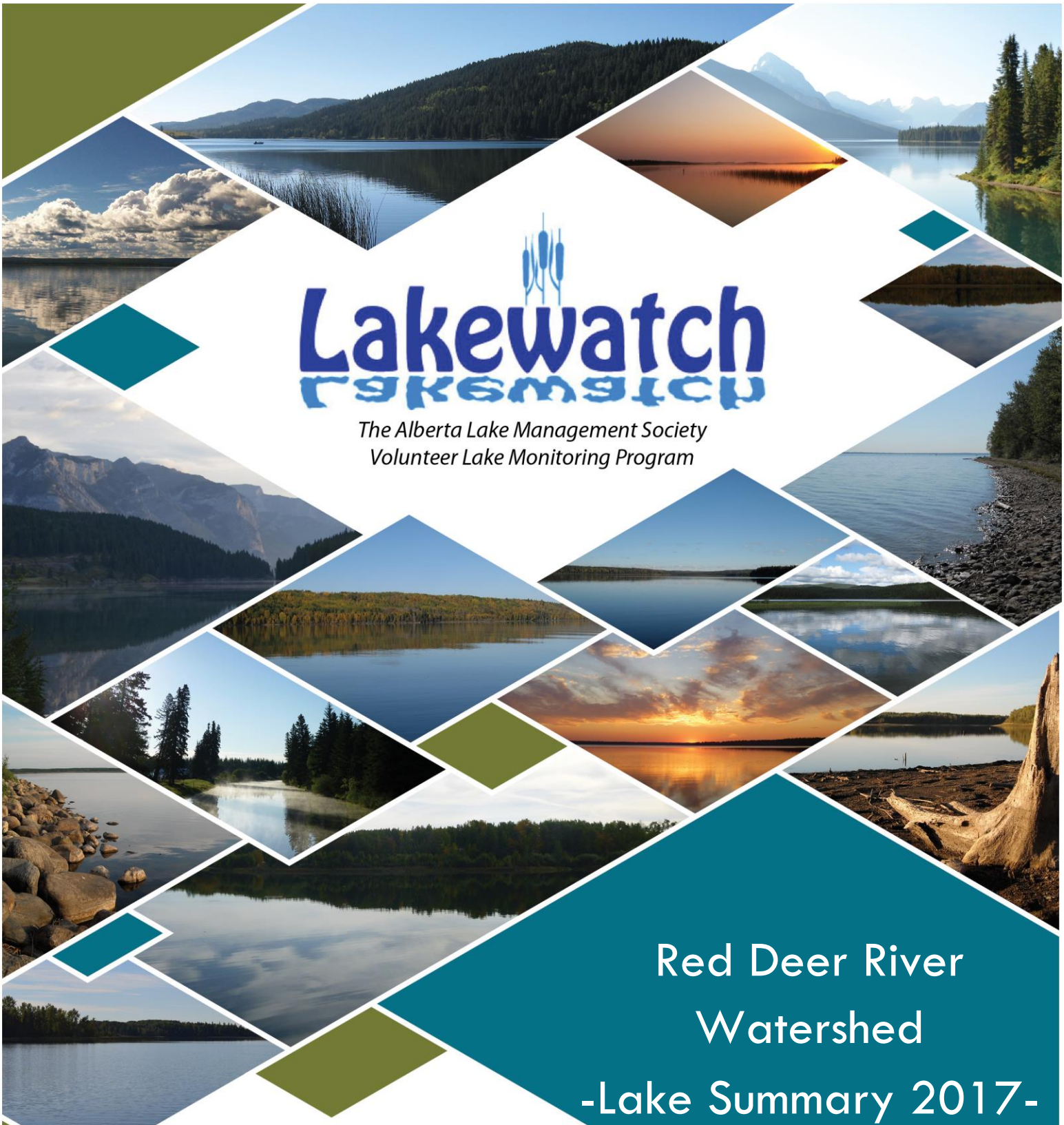

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Red Deer River Watershed
-Lake Summary 2017-

Lakewatch is made possible with support from:

Beaver River Watershed Alliance

Red Deer River Watershed Alliance

LICA Lakeland Industry & Community Association

Alberta

Cargill

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This project was undertaken with the financial support of:
Environnement Canada Environment Canada

ALMS

ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data on Alberta Lakes. Equally important is educating lake users about their aquatic environment, encouraging public involvement in lake management, and facilitating cooperation and partnerships between government, industry, the scientific community and lake users. This report is a summary of a sampling project conducted in partnership with the Red Deer River Watershed Alliance with specific project funding from Environment Canada's Environmental Damages Fund granting program in the summer of 2017. Key parameters are highlighted and compared in this report. Detailed reports on each individual lake can be found in the respective LakeWatch reports at www.alms.ca.

ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeWatch program. These people prove that ecological apathy can be overcome and give us hope that our water resources will not be the limiting factor in the health of our environment.

Data in this report has been prepared with un-validated 2017 data.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to thank the following volunteers:

- Alix Lake: Claudia Lipski, Linda Howitt-Taylor, Brian Laver, Geoff Parlby
- Haunted Lake: Claudia Lipski, Linda Howitt-Taylor, Brian Laver, Geoff Parlby
- Gleniffer Lake: Wade Mrochuk
- Pine Lake: Ed Lawrence
- Burnstick Lake: Bill Post

We would also like to thank Melissa Risto and Elashia Young who were summer technicians with ALMS in 2017. Executive Director Bradley Peter and Lakewatch Coordinator Laura Redmond were instrumental in planning and organizing the field program. This report was written by Laura Redmond and Bradley Peter. A special thank you to Jeff Hanger of the Red Deer River Watershed Alliance for his assistance with grant management and volunteer coordination.
Environment Canada was a major sponsor of this project.

EXECUTIVE SUMMARY

In 2017, the Alberta Lake Management Society partnered with the Red Deer River Watershed Alliance to monitor five lakes as part of the LakeWatch Program: Alix Lake, Haunted Lake, Gleniffer Lake, Pine Lake and Burnstick Lake.

Key parameters including Secchi disk depth, total phosphorus (TP), chlorophyll-*a*, microcystin, temperature, and dissolved oxygen are presented in this report.

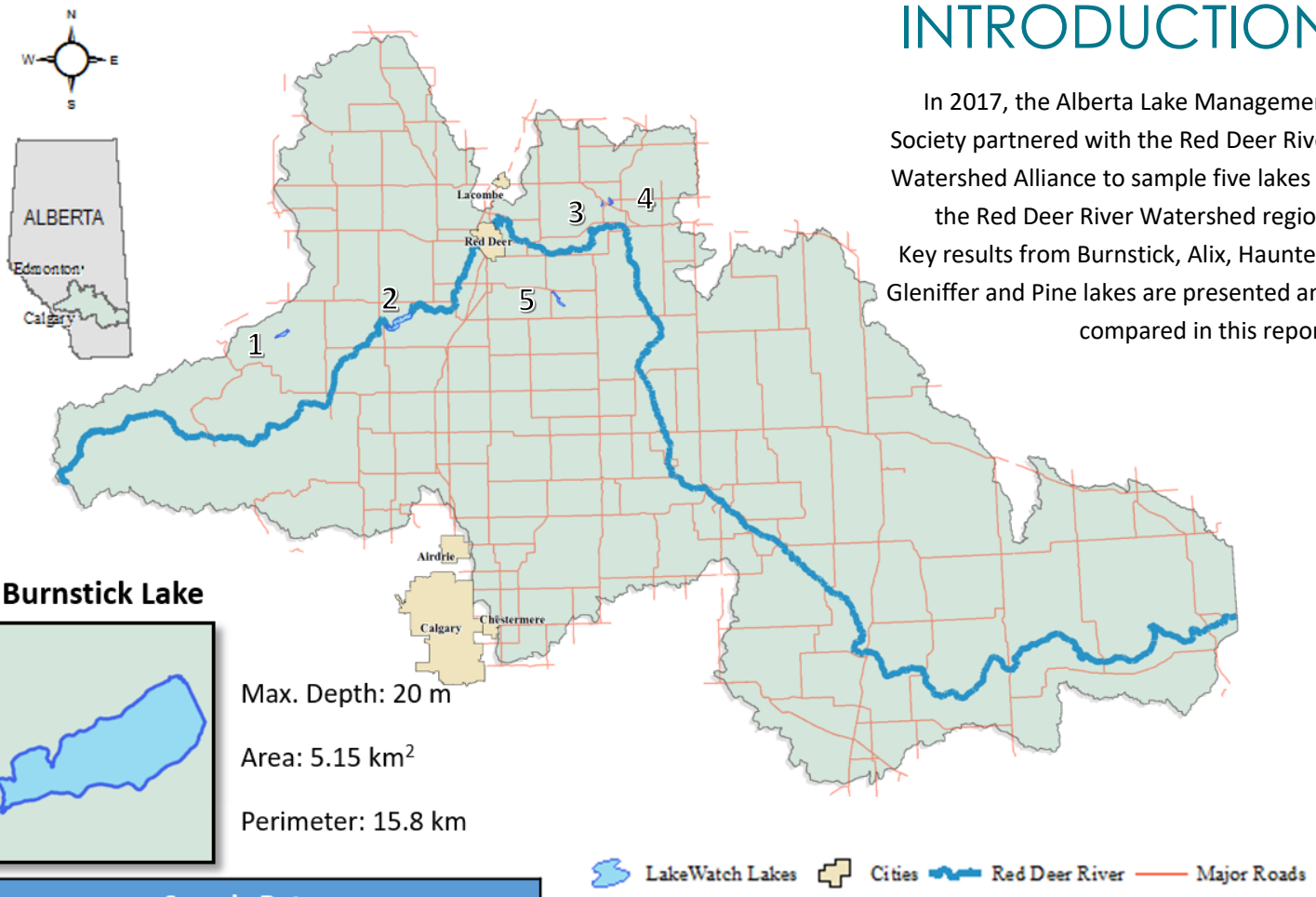
Water clarity varied greatly across lakes and appears correlated with concentrations of chlorophyll-*a*. Gleniffer Lake demonstrated the highest water clarity while Haunted Lake demonstrated the lowest water clarity. According to total phosphorus concentrations, the lakes span four trophic classification: oligotrophic, mesotrophic, eutrophic and hypereutrophic. According to chlorophyll-*a* concentrations, the lakes span three trophic classifications: oligotrophic, eutrophic and hypereutrophic.

Microcystin concentrations were low in Alix, Burnstick and Gleniffer, consistently falling below 1.0 µg/L. Pine Lake levels fell below the recreational guideline on all trips. In Haunted Lake, microcystin levels exceeded the recreational guideline of 20 µg/L in July and August.

Only one lake (Burnstick) demonstrated substantial thermal stratification which remained strong into September. Pine Lake demonstrated weak thermal stratification in July. Dissolved oxygen concentrations responded similarly, with three lakes (Alix, Haunted and Gleniffer) being well mixed and demonstrating well oxygenated water columns. Oxygen concentrations declined to anoxia in Burnstick Lake and during three visits in Pine Lake.

INTRODUCTION

In 2017, the Alberta Lake Management Society partnered with the Red Deer River Watershed Alliance to sample five lakes in the Red Deer River Watershed region. Key results from Burnstick, Alix, Haunted, Gleniffer and Pine lakes are presented and compared in this report.



1. Burnstick Lake

Max. Depth: 20 m

Area: 5.15 km^2

Perimeter: 15.8 km

Sample Dates				
Jun 5	Jul 4	Aug 1	Aug 18	Sep 7

2. Gleniffer Lake

Max. Depth: 26 m

Area: 16.6 km^2

Perimeter: 40.9 km

Sample Dates				
X	Jul 12	Aug 6	Aug 21	Sep 5

3. Alix Lake

Max. Depth: 2.9 m

Area: 0.58 km^2

Perimeter: 5.4 km

Sample Dates				
Jun 19	Jul 31	Aug 16	Aug 28	Sep 15

4. Haunted Lake

Max. Depth: 3.5 m

Area: 0.93 km^2

Perimeter: 12.9 km

Sample Dates				
Jun 18	Jul 31	Aug 16	Aug 28	Sep 15

5. Pine Lake

Max. Depth: 12 m

Area: 4.05 km^2

Perimeter: 20.0 km

Sample Dates				
Jun 24	Jul 19	Aug 11	Aug 30	Sep 26

WATER CLARITY AND SECCHI DEPTH

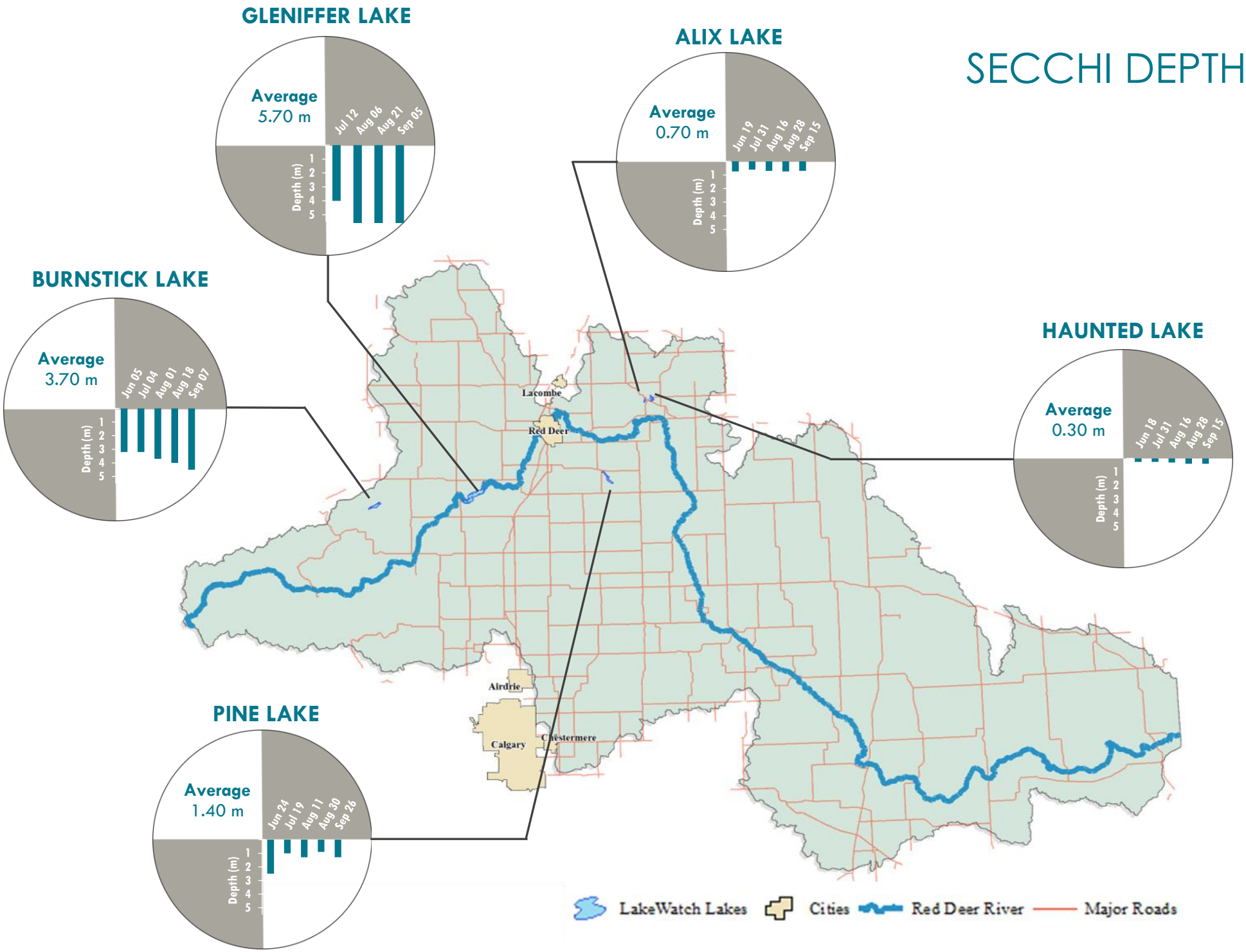
Water clarity is influenced by suspended materials, both living and dead, as well as dissolved colored compounds in the water column. During the melting of snow and ice in spring, lake water can become turbid (cloudy) from silt transported into the lake. Lake water usually clears in late spring but then becomes more turbid with increased algal growth as the summer progresses. The easiest and most widely used measure of lake water clarity is the Secchi disk depth. Two times the Secchi disk depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

Secchi disk depth was measured at the profile site of each lake on each sampling trip. It is typical for water clarity to decrease throughout the summer as phytoplankton concentrations increase. This was observed at each lake sampled in 2017 with the exception of Burnstick Lake and Gleniffer Lake, which showed an increase in water clarity over the course of the summer. At Burnstick Lake, macrophyte growth throughout the summer combined with its small size and deep depth may help to maintain a clear-water state and thus explain this pattern of water clarity. Gleniffer Lake is a reservoir that is filled in early summer which could increase turbidity and decrease water clarity in June.

In 2017, the highest average Secchi disk depth measured 6.50 m at Gleniffer Lake, while the lowest average Secchi disk depth measured 0.25 m at Haunted Lake (Page 4). Average water clarity values and chlorophyll-*a* concentrations shared an inverse relationship: as Secchi disk depth increased, chlorophyll-*a* concentration decreased (Page 4, Page 8). This supports the idea that chlorophyll-*a* is one of the key factors impeding water clarity in these lakes. Other factors which may contribute to differences in water clarity include dissolved organic compounds (which make the water brown) or suspended sediments, particularly in shallow lakes.

Clear water and aquatic plants observed at Burnstick Lake in 2016.

SECCHI DEPTH



TOTAL PHOSPHORUS, CHLOROPHYLL-A, AND MICROCYSTIN

ALMS measures a suite of water chemistry parameters. Phosphorus acts as one of the nutrients driving algae blooms in Alberta, while chlorophyll-a acts as an indicator of phytoplankton biomass, or how much algae is in the lake. These parameters together can help to identify the process of eutrophication, or excess nutrients, which can lead to harmful algae/cyanobacteria blooms. Taking these parameters together, lakes can be classified into oligotrophic (low nutrients), mesotrophic (moderately productive), eutrophic (productive) or hypereutrophic (highly productive). Microcystin represents the most common cyanobacterial toxin in Alberta.

Lakes can be grouped into trophic classifications based on their average total phosphorus (TP) concentrations. The five lakes sampled in 2017 fell into all four trophic categories based on TP: oligotrophic (Gleniffer Lake), mesotrophic (Burnstick Lake), eutrophic (Alix Lake and Pine Lake) and hypereutrophic (Haunted Lake). Similarly, lakes can also be grouped into trophic classifications based on their average chlorophyll-*a* concentrations. The five lakes sampled in 2017 fell into three trophic categories based on chlorophyll-*a* concentrations: oligotrophic (Burnstick Lake and Gleniffer Lake), eutrophic (Alix Lake) and hypereutrophic (Pine Lake and Haunted Lake).

Microcystin concentrations differed at each of the lakes monitored (Table 1). Concentrations consistently fell below 1.0 µg/L, well below the recreational guideline of 20 µg/L in Alix, Gleniffer and Burnstick. Microcystin concentrations were highest in Haunted Lake with levels above the recreational guideline in July and August. Pine Lake levels remained below the guideline, however recreating in cyanobacteria blooms should be avoided.

Cyanobacteria bloom on Pine Lake in 2013- Photo by Jessica Davis

TOTAL PHOSPHORUS

BREAKDOWN BY DATE

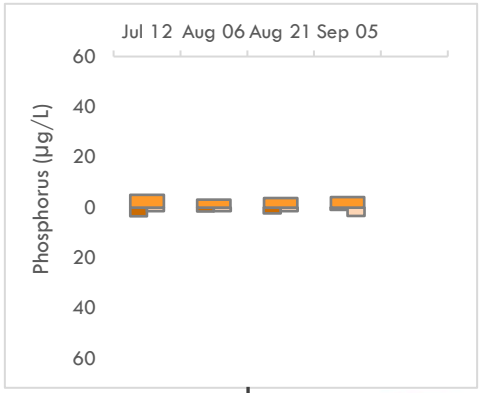
Total Phosphorus (TDP + TPP)

Total Dissolved Phosphorus (TDP)

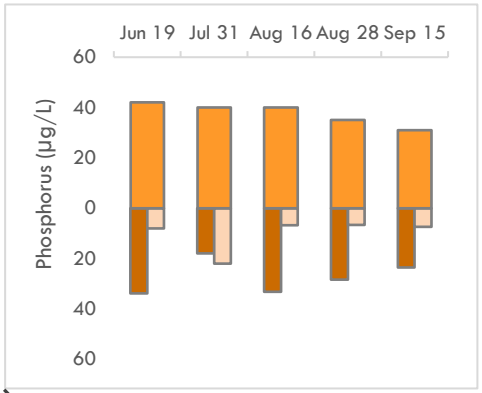
Total Particulate Phosphorus (TPP)

*Graphs presented may have different scales

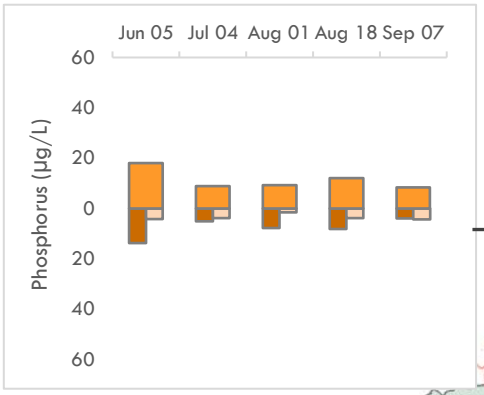
GLENIFFER



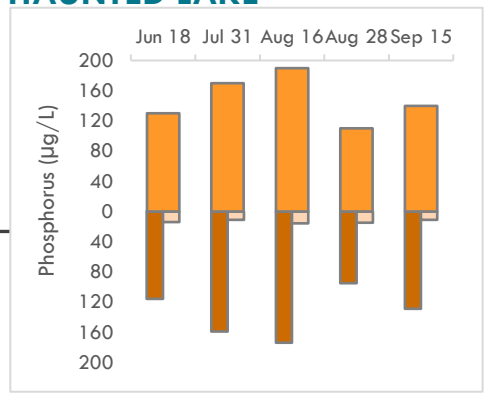
ALIX LAKE



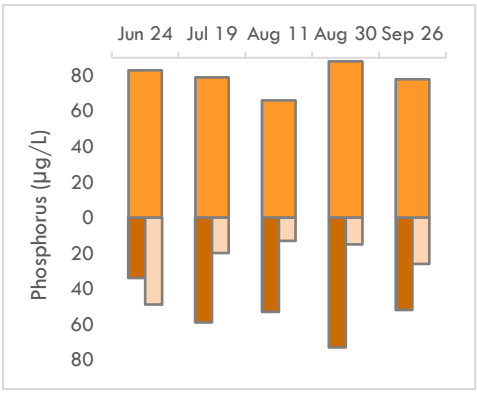
BURNSTICK LAKE



HAUNTED LAKE

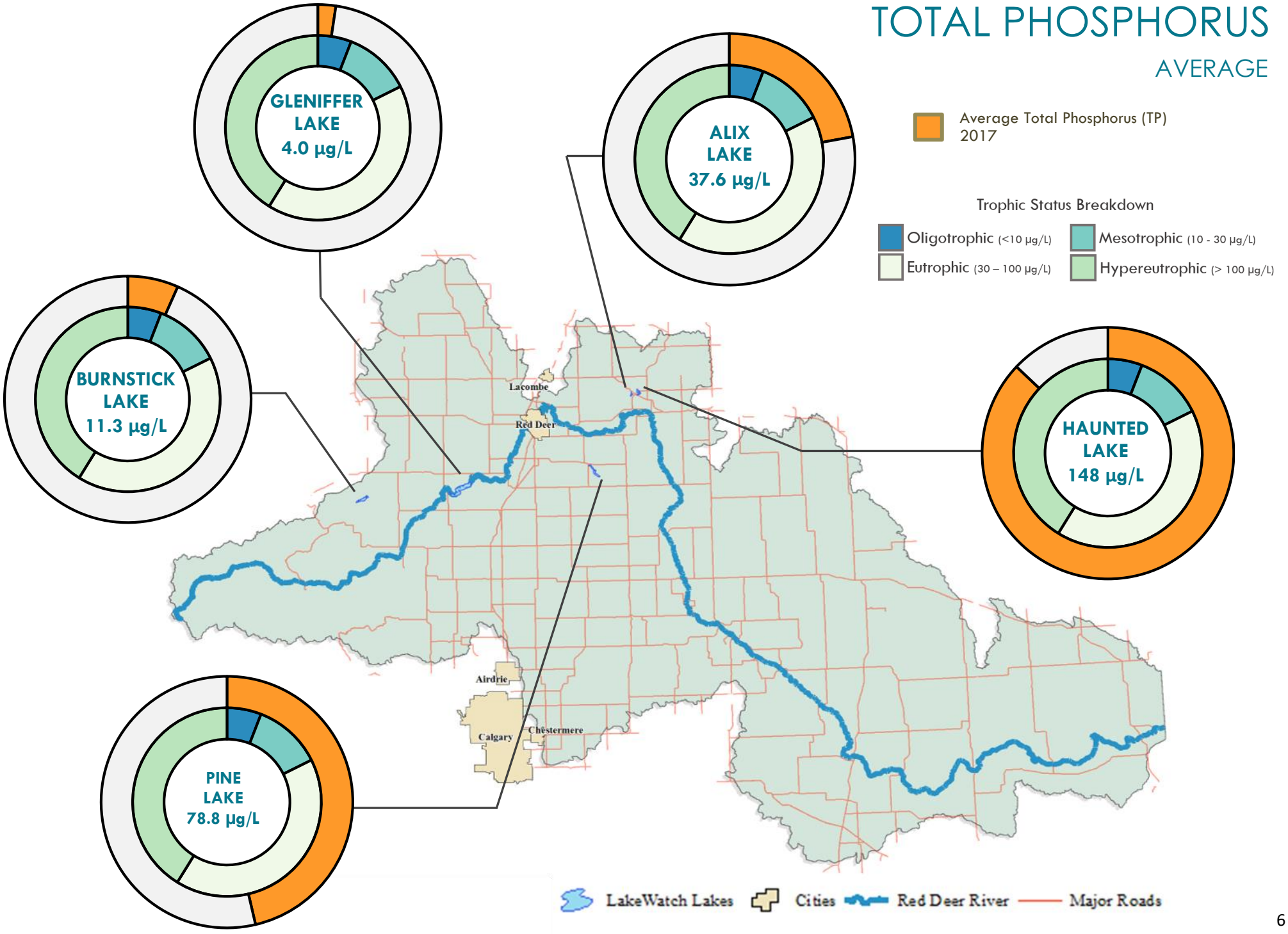


PINE LAKE



TOTAL PHOSPHORUS

AVERAGE

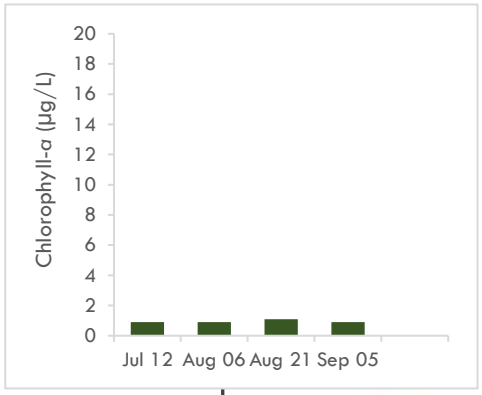


CHLOROPHYLL - A

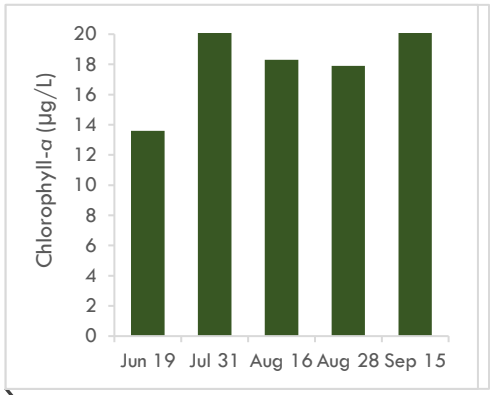
BREAKDOWN BY DATE

*Graphs presented may have different scales

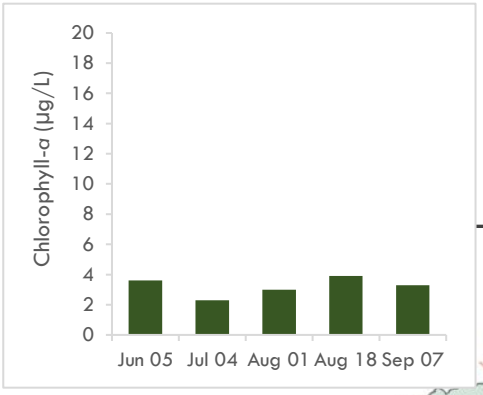
GLENIFFER LAKE



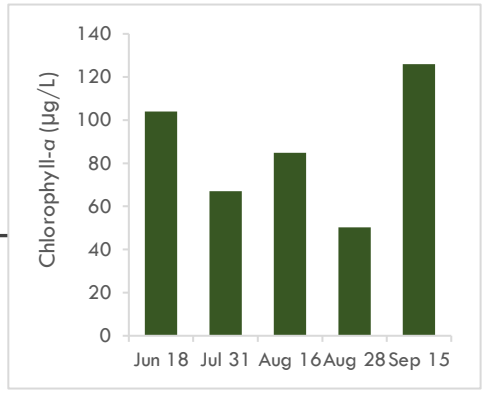
ALIX LAKE



BURNSTICK LAKE



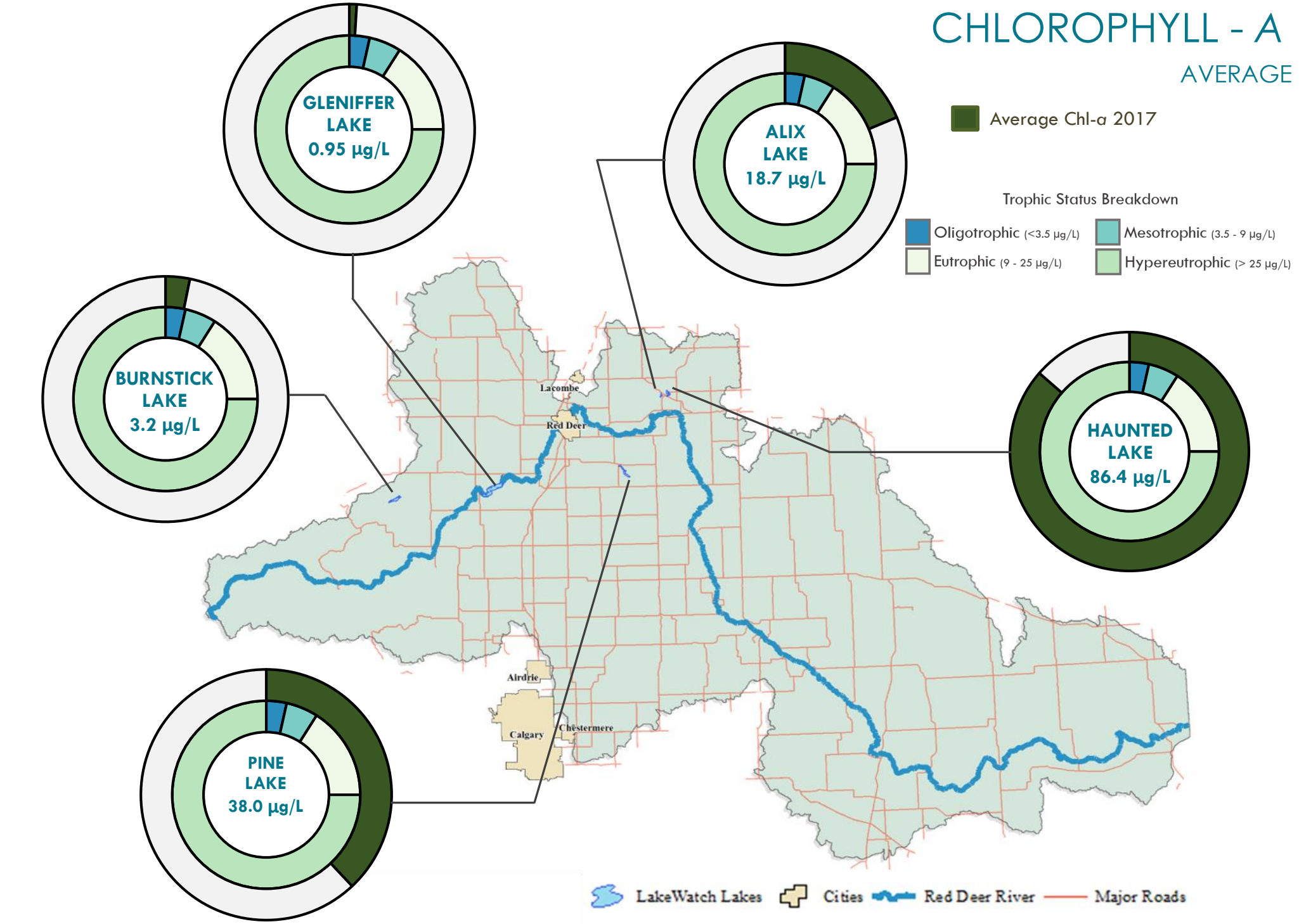
HAUNTED LAKE



PINE LAKE

CHLOROPHYLL - *A*

AVERAGE



TEMPERATURE AND DISSOLVED OXYGEN PROFILES

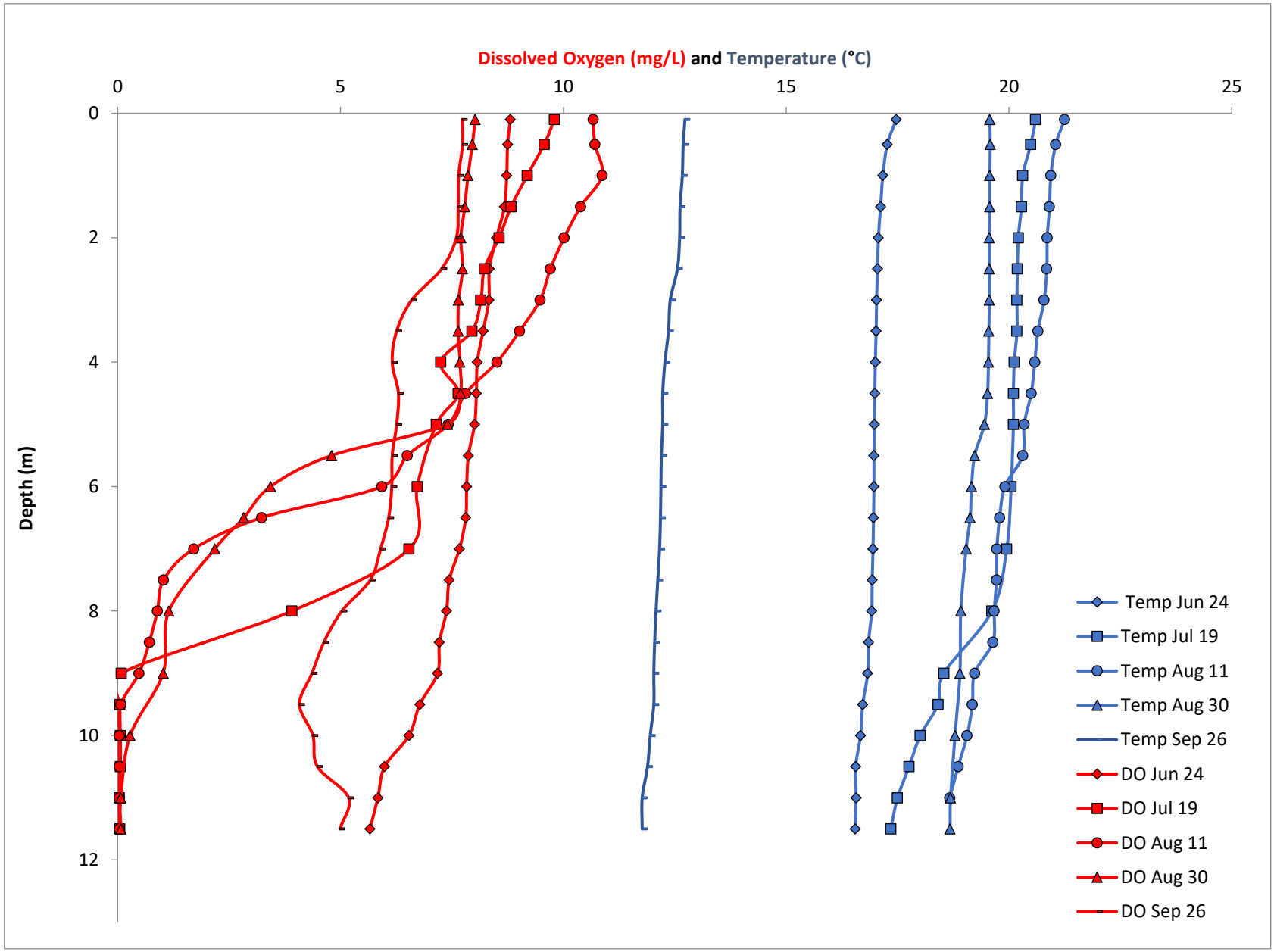
Water temperature and dissolved oxygen profiles in the water column can provide information on water quality and fish habitat. The depth of the thermocline is important in determining the depth to which dissolved oxygen from the surface can be mixed. Please refer to the end of this report for descriptions of technical terms.

The five lake sampled in 2017 vary greatly in their depths (Page 1). As such, temperature and dissolved oxygen profiles behaved differently across the five lakes.

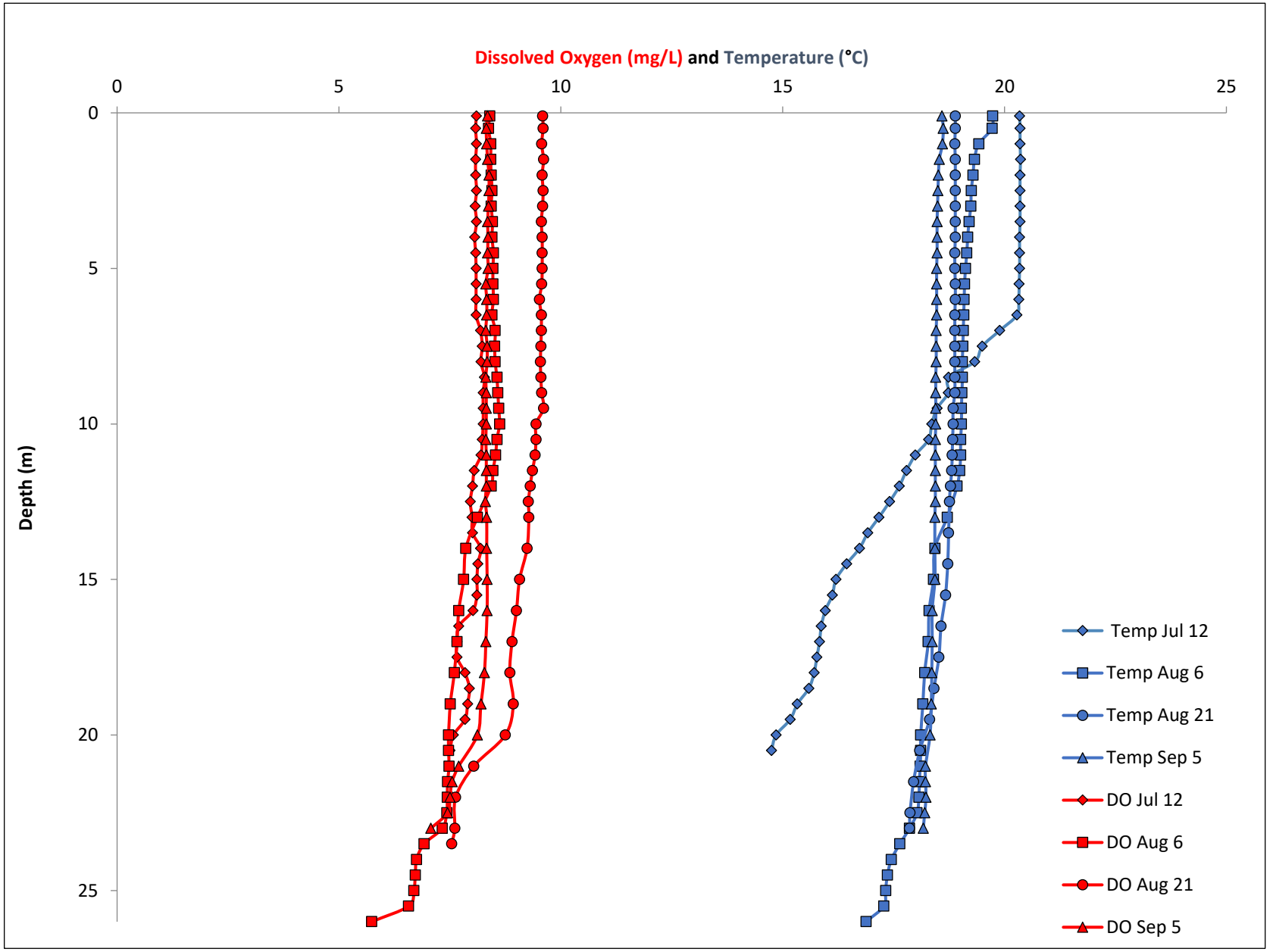
As Alix Lake and Haunted Lake are shallow, no thermal stratification was observed (Page 13, 15), suggesting they mix regularly throughout the summer. At Pine Lake, weak thermal stratification was observed on July 19th, but the water column remained well mixed during the remainder of the summer (Page 11). Gleniffer Lake is a reservoir that is mixed regularly, and therefore no thermal stratification was observed in the summer of 2017 (Page 12). Finally, at Burnstick Lake, no mixing events were observed due to the strong thermal stratification established at the deep spot on the lake (Page 14). Across the five lakes, a maximum surface water temperature of 22.56 °C was observed at Alix Lake on July 31st.

Thermal stratification has important implications for dissolved oxygen concentrations within the lakes. Due to the mixing of the water column, Alix, Haunted and Gleniffer lakes had well oxygenated waters for much of their depths (Page 13, 14, 15). At Pine Lake, oxygen concentrations declined slightly in the presence of thermal stratification, and proceeded toward anoxia at the bottom on June 24, July 19 and August 11 (Page 11). At Burnstick Lake, dramatic declines in oxygen concentrations were observed with thermal stratification, with the lake reaching anoxia as early as 8.5 m (Page 14).

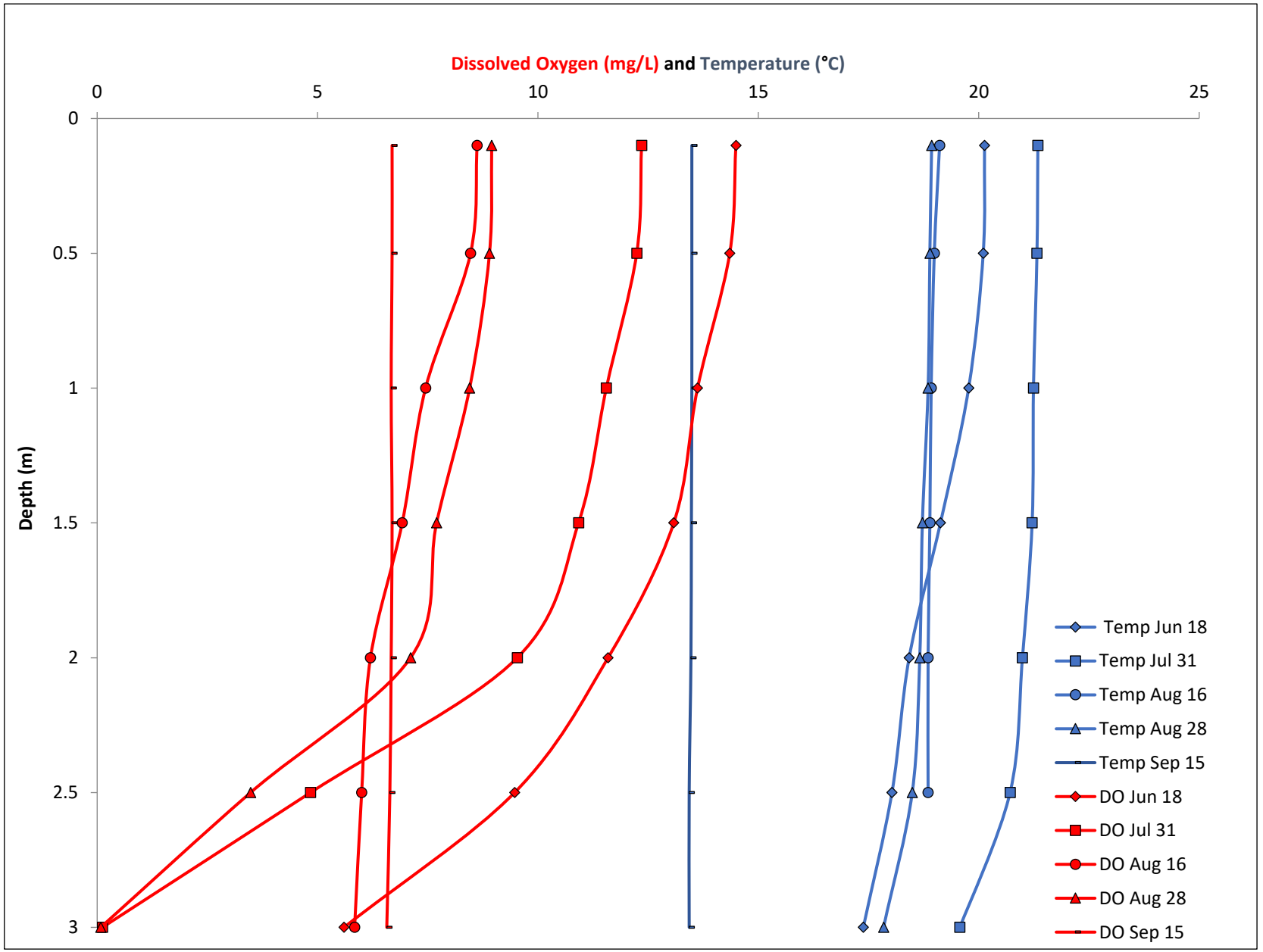
Pine Lake 2013- Photo by Jessica Davis



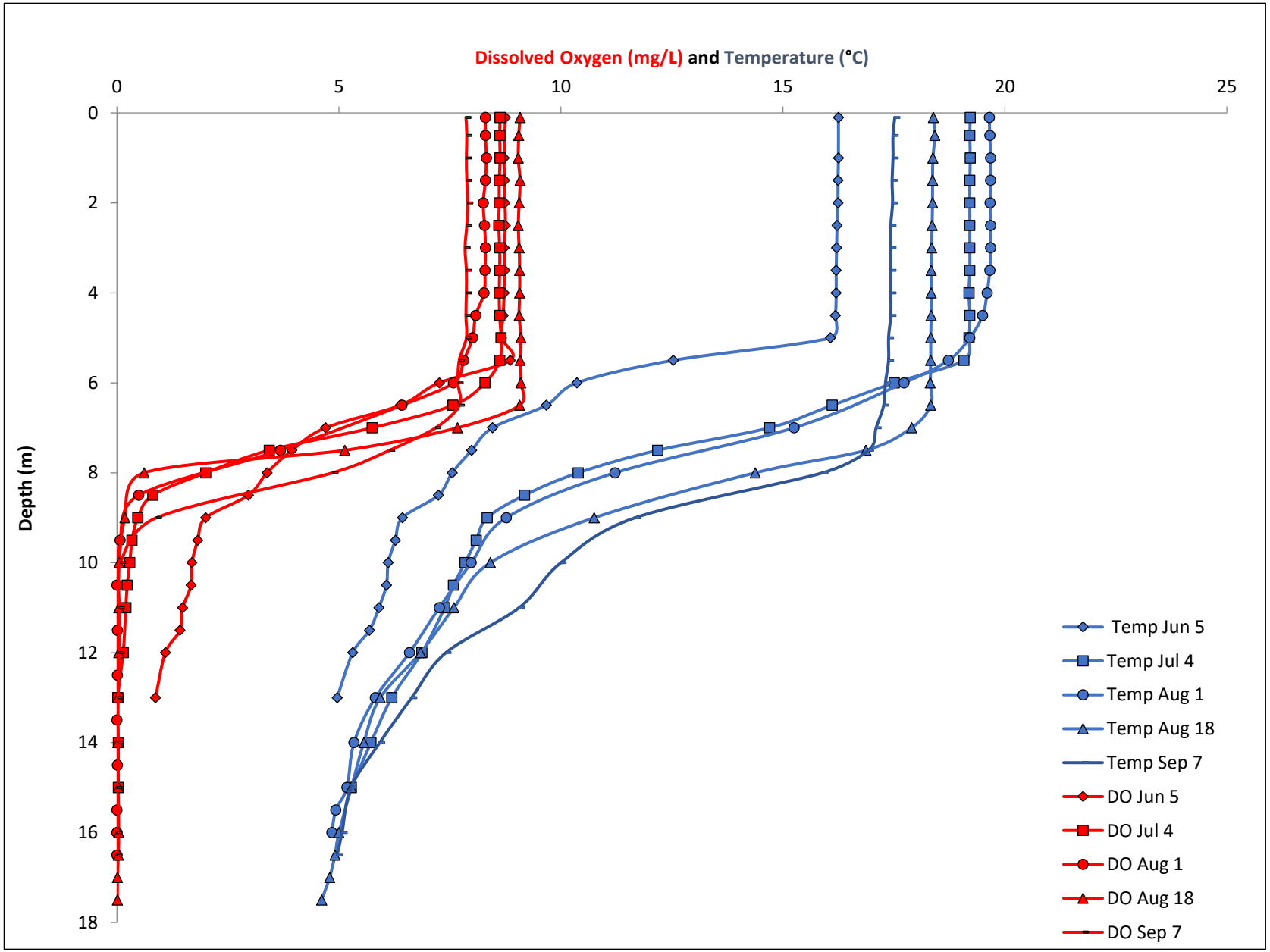
Pine Lake Profile: Temperature and dissolved oxygen profiles measured five times over the course of the summer at Pine Lake.



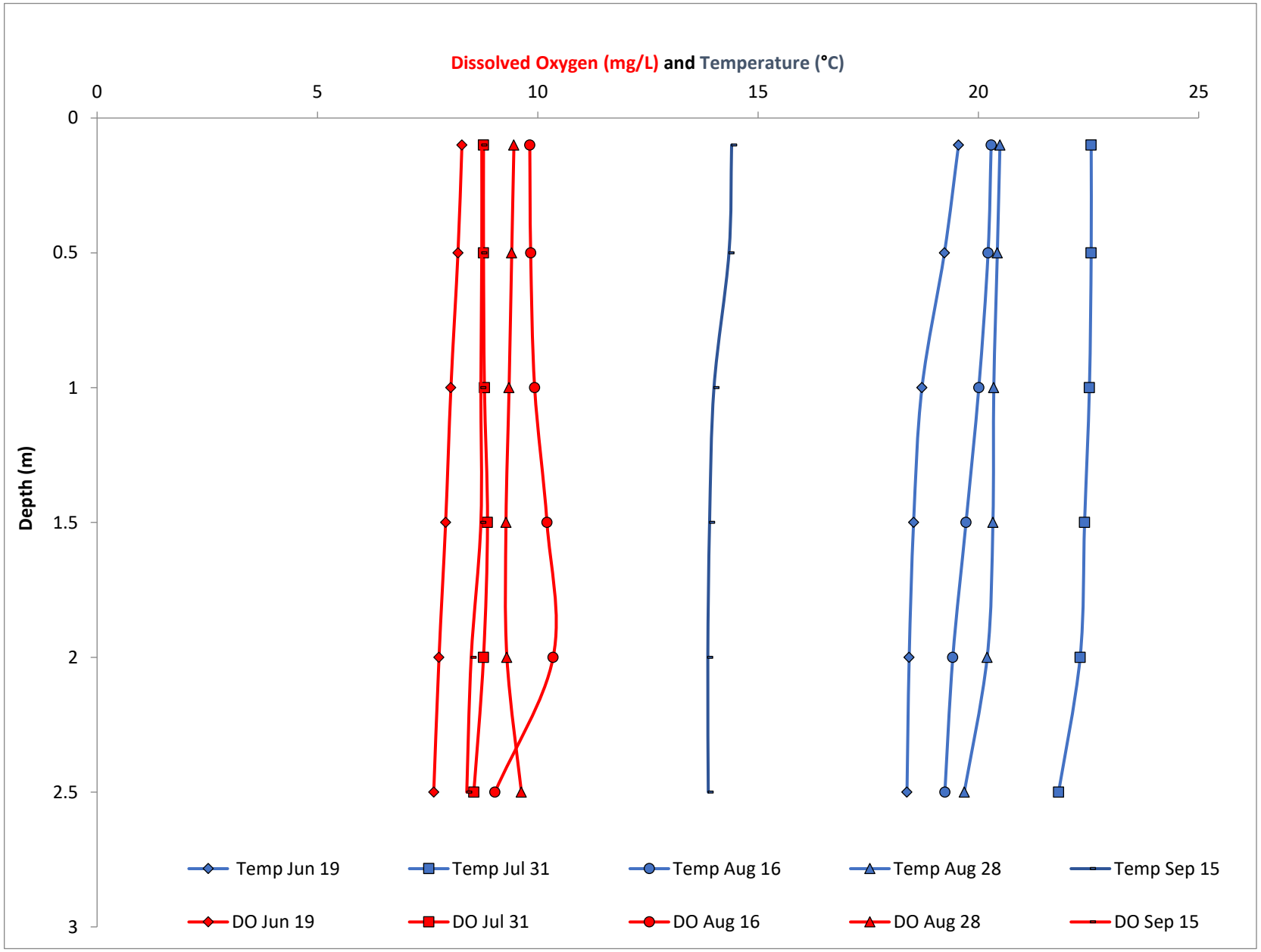
Gleniffer Lake Profile: Temperature and dissolved oxygen profiles measured four times over the course of the summer at Gleniffer Lake.



Haunted Lake Profile: Temperature and dissolved oxygen profiles measured five times over the course of the summer at Haunted Lake.



Burnstick Lake Profile: Temperature and dissolved oxygen profiles measured five times over the course of the summer at Burnstick Lake.



Alix Lake Profile: Temperature and dissolved oxygen profiles measured five times over the course of the summer at Alix Lake.

APPENDIX

Table 1-- Water clarity and water chemistry values measured at five lakes during the summer of 2017.

LAKE	SAMPLE DATE	TP (µG/L)	TDP (µG/L)	CHL-A (µG/L)	SECCHI (M)	PH	COND.	MICROCYSTIN
PINE	Jun 24	83	49	20.6	2.50	8.69	780	0.85
	Jul 19	79	20	47.3	1.00	8.83	730	1.97
	Aug 11	66	13	37.5	1.30	8.91	720	2.82
	Aug 30	88	15	53.2	0.90	8.85	740	3.20
	Sep 26	78	26	31.2	1.30	8.59	740	2.43
	2017 Average	**79**	**25**	**38.0**	**1.40**	**8.77**	**742**	**2.25**
HAUNTED	Jun 18	130	14	104.0	0.25	9.28	1200	2.83
	Jul 31	170	11	67.1	0.25	9.49	1300	20.41
	Aug 16	190	16	84.8	0.30	9.32	1300	29.00
	Aug 28	110	15	50.3	0.40	9.33	1300	4.18
	Sep 15	140	11	126.0	0.40	9.18	1400	1.10
	2017 Average	**148**	**13**	**86.4**	**0.32**	**9.32**	**1300**	**11.50**
GLENIFFER	Jul 12	5	2	0.9	4.00	8.36	350	<0.1
	Aug 06	3	2	0.9	5.80	8.38	360	<0.1
	Aug 21	4	2	1.1	6.50	8.40	360	<0.1
	Sep 05	4	3	0.9	6.50	8.37	390	<0.1
	2017 Average	**4**	**2**	**0.9**	**5.70**	**8.38**	**365**	**<0.1**
BURNSTICK	Jun 05	18	4	3.6	3.20	8.33	280	0.30
	Jul 04	9	4	2.3	3.20	8.36	270	<0.1
	Aug 01	9	2	3.0	3.70	8.26	270	<0.1
	Aug 18	12	4	3.9	4.00	8.31	270	0.10
	Sep 07	8	4	3.3	4.50	8.19	280	<0.1
	2017 Average	**11**	**4**	**3.2**	**3.72**	**8.29**	**274**	**0.11**
ALIX	Jun 19	42	8	13.6	0.75	8.51	1000	0.25
	Jul 31	40	22	20.9	0.60	8.89	1000	0.42
	Aug 16	40	7	18.3	0.70	8.89	1000	0.36
	Aug 28	35	7	17.9	0.75	8.88	1100	0.27
	Sep 15	31	7	22.7	0.70	8.81	1100	0.25
	2017 Average	**38**	**10**	**18.7**	**0.70**	**8.80**	**1040**	**0.05**

Values with a < symbol fall below the minimum detection limit and have been divided by two for calculations.

*TDP cannot exceed TP – an artefact of the analytical process when the values are similar.