

Small Lakes of the Stony Plain Region -2020 Surveys-

Presented by David O. Trew
Mayatan Lake Management Association AGM
Nov 29, 2020

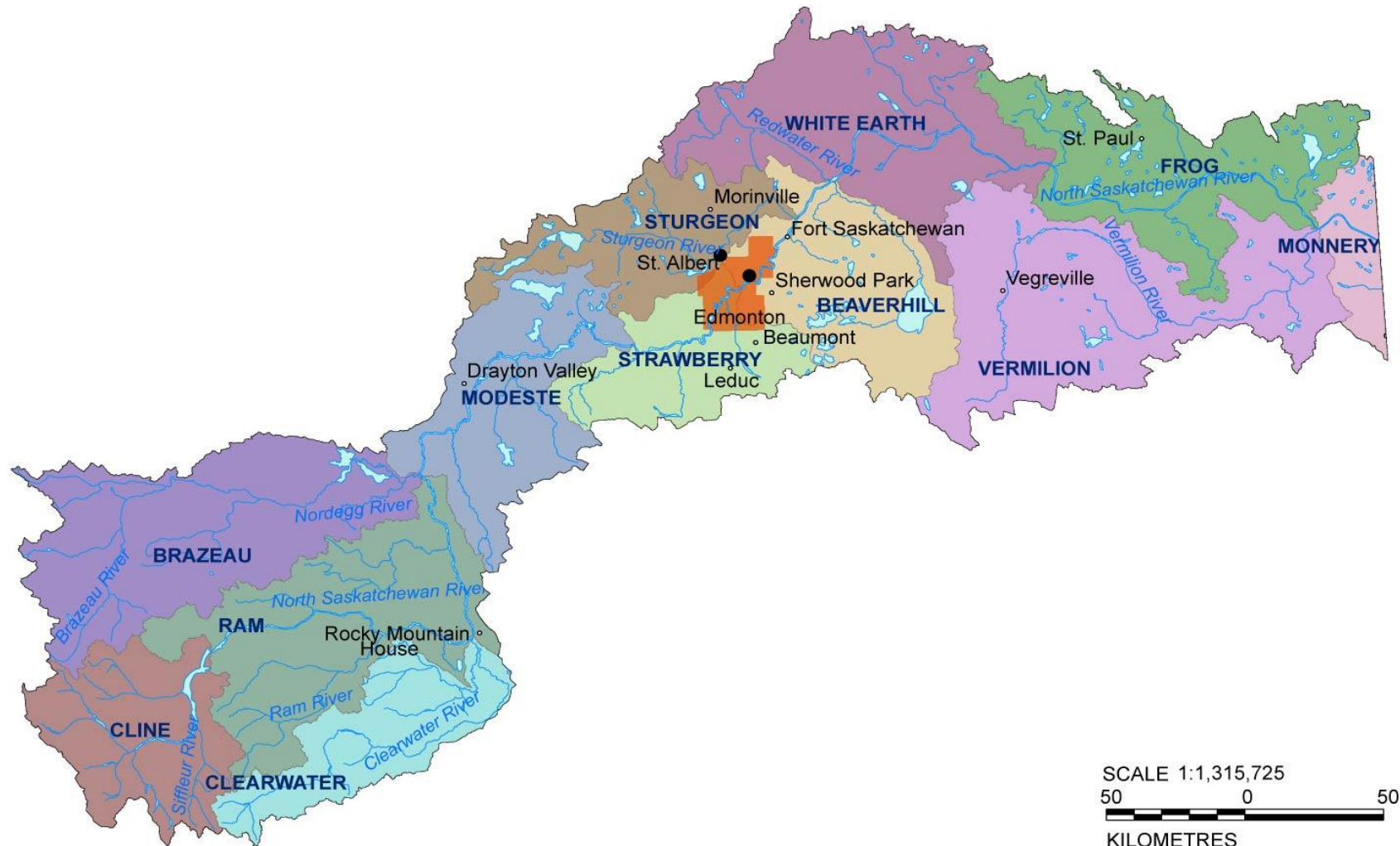


Regional Setting

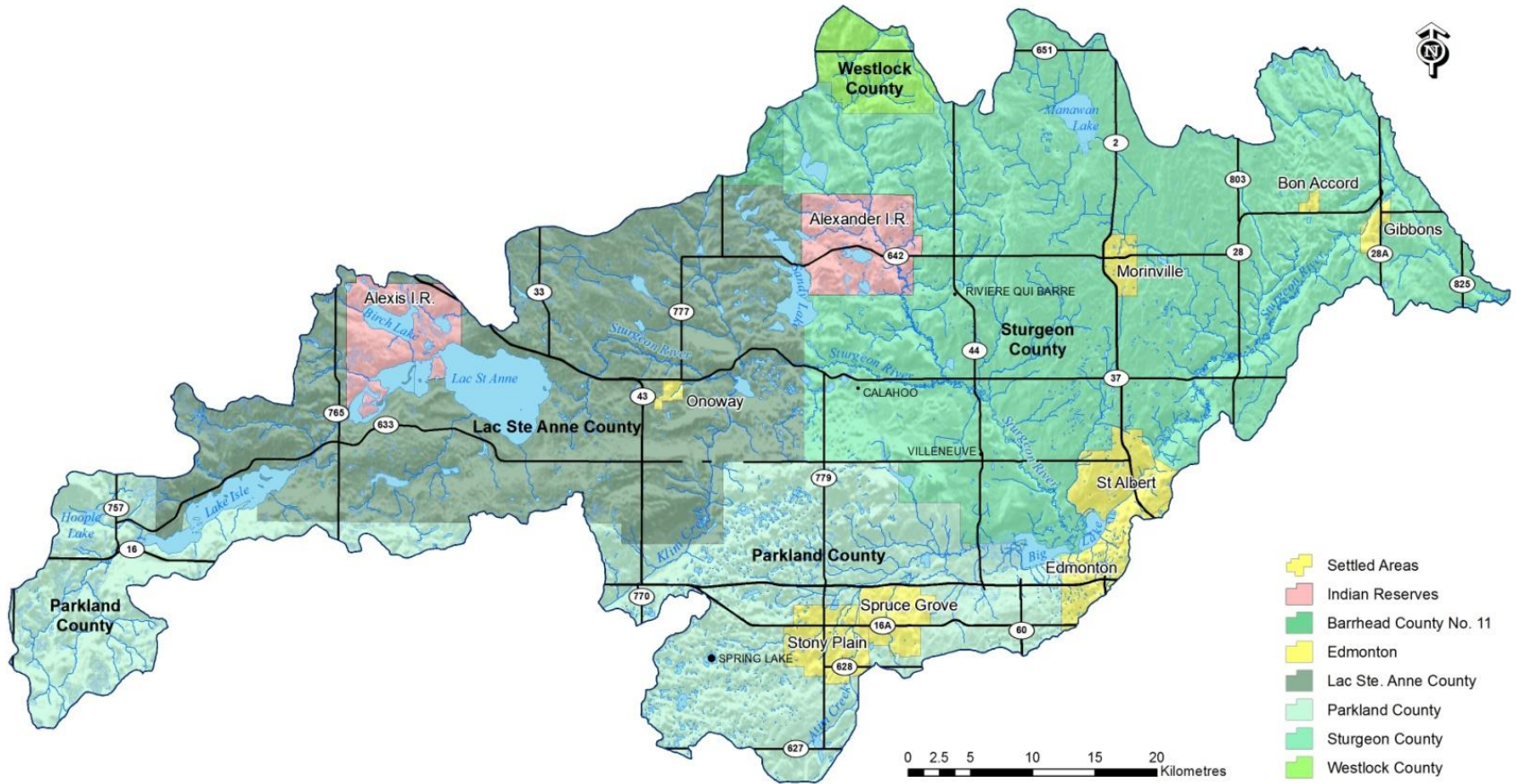
All lakes in this survey are located on the post-glacial landform known as the “Carvel Pitted Delta” which is located north and west of Stony Plain, Alberta

Most of these lakes and their watersheds are also part of the larger Sturgeon River Watershed

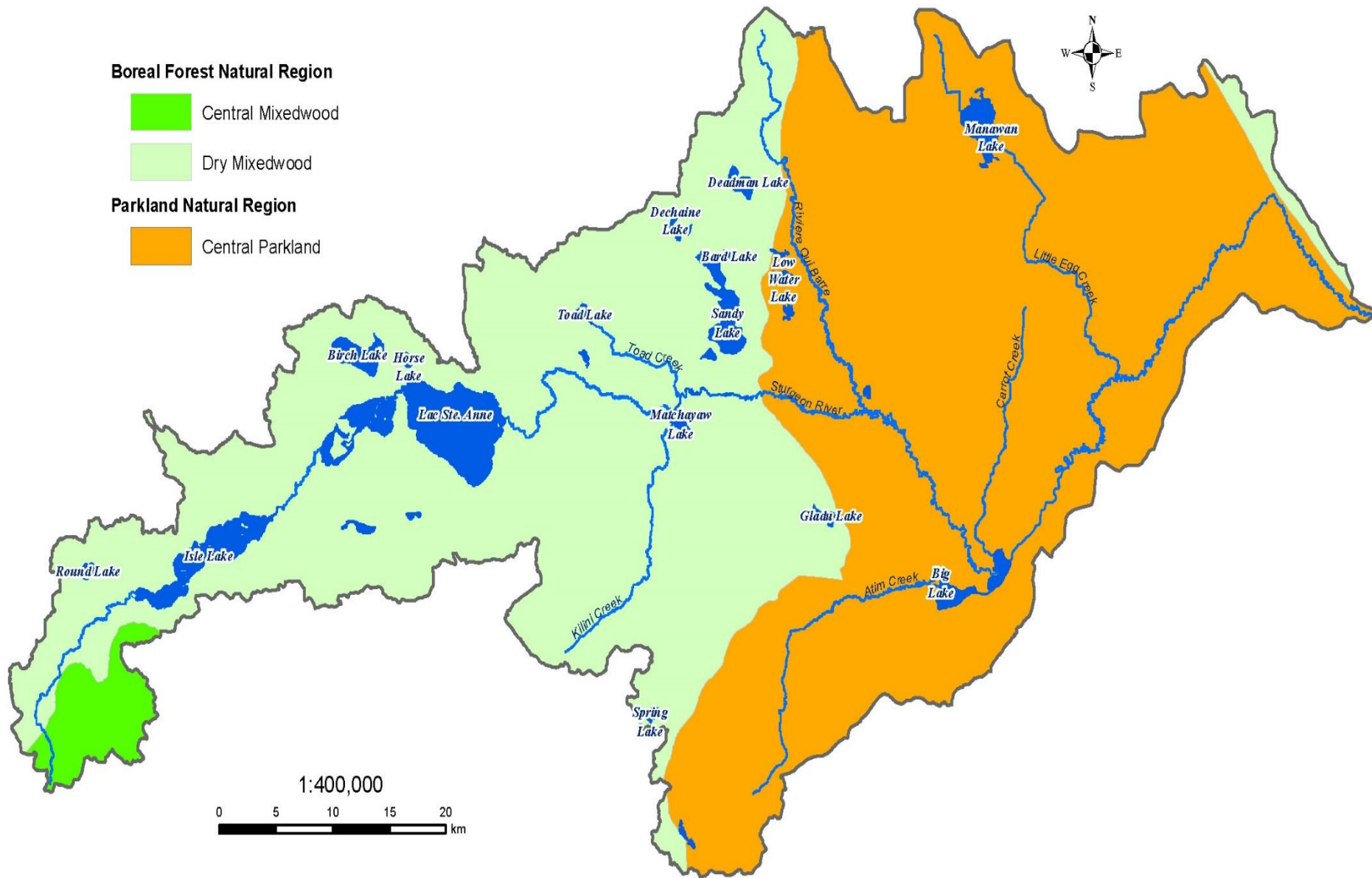
The North Saskatchewan River Basin: Twelve Subwatersheds



Sturgeon River Watershed: Municipalities

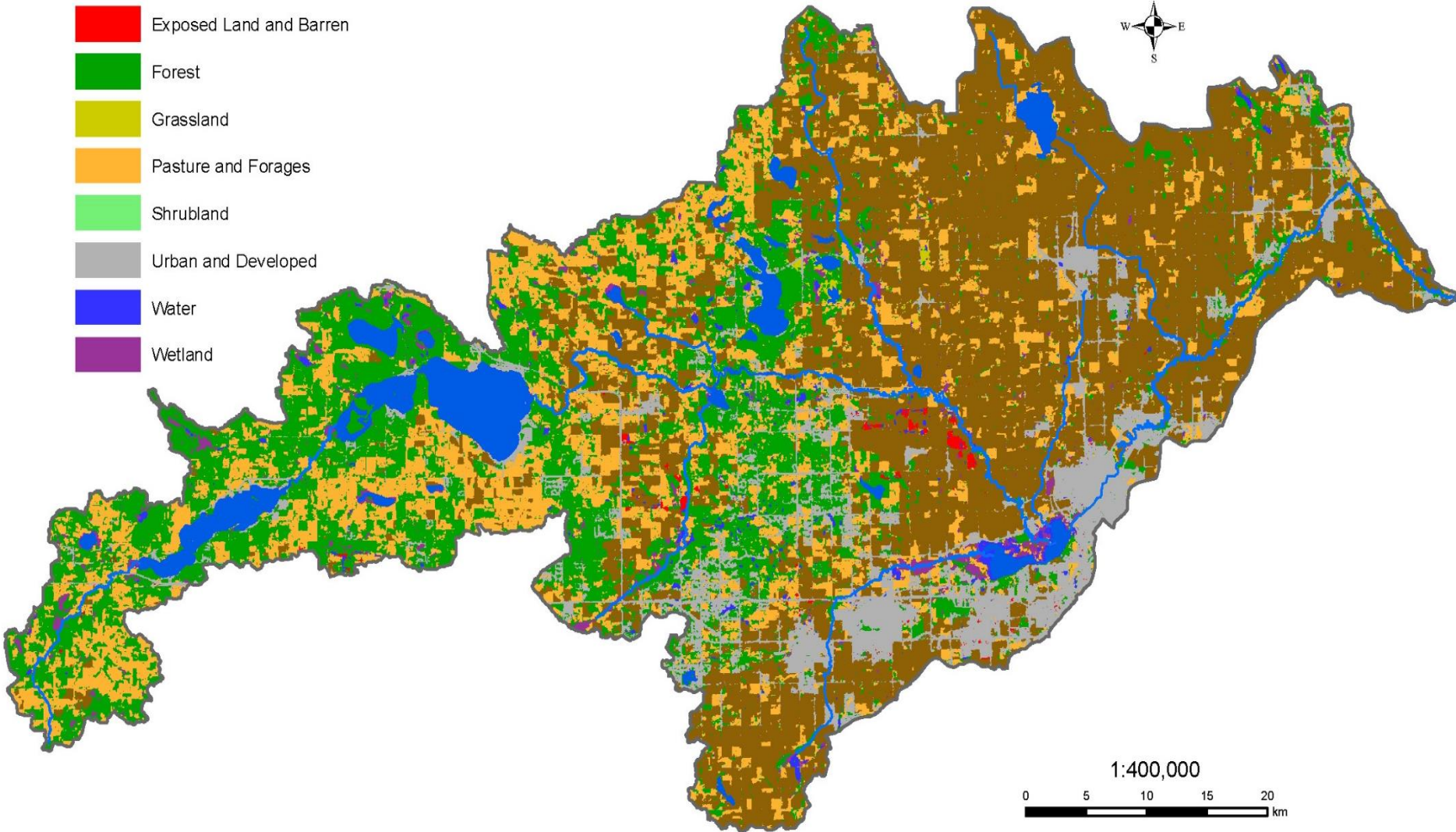


Sturgeon River Watershed: Natural Regions

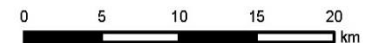


Sturgeon River Watershed: Land Cover

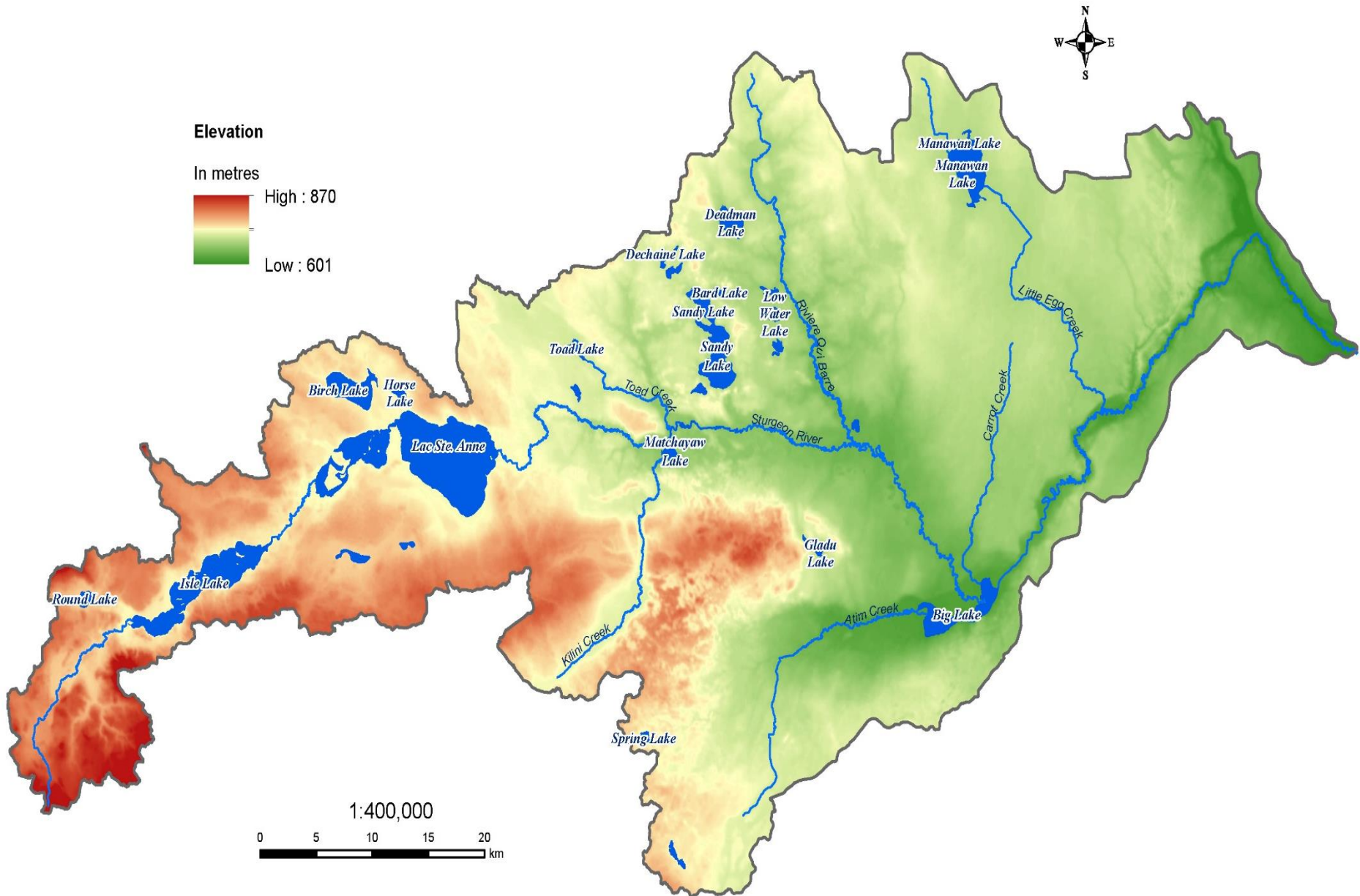
Land Cover Class



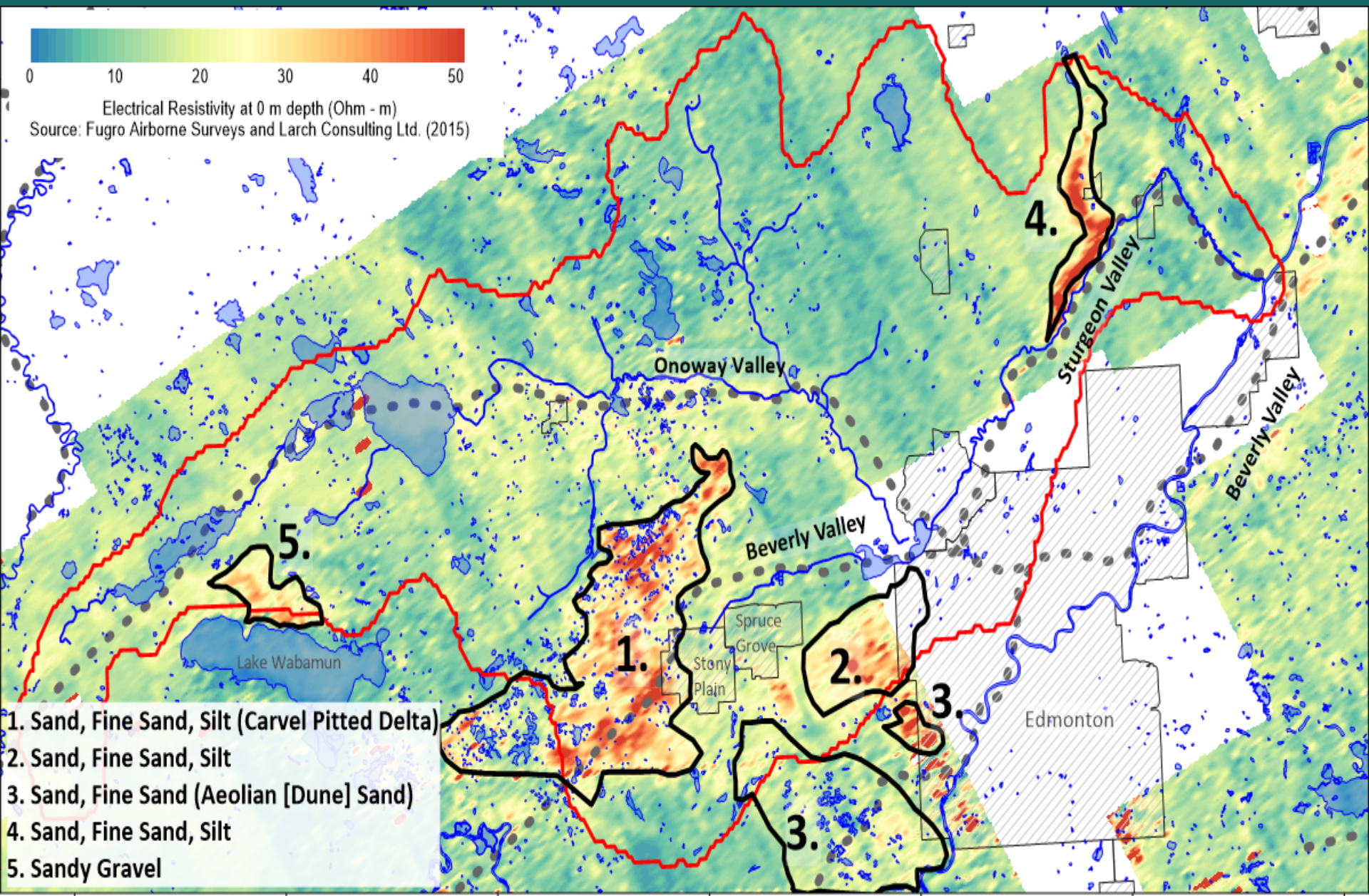
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Sturgeon River Watershed: Topography



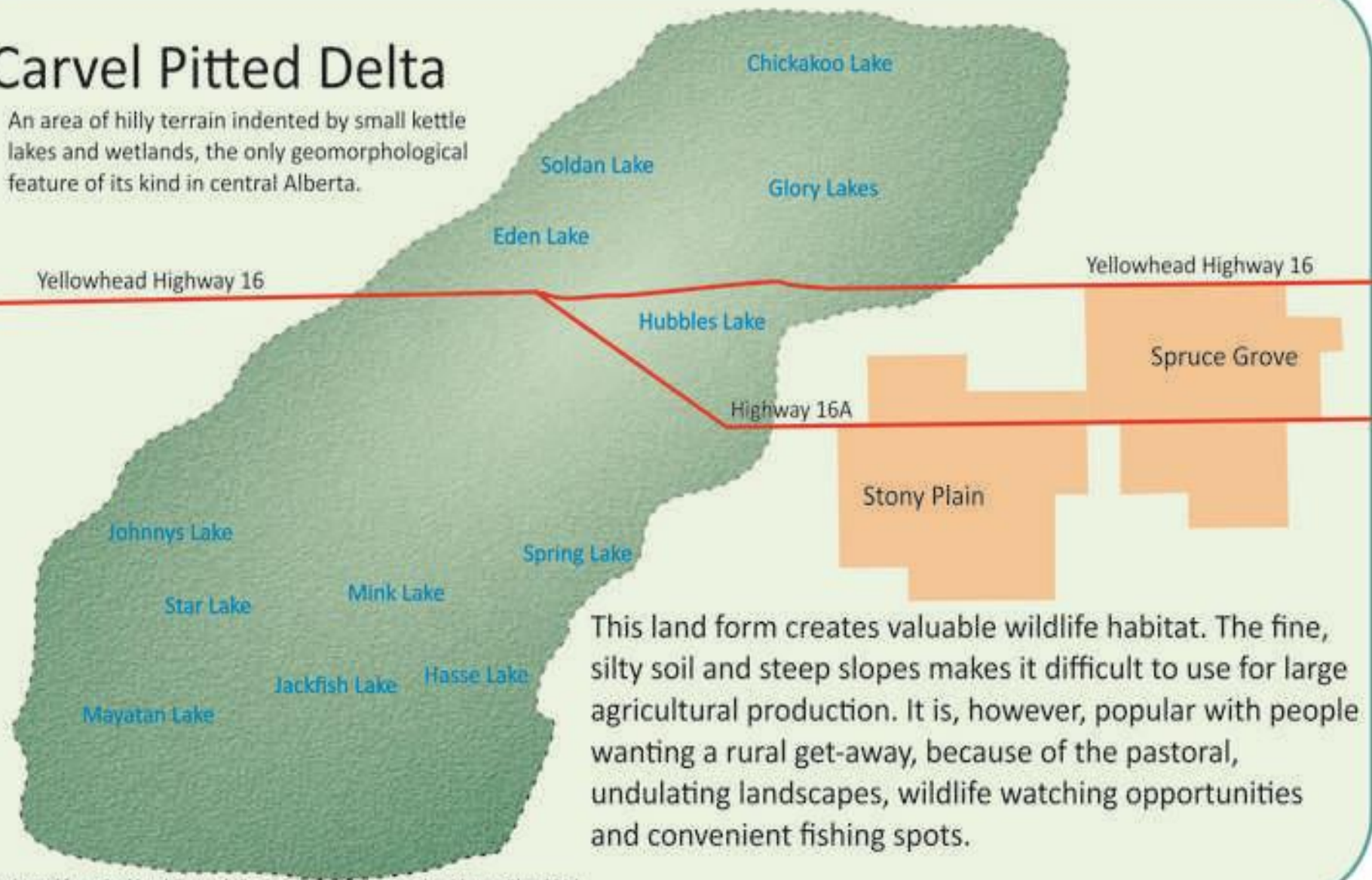
The Carvel Pitted Delta



The Carvel Pitted Delta

Carvel Pitted Delta

An area of hilly terrain indented by small kettle lakes and wetlands, the only geomorphological feature of its kind in central Alberta.



This land form creates valuable wildlife habitat. The fine, silty soil and steep slopes makes it difficult to use for large agricultural production. It is, however, popular with people wanting a rural get-away, because of the pastoral, undulating landscapes, wildlife watching opportunities and convenient fishing spots.

The Carvel Pitted Delta

More information on this post-glacial landform and its unique hydrogeology can be found in the following NSW technical report:

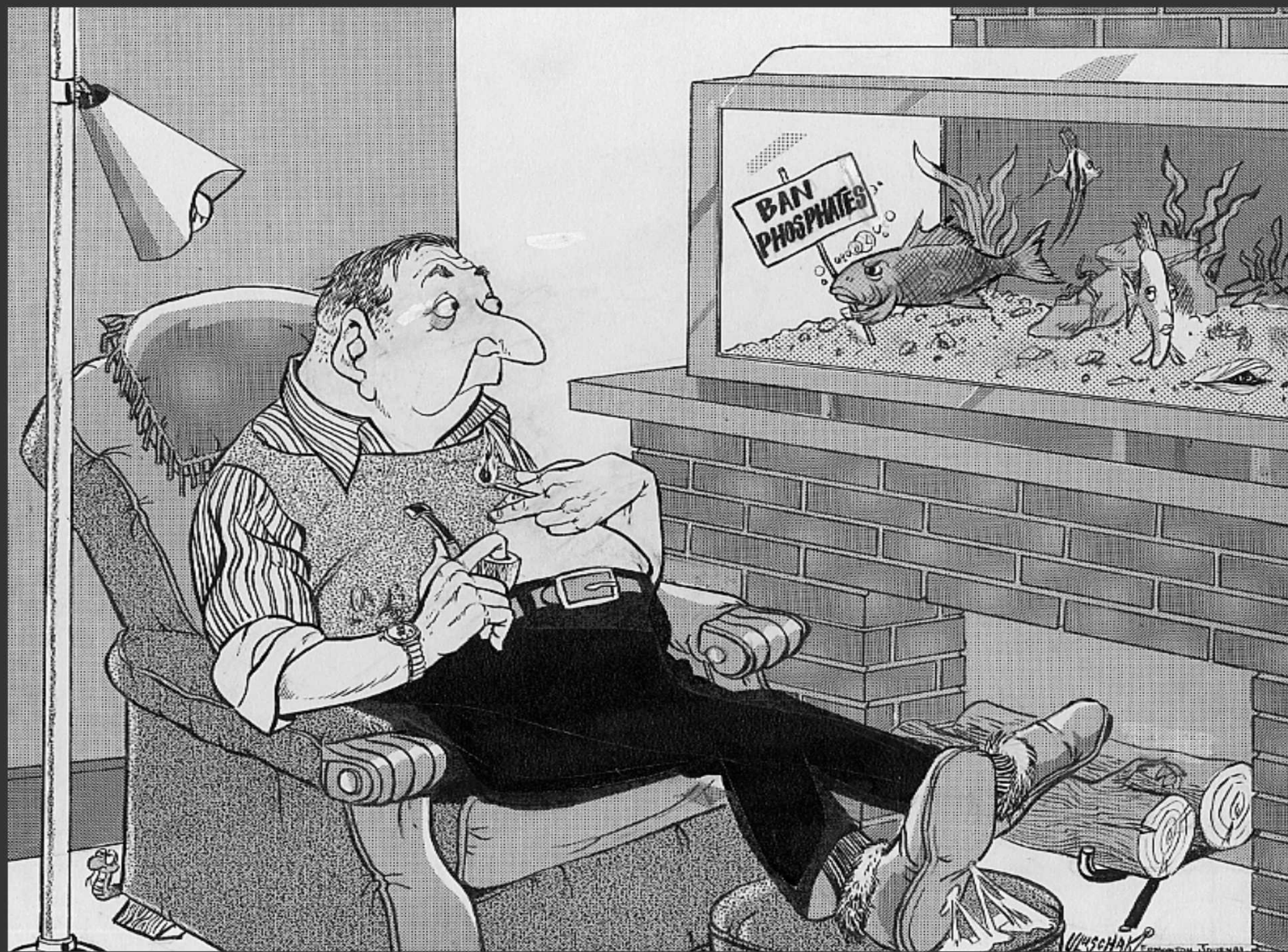
Summary of Groundwater Conditions in the Sturgeon River Basin (Alex Oiffer, 2019)

<https://www.nswa.ab.ca/resource/groundwater-conditions-sturgeon-river-basin/>

Alberta Lakes

Alberta lakes have been the subject of much scientific study over the past 70 years. Most of the research has been conducted to support fisheries and water quality management

The following editorial cartoons were published by Ed Ulaschuk (Edmonton Journal) in 1970, and illustrate that lakes and water pollution have been common topics of interest in Alberta for some time!





"We carry the latest fishing equipment... Geiger counters, mercury content meters, phosphate level indicators..."

Alberta Lake Studies – Brief History

- ◆ Dr. R. B. Miller (U. of A.)
 - *"Preliminary Biological Surveys of Alberta Watersheds"* (1949)
- ◆ Dr. M. Paetz (Fisheries Branch), Dr. J. Nelson (U. of A.)
 - *"Fishes of Alberta"* (1970)
- ◆ Provincial fisheries biologists collected basic lake morphometry and water quality data during regional fisheries surveys and as part of the *"CLI-ARDA"* programs (1960s-70s)

THE FISHES
OF
ALBERTA

PAETZ
NELSON

FIRST EDITION

Alberta Lake Studies – Brief History

- ◆ Alberta Research Council
 - Lake chemistry surveys (1950s-60s)
- ◆ Canadian Wildlife Service, University of Calgary
 - Dr. R. S. Anderson - Alpine lakes (1960s-70s)
- ◆ University of Alberta (Faculty and Students)
 - Drs. Kerekes, Hickman, Gallup, Nursall, Gorham (1960s-80s)
 - Drs. Prepas, Schindler, Vinebrooke (1980s-2020s)

Alberta Lake Studies – Brief History

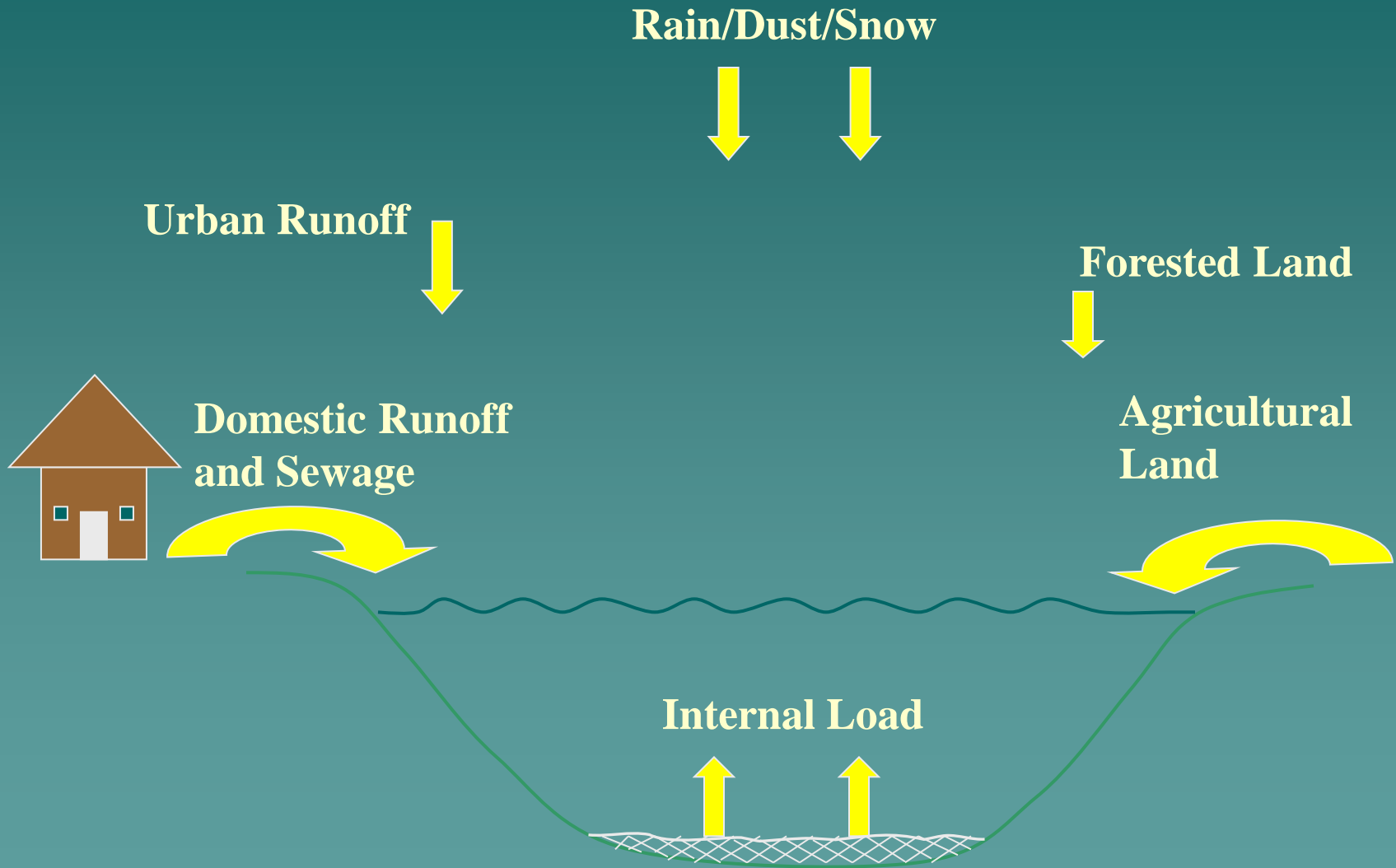
- ◆ Alberta Environment (1970s-2020s)
 - Lake water quality and trophic assessments
 - Watershed studies and lake nutrient budgets
 - Cyanotoxicity research
 - Long-term water quality monitoring networks
 - Lake acidification studies
 - Bathymetry and lake level monitoring
- ◆ Alberta Lake Management Society (1990s-2020s)
 - Monitoring, Citizen Science, Education
- ◆ WPACS and WSGs "*Water for Life*" (2003-2020s)
 - Lake State of Watershed Reports
 - Lake Watershed Management Plans

Algal growth in Alberta lakes is influenced by nutrient supply (phosphorus, nitrogen)





Phosphorus Sources - Alberta Lakes



Mayatan Lake Management Association

- ◆ The MLMA approached the North Saskatchewan Watershed Alliance (NSWA) in 2010 to provide lake and watershed management advice.
- ◆ Two major projects were completed by the NSWA:
 - Mayatan Lake - State of the Watershed Report (2012)
 - Mayatan Lake - Watershed Management Plan (2016)
- ◆ Reports were also prepared by the NSWA for three other Watershed Stewardship Groups in the region:
 - Jackfish Lake - State of the Watershed Report (2016)
 - Lake Isle/Lac Ste Anne - State of the Watershed Report (2017)
 - Hubbles Lake - State of the Watershed Report (2018)

Mayatan Lake State of the Watershed Report



August 2012

Mayatan Lake Watershed Management Plan



July 2016

**Jackfish Lake
State of the Watershed Report**



April 2016

Isle Lake and Lac Ste Anne State of the Watershed Report



May 2017

**Hubbles Lake
State of the Watershed Report**



December 2018

The 2020 small lakes survey started with an introduction to “Lake Idano” in 2018...



“Lake Idano”

- ◆ The landowner expressed interest in the protection of this unique, unnamed lake
- ◆ Initial inspections of the lake and its watershed were carried out in summer 2018
- ◆ No previous water quality data were available
 - Preliminary lake sampling was conducted by ALMS in August 2019
 - The unique clarity of the lake and its extremely low nutrient/algal concentrations prompted much further discussion
 - The lake also had a continuous outflow, which suggested a potential groundwater influence









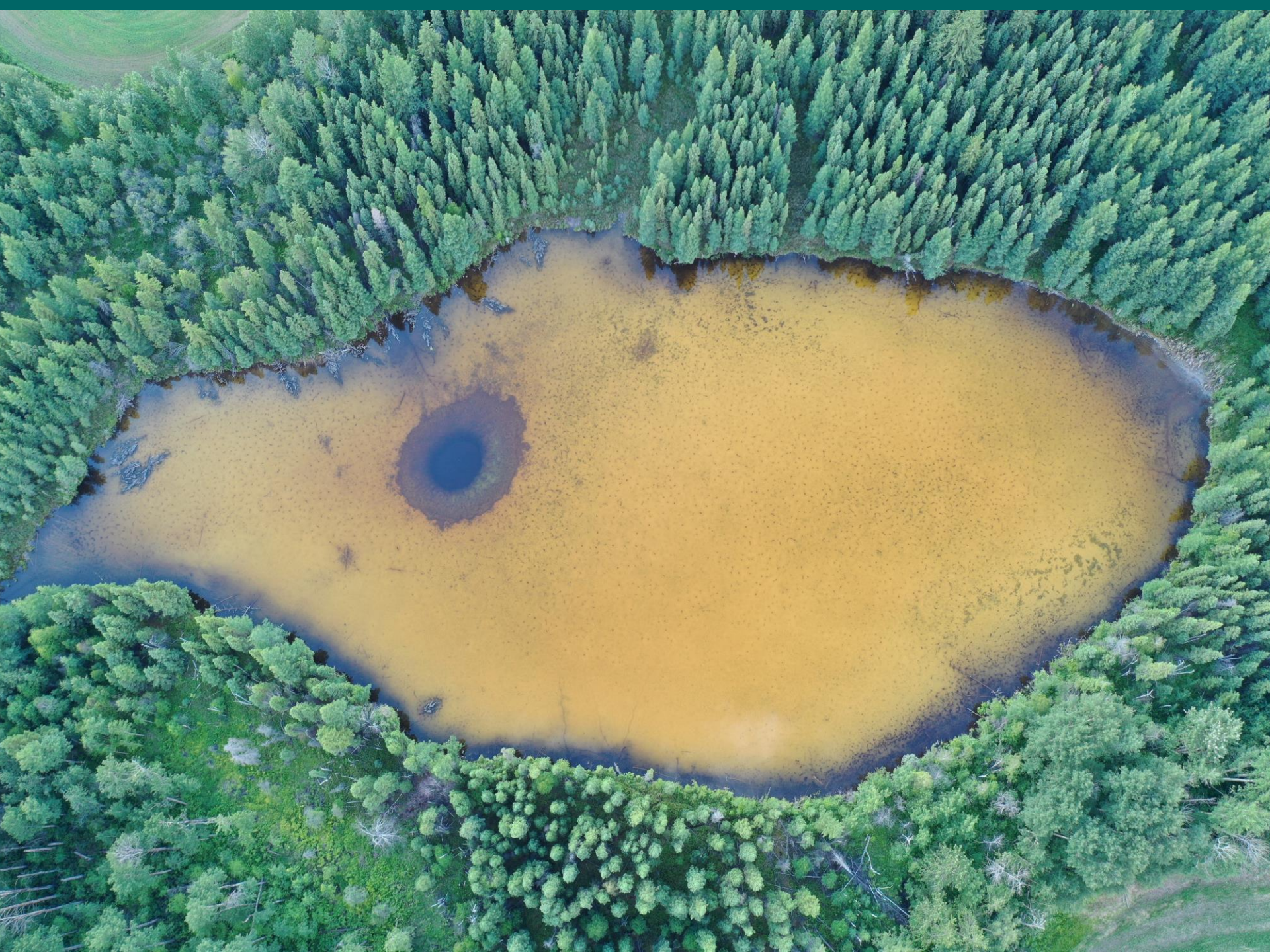






Satellite and 2020 drone images
suggested that the lake was also fed
by three upstream “fens”











Are there other similar lakes in the Stony Plain region?

Information Review – Spring 2020

- ◆ The total number of small lakes in the Stony Plain region was estimated from 1:50,000 NTS maps (83 G/9, 83 G/8, 83 H/12)
 - 26 small, named lakes were identified on the maps
 - Over 65 small, unnamed waterbodies were also identified

- ◆ Preliminary review of historic water quality data
 - Data for 7 named lakes were published by Prepas and Trew (CJFAS 1983)
 - Some of these 7 lakes were also investigated by U. of A. graduate students in the mid-late 1980s
 - Five named lakes have been sampled by ALMS in recent years
 - 14 named lakes and 65 unnamed waterbodies may not have any water quality or hydrological information

Reprinted from

Réimpression du

Canadian
Journal
of Fisheries
and Aquatic
Sciences

Journal
canadien
des sciences
halieutiques
et aquatiques

**Evaluation of the phosphorus–chlorophyll relationship for lakes
off the Precambrian Shield in western Canada**

E. E. PREPAS AND D. O. TREW

Volume 40 • Number 1 • 1983

27–35

Canada



Government of Canada
Fisheries and Oceans

Gouvernement du Canada
Pêches et Océans

Named Lakes (26)

- ◆ Atim
- ◆ Bell
- ◆ Byers
- ◆ Cameron
- ◆ Chickakoo*
- ◆ Cottage
- ◆ Eden*
- ◆ Gerharts*
- ◆ Gladu
- ◆ Glory
- ◆ Hasse*
- ◆ Hubbles*
- ◆ Jackfish*
- ◆ Johnny's
- ◆ Kettle
- ◆ Longhurst
- ◆ Mayatan*
- ◆ Mere
- ◆ Little Mere
- ◆ Mink*
- ◆ Muir*
- ◆ Sauer*
- ◆ Soldan
- ◆ Spring*
- ◆ Star*
- ◆ Whale

*(various/limited WQ data available)

The 2020 Lake Survey Project

- ◆ Designed as a preliminary (summer) water quality survey of 12 small lakes (4 named and 8 unnamed)
- ◆ Nine of the 12 lakes had not been sampled previously
- ◆ There was keen interest from 10 local landowners to have lakes on or adjacent to their properties evaluated
- ◆ Analytical support and equipment provided by ALMS and the Dept. of Earth Sciences, U. of A.
- ◆ Chemical testing for two lakes funded by MLMA and the Land Stewardship Centre of Canada
- ◆ Unnamed lakes were originally assigned “informal” names
- ◆ These informal names were replaced by (PL#) codes in fall 2020

Acknowledgements and Technical Support

- ◆ Alberta Lake Management Society
 - LakeKeepers Program (Caleb Sinn, Brad Peter)
- ◆ University of Alberta
 - Dr. Dan Alessi, Dr. Konstantin Von Gunten
- ◆ Volunteers and Contributors
 - Alec MacDonald, Walt Neilson, Jennifer Regier, Eric Neilson, Mike Myshak, Alex Oiffer
 - Field logistics, data prep, mapping, photos, technical advice

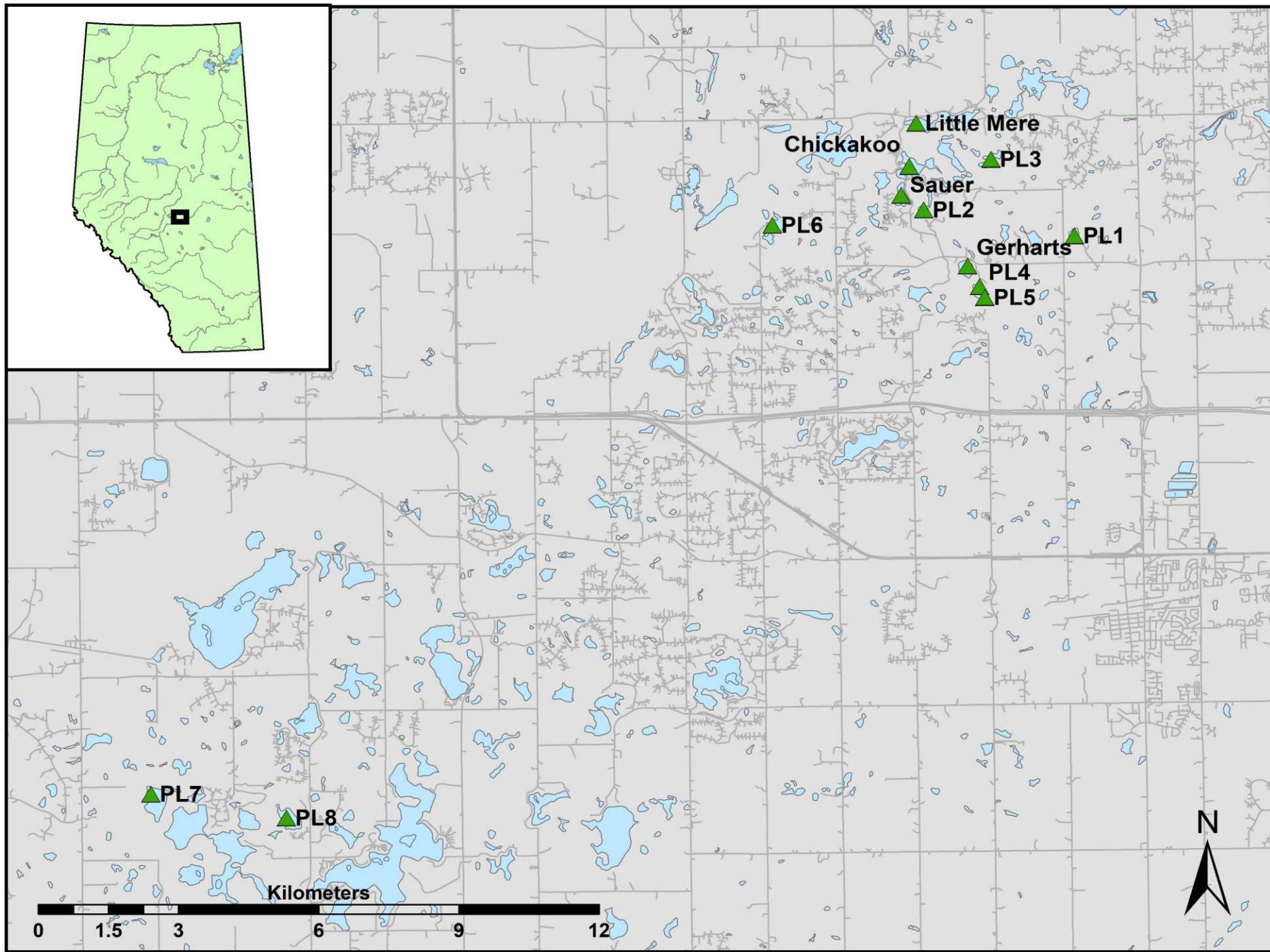
2020 Survey Lakes

Named Lakes

- ◆ Gerharts Lake
- ◆ Little Mere Lake
- ◆ Chickakoo Lake
- ◆ Sauer Lake

Unnamed Lakes

- ◆ PL1 (Lake Idano)
- ◆ PL2 (Pete's Pond)
- ◆ PL3 (Troudt Lake)
- ◆ PL4 (Roi Lake Mid)
- ◆ PL5 (Roi Lake South)
- ◆ PL6 (Kinsey Cove)
- ◆ PL7 (McMorran Lake)
- ◆ PL8 (Neilson Lake)





Sign in

779

Muir Lake Community Alliance Church

Muir Lake Community League & Hall

Muir Lake School

779

779

PL1

779

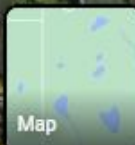
534

Township Rd 534

Township Rd 534

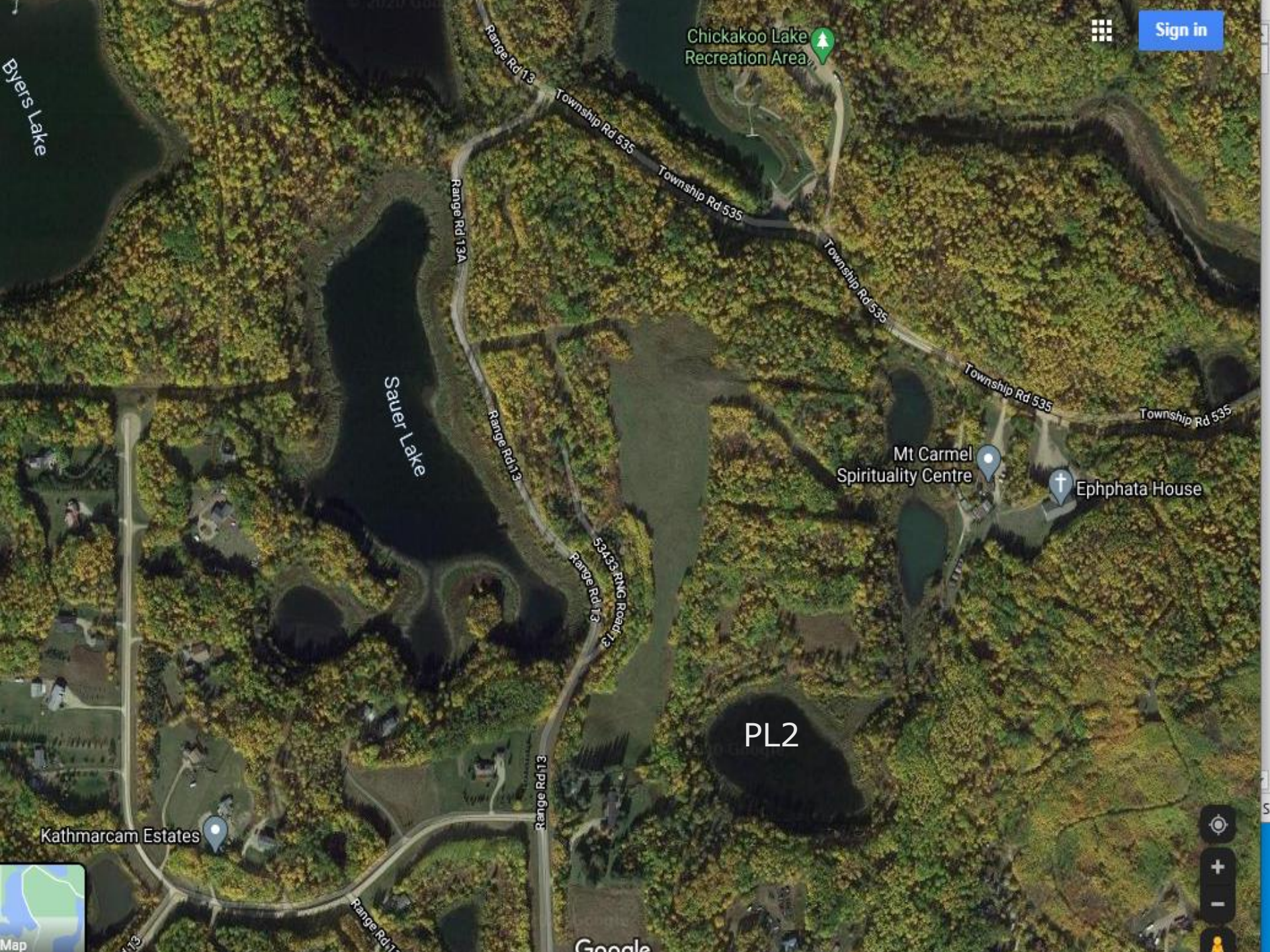
Township Rd 534

Township Rd 534



Map

Google



Byers Lake

Chickakoo Lake
Recreation Area

Sign in

Sauer Lake

Mt Carmel
Spirituality Centre

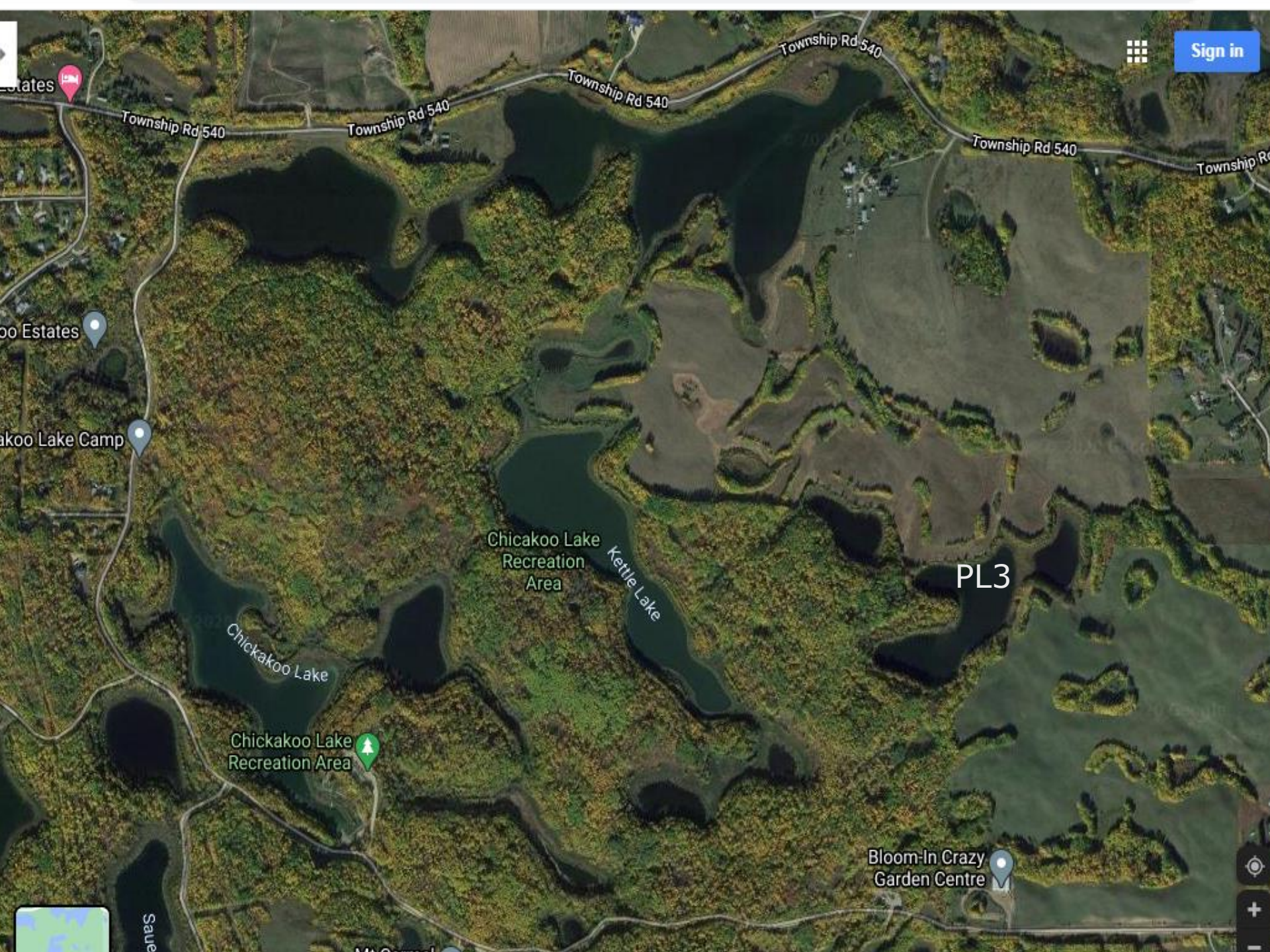
Ephphata House

PL2

Kathmarcam Estates



Google



Sign in

Estates

oo Estates

akoo Lake Camp

Chicakoo Lake
Recreation
Area

Kettle Lake

PL3

Chickakoo Lake

Chickakoo Lake
Recreation Area

Bloom-In Crazy
Garden Centre

Saue

McGowan



Sign in

Gerharts Lake

Township Rd 534

Township Rd 534

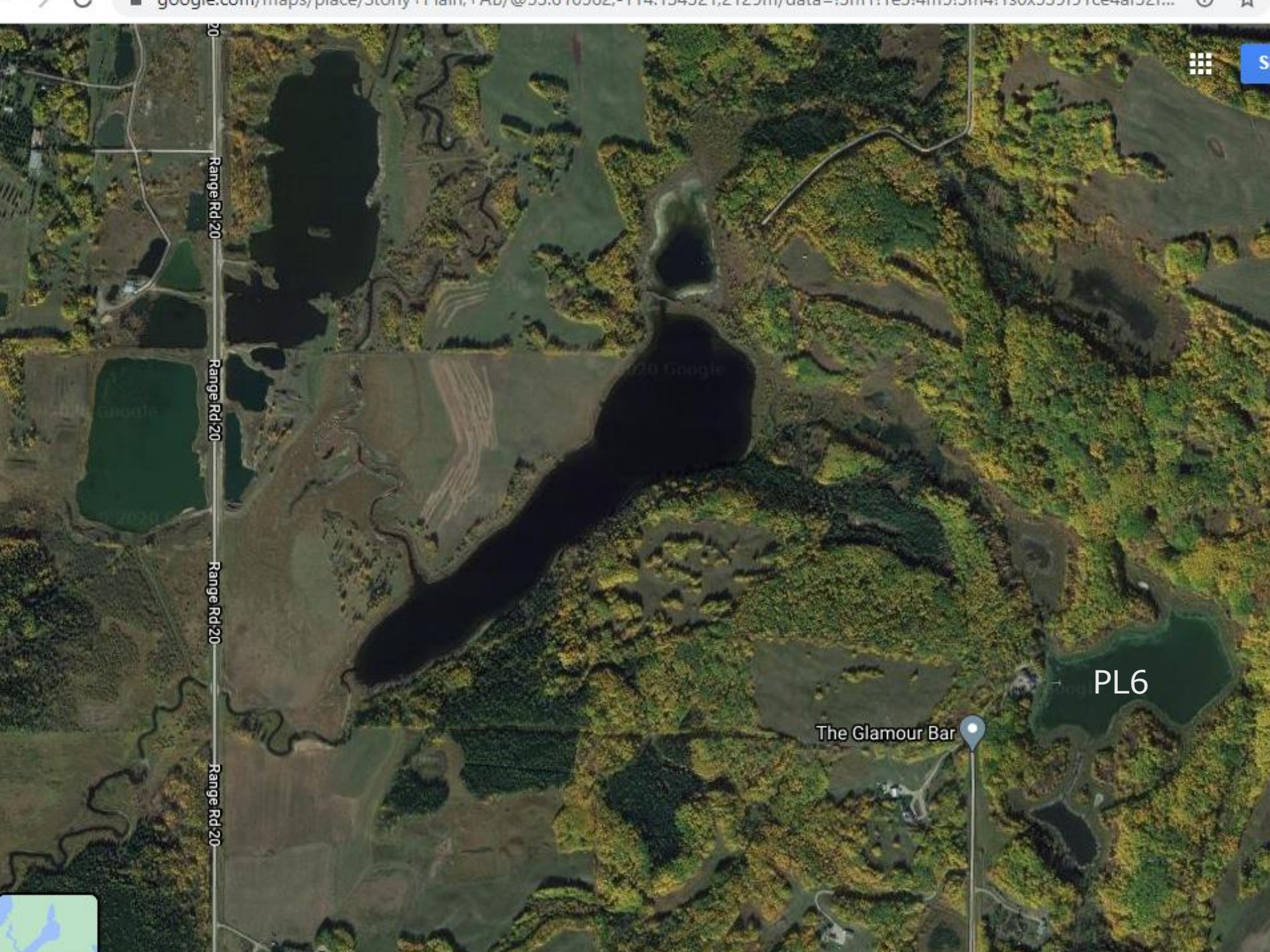
Township Rd 534

PL4

PL5

Google

Map



Range Rd/20

Range Rd/20

Range Rd/20

Range Rd/20

The Glamour Bar

PL6



Mayatan Lake Estates

PL7

Genesee Park

PL8

Terralta

Mayatan Lake

Amity Bay

Rainbow Beach Est

The 2020 Sampling Team:

Alec MacDonald

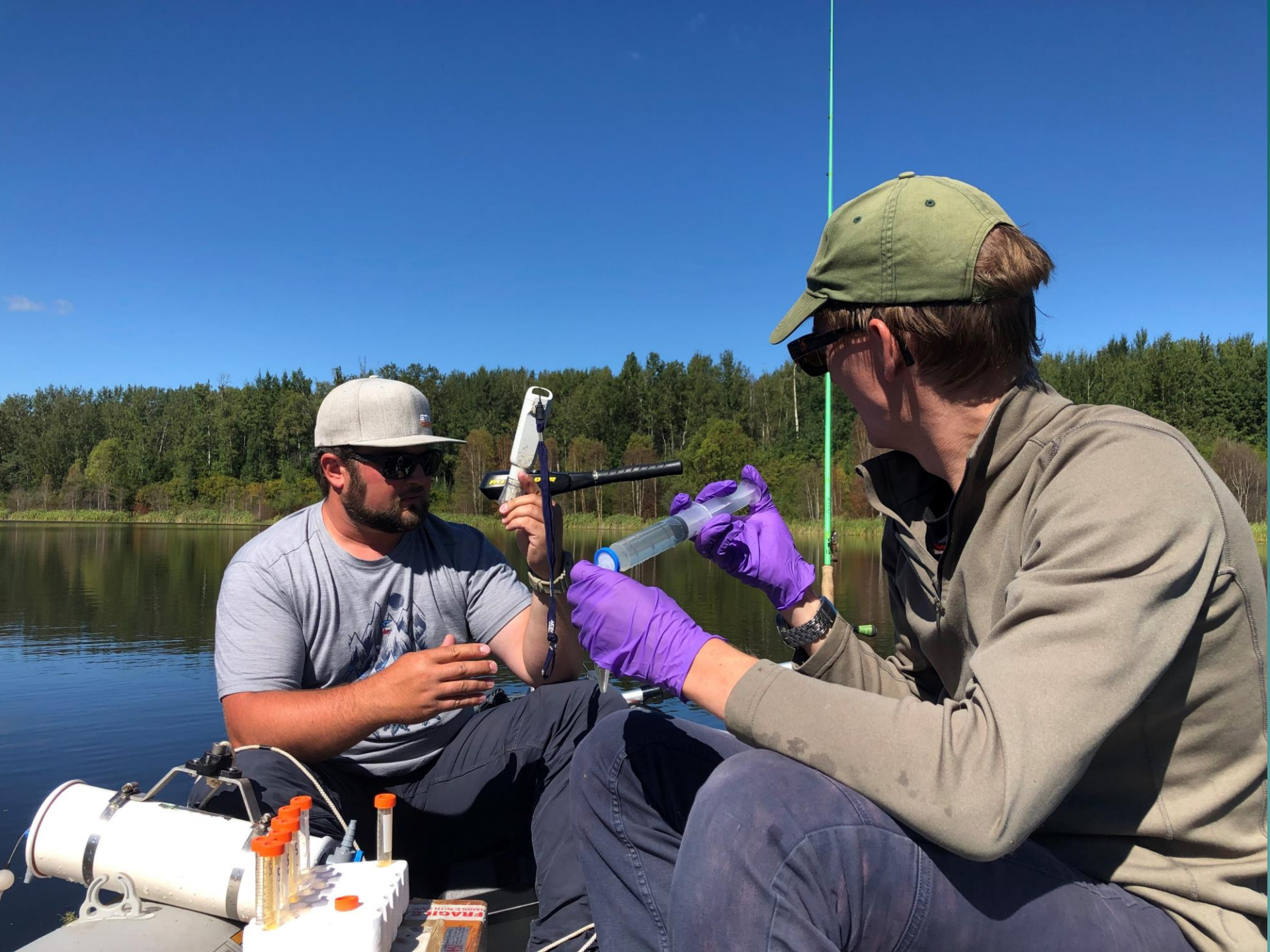
Dr. Konstantin Von Gunten

Caleb Sinn

David Trew























Photos of the study lakes

PL1 Idano









PL2 Pete's Pond









Little Mere Lake (west basin)









PL3 Troudt Lake













Sauer Lake







Chickakoo Lake







Gerharts Lake











PL4 Roi Lake Middle









PL5 Roi Lake South











PL6 Kinsey Cove







PL7 McMorran Lake







PL8 Neilson Lake









A few local inhabitants















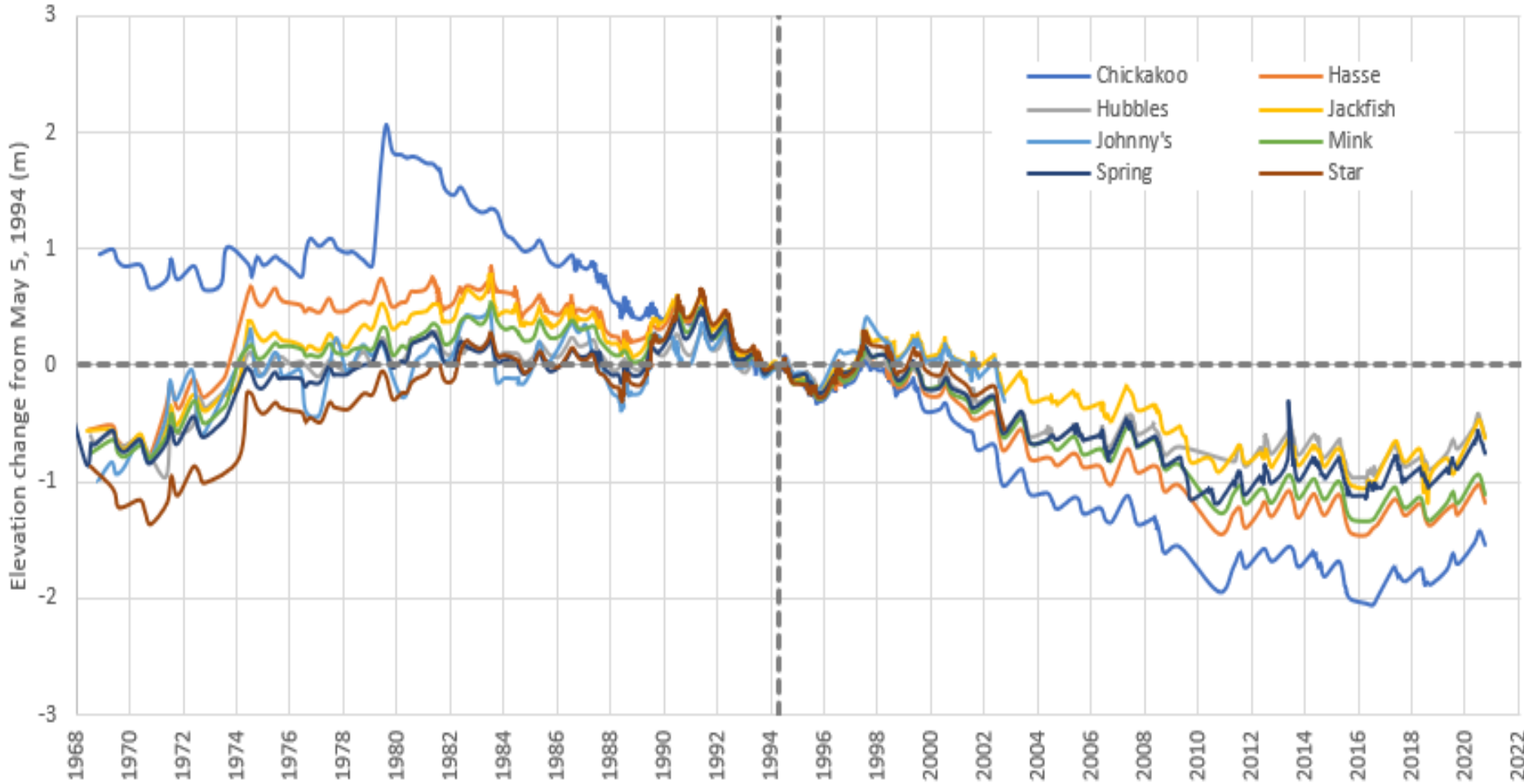


Preliminary Results and Observations

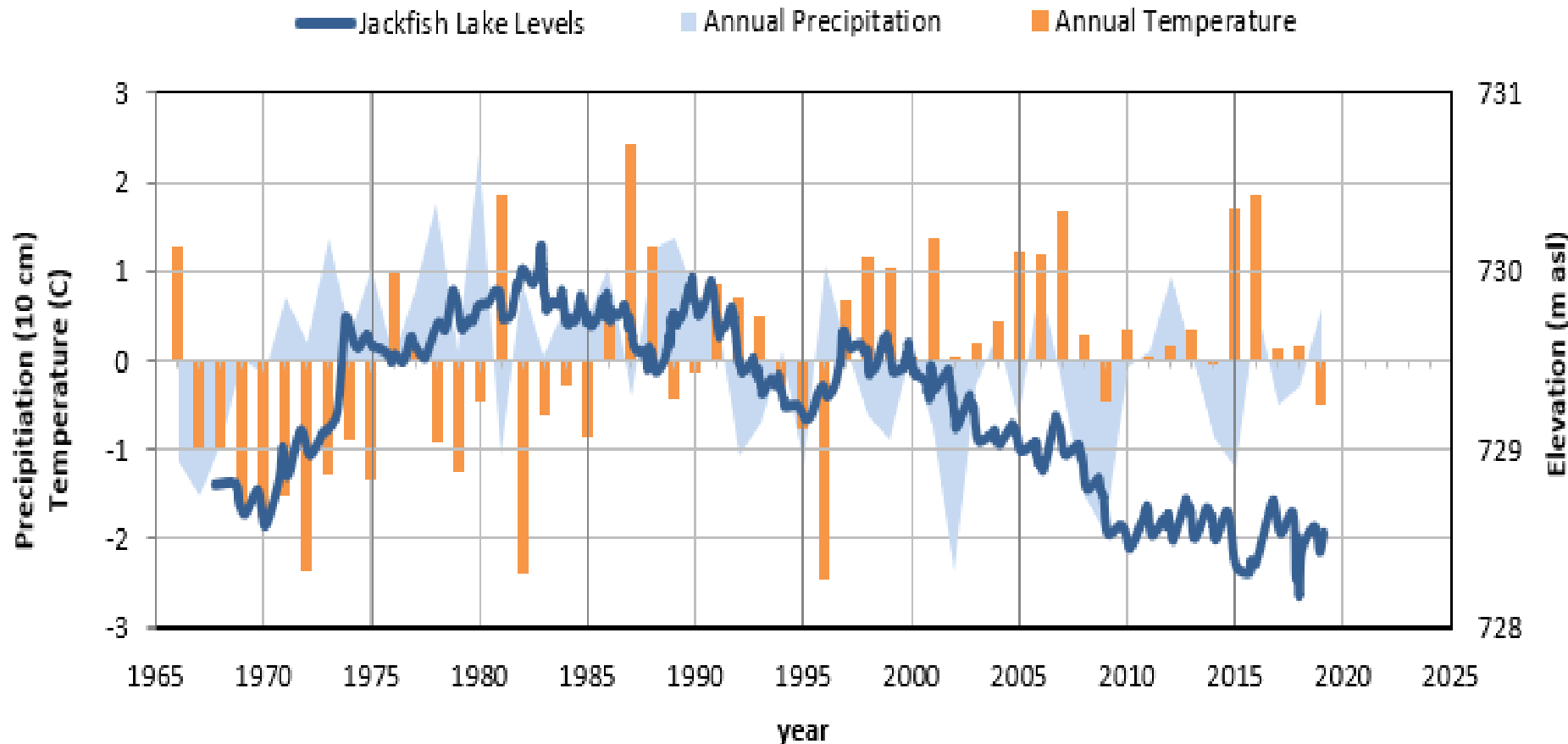
Historic Lake Level Trends

- ◆ Eight small lakes in the region have long-term hydrometric stations (1968-2020) managed by AEP
- ◆ When plotted on a comparative scale most lakes displayed similar trends over the period of record:
 - Lake levels increased from the late 1960s to the late 1980s
 - The 1990s appear to be a transitional period
 - Lake levels have declined since the early 2000s
- ◆ Actual levels (illustrated for Jackfish Lake) also reflect precipitation and temperature data recorded at the ECCC Weather Station in Stony Plain.
 - The 1960s to 1980s were somewhat cooler and wetter
 - The 2000s have been warmer and drier
- ◆ Spring Lake has a longer period of record and shows an earlier decline in lake levels - from the late 1930s to the late 1960s

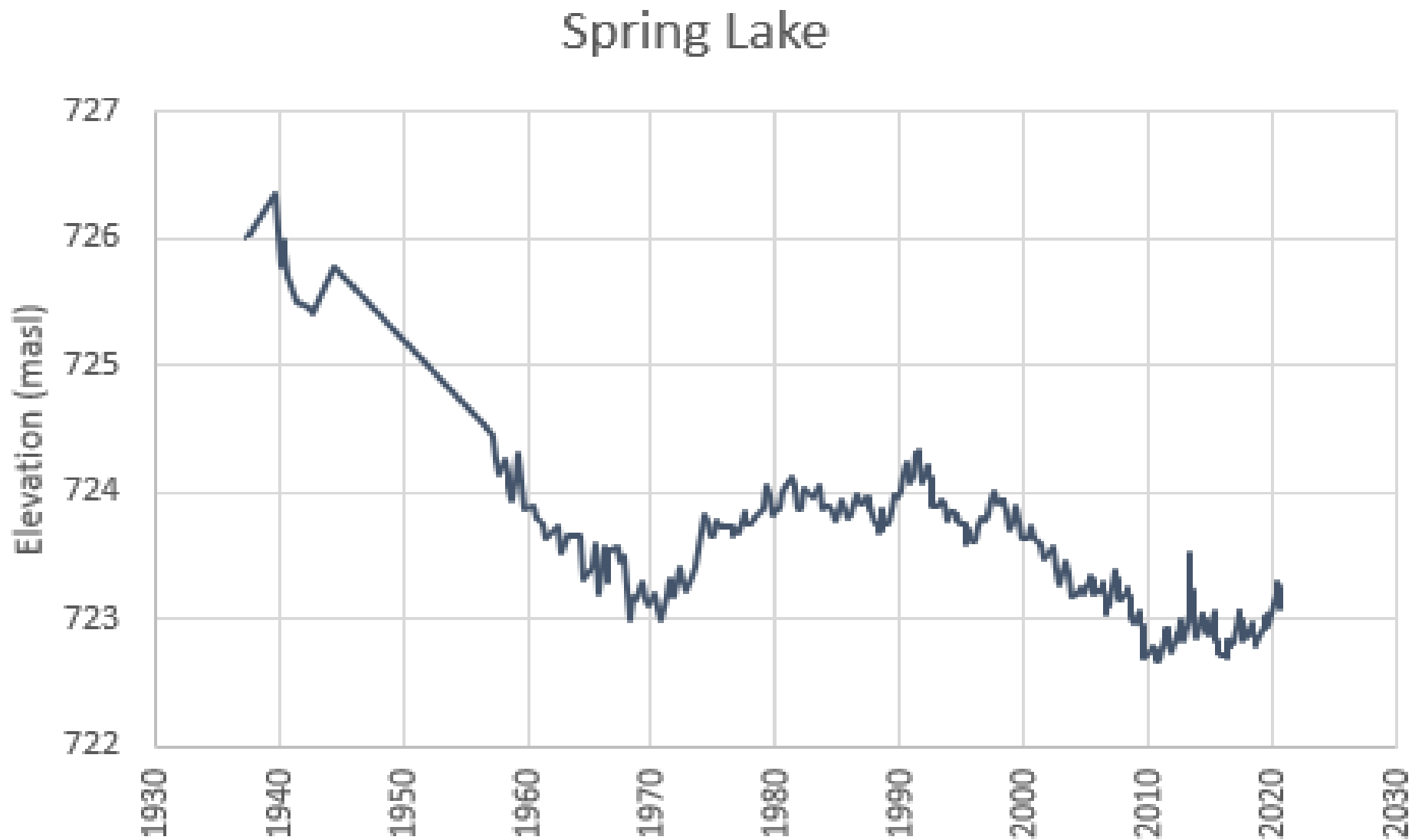
Historic Lake Level Trends for Regional Lakes (1968-2020)



Lake Level Trends at Jackfish Lake Compared with Climate Data (1968-2020)



Lake Level Trends at Spring Lake (1937-2020)



Initial Lake Sampling Dates

(Secondary sampling dates not shown)

Lake	Date	Sampling Team
PL1 Lake Idano	May 19 2020	DT, KVG, AMcD
Sauer Lake	June 8 2020	DT, KVG, AMcD
PL2 Pete's Pond	July 4 2020	DT, KVG
PL3 Troudt Lake	July 27 2020	DT, KVG, AMcD
Chickakoo Lake	July 27 2020	DT, KVG, AMcD
Little Mere Lake	Aug 25 2020	DT, KVG, AMcD
Gerharts Lake	Aug 25 2020	DT, KVG, AMcD
PL4 Roi Lake Middle	Sept 6 2020	DT, KVG
PL5 Roi Lake South	Sept 6 2020	DT, KVG
PL6 Kinsey Cove	Aug 27 2020	DT, CS
PL7 McMorran Lake	Sept 15 2020	DT, CS
PL8 Neilson Lake	Sept 15 2020	DT, CS

Maximum Observed Depths

Manual measurements (m)

Shallow Lakes (<10.0m)

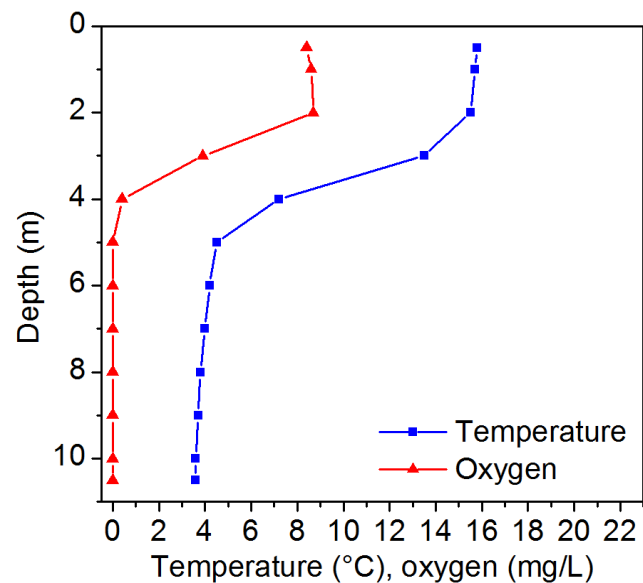
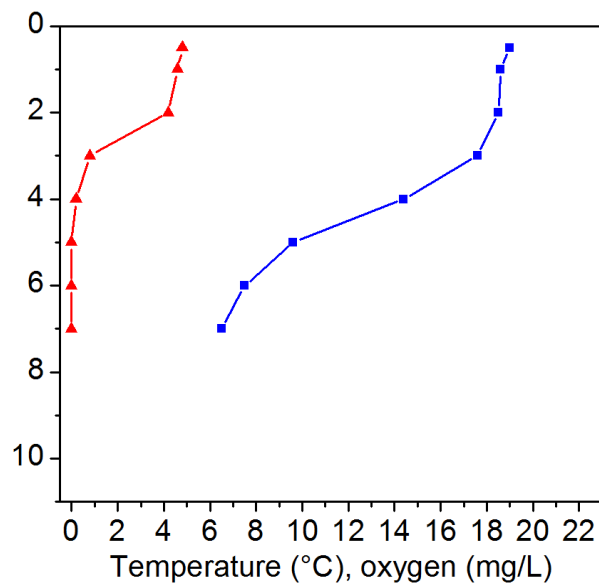
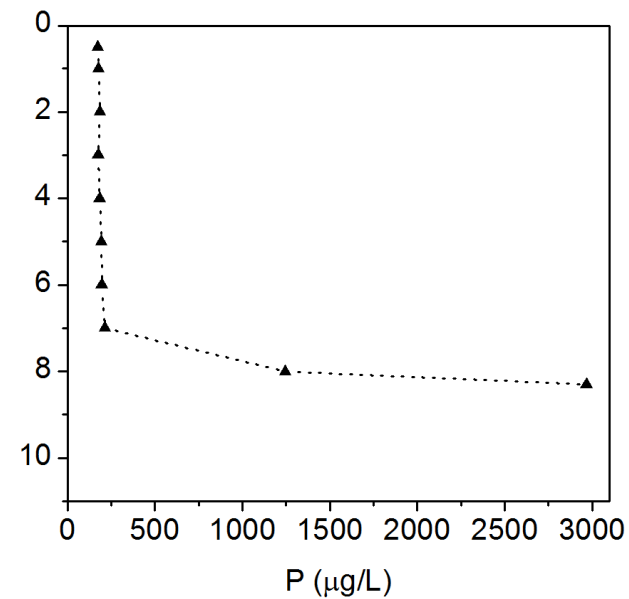
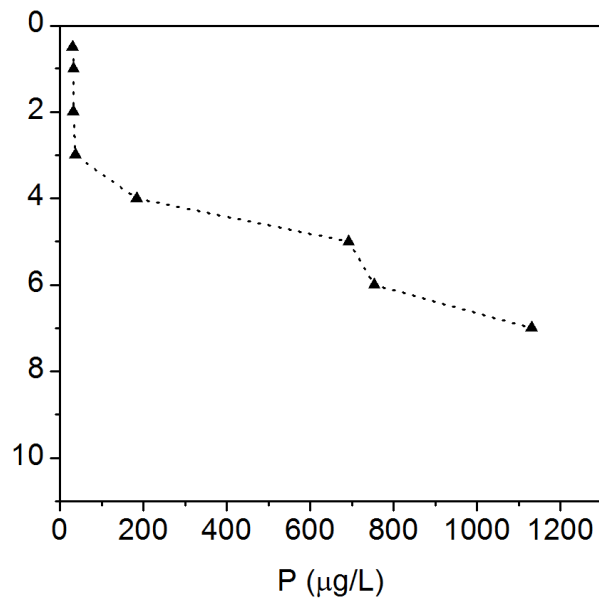
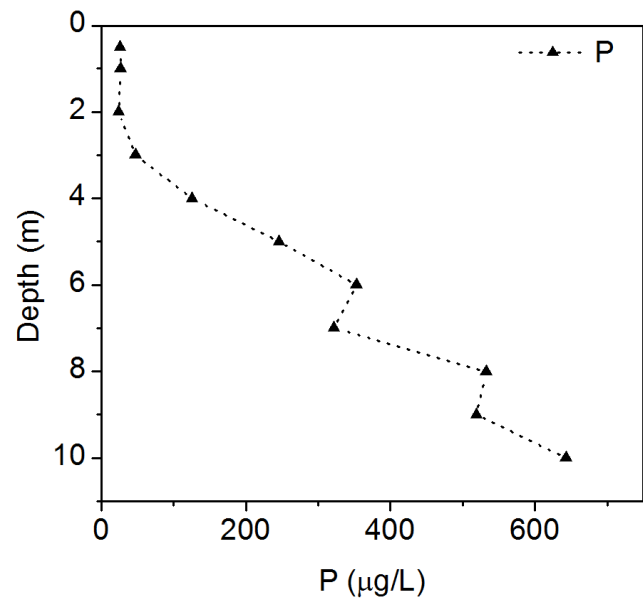
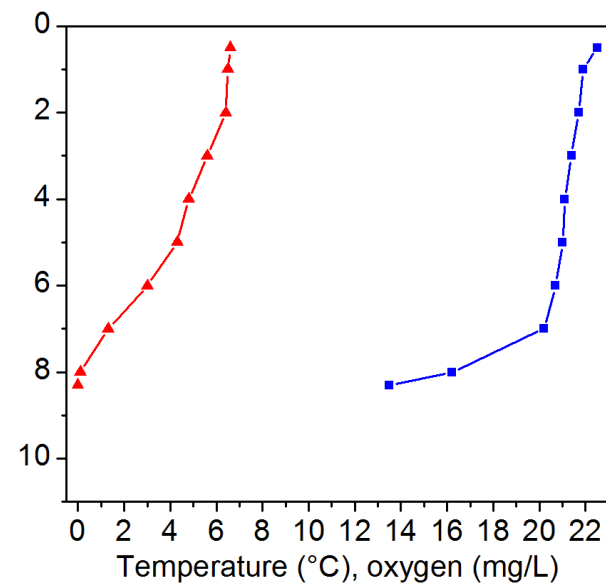
◆ Kinsey Cove	(5.0)
◆ Troudt	(6.5)
◆ Little Mere W.	(7.0)
◆ Pete's Pond	(7.5)
◆ Chickakoo	(8.5)
◆ Roi Mid.	(9.5)
◆ Neilson	(10.0)

Deep Lakes (>10.0m)

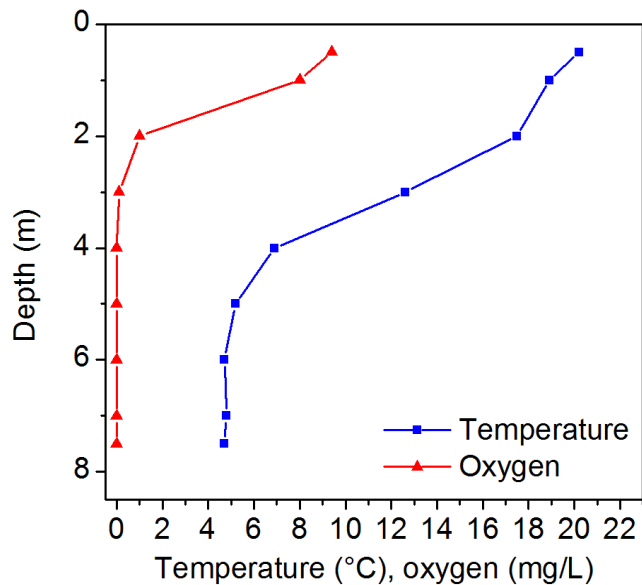
◆ Sauer	(11.0)
◆ Idano	(12.0)
◆ Roi South	(15.0)
◆ Gerharts	(16.0)
◆ McMorran	(17.0)

Dissolved Oxygen and Temperature Profiles

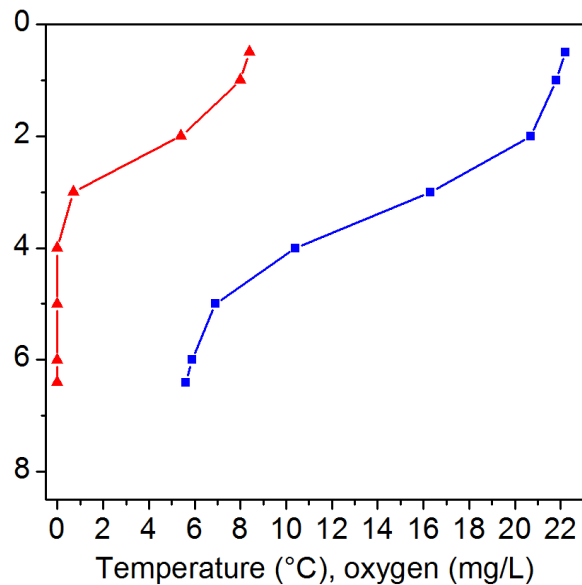
- ◆ One set of profiles was recorded for each of the 12 lakes
- ◆ Individual sampling dates ranged from May to September 2020, spanning both warming and cooling periods
 - Most lakes demonstrated limited mixing depths and strong thermal stratification
 - Thermoclines in the shallow lakes were generally observed between 2 and 5 m
 - Dissolved oxygen in shallow lakes was rapidly depleted between 2 and 4 m
 - Thermoclines in the deeper lakes were more variable and recorded at depths between 3 and 8 m
 - Dissolved oxygen in deeper lakes was depleted between 3 and 7m
 - Limited spring mixing may be a feature of certain lakes (meromixis)
 - Chickakoo was an exception: it was more uniformly mixed due to the presence of aeration devices

Sauer**Little Mere****Chickakoo**

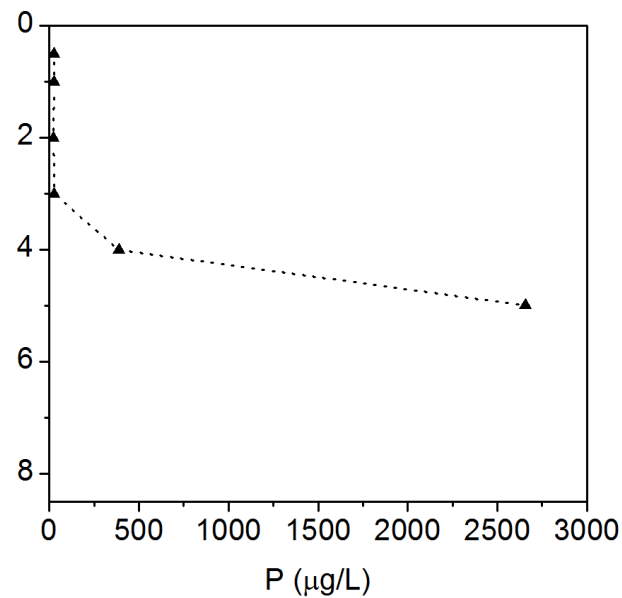
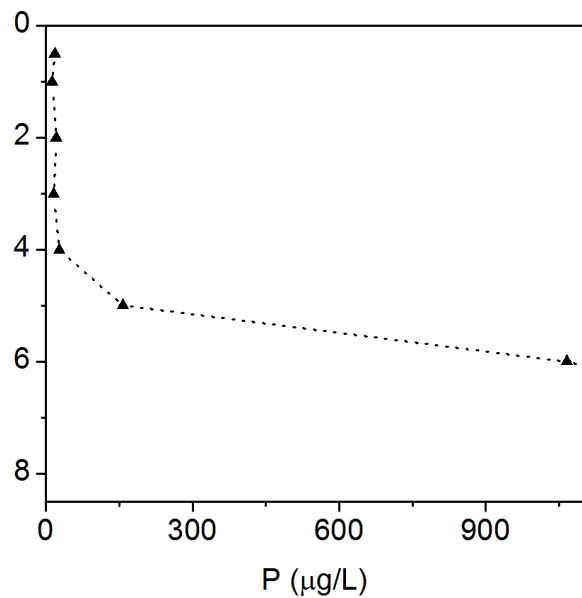
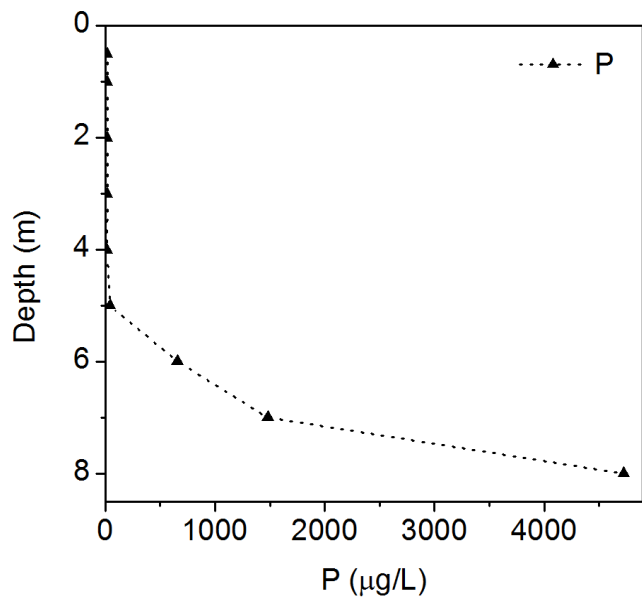
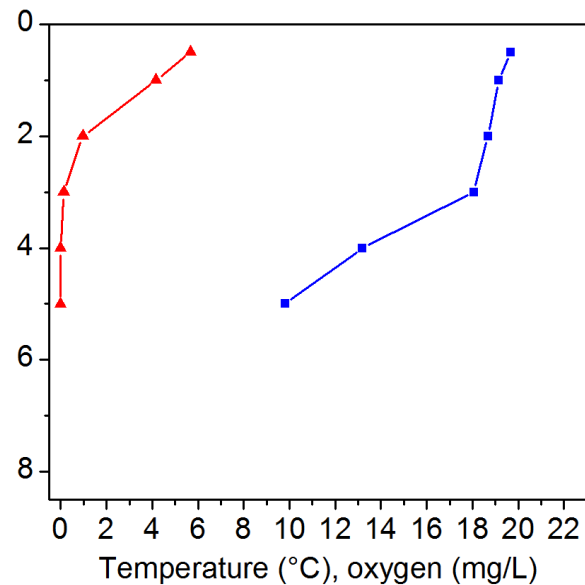
Pete's pond south



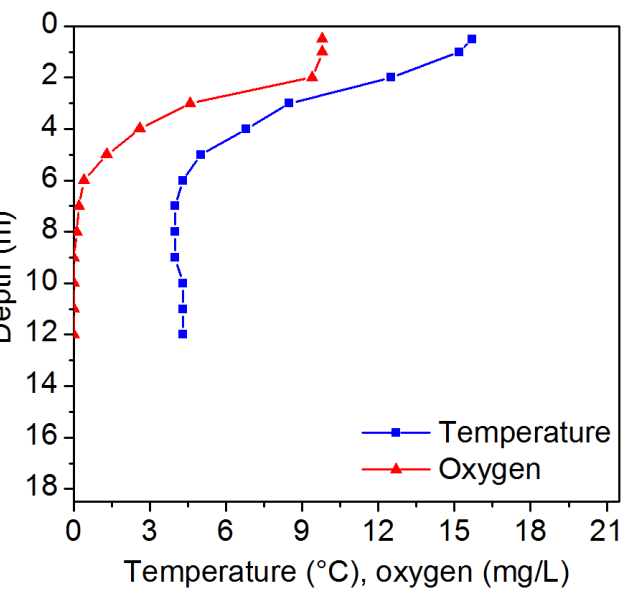
Trout Lake



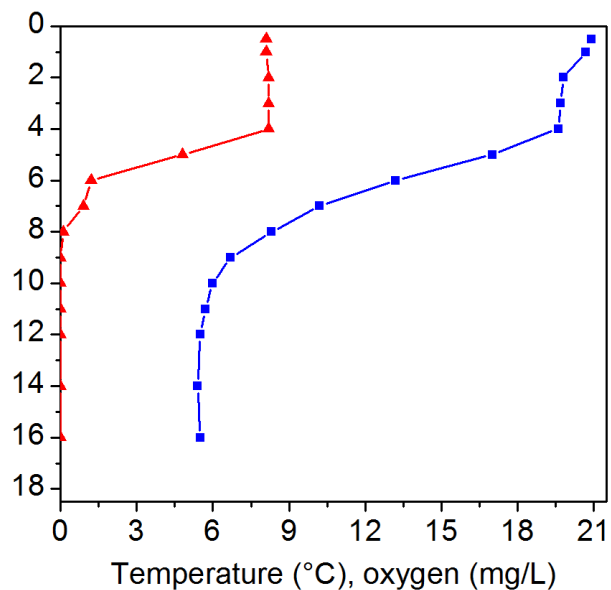
Kinsey Cove



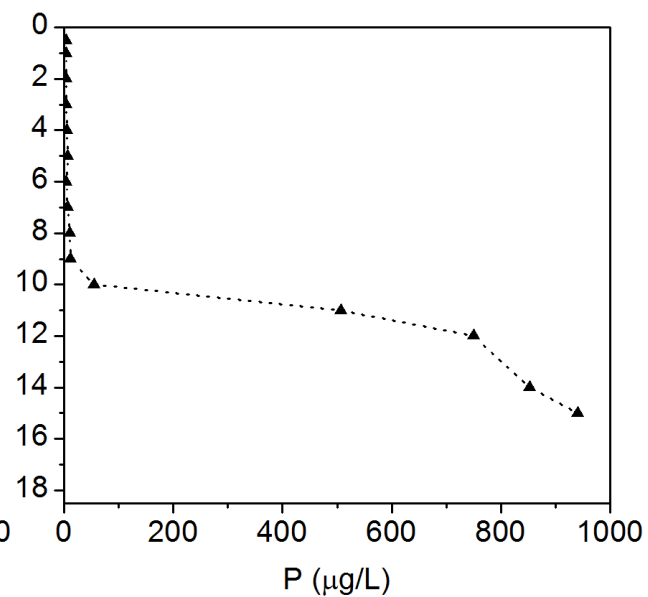
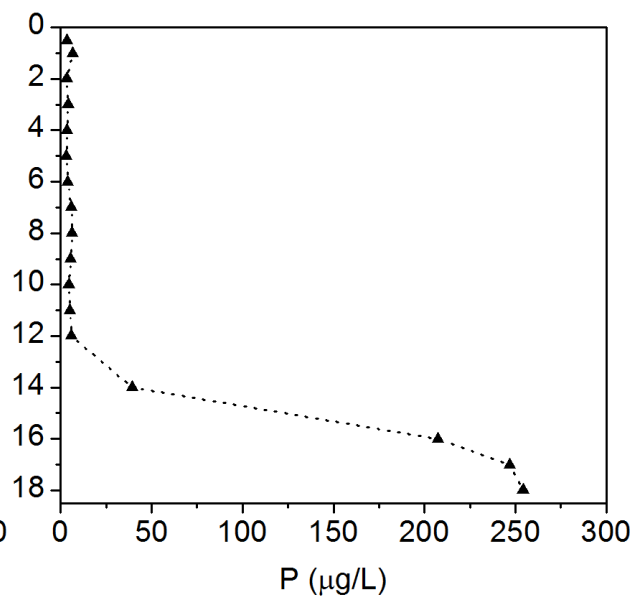
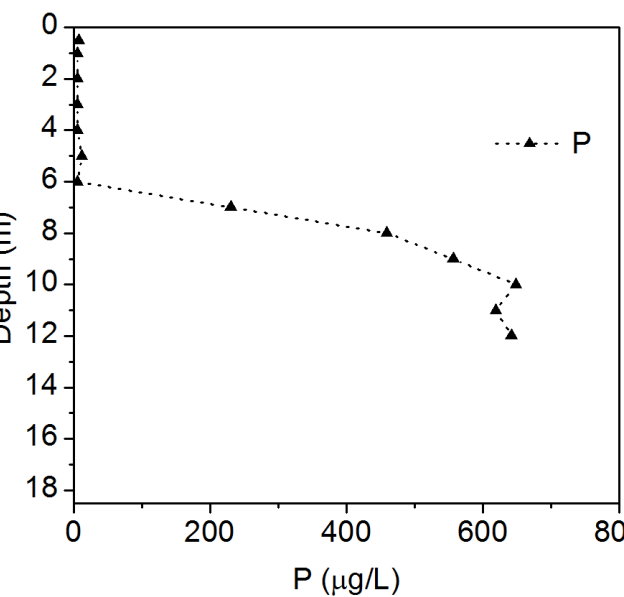
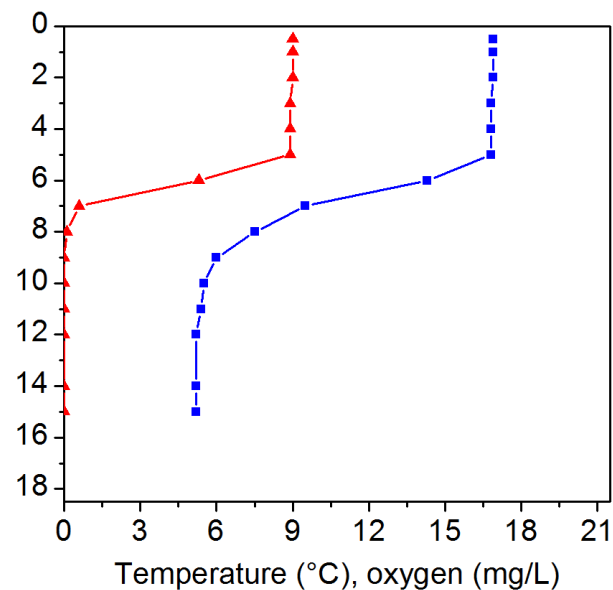
Idano



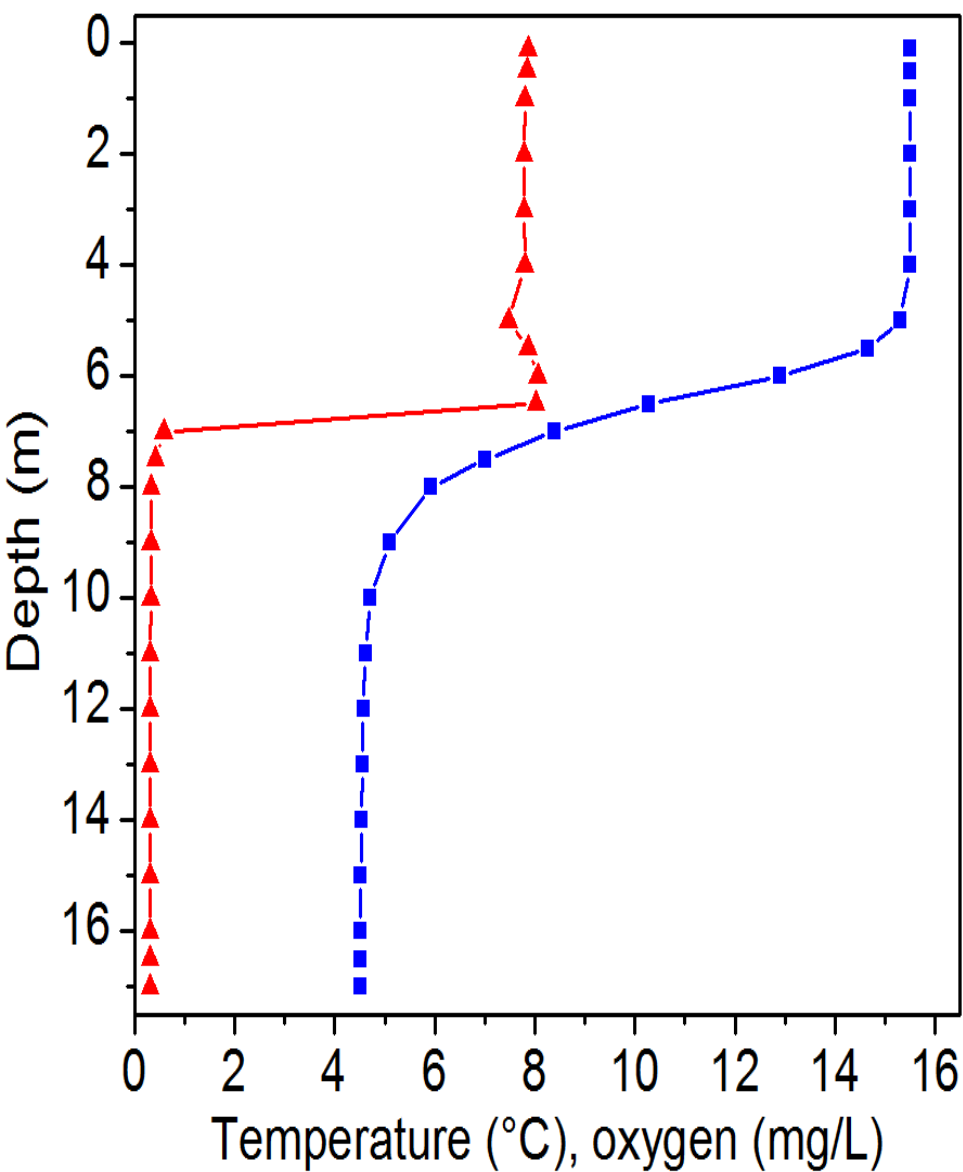
Gerharts



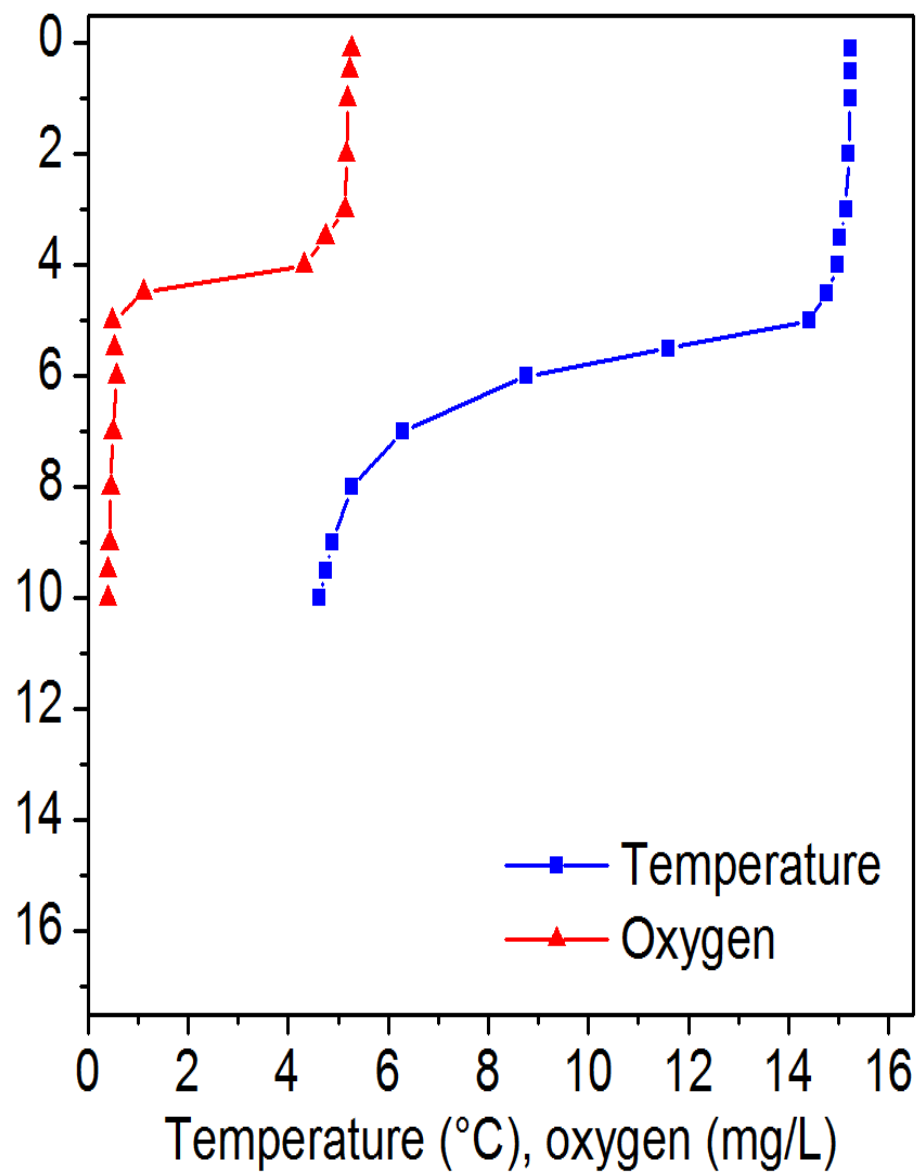
Roi South



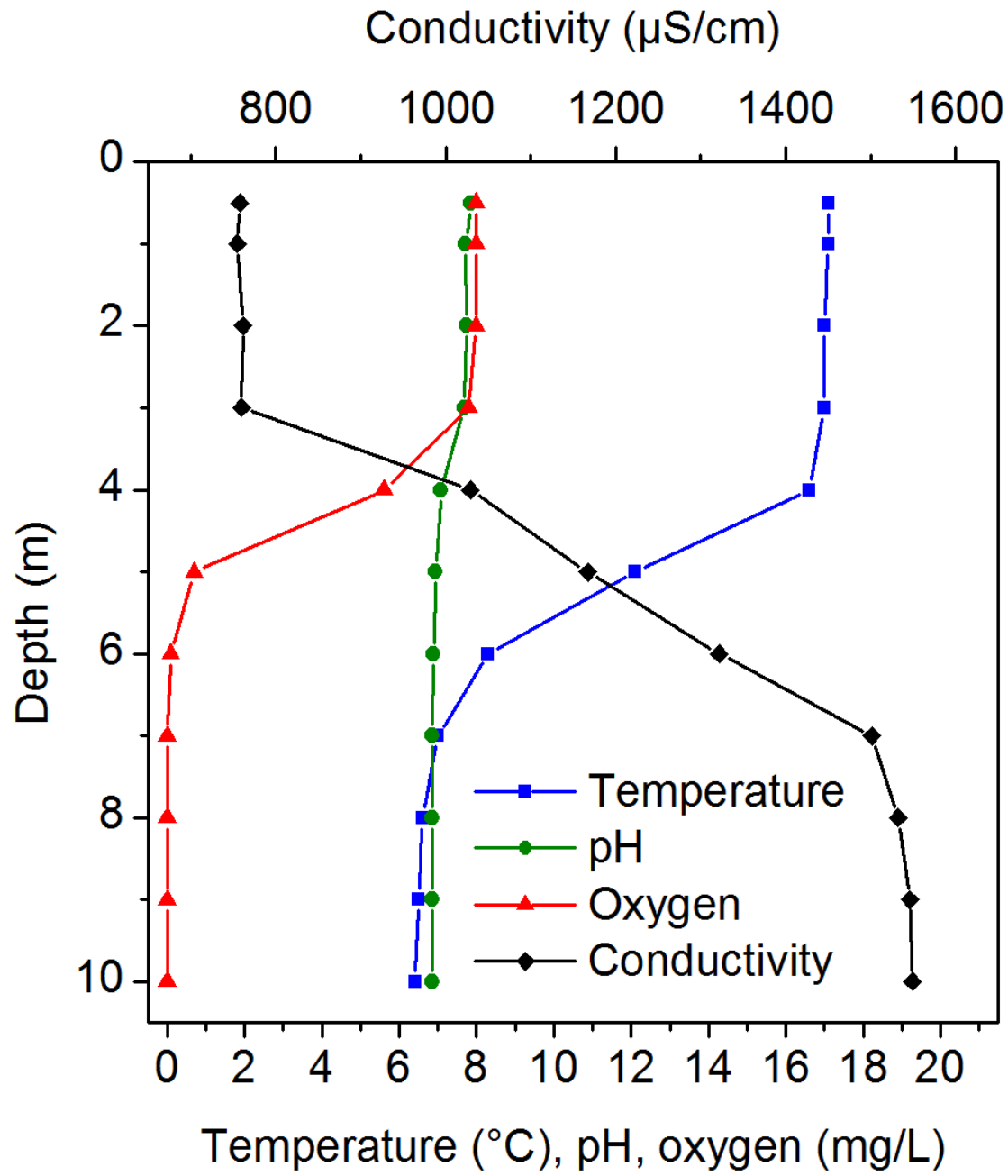
McMorran



Neilson



Roi Middle



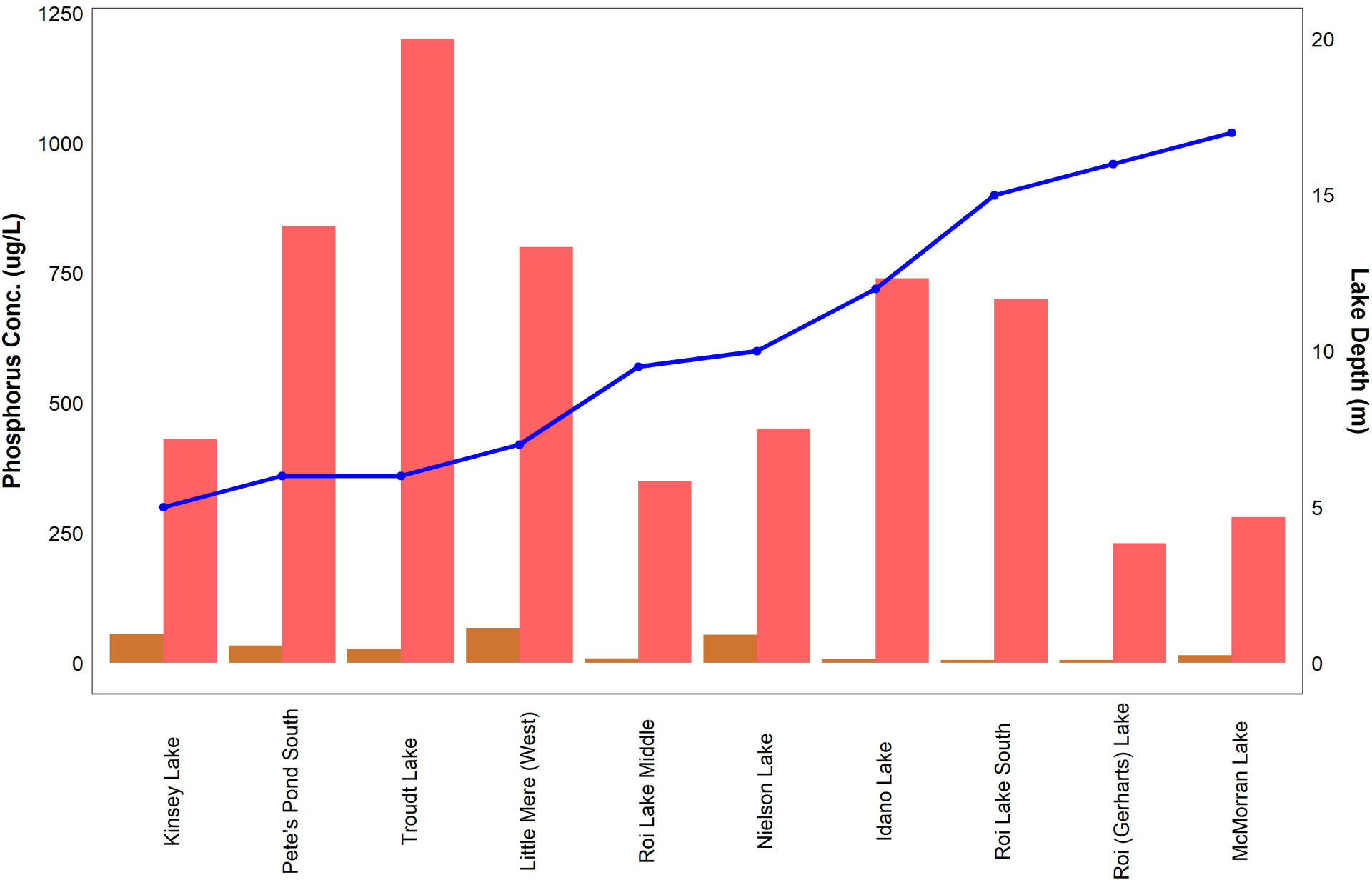
Nutrients and Related Variables

(Based on grab samples taken at 0.5m and near the bottom)

- ◆ Grab samples for [TP] were analyzed at Bureau Veritas Labs, Edm.
- ◆ Profile samples for [TP]* analyzed at Dept. Earth Sciences, U. of A.
 - Four deep, clear lakes (PL1, PL4, PL5, Gerharts) displayed oligotrophic (O) characteristics in their surface waters, but are complex systems with very high phosphorus concentration in deeper waters.
 - PL7 was very similar but had slightly elevated [TP]. It was sampled later in the season and was undergoing preliminary mixing
 - Shallow lakes generally displayed higher surface concentrations of Total Phosphorus and Chlorophyll a than deeper lakes
 - All lakes displayed very high TP concentrations in bottom samples
 - Shallow lakes were generally more turbid and had lower transparencies than deeper lakes
 - Most shallow lakes would likely be classified as mesotrophic (M) or eutrophic (E) – more data required
 - Chickakoo Lake appears to be hypereutrophic (H)

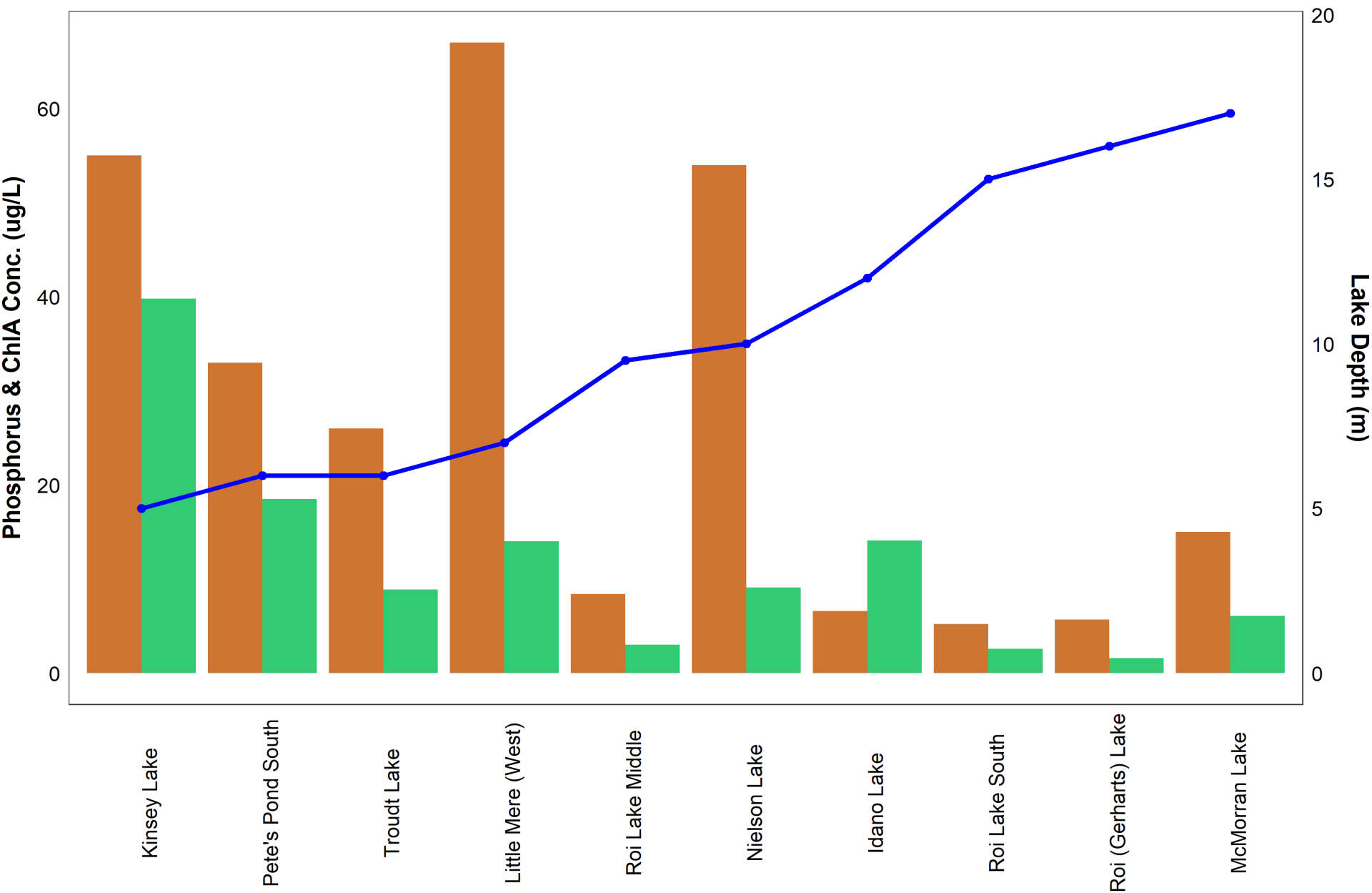
Carvel Lakes TP

● Lake Depth ■ Top TP ■ Bottom TP



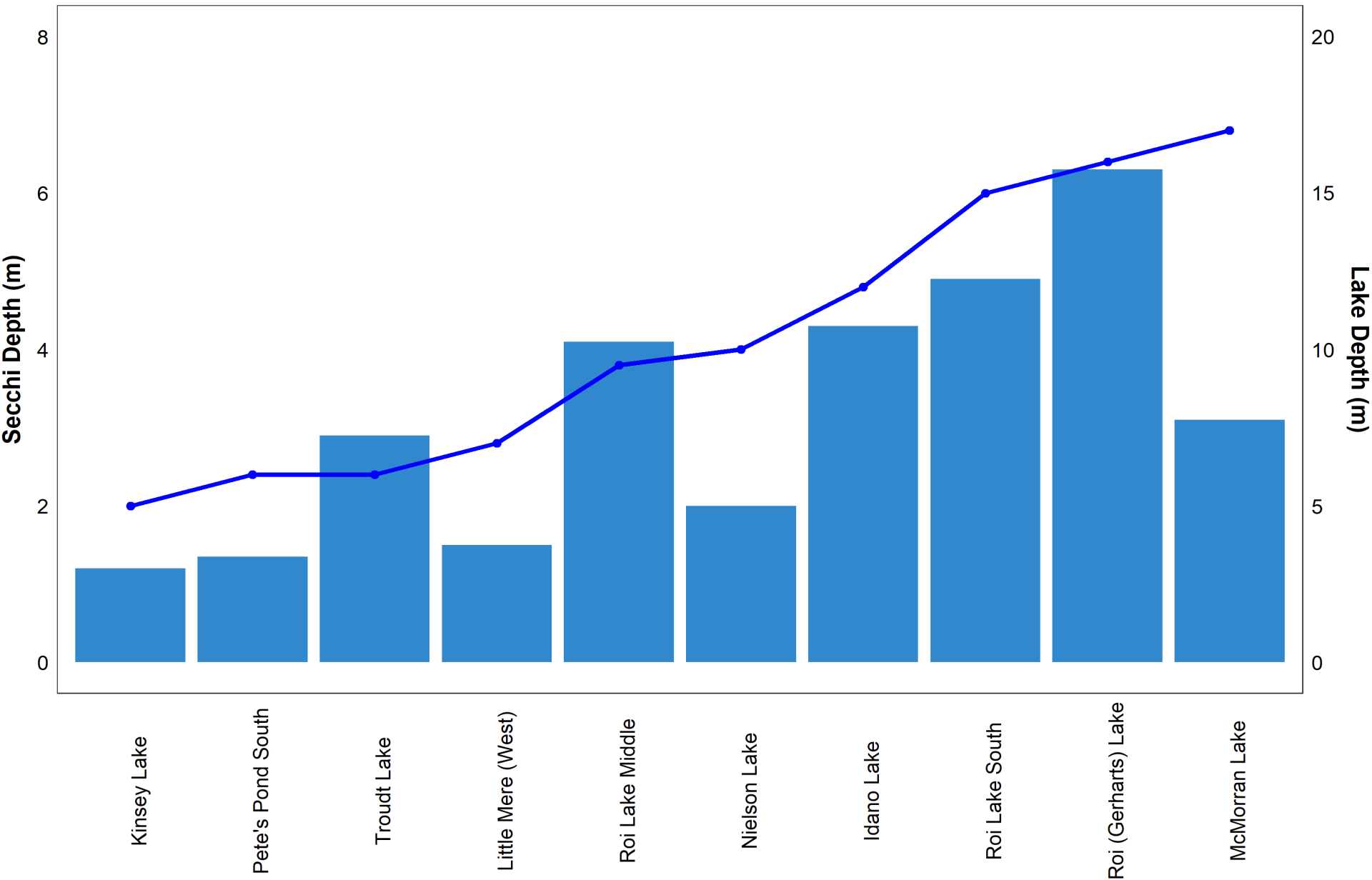
Carvel Lakes Top TP & ChlA

● Lake Depth ■ Top TP ■ ChlA



Carvel Lakes Secchi Depth

● Lake Depth ■ Secchi Depth



Lake	TP ug/L 0.5m	Chl a ug/L 0.5m	Secchi (m)	TKN mg/L 0.5m	TP ug/L bottom
PL5 Roi S.	5.2 (O)	2.6 (O)	4.9 (O)	0.69	700
Gerharts	5.7 (O)	1.6 (O)	6.3 (O)	0.55	230
PL1 Idano	6.6 (O)	---	5.0 (O)	---	740
PL4 Roi M.	8.4 (O)	3.0 (O)	4.1 (O)	0.61	350
PL7 McM	15.0 (M)	6.1 (M)	3.1 (M)	1.2	280
PL3 Troudt	26.0 (M)	8.9 (M)	2.8 (M)	1.3	1200
Sauer	26.2* (M)	---	3.9 (M)	---	519*
PL2 Pete's	33.0 (E)	18.5 (E)	1.4 (E)	1.8	840
PL8 Neilson	54.0 (E)	9.1 (E)	2.0 (E)	1.9	450
PL6 Kinsey	55.0 (E)	39.8 (E)	1.2 (E)	1.8	430
Little Mere	67.0 (E)	14.0 (E)	1.5 (E)	1.8	800
Chickakoo	173.0* (H)	---	1.8 (E)	---	214*

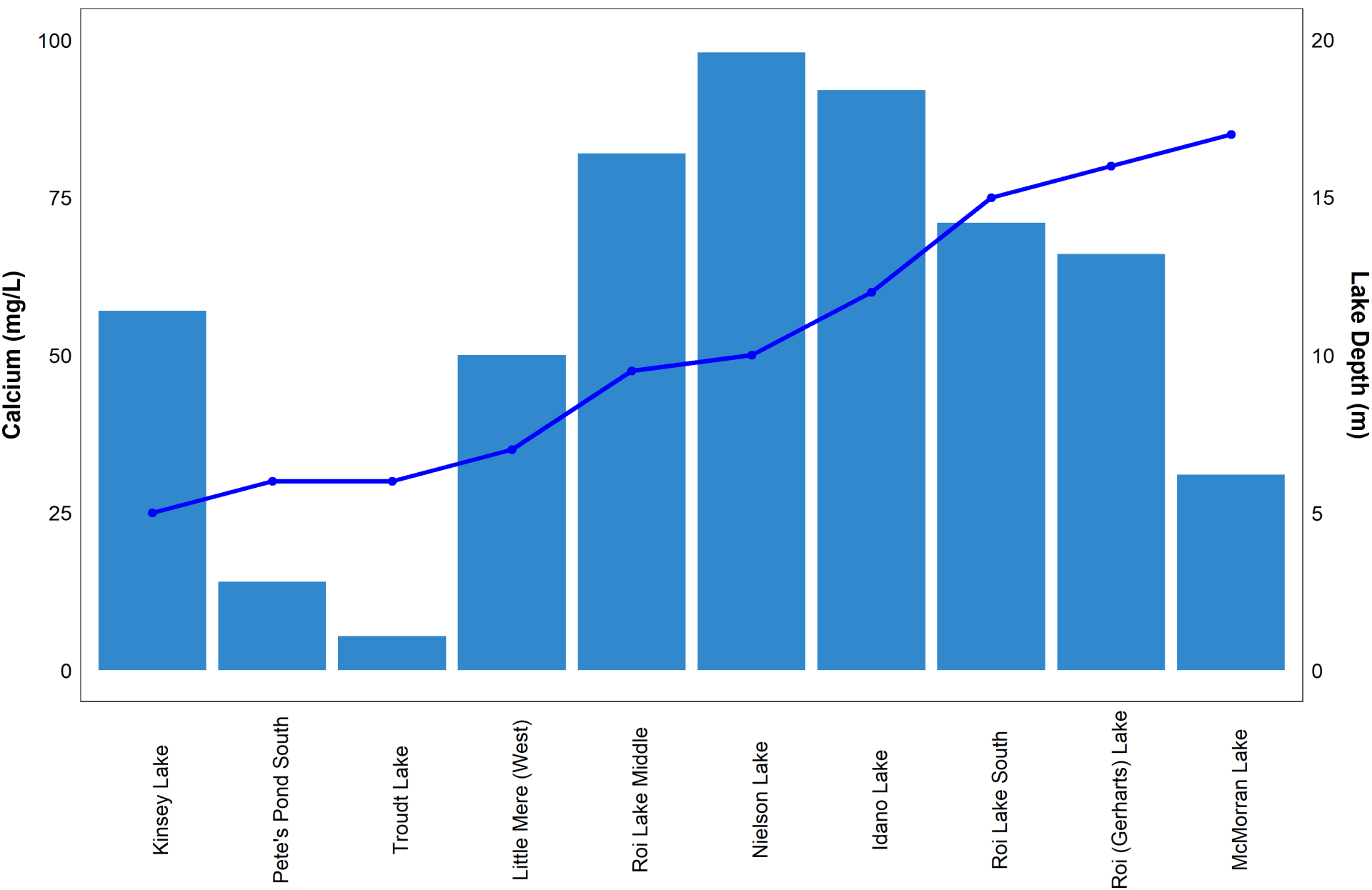
Major Ions and Related Variables

Based on grab samples taken at 0.5m

- ◆ Grab samples analyzed at Bureau Veritas Labs, Edmonton
- ◆ Conductance and pH values* provided by Dept. Earth Sciences, U. of A.
 - High chemical variabilities were observed among these 12 lakes, and often among lakes only a short distance apart
 - Four deep lakes (PL1, PL4, PL5, Gerharts) had high concentrations of calcium, magnesium, sodium, bicarbonate, sulfate, TDS and conductivity
 - Two shallow lakes (PL2, PL3) had very low concentrations of these ions and related variables
 - The same two shallow lakes had the highest iron concentrations, whereas the four deeper lakes had very low iron concentrations

Carvel Lakes Calcium

● Lake Depth ■ Calcium



Major Cations (mg/L)

*Samples analyzed at Dept. of Earth Sciences, U. of A.

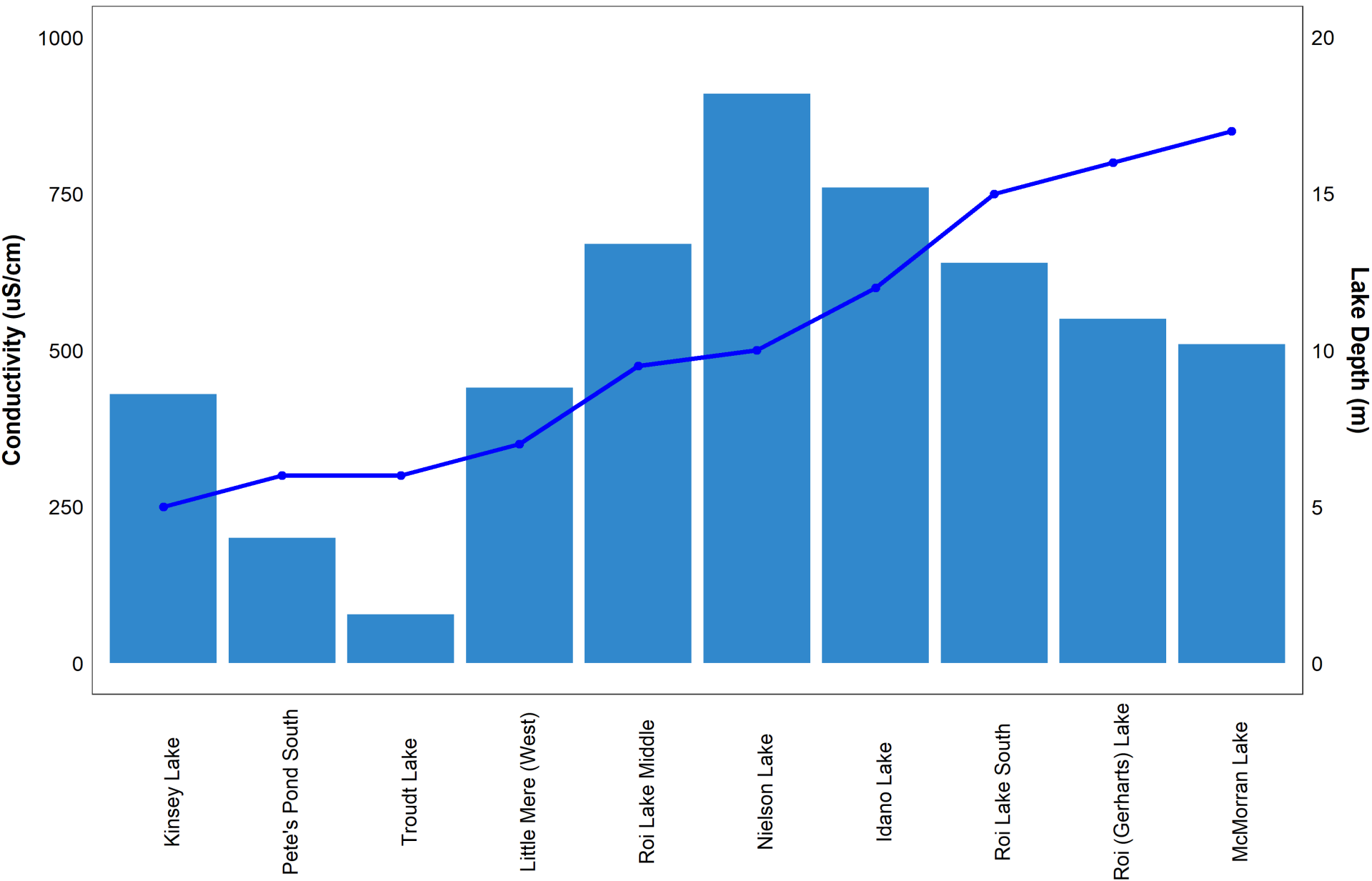
Lake	Calcium	Magnesium	Potassium	Sodium
PL3 Troudt	5.4	2.3	12	0.6
PL2 Pete`s	14	4.6	11	12
Sauer	26*	12*	13*	5.3*
PL7 McMorran	31	43	19	14
Chickakoo	48*	20*	17*	4.5*
Little Mere	50	18	17	9.5
PL6 Kinsey	57	18	13	4.7
Gerharts	66	31	4.0	18
PL4 Roi South	71	37	4.2	17
PL5 Roi Mid	82	35	3.9	16
PL1 Idano	92	33	5.4	26
PL8 Neilson	98	56	25	16

Major Anions (mg/L)

Lake	Bicarbonate	Chloride	Sulfate	
PL3 Troudt	38	1.8	n.d.	
PL2 Pete`s	54	30	n.d.	
Little Mere	180	19	50	
PL6 Kinsey	140	3.2	93	
PL7 McMorran	260	1.0	56	
Gerharts	220	5.8	98	
PL4 Roi South	230	3.9	150	
PL5 Roi Mid	260	3.8	170	
PL1 Idano	340	5.6	140	
PL8 Neilson	180	1.8	360	
Sauer	---	---	---	
Chickakoo	---	---	---	

Carvel Lakes Conductivity

● Lake Depth ■ Conductivity



Related Variables

*Samples analyzed at Dept. of Earth Sciences, U. of A.

Lake	TDS mg/L	Cond uS/cm	pH	Iron ug/L
PL3 Troudt	41	78	7.03	55.6*
PL2 Pete`s Pond	99	200	7.16	62.9*
Sauer	---	347*	7.87*	26.5*
Little Mere	250	440	7.96	15.5*
PL6 Kinsey Cove	260	430	8.05	11.4*
Chickakoo	---	487*	7.33*	44.7*
PL7 McMorran	300	510	8.48	---
Gerharts	330	550	8.33	n.d.
PL5 Roi South	410	640	8.21	n.d.
PL6 Roi Middle	420	670	8.05	---
PL1 Idano	500	760	7.75	7.3*
PL8 Neilson	650	910	7.04	---

Ongoing Data Analyses

- ◆ Dr. K. Von Gunten collected detailed water and sediment chemistry data to characterize phosphorus dynamics between water and sediments - to be reported elsewhere
- ◆ He is also evaluating groundwater characteristics in the region and the potential for groundwater input to the study lakes



Summary

- ◆ Twelve lakes were sampled once under the ALMS “LakeKeeper” and U of A programs
 - Shallow lakes have declined since the late 1990s
 - Lakes exhibited diverse chemical compositions and trophic levels
 - Four lakes were observed to be deep and clear with very low surface phosphorus concentrations (PL1, PL4, PL5, Gerharts)
 - Shallow lakes had higher phosphorus and chlorophyll concentrations
 - Most lakes were thermally stratified at relatively shallow depths (except Chickakoo which is aerated)
 - Most had acute anoxia and very high [TP] in mid and bottom depths
 - Fish overwintering capacities (dissolved oxygen) are uncertain for most of the study lakes
 - Most lakes had highly intact riparian areas and adjacent forest cover
 - Bathymetry unavailable for most lakes

Suggested Next Steps

- ◆ Sample lakes in February/March 2021 to evaluate oxygen conditions and winterkill risk
- ◆ Expand survey of small lakes during summer 2021 and upgrade the existing water quality data base
- ◆ Summarize available information on watershed conditions and hydrology
- ◆ Continue to promote public education and lake stewardship

Thank you!



Thanks again!

