LAKE COCHRAN

REPORT DESCRIPTION

This report is an annual update to the 2003 State of the Lakes Report and includes water quality data collected from 2003 through 2010. For additional background on the information provided here or to find out more about Lake Cochran visit www.lakes.surfacewater.info or call Snohomish County Surface Water Management (SWM) at 425-388-3464.

LAKE DESCRIPTION

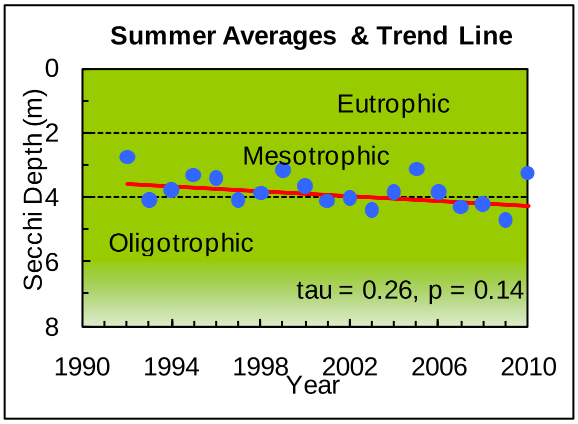
Lake Cochran is a 33-acre lake located approximately five miles northeast of Monroe. It is relatively deep for a lake of this size, with a maximum depth of 16.5 meters and a mean depth of 7.9 meters. The watershed is largely undeveloped, but much of the lake shore is occupied by single family homes.

LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (in red) for water clarity, total phosphorus, and chlorophyll *a* for Lake Cochran. Please refer to the table at the end of the report for long-term averages and for averages and ranges for individual years.

Water Clarity

The water clarity in Lake Cochran is somewhat variable, with a long-term summer average from 1992 through 2009 of 3.8 meters. Between 1992 and 2009 there had been a statistically significant trend towards improving water clarity. In 2009 monitoring showed an average clarity of 4.7 meters, which is the deepest Secchi depth average on record. However, during 2010, the water clarity average fell to only 3.3 meters. There still appears to be an overall improvement in water clarity, but that trend is no longer statistically significant. Instead, there seems to be an oscillating pattern of the water clarity improving for a few years and then getting worse for a few years. Such a pattern may be tied to weather cycles, with more nutrients or greater color in some years.



Temperature

From May through September 2010, temperature data were collected at each meter throughout the Lake Cochran water column. The temperature data show that the lake was strongly thermally stratified during the entire May through September period (see graph on page 2). This means that there was a strong temperature difference between the warm upper waters and the cool bottom waters, and mixing did not occur between these layers. The relative depth of the lake compared to its small size accounts for the strong stratification.

By May the upper waters were already significantly warmer than the lower waters, with over a 13°C (24°F) temperature difference. The upper waters were much warmer in July and August, reaching a peak in temperature of 24.5°C (72°F) in August. At the same time, bottom water temperatures changed only a little, remaining below 5°C (41°F). Strong temperature stratification prevents dissolved oxygen from being replenished in the bottom waters as described below and can lead to a build-up of nutrients in the bottom waters.

By September, the upper waters were cooling, and this cooling will continue through the fall until the temperatures are almost equal from top to bottom. As stratification weakens, the lake water will turn over (or mix). The lake will stay mixed through the winter until springtime, when the upper waters begin to warm again.

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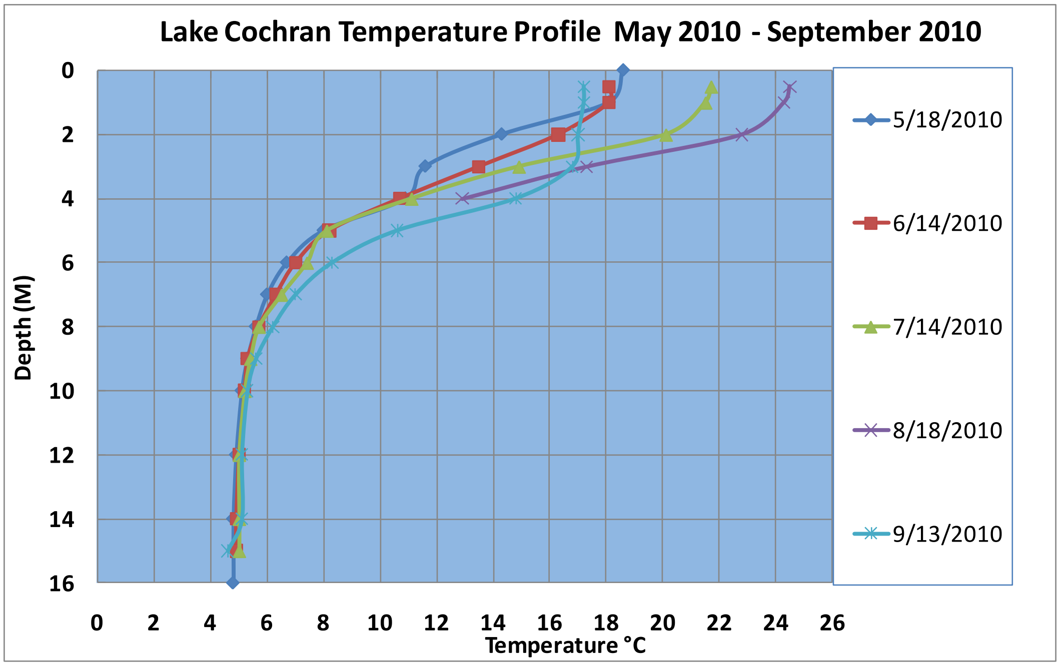

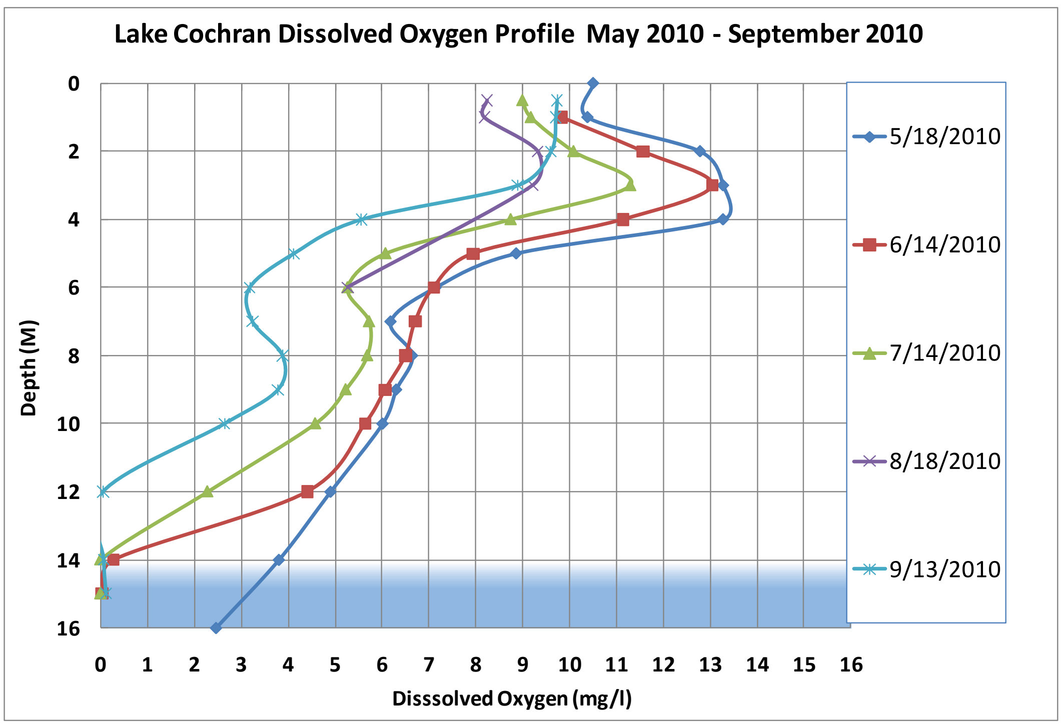

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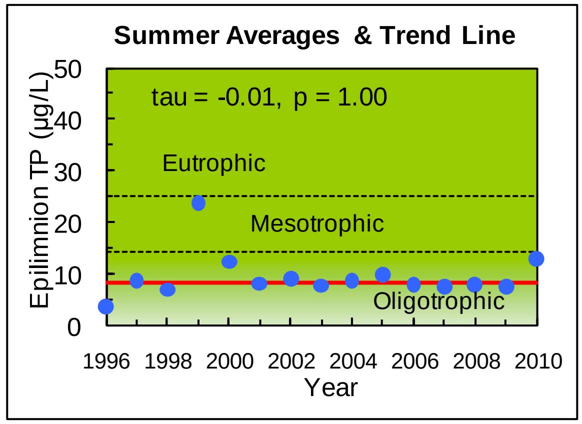
Dissolved Oxygen

The depth profiles of dissolved oxygen measured in 2010 largely mirrored the temperature profiles seen during that time period (see graph on page 2). Oxygen levels were higher throughout the deeper waters in May and gradually declined throughout the summer. By July there was little or no oxygen in the water at 14 meters and below. During the stratified summer period, oxygen in the lower waters is consumed by the decomposition of organic material within the lake. Since the lake is strongly stratified, the oxygen is not replenished by the overlying oxygen-rich upper waters or by the atmosphere. Even in September when the upper waters began to cool, the dissolved oxygen was still near zero below 12 meters. Sometime during the fall or early winter, the lake will mix and dissolved oxygen will be replenished throughout the water column.

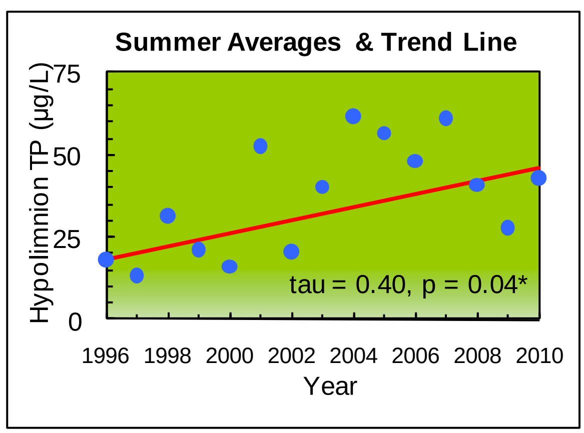
Several times during the summer, dissolved oxygen levels around 3 or 4 meters depth increased sharply. This is likely due to vigorous algal growth at the interface between the upper and lower waters. Algae often thrive in this zone because there is available light in the upper waters and higher nutrients available in the lower waters. During this period the water clarity was also reduced, which indicates that algae were likely present and affecting the clearness of the water.

Total Phosphorus (key nutrient for algae)

Total phosphorus concentrations in the epilimnion (upper waters) are low and stable, with a long-term average of 10 µg/l. In 1999, there were much higher levels of phosphorus, with a summer average of 24 µg/l. However, during the summers of 2001-2010, phosphorus levels in the epilimnion have been stable and close to the long-term average. Overall, there has been no significant trend detected in epilimnion phosphorus values.



Summertime phosphorus averages in the hypolimnion (bottom waters) are moderate. The 1996 to 2010 long-term average is 37 µg/l. However, there has been a statistically significant trend toward increasing phosphorus concentrations in the hypolimnion. The trend became apparent in 2004 and is even stronger with the addition of six more years of data. This build-up of phosphorus in the bottom waters may be a warning sign of accelerated eutrophication that could lead to more frequent and severe algal blooms.



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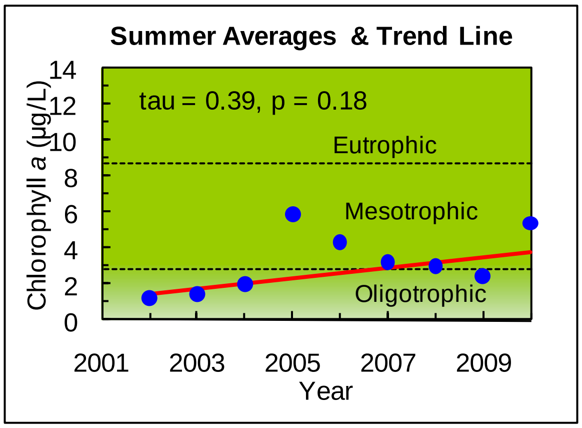
Chlorophyll a (Algae)

Chlorophyll *a* values have been low to moderate and variable during the 2002 to 2010 sampling period. The long-term average summer concentration is 3.2 µg/l. However, averages in 2005, 2006, and 2010 were higher, reflecting more algal growth. The higher values might be a response to the phosphorus increase in the bottom waters. However, chlorophyll *a* levels were lower in 2007 – 2009. More years of data are needed to determine if chlorophyll *a* levels are changing in Lake Cochran.



SUMMARY

Trophic State

Lake Cochran may be classified as mesotrophic based on moderate water clarity, moderate phosphorus levels, and low to moderate productivity of plants and algae.

Condition and Trends

The targets for Lake Cochran set forth in the 2003 State of the Lakes Report were to maintain stable long-term water clarity and phosphorus levels. The lake is partially meeting these targets because water clarity is somewhat better and phosphorus levels in the upper waters are stable. However, phosphorus levels in the hypolimnion are steadily increasing. The increased phosphorus in the hypolimnion raises concerns about accelerated eutrophication that may lead to more algal growth and reduced water clarity in the future.

Overall, Lake Cochran is in satisfactory condition. However, the lake is at risk of future water quality declines. The primary threat to lake water quality is an increase of nutrients entering the lake through new development and human activities in the watershed. Nutrients enter the lake through stormwater runoff from the watershed. Sources of nutrients include fertilizers, pet wastes, and erosion from land clearing and construction. Nutrients may also directly enter the lake through poorly maintained septic systems. Measures to control nutrients in the watershed should be taken now to prevent any future negative impacts to the lake. To find out more about ways to protect lake water quality and information on the causes and problems of elevated lake nutrient levels visit www.lakes.surfacewater.info.

DATA SUMMARY FOR LAKE COCHRAN					
		Water Clarity (Secchi depth	Total Phosphorus (*ug*/l)		Chlorophyll *a* (*ug*/l)
Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Epilimnion**
Bortleson, et al, 1976	**7/23/73**	3.0	7	13	-
Volunteer	**1992**	2.8	-	-	-
Volunteer	**1993**	2.8 - 5.6 (4.1) *n = 10*	-	-	-
SWM Staff or Volunteer	**1994**	3.1 - 4.9 (3.8) *n = 9*			2.0 - 8.3 (5.2) *n = 2*
SWM Staff or Volunteer	**1995**	2.7 - 4.0 (3.3) *n = 5*			3.2
SWM Staff or Volunteer	**1996**	3.0 - 4.0 (3.4) *n = 6*	3 - 4 (4) *n = 2*	17 - 19 (18) *n = 2*	-
SWM Staff or Volunteer	**1997**	3.8 - 4.5 (4.1) *n = 3*	8 - 9 (9) *n = 2*	10 - 17 (14) *n = 2*	-
Volunteer	**1998**	3.3 - 4.5 (3.9) *n = 7*	5 - 8 (7) *n = 4*	13 - 65 (31) *n = 4*	-
Volunteer	**1999**	2.9 - 3.9 (3.2) *n = 6*	9 - 52 (24)[a] *n = 4*	13 - 31 (21) *n = 4*	-
SWM Staff or Volunteer	**2000**	3.1 - 4.2 (3.7) *n = 5*	9 - 20 (12) *n = 4*	5 - 25 (16) *n = 4*	-
SWM Staff or Volunteer	**2001**	4.0 - 4.4 (4.1) *n = 5*	4 - 13 (8) *n = 4*	48 - 57 (53) *n = 4*	
SWM Staff or Volunteer	**2002**	3.7 - 4.4 (4.0) *n = 4*	6 - 12 (9) *n = 4*	11 - 29 (21) *n = 4*	0.3 - 2.1 (1.3) *n = 4*
SWM Staff or Volunteer	**2003**	4.0 - 5.3 (4.4) *n = 9*	5 - 9 (8) *n = 4*	22 - 57 (40) *n = 4*	0.8 - 2.1 (1.5) *n = 4*
SWM Staff or Volunteer	**2004**	3.2 - 4.5 (3.9) *n = 8*	5 - 11 (9) *n = 4*	40 - 79 (62) *n = 4*	1.6 - 2.4 (2.0) *n = 4*
SWM Staff or Volunteer	**2005**	1.8 - 4.2 (3.1) *n = 9*	6 - 16 (10) *n = 4*	31 - 99 (57) *n = 4*	1.1 - 19 (5.9) *n = 4*
SWM Staff or Volunteer	**2006**	3.1 - 4.4 (3.8) *n = 10*	6 - 9 (8) *n = 4*	30 - 64 (48) *n = 4*	1.1 - 11 (4.4) *n = 4*

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DATA SUMMARY FOR LAKE COCHRAN					
		Water Clarity (Secchi depth in meters)	**Total Phosphorus (*ug*/l)**		**Chlorophyll *a* (*ug*/l)**
Source	**Date**		**Surface**	**Bottom**	**Epilimnion**
SWM Staff or Volunteer	**2007**	2.2 - 5.1 (4.3) *n = 10*	4 - 10 (7) *n = 4*	40 - 80 (61) *n = 4*	1.1 - 6.9 (3.2) *n = 4*
SWM Staff or Volunteer	**2008**	3.5 - 5.1 (4.2) *n = 10*	6 - 10 (8) *n = 4*	24 - 71 (41) *n = 4*	1.8 - 4.3 (3.0) *n = 4*
SWM Staff or Volunteer	**2009**	3.5 - 5.9 (4.7) *n = 13*	7 - 8 (7) *n = 4*	16 - 37 (28) *n = 4*	1.8 - 3.7 (2.4) *n = 4*
SWM Staff or Volunteer	**2010**	2.4 - 4.0 (3.3) *n = 6*	7 - 20 (13) *n = 4*	32 - 55 (43) *n = 4*	2.1 - 9.3 (5.4) *n = 4*
Long Term Avg		**3.8** **(1992-2010)**	**10** **(1996-2010)**	**37** **(1996-2010)**	**3.2** **(2002-2010)**
TRENDS		**None**	**None**	**Increasing**	**None**

NOTES

- Table includes summer (May-Oct) data only.
- Each box shows the range on top, followed by summer average in ( ) and number of samples (*n*).
- Total phosphorus data are from samples taken at discrete depths only.
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.

[a] Average is influenced by one high TP value.