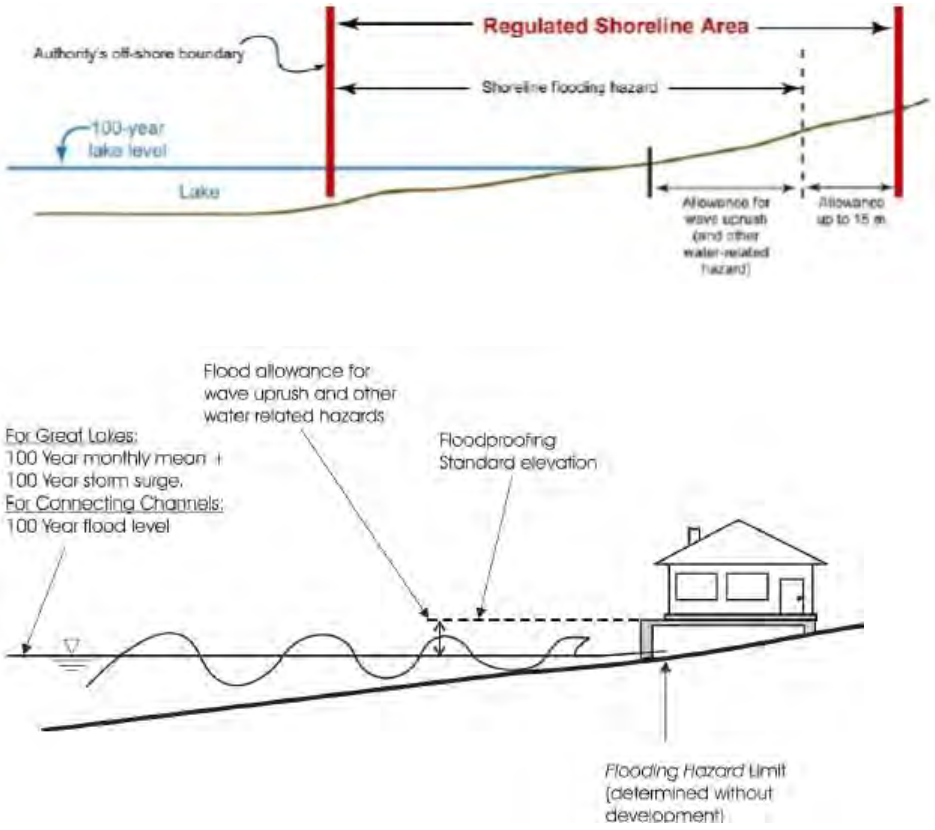


Figure 31 Flood hazards – horizontal and vertical aspects (MNR Technical Guides)

Similarly, the existing CRCA regulatory policies are as follows:

- 15 m allowance from regulatory flood plain
- 6 m setback for buildings and structures
- 0.3 m freeboard for lowest floor, other requirements for other development components
- Floodproofing Standard
- Must have no adverse impacts on environmental conditions and coastal processes.

Discussion*:*

The flood hazard is best defined both as a vertical surface and as a horizontal (plan) boundary. In the U.S., for example, FEMA establishes a base flood elevation (BFE) that is a vertical surface that encompasses the 1% annual exceedance flood water level, plus a wave envelope which is based on both the elevation of wave crests and the effects of wave runup. A similar approach has been recently adopted in British Columbia using a base flood elevation using flood waters and wave effects and an additional *Flood Construction Level* (FCL) which is used for determining minimum allowable floor sill and opening elevations.

For CRCA, flood elevations could be set at the vertical limit of wave runup plus a 0.3 to 0.6m clearance allowance. The existing wave runup estimates from the (updated) Anthony study do not provide sufficient spatial resolution to drive the development of more specific setbacks. The MNRF Technical Guides (Section 7.4.3) provide a framework for a zoned approach to floodproofing based on wave energy within the flood hazard. This general approach could be adapted to develop zonal freeboard guidelines within the regulatory floodplain.

LiDAR-derived topography and recent developments in wave transformation modelling should be used to re-evaluated flood hazard conditions throughout CRCA's Lake Ontario and St. Lawrence River shorelines. This work could provide the technical basis for establishing appropriate horizontal and vertical setbacks. As discussed in Section 3 of this report, the existing wave climate and wave runup prediction methodologies should be reviewed to provide an updated guidance and methodology for inclusion of wave effects in flood hazard evaluations.

Recommendation

R24 New, high spatial resolution flood hazard mapping including nearshore waves, and wave runup/overtopping conditions should be developed to inform the development of new horizontal and vertical setbacks. Analysis of uncertainties, error and bias in available wave and runup predictors should be re-evaluated to guide freeboard recommendations as a function of site exposure and site geometry.

5.7. Asset Management of Protection Works (TQ 7)

Question: *There may be circumstances in which structural means such as shore walls and vertical piles are proposed to facilitate development along the waterfront.*

How can municipalities limit the inherent liability associated with such structures using engineering, financial and legal tools and ensure that the assets will be appropriately managed over the long-term?

Context:

The PPS and the CRCA policies require that if shoreline works are carried out then the Protection Works Standards (PWS) along with the Access Standard (AS) must be administered.

The MNR Technical Guides recommends an erosion setback along with the installation of the Protection Works as a result of the natural process which occur along the shoreline and the inability of the protection works to stop naturally occurring erosion, undercutting and scouring. As noted in the MNR Technical Guide, some provision can be made for reductions to the overall allowances depending on the expected life of the erosion structures provided an assessment of the design life has been carried out according to "accepted scientific and engineering practices" and these considerations applied to the erosion component of the hazard criteria. Additionally, the access standard is required. Please see Appendix A for further r details on the PWS.

All of the Standards must be met by the proponent, and a thorough review of the shoreline design and natural process should be carried out by the approval agencies. Depending on the complexity of the site it may be prudent for the approval agency to carry out a peer review.

Once these works are built there is no mechanism within Provincial Natural Hazards policies for the agencies to ensure future maintenance of these structures is undertaken. As noted in Section 5.2, provisions within the Ontario Building Code, the Condominium Act and municipal property by-laws stipulate standards for ancillary structures such as retaining walls. Most vertical and composite shore protection structures are classified as retaining walls and those retaining walls that are over 1100mm in height fall under the requirements of the Ontario Building Code and through this there is implicitly a pathway for requiring that the structural integrity of these works are maintained. Armour stone protection works do not necessarily qualify as retaining walls depending on their slope and configuration and hence the property standards by-laws and Building Code regulations may not be directly applicable.

Finding:

There are a number of future implications and liabilities that agencies need to consider when approving protection works that are not within public ownership are: the financial and legal impacts of the structures if they are not maintained and fail, the costs to repair the structures assuming the private landowner does not take responsibility, potential injury to public should the structures fail, physical impacts on coastal process that could affect other shoreline areas as a result of the structures failure, and climate change impacts which are not yet known and have not been designed for. Some of the long-term implications and liabilities that the public agencies need to consider when owning these structures and associated lands are: the financial responsibilities and implications and management of these assets which will require future upgrading, maintenance and maintaining safety for the public.

There are a number of advantages of having these structures within public ownership, some of which are: the ability to achieve public linkages, trails and access, parkland, open space, hazard setback requirements, easements, environmental protection of lands, management, restoration and rehabilitation goals. The public agency would also have the opportunity to be able to integrate waterfront objectives and planning management such as; recreational areas, cultural, urban spaces, aesthetics, parks, protection of character areas and views. In other shoreline areas, typically these hazard lands and associated waterfront structures have been transferred in to public ownership as a condition of the development approval. This approach addresses not only the long-term liability issues but also serves many of the shoreline management and planning goals as noted above.

This could be treated as two somewhat separate issues: The ownership of waterfront space including public access areas, parklands, water access, maintenance and egress corridors as well as any flood/erosion protection works, and; the responsibility for, and financial vehicles to pay for maintenance of these structures.

Considerations for successful financial management and strategies of these areas could be the introduction of development charges which would be specifically used to facilitate carrying out the protection works, the subsequent maintenance and public ownership of these structures and associated hazards lands. Long term acquisition plans by the agencies is a very common approach in other jurisdictions.

Condominium corporations and trust funds are possible legal structures to address these concerns. Alternatively, land transfers to the public put responsibility clearly into the government's hands. Public agencies can consider taxation levies to directly tax the developers for these expenses, or can accept this ongoing liability in return for tax revenue, economic growth and community benefits (public spaces). Government ownership might possibly facilitate access to alternate funding mechanisms in response to hazard damages, e.g. federal disaster relief funding.

The CRCA could add to their documents (i.e. CRCA Environmental Planning Policies and CRCA Guidelines for Implementing Ontario Regulation 148/06) these further discussions on the ownership, maintenance and the implications of the responsibility of the flood and erosion protection works on the public or private owners. Additionally, CRCA is constrained by its inability to legally require owners to follow up with maintenance of privately-owned structures once they are approved. One consideration in this matter is that the structure of the Provincial and local hazard regulations are based on a 'regulatory' flood level with a 1% annual exceedance probability (AEP). This tends to encourage use of the 1%AEP condition as a standard design criterion. As noted in the Technical Guides, the 1%AEP condition is not an overly stringent criterion in terms of encounter probability. A probabilistic, risk-based approach to the design and evaluation of coastal infrastructure should be explored as an alternative approach to ensure that appropriate design standards are applied according to the sensitivity and criticality of the works under consideration.

R25 The CRCA should engage legal and planning policy advice on this matter to further explore the issues discussed herein. The use of risk-based design should be explored as a means of ensuring that protection works are designed appropriately relative to the consequences of failure. This could be an important component of future integrated shoreline management plans.

6. Recommendations

Shoreline Management Plan

One over-arching recommendation is that, in order to address many of the technical issues related to flood and erosion hazards, integrated shoreline management plans should be developed for the Lake Ontario and St. Lawrence River shorelines. This could be undertaken as a regional assessment spanning the entire CRCA waterfront, or could be undertaken on a community-by-community basis. The specific scope of such a study would need to be worked out in detail with each community. The general goals of the study(ies) would be to re-view and update flood and erosion hazard guidance and to map out coastal flood hazards at a much finer scale than has previously been undertaken. This would allow a more accurate delineation of flood hazard zones and provide for a more consistent basis upon which individual permit applications could be evaluated. A key aspect of this work would be a re-evaluation of the regulatory flood hazard in light of recent extreme water levels.

Aside from this over-arching recommendation, the report's recommendations for CRCA policies and guidelines have been summarized as follows.

City of Kingston OP - Ribbon of Life Policy

R1 The City of Kingston should consider amending the 'Ribbon of Life' buffer to use a statistically-derived definition for its shoreward boundary, such as the 75.1m IGLD85 lake level noted herein. (Note that this is equivalent to 74.80m CGG2013 and 75.14m CGVD28 – see Section 3.3.1 for more details).

City of Kingston Schedule 11-A Constraint Mapping

R2 - Inclusion of an updated erosion hazard should be a priority in updating this Schedule 11-A mapping – this could have significant implications for potential future planning for not only identifying the hazard areas but also the implications for the environmental and open space areas which are key components of the City's Waterfront Plan and Natural Heritage Zones. It is recommended that the City of Kingston in collaboration with the CRCA, carry out a study where the erosion hazard setback be determined and delineated along the shoreline throughout the City of Kingston jurisdiction. The results of this study could then be incorporated into both the City of Kingston and the CRCA Hazard mapping.

City of Kingston OP (General)

R3 As detailed in Section 2.3.1, there are a number of areas within the City of Kingston OP where additional references could be included so that the natural hazards could be strengthened and highlighted through the various sections as a unique issue.

City of Kingston Waterfront Master Plan

R4 A recommendation for future input to the Waterfront Master Plan document would be for the natural hazard waterfront lands to also be included. The inclusion of these lands would assist in highlighting further potential future linkages along the Lake Ontario and St. Lawrence River waterfront, and river and stream systems. The natural hazards also indicate areas which may potentially be considered for future acquisition because of their associated hazards. The natural hazard lands often work well with the overall concepts being considered for a waterfront plan related to environmental and open space lands and waterfront trails.

The recommendation is to include the natural hazard waterfront lands in future updates of the Waterfront Master Plan document. At this stage of the City of Kingston's development it is additionally recommended that an integrated shoreline management planning document be carried out in the future along their shoreline.

City of Kingston Downtown and Harbour By-Law # 96-259

R5 - The Downtown and Harbour By-Law # 96-259 (includes last amending By-law # 2018-50) does not make reference to the full requirements of the Flooding Hazard, and the Erosion Hazard requirements for either the *CRCA Regulation* or the *PPS*. It is recommended that the Flood and Erosion hazards should be included in future updates to more accurately reflect the requirements of the *PPS* and *CRCA regulation* regarding the flood and erosion hazard allowances.

R6 - It is recommended that additional descriptions be added in future revisions of the By-Law # 96-259 (includes last amending By-law # 2018-50) such as, 'OR a distance determined by the CRCA satisfying all the Natural Hazard CRCA Regulation and PPS Requirements'.

City of Kingston Restricted Area Zoning By-Law #8499

R7 - It is recommended that an additional description to include the Hazard Setbacks (Flooding and Erosion Hazards) requirements be added in each of the sections (i.e. Section 32: "P" – General Recreation Park, Section 33: "P1" – Recreational building, Section 34: "P2" – Water-Area, Section 35: "OS1" – Public Open Space, Section 36: "OS2" – Private Open Space, Section 37: "OS3" – Harbour Open Space, Section 38: '"EPA" – Environmental Protection Area and Part V: Industrial Zones, Section 28: "M5"– Waterfront Industrial), outlined in of the By-Law #8499 'Restricted Area Zoning By-Law' to strengthen the natural hazards.

City of Brockville OP

R8 - Any updates to the Waterfront Master Plan should reflect the current OP and CRCA hazard mapping requirements.

R9 - Additionally it is recommended that the development of an integrated shoreline management planning document be considered in the future for the City of Brockville.

Town of Gananoque OP

R10 - The Town of Gananoque erosion hazard requirements should be reviewed and should be included, along with the Access, Flooding and Protection Works Standards, in subsequent revisions of the Official Plan.

R11 - Further review of Ganaoque's Development Permit By-Law (DPBL) system issue related to natural hazards would be required in order to make any specific recommendations, however a future consideration for the addition of the prerequisite for the CRCA to carry out an assessment before any conditional approvals, variations to standard requirements could be inserted into the DPBL as a requirement for any waterfront property. This, along with additions to the OP related to the erosion hazards as noted above, should be considered in subsequent revisions of these documents.

R12 – Additionally, the Schedule mapping could also be updated to include the entire CRCA regulatory area, so that any properties that are within this area would automatically flagged and go to the CRCA for review before any conditional approvals and/or variations to standard requirements could be issued for an application.

From Chapter 3 - Natural Hazards

R13 - A statistical re-evaluation should be undertaken for extreme water levels along the CRCA's Lake Ontario and St. Lawrence River shorelines including the most recent water level data (i.e. 2017 through 2019). This analysis should examine the joint probabilities of storm surge and mean water levels. For the Lake Ontario shoreline, it would be useful to also examine the joint probabilities of waves and storm water levels since the largest storm waves typically occur in late autumn, when lake levels are relatively low.

R14 - One of the key recommendations of this study is that the wave uprush calculations for the flooding hazard component of the CRCA regulation be updated, for further information please see Section 6 with the Summary of Recommendations and the individual technical questions in Section 5 which will outline the detailed recommendations.

R15 - The CRCA and local municipalities should develop clear guidance on the use and applicability of vertical datums when dealing with flood hazards and should provide clear guidance on applying the flood hazard using the new CGVD2013 datum.

R16 - The stable slope allowance should be considered and applied at all stages in the evolution of the shoreline. This means that the stable slope allowance applies to the present-day shore position, as it does to the assumed future shore position (e.g. after

100 yrs x the Annual Average Recession Rate). In determining hazard limits, the approach of applying the recession allowance and subsequently applying the stable slope allowance landward from the toe of the future shoreline position as presented in existing CRCA guidance documents is appropriate. Using the stability of the existing slope as a proxy for the stability of the future slope should be based on the judgement of the Professional Engineer conducting the hazard assessment.

The existing technical guidance in the CRCA EPP documentation should be modified to clarify the water level used for definition of toe of slope (shoreline) for low-lying and sheltered shorelines.

R17 - It is recommended that the City of Kingston in collaboration with the CRCA, carry out a study where the erosion hazard setback be determined and delineated along the shoreline throughout the City of Kingston jurisdiction. The results of this study could then be incorporated into both the City of Kingston and the CRCA Hazard mapping. This work would ideally be part of a re-analysis of the flood and erosion hazards for Kingston and the CRCA jurisdiction, providing updated hazard guidance at a finer spatial scale. This work would effectively replace the existing Paine (1995) and Anthony (1993) reports which are both now over 20 years old.

From Chapter 4 - Comprehensive Approach to Planning and Policy

R18 - It is recommended that CRCA and local municipalities consider developing and adopting integrated shoreline management plans as a means to develop a more comprehensive approach to shoreline land use planning, natural hazards and environmental protection.

From Chapter 5 – Technical Questions

R19 - The CRCA and/or interested municipalities should develop a Terms of Reference for a flow modelling study to a) delineate ‘defined portions’ of the St. Lawrence River which are critical to the conveyance of the flows associated with the one hundred year flood level, and b) to establish the necessary criteria for site-specific studies of proposed activities outside of the ‘defined portions’. This second part of the study (part b) might also provide guidance for establishing negligible/permissible ‘minor activities’. The guidance for this approach may possibly be based on previous work by Moin & Shaw (1991). It is suggested that flow modelling be undertaken using a two-dimensional hydrodynamic model. Coldwater Consulting would be willing to assist in the development of these Terms of Reference if so desired.

R20 - Planning and/or regulatory decisions that could affect permitting and development of historic waterfront properties should be undertaken within the context of an integrated shoreline management plan that considers all aspects of present and future land use as well as ecological services and natural hazards. A technical study should be undertaken on candidate dockland artificial shoreline areas as part of, or supplemental to, an integrated shoreline management plan. This study would assess the candidate

areas in terms of the coastal processes described herein and establish appropriate criteria for ensuring that natural hazards are appropriately addressed. The establishment of technical criteria for acceptance as a dockland artificial shore should be undertaken in consultation with urban planning and legal advice.

R21 - A new section outlining when the 'placement of fill on the bed of the Lake and/or River', could be considered as an addition to the CRCA documents (i.e. CRCA Environmental Planning Policies and CRCA Guidelines for Implementing Ontario Regulation 148/06) whereby the above discussion is provided. There are no clear answers when it comes to the questions of conveyance/storage/flood hazards to specifically determine with set technical criteria when this would be applicable, so individual studies could be considered on a site by site basis.

R22 - At this stage the recommendation is to carry out the site-specific detailed studies of any candidate infilling projects in order to provide further technical clarification. No specific changes to the CRCA existing documentation (i.e. CRCA Environmental Planning Policies and CRCA Guidelines for Implementing Ontario Regulation 148/06) are recommended at this time.

R23 - Unless directly related to marine-related infrastructure, it is recommended that CRCA not approve new over-water piled developments since they are generally inconsistent with the natural hazard requirements of the PPS (i.e. "The Provincial Policy Statement directs development away from areas of natural and human-made hazards." Section 3.0).

R24 - New, high spatial resolution flood hazard mapping including nearshore waves, and wave runup/overtopping conditions should be developed to inform the development of new horizontal and vertical setbacks. Analysis of uncertainties, error and bias in available wave and runup predictors should be re-evaluated to guide freeboard recommendations as a function of site exposure and site geometry.

R25 - The CRCA should engage legal and planning policy advice on this matter to further explore the issues discussed herein. The use of risk-based design should be explored as a means of ensuring that protection works are designed appropriately relative to the consequences of failure. This could be an important component of future integrated shoreline management plans.

7. References

Anthony, T. (1993). *Regulatory Shore Lands Limit - A Study for the CRCA Shoreline.* CRCA.

Atria Engineering Inc. (1997). *Wave uprush and overtopping, methodologies and applications.* Prepared for Ontario Ministry of Natural Resources.

Ballantyne, B. (2016). *Water Boundaries on Canada Lands: That fuzzy shadowland.* Edmonton: Natural Resources Canada.

CEM. (2002). *Coastal Engineering Manual.* US Army Corps of Engineer, Coastal and Hydraulics Lab.

City of Brockville. (2009). *Downtown & Waterfront Master Plan & Urban Design Strategy.* Adopted by council, December 15, 2009 .

City of Brockville. (2012). *Official Plan.* Retrieved from City of Brockville - Official Plan: https://brockville.com/index.cfm?ID=332

City of Kingston. (2016). *Kingston's Waterfront Master Plan.* Retrieved from cityofkingston.ca: https://www.cityofkingston.ca/city-hall/projects-construction/waterfront-master-plan

City of Kingston. (2017). *Official Plan (Consolidated as of May 1 2018).* Retrieved from cityofkingston.ca: https://www.cityofkingston.ca/documents/10180/541790/Official+Plan/17793cad-90db-4651-8092-16c587600001

coastalwiki.org. (2019, 06 24). *Integrated CoaStal Zone Management*. Retrieved from CoastalWiki: http://www.coastalwiki.org/wiki/Integrated_Coastal_Zone_Management_(ICZM)

CRCA. (2015). *Draft CRCA Environmental Planning Policies - Appendix C.* Kingston: Cataraqui Region Conservation Authority.

CRCA. (2015). *Environmental Planning Policies.* Rev. 2 - April 2015: Cataraqui Region Conservation Authority.

CRCA. (2017). *Guidelines for Implementing Regulation 148/06.* Cataraqui Region Conservation Authority.

Davidson-Arnott, R. (2016). *Climate change impacts on the Great Lakes.* Draft discussion paper for Ausable Bayfield CA.

Environment Canada - Ontario MNR. (1975). *Canada-Ontario Great Lakes Shore Damage Survey, Technical Report.* R.S. Boulden (Ed.), 97 pp.

FEMA. (2009). *Recommneded residential construction for coastal areas.* Washington, DC: US Federal Emergency Management Administration.

FEMA. (2018). *Coastal Floodplain Mapping.* Washington, DC: US Federal Emergency Management Administration.

FEMA. (2018). *Coastal Wave Runup and Overtopping.* Washington, DC: U.S. Federal Emergency Management Agency.

Fread, D. (1976). *Theoretical development of implicit dynamic routing model.* As referenced in Daly&Ashton 1983: National Weather Service, NOAA (unpublished).

International Joint Commission. (2010). *Adaptive Management for the Lake Ontario - St. Lawrence River System.* Review of the Lake Ontario - St. Lawrence River Orders of Approval. Retrieved from http://www.ijc.org/LOSLdocuments.

Kingston, C. o. (2009). *Waterfront Strategy - Past Directions. A Review of Waterfront Studies Over the Past 30 Years.* Kingston: Planning and Development.

Lake Ontario - St. Lawrence River Study International Study Board. (2006). *Options for Managing Lake Ontario and St. Lawrence River Water Levels and Flows: Final Report.* Report submitted to the International Joint Commission.

Mase, H., Tamada, T., Yasuda, T., Hedges, T., & Reis, M. (2013). Wave runup and overtopping at seawalls built on land and in very shallow water. *J. Waterway, Port, Coastal and Ocean Engg. (ASCE)*, 346-357.

Melby, J. (2012). *Wave runup prediction for flood hazard assessment.* Vicksburg, MS: USACE-ERDC-CHL.

MNRF. (2001). *Great Lakes - St. Lawrence River System and large inland lakes. technical guide for flooding, erosion and dynamic beaches [computer file].* Peterborough, ON: ISBN 0-9688196-1-3 Available through: Watershed Science Centre, Trent University.

MNRF. (2001). *Understanding Natural Hazards.* Ministry of Natural Resources. Queen's Printer for Ontario.

Moin, S., & Shaw, M. (1991). *Technical Guidelines: Floodway / Flood Fringe Analysis (Vol. 1 & 2).* Burlington, ON: Env. Canada Inland Waters Directorate.

Ontario Ministry of Natural Resources. (2002). *Technical Guide: River and Stream Systems: Flooding Hazard Limit.* Lands and Waters Branch, Water Resources Section, Peterborough, ON.

Ontario Ministry of Natural Resources and Conservation Ontario. (2008). *Draft Guidelines to Support Conservation Authority Administration of the "Development, Interference, with Wetlands and Alterations to Shorelines and Watercourses" Regulation.* MNR/Conservation Ontario.

Paine, J. (1995). *Methodology for defining the regulatory erosion standard on Great Lakes shorelines.* Westbrook: for CRCA.

Province of Ontario. (1990). *The Planning Act.* Ministry of Municipal Affairs and Housing.

Province of Ontario. (2009, March 03). *Citizens' Guide to Land-use Planning*. Retrieved January 15, 2010, from Ministry of Municipal Affairs and Housing: http://www.mah.gov.on.ca/Page1760.aspx

Province of Ontario. (2010). *Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005 (2nd edition).* Ontario Ministry of Natural Resources. Queen's Printer for Ontario.

Province of Ontario. (2014). *Provincial Policy Statement.* Ministry of Municipal Affairs and Housing.

Pugh, D. (1987). *Tides, Surges and Mean Sea-Level.* Wiltshire, UK: John Wiley & Sons Ltd.

Roelvink, D., McCall, R., Mehvar, S., Nederhoff, K., & Dastgheib, A. (2018). Improving predictions of swash dynamics in XBeach: The role of groupiness and incident-band runup. *Coastal Engg Vol 134*, 103-123.

Stantec. (2009). *The Town of Gananoque Offical Plan.* Stantec Consulting Ltd.

The SWAN Team. (2009). *SWAN User Manual.* Delft, NL: Delft University of Technology.

Toronto Region Conservation Authority. (1996). *Integrated Shoreline Management Plan: Tommy Thompson Park to Frenchman's Bay.* Toronto, ON: TRCA. Retrieved from http://trca.on.ca/trca-user-uploads/IntegratedShorelineManagementPlan.pdf

US Army Corps of Engineers. (2007). *Coastal Engineering Manual.* CHL, ERDC.

USACE. (2012, December). US Army Corps of Engineers, Wave Information Studies. http://www.frf.usace.army.mil/wis2010/hindcasts.shtml?dmn=lakes.

Waterfront Regeneration Trust; Brook-McIlroy. (2014). *Waterfront Land Use Planning Survey.* Toronto: The Great Lakes Waterfront Trail.

A

8. APPENDIX A – Hazard & Standards References

Hazardous Lands*: means property or lands that could be unsafe for development due to naturally occurring processes, generally considered to include the furthest landward limit of the flooding, erosion or dynamic beach hazard limits. (CRCA Consolidated Conservation Strategy 2013 definitions, p. 19)

Ontario Regulation 148/06 for the Great Lakes-St. Lawrence River System

Section 6.1 from the Guidelines provides a summary of the Ontario Regulation 148/06 for the shoreline.

"**Development prohibited**

2.(1) Subject to section 3, no person shall undertake development or permit another person to undertake development in or on areas within the jurisdiction of the Authority that are:

(a) adjacent or close to the shoreline of the Great Lakes-St. Lawrence River System or to inland lakes that may be affected by flooding, erosion or dynamic beaches, including the area from the furthest offshore extent of the Authority's boundary to the furthest landward extent of the aggregate of the following distances:

i) the 100 year flood level, plus the appropriate allowance for wave uprush shown in the most recent Table entitled "Lake Ontario-St. Lawrence River 100 Year Flood Level and Wave Uprush" or in the case of Amherst Island, contained in the most recent document entitled "Amherst Island Flood Risk Information Report", available at the head office of the Authority,

ii) the predicted long term stable slope projected from the existing stable toe of the slope or from the predicted location of the toe of the slope as that location may have shifted as a result of shoreline erosion over a 100-year period,

iii) where a dynamic beach is associated with the waterfront lands, an allowance of 30 metres to accommodate dynamic beach movement, and

iv) an allowance of 15 metres inland."

"Permission to develop

3.(1) The Authority may grant permission for *development* in or on the areas described in subsection 2(1) if, in its opinion, the control of flooding, erosion, dynamic beaches, pollution or the conservation of land will not be affected by the development.

(2) The permission of the Authority shall be given in writing, with or without conditions."

Note: There is no reference to "alterations to shorelines" within the Ontario Regulation 148/06. However, the additions of "shorelines" to Section 28(17) (b) and 28(18) of the *Conservation Authorities Act* was a Conservation Ontario Council-approved proposed amendment (February, 2008). (GIOR 148/06: DIWASW, 2017)

Public Safety is paramount and vehicles and people must have a safe way of entering and exiting during times of flooding, erosion and other emergencies. For this reason the 'Access Standard' is required for the development of any properties. Additionally Part of the Regulation requirements are that any alteration and development works must be carried out in accordance with the 'Protection Works Standard' and 'Floodproofing Standards'.

The 2014 *PPS* Section 3.1.7 states that:

3.1.7. Further to policy 3.1.6, and except as prohibited in policies 3.1.2 and 3.1.5, *development* and *site alteration* may be permitted in those portions of *hazardous lands* and *hazardous sites* where the effects and risk to public safety are minor, could be mitigated in accordance with provincial standards, and where all of the following are demonstrated and achieved:

a) *development* and *site alteration* is carried out in accordance with ***floodproofing standards, protection works standards,*** **and** ***access standards***;

The CRCA Environmental Planning Policy 2015 States that: (2015, Section 4.1 CRCA, EPP)

4.2.3 Development and site alteration **should not be supported** within areas that would be rendered **inaccessible to people and vehicles during times of erosion hazards**, unless it has been demonstrated that the site has safe access appropriate for the nature of the development and the natural hazard.

4.2.4 and 4.1.8 Policy

Except where prohibited by the Provincial Policy Statement and where specified elsewhere in this document, development and site alteration **may be supported** in those portions of the erosion hazard where the **effects and risk to public safety are minor, could be mitigated in accordance with provincial standards,** and where all of the **following are demonstrated and achieved**:

a. **development and site alteration is carried out in accordance with floodproofing standards, protection works standards, and access standards;**

The Floodproofing Standard

Provincial direction on floodproofing standards is provided in the *PPS* 2014 and MNR Technical Guides as follows:

PPS Floodproofing Standard – Excerpt

3.1.7. Further to policy 3.1.6, and except as prohibited in policies 3.1.2 and 3.1.5, development and site alteration may be permitted in those portions of hazardous lands and hazardous sites where the effects and risk to public safety are minor, could be mitigated in accordance with provincial standards, and where all of the following are demonstrated and achieved:

*b) development and site alteration is carried out in accordance with **floodproofing standards,** protection works standards, and access standards;*

The minimum floodproofing standard for development and site alteration located within the flooding hazard limit is as follows:

In Lake Huron development and site alteration is to be protected from flooding, as a minimum, to an elevation equal to the sum of the 100 year monthly mean lake level plus the 100 year wind setup plus a flood allowance for wave uprush and other water related hazards (see Figure 7.30, MNRF Pg. 55); **'Dry Passive' Floodproofing measures are recommended for the ABCA shoreline. 'Active' Floodproofing measures are also applicable during flooding emergencies.**

Floodproofing measures are applicable with certain limitations and only after certain prerequisite information is given to verify its feasibility. Since there are various types of floodproofing measures, selection of the most appropriate approach depends on the following conditions:

- Nature of the development and adjoining property under consideration (i.e., existing structure or proposed new structure, type of land use, impact on neighbouring properties);
- Physical characteristics of the shoreline and the potential for updrift and/or downdrift impacts;
- Local flood and other water related hazard(s) conditions and the level of the floodproofing standard, in order to evaluate the type or degree of floodproofing required and the requirements for access (i.e., ingress/egress); and
- Cost-effectiveness of the floodproofing measure(s).

In Ontario, two approaches to dry floodproofing are provided for:

- the use of fill, columns, or design modifications to elevate openings in buildings or structures above the floodproofing standard,
- the use of water tight doors, seals, berms/floodwalls to prevent water from entering openings below the floodproofing standard.

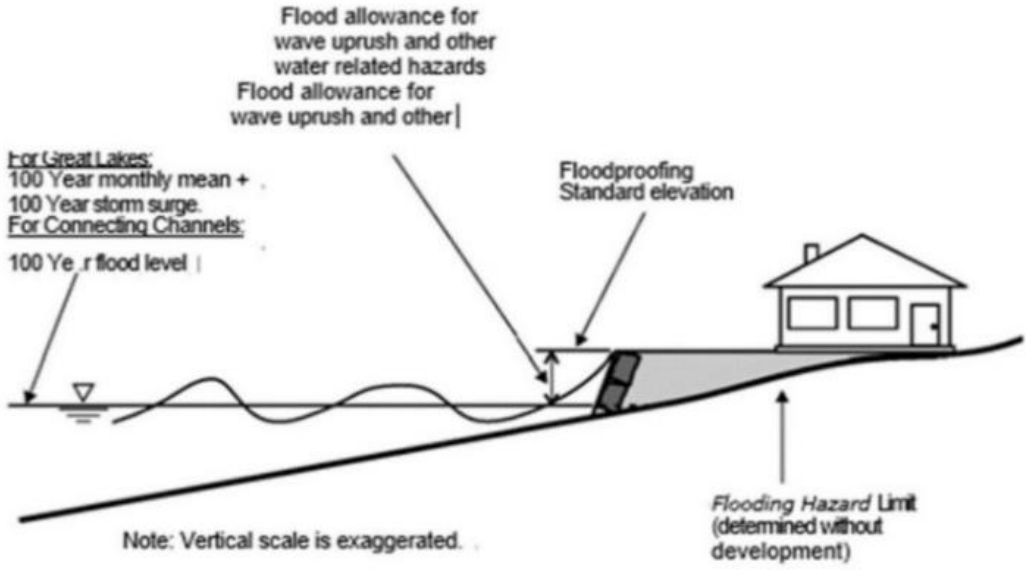
In addition, there are two basic techniques to floodproofing: passive floodproofing and active floodproofing. More information on each of these two techniques follows:

Passive floodproofing**:** Floodproofing techniques which are permanently in place and do not require advance warning and action in order to make the floodproofing and/or flood protection measure effective

Active floodproofing: Floodproofing techniques which require some action prior to any impending flood in order to make the flood protection operational (e.g., closing of water tight doors, installation of waterproof protective coverings over windows, etc.)

With increases in flood levels and the impacts associated with other water related hazards (e.g., wave action, wave spray, ice, etc.), design considerations for floodproofing buildings and structures generally becomes more complex and costly. In addition, increasing flood levels and associated hazards pose greater risks to loss of life and property damage.

Given that different buildings and structures can withstand flooding, associated 'other water related hazards' and related loadings better than others, it is recommended that a qualified professional coastal engineer experienced in floodproofing carry out the required evaluation and design, to ensure that these factors have been critically assessed and duly recognized in the selection of the floodproofing measure(s) deemed appropriate for the given shoreline location. See below from the MNR Technical Guide, Part 7- Floodproofing, pp. 7-56 (2001).



Note: Development not permitted within *defined portions* of the *100* Year flood level *along connecting channels*. Development must also meet other Policy requirements, including safe access.

MNR Technical Guide—Part 7: Figure 7.3 Elevation of Flood Prone Residence-Dry Passive Floodproofing(2001)

MNR Floodproofing Criteria

The Protection Works Standard

The following section describes the 'Protection Works Standard', and has been taken from MNR, Part 7, Addressing the Hazards. (2001).

It is acknowledged that this term is somewhat misleading, in the sense that total protection from these hazards cannot always be assured (i.e., structural integrity cannot be assured for the long term because of the continual downcutting and recession).

Protection works using structural approaches should only be considered where such actions are required to protect existing developments that are at high risk, where non-structural or bio-engineering solutions are not feasible, and where environmental impacts have been appropriately addressed and incorporated into the design of the protection works.

A prime consideration is the potential impact of the proposed protection works on the updrift and downdrift shorelines. Disruption of the supply and transport of littoral materials is one of the physical shoreline processes and characteristics which may affect the flood, and erosion hazards at updrift/downdrift properties.

If it has been determined that protection works will not disturb sediment processes and are acceptable along the shoreline then it is recommended by the *PPS* that the following criteria be applied when installing protection works.

"Where development is proposed within the least hazardous portion of the erosion hazard limit and involves the installation of protection works, the development must be setback a distance equivalent to the stable slope allowance (3:1 or as determined by a study) plus a hazard allowance (30 metres (Figure 7.32b(i)) or as determined by a study (Figure 7.32b(ii)). Where a study using accepted scientific and engineering principles is used to establish the hazard allowance, the erosion component of the hazard allowance usually involves two steps.

The first step is to setback the development from the stable slope allowance a distance equivalent to:
[100 years minus the initial design life of the protection works] multiplied by
[the average annual recession rate].

This approach (see Figure 7.32b)(ii)) recognizes that most protection works have a design life that is significantly less than the planning horizon of 100 years and that there is no mechanism to ensure that the present owner or subsequent buyers of the property will be able to rebuild or replace the protection works. Design life is discussed in Appendix A7.1." (Pg. 7-61 MNR. Part 7 Technical Guide)

The Protection Works Standard consists of the following components and is indicated in the following drawing:

- The Protection Works Structure PLUS,
- Stable Slope Allowance PLUS,
- 30 m Erosion Hazard Setback.

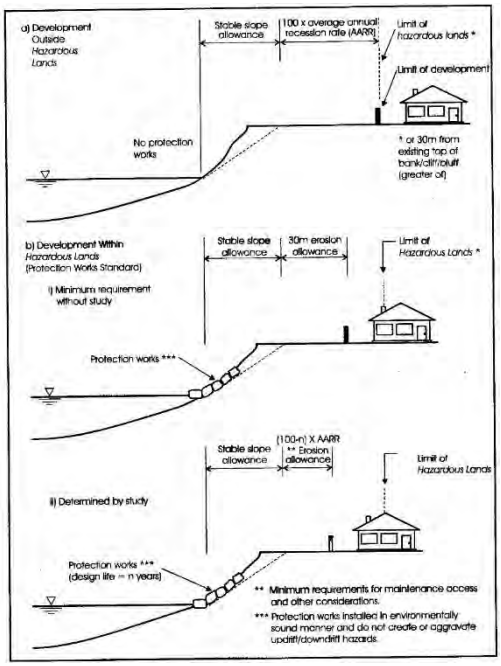


Figure 7.32b)(ii)) - Protection Works Standard: MNR, Technical Guide, Part 7, Pg. 7-62, 1997

The reason for the Provincial Policy to still recommend an erosion setback along with the installation of the Protection Works was because of the nature of the natural erosive shoreline process and the inability of the protection works to stop the natural erosion process.

Some provision can be made for reductions to the overall allowances depending on the expected life of the erosion structures provided the design has been carried out according to "accepted scientific and engineering practices" with the expected life of the structure timeframe. For example if the design life expectancy of the structure is 30 years (provided the design of the structure is stamped by a professional engineer specializing in coastal engineering), then the erosion allowance portion of the setback could be reduced to 70 years Average Annual Recession Rate PLUS the Stable Slope Allowance. "(Technical Guide, MNR 2001, Appendix A7.2, Existing Development Within the Hazardous Lands).

B

9. APPENDIX B – Flooding Hazard

Appendix B: Lake Ontario/St. Lawrence River Shoreline Flooding Hazards

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100 Year Flood Level and Wave Uprush

The table in this appendix describes the 100 year flood level and wave uprush values for the Lake Ontario – St. Lawrence River shoreline that was defined by Anthony (1993) and updated by the CRCA in January 2014.

REFERENCES

Anthony, T. 1993. Regulatory Shore Lands Limit: A Study for the CRCA Shoreline. Cataraqui Region Conservation Authority. Glenburnie, Ontario.

FOR MORE INFORMATION

Please contact the CRCA at 613-546-4228 or info@crca.ca, or visit our website at www.crca.ca.

Reach	Floodplain Elevation (m GSC)	Wave Uprush Offset (m)	Flood Hazard Elevation (m GSC)	Reach	Floodplain Elevation (m GSC)	Wave Uprush Offset (m)	Flood Hazard Elevation (m GSC)
001-BETH	75.9	0.19	76.1	043-LEMO	76.0	2.83	78.9
002-BETH	75.9	0.38	76.3	044-EVER	76.0	2.28	78.3
003-HUFF	75.9	0.45	76.4	045-SAND	76.0	1.59	77.6
004-SHER	75.9	0.97	76.9	046-CATA	76.0	3.14	79.2
005-GOSP	75.9	0.17	76.1	047-PORT	76.0	3.43	79.5
006-GOSP	75.9	0.37	76.3	048-KING	76.0	0.74	76.8
007-HAYB	75.9	0.40	76.3	049-KING	76.0	N/A	76.0
008-HAYB	75.9	0.19	76.1	050-FORT	76.0	1.25	77.3
009-HAYB	75.9	0.03	76.0	051-CART	76.0	0.98	77.0
010-HAYB	75.9	0.04	76.0	052-RAVE	76.0	1.01	77.1
011-HAYB	75.9	N/A	75.9	053-EAST	76.0	1.08	77.1
012-HAYB	75.9	0.06	76.0	054-TRES	76.0	0.48	76.5
013-HAYB	75.9	0.27	76.2	055-PITT	76.0	0.31	76.4
014-HAYB	75.9	0.09	76.0	056-PITT	76.0	0.56	76.6
015-HAYB	75.9	0.12	76.1	057-GRAS	76.0	0.69	76.7
016-5HAY*	75.9	0.47	76.4	058-TRID	76.0	1.00	77.0
016-HAYB*	75.9	0.57	76.5	059-TRID	76.0	0.24	76.3
017-WITL	75.9	0.25	76.2	060-WILL	76.0	0.22	76.3
018-WITL	75.9	0.47	76.4	061-LIND	76.0	0.25	76.3
019-THOM	75.9	0.23	76.2	062-GANA	75.9	0.48	76.4
020-THOM	75.9	0.23	76.2	063-GRAY	75.9	0.40	76.3
021-TRUM	75.9	0.25	76.2	064-HALS	75.9	0.32	76.3
022-LENI	75.9	0.31	76.3	065-ADMI	75.9	0.31	76.3
023-YOUN	75.9	0.21	76.2	066-CHAM	75.9	0.28	76.2
024-YOUN	75.8	0.29	76.1	067-SMUG	75.9	0.63	76.6
025-PULL	75.8	0.55	76.4	068-CLUB	75.9	0.76	76.7
026-ALLE	75.8	0.44	76.3	069-ROCK	75.9	0.28	76.2
027-COLE	75.8	0.97	76.8	070-TAR.	75.9	0.16	76.1
028-CONW	75.8	0.42	76.3	071-COOK	75.9	0.14	76.1
029-SAND	75.8	0.60	76.4	072-THOM	75.9	0.25	76.2
030-POWE	75.8	1.54	77.4	073-LARU	75.9	0.19	76.1
031-CEME	75.8	1.74	77.6	074-MALL	75.9	0.27	76.2
032-BATH	75.8	0.51	76.4	075-BROW	75.8	0.23	76.1
033-MILL	75.8	0.63	76.5	076-WHIT	75.8	0.56	76.4

034-MILL	76.0	0.30	76.3	077-BUTT	75.8	1.52	77.4
035-PARO	76.0	0.21	76.3	078-COLE	75.8	0.32	76.2
036-PARO	76.0	1.48	77.5	079-FULF	75.8	0.68	76.5
037-NICH	76.0	1.47	77.5	080-LILY	75.8	0.52	76.4
038-NICH	76.0	0.40	76.4	081-FERN	75.8	0.66	76.5
039-AMHE	76.0	0.71	76.8	082-FERN	75.8	0.50	76.3
040-COLL	76.0	0.73	76.8	083-BROC	75.8	1.16	77.0
041-COLL	76.0	0.23	76.3	084-BROC	75.8	0.48	76.3
042-LEMO	76.0	2.75	78.8				

Calculation of the CRCA Regulation for flood hazard (Figure below) requires that consideration be given to the following components:

- 100-year flood level
- Flood allowance for wave uprush & other water related hazards (15 m for Lake Ontario and 5 m for St. Lawrence River)
- Allowance of 15m

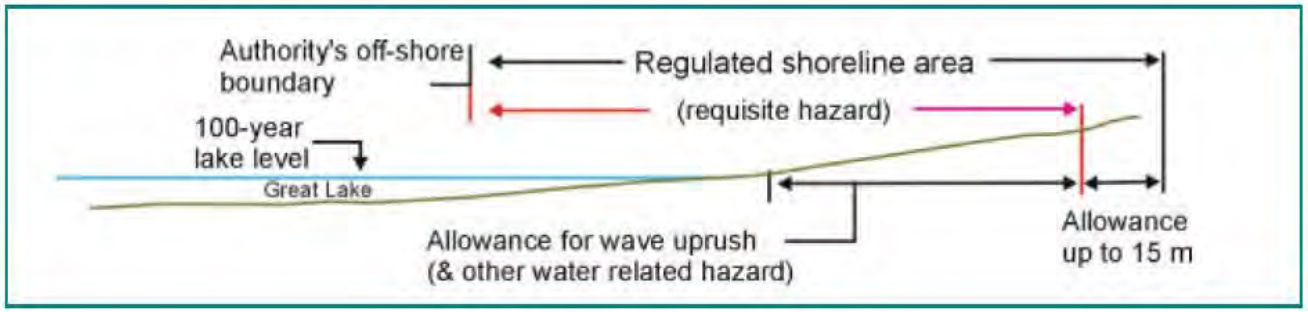


Figure - Guidelines for developing Schedules of Regulated areas, 2005, (Figure from Page 19).

The 100-year flood level is the minimum design flood criteria standard in Ontario. It consists of the sum of the mean lake level and the storm surge with a combined probability of the 100 year return period.

"The 100 year flood level means the peak instantaneous still water level plus an allowance for wave and other water-related hazards for Lake Ontario and the St. Lawrence River in the Great Lakes-St. Lawrence River System that has a probability of occurrence of one per cent during any given year." (O. Reg. 148/06, Schedule. 1.) This means that on average, it has a 1 percent probability of occurring in any given year or on average, once every 100 years. Detailed information about how to calculate flooding and wave uprush may be found in the MNR Technical Guide Part 3 – Flooding Hazards (2001).

Where specific technical information (from studies) is not available, the province requires a minimum of 15 metres for Lake Ontario and 5 m for the St. Lawrence River, measured horizontally from the 100 year Flood level to be included for wave uprush and other water related hazards. This has been applied in areas not covered by the Anthony (1993) study. The MNR Figure below illustrates this requirement.

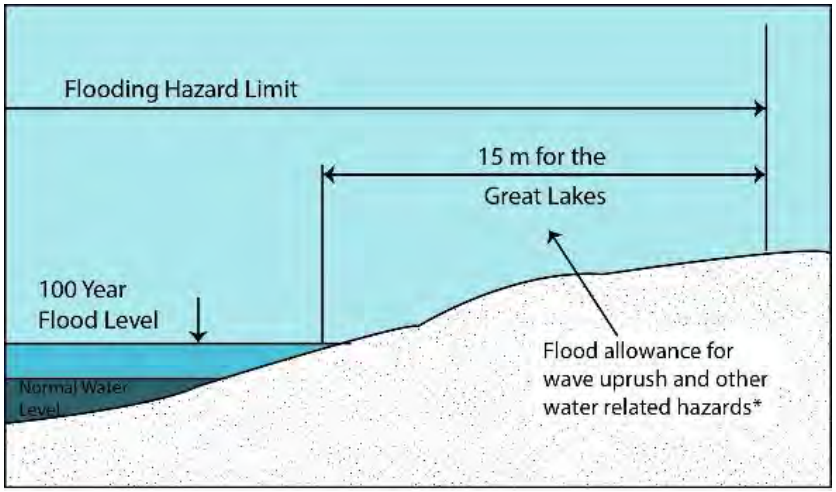


Figure: Flooding Hazard - Source: MNR, Understanding Natural Hazards (2001).

Where the 15 metre allowance for Lake Ontario and 5 m for the St. Lawrence River is considered to be either too large or too small, a study may be carried out by professionally qualified coastal engineer or coastal geomorphologist. The flooding hazard limit would then be determined by relying on:

1) The 100-year flood level, plus
2) The flood allowance for wave uprush and other water-related hazards as determined by a site-specific study conducted by a professionally qualified coastal engineer or coastal geomorphologist.

CRCA Flooding Hazard Policies

The CRCA Flooding Hazard Policies from Section 4.1 of the Environmental Planning Policy (EPP) 2015 document have been provided as follows. (2015, Section 4.1 CRCA, EPP)

"4.1.1 Development and site alteration should generally be directed to areas **outside of lands that are subject to flooding hazards**.

4.1.2 The placement of the following uses on lands that are subject to flooding hazards should not be supported:

a. institutional uses including hospitals, long term care homes, retirement homes, pre-schools, school nurseries, day cares and schools;

b. essential emergency services such as that provided by fire, police and ambulance stations and electrical substations; and

c. uses associated with the disposal, manufacture, treatment or storage of hazardous substances.

4.1.3 A **minimum 15 metre setback between development and the regulatory flood plain** is preferred to account for variation in the regulatory flood plain elevation within a given reach of a waterbody, changes over time in the anticipated extent of the regulatory flood plain, and situations such as debris jams that may affect flood levels. **New development should be set back a minimum of 6 metres from the regulatory flood plain,** where there are no additional, more restrictive requirements regarding natural hazards, natural heritage or surface water quality.

4.1.4 Development and site alteration **should not be supported** within **defined portions of the flooding hazard along the St. Lawrence River**, where such development and site alteration will create flooding hazards, cause upstream and/or downstream impacts, and/or cause adverse environmental impacts.

4.1.5 Development and site alteration should **not be supported within areas that would be rendered inaccessible to people and vehicles during times of flooding hazards**, unless it has been demonstrated that the site has safe access appropriate for the nature of the development and the natural hazard.

4.1.6 The placement of stormwater management facilities and snow storage areas in the regulatory flood plain should not be supported.

4.1.7 Development that by its nature must necessarily be located within the regulatory flood plain, such as flood and/or erosion control works, marine facilities or passive non-structural uses which do not affect flood flows, may be supported.

4.1.8 Except where prohibited by the Provincial Policy Statement and where specified elsewhere in this document, development and site alteration **may be supported** in those portions of the flooding hazard where the **effects and risk to safety are minor, could be mitigated in accordance with provincial standards,** and where all of the **following are demonstrated and achieved**:

a. **development and site alteration is carried out in accordance with floodproofing standards, protection works standards, and access standards;**

b. vehicles and people have a way of **safely entering and exiting** the area **during times of flooding, erosion and other emergencies**;

c. **new hazards are not created** and **existing hazards are not aggravated**;

d. **no adverse environmental impacts will result**; and

e. it meets **all of the applicable requirements of the Guidelines for Implementing Ontario Regulation 148/06**.

4.1.9 In areas where new development is proposed within, or in close proximity to, lands having susceptibility to flooding and the elevation of the regulatory flood plain is unknown, a **minimum setback of 30 metres from the average high water mark or top of bank** should be applied provided that, in the opinion of CRCA staff, there is sufficient difference in elevation (to be determined on a case by case basis).

4.1.10 The CRCA may recommend that a technical study be completed by a qualified professional to determine the extent of the regulatory flood plain for a site, in order to ensure that any development would comply with provincial policy, municipal policy and provisions, and CRCA policies and guidelines on natural hazards. Such a study would be done at the applicant's expense, using accepted scientific and engineering principles, and be completed to the satisfaction of CRCA staff and the approval authority." (2015, Section 4.1 CRCA, EPP)

Additional detailed information and guidance should be consulted from Section 6 and the Appendices of the CRCA Guidelines for Implementing Ontario Regulation 148/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, November 2017 document.

C

10. APPENDIX C – Erosion Hazard

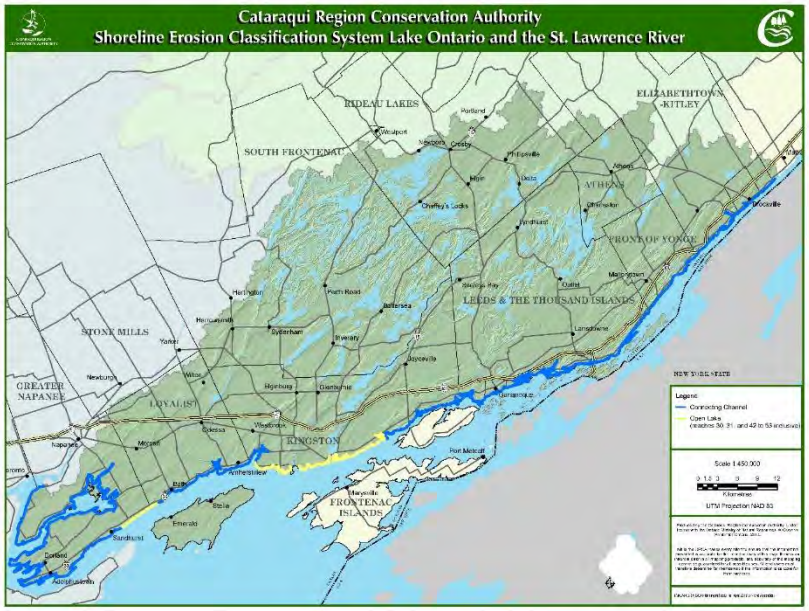
Appendix C: Shoreline Erosion Classification System

Lake Ontario and the St. Lawrence River - Cataraqui Region

The table in this appendix describes a simplified Lake Ontario – St. Lawrence River shoreline classification system and the regulatory erosion standard that was defined by J.D. Paine Engineering Inc. (1995) for the Cataraqui Region. For the purpose of this system, the entire shoreline is considered to be a connecting channel, or sheltered shoreline, with the exception of reaches 30, 31 and 42 to 53 inclusive (as defined by Anthony, 1993) which are open lake. The map on the next page identifies the locations of the connecting channel and open lake reaches.

SHORELINE TYPE	REGULATORY EROSION STANDARD		
	Stability Allowance	Erosion Allowance	
		Open Lake	Connecting Channel
High Bedrock* (>2m)	1:1 on rock portion 3:1 on till portion	5m if till covered 0m if exposed rock	5m if till covered 0m if exposed rock
Low Bedrock* (<2m)	1:1 from toe of slope	10 m	5 m
High Till (> 2m)	3:1 from toe of slope	30 m	15 m
Low Till (<2m)	3:1 from toe of slope	30 m	10 m

* For a composite till on bedrock shoreline to be classified as bedrock shoreline, the elevation of the top of rock must exceed the seasonal high water level by a minimum of 1.0 m.


Cataraqui Region Conservation Authority
Shoreline Erosion Classification System Lake Ontario and the St. Lawrence River
RIDEAU LAKES
SOUTH FRONTENAC
ELIZABETHTOWN-KITLEY
ATHENS
FRONT OF YONGE
LEEDS & THE THOUSAND ISLANDS
STONE MILLS
GREATER NAPANEE
LOYALIST
KINGSTON
FRONTENAC ISLANDS
Legend
Connecting Channel
Corn Lake
(reaches 30, 31, and 49 to 53 inclusive)
Scale 1:450,000
Kilometres
UTM Projection NAD 83

The Erosion Hazard

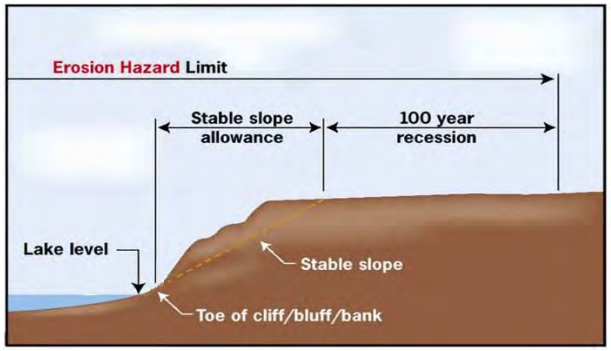
The erosion hazard limit is determined using the two components of;

- 100 year erosion rate (the average annual rate of recession extended over a hundred year time span), plus
- An allowance for slope stability (3:1 in absence of a study) HOWEVER CRCA has a carried out specific studies for their area and a study by J. D. Paine Engineering Inc. (1995) determined setbacks for specific areas along the CRCA shoreline.

The study and summary charts have been provided above in Appendix C of this document and can also be found in Appendix of the 2017, GIOR 148/06:DIWASW, the 2015, Environmental Planning Policies Appendices document.

Along Lake Ontario and the St. Lawrence River (See CRCA Figure below from the 1995 Paine study), *"The CRCA defines the erosion hazard along the shoreline of Lake Ontario and the St. Lawrence River, to consist of a stable slope allowance and erosion allowance that are based on a study by J. D. Paine Engineering Inc. (1995) plus a minimum erosion access allowance of 6 metres. These allowances are described in Appendix C*" of the Environmental Planning Policy 2015 document.

The Erosion Hazard limit as defined in the Understanding the Natural Hazards (MNR 2001) and the MNR Technical Guide (2001) applies the Stable Slope Allowance first and then the recession allowance (See MNR Figure below).–This same approach is followed in CRCA's 'Paine Study' (Paine, 1999) and subsequently, the CRCA 148/06 Regulations as well as the CRCA Guidelines for Implementing O. Reg. 148/06.



Erosion Hazard Limit - Source: MNRF, Understanding Natural Hazards (2001).

CRCA Erosion Hazard Policies

The CRCA Erosion Hazard Policies from Section 4.2 of the Environmental Planning Policy 2015 document have been provided as follows. Additional detailed information should be referenced from Section 6.2.2 to 6.3.2 of the CRCA Guidelines for Implementing Ontario Regulation 148/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, November 2017 document.

4.2.1 Development and site alteration should generally be directed to areas **outside of lands that are subject to erosion hazards.**

4.2.2 The placement of the following uses on lands that are subject to erosion hazards should not be supported:

a. institutional uses including hospitals, long term care homes, retirement homes, pre-schools, school nurseries, day cares and schools;

b. essential emergency services such as that provided by fire, police and ambulance stations and electrical substations; and

c. uses associated with the disposal, manufacture, treatment or storage of hazardous substances.

4.2.3 Development and site alteration **should not be supported** within areas that would be rendered **inaccessible to people and vehicles during times of erosion hazards**, unless it has been demonstrated that the site has safe access appropriate for the nature of the development and the natural hazard.

4.2.4 Except where prohibited by the Provincial Policy Statement and where specified elsewhere in this document, development and site alteration **may be supported** in those portions of the erosion hazard where the **effects and risk to public safety are minor, could be mitigated in accordance with provincial standards,** and where all of the **following are demonstrated and achieved**:

a. **development and site alteration is carried out in accordance with floodproofing standards, protection works standards, and access standards;**

b. vehicles and people have a way of **safely entering and exiting** the area **during times of flooding, erosion and other emergencies;**

c. **new hazards are not created and existing hazards are not aggravated;**

d. **no adverse environmental impacts will result;** and

e. it meets **all of the applicable requirements of the Guidelines for Implementing Ontario Regulation 148/06.**

4.2.5 A **10 metre setback from the stable toe of slope should be required for unstable slopes and embankments that exist above/inland of a proposed site for development**. A reduction to this allowance may be considered if it can be demonstrated that the hazard will not be aggravated and the development will not be negatively affected by the hazard. Generally, a technical study completed by a qualified professional will be required for a reduction to be considered.

4.2.6 The Conservation Authority may recommend that a technical study be completed by a qualified professional to determine the extent of the erosion hazard for a site, in order to ensure that any development would comply with provincial policy, municipal policy and provisions, and CRCA policies and guidelines on natural hazards. Such a study would be done at the applicant's expense, using current provincial technical guidelines for geotechnical investigations, and be completed in accordance with Appendix D of the Environmental Planning Policy 2015 document to the satisfaction of CRCA staff and the approval authority.

Additional detailed information and guidance should be consulted from Section 6 and the Appendices of the CRCA Guidelines for Implementing Ontario Regulation 148/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, November 2017 document.

D

11. APPENDIX D – Examples from Other Jurisdictions

Examples from other Urbanized Jurisdictions

Examples from other urbanized shorelines along Lake Ontario have been provided in the following sections. Section A) focuses on the Toronto historical area of the Lake Ontario shoreline and Section B) focuses on other urbanized areas in Ontario along the Lake Ontario shoreline.

A) Historical Areas with high intensity development for comparison the Historical Toronto Harbour Area

It is within the Toronto Port Authority's Jurisdiction and does not need a permit from Toronto Region Conservation Authority (TRCA).

Waterfront setbacks for this Historical area are developed by the Toronto Port Authority but they collaborate with the City of Toronto.

- The City of Toronto has Urban Development Guidelines, which include the Waterfront areas specifically.
- Waterfront Toronto (Previously was Waterfront Regeneration Trust)

Newer developments closest setbacks are typically 30 m, and many of the waterfront areas have much greater setbacks than 30m and include large park land areas.

An older Waterfront Development is along Queen Quay Toronto.

Sugar Beach Toronto Harbour area is an example of New Development along the historical waterfront area of Toronto.

B) Other Urbanized Areas in Ontario

Along other urbanized sections of Lake Ontario shoreline, they typically follow *PPS* + CA Regulations (i.e. Flooding, Erosion, Dynamic Beach hazard setbacks).

In Toronto West, East of the historical Toronto Harbour, and in the City of Etobicoke the Toronto Region Conservation Authority (TRCA) Regulation 166/06 is administered.

- In these areas developments do need permits from TRCA.
- These permits follow the *PPS* + CA Regulations (Flooding, Erosion and Dynamic Beach Hazard setbacks). For example the Erosion Hazard setback of 30m plus Stable Slope allowance is standard along these sections of the TRCA shoreline.
- Most of these shorelines include public ownership as part of the integrated shoreline management approach.

The Burlington and Oakville shorelines follow the Halton Conservation Ontario Regulation 162/06. This regulation is very clearly set out the Policies and Guideline requirements for the administration of their Regulation and Land Use Planning Policy for shoreline development. (Conservation Halton. 2015)

There are some exceptions in Ontario of some harbours (e.g. Hamilton Port Area, Trenton Base) which are federally owned and do need permits from the local CA's.

CATARAQUI REGION CONSERVATION AUTHORITY

DATE: **JUNE 26, 2019** **REPORT #** **IR-051-19**

TO: FULL AUTHORITY BOARD

FROM: BERT HERFST, CHAIR
PERSONNEL COMMITTEE

1.0 TYPE OF REPORT

CONSENT ITEM [☐]
ITEM FOR BOARD CONSIDERATION [☒]

2.0 TOPIC

REPORT FROM OPEN SESSION OF THE PERSONNEL COMMITTEE MEETING OF JUNE 26, 2019

Item 5.1 Report IR-042-19-PC, Position Description – GIS & Corporate Technology Analyst, from the Open Session of the Personnel Committee meeting of June 26, 2019 is presented for consideration.

3.0 RECOMMENDATIONS

THAT Report IR-051-19, Report from Open Session of the Personnel Committee meetings of June 26, 2019, BE APPROVED.

a) **THAT** Report IR-042-19-PC, Position Description – GIS & Corporate Technology Analyst, BE RECEIVED; and,

THAT the position description and salary level for the GIS & Corporate Technology Analyst BE APPROVED.

Respectfully submitted,

(original signed by)

Bert Herfst
Chair, Budget Review Committee

Attachment - Report IR-042-19-PC, Position Description – GIS & Corporate Technology Analyst

CATARAQUI REGION CONSERVATION AUTHORITY

DATE: JUNE 26, 2019 **REPORT #** **IR-042-19-PC**

TO: PERSONNEL COMMITTEE

FROM: GEOFF RAE, MBA, P.ENG.
GENERAL MANAGER

1.0 TYPE OF REPORT

CONSENT ITEM [☐]
ITEM FOR BOARD CONSIDERATION [☒]

2.0 TOPIC

POSITION DESCRIPTION – GIS & CORPORATE TECHNOLOGY ANALYST

3.0 RECOMMENDATION

THAT Report IR-042-19-PC, Position Description – GIS & Corporate Technology Analyst, BE RECEIVED; and,

THAT the position description and salary level for the GIS & Corporate Technology Analyst BE APPROVED.

4.0 PURPOSE

The purpose of this report is to seek Personnel Committee approval of the position description and associated salary level of the GIS & Corporate Technology Analyst.

5.0 BACKGROUND

In 2017, Cornerstones Management Solutions Limited completed a project that included a new organizational design, creation of position descriptions, and a compensation review. As part of the organizational design phase of the project new positions that could improve organizational performance in the future were identified and evaluated. These future positions were to be considered in future budget deliberations for funding when it was appropriate to fill them. In the Information Technology Section of Corporate Services one such position, Application Support Analyst, was identified. This position and the GIS Analyst report to the Supervisor, Information Technology in the current organizational design. There has been recent turnover in the GIS Analyst position, and staff are recommending a consolidation of the Application Support Analyst role with that of the GIS Analyst.

6.0 STRATEGIC PLAN

This report supports Goal F in the Strategic Plan, Cataraqui to 2020.

To operate an efficient and financially sound organization that provides excellent service to the community; promotes best environmental practices; and that offers a healthy, positive and nurturing workplace environment for staff, members and volunteers.

- Maintain a positive image in the community.
- Make customer service a top priority in all work areas.
- Maximize the efficient use of time and resources to avoid waste.
- Demonstrate leadership in environmental design as well as energy and materials conservation.
- Foster the health, safety, morale and career development of our staff.
- Maintain up-to-date corporate policies.
- Maintain internal capacity in support services such as accounting, communications, document management, geomatics and information technology.
- Manage capital assets in a long-term, sustainable way.

7.0 INPUT FROM OTHER SOURCES

The Manager, Corporate Services assisted in the development of this report.

8.0 ANALYSIS

The position description for the GIS & Corporate Technology Analyst is attached to this report (Attachment #1). Staff have reviewed the needs of the Information Technology Section of Corporate Services because of the recent departure of the GIS Analyst. Given corporate budget challenges, it is unlikely that Cataraqui Region Conservation Authority will be able to hire both a GIS Analyst and an Application Support Analyst in the near term. To integrate key components of both positions, with an emphasis on the GIS responsibilities, staff recommend that CRCA create a GIS & Corporate Technology Analyst position. The role of this combined position will be to support staff and the public with GIS analysis and the creation of new data products, and to source, acquire and configure appropriate commercial software tools to support business lines and improve efficiency.

Both the GIS Analyst and the Application Support Analyst positions have been rated at Level 10 in the compensation plan. This more senior position will require greater communication, confidentiality, procurement skills and as such is recommended to be placed at Level 8 in the compensation plan.

9.0 FINANCIAL IMPLICATIONS

There are no financial implications in the approval of the position description and placement in the compensation plan.

10.0 CONCLUSION

Staff recommend the creation of a new position, GIS & Corporate Technology Analyst, to help fill skill gaps in the Information Technology Section of Corporate Services.

Approved for circulation,

(Original signed by)
Geoff Rae, MBA, P.Eng.
General Manager

Attachment #1 –GIS Corporate Technology Analyst position description

Cataraqui Region Conservation Authority June 27, 2019

32. Job Description – GIS & Corporate Technology Analyst

Summary

A key member of the Corporate Services Team, the GIS & Corporate Technology Analyst leads the provision of Geographical Information Systems (GIS) and cartography services as well as other Information Technology (IT) support services.

Overview of Responsibilities (this is not an exhaustive list)

1. Performs complex GIS analytical and geoprocessing functions, including input, editing, manipulation, management, analysis, and output of spatial and tabular datasets
2. Conducts, as appropriate, implementation, configuration, and support of software applications and technologies
3. Create, update and integrate data, ensuring that data is quality checked and meets integrity standards, identify gaps in data and data structure inefficiencies
4. Create and maintain ArcGIS Server-based map services
5. Create, edit, and amend GIS layers using existing documentation, maps, and information obtained from a variety of external datasets and data collected by CRCA
6. Develop data models, standards and work flows to guide the development, use and maintenance of the corporate GIS
7. Monitor and remedy database performance issues, and update services as required
8. Ensure that metadata and data documentation is created and maintained, including user manuals and methodology reports
9. Act as a strategic resource by providing robust technical and analytical support to project teams and other users
10. Using the appropriate programming language, create and maintain graphical user interfaces, customizations, and tools to extend database and software functionality. Assess project needs and database services to determine where these tools could be implemented to increase ease of use, efficiency and data integrity
11. Visualize data by generating maps and graphs, charts, conducting data analysis, and other products. Develop and modify mapping standards and templates
12. Research, evaluate, and test software, hardware and other enterprise software applications
13. Guide and process external data requests for the public, external agencies, or governments
14. Provide end-user support

Skill

- Degree in Geography, Computer Science, Environmental Sciences, or equivalent with an emphasis on GIS, or a post-graduate GIS certificate
- 2 to 3 years experience applying GIS and database management technologies and strong understanding of spatial and relational database concepts and design
- Familiarity with GIS methods related to the creation, manipulation and display of raster and LiDAR datasets, i.e. DEM imagery, and vector datasets
- Demonstrated ability to quickly learn GIS and other enterprise software applications
- Advanced knowledge of applicable legislation and relevant departmental policies and procedures
- Highly proficient in computer applications, including the full suite of Microsoft Office software and ArcGIS software suite
- Accuracy and attention to detail
- Demonstrated flexibility and the ability to adapt to a fast-paced changing environment
- Excellent verbal and written communication, interpersonal, problem solving and organizational skills
- Ability to perform under pressure, and juggle multiple priorities
- Valid Class G Driver's License or equivalent required

Effort

- Demand on energy as a result of extended periods entering, analyzing and reporting information, reading maps, etc.
- Work does not require extended physical effort; however, installing and repairing hardware or other technology related equipment may require some physical effort

Working Conditions

- Most working hours are in a normal indoor working environment
- Occasionally exposed to difficult or demanding clientele
- Occasionally required to work flexible hours to meet deadlines

Office of the City Clerk

June 24, 2019

Via email: grae@crca.ca

Geoff Rae, General Manager
Cataraqui Region Conservation Authority
1641 Perth Road, PO Box 160
Glenburnie, ON K0H 1S0

Dear Mr. Rae:

Re: City Council Meeting – June 18, 2019 – New Motion 1

I would confirm that Kingston City Council at its regular meeting held on June 18, 2019, approved the following New Motion:

> **Whereas** Canada's national banks, global insurance companies, and the world's scientists are urging swift and significant action on climate change, with a 50% reduction needed by 2030 to avoid catastrophic economic, social, and environmental damage; and
> **Whereas** the current Kingston City Council declared a climate emergency and such an emergency calls for immediate response to reduce Green House Gases (GHG); and
> **Whereas** the current Kingston City Council committed to demonstrated leadership on climate action through strategic planning, including reducing emissions drastically and equally across the corporation and community; and
> **Whereas** the current Kingston City Council has, to date, endorsed climate initiatives that will see emissions reduced in 2021/2022, mainly through corporate efforts (like electrifying the city's fleet, retrofitting buildings, and a new Climate Change Management Strategy); and
> **Whereas** Kingston City Council has the ability to create a Working Group to bring together corporate and community partners to find immediate and inexpensive GHG emission reduction strategies in the community, especially in

The Corporation of the City of Kingston
216 Ontario Street, Kingston, ON K7L 2Z3
Phone: (613) 546-4291 ext. 1247 Fax: (613) 546-5232 jbolognone@cityofkingston.ca

the industrial, commercial, and institutional (IC&I) sectors; and
Whereas the IC&I sector accounts for a significant portion of emissions in Kingston; and
Whereas such a Working Group is within the scope of council's approval powers and has been done before; and
Whereas the motions establishing such a Working Group previously approved by council have included their mandate, membership, leadership, and reporting structures; and
Whereas the mandate of this proposed Working Group is intended to be completed by early Fall, 2019, therefore time is of the essence; and**Therefore Be It Resolved That** council establish the "Working Group on Climate Action"; and

That the mandate of this working group be to promote, engage, inform, and challenge community organizations, institutions, and businesses to reduce GHG emissions in the IC&I sector as soon as possible at no to little cost; and
That Councillors Kiley and Doherty be appointed to the Working Group on Climate Action; and

That the following organizations be invited to appoint a representative to the Working Group:

- St. Lawrence College;
- Royal Military College;
- Queen's University;
- Kingston Environmental Advisory Forum;
- Cataraqui Region Conservation Authority;
- Greater Kingston Chamber of Commerce;
- SWITCH Ontario;
- Kingston, Frontenac and Lennox & Addington Public Health;
- Sustainable Kingston;
- Kingston Climate Hub;
- 350 Kingston;
- Limestone District School Board;
- Algonquin-Lakeshore Catholic District School Board;
- Conseil des écoles publiques de l'Est de l'Ontario;
- Conseil des écoles catholiques du Centre-Est; and
- Kingston Construction Association

That the membership of the Working Group include two co-chairs, with one co-chair being one of the two appointed Members of Council and one co-chair being

a representative from the industrial, commercial and institutional sector (ICI), to be selected by the Working Group members, at the first meeting of the Working Group; and

That the working group meet at the discretion of the chairs, consult with KEAF, and report to council no later than October 31, 2019 with a list of actions for potential implementation by community partners/businesses and the corporation to reduce GHG emissions in an immediate and inexpensive manner.

We invite you to submit the name of a representative from your organization to be a part of this working group to Julie Salter-Keane, Community Projects Manager at jsalter-keane@cityofkingston.ca.

Sincerely,

John Bolognone
City Clerk

C.C. Julie Salter-Keane, Community Projects Manager