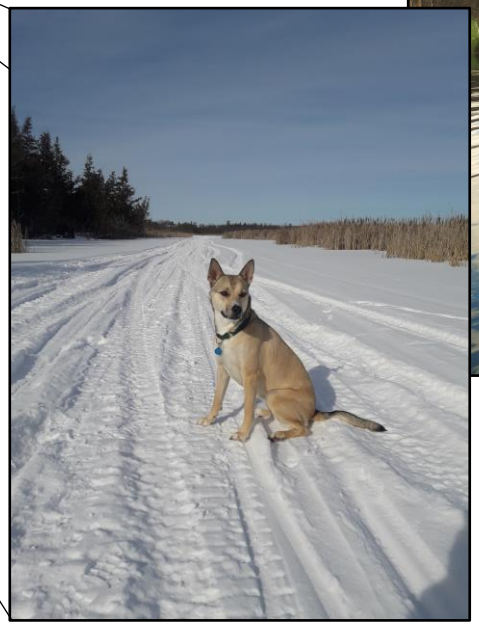
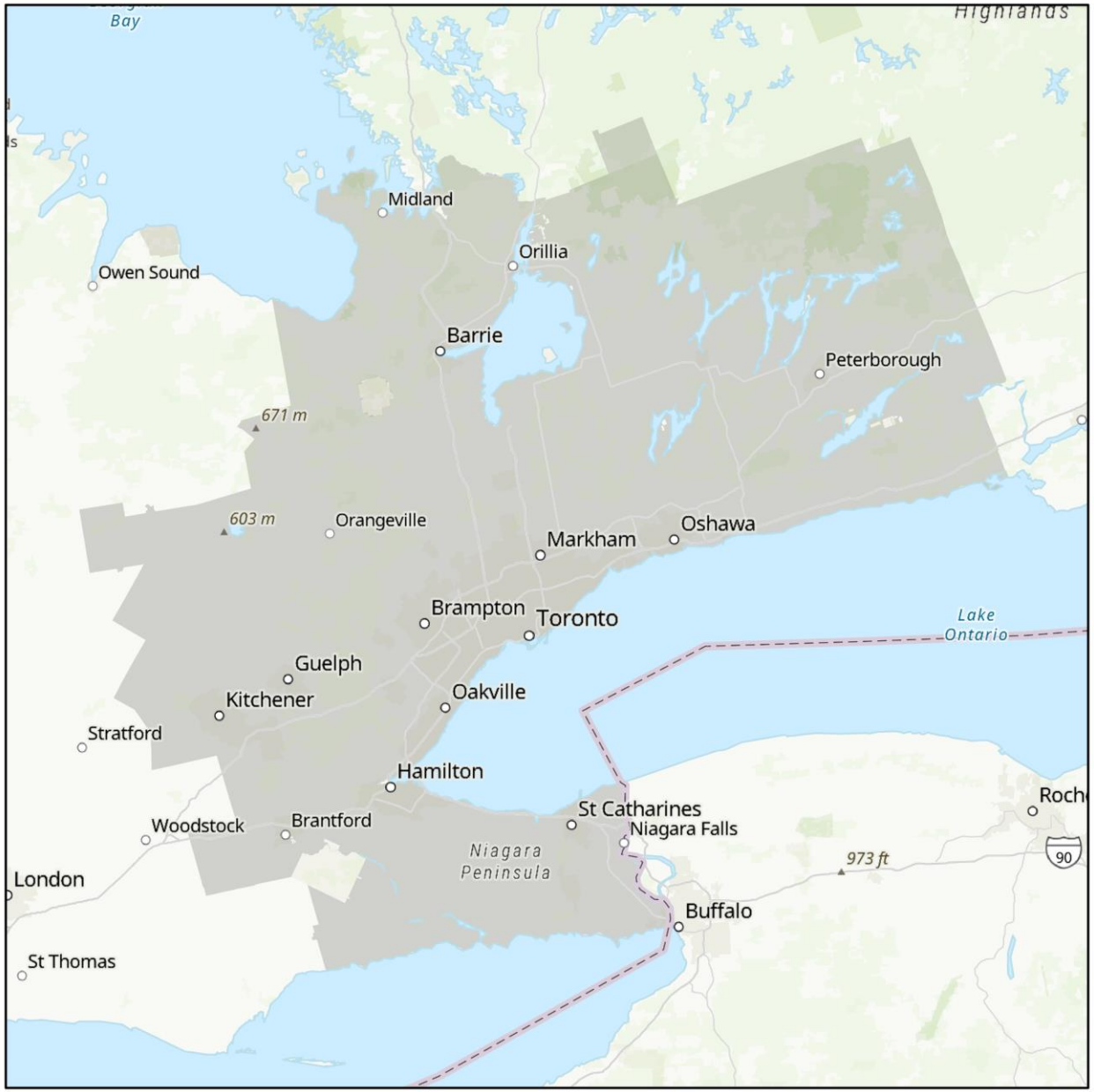
Trent Aquatic Research Program

Winter Limnology in the Kawarthas

Dr. Nolan J. T. Pearce

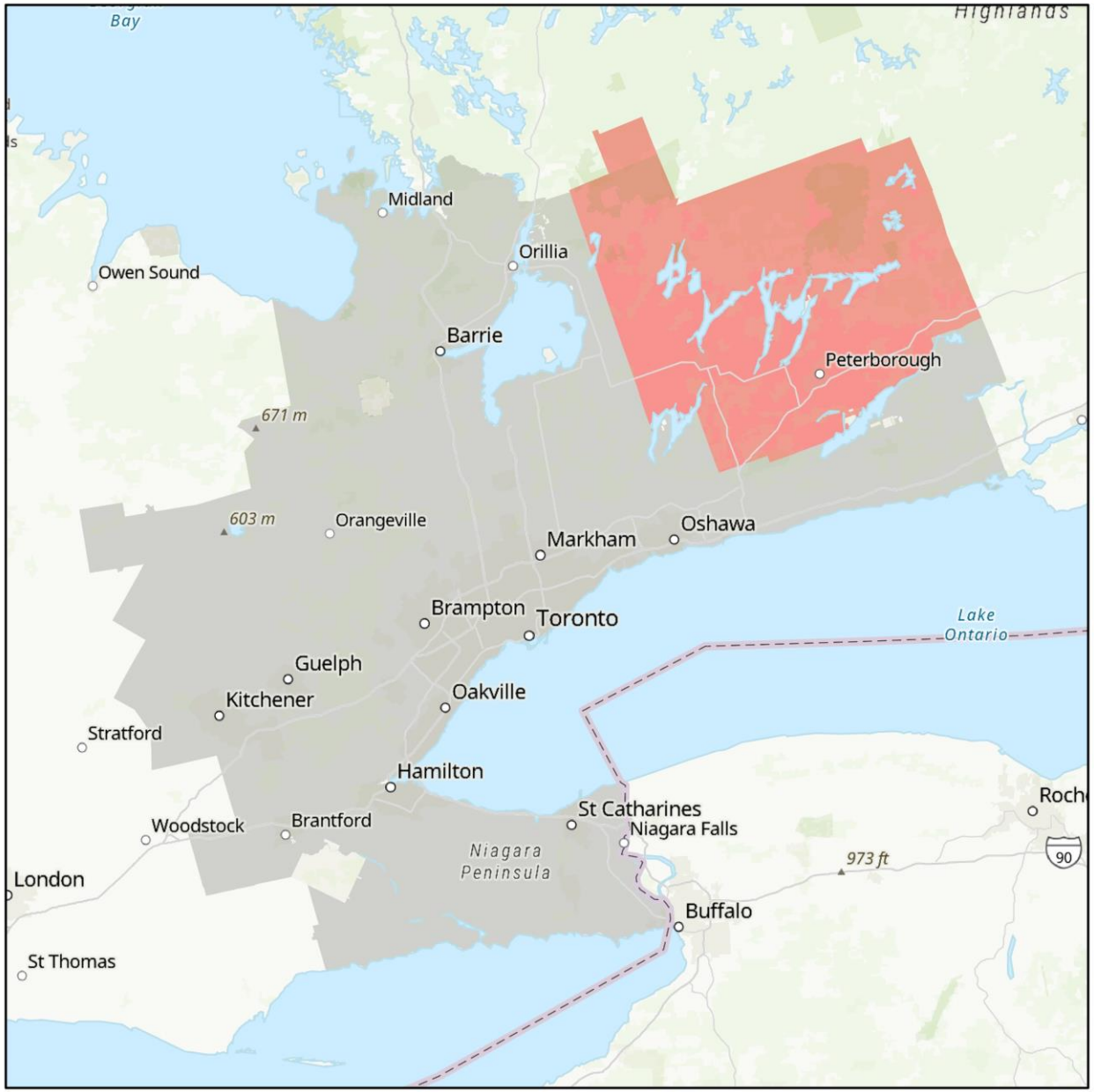

Canada
USA
Canadian Shield
Kawartha Highlands
Lake Huron
St. Lawrence Lowlands
Lake Ontario
Lake Erie
200
km





Greater Golden Horseshoe

- Rapidly growing municipalities, mid-sized centers, small towns and villages, and rural areas
- Boundary of Ontario's Growth Plan

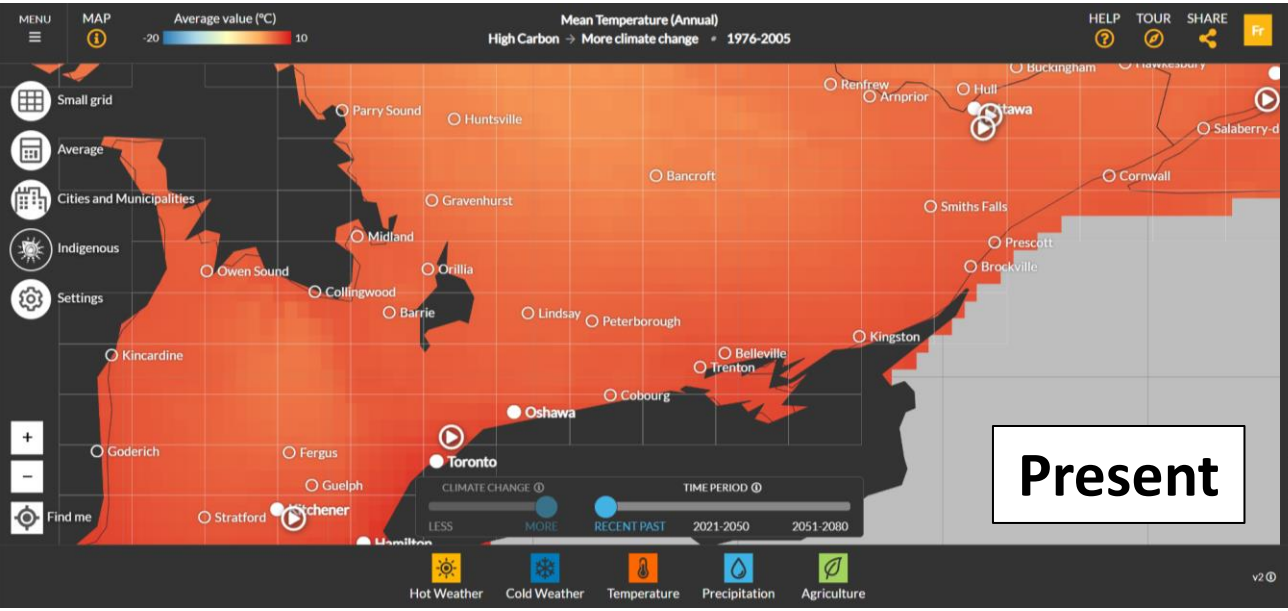


Greater Golden Horseshoe

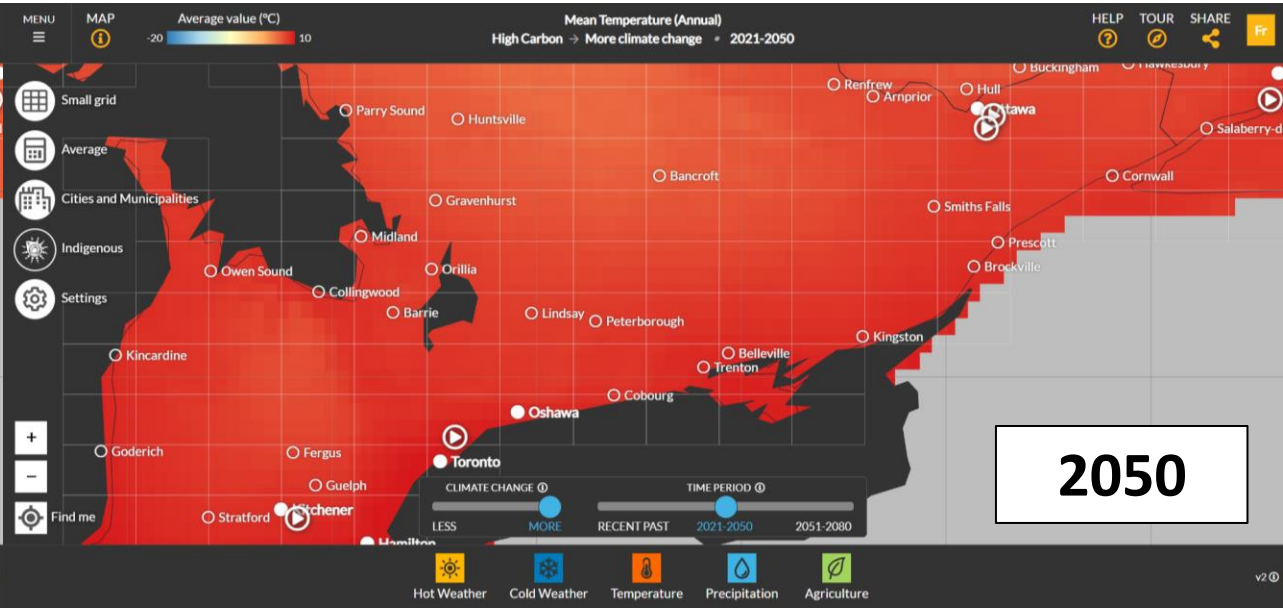
- Growth projections for the Kawarthas
  - ~ 110,000 people by 2050

- ~ 4 million people for the GGH

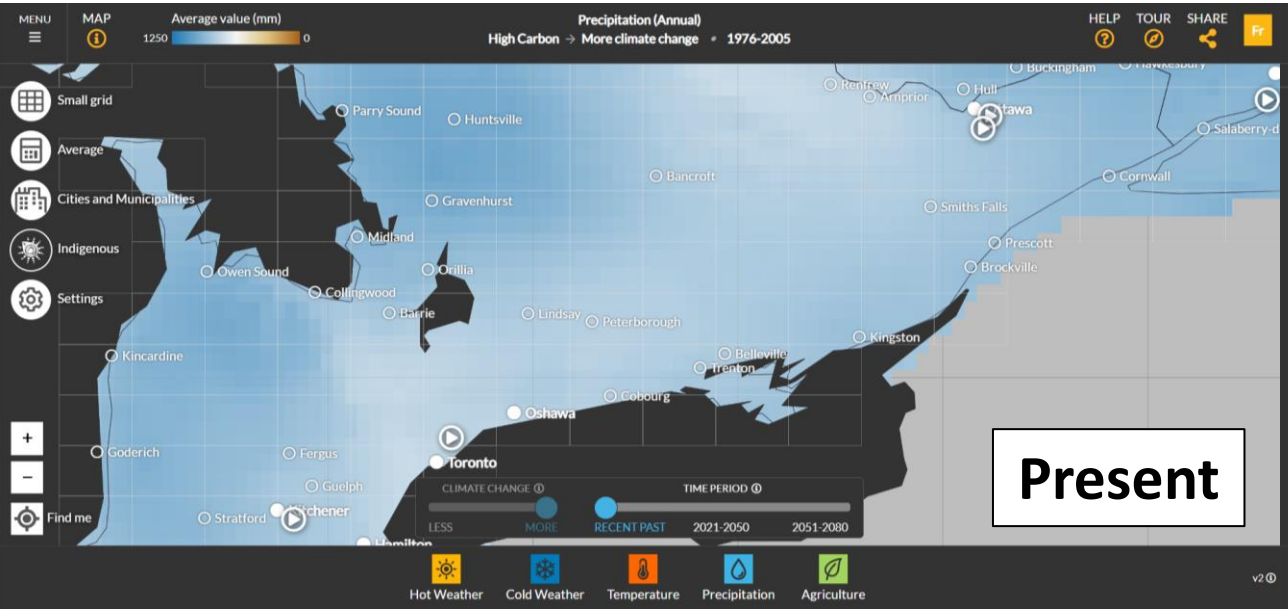
HEMSON CONSULTING LTD. 2020



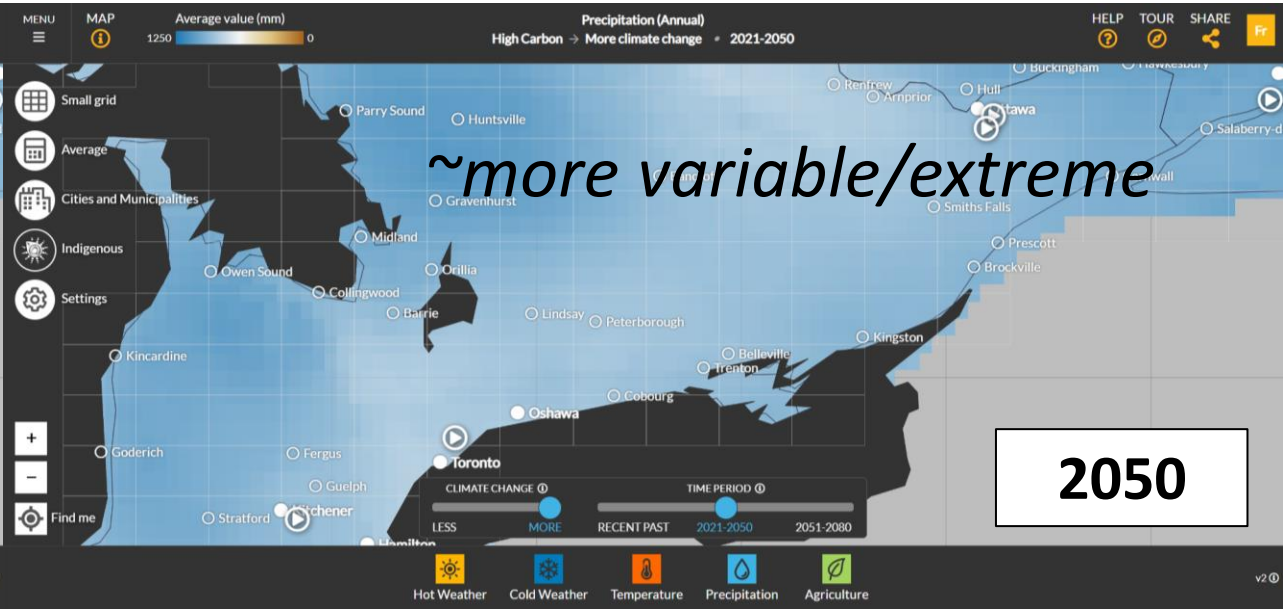
Present



2050



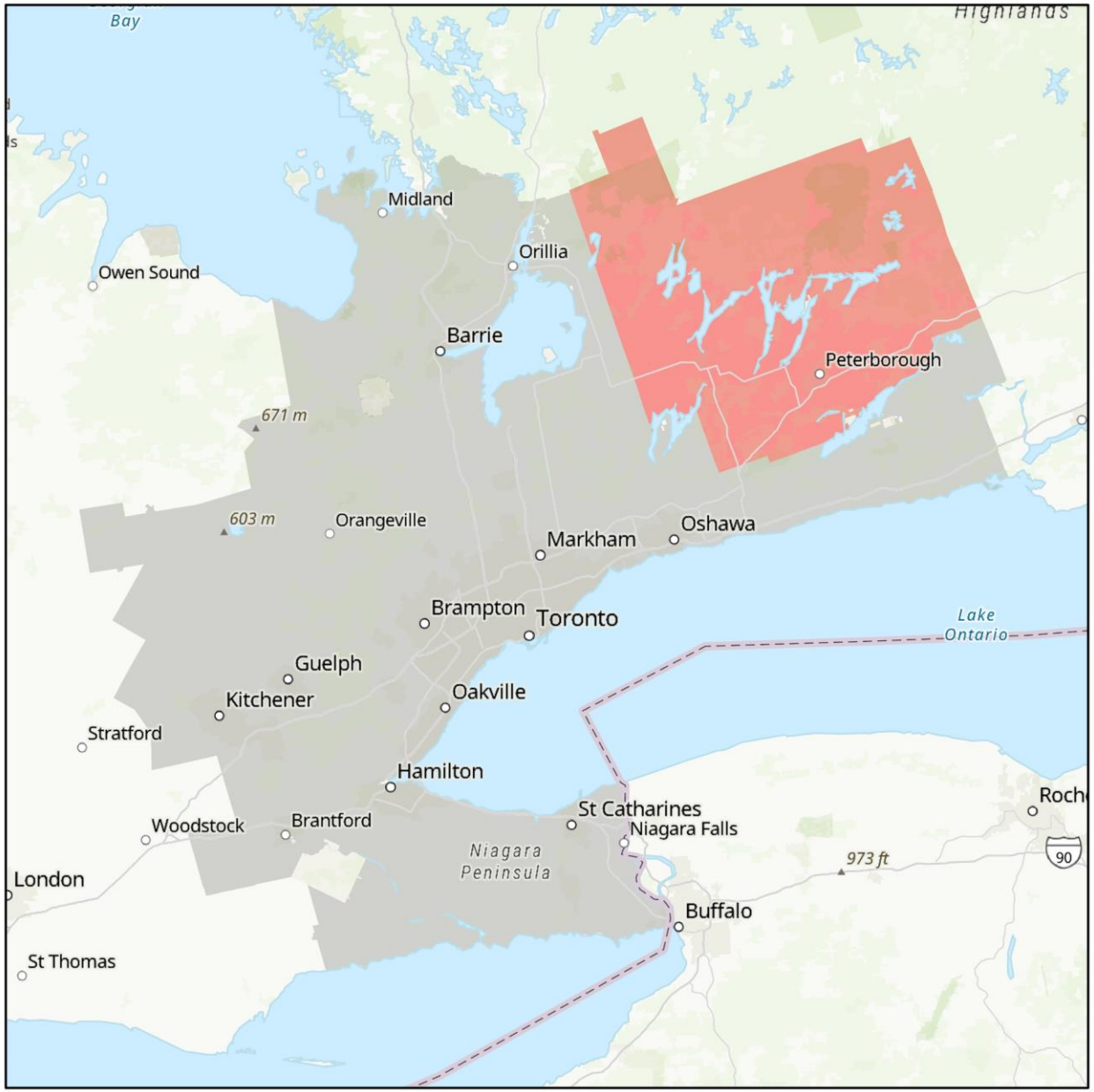
Present



~more variable/extreme

2050

climateatlas.ca



Kawartha Lakes

- Socially, economically, and ecologically important

But threatened by:

- Population Growth
- Land Use Change
- Climate Change

TARP

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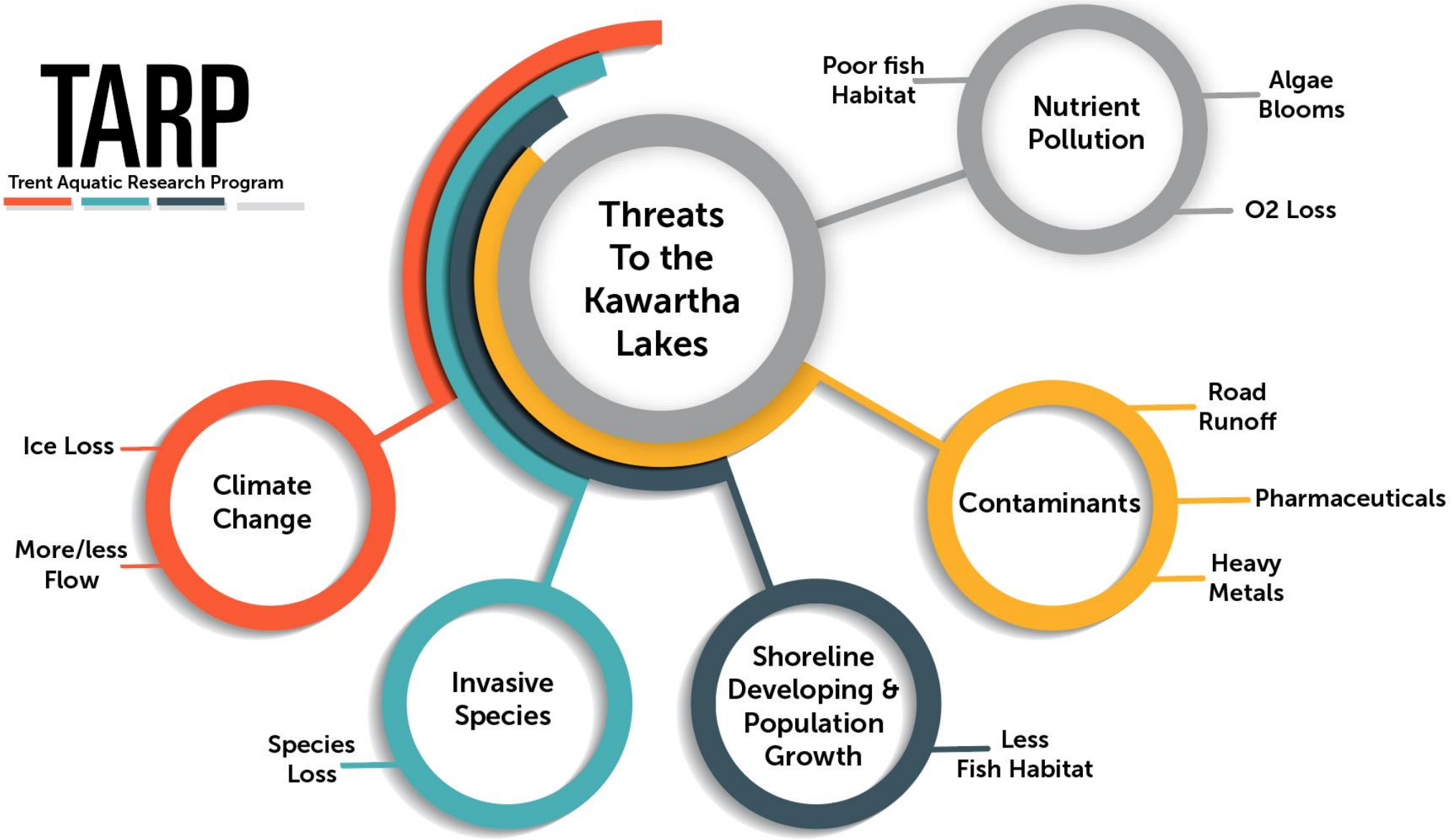
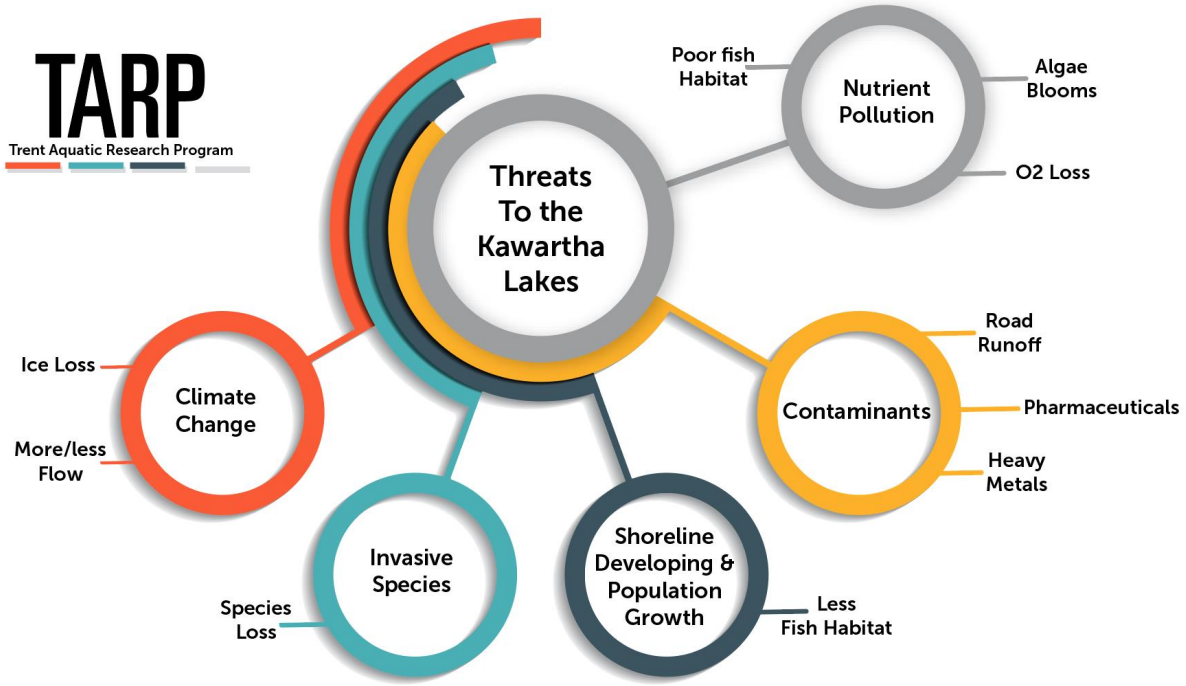


Long-Term Ecological Monitoring

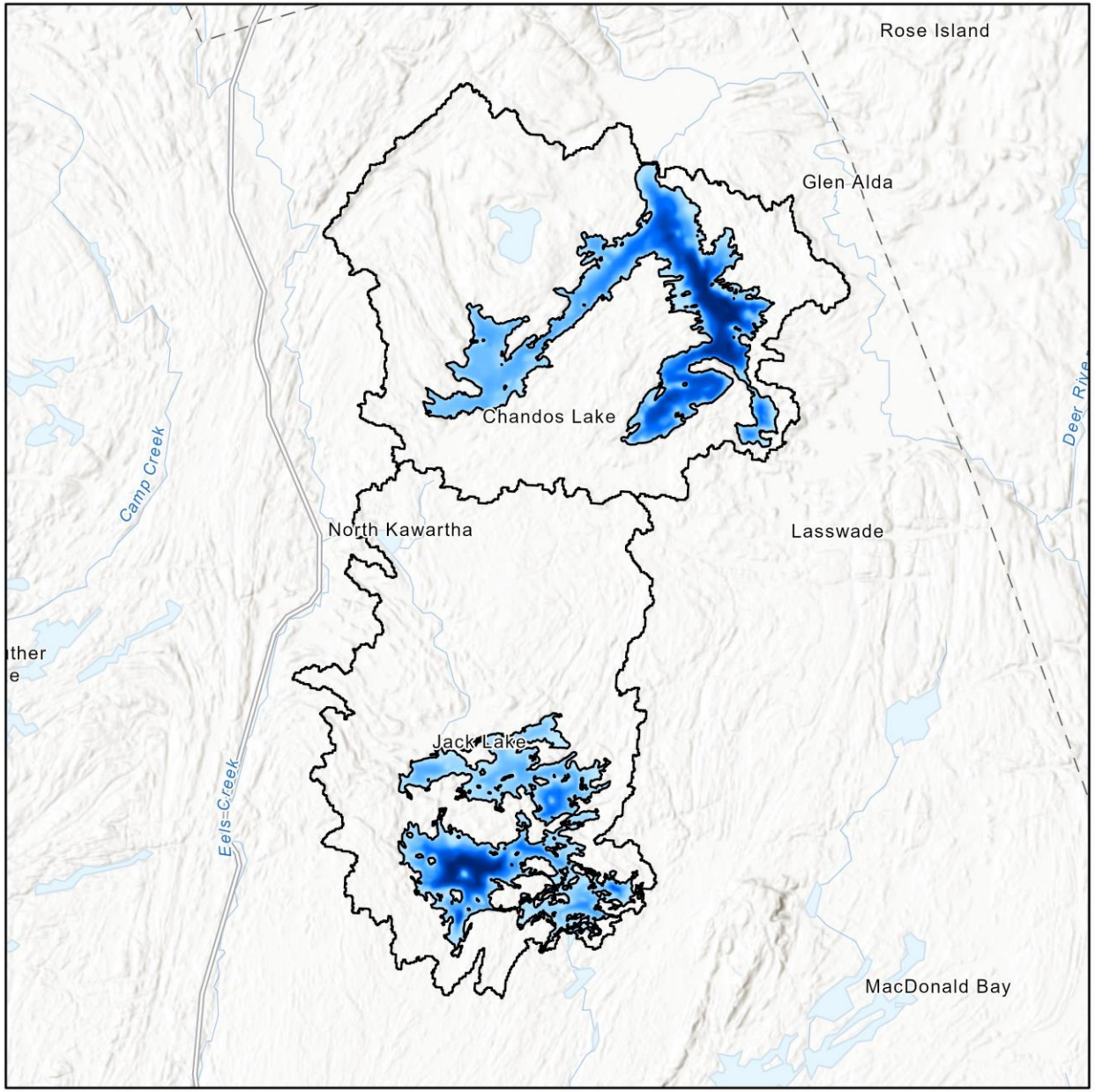
- Systematic repeated measurement of ecosystem conditions (e.g., water quality)
- Used to assess the heath of lakes and diagnose potential issues
- Provide a baseline to evaluate the changing status of ecosystem structure, ecological processes, and the services these ecosystems provide

- **Education and outreach**

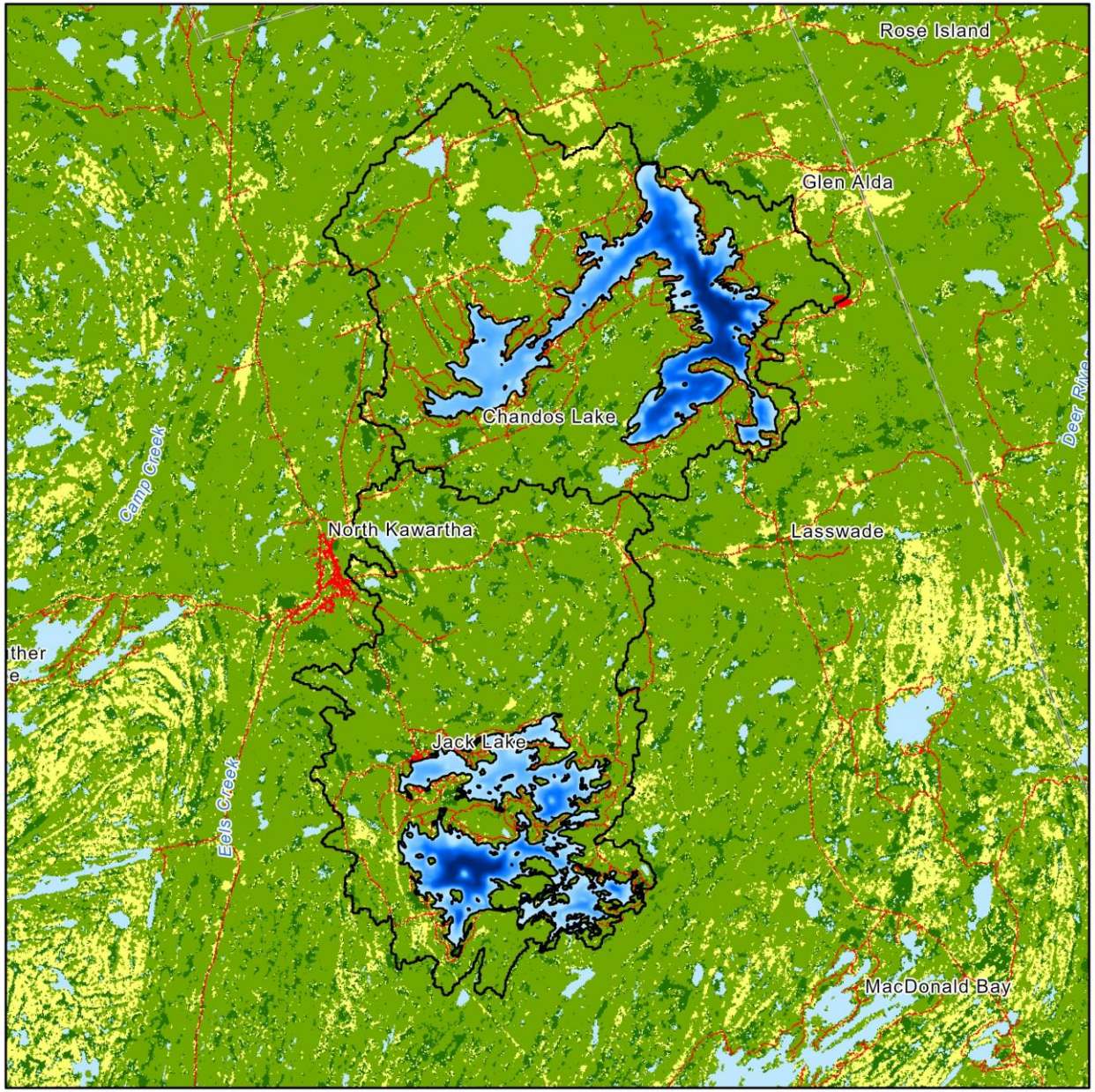


specific conductivity	µS/m
dissolved oxygen, concentration	mg/L
dissolved oxygen, percent saturation	%
water temperature	°C
Secchi depth	m
pH	
total suspended solids	mg/L
dissolved organic carbon	mg C/L
absorbance at 280 nm, in absorbance units	m^{-1}
molar absorptivity at 280 nm	L mol C^{-1} cm^{-1}
total phosphorus	µg P/L
soluble reactive phosphorus	µg P/L
particulate phosphorus	µg P/L
total dissolved nitrogen	mg N/L
nitrate	mg N/L
ammonium	mg N/L
chlorophyll a	µg/L
dissolved calcium	mg Ca/L

- Annual (summer) monitoring of about 35+ lakes
  - Since 2015
- Measure water quality and various limnological variables
  - **Dissolved oxygen**
  - Nutrients (nitrogen and **phosphorus**)
  - **Algae** biomass
  - And many more…
- Facilitate hypothesis driven research projects with collaborators and graduate students



- Spatial analysis of lake physiography
  - Bathymetry, surface area, volume, residence time etc.
- Watershed delineation and characterization
  - Land cover
  - Surficial geology and soil type



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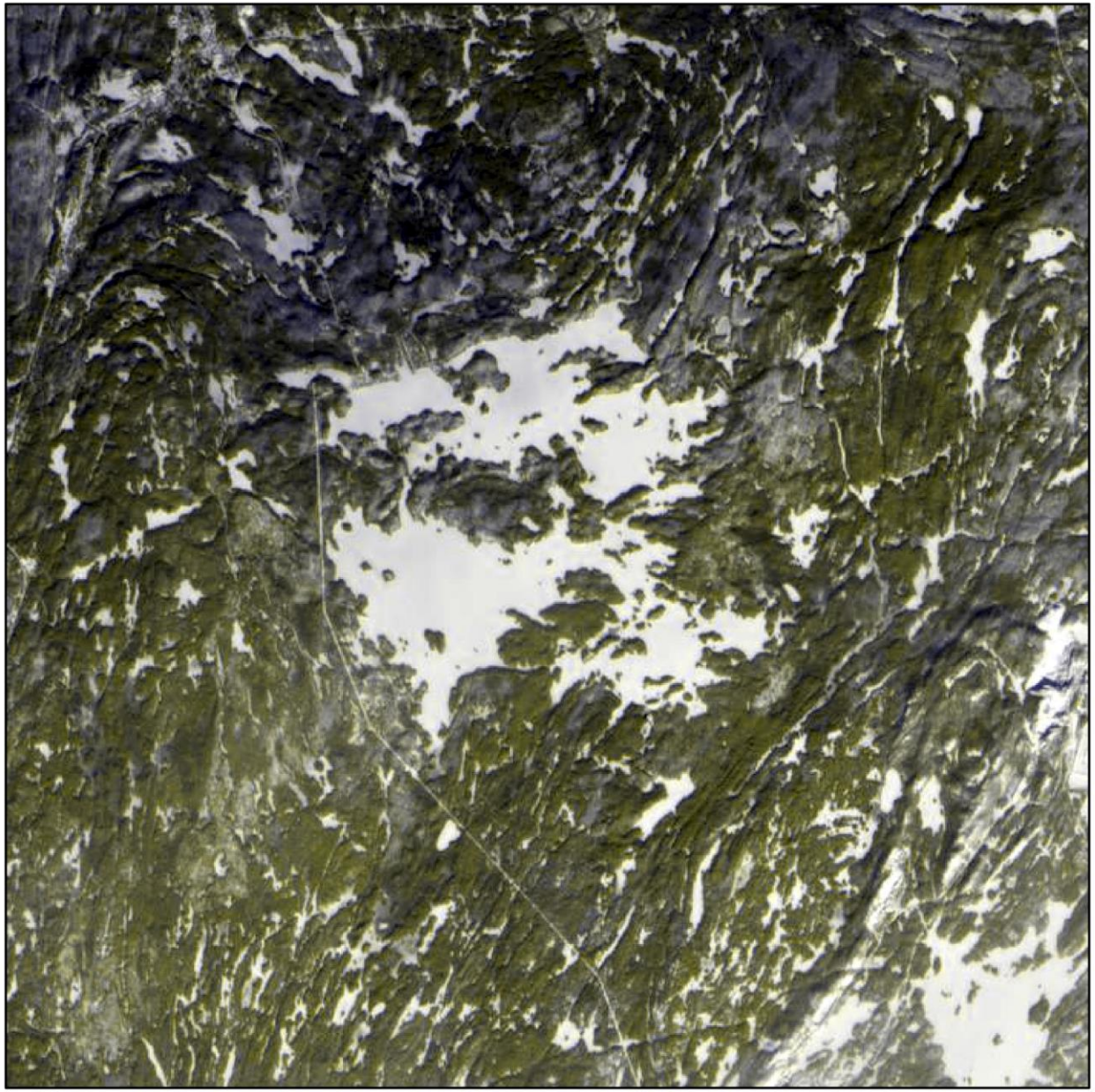
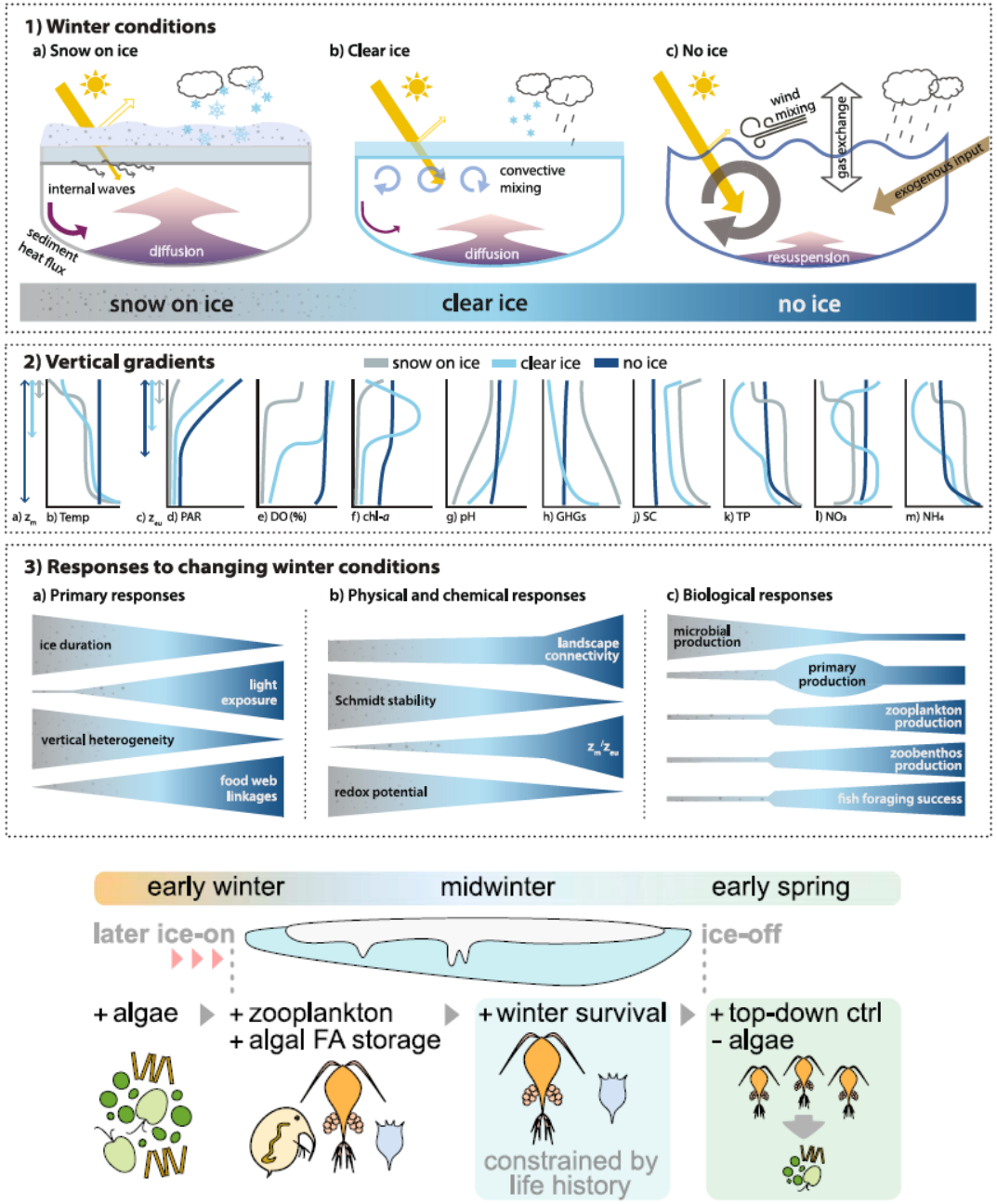
- **Aquatic ecosystems are a product of their watersheds!**



Winter Limnology

- Winter is changing
  - Ice on later – ice off earlier
  - Ice thickness and snow pack
  - Increased stratification duration

- **Largely understudied!**



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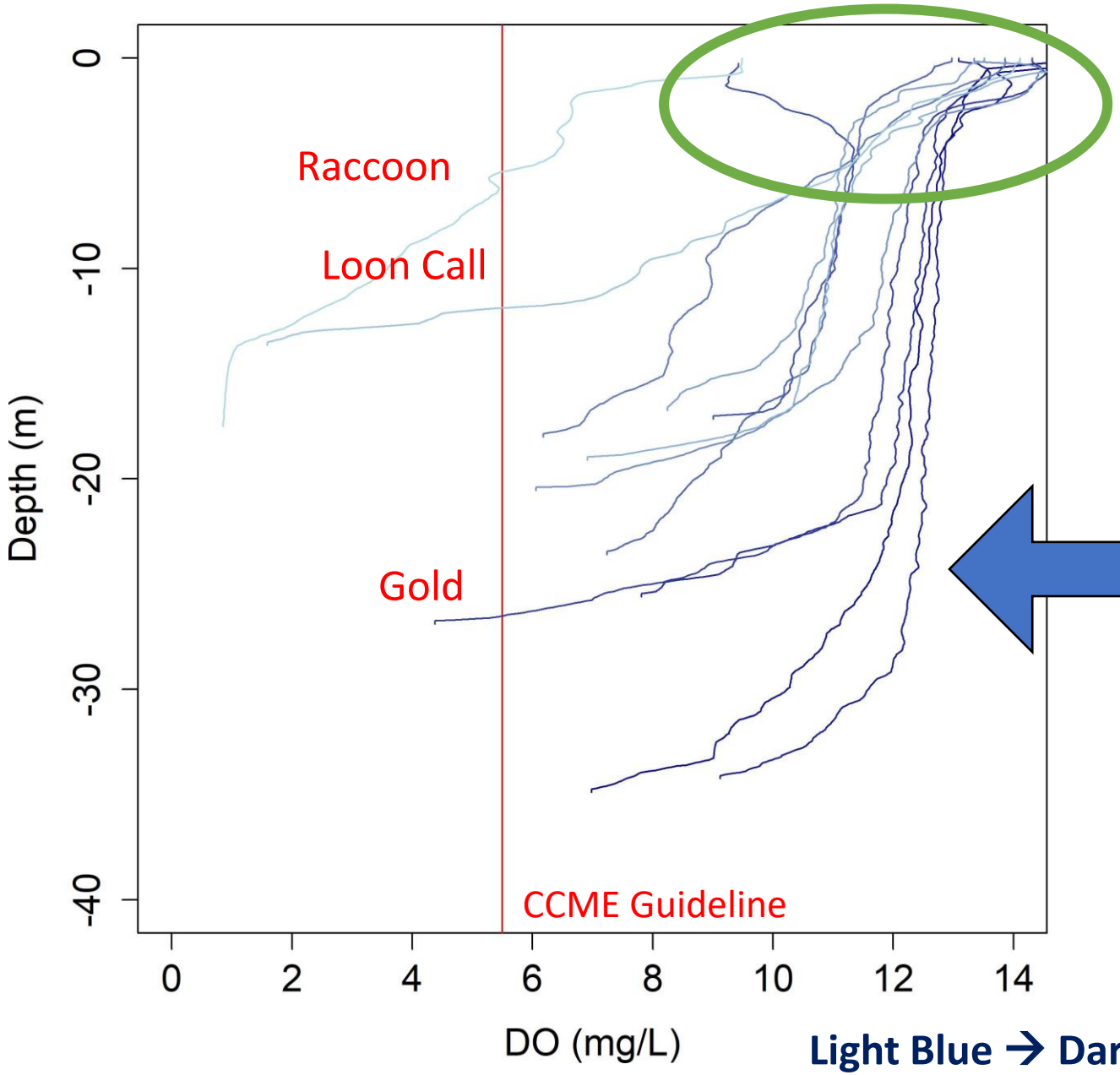
- Consequences for physical, biological, and chemical processes in lakes
  - Dissolved oxygen depletion
  - Food web instability
    - Community composition
    - Timing of resource availability

Winter Limnology

- To support our monitoring goals, 12 lakes were sampled in the winter of 2022
  - Anstruther, Big Cedar, Bottle, Catchacoma, Gold, Kasshabog, Loon Call, Long, Mississauga, Pencil, Raccoon, Salmon
- Provide a baseline of winter conditions
- Investigate spatial differences among lakes with contrasting physical geographies

Winter Limnology

- Vertical Profiles – 5 cm resolution
  - Temperature
  - Light
  - **Dissolved oxygen**
  - **Chlorophyll a**
  - Conductivity … etc.
- Water Chemistry
  - 1m below ice 1m above bottom
  - Nutrients (nitrogen and **phosphorus**)
  - Dissolved organic carbon … etc.



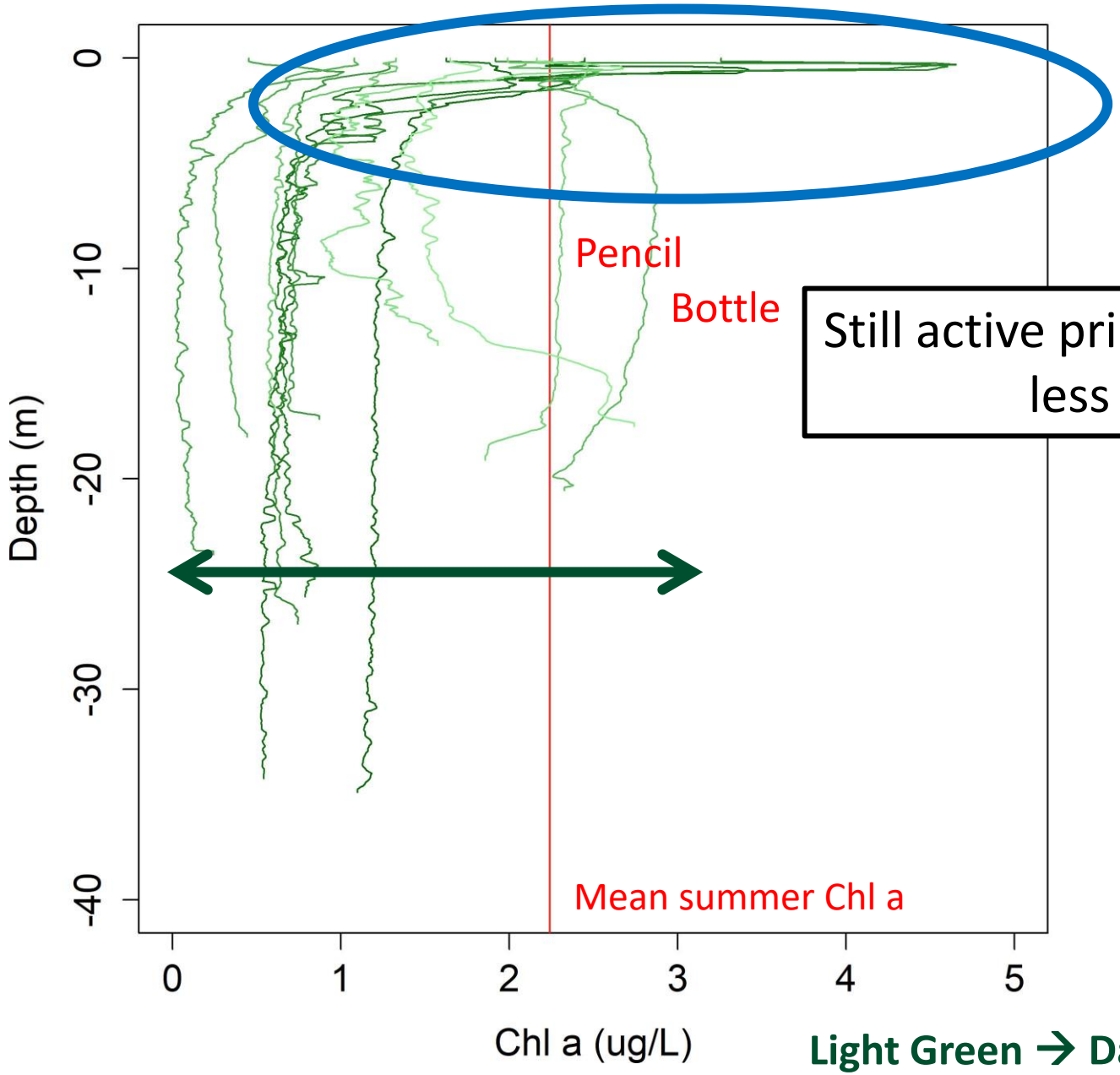
DO peak below the ice

- Primary Production?
- Photosynthesis increase DO during the day

DO declines at the bottom of the lake

- Microbial respiration active in the winter
- Most still have sufficient DO
- Low DO area dependent on lake morphology – might only be a small %
- Some lakes below guidelines
- Drivers? – TBD

Light Blue → Dark Blue = Increasing Volume



Chlorophyll a peak below the ice

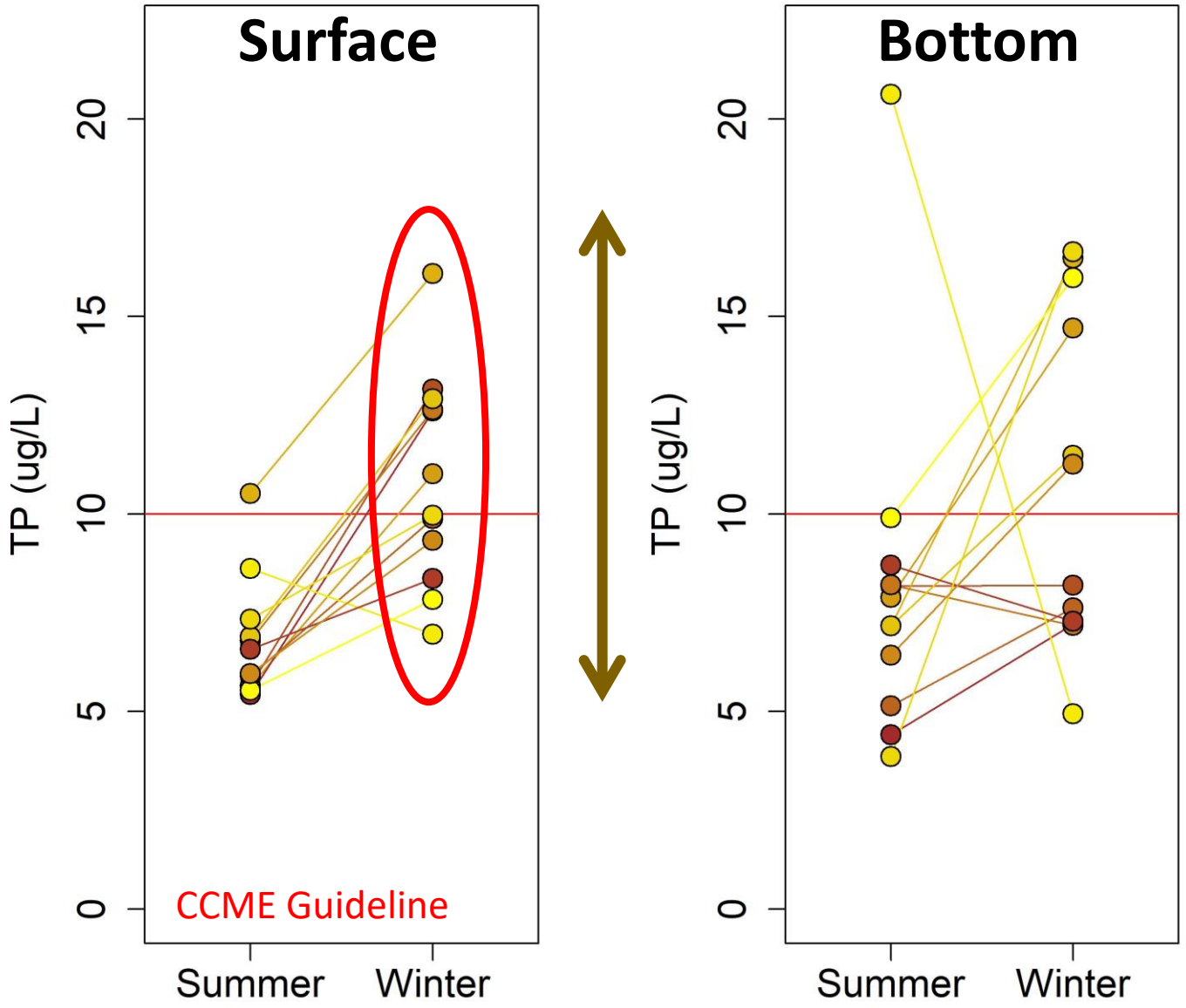
- Corresponds to DO peak
- Sufficient light for some primary producers – but only so far down

Still active primary producers but far less than summer

Spatial variation in chlorophyll a

- Average chlorophyll a varied among lakes
- Most lower than the average summer chlorophyll a
- Peak chlorophyll a is lower than the summer average (12 ug/L)
- Lakes that were higher than average had higher than average chlorophyll a in the summer (~ 3.5 ug/L)

Light Green → Dark Green = Increasing Volume



TP is higher in the winter, particularly at the surface

- Internal P inputs following turnover
- Less uptake by phytoplankton
- Regeneration by microbes
- Need to look closer!

- Some lakes higher than 10 ug/L

More spatial variation in the winter

- Why?
- Implications for spring!

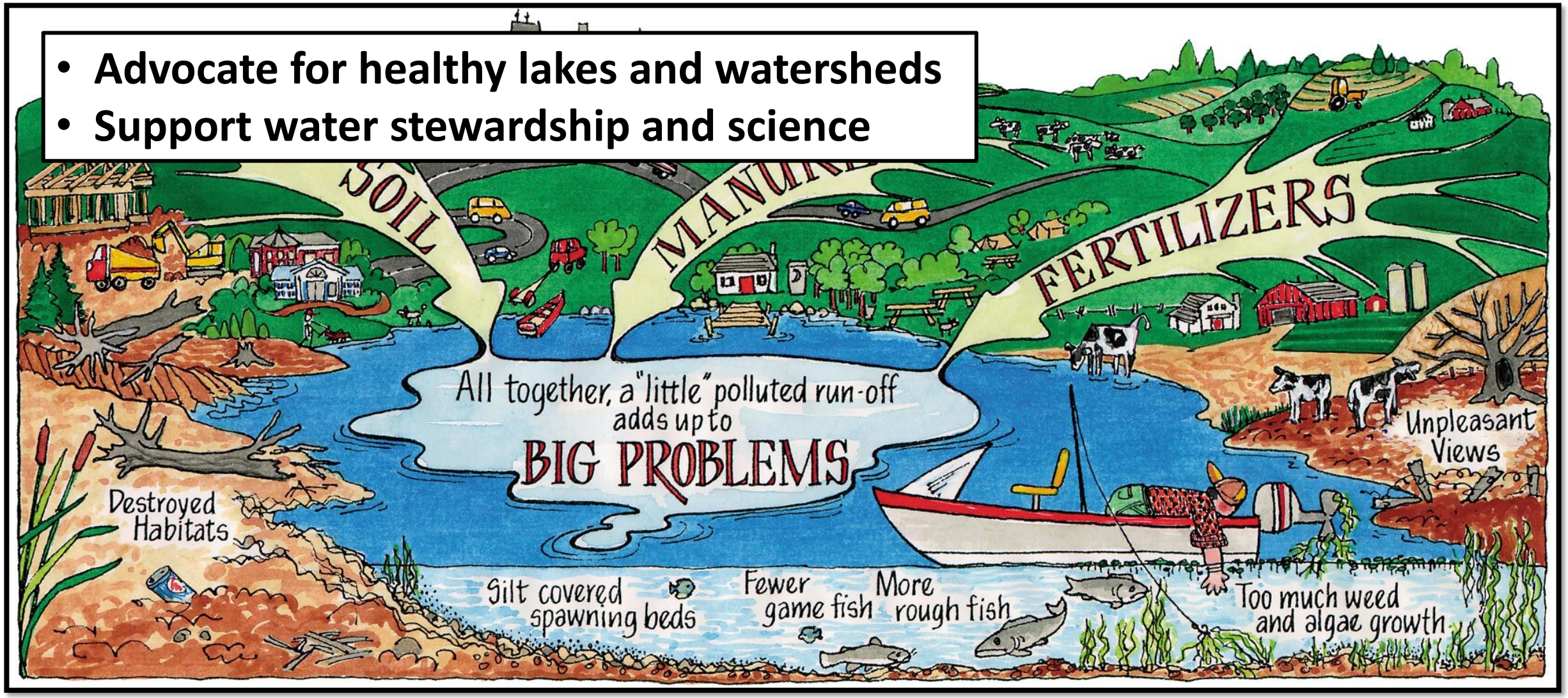
Yellow → Brown = Increasing Volume

Current Work

- Summer monitoring complete – lab work in process
- Graduate student projects
  - Intensive sampling on bottle lake and stoney lake
  - Experimental work on several lakes to investigate drivers of primary production
  - Spatial drivers of Kawartha Lakes limnology
- Standardizing sampling and improving data storage
- Gathering, digitizing, and archiving historic (~1960s onwards) data on the Kawartha Lakes

Publication In Progress – Limnology of the Land Between

- **Advocate for healthy lakes and watersheds**
- **Support water stewardship and science**



https://mycommunity.trentu.ca/tarp

Questions?

NSERC
CRSNG

Canada Foundation for Innovation
Fondation canadienne pour l'innovation

Ontario
Ministry of Natural Resources

New Aquatic Research Program at Trent to Advance Freshwater Conservation in Kawarthas

March 20, 2020

At Trent's annual David Schindler Lecture, Dr. Paul Frost announces new program to educate scientists and community about freshwater ecosystem monitoring

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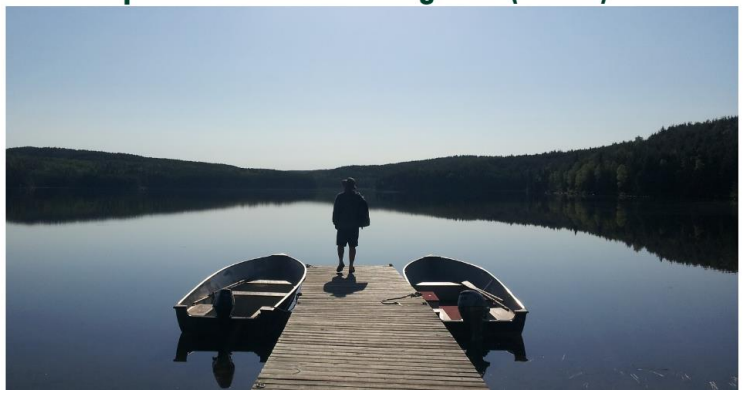

Support TARP

"Water is a defining feature of our region, understanding and protecting its health should be among our top priorities."

Dr. Paul Frost
David Schindler Professor in Aquatic Science