



# THE ZONE

Welcome to the Fall/Winter 2017 issue of **THE ZONE**, the CZCA digital newsletter.

## Coastal Zone Canada 2018 Conference Update

Cabot Tower sits high above the Port of St. John's on Signal Hill and is synonymous with the conference goal of communication, since it received the first transatlantic wireless message from the United Kingdom in 1901. Recognizing the importance of communication, the agenda will explore the conference theme "Seeking Practical Solutions to Real Issues; Communities Adapting to a Changing World".

Throughout the conference, we will share examples of communities that embrace change to create opportunities, leverage stakeholders and collaboration, and embrace technology to develop solutions to the challenges faced by coastal communities across Canada and around the world. [Z](#)



**Date:** July 15-19, 2018

**Location:** Campus of Memorial University, St. John's, Newfoundland and Labrador

**Conference Sub-themes:** Change and Challenge – Realizing Opportunity  
Engagement and Collaboration – Examples from the Field  
Tools and Technologies – Practical Applications

**Call for Abstracts:** Coming in early 2018

**Sponsorship:** Visit the conference website to learn more about partnership opportunities <http://www.coastalzonecanada.org/czc-2018-conference/>

**Contact the Organizing Committee for further information:** [czc18@mi.mun.ca](mailto:czc18@mi.mun.ca)



**2018**  
**COASTAL**  
**ZONE**  
**CÔTIÈRE**  
**CANADA**

**ST. JOHN'S**  
NEWFOUNDLAND AND LABRADOR



# Announcing our New Bi-National Community of Practice for Living Shorelines

Danker Kolijn, Co-Chair, Gene Clark, Co-Chair\*

At the 2016 CZC conference in Toronto, an entire day was focused on the topic of Natural and Nature Based Shorelines, also known as Living Shorelines. Plus, immediately following the conference, a local field trip was led by Gord MacPherson from the Toronto and Region Conservation Authority to observe existing examples of Living Shorelines along the Toronto waterfront. The field trip attendees are seen in the adjacent photograph taken while visiting Tommy Thompson Park, the site of numerous large-scale wetland restoration projects.

The first special session focused on background presentations on the rationale for Living Shorelines, key design considerations, local examples from the Toronto Waterfront, recent activities in New York State, and an overview of the Green Shores™ program in British Columbia.

The second special session featured small breakout groups which discussed and reported out on barriers to implementation, selection of appropriate site locations, demonstration opportunities including leveraging existing protected areas for pilot approaches, research needs, and knowledge dissemination.

The day concluded with a facilitated session by Randy French on the need for and opportunities for a new Community of Practice (CoP) for Living Shorelines. There was overwhelming support for the development of a bi-national CoP, with a specific focus on Canada's coastal zones and the northern regions of the United States. A series of recommendations were developed by the attendees on objectives, governance, funding, and technical oversight. The full report summarizing the three sessions can be found on the CZCA website, under the CoP menu, along with copies of the PowerPoint Presentations.

<http://www.coastalzonecanada.org/>

Given the growing need for viable alternatives to hard engineering structures in the world's coastal environments and the CZCA's commitment to knowledge sharing, we are pleased to announce the launch of a new bi-national CoP for Living Shorelines. The CoP

will be co-chaired by Danker Kolijn from the CZCA Board of Directors and Gene Clark from the University of Wisconsin Sea Grant Office.

The CoP has currently adopted the working name "Living Shorelines." However, we would like to establish a more permanent name which reflects the unique temperate climate and ice conditions in the northern United States and Canada. And we need your help! We would like to leverage the expertise and creativity of the CZCA members to establish the permanent name for the CoP. Follow the link below to cast your vote. Contest closes January 31, 2018.



engage expert panels, produce technical guidance documents specific to coastlines with a temperate climate, and generate regular outreach.

Future updates from the CoP will be posted on our website and included in our newsletter.

**Help determine the working name of our new bi-national community of practice by voting for, or contributing, a suggestion at the link here:**

<https://www.surveymonkey.com/r/7WHRZKF>

**Name to be announced in the next issue of The Zone (2018)!**

We envision that the CoP will become an important and unique part of the organization with the goal of providing information to public and private stakeholders based on science and engineering principles tailored to our climate.

In the coming months, the CoP Co-chairs will work to finalize the mandate of this new knowledge sharing platform. The intent is to use both internal and external resources, and your feedback to establish the CoP. The proposed scope of the CoP includes:

1. Hosting webinars to share knowledge and project examples;
2. Integrating the Living Shorelines topic into our biennial conferences;
3. Securing funding to expand our mandate and knowledge sharing platform;
4. If future funding is secured, the CoP could

Also look for details about dedicated content on Living Shorelines at our upcoming 2018 conference in St. John's, Newfoundland and Labrador. We look forward to your participation in our new bi-national CoP for Living Shorelines. Don't forget to vote for the new CoP name using the link above! 

\* *Authors: Danker Kolijn, P.Eng., Coastal Engineer, CBCL Limited Halifax, Gene R. Clark, PE, Coastal Engineering Specialist, UW Sea Grant Institute*



# GET IN THE ZONE

Submit your news items for the next issue of The Zone. We wish to continue the dialogue of coastal zone work across Canada between our biennial conferences, so please consider sharing an update with us to be included in the next issue. [Z](#)

## News Items

To submit a news item (maximum 500 words) please send to [thezone@coastalzonecanada.org](mailto:thezone@coastalzonecanada.org)

# CALL FOR PAPERS

Please consider submitting a paper to the next issue of the CZCA Newsletter. We are looking for paper submissions of 1000-2000 words on a wide range of topics covering Canada's coastal zone: governance and policy, engineering, ocean science, and social science.

**If you wish to submit a paper please submit your abstracts (maximum of 250 words) to [thezone@coastalzonecanada.org](mailto:thezone@coastalzonecanada.org) by March 15, 2018. Papers are due April 15, 2018. [Z](#)**

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We would like to sincerely thank all of the contributors to this edition of the Zone, the authors of the papers and articles herein, as well as the reviewers.



Inverness Beach NS in March  
Credit: Vincent Leys

## Call for French Editors

The Zone is looking for French speaking or bilingual (French and English) volunteer editors. For further information please contact us at [thezone@coastalzonecanada.org](mailto:thezone@coastalzonecanada.org)

## CZCA Membership

Registration at the biennial conferences automatically includes CZCA membership dues for two years. If you missed the 2016 conference and would like to update your membership or become a new member, please visit our website for more details. The fee is \$20/year or \$40 for two years.

[www.coastalzonecanada.org](http://www.coastalzonecanada.org)



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## Great Lakes water levels in 2017- reflections on a wet year

Rob Caldwell, Wendy Leger, Mike Shantz\*

2017 will be a year to remember throughout the Great Lakes and St. Lawrence River system, as persistent and at times exceptional wet weather caused a rapid rise in water levels and resulting in levels not seen in decades or longer.

Lake Superior and Lakes Michigan-Huron peaked at their highest levels in over 20 years, while on Lake Erie, water levels peaked in early June near the record highs of 1986. Even more exceptional were the conditions seen on Lake Ontario, where water levels exceeded the highest in recorded history (1918-present), and also downstream of here on the St. Lawrence River, where record flows caused levels to also reach or exceed record highs. Increased flooding and erosion issues as well as impacts to public and private property owners and recreational users along the shoreline provided challenges for managers who had not experienced impacts of such magnitude in recent years.

There is considerable interest amongst shoreline managers and stakeholders in better understanding how various factors contributed to the observed conditions. This is especially true for Lake Ontario and the St. Lawrence River, where on January 7th, 2017, the International Joint Commission (IJC) implemented a new regulation plan, or set of rules, for managing the outflows of Lake Ontario to the St. Lawrence River. Many questions have been raised about the role of the new regulation plan in contributing to the high water levels, as well as the likelihood of seeing similar extreme conditions in the future. These questions underscore the importance of the implementation of the Great Lakes – St. Lawrence River Adaptive Management (GLAM) Committee in helping understand the impacts and in gathering information that may lead to improved water level regulation in the future.

### Understanding Seasonal and Inter-annual Water Level Changes on the Great Lakes

Water levels on the Great Lakes are constantly changing. The primary driver for seasonal and inter-annual changes in levels for any one of the Great Lakes is the net amount of water those lakes receive. This includes inflows to the lakes, which are primarily composed of precipitation falling directly onto the surface of the lake, runoff from its surrounding drainage basin, and water entering from upstream Great Lakes by way of their connecting channels. Subtracted from this is water removed from each Great Lake, primarily through water evaporated from the lake surface. Diversions into and out of the Great Lakes have a much lesser impact on lake levels, while consumptive uses have nearly negligible impacts. All these factors combine to give the total net amount of water flowing into the lakes, and this is known as the net total water supply (NTS).

Typically, precipitation and runoff from surrounding watersheds is highest in the spring period causing the lakes to rise, peaking in the June through September period depending on the lake. Evaporation from the lake surface increases into the fall and early winter leading to a general decline in water levels during that period. Each of the Great Lakes typically reaches its seasonal minimum at some point in the winter. Over the long term, periods of above average NTS drive lake levels higher, while periods of below average NTS will draw them down.

Outflows from each of the Great Lakes are the remaining component that also affect water levels. Each of the Great Lakes discharges water through an outlet channel, either to the next Great Lake downstream, or in the case of Lake Ontario, to the Atlantic Ocean via the St. Lawrence River. Flows in these channels - including both those that are regulated and those that are not- are largely a function of lake

levels and water supply conditions. Outflows respond to variations in these conditions over time, and are generally highest during periods of wetter weather and higher lake levels, and lowest during periods of drier conditions and lower lake levels.

### 2017 Water Supply Conditions for Lake Ontario and the St. Lawrence River

Water supply conditions are the primary driver of water level fluctuations in the Great Lakes and that was no exception for Lake Ontario and the St. Lawrence River in 2017. An unusually mild and wet winter, above-normal inflows from the Lake Erie, a record-setting spring freshet in the Ottawa River basin, and heavy persistent rainfalls across the Lake Ontario and the St. Lawrence River system that continued through spring and early summer all combined to cause Lake Ontario to reach levels not previously seen within the historical record (1900-present).

The beginning of 2017 saw water levels on Lake Ontario very close to their long-term average. During the January-March period, water supplies to the Lake Ontario basin were above normal. In fact, the NTS (i.e. the net total inflow) was the 12th highest for that three month period since records began in 1900. This was due to a combination of precipitation, snowmelt and runoff from within the basin, and above-average and increasing inflows from Lake Erie, which also saw wet conditions and generally rising water levels throughout this period. Lake Ontario levels rose steadily during this period, but tracked closely the water level rise seen during this period in 2016. By March 31st, 2017 levels were only 6 cm higher than they had been at the same time the previous year.

Then came exceptionally wet conditions in April and May within both the Lake Ontario basin and the Ottawa River basin, which drains into

the St. Lawrence River at Montreal, Quebec (Figure 1). Total inflows to Lake Ontario for April were the 2nd highest observed in the historical record (1900-present) for that month, while May inflows were the highest ever recorded in May (Figure 2). Combined, Lake Ontario inflows for April and May set a record for the 1900-2017 period. The record high inflows were due to a combination of well- above-average contributions from Lake Erie and significant storm events over the Lake Ontario watershed, some of which contributed as much as 75 mm of rain directly onto the lake surface and higher amounts in the surrounding watershed. During this same period, significant runoff was occurring in the Ottawa River basin, leading to the highest ever Ottawa River flow recorded

at the Carillon Dam in the lower Ottawa River since it was completed in 1963. These unprecedented conditions combined to cause significant flooding in the Montreal area and further downstream on the lower St. Lawrence River. During this same time, Lake Ontario water levels rose rapidly and reached their record peak of 75.88 m IGLD at the end of May, 2017 contributing to flooding and erosion damages along the shoreline as well as impacts to a range of public and private shoreline uses.

High water supplies to Lake Ontario continued in June and July. With Lake Erie water levels well above average, inflows through the Niagara River to Lake Ontario were also well above average and precipitation and runoff remained

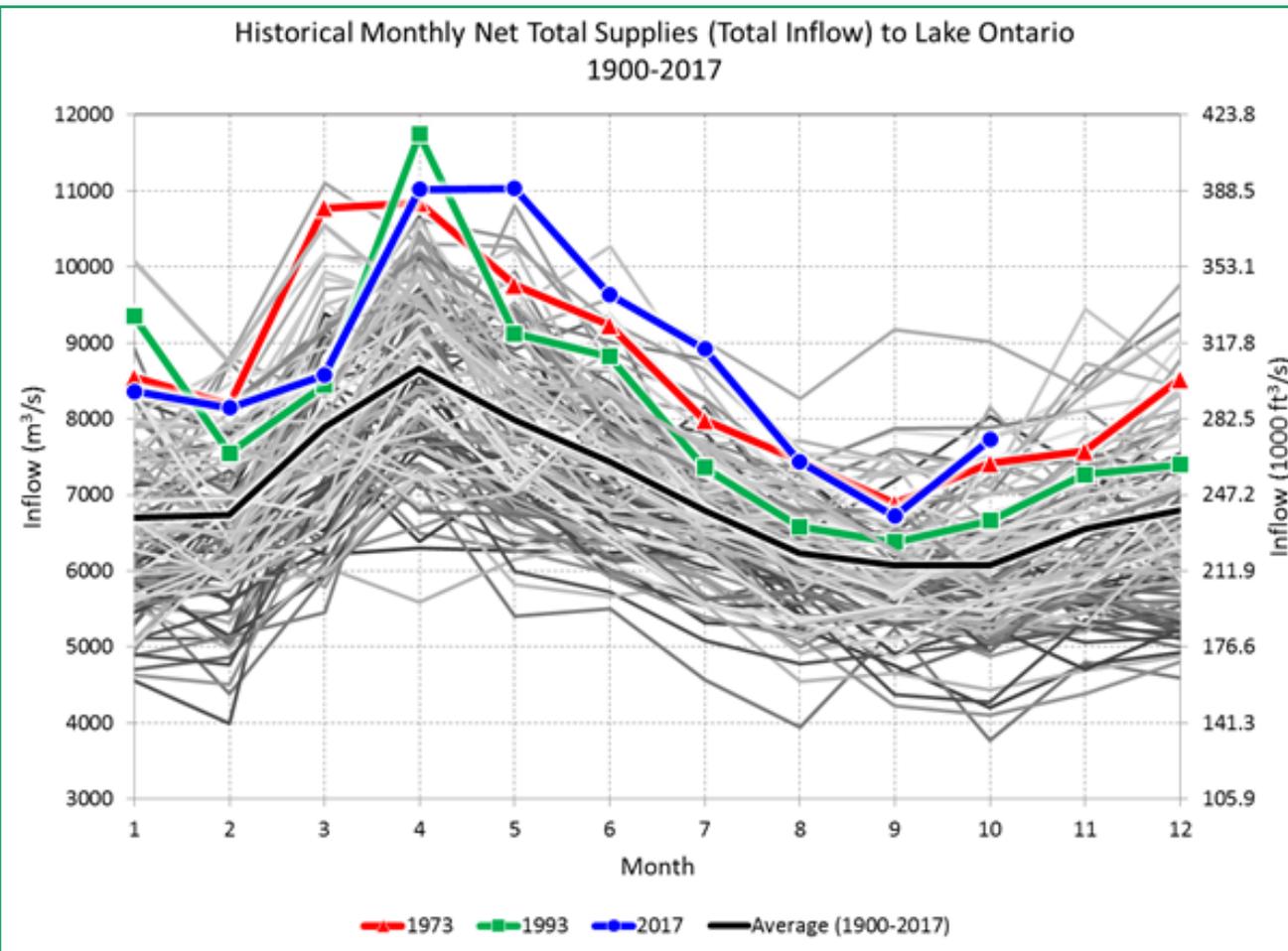
high in the Lake Ontario basin. June 2017 had the 2nd highest June water supply conditions on record and July was the 2nd highest for that month. All and all, the January to July period was the 2nd highest for that period. It was only later in July and then into August and September when drier conditions returned to the Lake Ontario basin along with lower inflows from Lake Erie.

### The Role of Lake Ontario Outflow Regulation

Essentially all water leaving Lake Ontario through the St. Lawrence River passes through a hydropower dam and associated spillway facilities located at Cornwall, Ontario



Continued on next page



**Figure 2: Net Total Supplies (total inflow) to Lake Ontario 1900-2017 – each line represents a different year in the historical sequence, with 1973, 1993, and 2017 highlighted due to their correspondence with high Lake Ontario water levels in those years (source: International Lake Ontario - St. Lawrence River Board)**

Challenges During High Water Levels on Lake Ontario and the St. Lawrence River- <http://ijc.org/greatlakesconnection/en/2017/08/extreme-conditions-challenges-high-water-levels-lake-ontario-st-lawrence-river/>) but the important point is that outflow management is designed to reduce the risk of ice jam flooding in the upper St. Lawrence River during the winter period and balance upstream and downstream high water conditions during the Ottawa River freshet period. In both cases, extreme conditions in 2017 made these operations very challenging, outflows were continuously adjusted according to rapidly varying conditions, and there was little opportunity to further increase outflows to avoid high water

and Massena, New York. This is where the importance of the International Lake Ontario – St. Lawrence River Board (ILOSLRB) and Plan 2014 come into play. Plan 2014 ([http://ijc.org/en/\\_news?news\\_id=581](http://ijc.org/en/_news?news_id=581)) prescribes a new set of rules that the board must ordinarily follow in setting the outflows from Lake Ontario through the St. Lawrence River and replaces the previous regulation plan, Plan 1958-D, which had been in operation since 1963. The implementation of Plan 2014 at the beginning of 2017 coincided with the extreme water supply conditions discussed in the previous section, leading many to wonder about whether the previous plan would have been able to reduce peak levels on either Lake Ontario or the St. Lawrence River.

While detailed analysis is ongoing, preliminary investigations suggest there is little that

changes in outflows could have done to improve outcomes this year. There are two main reasons. First, water supplies were exceptional in 2017 meaning there was too much water throughout the Lake Ontario – St. Lawrence River system, with nowhere for it to go, making it difficult to balance and impossible to protect against the severe impacts that were being felt both upstream and downstream. Second, the operational outflow strategies that must be employed during critical periods associated with ice formation and with managing St. Lawrence River flooding during the Ottawa River spring freshet period, are very similar under any regulation plan owing to the fact they are developed based largely on the considerable operational experience gained over the past many decades. Further details are well described in a recent article published for an IJC newsletter (Extreme Conditions and

levels upstream and downstream during this critical period. Once these critical conditions had passed, and once Ottawa River inflows and St. Lawrence River water levels started to subside in mid-May, the ILOSLRB was in a position to undertake more extreme measures to deal with the rapidly rising water levels, and increased outflows substantially, to the highest Lake Ontario releases ever previously recorded. Average weekly outflows matched previous records for the period 24 May to 14 June and then exceeded the previous record from 14 June to 8 August. Despite these record high flows, the decline of Lake Ontario water levels was gradual at first, as wet conditions continued, and only really picked up speed in August and September as water supplies to the basin returned slowly to more normal conditions.

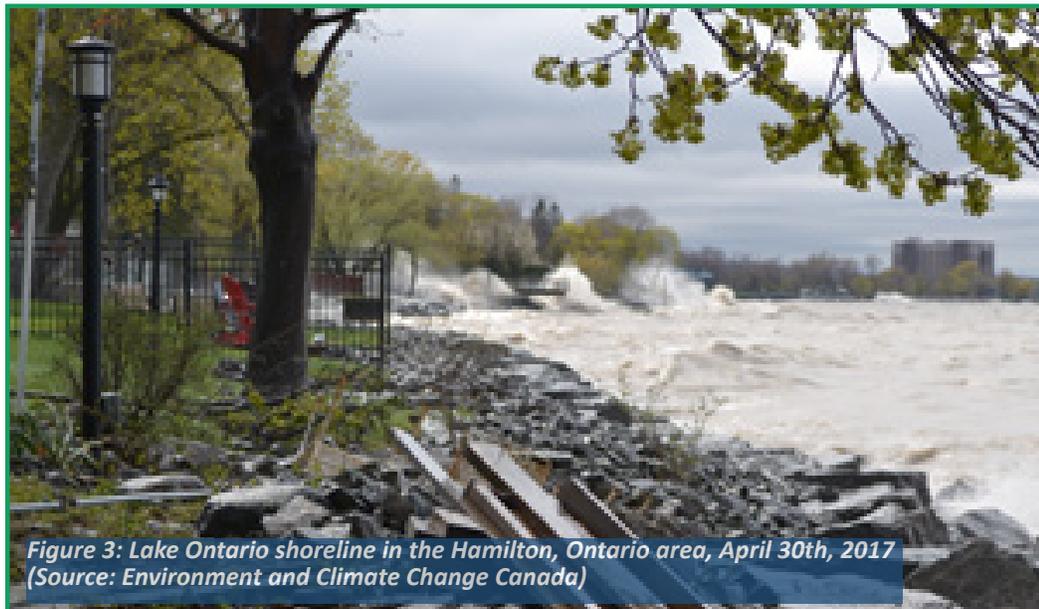
*Continued on next page*

## Preparing for the Future – Adaptive Management for Outflow Regulation

In implementing Plan 2014, the IJC recognized that there would be some differences in the balancing of socio-economic and environmental outcomes over the long-term compared to the previous regulation plan (International Joint Commission 2014 - [http://www.ijc.org/en/\\_Plan2014/Report](http://www.ijc.org/en/_Plan2014/Report)). Given the scale and complexity of the system and the inherent uncertainties about future conditions, including climate change, the IJC and governments made a bold commitment to implement an adaptive management process through the establishment of the GLAM Committee under the authority of the Board (s). The committee thus reports to the IJC's three Great Lakes water level boards and is directed by the IJC to provide an ongoing assessment of regulation plans and examine how these plans perform under a range of actual and potential future hydrologic conditions.

The committee's primary responsibility is to assess how well currently available scientific data, information, models and tools reflect real world conditions, so that improvements and updates can be made as early as possible as our understanding of the system evolves. The extreme water supply conditions of 2017 illustrate the importance of an adaptive management process and remind us just how dynamic this system is and that despite all we know, there is still so much to learn. The committee is working hard to gather information from a range of government agencies, academic researchers, key stakeholders and coastal communities from both countries to better describe the type and extent of high water impacts observed in 2017. The information is critical to support more detailed investigations of Lake Ontario outflows and whether there are improvements that can be made to better prepare and adapt for longer-term changes in the system.

Outcomes for the coastal zone are a critical component for the work, particularly as they relate to people that live, make their livelihood, and/or undertake recreational activities along the shoreline, as well as ecosystem response.



**Figure 3: Lake Ontario shoreline in the Hamilton, Ontario area, April 30th, 2017 (Source: Environment and Climate Change Canada)**



**Figure 4: Flooding on the St. Lawrence River in the Lac St. Pierre, Quebec area, May 2017 (Source: Transport Canada National Aerial Surveillance Program)**

Impacts were seen throughout the system, both upstream and downstream (Figures 3-5). How well are flooding and erosion impacts to public and private shoreline property represented by existing models and tools? How do these flooding and erosion impacts change for different water levels and how well are the impact thresholds defined? What kind of ecosystem changes occurred during the high water period in 2017, are those changes adequately captured by existing models and tools, and what kind of adaptive response was undertaken by shoreline stakeholders to try and reduce impacts? How likely is it that we would see hydrologic conditions in the future similar to the extreme conditions of 2017? These

are some of the key questions that the GLAM Committee has to address over time, as it gathers information and refines tools to assess long-term regulation plan performance.

The extraordinary conditions of 2017 represent only a small sample of what future water supply conditions might be like and how various interests are affected, and as a result are insufficient to fully assess the performance of a regulation plan. Nonetheless, the information gathered by the GLAM Committee and through other agencies and stakeholders will be used to help inform the IJC, its boards and governments on the overall long-term performance of Plan 2014 and will more immediately serve to



**Figure 5: Lake Ontario shoreline erosion in the Oshawa, Ontario area, June 8th, 2017 (Source: Transport Canada National Aerial Surveillance Program)**

validate and improve the models and tools used to assess regulation plan outcomes, with the aim at improving performance as more is learned and as conditions change.

The GLAM Committee is already in the process of pulling together information on 2017 hydroclimate conditions, stakeholder impacts, and scenario testing as part of its annual reporting activities to the ILOSLRB. This is the essence of a collaborative adaptive management process: continued monitoring and assessment to test assumptions, improve methods and determine if regulation plans are meeting expectations and will continue to do so under changing conditions.

**NOTE:** This article was developed using material from articles previously published through the IJC's Great Lakes Connection newsletter including "How Are Great Lakes Water Level Regulation Plans Performing?" authored by Wendy Leger and Arun Heer in the October Issue and "Extreme Conditions and Challenges During High Water Levels on Lake Ontario and the St. Lawrence River" authored by Rob Caldwell in the August issue. 

*\* Authors: Rob Caldwell, International Lake Ontario – St. Lawrence River Board Canadian Regulation Representative, Wendy Leger, Great Lakes – St. Lawrence River Adaptive Management Committee Canadian Co-chair, Mike Shantz, Great Lakes – St. Lawrence River Adaptive Management Committee Canadian Secretary*

## References and Resources

*International Joint Commission. 2014. Lake Ontario St. Lawrence River Plan 2014: Protecting against extreme water levels, restoring wetlands and preparing for climate change. ISBN: E95-2/18-2014E-PDF 978-1-1*

*Tags: Great Lakes, St. Lawrence River, water levels, International Joint Commission, adaptive management*

## The world's oceans desperately need our help

Peter Ricketts

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*(<http://thechronicleherald.ca/opinion/1524578-opinion-the-world's-oceans-desperately-need-our-help>)*

Rising sea levels, the intensification of storms, and the continued melting of Arctic ice are generating legitimate concerns about the growing vulnerability of our coasts to erosion and flooding, including many coastal communities.

Among those threatened are major cities like Vancouver, Toronto (associated with record high lake levels) and Charlottetown-- and in some cases, it's entire provinces, such as the potential for Nova Scotia to become an island if the Tantramar marshes become completely inundated by tidal waters.

There is no doubt that in Canada and around the world we are seeing real and tangible impacts of climate change that are causing loss of life and livelihood, as well as inflicting billions of dollars in damage to buildings, harbours and infrastructure in coastal zones.

I have recently returned from the 23rd Conference of the Parties (known as COP23) to the UN Framework Convention on Climate Change (UNFCCC) in Bonn, Germany, where there was a series of events to promote the importance of oceans in the international dialogue and negotiations on global climate change.

Although held in Bonn, the presidency of COP23 was actually held by Fiji which, like many other Small Island Developing States (SIDS), is facing catastrophic consequences resulting from climate change, including the loss of vital coral reefs and the potential displacement of large portions of its population.

Some South Pacific islands, like Kiribati and Tuvalu, are facing the prospect of complete submergence and the necessity of evacuating their entire population to another country, like New Zealand or Australia.

A significant focus of discussion at COP23 was Fiji's Ocean Pathways Initiative, which is designed to raise the profile of oceans within the UNFCCC negotiations. An Oceans Action Day was held at COP23, and brought together over 220 high-level representatives,

including heads of state, from 60 countries and representatives from governments, intergovernmental organizations and international agencies, non-governmental organizations, industry, donors and scientific institutions.

Spearheaded by the Global Oceans Forum, a global multi-agency initiative hosted at the

hurricane and typhoon year on record, not just in the Caribbean and the U.S. but around the world as well.

The ocean is absorbing 93 per cent of the extra heat energy from global warming and has taken up 27 per cent of total carbon dioxide emissions. The resulting combined impacts of ocean warming, deoxygenation, acidification



University of Delaware, the Oceans Action Day reviewed progress towards implementation of a Roadmap to Oceans and Climate Action and a number of startling conclusions emerged. Global concentrations of carbon dioxide in the atmosphere are now above the 400 parts per million (ppm), which has long been considered the tipping point at which climate impacts will continue to increase even if emissions are brought down.

2016 was the hottest year on record, beating previous records set by 2015 and 2014, and 2017 is on-track to be in the top five hottest years on record and perhaps break that record again. Furthermore, 2017 is the most intense

and sea level rise are causing major adverse impacts on marine species and millions of people living in coastal regions around the world, including some of the world's most populous cities.

In short, the oceans are warming, rising, souring, and asphyxiating as they have for the past few decades, but today at an alarming rate of increasing intensity. Consequently, the physical, economic, and food security of populations living in coastal and ocean locations are all at risk like never before.

So, what can be done to address this dangerous situation?

A combination of responses is required, and the roadmap to effective action on oceans includes the need for stronger global action by all countries in four important areas:

1) develop and implement mitigation measures that will reduce global warming trends, such as so-called “Blue Carbon” policies that use the capacity of the ocean and its ecosystems to store and absorb carbon, and enhanced international action to reduce carbon dioxide emissions and at least reach the “less than 2o C” target of the Paris Agreement and ideally get to 1.5oC;

2) increase the level of scientific research to further increase our understanding of how oceans are responding to global warming, the impacts on human populations, and the best ways to respond;

3) develop and implement measures to adapt to the new norms of a warmer climate, especially ones that use natural techniques to reduce the vulnerability and increase resilience of coastal ecosystems and populations;

and 4) develop, promote, and apply “Blue Economy” approaches that recognize the capacity of the oceans to sustain economic activities and promote low-carbon techniques to increase economic diversity and ensure sustainable management of ocean and coastal resources.

In addition to these four action areas, the importance of addressing population displacement, financing and capacity development for SIDS were also identified as critical areas where immediate action is required.

The past year has seen an acceleration in adverse trends on oceans and climate, and a situation of increased urgency for adapting to a climate that has already changed and will continue to do so with increasing pace.

Adoption of Fiji’s Oceans Pathways would certainly help to increase global action on oceans through the UN framework on climate change. In Canada, we have the Oceans Act which, although 20 years old, is a far-sighted piece of legislation that provides a federal framework for addressing many of the issues raised at the Oceans Action Day and other oceans sessions at COP23.

Our federal government has committed

significant resources to its Oceans Protection Plan and the Disaster Mitigation and Adaptation Fund, and many provinces are taking action to address the increased impacts they are facing from climate change.

However, we need a more effective collaboration between federal and provincial governments to implement those sections of the Oceans Act that specifically speak to ecosystem-based management and integrated coastal and ocean management.

In addition, the active engagement of First Nations, local governments, industry and business, and coastal communities needs to be incorporated into this integrated approach. Without this kind of strategic approach, we will never be able to co-ordinate the necessary balance between mitigation, adaptation and science that is desperately required if we are to start turning the tide of managing climate change and its inevitable impacts on humanity. [Z](#)

*Peter Ricketts is president and vice-chancellor of Acadia University, professor of Earth and environmental science and past-president of the Coastal Zone Canada Association.*