



Welcome



Extreme Water Levels – Impacts and Strategies.

- A. Climate Change Impacts – What is coming?**
- B. Action Plan 2030**
- C. Impact on wetlands, flora & fauna**





Rolfe Jones
Chair
Georgian Bay Association

Water Levels 2021 - Marilyn Longlade Capreol



- Early spring of 1949, I was born to Napoleon and Norah Geroux Longlade. My first home was the island behind the Ojibway Island. During the winter months we moved to our mainland location on the shores of Pointe au Baril.
- Summer's home was always bustling with Grandparents, aunts, uncles and many cousins. We would hear the song of languages, both Ojibway and French. Hear the fishing stories each day and/or watch Grandma and aunts make their quill boxes.
- Very young we were taught to respect and understand the gifts of water, wind, animals, plants, the sky that holds beautiful stars. Our first knowledge and education were done by our parents, grandparents and community. There are no books to this day for this gift of learning. It was and is strictly learned by the teachings.
- I am very grateful and acknowledge, Mishomis Giiziis (Grandfather Sun) miinwaa (and) Nokomis Dibik Giiziis (Grandmother Moon). They encourage every living being and walk beside all each day.



Rupert Kindersley

Executive Director

Georgian Bay Association

Water Levels 2021 – Pierre Béland



- **Pierre Béland** is a scientist in environmental biology and toxicology, best known as an expert on the conservation of beluga whales. He was a founder and research scientist with the St. Lawrence National Institute of Ecotoxicology, an NGO dedicated to research and education on toxic compounds in estuarine ecosystems.
- Dr. Béland has published three books, numerous scientific and popular articles, has hosted a TV series on the environment, and participated in several documentary films. He served for ten years as a Commissioner for BAPE, the Quebec environmental assessment Board. He has chaired public hearings for various agencies such as Parks Canada, Fisheries and Oceans Canada, Quebec Energy Efficiency Agency, Telus. Previously he headed the Fisheries Ecology Research Center with the Department of Fisheries and Oceans Canada, and was a paleoecologist with the National Museum of Nature. From Sept 1995 to Sept 1998, Dr. Béland was one of three Canadian Commissioners (and Acting Chair) with the International Joint Commission.
- Until recently he owned and managed a company manufacturing equipment for research and management of aquatic and marine ecosystems. His most recent duties were as a Director of AquaForum, whose AquaHacking Challenge is a Canada-wide competition for graduate students and innovators aiming to create start-ups in the field of water technology and the blue economy.
- Dr. Béland holds a BA and a BSc from Laval University (Quebec City), and a PhD from Dalhousie University (Halifax). He was a Post-Doctoral Fellow at ORSTOM Centre, New Caledonia, and at the University of Queensland, Australia. He resides in Montreal, QC; he is fluent in French and English and proficient in Mandarin.

Water Levels 2021 – Jane Corwin



- Jane Corwin served as a member of the New York State Assembly from 2009 through 2016, where she was the Minority Leader Pro Tempore and the ranking member of the Corporations, Authorities and Commissions Committee.
- Additionally, she was a member of the Environmental Conservation, Education and Mental Health Committees.
- Ms. Corwin has also served as president of the Philip M. and Jane Lewis Corwin Foundation since 2005, and was the director of Gibraltar Industries out of Buffalo from 2014-2018. She succeeds former US Co-Chair Lana Pollack, who served from 2010 to 2019.

Georgian Bay and Upper Great Lakes Water Levels

International Joint Commission
Opening Remarks

Extreme Water Levels: Impacts and Strategies Webinar Series

October 23, 2021



IJC Canadian Chair



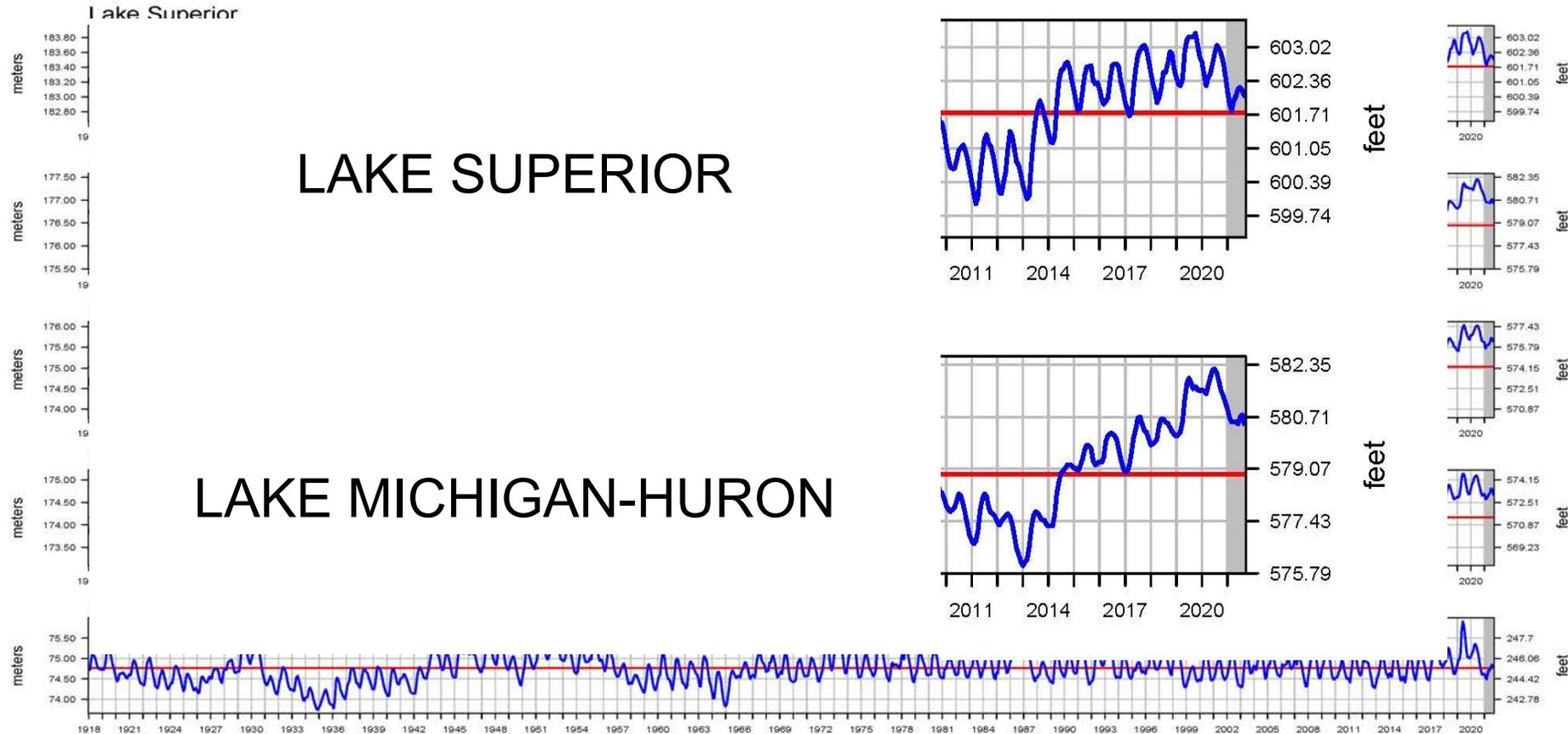
Pierre Béland
Canadian Section Chair
International Joint Commission

Variability in Great Lakes Water Levels



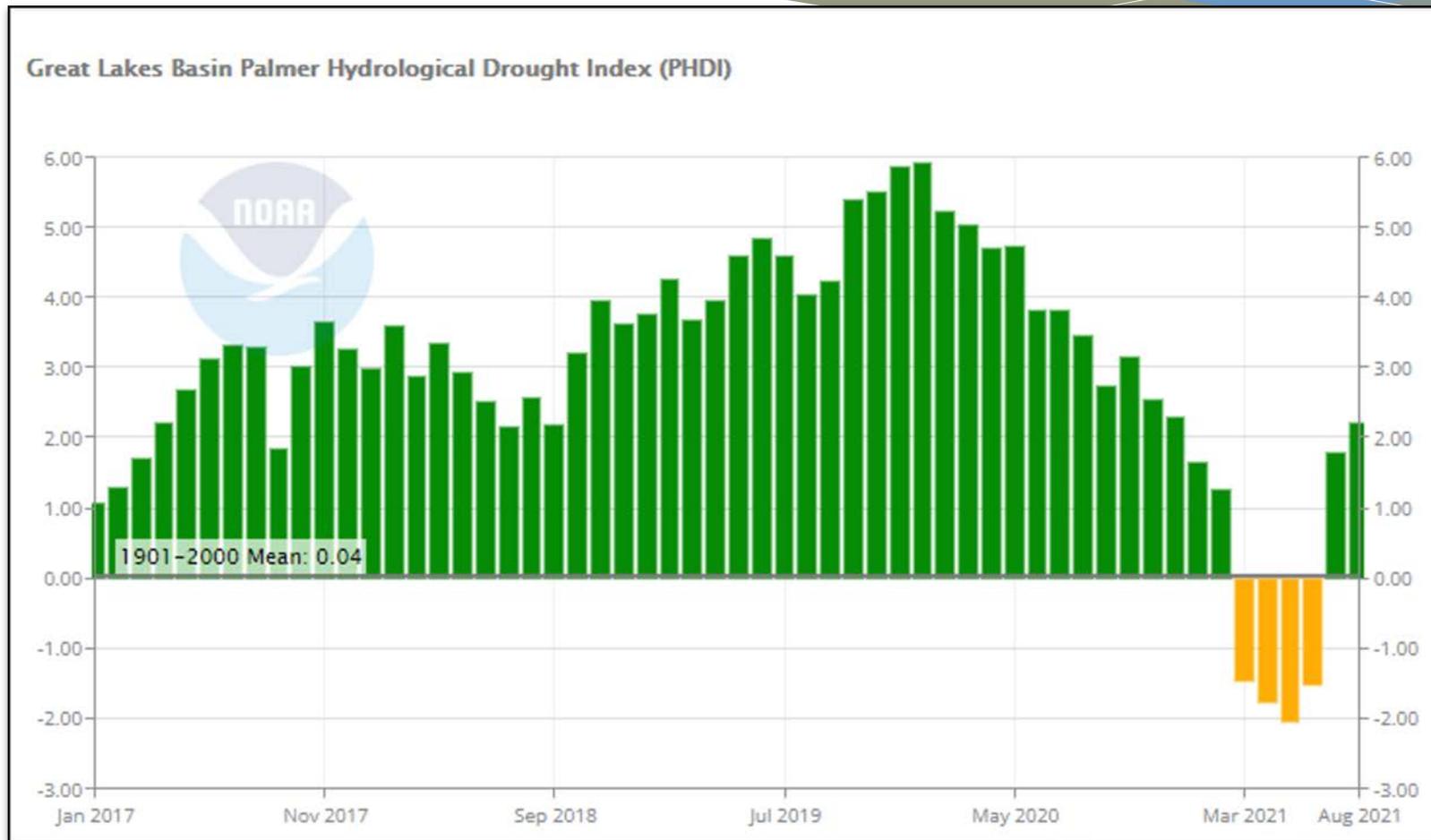
Great Lakes Water Levels (1918–2021)

— Monthly Mean Level — Long Term Average Annual



Drier than Average Water Supplies

Palmer Hydrological Drought Index: quantifies hydrological impacts of drought
<https://www.ncdc.noaa.gov/cag/regional/time-series>



IJC US Chair



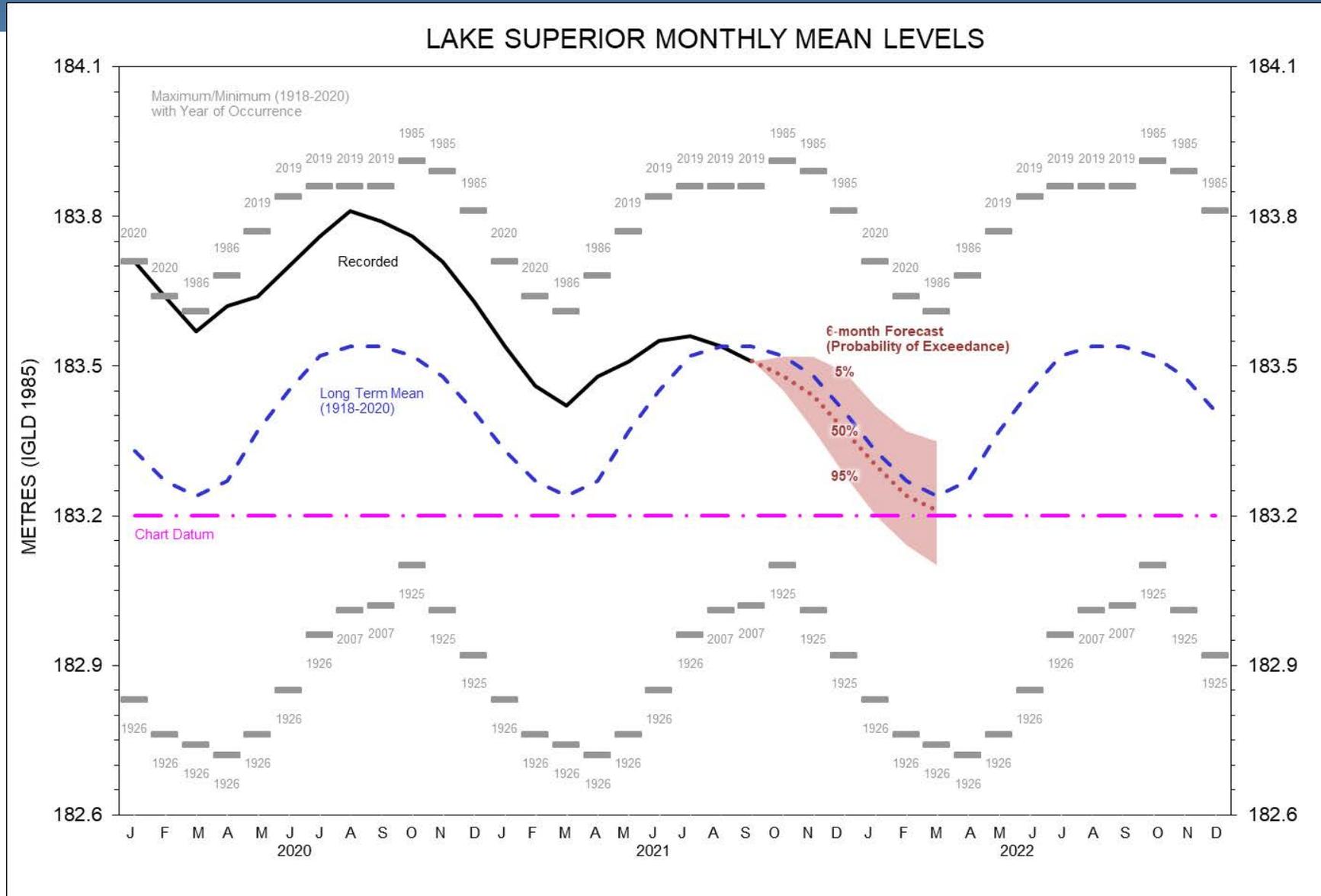
Jane Corwin
US Section Chair
International Joint Commission

Regulation of Lake Superior Outflows

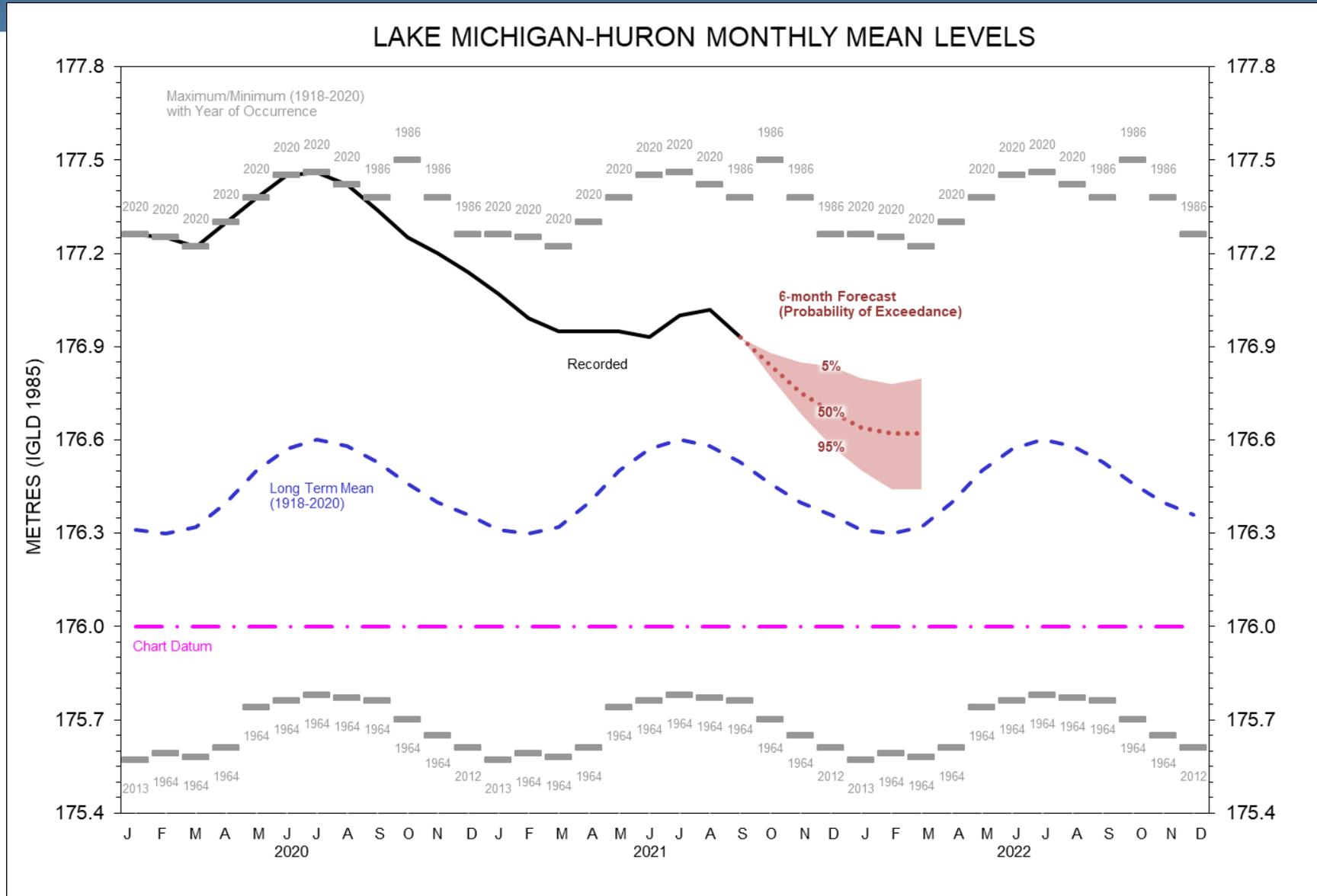


- * Lake Superior outflows are adjusted in response to Lake Michigan-Huron levels
- * Plan 2012 tries to balance water levels of both Lake Superior and Lake Michigan-Huron but net basin supplies are the dominating factor in determining Georgian Bay water levels

Lake Superior Water Level Forecast



Lake Michigan-Huron & Georgian Bay



Resiliency

- Erosion setbacks
- Relocation of dwellings
- Flood elevation and protection requirements
- Shoreline alteration requirements
- Real estate disclosure requirements
- Acquisition of high-risk properties
- Hazard insurance



Methods of Alleviating the Adverse Consequences of Fluctuating Water Levels in the Great Lakes-St. Lawrence River Basin: A Report to the Governments of Canada and the United States. December 1993. <https://ijc.org/sites/default/files/ID1007.pdf>

Thank you

FOR MORE INFORMATION

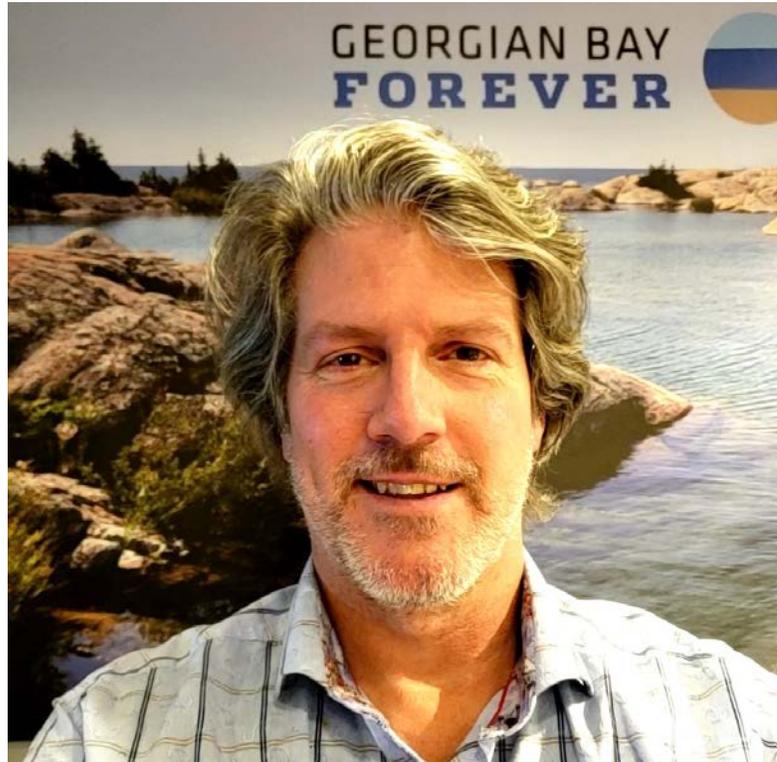
International Joint Commission Website:

www.ijc.org

International Lake Superior Board of Control Website:

www.ijc.org/lsrc





David Sweetnam

Georgian Baykeeper
Executive Director
Georgian Bay Forever



A. Climate Change Impacts – What’s coming?

Water Levels 2021



A. What's the latest update about water-levels?

Speakers:

David Sweetnam, Executive Director, Georgian Bay Forever

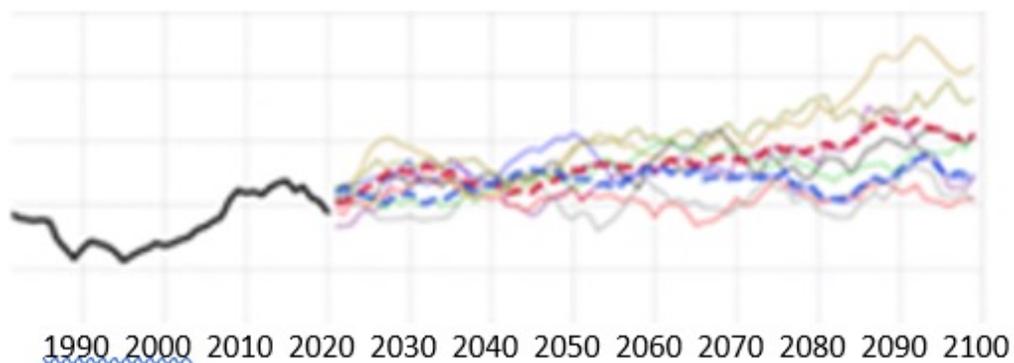
Rupert Kindersley, Executive Director, Georgian Bay Association



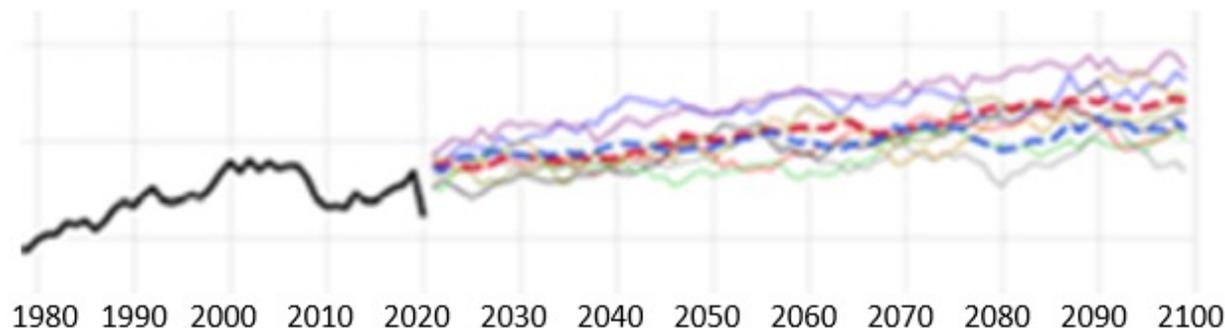


Both precipitation and evaporation are projected to increase under various climate change scenarios. Future lake levels will depend on the balance between the rates of these increases.

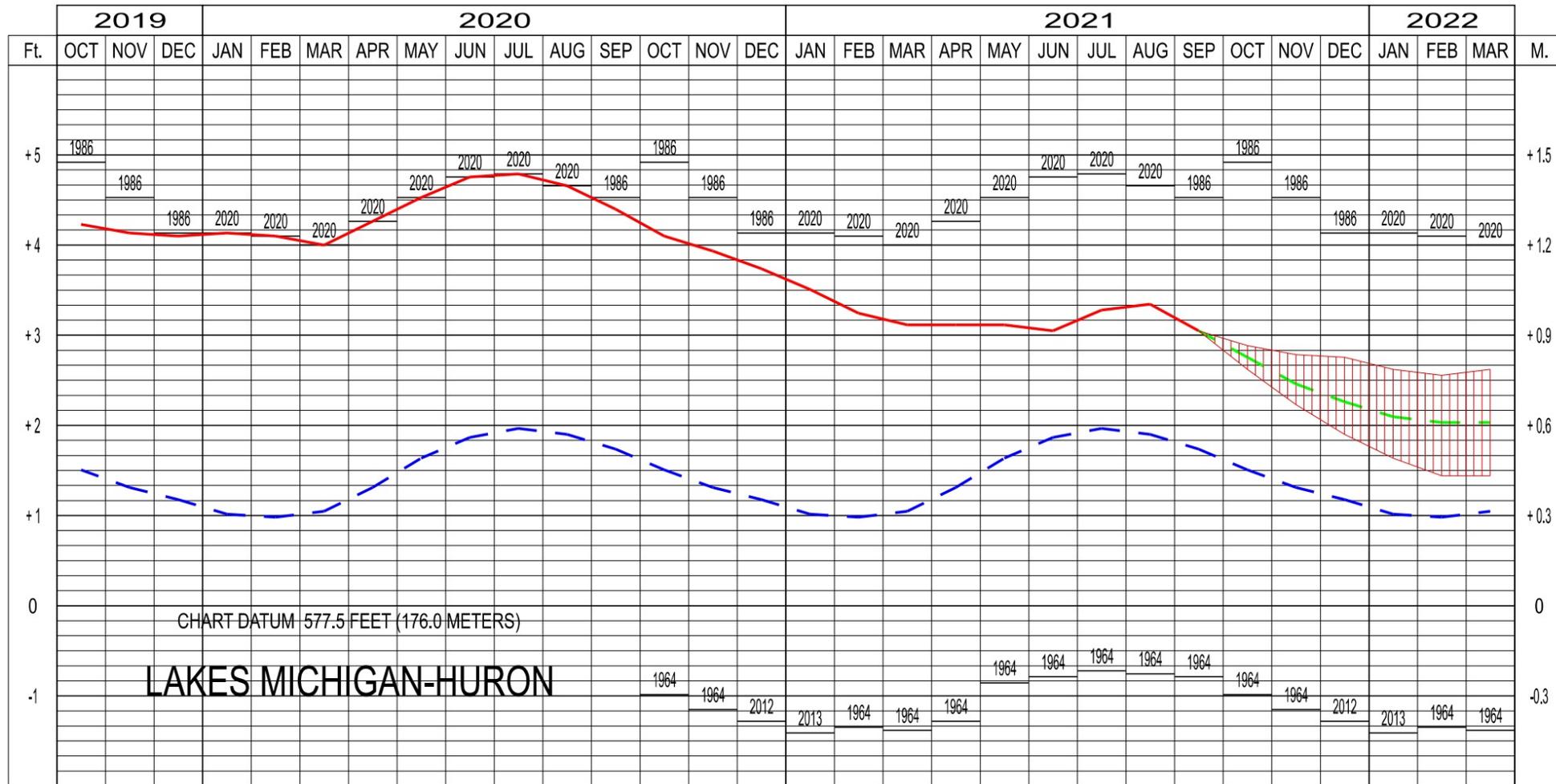
Precipitation



Evaporation



LAKES MICHIGAN-HURON WATER LEVELS - OCTOBER 2021



RECORDED

PROJECTED

AVERAGE **

MAXIMUM **

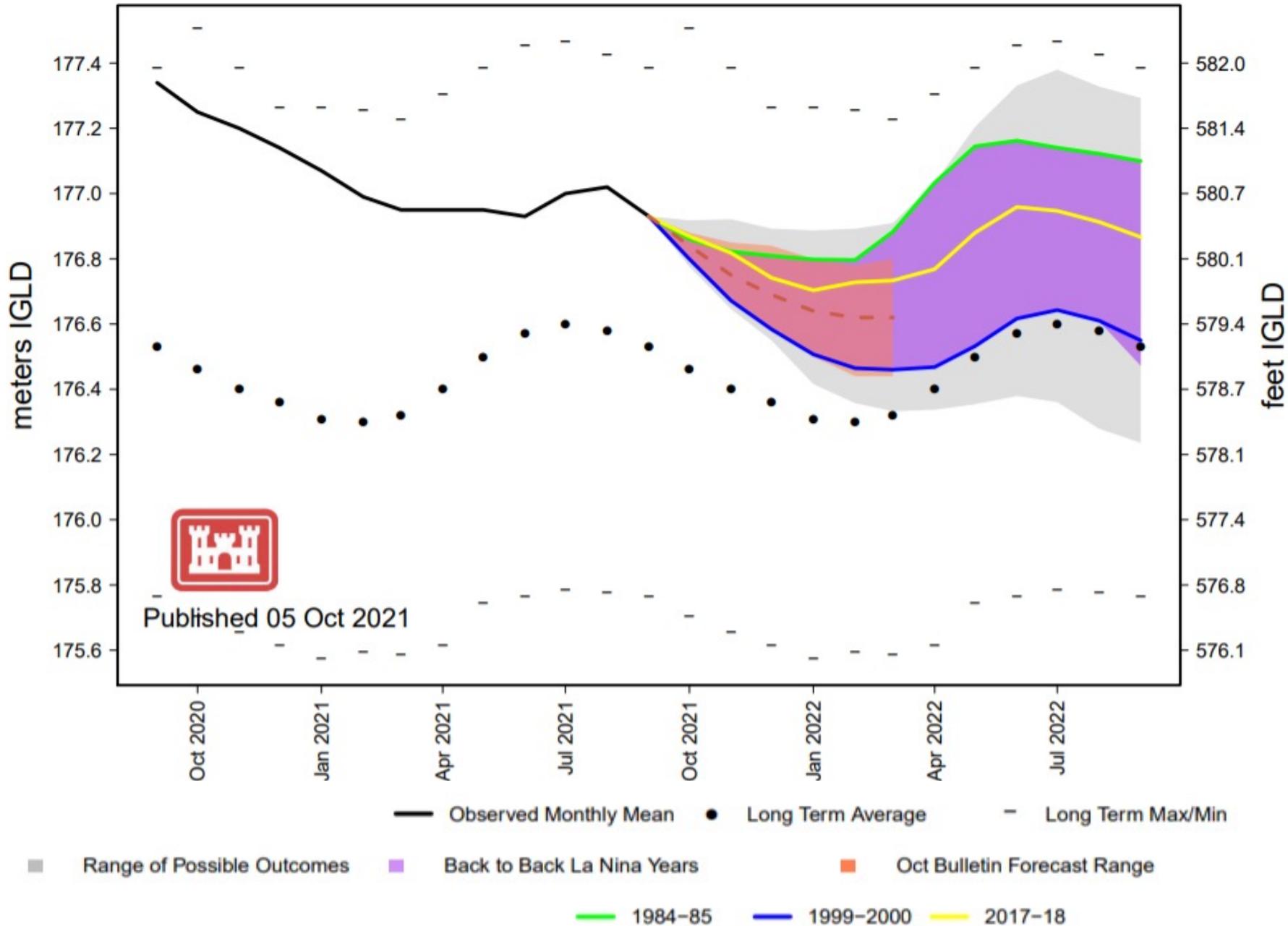
MINIMUM **

** Average, Maximum and Minimum for period 1918-2019

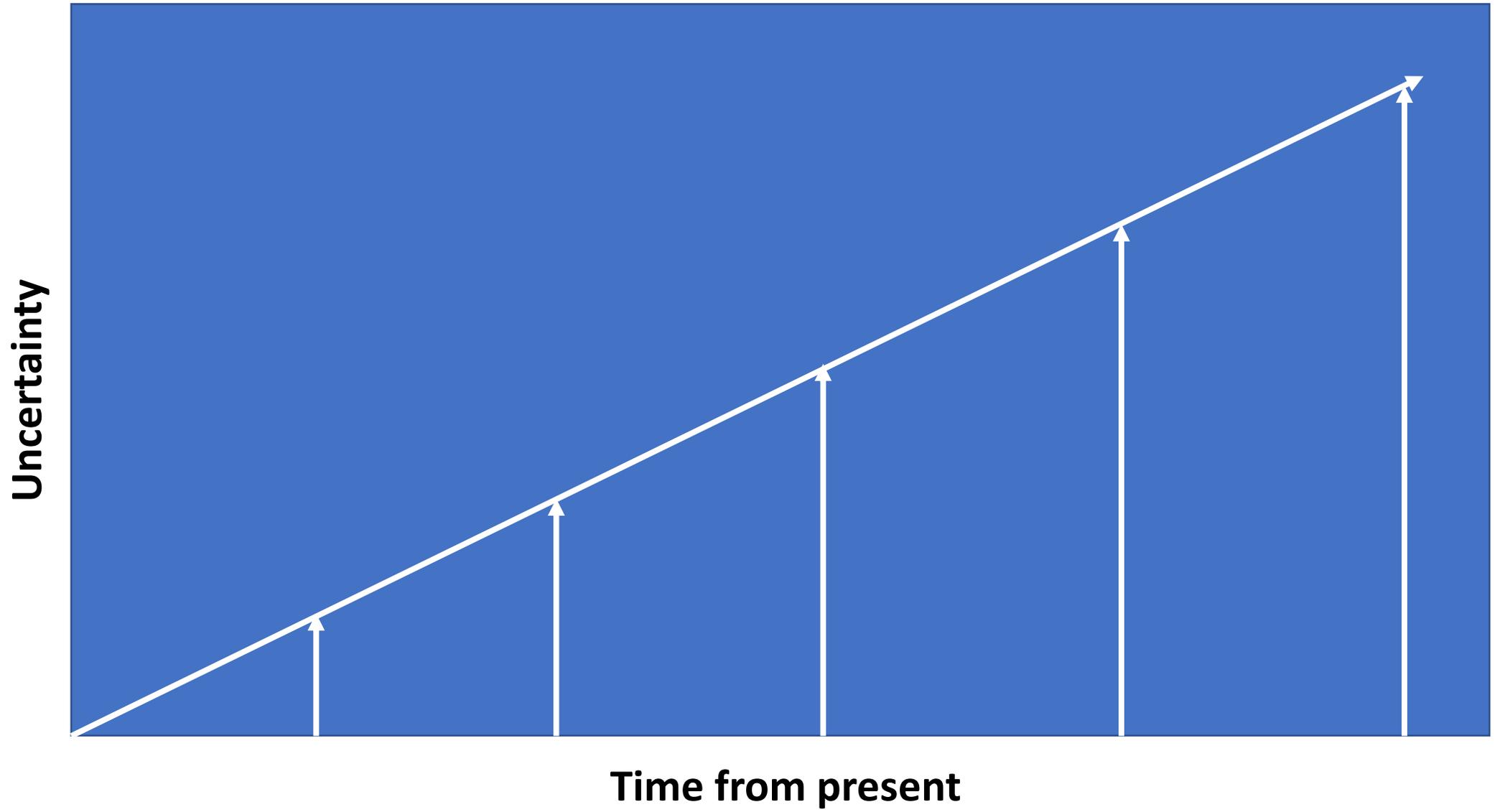
Water Levels 2021



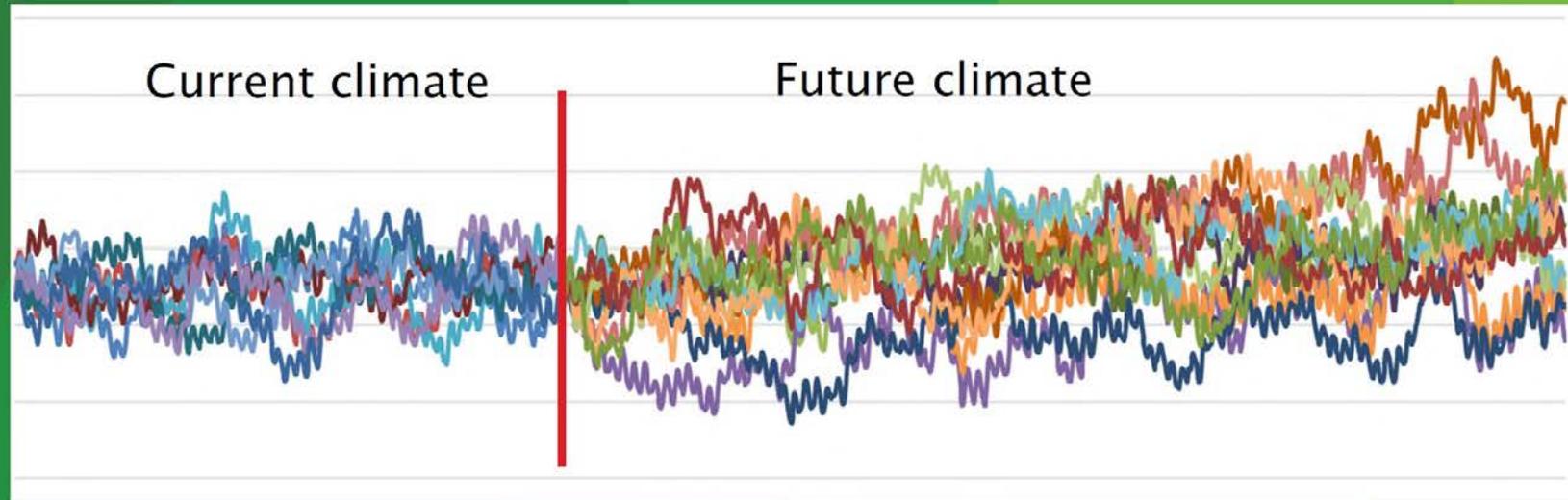
Lake Michigan–Huron Monthly Mean Water Levels



Seasonal cycle: evaporation causes decline in fall/winter; precipitation & snowmelt causes rise in the spring. Purple Plume: La Niña occurred in the winter 2020-21 and is expected to develop for the winter 2021-22.



Future lake levels under a changing climate



More uncertainty

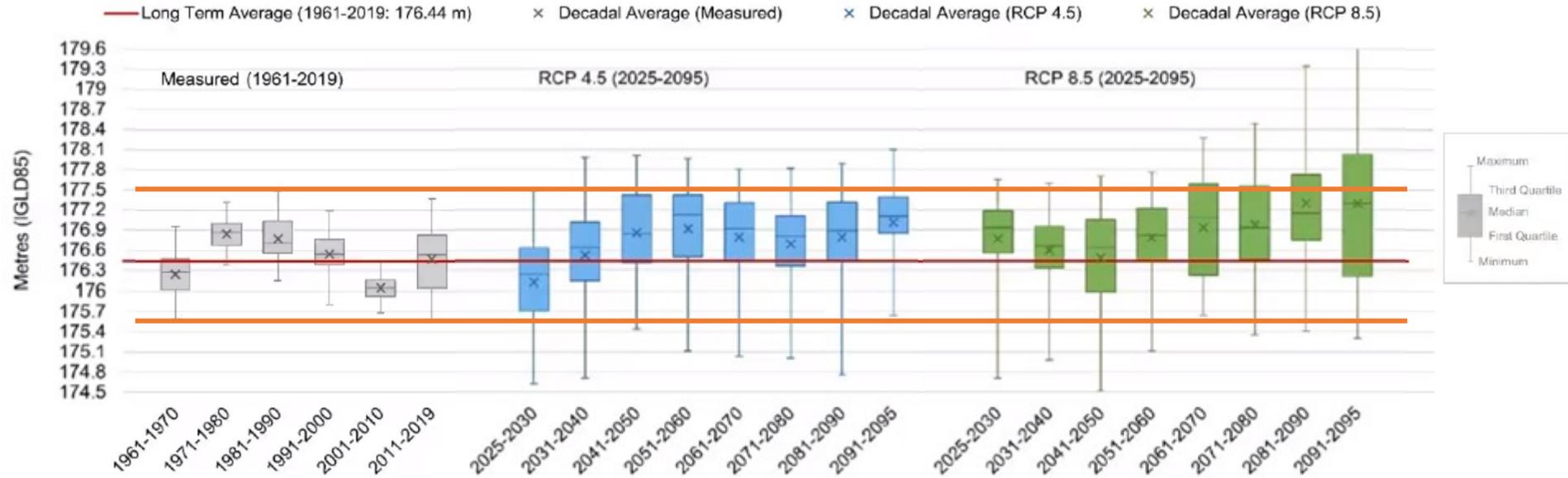


Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

Canada

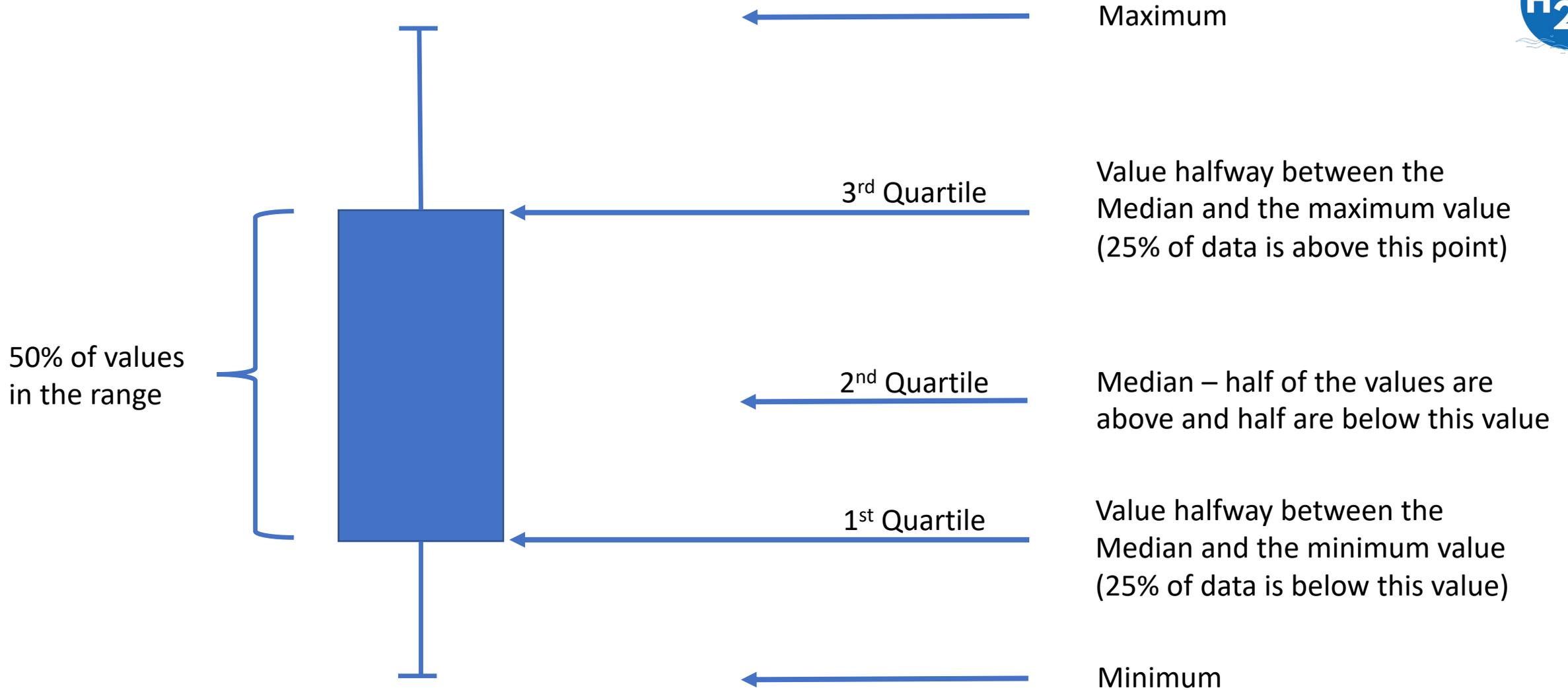
Lake Michigan-Huron: Historical and Projected Decadal Mean Lake Levels



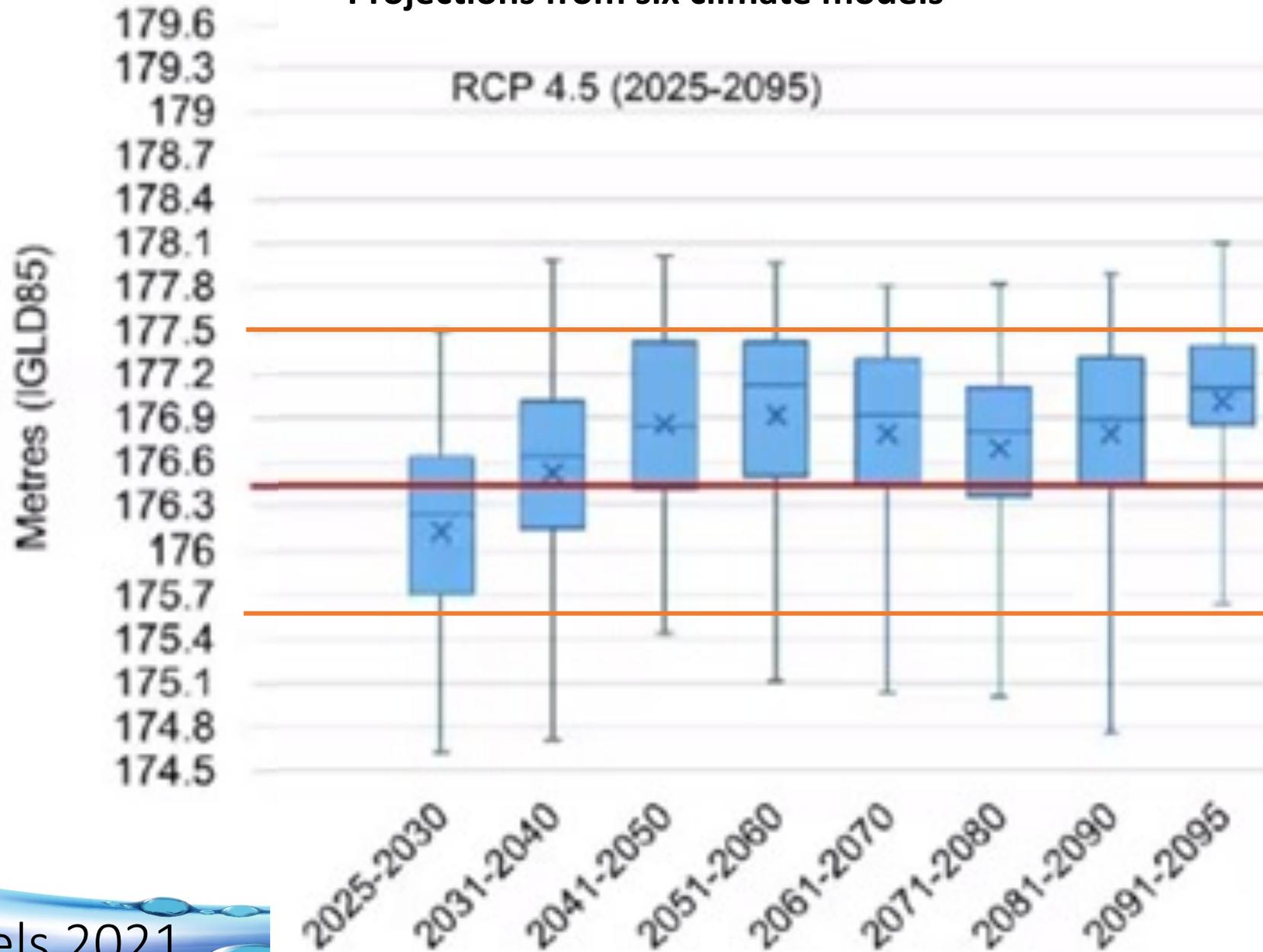
This graph shows historical and projected lake levels for Lake Michigan-Huron by decade as a box and whisker plot. Projected lake levels under both climate change scenarios (RCPs 4.5 and 8.5) are presented side by side. Historical lake levels are presented in grey between 1961 and 2019. The red line shows the long-term average reported for Lake Michigan-Huron between 1918 and 2019 as a point of reference. Future lake levels are projected for the period between 2025 and 2095. Projections under six RCP 4.5 models are presented in blue and projections under seven RCP 8.5 models are presented in green.

Date: 2/22/2021

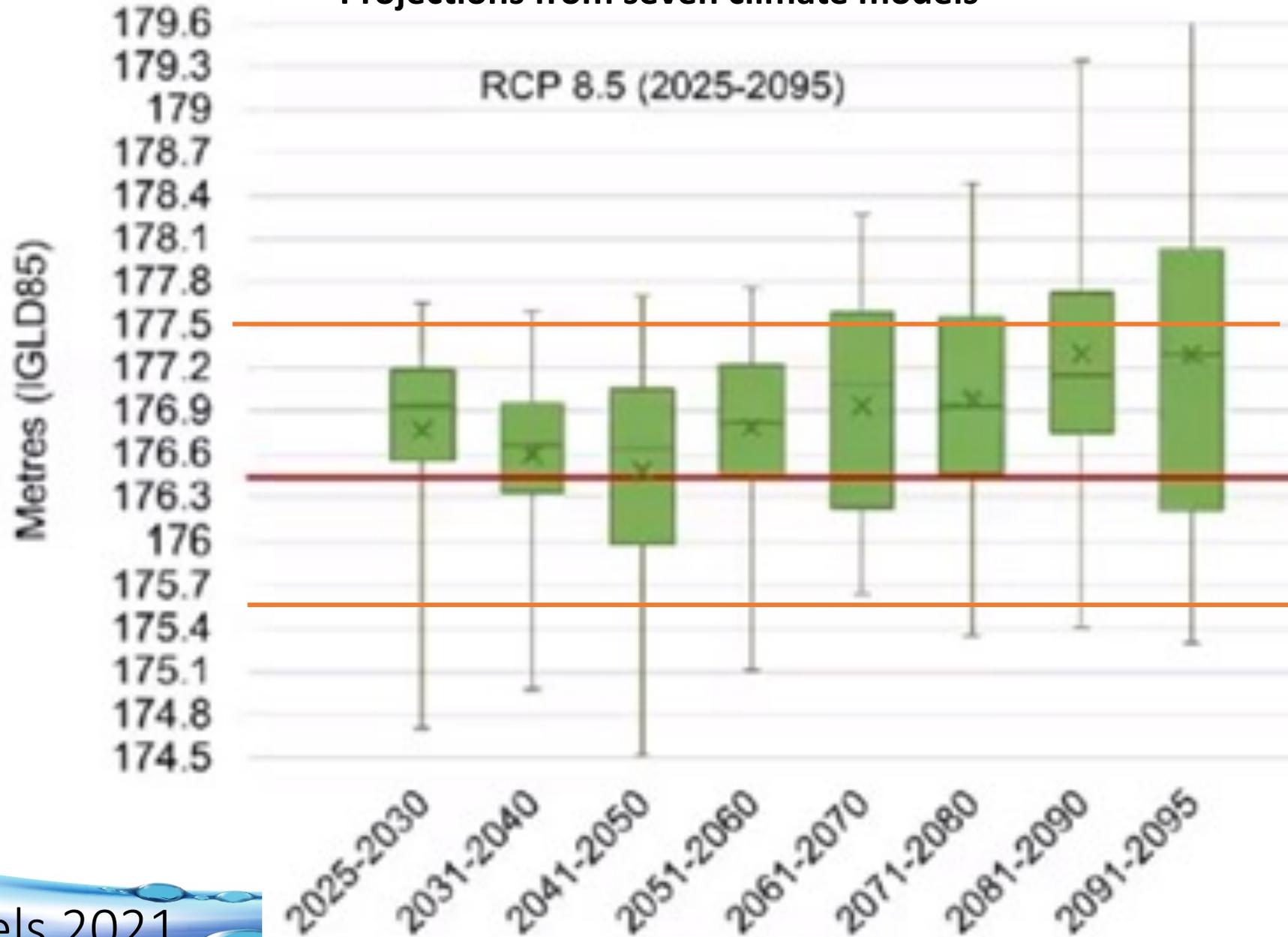
Data Sources: Historical data were retrieved from the NOAA-Great Lakes Environmental Research Laboratory (GLERL). Projections were developed by Environment and Climate Change Canada (ECCC) using dynamically downscaled data from the Coupled Model Intercomparison Project Phase 5 (CMIP5) available from NA-CORDEX, the North American component of the international Coordinated Regional Downscaling Experiment program sponsored by the World Climate Research Program (WCRP). Projections were developed as part of the Assessing and Enhancing the Resilience of Great Lakes Coastal Wetlands study under the Great Lakes Protection Initiative (2017-2022).



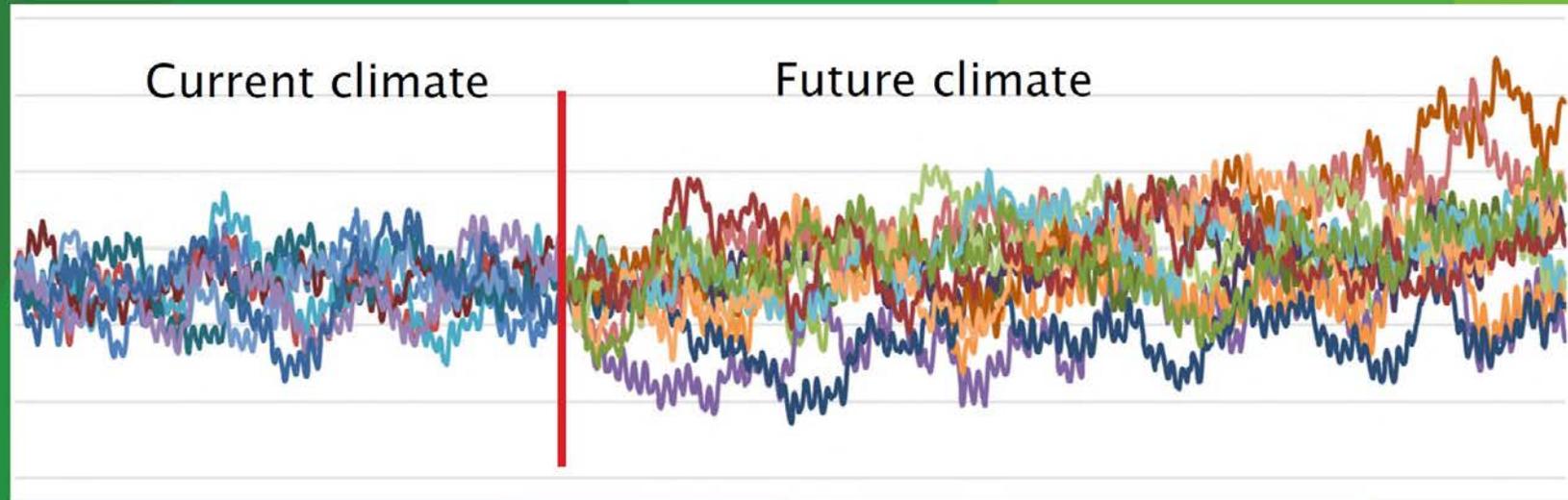
Projections from six climate models



Projections from seven climate models



Future lake levels under a changing climate



More uncertainty

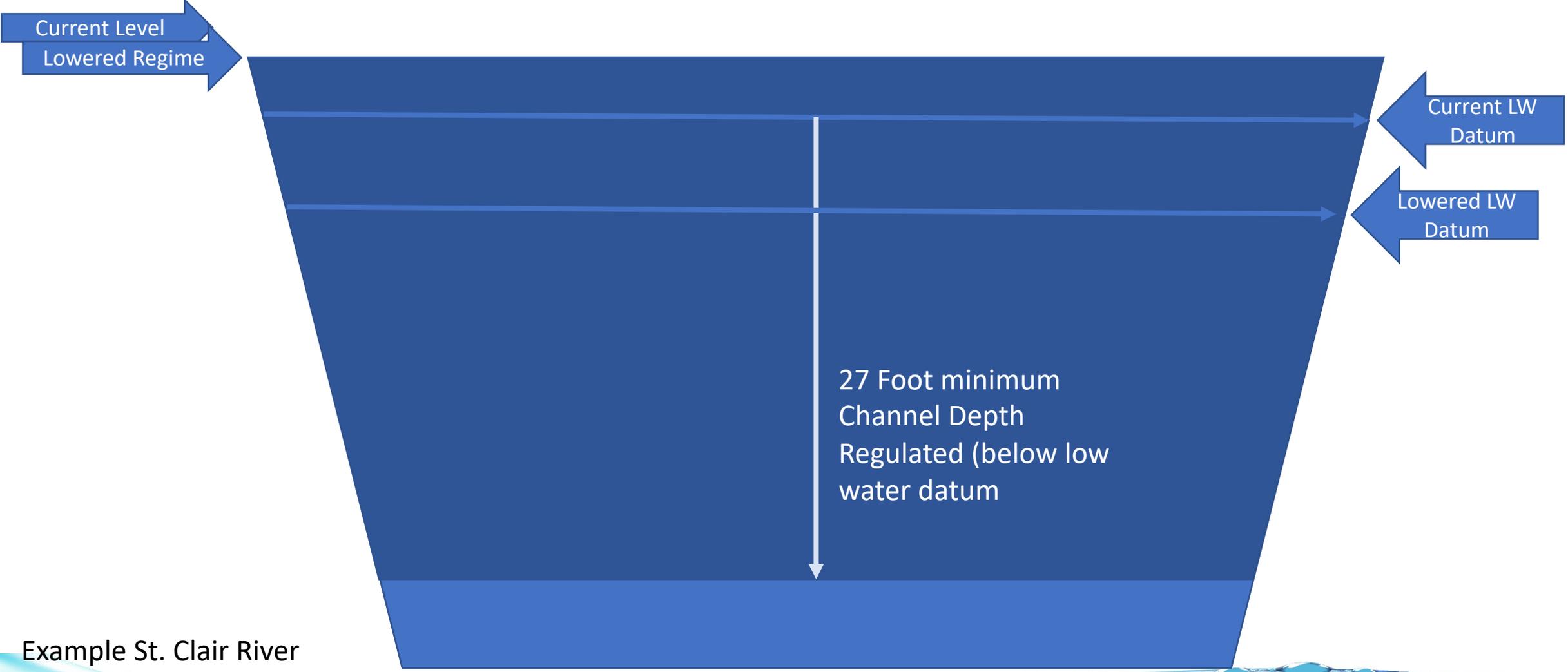


Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

Canada

Analysis by the subcommittee may result in a lowering of the Low Water Datum for Lake M-H by 9 to 12 inches.



Example St. Clair River



Questions

Water Levels 2021



GEORGIAN BAY
FOREVER





B. Plan 2030 – What's coming?

Water Levels 2021



GEORGIAN BAY
FOREVER



Water Levels 2021 – Mark Fisher



- Mark Fisher, B.SC, ICD.D
- President and CEO
- Council of the Great Lakes Region
- Mark Fisher became the President and CEO of the Council of the Great Lakes Region (CGLR) in 2014, which is comprised of CGLR Canada, CGLR USA and the CGLR Foundation.
- Prior to joining CGLR, he served as a foreign policy advisor in the Privy Council Office, which supports the Prime Minister of Canada and the federal Cabinet, where he focused on advancing Canada's interests in North America and the Asia-Pacific region.
- Mark has extensive experience advising senior decision-makers on a range of socioeconomic and environmental issues facing government, business, and the non-profit sector.
- In addition to CGLR, he is an elected school board trustee with the Ottawa-Carleton District School Board, is a member of the International Joint Commission's Great Lakes Water Quality Board, and is a director on the board of Easter Seals Ontario.
- Mark is also a recipient of the Royal Canadian Legion Cadet Medal of Excellence.

COLLABORATIVE
**GREAT LAKES
ST. LAWRENCE**



Great Lakes St. Lawrence Action Plan 2020-2030

Thursday, May 21, 2020

Mark Fisher, President and CEO
Council of the Great Lakes Region

Founding partners



**GREAT LAKES AND
ST. LAWRENCE**
CITIES INITIATIVE



Goals

- An **integrated Great Lakes-St. Lawrence vision**
- Increase in **investments in Great Lakes St. Lawrence protection**
 - inspired by the US ***Great Lakes Restoration Initiative***, a US federal program that has delivered over \$2B in investments in the Great Lakes region over the last ten years.
- **Innovative Approaches**
- **Alignment across governments**
- **Engagement** with stakeholders, experts and First Nations





Major Milestones

- Stakeholder Roundtables in Quebec City and Toronto, Fall 2017
- Great Lakes St. Lawrence Day on Parliament Hill, meeting with Environment Minister Catherine McKenna, November 2017
- Proposal to Environment and Climate Change Canada
 - Secured \$400,000 towards project, September 2018
- Expert Panel recruited
 - Gord Miller, Jean Cinq-Mars co-chairs, October 2018
- Three reports developed and released:
 - Great Lakes Action Plan 2030, June 2019
 - Action Plan for the Future of the St. Lawrence 2020-2030, March 2020
 - Integrated Report, May 2020

3 major phases over 18 months

GREAT LAKES REVIEW

Oct. 2018 – JunE 2019

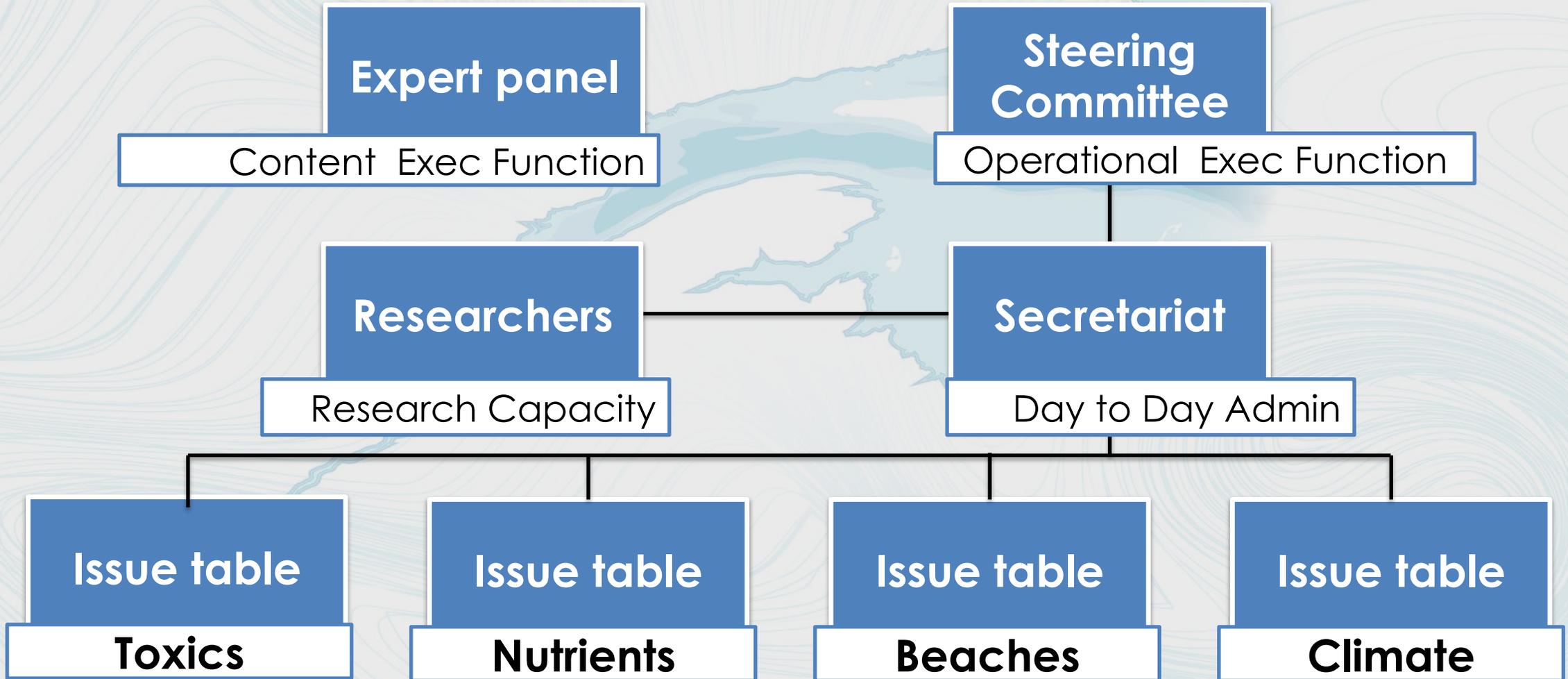
ST. LAWRENCE REVIEW

May 2019 – Jan. 2020

Integrated Review

Jan. 2020 – April 2020

Structure of the Collaborative



Expert panel



Jean Cinq-Mars
Co-chair



Sarah Zammit,
l'Institut de
développement durable
des Premières Nations
du QC et Labrador



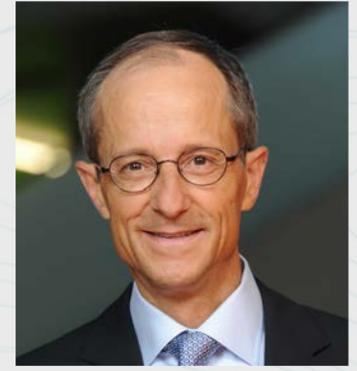
Denis Lapointe, co-
chair of the Table de
Concertation Haut-Saint-
Laurent – Grand
Montréal



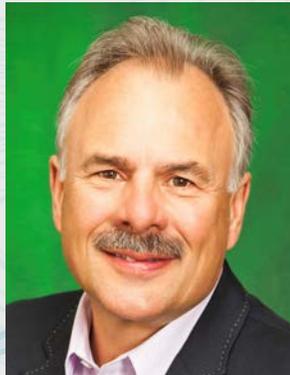
Hélène Lauzon
President, Conseil
Patronal de
l'Environnement du
Québec (CPEQ)



Denise Cloutier
Executive Director,
Centre
d'interprétation de
l'eau



Dr. Yves Comeau
Dept of Civil
Engineering, Geology
and Mines,
Polytechnique Montréal



Gord Miller
Co-chair



Edward Wawia
Deputy Grand Chief of
the Anishinabek



Walter Sendzik
Mayor, St. Catharines,
ON



Dre. Ariane Plourde
Director, Institut des
Sciences de la Mer de



Theresa McClenaghan,
Canadian Environmental
Law Association (CELA)

Issue table Co-chairs – Great Lakes phase



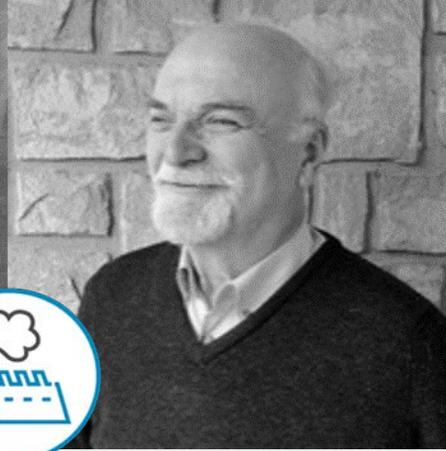
Ewa Jackson,
Deputy Director, ICLEI
Canada



Al Douglas,
Director, Ontario Centre for
Climate Impacts and
Resources



Helen Doyle,
Chair of Ontario Public
Health Association's
Environmental Health Work
Group, retired from York
Region Public Health



John Carey,
Retired Director General,
National Water Research
Institute, Environment
Canada



Gayle Wood,
Retired CAO of Lake
Simcoe Region
Conservation Authority



Dale Cowan,
Senior Agronomist and
Sales Manager, ARGIS and
Wanstead Cooperatives



Sandra Cooper,
Former Mayor, Town of
Collingwood
Past Chair, Great Lakes and
St. Lawrence Cities Initiative



Bernie Mayer,
Haliburton Kawartha
Pine Ridge Public
Health Dept.

Issue table Co-chairs – St-Lawrence phase



Ursule Boyer-Villemare,
Associate Professor,
Geography Department of
UQAM



Marie-Claude Bellemare,
Lawyer,
Partner at Davies Ward
Phillips & Vineberg



Jean Paquin,
ing., ÉESA, Vice-president at
Sanexen Environmental
Services Inc.



Émilien Pelletier,
chemist, ecotoxicologist,
professor emeritus at UQAR



Marco Allard,
Provincial coordinator of
collective agricultural
projects, ROBVQ



François Guillemette,
Assistant Professor,
Department of
Environmental Sciences at
UQTR



Carole Fleury, Biologist,
microbiologist, Scientific
advisor to the Water
Service, Montréal



Gilles Rivard,
ing., M. Sc., Vice-
president urban
hydrology, Lasalle NHC

Significant stakeholder participation

ST.LAWRENCE PHASE

- **80 experts** directly involved
- **28 meetings** with the four issue tables members
- **60 participants** to the webinars
- **115 participants** to the Summit

GREAT LAKES PHASE

- **80 experts** directly involved
- **24 meetings** with the four issue tables members
- **60 participants** to the webinars
- **110 participants** to the Summit

Launch of reports



- Great Lakes report released June 20, 2019
- St. Lawrence report released March 10, 2020, Salon des Teq
- Integrated report released May 21, 2020



Un milliard réclamé pour la sauvegarde du Saint-Laurent

[Accueil] / [Société] / [Environnement]



Media Coverage

Print

- [Feature article](#) in Le Devoir

Radio

- Extensive coverage on CBC morning radio, Radio-Canada

TV/Video

- [The Agenda](#) on TVO, with Gord Miller

4 challenges facing the Region



1. CLIMATE CHANGE



2. BEACHES



3. NUTRIENTS



**4. TOXICS AND
HARMFUL POLLUTANTS**



CLIMATE CHANGE

- In 2017 and 2019, lake and river levels at historical highs, caused flooding, erosion, infrastructure damage.
- Localized in 4-5 Great Lakes regions, i) between Chatham-Kent and Leamington on Lake Erie; ii) between Amberley to Grand Bend on Lake Huron; iii) between the City of Toronto to Prince Edward County, on Lake Ontario; iv) between Fort William First Nation and Thunder Bay on Lake Superior; and v) between Penetanguishene and Tiny Township on Georgian Bay.
- Pervasive flooding in St. Lawrence region, hundreds of communities affected, from south of Montreal through to north of Quebec City
- Accelerating erosion in the St. Lawrence estuary and the Cote Nord region threatening homes, roads, infrastructure.





CLIMATE CHANGE

- The US [National Coastal Zone management program](#) has provided government and local agency coordination since 1972.
- Eight regional coastal zone management programs in the US Great Lakes Region.
- Voluntary partnership between the federal government and U.S. coastal and Great Lakes states and territories to address national coastal issues.
- Could serve as a model for shoreline priority zones.





Key recommendation for municipalities

Climate change

- Establish a **joint Office of Shoreline Climate Change Adaptation and Resilience** to develop a **regional shoreline adaptation and resiliency strategy** and **provincial action plans** and coordinate their implementation
- Establish and **fund Shoreline Resiliency Priority zones and management teams** to identify and address significant threats from climate change.
 - Chatham-Kent , Tiny Township and Penetanguishene, City of Toronto-Clarington-Prince Edward County, Amberly to Grand Bend. Thunder Bay/Fort-William First Nation
 - Greater Montreal, including Outaouais River influence; Region of Quebec City, Lac Saint Pierre, north of Baie Comeau.
 - First Nations along Saint Lawrence shoreline, Abenakis of the Odanak and Wolinak, the Huron-Wendat of the Wendake, the Innus of the Essipit, Pessamit, Washat, and Ekuanitshit, the Mi'gmaq of Gespeg and Gesgapegiag, and the Mohawks of Akwesasne, Kahnawake and Kanesatake

Investment \$800 million



BEACHES AND BACTERIOLOGICAL CONTAMINATION



- Despite having many beautiful beaches, 15-20% of Great Lakes beaches have chronic e-coli contamination problems through the summer season.
- St. Lawrence has few beaches, access points, no regulatory regime to protect public health at beaches.



BEACHES AND BACTERIOLOGICAL CONTAMINATION

- In US, there are conditions that trigger closure of beaches due to public health risks (bac-t contamination, strong undertow, blue green algae outbreak).
- US also has national rules with respect to posting beach survey information on a central portal.
- US further ahead in using time sensitive techniques to monitor beach quality, publicly posting the results.

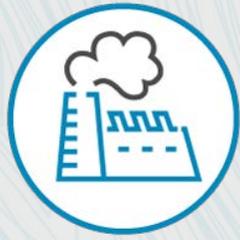




Key recommendation for municipalities Beaches and bacteriological cont.

- Introduce a new **risk-based categorization system for Great Lakes and St. Lawrence beaches**, and require actions of owners of 'impaired' beaches that have chronic bacteriological contamination issues.
- Create and maintain a publicly-accessible, **central portal with beach quality information**, including information on the status of the beach
- Amend the Public Health Ontario's Public Beach Water guidance on test methods for E. coli to **allow for alternate testing methods** other than membrane filtration as per Ontario Ministry of Environment, Conservation and Parks (MECP) guidance on drinking water testing methods

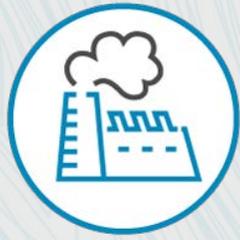
Investment \$33 million



TOXICS AND OTHER HARMFUL POLLUTANTS

- Effects of substances not on CEPA toxics list may go undetected for years e.g. collapse of bee colonies, feminization or intersex effects in some aquatic species, salmon that lose their ability to adapt to saltwater, microplastics.
- Through broad surveillance these effects can be detected and the cause of these effects can be investigated.





TOXICS AND OTHER HARMFUL POLLUTANTS

SOLUTIONS is a European Union surveillance program that monitors existing and future emerging pollutants on land and in water.

- Its goal is to produce consistent solutions for the large number of legacy, present and future chemicals posing a risk to European water resources with respect to ecosystems and human health.
- It identifies substances and mixtures posing risks by developing new monitoring approaches and tools for the early detection and identification of harmful substances.
- It provides improved understanding and capacity for exposure, effect and risk modelling to support decisions in environmental and water policies.





Key recommendations Toxics and other Harmful Pollutants

- Develop a **targeted environmental and human health effects monitoring, human biomonitoring and surveillance program** to provide early detection of unexpected effects in the Great Lakes basin that feeds directly into a regulatory and non-regulatory response plan to reduce exposure.
- Review and strengthen the standards and **upgrade the performance of existing wastewater treatment facilities** for municipalities, businesses, and institutions.(QC)
- Introduce a **strategy to promote substitution of harmful chemicals** in products, including a centre for chemical substitution, and a chemical substitution recognition program.

Investment: \$260 million



NUTRIENTS AND ALGAL BLOOMS

Contributions from non-point sources, e.g. farms, are at low concentrations, but cumulative impact is significant. Difficult to determine where to focus efforts for greatest impact given limited funding.





NUTRIENTS AND ALGAL BLOOMS

30+ years effort in Chesapeake Bay, slow results from broad based approach, now adopting "precision conservation" approach, focusing at lot level to apply best practices where they can have greatest impact.





Key recommendations

Nutrients and Algal Blooms

- Establish a **Centre for Water Quality and Nutrient Management** supported by a university consortium, indigenous communities and relevant organisations to generate and coordinate information to support precision conservation and best practices and provide extension support to farmers (11 priority zones identified in Quebec)
- Review and **adapt agricultural income support and technical programs** to reduce water contamination as well as technical assistance outreach to farmers, especially incorporating green infrastructure, payment for ecosystem services for landowners,
- Designate a **dedicated network of extension workers** that receive standardized training and provide consistent technical advice to farmers

Investment: \$400 million



Key recommendation for municipalities Wastewater Treatment

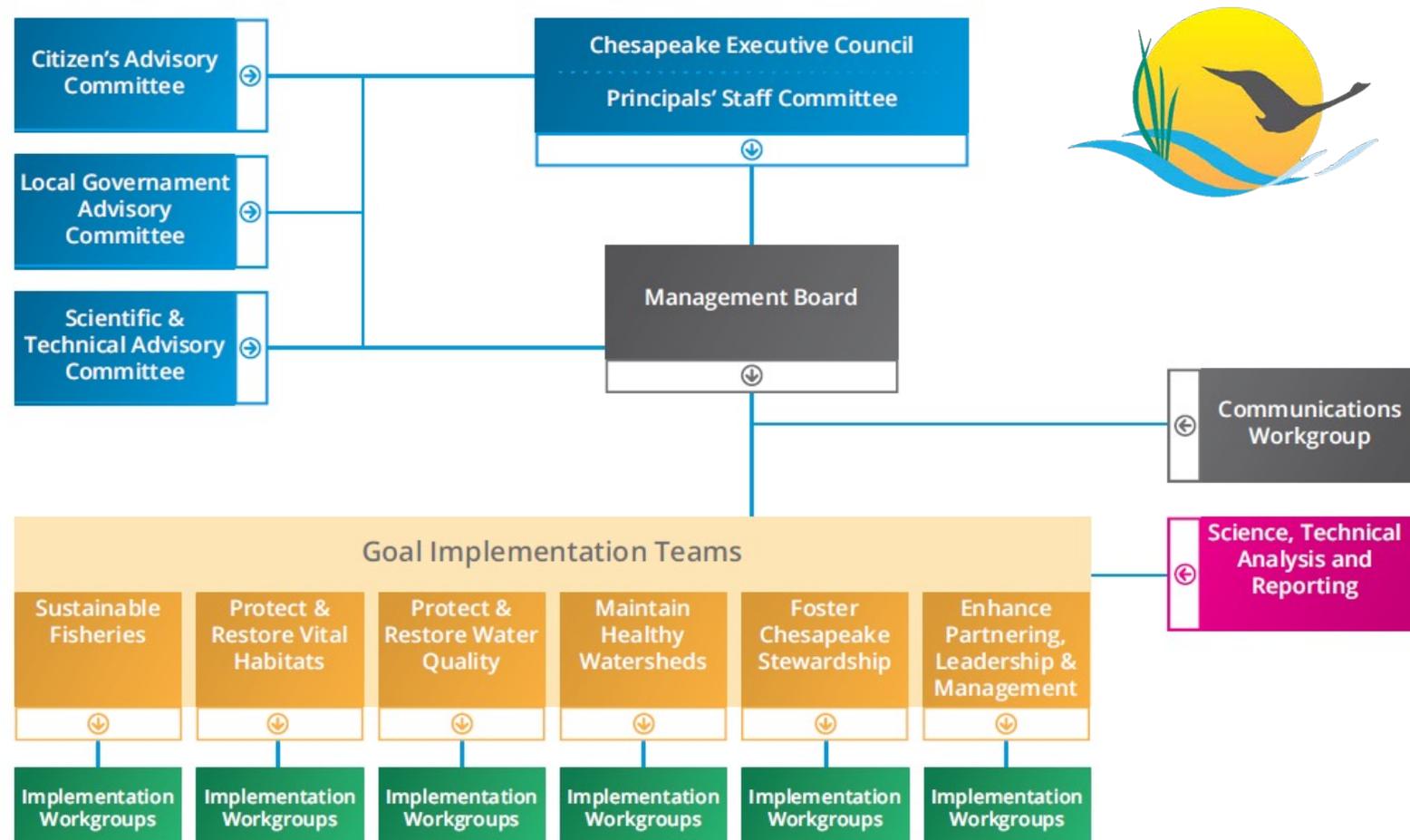


- Provide financial support for **wastewater treatment facility upgrades** and the installation of **green infrastructure** to reduce the number of sewer overflows in priority sectors, remove emerging contaminants, nitrogen, and to mitigate shoreline bacteriological pollution.
 - Carry out and finance pilot projects to test innovative approaches, strategies and technologies (QC- Montreal, Longueuil, Repentigny, Laval)
 - Accelerate capital works in large cities like Toronto, Hamilton and Kingston to eliminate CSOs, support wastewater capacity upgrades in smaller municipalities whose plants are found to be the source of bacteriological contamination of beaches.

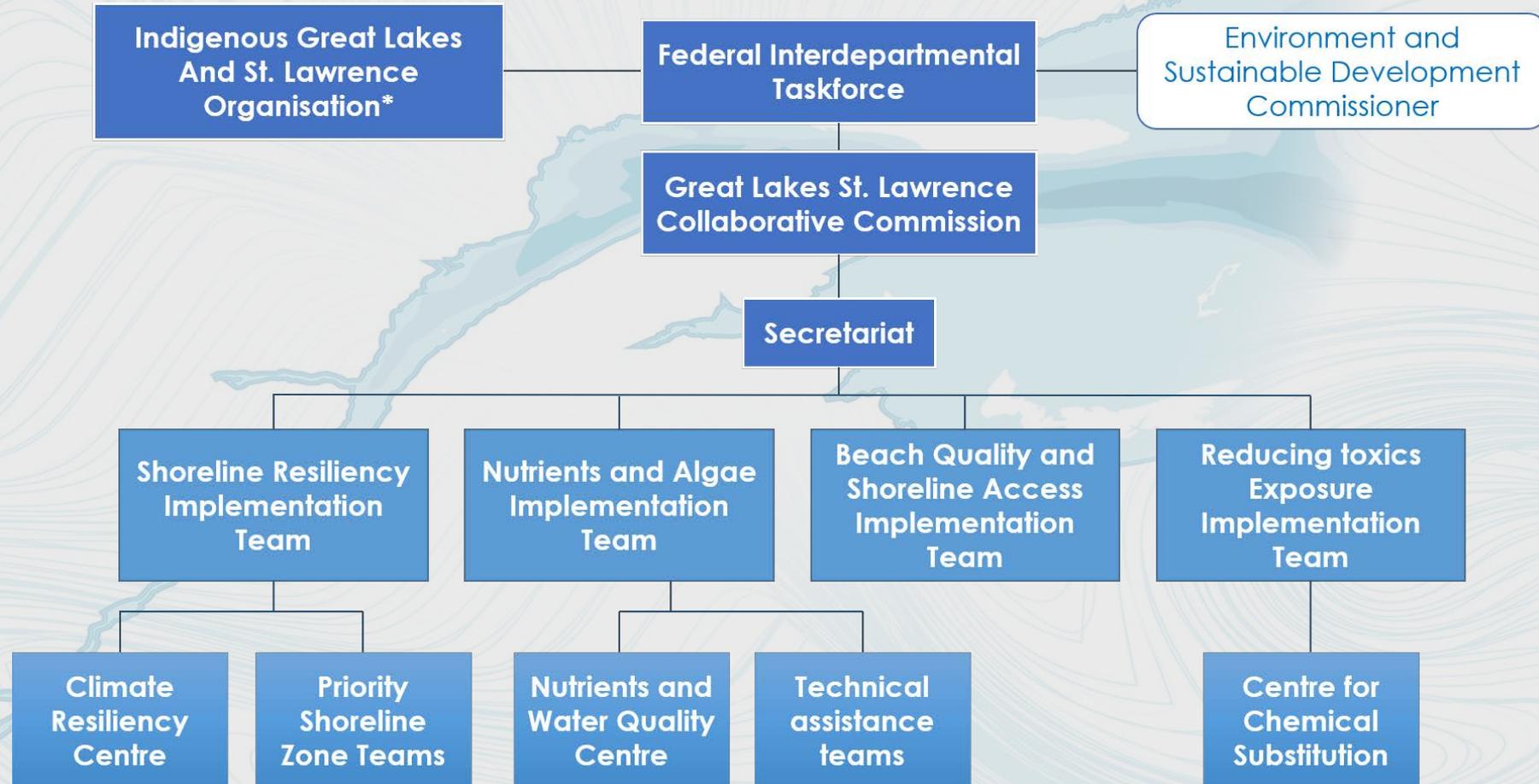
Investment \$560 million

Institutional Arrangements for Action Plan Implementation

Figure 1. Organizational Structure of the Chesapeake Bay Program



Institutional Arrangements for Action Plan Implementation



* Institutional arrangements involving indigenous groups will be determined following further consultations with Great Lakes and St. Lawrence indigenous groups

Next Steps

- Leverage federal commitments regarding a strengthened Freshwater Action Plan and the creation of a Canada Water Agency to advance the priorities laid out in the Collaborative's Action Plan.
- Meet with key ministers, caucuses, shoreline MPs, senators in advance of the Speech from the Throne and Budget 2021 to ensure freshwater and the Great Lakes remains a top priority for the Trudeau government in a minority parliament.

COLLABORATIVE
GREAT LAKES
ST. LAWRENCE



**GREAT LAKES AND
ST. LAWRENCE**
CITIES INITIATIVE



Questions

Great Lakes St. Lawrence Action Plan 2020-2030

For more information :
Mark Fisher
Council of the Great Lakes Region
mark@councilgreatlakesregion.org

La Malbaie, Charlevoix
Credit: Jean Paquin



Questions

Water Levels 2021



GEORGIAN BAY
FOREVER





C. Impacts on wetlands, flora and fauna

Water Levels 2021



GEORGIAN BAY FOREVER



Water Levels 2021 – Julie Cayley



- **Julie Cayley B.Sc., P.Ag.,** is the Executive Director of the Severn Sound Environmental Association (SSEA) in Port McNicoll Ontario. Julie is a Government and Industry relations expert with a significant background in creating successful connections within Government, Industry and NGO/Not for Profits. Over her career she has worked for Provincial Government and NGOs as well as running her own consulting business. She specializes in Environment and Conservation with agriculture and rural partnerships and has a passion for working with communities on the Great Lakes.
- Julie is a Professional Agrologist, has a B.Sc. in Environmental and Resource Science from Trent University and is a graduate of Class 8 of Ontario's Advanced Agricultural Leadership Program (AALP). Julie was the first woman to Chair the North East Agriculture and Biological Engineering Community, is a Director on the Huronia Community Foundation Board and in 2019 was appointed by Minister Yurek (MECP) to the Muskoka Watershed Advisory Group.

Water Levels 2021 – Aisha Chiandet



- Aisha is a water scientist with the Severn Sound Environmental Association and focuses on water quality monitoring of lakes and tributaries in the Severn Sound watershed with a particular emphasis on nutrient conditions and responses of biological communities.
- Her work has also included analyses of climate impacts on local waterways, including on water levels. More recently she initiated several citizen science programs with goals to monitor the impacts of climate change, algae growth and water level fluctuations.



Impacts of Climate Change on Open Waters – Observations from Severn Sound and Beyond

Aisha Chiandet

achiandet@severnsound.ca

H2O 2021 – Extreme Water Levels



Climate Drivers & Lake Impacts

Drivers:

- Temperature – air/water
- Wind speed
- Precipitation
- ❖ Operate at different scales

Impacts:

- Ice
- Algae growth
- Water levels

Drivers & Impacts:

- Focus on local/regional trends, implications, projections



Blue Green algae bloom, MacLean Lake

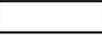


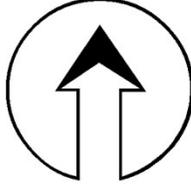
Picnic Island gas dock, Honey Harbour

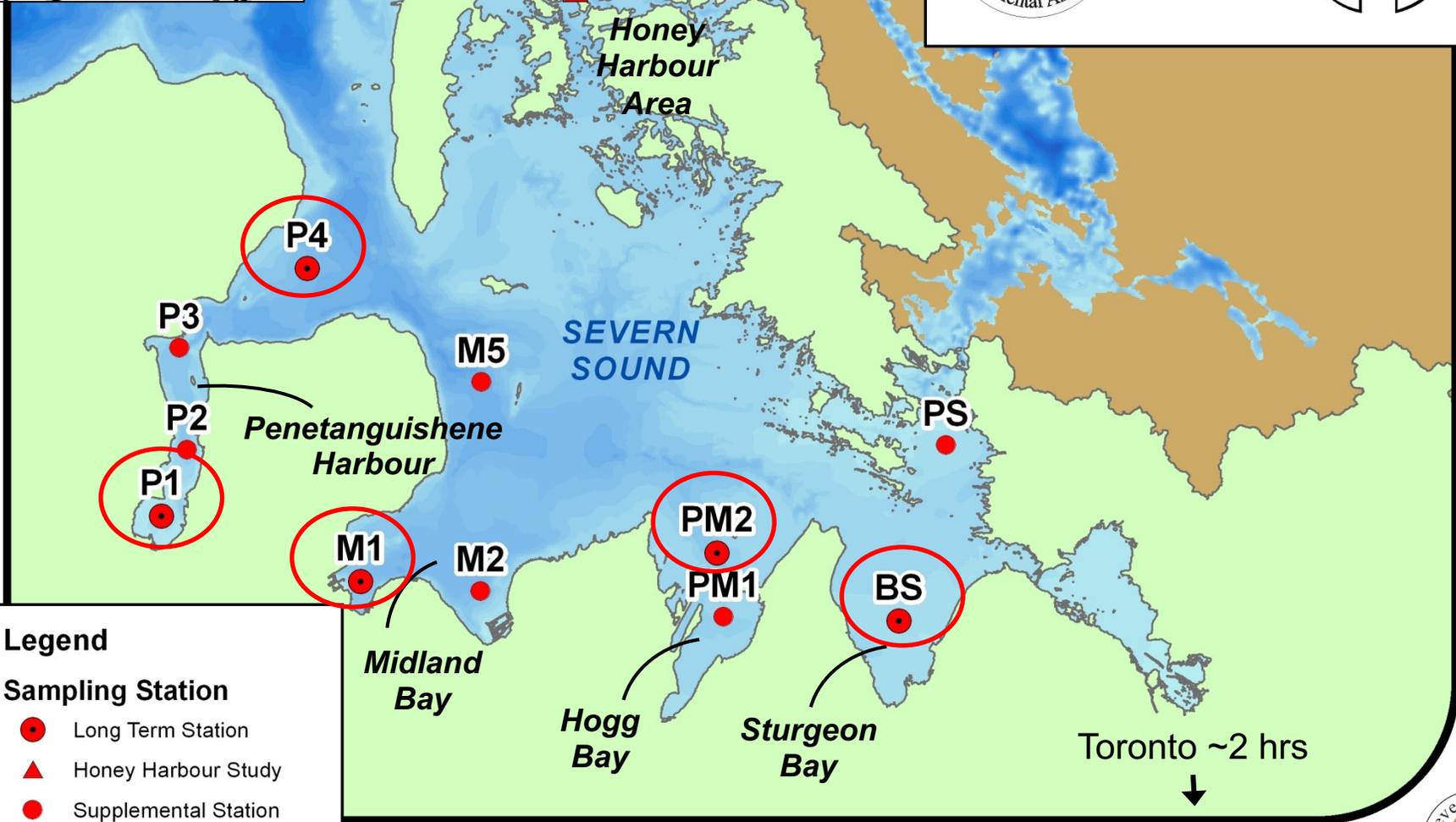


Open Water Monitoring Stations



 2 Km





Legend

Sampling Station

- Long Term Station
- ▲ Honey Harbour Study
- Supplemental Station
- Severn Sound Watershed

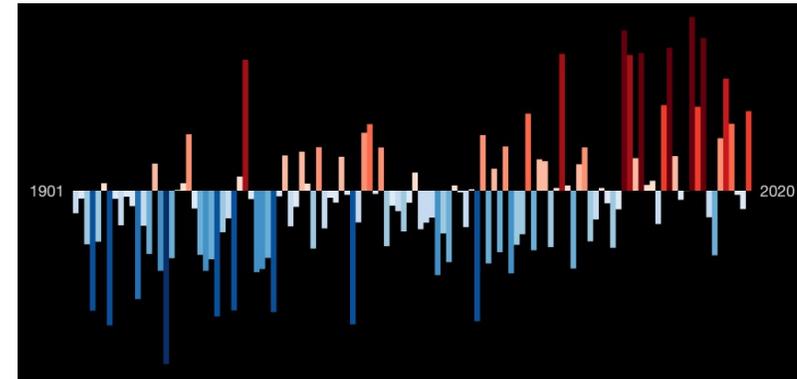
Produced by the Severn Sound Environmental Association with data supplied in part from the County of Simcoe, the Ontario Ministry of Natural Resources (© Queen's Printer 2013) and under License with members of the Ontario Geospatial Data Exchange, 2014. Depth Sounding data was supplied under license by the Canadian Hydrographic Service (© CHS in right of her majesty the Queen, 2014). Not for navigational purposes.



Driver: Temperature

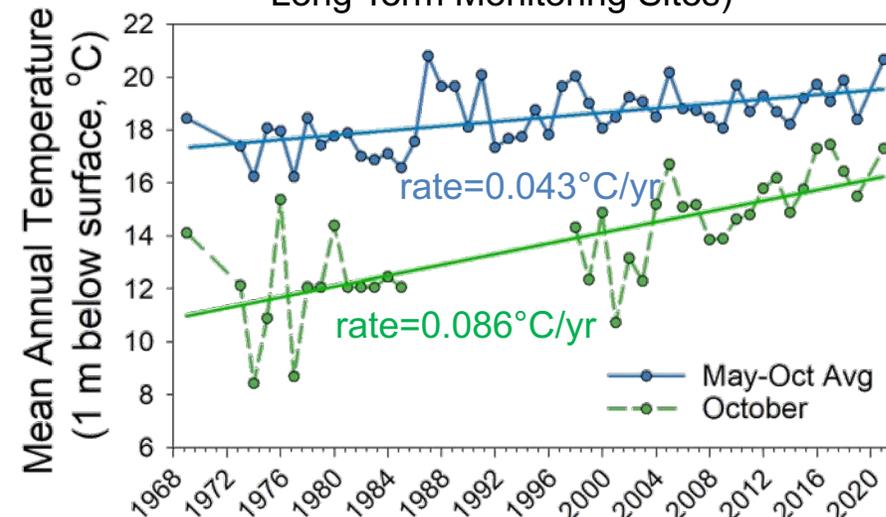
- \uparrow air temperature in the region - leads to \uparrow water temperature
- Significant \uparrow in surface water temperatures in Severn Sound over past ~50 years – avg rate of $0.43^{\circ}\text{C}/\text{decade}$
- Fall water temperatures \uparrow at double the rate, $0.86^{\circ}\text{C}/\text{decade}$ – fuels fall algae growth, delays ice formation
- \uparrow in growing days leads to longer window for algae blooms
- ***Air temperature projected to increase***

Air Temperature Change in Ontario, 1901-2020



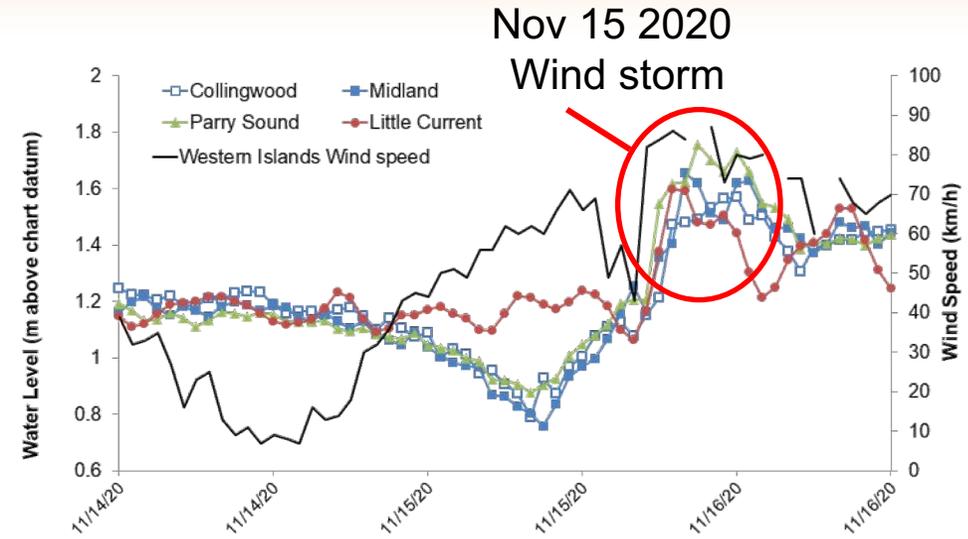
Data Source: Berkley Earth, NOAA; showyourstripes.info

Ice Free Season & Fall Surface Water Temperature for Severn Sound (Avg of 5 Long Term Monitoring Sites)



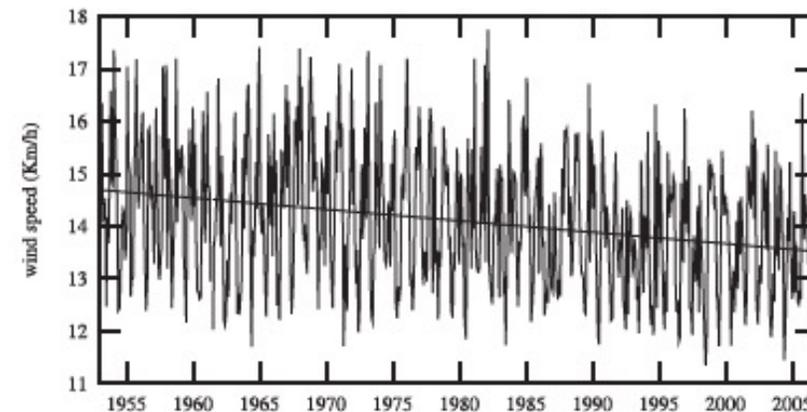
Driver: Wind

- ↓ in avg wind speeds across Ontario, combines with temp to make water column warmer & calmer
- Strong wind events causes short term water level fluctuations (seiches) that can lead to coastal flooding and erosion, esp. in combination with high water levels
- Wind driven mixing of shallow waters can resuspend nutrients in sediments and fuel algae growth
- **Projected ↓ in avg. wind speed but ↑ in intense storm events**



Data Sources: Environment & Climate Change Canada (ECCC), Canadian Hydrographic Service (CHS)

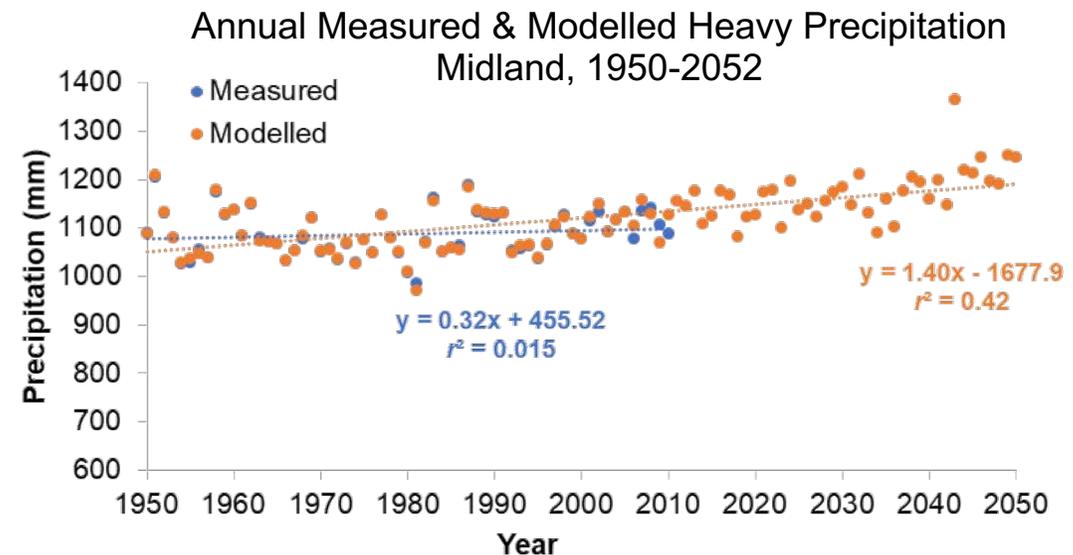
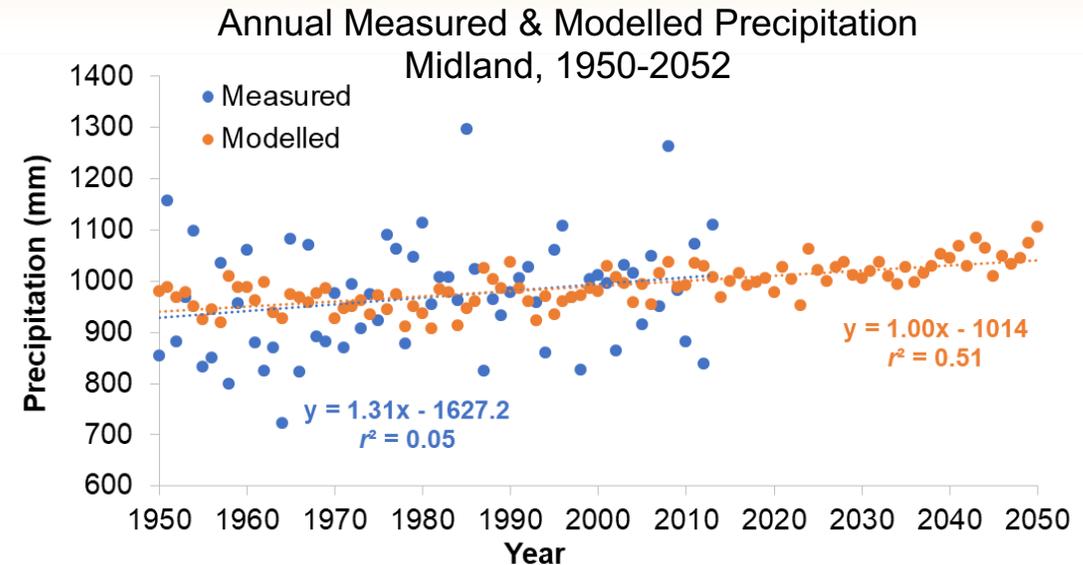
Average Monthly Homogenized Wind Speed for Ontario ECCC Weather Stations



Wan et al. 2010, J. Climate, 23:1209-1225

Driver: Precipitation

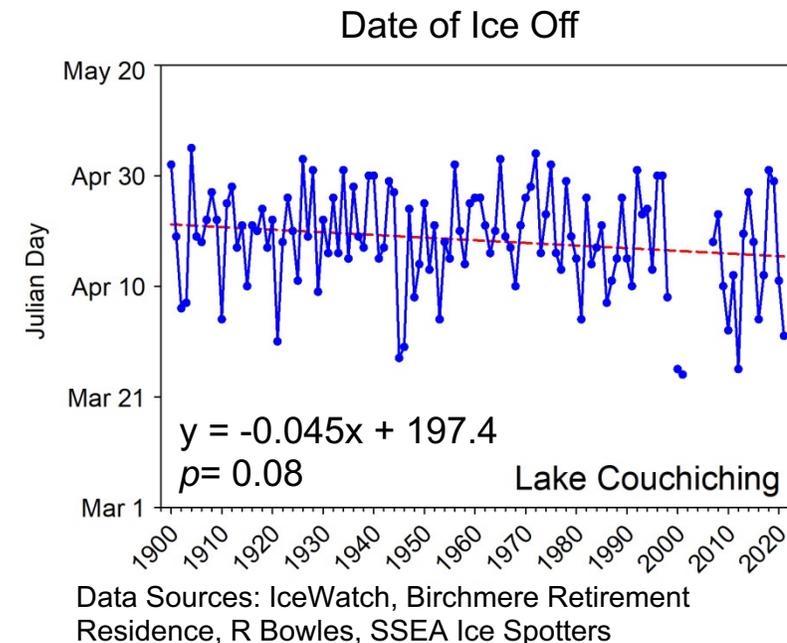
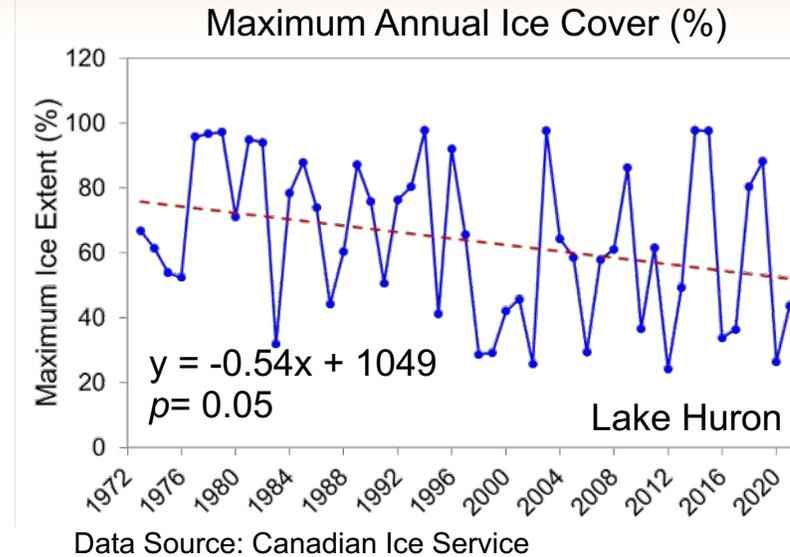
- Great Lakes basin-wide trend toward \uparrow in total precipitation - fluctuations from year to year influence water levels
- More frequent & more intense storm events bring pulses of nutrients into water bodies - can contribute to algae blooms
- Punctuated by calm, dry periods – favour algae growth
- Increase in winter rainfall – impact on rural/urban stormwater runoff & nutrients
- ***Rainfall projected to increase in amount and intensity***



Data Sources: ECCC, Natural Resources Canada

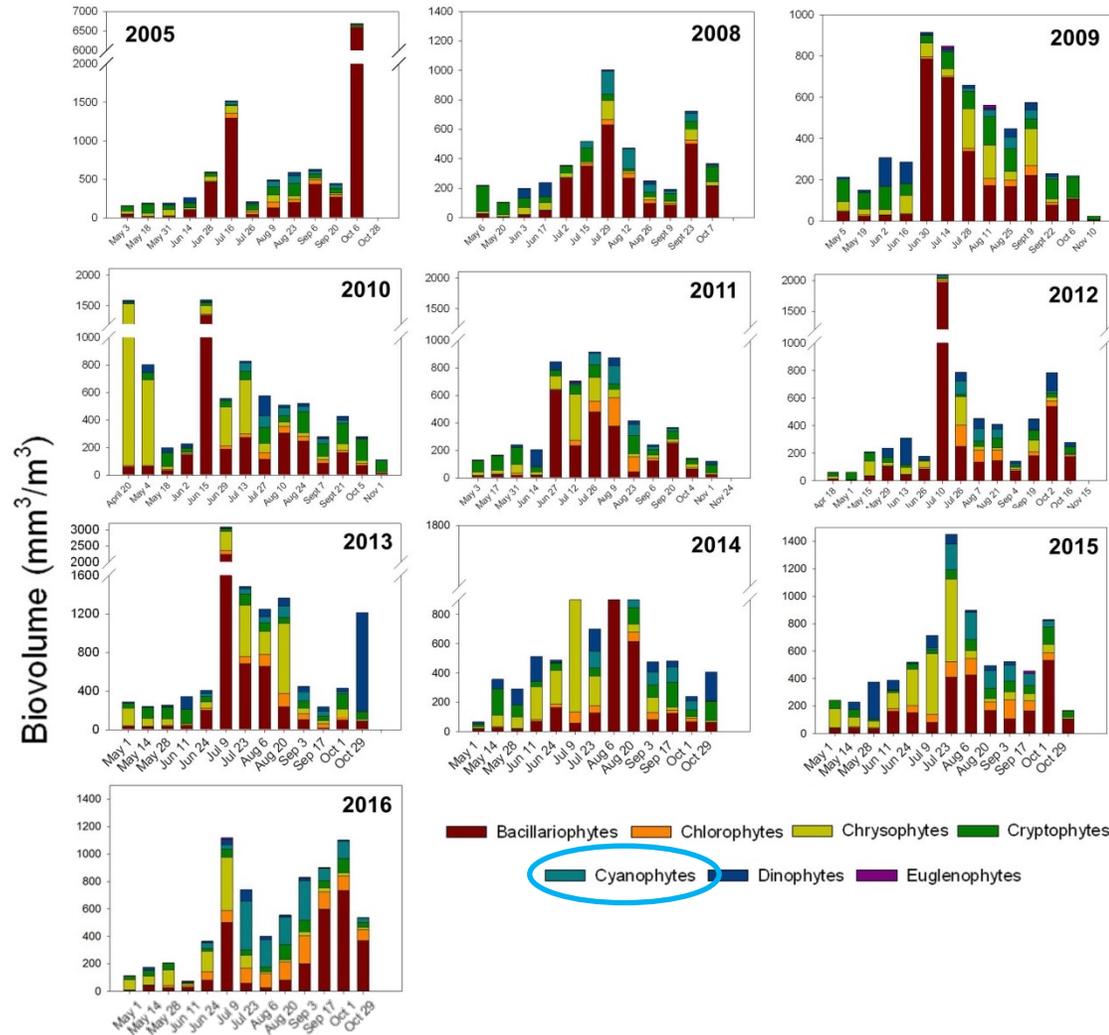
Impact: Ice Cover & Phenology

- ↓ in annual max ice cover for Lake Huron over last 40 years
- Ice phenology (on/off dates) changing
- Longest dataset in Severn Sound area: Lake Couchiching
 - Shift to earlier ice off
- Length of ice cover season influences water balance, potential for erosion
- Short ice cover season = longer growing season for plants & algae
- **Projected ↓ in ice cover and shorter ice season – later ice on, earlier ice off**

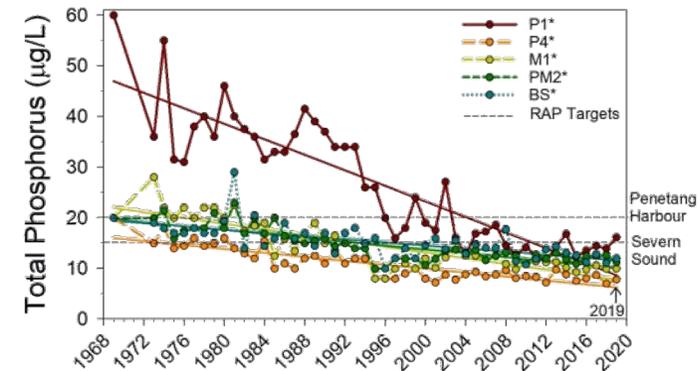


Impact: Algae Growth

Seasonal Algal Biovolume by Class
Severn Sound Open Water (M5)



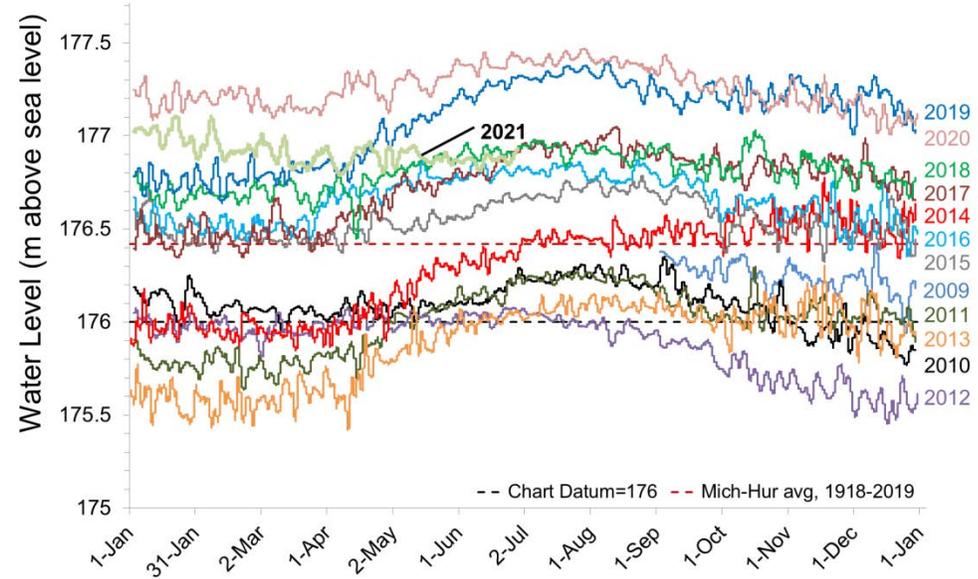
- Warm waters favour Bluegreen (BG) algae
- Increasing presence of BG late in the summer, despite reduction/plateau in phosphorus
- Nitrogen also an important nutrient, rising in some areas
- **Harmful algal blooms projected to ↑ with water temperature & storm events/drought cycles**



Impact: Water Levels

- Short term fluctuations due to wind events
- Longer term fluctuations due to basin-scale changes in precipitation and evaporation (links to air temp., wind, ice cover)
- Impacts of highs & lows vary
 - Flooding/erosion, habitat gain/loss, property damage
- **Shifts between extremes projected to occur more rapidly, larger difference between highs and lows**

Seasonal Water Levels, Midland Bay, 2009-2021



Lines show 3 day moving average of hourly water levels
Data Source: CHS



What Can You Do?

- Invest in resilient shorelines
 - Use bioengineering, soft-engineering, green infrastructure technologies
 - Relocate infrastructure away from the shoreline where possible
- Reduce nutrient inputs & carbon emissions
(www.severnsound.ca, www.sustainablesevernsound.ca)
 - Calculate your carbon footprint:
gbr.ca/carbon-calculator
- Learn how to recognize & report harmful algae
- Join citizen science programs near you!
 - SSEA programs - Ice Spotters, Shore Watch, Stream Watch, Invasive Species Spotters
<http://bit.ly/sseacit-sci>
 - Outside SSEA area – Muskoka Watershed Council, Lake Huron Coastal Centre, Nottawasaga Valley Conservation Authority, Georgian Bay Biosphere



Shrubs like willows naturally help secure the shoreline



Conclusions

- Climate change impacts lakes through many different processes that act at basin-wide and local scales
- Climate drivers that impact lakes include: temperature, wind and precipitation
- Future projections predict “*warmer, wetter, wilder*” conditions
- Local effects observed:
 - ↓ ice cover/length of ice season, ↑ algae growth, ↑ variability in short/long term water level fluctuations
- To control harmful and nuisance algae growth, need to reduce nutrient inputs even more in a warmer, stormier world
 - Bluegreen blooms like it hot, extreme events favour blooms
- Need to **adapt** and **mitigate** against climate impacts
 - Build shoreline resilience, reduce emissions and nutrient inputs



Acknowledgements

- Funding support from our member municipalities
- Provincial support (MECP lab analysis, use of historical data, technical advice)
- Past COA funding (federal/provincial partnership)
- Fabulous staff (past and present) at SSEA



More Info: www.severnsound.ca



@severnsoundea



@SSEA_SSRAP

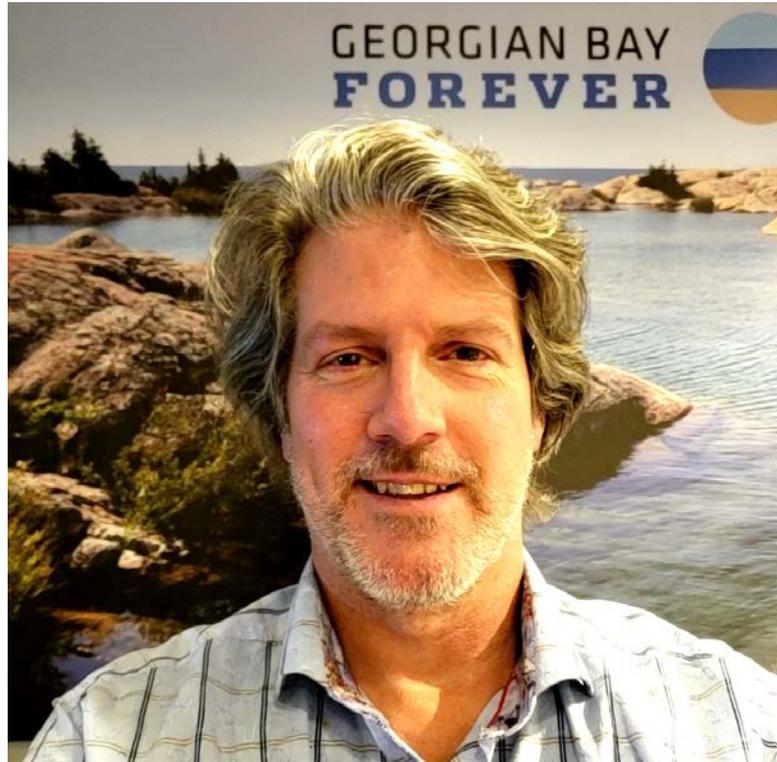


YouTube

Thanks for
listening!!

achiandet@severnsound.ca

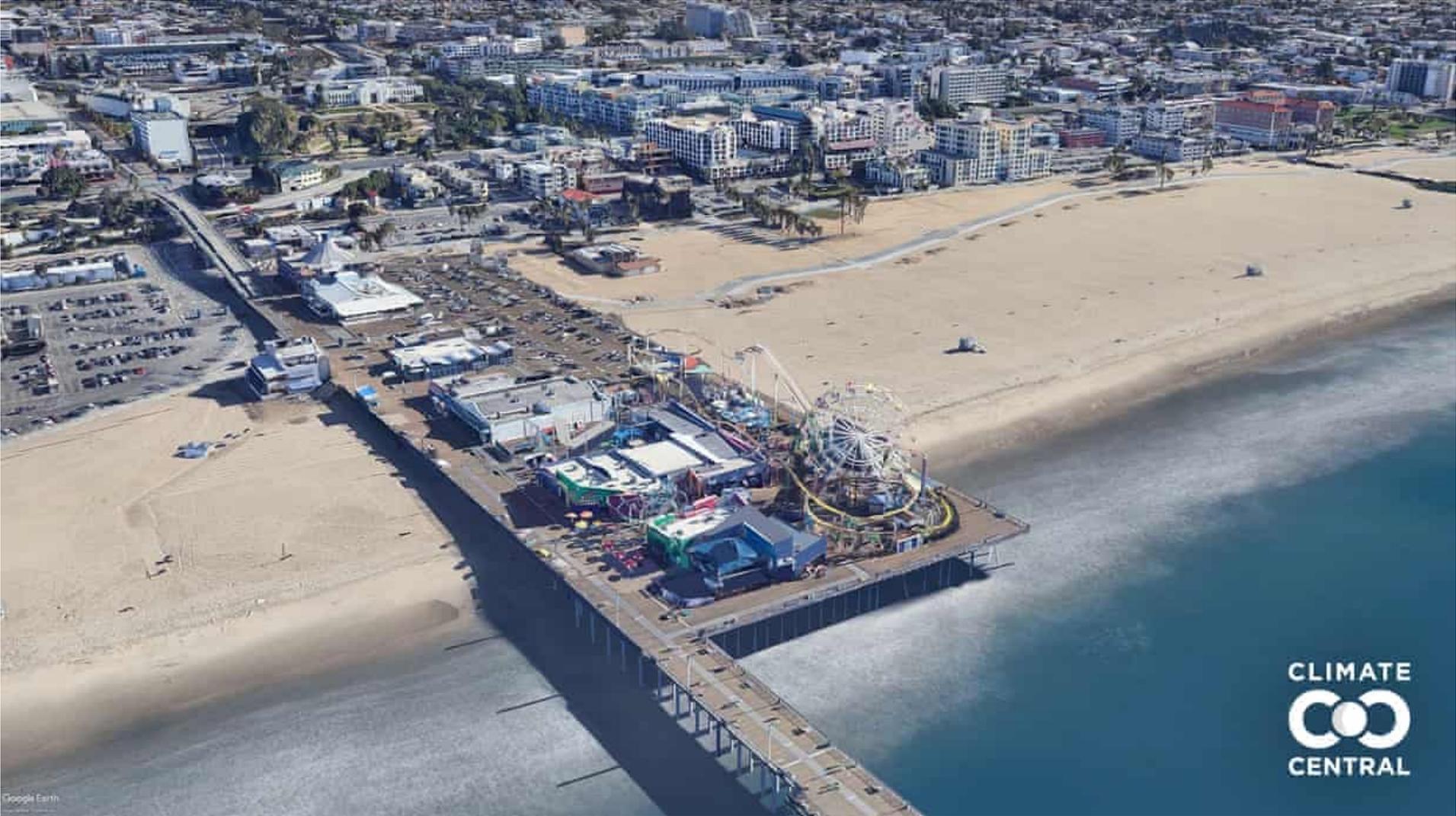




David Sweetnam

Georgian Baykeeper
Executive Director
Georgian Bay Forever

Santa Monica Pier, present day



Google Earth



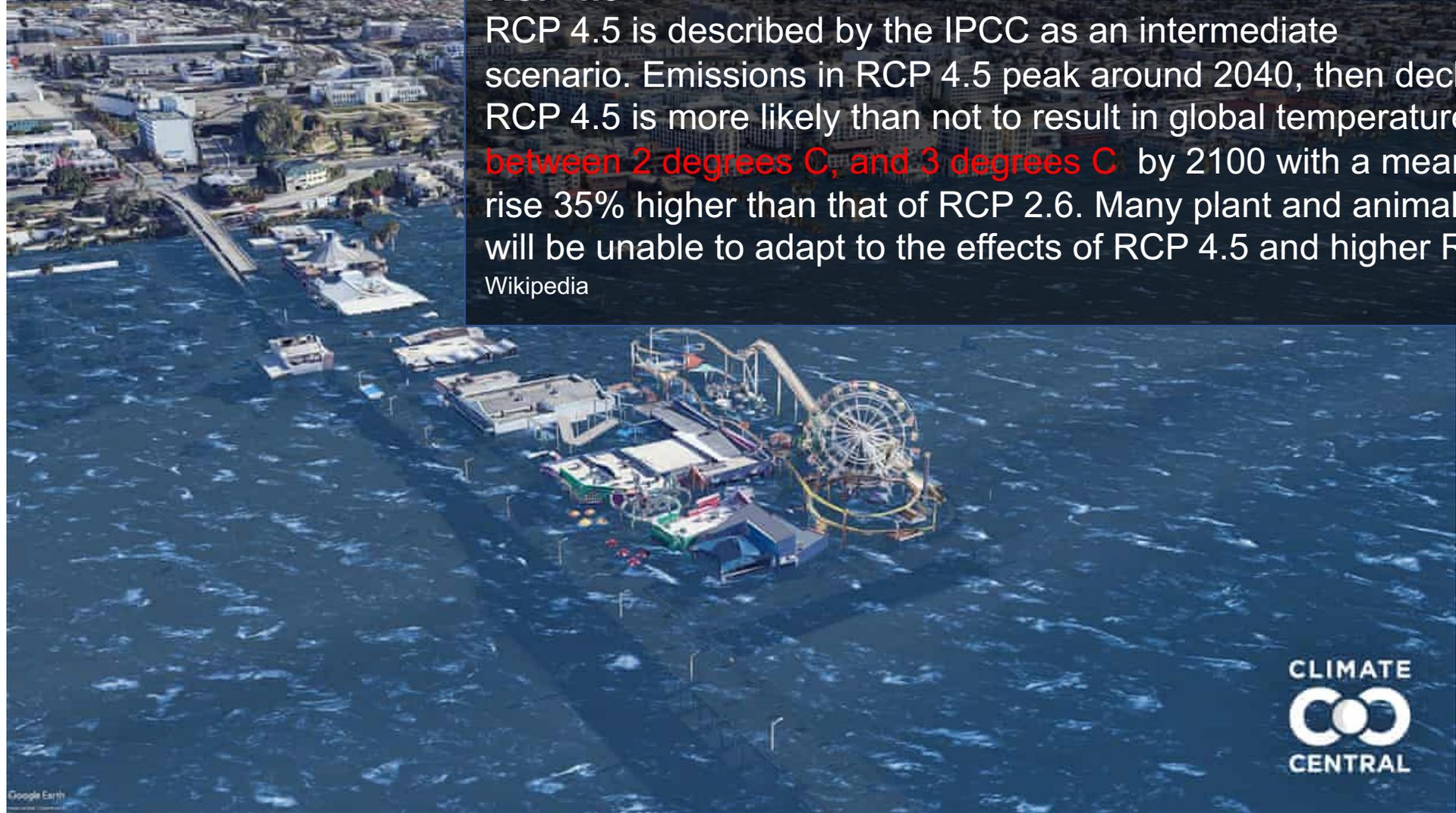
Santa Monica Pier, +1.5°C



RCP 1.9

RCP 1.9 is a pathway that limits global warming to below 1.5 °C, the aspirational goal of the Paris Agreement. - Wikipedia

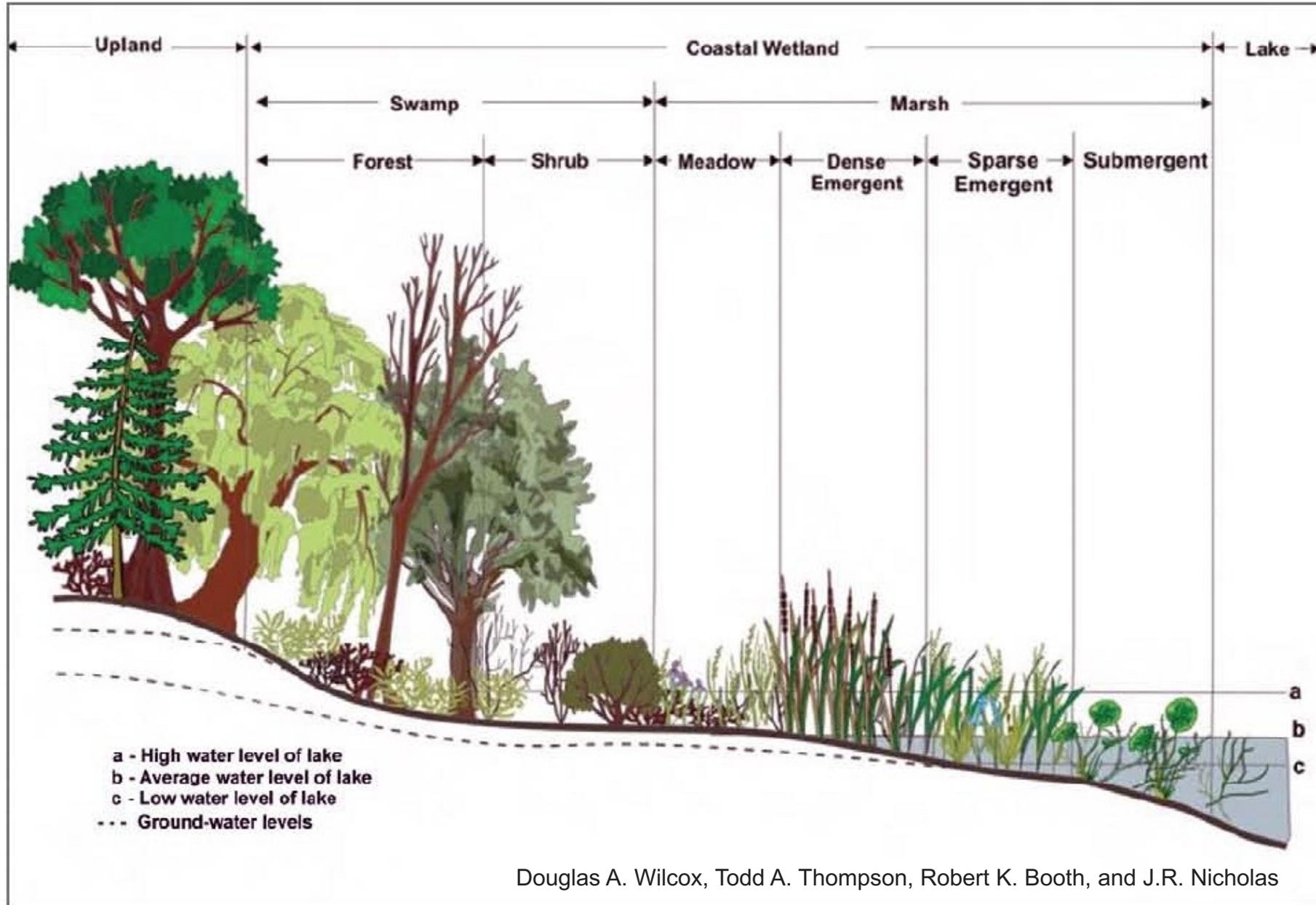
Santa Monica Pier, +3°C



RCP 4.5

RCP 4.5 is described by the IPCC as an intermediate scenario. Emissions in RCP 4.5 peak around 2040, then decline. RCP 4.5 is more likely than not to result in global temperature rise **between 2 degrees C, and 3 degrees C** by 2100 with a mean sea level rise 35% higher than that of RCP 2.6. Many plant and animal species will be unable to adapt to the effects of RCP 4.5 and higher RCPs. -

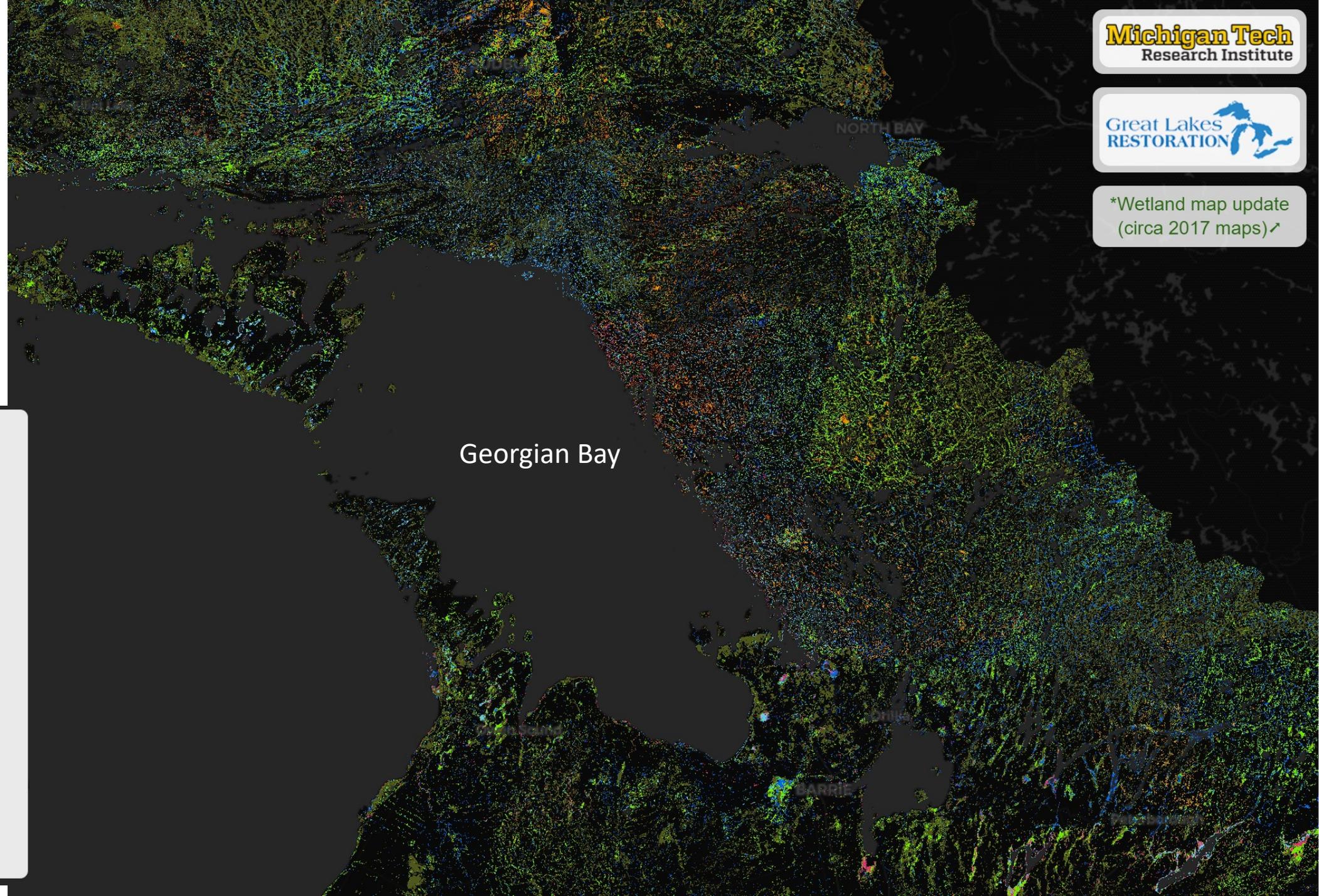
Wikipedia



Douglas A. Wilcox, Todd A. Thompson, Robert K. Booth, and J.R. Nicholas

Wetland maps

-  Aquatic Bed
-  Emergent Wetland
-  Shrub Wetland
-  Forested Wetland
-  Open Peatland
-  Shrub Peatland
-  Treed Peatland
-  Schoenoplectus
-  Typha
-  Phragmites
-  Mixed Phragmites
-  Phragmites Detritus



Wetland maps

- Aquatic Bed
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- Mixed Phragmites
- Phragmites Detritus





- Wetlands provide protection from wave action, roots of plants stabilize soils.
- Wetlands provide services that filter and clean our water
- Wetlands provide habitat for fish and other wildlife including migrating birds
- Wetlands in Georgian Bay have evolved within the long-term water level regime of 6.33 feet of water level fluctuations
- Wetlands include the forest fringe surrounding them so occasional dead trees are part of Mother Nature's plan.

“Climate change vulnerability assessment of species in the Ontario Great Lakes Basin”, 2018 - Ontario Ministry of Natural Resources and Forestry

- Climate change **will** affect the distribution and abundance of species in the Ontario Great Lakes Basin.
- Assessed the relative vulnerability of 280 species in Ontario’s Great Lakes basin to climate change. Separated each species’ vulnerability into 2 main components: the species’ exposure to climate change in the Ontario Great Lakes Basin and its sensitivity/ adaptive capacity.
- Climate projections for the 2050s period were downscaled from the Intergovernmental Panel on Climate Change Fifth Assessment Report representative concentration pathways scenario 4.5 (**RCP4.5**).

“Climate change vulnerability assessment of species in the Ontario Great Lakes Basin”, 2018 - Ontario Ministry of Natural Resources and Forestry

- Report results showed 175 of the 280 assessed species to be vulnerable to climate change.
- Eleven were found to be extremely vulnerable, 49 were highly vulnerable, and 115 were moderately vulnerable. The remaining 105 were found to be less vulnerable.
- Of the 10 taxonomic groups assessed, **those depending most on water (molluscs, fishes, amphibians, lichens) were most vulnerable.** Vascular plants and mammals varied widely in assessed vulnerability, while birds, insects and spiders, and reptiles were found to be the least vulnerable.

“Climate change vulnerability assessment of species in the Ontario Great Lakes Basin”, 2018 - Ontario Ministry of Natural Resources and Forestry

- “Results support the development of adaptive conservation strategies aimed at mitigating identified vulnerabilities. They also highlight the **importance of considering climate change** in managing species at risk and the need for better, more coordinated, and centralized biodiversity and distribution data for all species of conservation concern...”

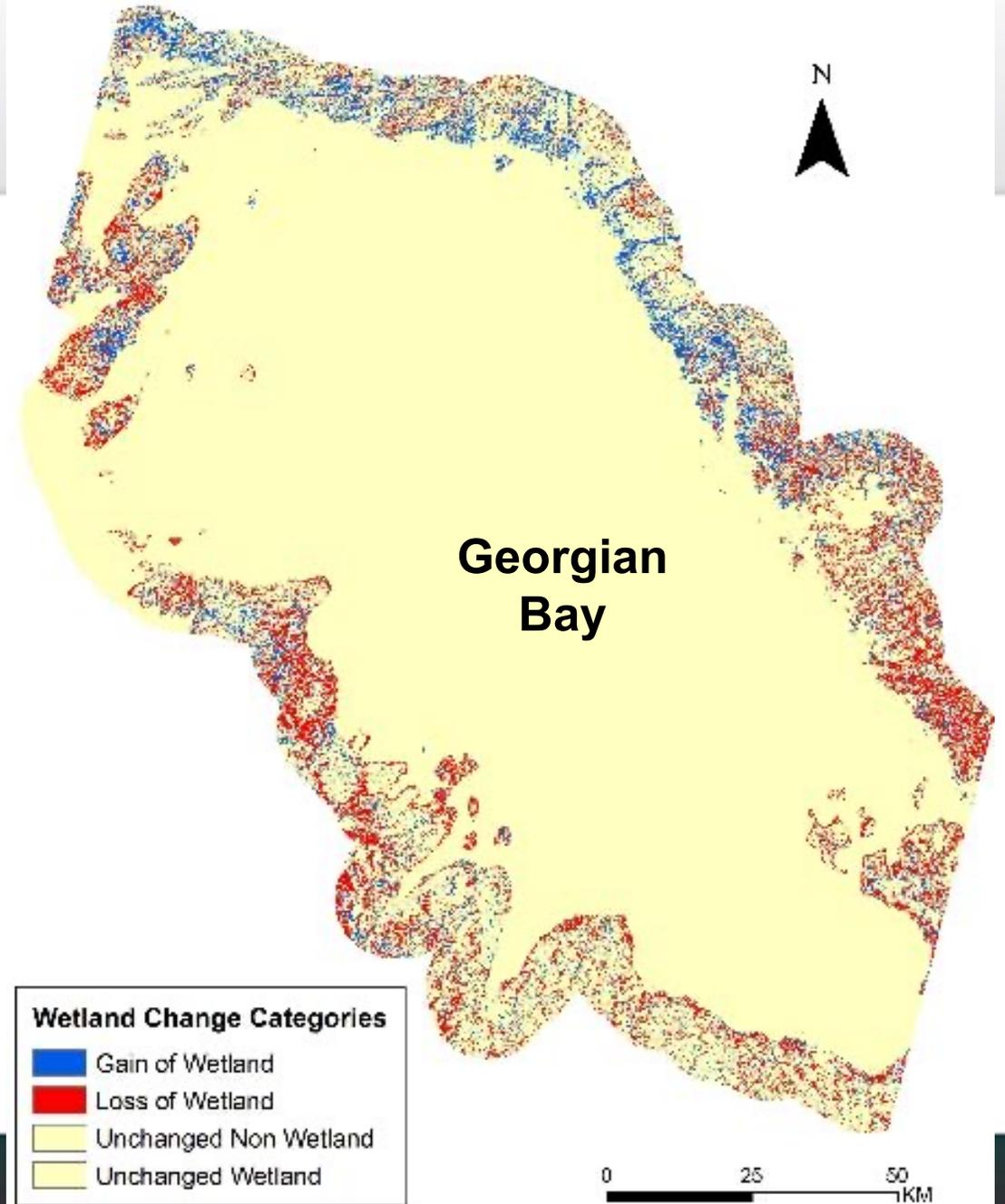


Great Lakes Climate II



Impact of Decreasing Lake Water Levels on Great Lakes Wetlands

Wetland Extent Change 1987-2013





Study Findings

- Georgian Bay: 1987-2013
 - 7% Wetland Gain in North
 - 10.8% Wetland Loss in South
 - net loss of 3.8%



Photo by Miriam Harris

2021-10-07 DEEP TREKKER -26 14C 218 5.9M



Photo Credit: David Sweetnam



- First Nations Traditional Ecological Knowledge (TEK) describes a healthy ecosystem where the water level would rise as the lake trout chased the herring into the bays...and the Lake Sturgeon ate cranberries from the bushes along the shores.





Fish Stressors

- Overfishing – commercial, recreational
- Development – Habitat loss
- Climate Change
 - Long term stressor for fish
 - Acute stressor for recruitment
 - Lack of ice cover = low viability
 - Anoxia, temperature changes
- Invasive Species
 - i.e. *Phragmites*, lamprey, mussels, goby, commercial bio-contamination, loss of zooplankton & habitat

“Declining ice cover could also stress whitefish reproduction in Lake Superior where ice protects eggs from winter storm disturbance.”

Great Lakes Integrated Sciences + Assessments

Saugeen Ojibway Nation confronts effects of climate change on whitefish fishery

Rhiannon Johnson · CBC News · Posted: Jan 20, 2019 4:00 AM ET | Last Updated: January 20



Paul Vecsei via Engbretson Underwater Photography/WWF

Sad News

Sad News this week in Southern Georgian Bay with hundreds of dead birds found along the shorelines of Wasaga Beach (current photo), Midland, Collingwood, and Tiny Township.

This has been a result of botulism, a serious illness caused by the ingestion of bacteria, likely through consuming infected fish. By the time the animals are found on shore, they have not survived or are very close to dying. The Shades of Hope Wildlife Refuge (<https://www.shadesofhope.ca/>), located in Pefferlaw, Ontario is doing everything they can to try and save those able to be brought to them.

Helpful Information from the Shades of Hope Wildlife Refuge:

- If you find a sick bird alive on shore or in the water, contact the Shades of Hope Wildlife Refuge at (705) 437-4654. [@shadesofhopewildliferefuge](https://www.instagram.com/shadesofhopewildliferefuge)
- If there is anyone in the area with a boat goes out and collect the sick animals before they wash up to shore. There is a higher likelihood of survival.
- If you are going to transport a sick/injured bird to the refuge, be sure to avoid contact to your face/mouth and wash your hands after. It is suggested you keep its head propped up to enhance its ability to breath. Botulism has a negative impact on respiratory function.



Photo Credit: Nicole Carpenter, GBF



- It is likely due in part to the unusually high water temperatures, which produced more filamentous algae (Cladophora) that rots producing botulinum bacteria taken up by and concentrated in invasive quagga mussels.
- Invasive round goby in turn eat the mussels and take up the toxins. Then they in turn are eaten by the birds.

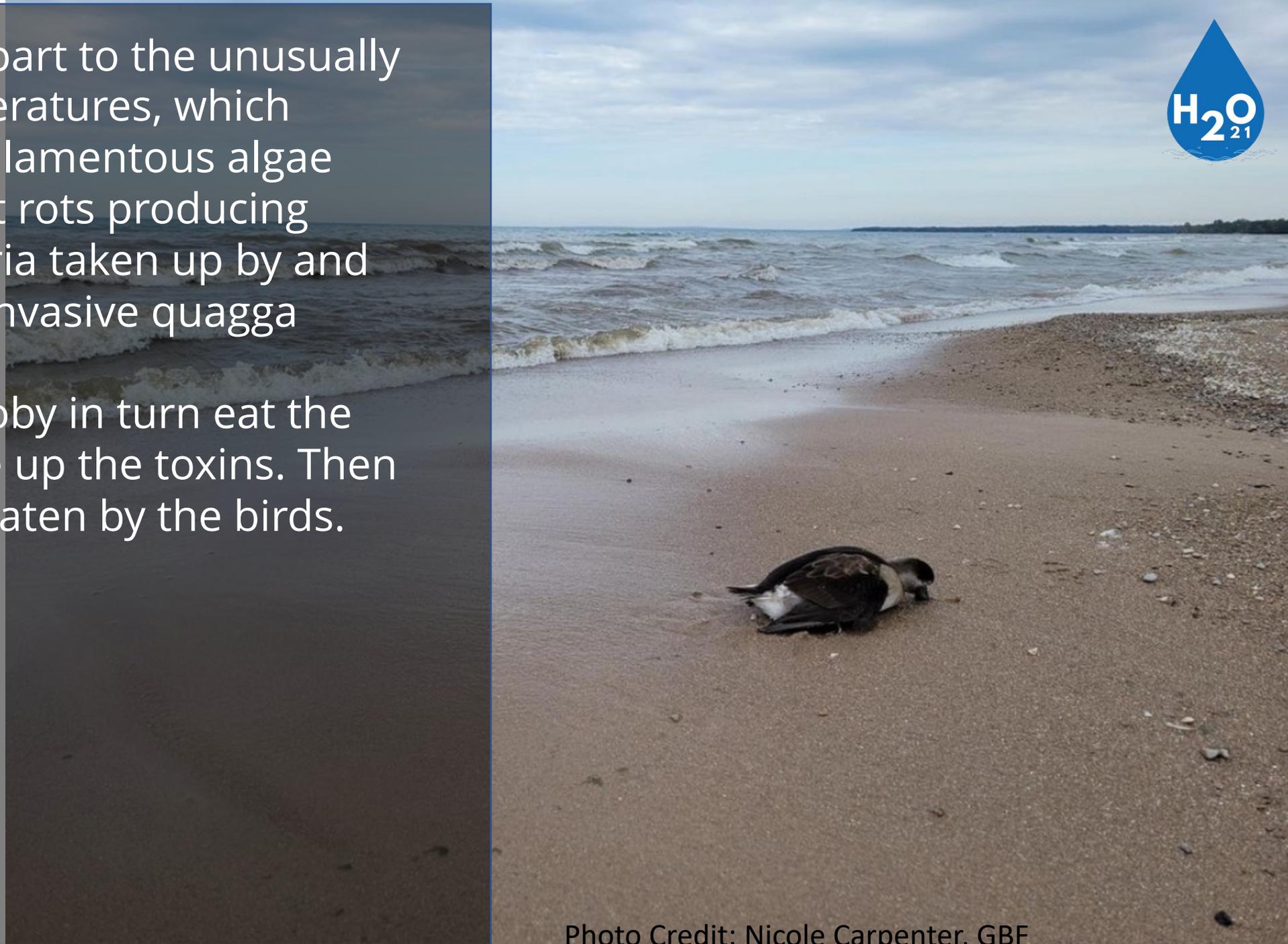


Photo Credit: Nicole Carpenter, GBF



Climate change is adding stress to coastal wetlands...

and helping invasive species take hold.



Phragmites

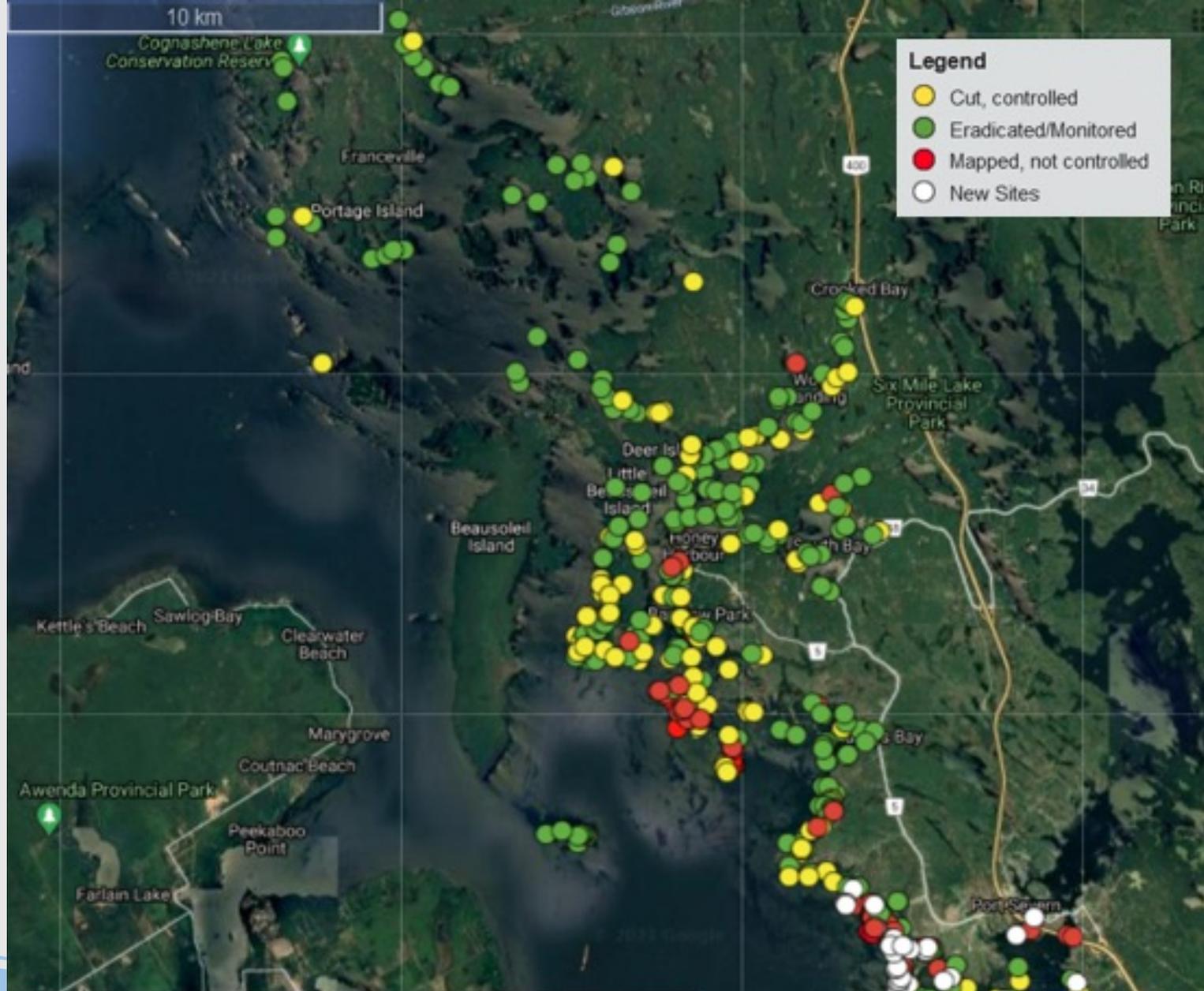




Phragmites



Photo courtesy of Janice Gilbert, MNR



Township of Georgian Bay 2021

Invasive Phragmites Stands



Increasing storm intensities are depositing more water in shorter time leading to more **flooding** increasing pollution and nutrient loads.





Increasing storm intensities are also overwhelming septic and stormwater systems designed for previous conditions leading to **raw sewage releases.**





14.5 hours of **raw sewage bypasses** and 21 hrs of **partial bypass** in Collingwood during the week of September 20th, 2021 during heavy rainfall (26.5 mm of rain in just over one hour).



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Diversion 2.0 Project

Gutter Bins



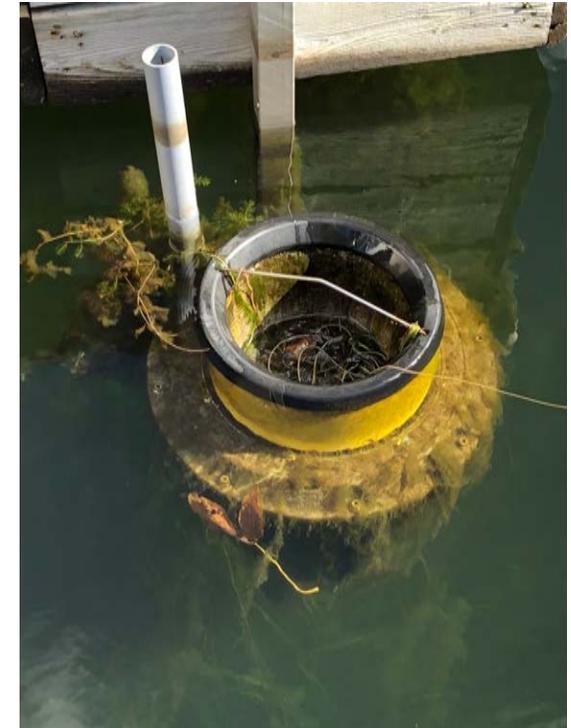
Photo Credit: Frog Creek Partners

Trash Traps



Photo Credit: InfraStruct

Seabins





GBF TrashTeam shoreline cleanups



- ECCCC Wetlands Study coming
 - GBF detailed bathymetry work
- ECCCC Coastal Wetlands Resilience Study coming soon -- March 2022 estimated release date

Adapting to Climate Change

*Solutions to Enhance Great Lakes
Coastal Wetland Resilience*



 Environment and
Climate Change Canada
Environnement et
Changement climatique Canada

Water Levels 2021



GEORGIAN BAY
FOREVER 

- GBF Rock Shoal mapping report completed December 2020
- Historic water levels fluctuations (6.33ft range) keep GB wetlands healthy.
- Wetlands are not “pushed up” against granite shorelines – they evolved there.
- NASA study in Georgian Bay showed wetland resilience to water levels changes.



- Investments to address Global Warming impacts on infrastructure and to protect ecosystems are not sufficient in Georgian Bay at this point.
- GBF participated in a formal session with ECCC to raise the priority needs for funding to protect coastal wetlands.
- We rely on our coastal wetlands to keep our water clean. In the face of increasing sewage discharge, these natural services will be increasingly important.

Thank you to these funders who have made this program possible:

The views expressed herein are solely those of Georgian Bay Forever.

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :



Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

The Weston Family Foundation

The Great Lakes Local Action Fund

The Township of The Archipelago

The Town of Collingwood

The Township of Georgian Bay

Georgian Bay Forever donors

We also want to thank these valuable partners:

The Nottawasaga Valley Conservation Authority

Blue Mountain Watershed Trust

The University of Toronto Trash Team

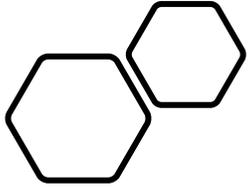
Questions

Water Levels 2021



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**NEXT: WHAT
CAN YOU DO**

**REGISTER
ONLINE AT
GBF.ORG/H2O**

**EXTREME WATER LEVELS:
IMPACTS AND STRATEGIES WEBINAR SERIES**

**SHORELINES AND
SHORELINE
STRUCTURES**

**10 AM - 12 PM
NOV 13**

**EXTREME WATER LEVELS:
IMPACTS AND STRATEGIES WEBINAR SERIES**

**SEPTICS,
INSURANCE AND
BUSINESSES**

**10 AM - 12 PM
DEC 04**

Closing

Water Levels 2021



GEORGIAN BAY
FOREVER



Water Levels 2021 - Marilyn Longlade Capreol



- Early spring of 1949, I was born to Napoleon and Norah Geroux Longlade. My first home was the island behind the Ojibway Island. During the winter months we moved to our mainland location on the shores of Pointe au Baril.
- Summers home was always bustling with Grandparents, aunts, uncles and many cousins. We would hear the song of languages, both Ojibway and French. Hear the fishing stories each day and/or watch Grandma and aunts make their quill boxes.
- Very young we were taught to respect and understand the gifts of water, wind, animals, plants, the sky that holds beautiful stars. Our first knowledge and education were done by our parents, grandparents and community. There are no books to this day for this gift of learning. It was and is strictly learned by the teachings.
- I am very grateful and acknowledge, Mishomis Giizis (Grandfather Sun) miinwaa (and) Nokomis Dibik Giizis (Grandmother Moon). They encourage every living being and walk beside all each day.



Survey

Water Levels 2021



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Water Levels 2021

Thank you!