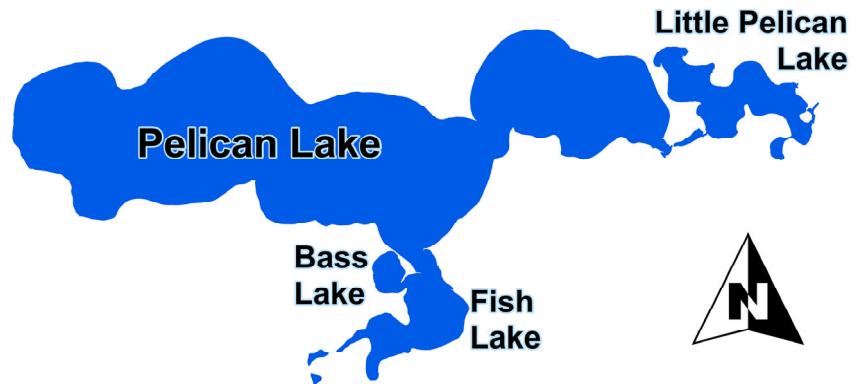


Chapter 3. Lake Assessments

Introduction

The Pelican Group of Lakes encompasses 4 lakes: Pelican, Little Pelican, Bass, and Fish. Although these lakes have somewhat different characteristics, they are all considered to have good water quality for northwest Minnesota.



Little Pelican Lake is the first of the PGOLID lakes when considering water flow. The Pelican River drains into Little Pelican Lake on the northeast side and provides the majority of the phosphorus entering the lake. Little Pelican Lake is considered a shallow lake because the majority of the area of the lake is 15 feet deep or less, and it is ringed with emergent vegetation (bulrush, cattails, wild rice, etc). Therefore, because Little Pelican Lake is a shallow lake and the Pelican River drains directly into it, it has the highest phosphorus and lowest clarity of the PGOLID lakes. It is still considered a very healthy shallow lake as the water quality and fishery characteristics are in the range of what is to be expected for a lake of this size and depth.

Pelican, Bass and Fish Lakes are all very similar in water quality and lake condition. In fact, they are all one large system of water. They are fairly deep (33-69 ft), have excellent fisheries, and are good for recreation. These characteristics make them a top tourist destination in northwest Minnesota. The Pelican River exits at the southwest end of Fish Lake.

These four lakes must be protected by preserving aquatic habitat and plants, restoring natural shoreline conditions, minimizing impervious surface, working with neighbors upstream of the Pelican River for good watershed management practices, proper maintenance of waste water treatment systems, and education of lakeshore property owners.

PGOLID Lake Vitals

	Pelican	Little Pelican	Bass	Fish
Size (acres)	3,986	345	48	261
Mean depth (ft)	22	12	18	27
Littoral area (%)	41	74	50	48
Maximum depth (ft)	55	25	33	69
Volume (acre ft)	87,692	4,140	864	7,047
Watershed Area (acres)	164,092	96,538	138	162,190
Trophic State Index (TSI)	41	46	42	40
Total Phosphorus Mean (ug/L)	14	24	17	12
Chlorophyll a Mean (ug/L)	5	10	5	4
Chlorophyll a Maximum (ug/L)	17	31	17	9
Transparency (Secchi depth, ft)	12.6	8.3	12.0	12.4

Pelican Lake

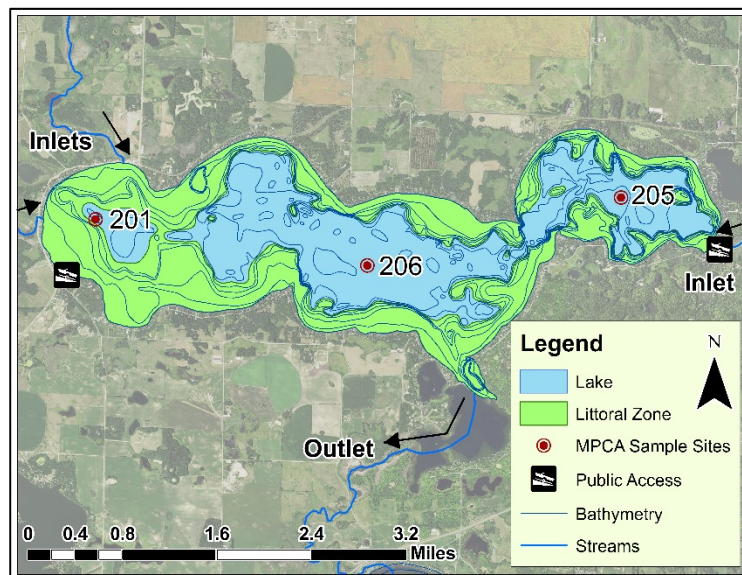
56-0786-00 OTTER TAIL COUNTY

Summary

Pelican Lake is a deep, mesotrophic lake. Pelican Lake has three inlets and a large watershed, which means the watershed is the main impact to the lake's water quality. There is an improving long-term trend in transparency and algae levels.

Lake Vitals

MN Lake ID:	56-0786-00
Major Drainage Basin:	Red River
Surface area (acres):	3,986
Littoral area (acres):	1,625
% Littoral area:	40%
Max depth (ft), (m):	55, 16.8
Inlets / Outlets:	3 / 1
Public Accesses	2
Development Class:	General Development
Aquatic Invasive Species:	Zebra Mussels (confirmed September 2009), Curly-leaf pondweed



Water Quality Characteristics

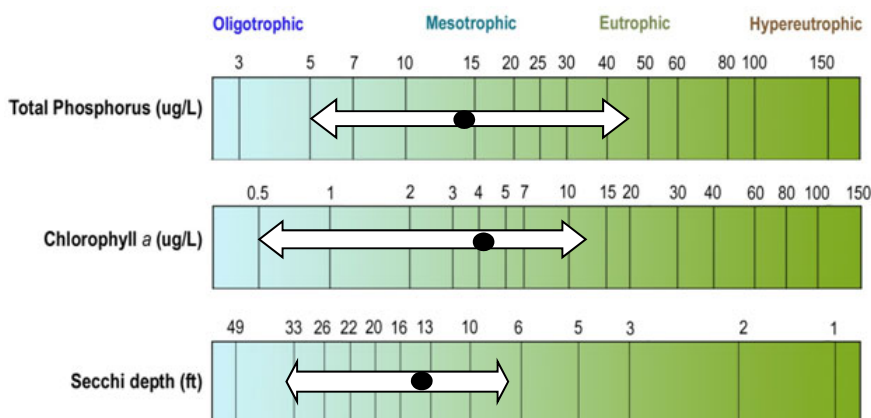
Years monitored: 1996-2017

Parameters	Primary Site 206	Site 201	Site 205
Phosphorus Mean (ug/L):	14.6	13.1	16.8
Phosphorus Min (ug/L):	5	6	2.5
Phosphorus Max (ug/L):	45	26	90
Number of Observations:	137	90	91
Chlorophyll-a Mean (ug/L):	4.1	3.3	4.3
Chlorophyll-a Min (ug/L):	0	0	0
Chlorophyll-a Max (ug/L):	12	12	17
Number of Observations:	110	63	64
Secchi Depth Mean (ft):	14.8	15.5	14.2
Secchi Depth Min (ft):	7	7	7
Secchi Depth Max (ft):	35	32	29.5
Number of Observations:	137	90	91

Trophic State Index

Trophic State: Mesotrophic (41)

The figure below shows the minimum and maximum values with the arrows and the mean with the black dot.



Long-term Trends

Primary site only. Recommend minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%

Data Quality	Good (meets minimum requirement above)
Total Phosphorus:	No Significant Trend
Chlorophyll-a:	Improving Trend (95%)
Secchi Depth:	Improving Trend (99.9%)

Ecoregion Comparisons

(Primary site only. Comparisons are based on interquartile range, 25th - 75th percentile, for ecoregion reference lakes)

Ecoregion:	Central Hardwood Forest
Total Phosphorus:	Better Than Expected Range
Chlorophyll-a:	Better Than Expected Range
Secchi Depth:	Better Than Expected Range

Phosphorus Loading

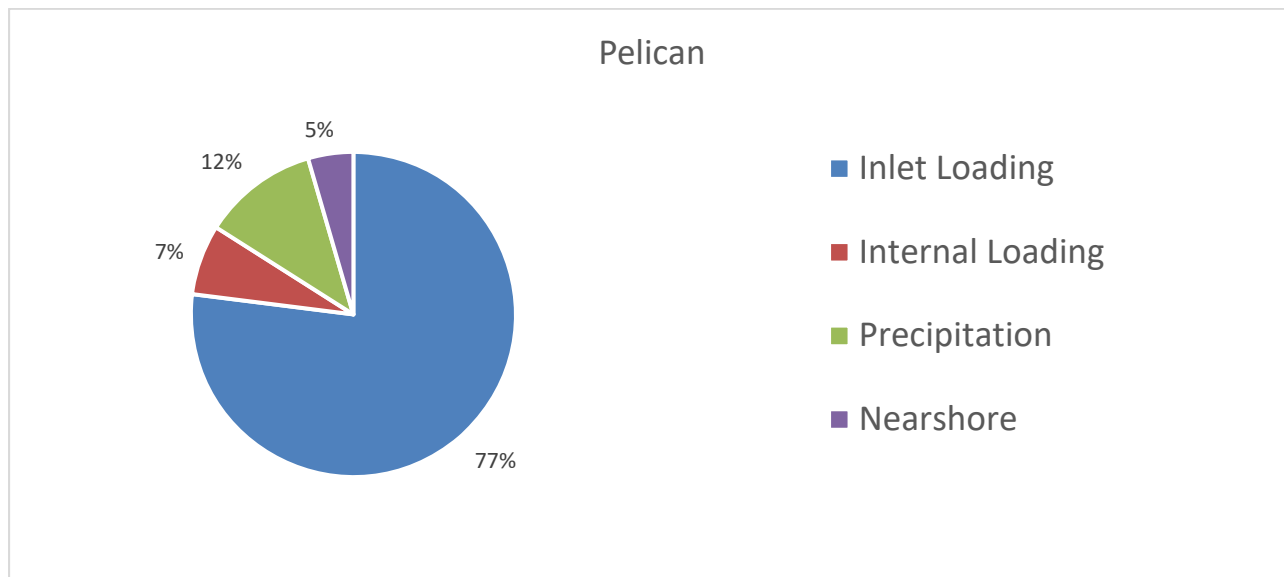
Pelican Lake has a large watershed, so there are upstream phosphorus sources that contribute to the lake's productivity.

Through DNR modeling, the phosphorus concentration target for Pelican Lake was determined to be 14 ug/L. The current historical mean phosphorus concentration is 14.6 ug/L (page 27), so it is really close to target.

Phosphorus Loading.

Phosphorus loading from nearshore	5%
Phosphorus loading from precipitation	12%
Phosphorus loading from inlets	77%

Lakeshed to Lake Area Ratio (lakeshed includes lake area)	4:1
Watershed to Lake Area Ratio (watershed includes lake areas)	38:1
Number of Upstream Lakes	29
Headwaters Lake?	No
Inlets / Outlets	3/1
Water Residence Time	0.76 years



Little Pelican Lake

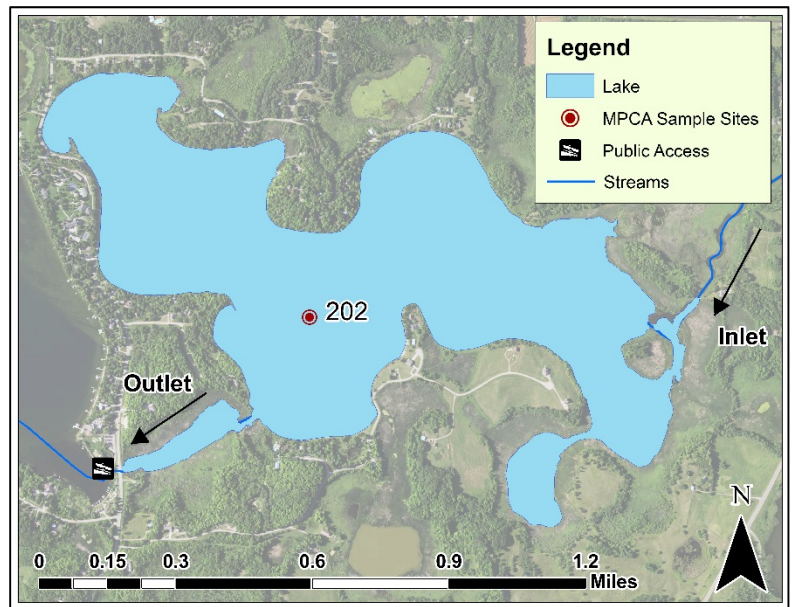
56-0761-00 OTTER TAIL COUNTY

Summary

Little Pelican Lake is a shallow, mesotrophic lake. Little Pelican Lake has one major inlet and a large watershed, which means the watershed is the main impact to the lake's water quality. There is currently no long-term trend in transparency.

Lake Vitals

MN Lake ID:	56-0761-00
Major Drainage Basin:	Red River
Surface area (acres):	345
Littoral area (acres):	256
% Littoral area:	74%
Max depth (ft), (m):	25, 7.6
Inlets / Outlets:	1 / 1
Public Accesses	1 Shared with Pelican Lake
Development Class:	Recreational Development
Aquatic Invasive Species:	Zebra Mussels (confirmed September 2009), Curly-leaf pondweed



Water Quality Characteristics

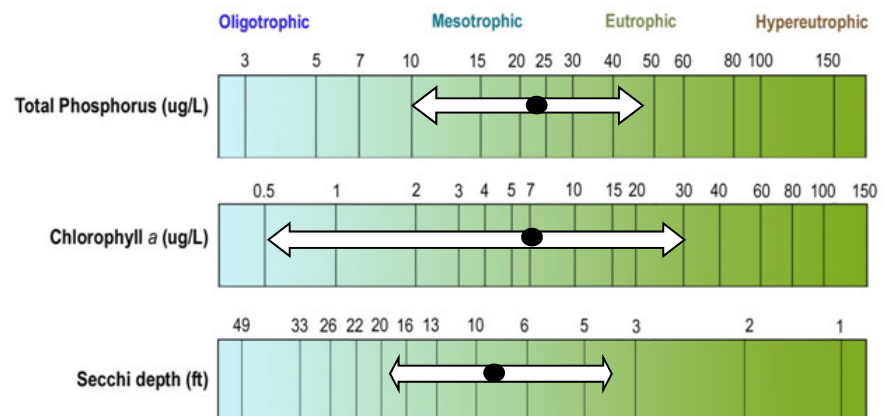
Years monitored: 2003-2017

Parameters	202
Phosphorus Mean (ug/L):	24.1
Phosphorus Min (ug/L):	10
Phosphorus Max (ug/L):	48
Number of Observations:	109
Chlorophyll-a Mean (ug/L):	7.4
Chlorophyll-a Min (ug/L):	0
Chlorophyll-a Max (ug/L):	30
Number of Observations:	82
Secchi Depth Mean (ft):	8.7
Secchi Depth Min (ft):	4
Secchi Depth Max (ft):	19
Number of Observations:	109

Trophic State Index

Trophic State: Mesotrophic (47)

The figure below shows the minimum and maximum values with the arrows and the mean with the black dot.



Long-term Trends

Primary site only. Recommend minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%

Data Quality	Good (meets minimum requirement above)
Total Phosphorus:	No Significant Trend
Chlorophyll-a:	Improving Trend (90%)
Secchi Depth:	No Significant Trend

Ecoregion Comparisons

(Primary site only. Comparisons are based on interquartile range, 25th - 75th percentile, for ecoregion reference lakes)

Ecoregion:	Central Hardwood Forest
Total Phosphorus:	Within Expected Range
Chlorophyll-a:	Within Expected Range
Secchi Depth:	Within Expected Range

Phosphorus Loading

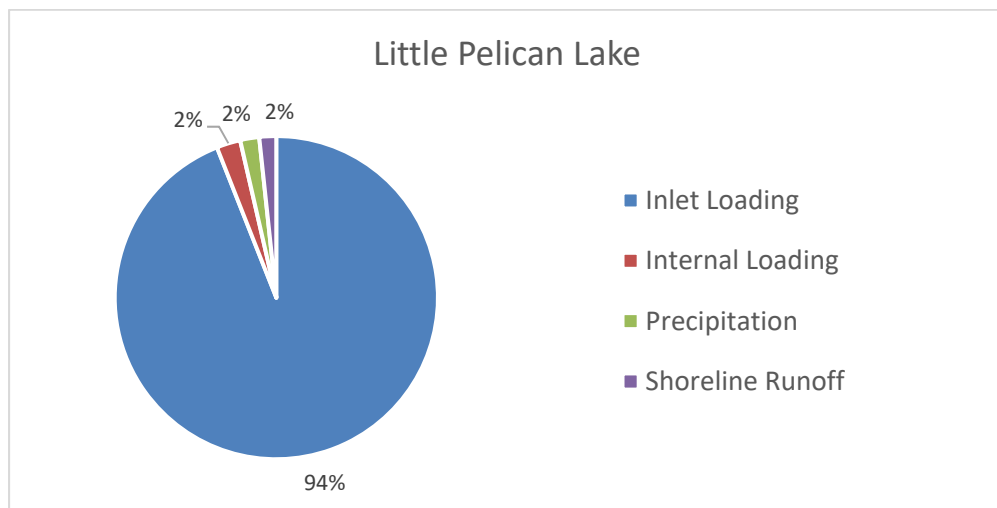
Little Pelican Lake has a large watershed, so there are upstream phosphorus sources that contribute to the lake's productivity.

Through DNR modeling, the phosphorus concentration target for Little Pelican Lake was determined to be 22 ug/L. The current historical mean phosphorus concentration is 24.1 ug/L (page 29), so it is really close to target.

Watershed characteristics.

Lakeshed to Lake Area Ratio (lakeshed includes lake area)	4:1
Watershed to Lake Area Ratio (watershed includes lake areas)	223:1
Number of Upstream Lakes	28
Headwaters Lake?	No
Inlets / Outlets	1/1
Water Residence Time	0.053 years

Phosphorus Loading.	Percentage
Phosphorus loading from nearshore	2%
Phosphorus loading from precipitation	2%
Phosphorus loading from inlets	94%



Fish Lake

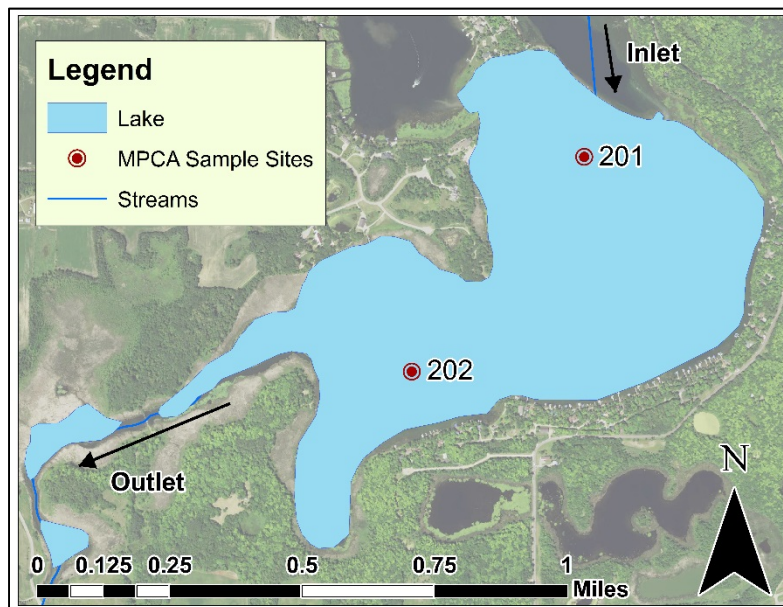
56-0768-00 OTTER TAIL COUNTY

Summary

Fish Lake is a deep, moderately mesotrophic lake. Fish Lake has no major inlets and a small watershed, which means the land practices around the lake are the main impact to the lake's water quality. There is a declining long-term trend in transparency.

Lake Vitals

MN Lake ID:	56-0768-00
Major Drainage Basin:	Red River
Surface area (acres):	261
Littoral area (acres):	127
% Littoral area:	48%
Max depth (ft), (m):	69, 21
Inlets / Outlets:	1/1
Public Accesses	0
Development Class:	General Development
Aquatic Invasive Species:	Zebra Mussels (confirmed September 2009), Curly-leaf pondweed



Water Quality Characteristics

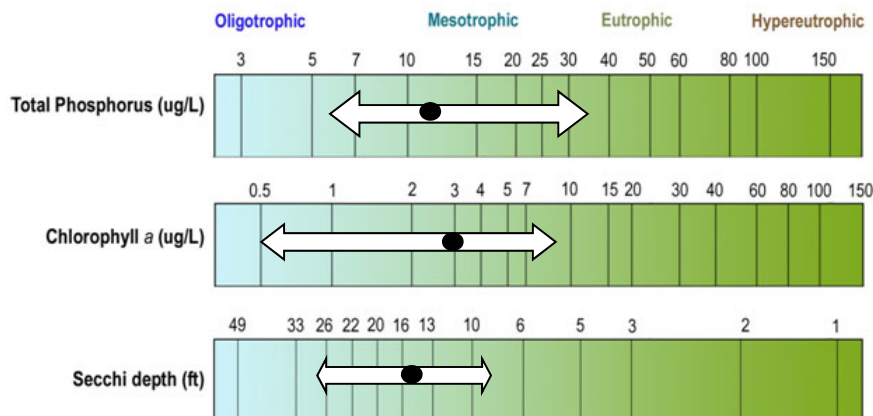
Years monitored: 2003-2017

Parameters	Primary Site 201	Site 202
Phosphorus Mean (ug/L):	11.8	12.3
Phosphorus Min (ug/L):	6	5
Phosphorus Max (ug/L):	21	34
Number of Observations:	109	28
Chlorophyll-a Mean (ug/L):	3	3.7
Chlorophyll-a Min (ug/L):	0	0
Chlorophyll-a Max (ug/L):	9	8
Number of Observations:	82	28
Secchi Depth Mean (ft):	15.2	14.6
Secchi Depth Min (ft):	8	9
Secchi Depth Max (ft):	26.5	23.5
Number of Observations:	109	28

Trophic State Index

Trophic State: Mesotrophic (39)

The figure below shows the minimum and maximum values with the arrows and the mean with the black dot.



Long-term Trends

Primary site only. Recommend minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%

Data Quality	Good (meets minimum requirement above)
Total Phosphorus:	No Significant Trend
Chlorophyll-a:	Improving Trend (99.9%)
Secchi Depth:	Improving Trend (99%)

Ecoregion Comparisons

(Primary site only. Comparisons are based on interquartile range, 25th - 75th percentile, for ecoregion reference lakes)

Ecoregion:	Central Hardwood Forest
Total Phosphorus:	Below Expected Range
Chlorophyll-a:	Below Expected Range
Secchi Depth:	Better than Expected Range

Phosphorus Loading

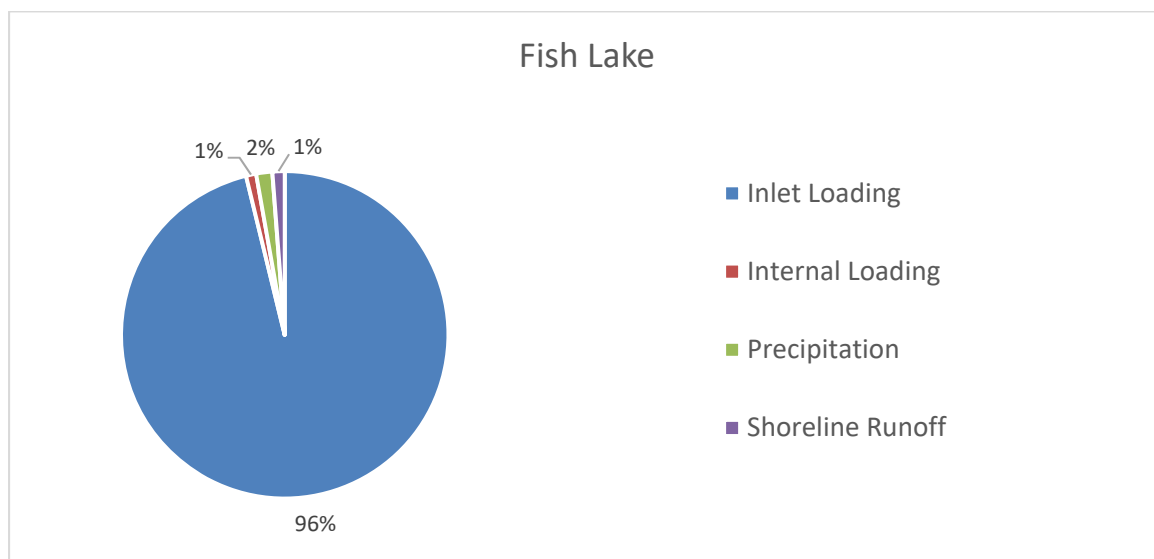
Fish Lake has a large watershed, so there are upstream phosphorus sources that contribute to the lake's productivity.

Through DNR modeling, the phosphorus concentration target for Fish Lake was determined to be 11 ug/L. The current historical mean phosphorus concentration is 11.8 ug/L (page 27), so it is really close to target.

Watershed characteristics.

Lakeshed to Lake Area Ratio (lakeshed includes lake area)	57:1
Watershed to Lake Area Ratio (watershed includes lake areas)	558:1
Number of Upstream Lakes	30
Headwaters Lake?	No
Inlets / Outlets	1/1
Water Residence Time	0.08 yrs

Phosphorus Loading.	%
Phosphorus loading from nearshore	1%
Phosphorus loading from precipitation	2%
Phosphorus loading from inlets	96%



Bass Lake

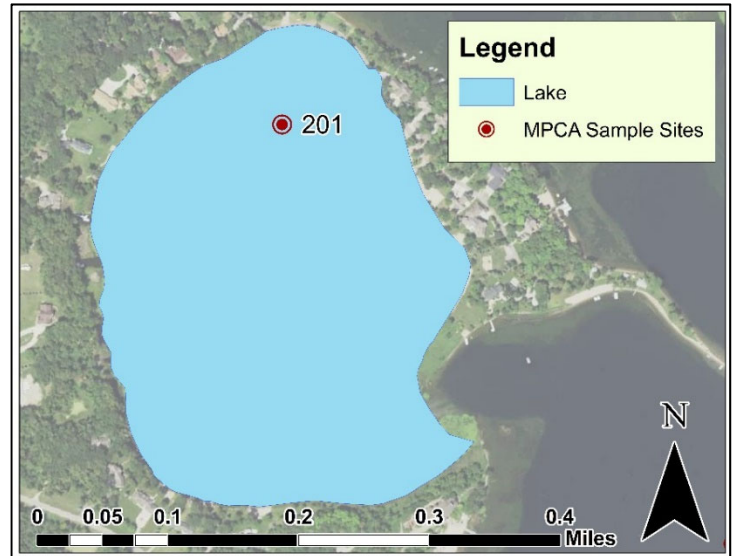
56-0770-00 OTTER TAIL COUNTY

Summary

Bass Lake is a moderately shallow mesotrophic lake. Bass Lake has no major inlets and a small watershed, which means the land practices around the lake are the main impact to the lake's water quality. There is an improving long-term trend in transparency.

Lake Vitals

MN Lake ID:	56-0770-00
Major Drainage Basin:	Red River
Surface area (acres):	48
Littoral area (acres):	24
% Littoral area:	50%
Max depth (ft), (m):	33, 10.1
Inlets / Outlets:	Connection to Fish Lake
Public Accesses	0
Development Class:	General Development
Aquatic Invasive Species:	Zebra Mussels (confirmed September 2009), Curly-leaf pondweed



Water Quality Characteristics

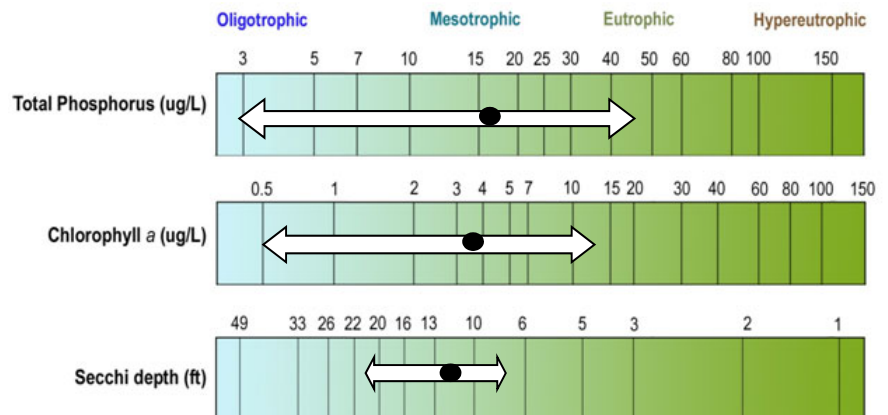
Years monitored: 2003-2017

Parameters	Primary Site 201
Phosphorus Mean (ug/L):	16.8
Phosphorus Min (ug/L):	2.5
Phosphorus Max (ug/L):	47
Number of Observations:	109
Chlorophyll-a Mean (ug/L):	3.8
Chlorophyll-a Min (ug/L):	0
Chlorophyll-a Max (ug/L):	13
Number of Observations:	82
Secchi Depth Mean (ft):	12.2
Secchi Depth Min (ft):	7.5
Secchi Depth Max (ft):	21.5
Number of Observations:	109

Trophic State Index

Trophic State: Mesotrophic (42)

The figure below shows the minimum and maximum values with the arrows and the mean with the black dot.



Long-term Trends

Primary site only. Recommend minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%

Data Quality	Good (meets minimum requirement above)
Total Phosphorus:	No Significant Trend
Chlorophyll-a:	Improving Trend (95%)
Secchi Depth:	Improving Trend (99.9%)

Ecoregion Comparisons

(Primary site only. Comparisons are based on interquartile range, 25th - 75th percentile, for ecoregion reference lakes)

Ecoregion:	Central Hardwood Forest
Total Phosphorus:	Below Expected Range
Chlorophyll-a:	Below Expected Range
Secchi Depth:	Above Expected Range

Phosphorus Loading

Bass Lake has a large watershed, so there are upstream phosphorus sources that contribute to the lake's productivity.

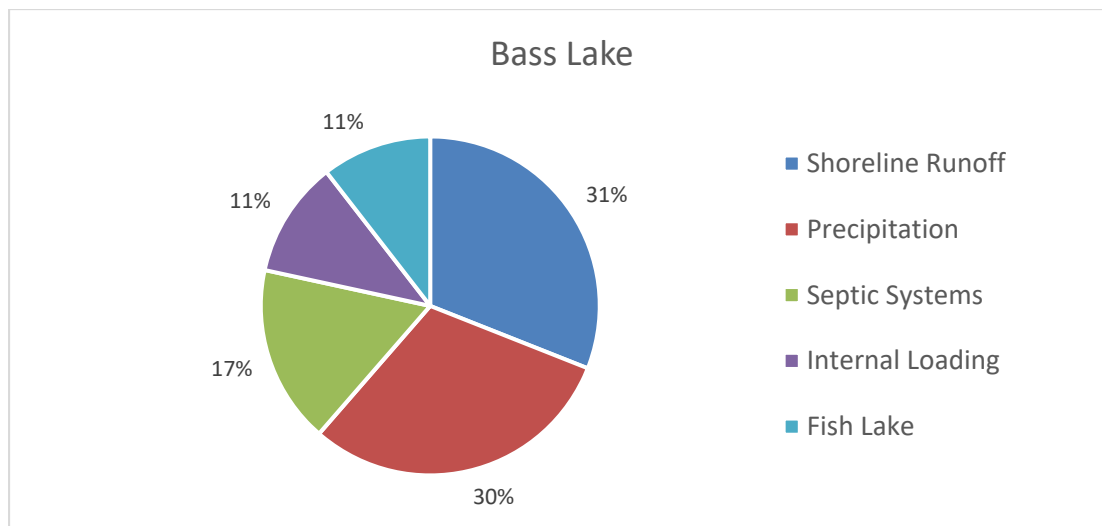
Through DNR modeling, the phosphorus concentration target for Fish Lake was determined to be 15 ug/L. The current historical mean phosphorus concentration is 16.8 ug/L (page 27), so it is really close to target.

Table 1. Watershed characteristics.

Lakeshed to Lake Area Ratio (lakeshed includes lake area)	305:1
Watershed to Lake Area Ratio (watershed includes lake areas)	2,989:1
Number of Upstream Lakes	0
Headwaters Lake?	Yes
Inlets / Outlets	0 / 1
Water Residence Time	0 years

Table 2. Phosphorus Loading. %

Phosphorus loading from nearshore	31%
Phosphorus loading from precipitation	30%
Phosphorus loading from inlets	11%



Land use

Activities that occur on the land within the lakeshed can greatly impact a lake. Land use planning helps ensure the use of land resources in an organized fashion so that the needs of the present and future generations can be best addressed.

6% of the PGOLID lakeshed is developed.

36% of the PGOLID lakeshed is protected. This total includes water, wetlands, and publicly owned land. There are easements, federal, and state land in the Pelican Lake lakeshed.

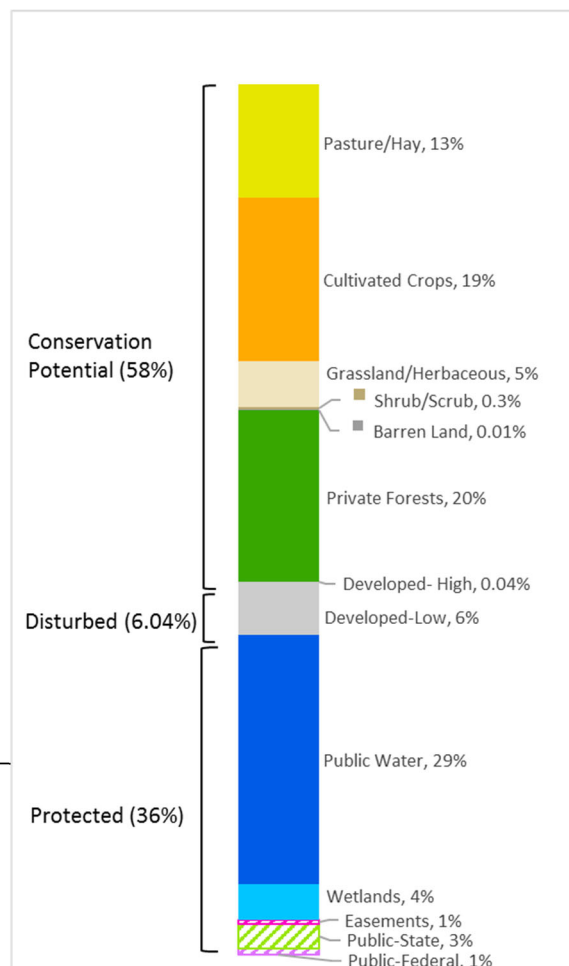
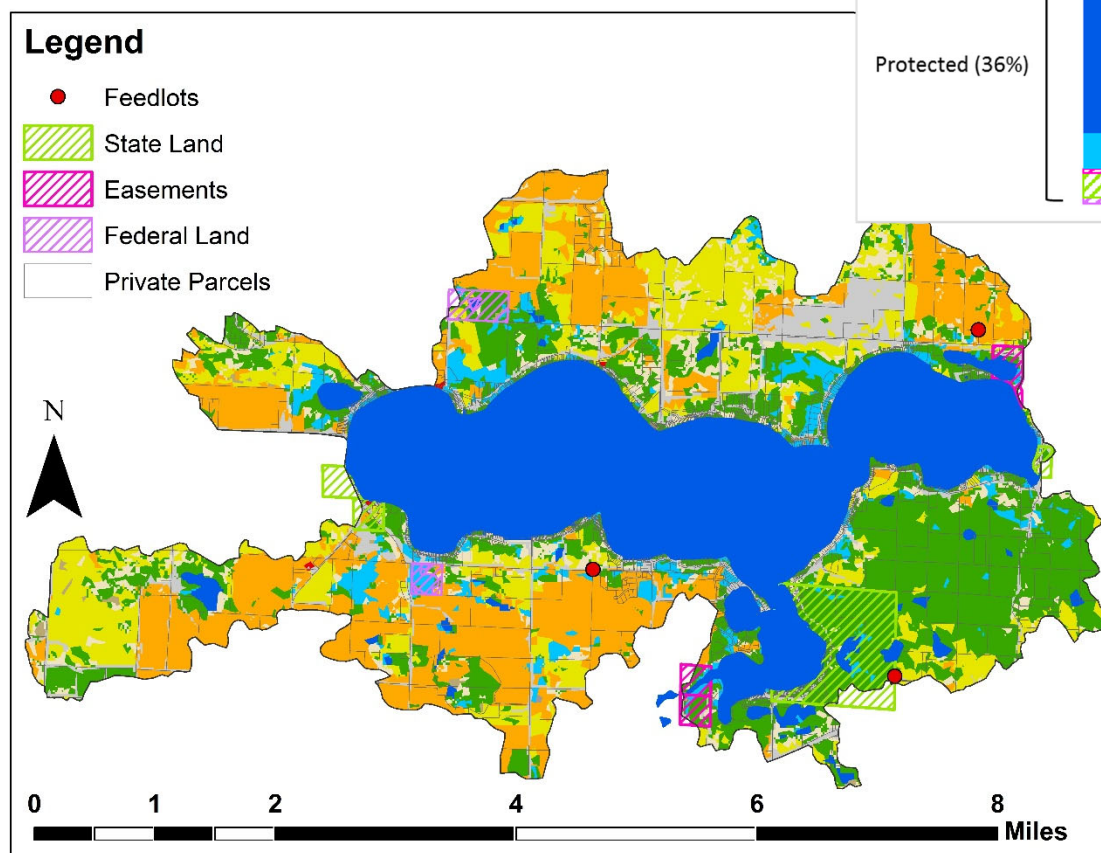
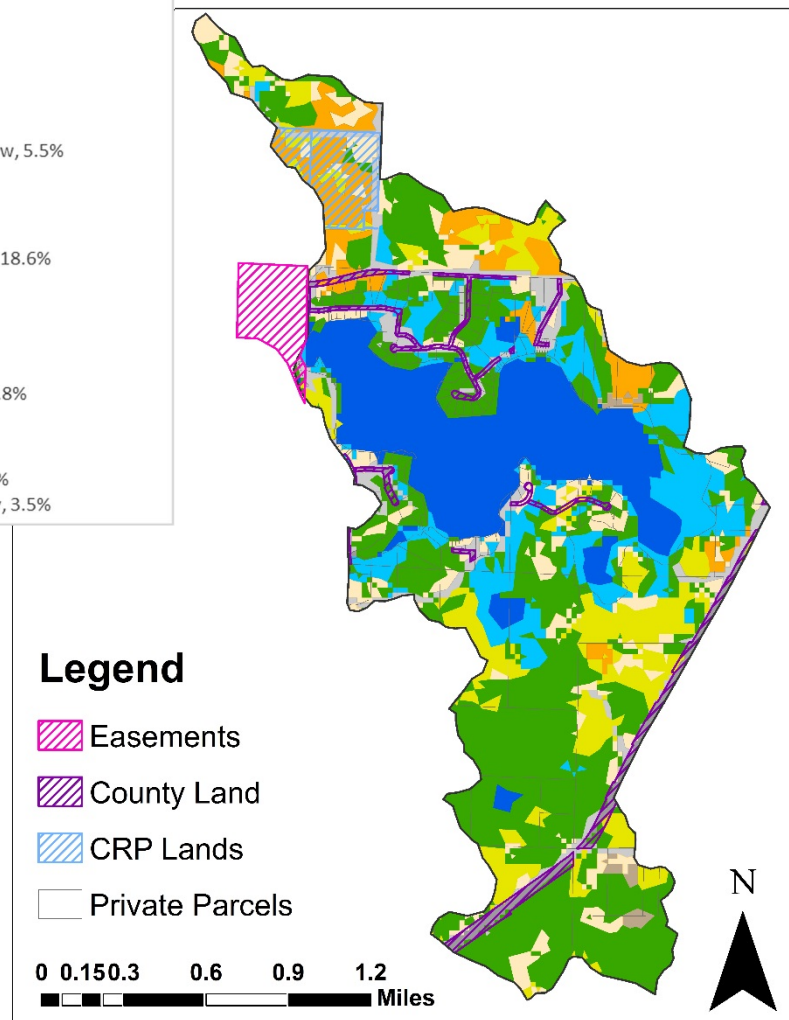
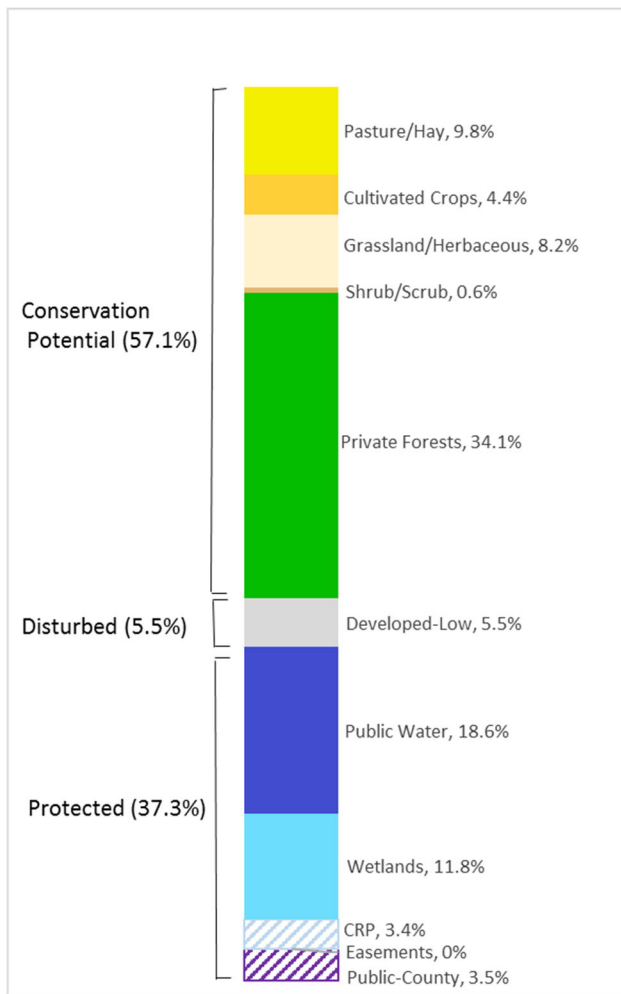


Figure 3. Land use and ownership in PGOLID lakeshed.



Lakeshed

The MN DNR has delineated three basic scales of watersheds (from large to small): 1) basins, 2) major watersheds, and 3) minor watersheds. The PGOLID Lakes are in the major Otter Tail River Watershed, which is in the Red River Basin (figure 2 left). The water exits the basin into the Red River.

Land can also be separated into lakesheds, which includes all land that contributes water to a lake (figure 2 right). These lakesheds don't include upstream lakes, so to evaluate all land that contributes to a lake we must include all the upstream lakesheds (figure 2 right).

Protection focus (green, Figure 2) means that water quality can be maintained that supports healthy and diverse native fish communities. Disturbed lands should be limited to less than 25%. Restoration focus (yellow, Figure 2) means that there is a potential for restoration of water quality and fish communities. Disturbed land percentage should be reduced.

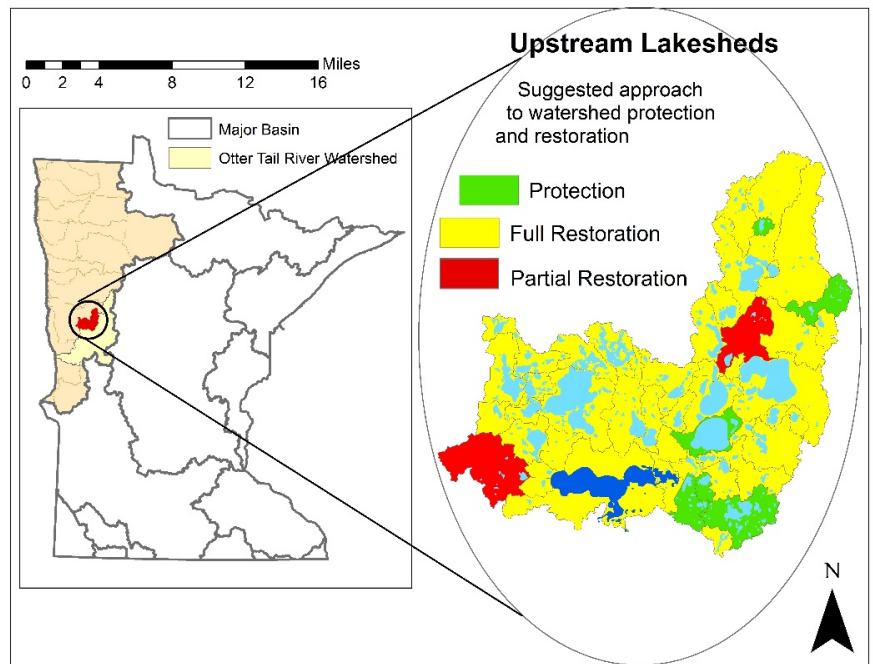


Figure 2. PGOLID Lakes major watershed and MN basins (left), and Pelican Lake lakeshed and upstream catchments with protection suggestions (right).

Conclusions

Conservation Easements

The charts on the previous page show that the lakesheds of Little Pelican, Pelican, Bass and Fish lakes are mostly made up of private land. This means this land is not protected from future development. Any undeveloped lots with lakeshore and those considered "second ring" development should be considered for conservation easements. With conservation easements, these lands would be protected from future development.

Forestry

Property owners who own large forested lots should consider forest stewardship planning. This planning will allow proper protection and management of the forested land. The DNR forestry program is available for private forest landowners including corporations whose stocks are not publicly traded and own between 20 - 1,000 acres of land. At least 20 acres of the land must have or will have trees. For more information, visit: <http://www.dnr.state.mn.us/grants/forestmgmt/stewardship.html>.

Developed Land

In the developed land around the lake, the most impact to the lake comes from runoff from grass lawns and impervious surface. To minimize this runoff, trees, shrubs and native vegetation should be planted along the shoreline. A secondary impact from developed land comes from improperly working septic systems. All septic systems should be properly maintained to protect the lake from excess nutrients.

Agriculture

Agricultural areas tend to have a high concentration of nutrients (fertilizers). Proper agricultural practices near lakes should minimize their impact to lakes. Conservation practices could include Conservation Reserve Program land and wetland restoration. The local Soil and Water Conservation District can help with both of these practices.