LAKE ROESIGER

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 Roesiger visit www.lakes.surfacewater.info or call Snohomish County Surface Water Management (SWM) at 425-388-3464.

LAKE DESCRIPTION

Lake Roesiger is located north of Monroe about seven miles east of Lake Stevens. Several small streams feed the lake. The outlet, Roesiger Creek, flows into Woods Creek and eventually to the Skykomish River. The lake is divided into three basins and has a total surface area of 348 acres. The north basin of the lake covers about 200 acres and has a maximum depth of 33 meters (108 feet). The south basin of the lake covers 104 acres and has a maximum depth of 21 meters (69 feet). The middle basin is about 44 acres in size with a maximum depth of only 3.7 meters (12 feet).

The shoreline of Lake Roesiger is densely developed with permanent homes and seasonal cabins. The watershed surrounding the lake is relatively small (only 6.3 times the size of the lake) and is comprised mostly of commercial forest lands. Therefore, the lake primarily receives pollution from shoreline development and from commercial logging activities. A large urban community was proposed for areas west of Lake Roesiger, but it appears that plans for this development have ended.

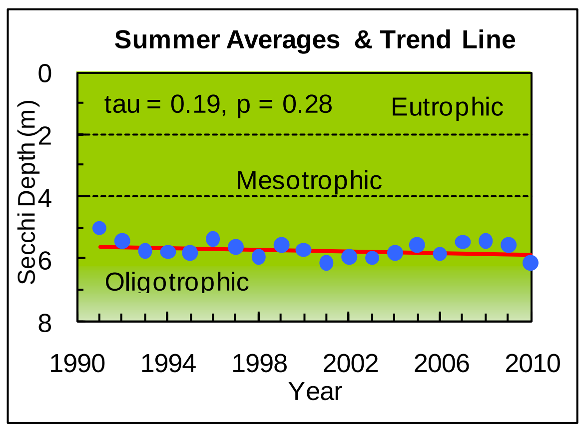
LAKE CONDITIONS

Water quality monitoring is conducted in both the north and south basins of the lake. The following graphs illustrate the summer averages and trend lines (in red) for water clarity, total phosphorus, and chlorophyll *a* for each of the basins. Data from 1992 through 2000 were collected in a different manner than more recent data, so the two data sets are analyzed separately. Please refer to the tables at the end of the report for long-term averages and for averages and ranges for individual years for each lake basin.

Water Clarity

Water clarity in the north basin of Lake Roesiger is high and stable. The 1991 – 2010 long-term summer average is 5.7 meters. There has been very little variation from year to year in water clarity, and there has been no statistically significant trend in summer water clarity averages between 1991 through 2010.

NORTH BASIN WATER CLARITY



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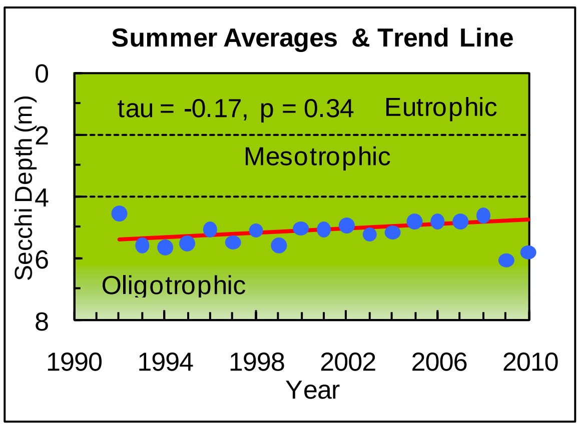
Water clarity in the south basin of Lake Roesiger is also high, with a 1992 – 2010 long-term summer average of 5.2 meters. From 1992 through 2008, there appeared to be a gradual reduction in water clarity. Then, the measurements showed substantially better water clarity in 2009 and 2010. (The 2009 value is based on only one measurement taken in late September.) However, SWM staff conducted the monitoring in 2009 and 2010, so differences between recent and prior water clarity may be related to changes in monitors.

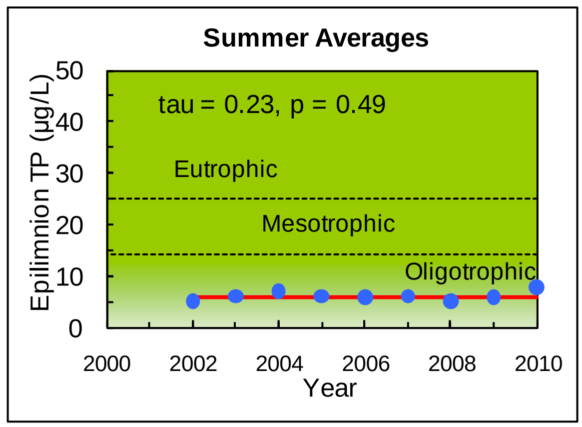
SOUTH BASIN WATER CLARITY



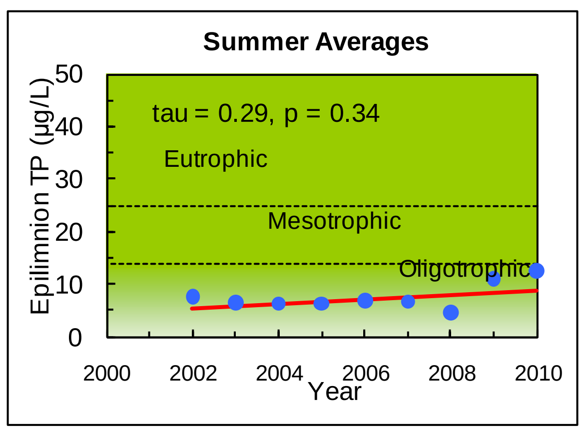
Total Phosphorus (key nutrient for algae)

Total phosphorus concentrations in the epilimnion (upper waters) are low in Lake Roesiger, with little year-to-year variation in both the north and south basins. The phosphorus levels in the epilimnion are actually the lowest of all the monitored lakes in Snohomish County. Between 1992 and 2000, the long-term summer average was 6 µg/l for both basins. From 2002 through 2010, the overall average has also been 6 µg/l in the north basin and 8 µg/l in the south basin. The 2009 average in the south basin was again taken from only one sample in September.

NORTH BASIN TOTAL PHOSPHORUS - EPILIMNION



SOUTH BASIN TOTAL PHOSPHORUS - EPILIMNION



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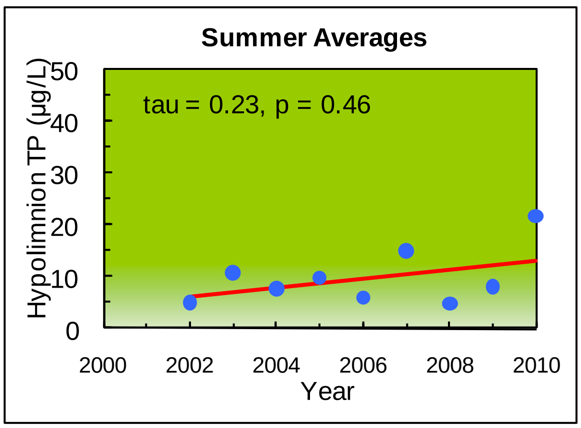
Summertime phosphorus averages in the hypolimnion (bottom waters) are also low. In the north basin, the 1992 - 2000 long-term average was 13 µg/l, while the 2002 - 2010 long-term average is 10 µg/l. The two time periods are considered separately because samples from the earlier period were taken in a different manner and in some years were taken at deeper depths, resulting in higher phosphorus levels. Since 2008 the samples are again being taken at a deeper depth. Between 2002 and 2010, there has been no evidence of a trend in phosphorus concentrations in the bottom waters in the north basin. However, the phosphorus average in the bottom waters during 2010 was 22 µg/l, the highest average since 1988.

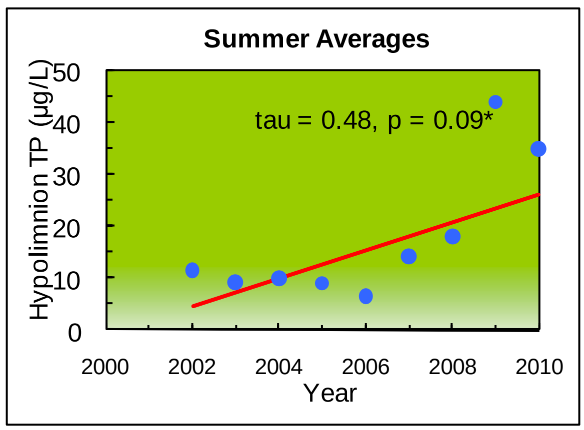
NORTH BASIN TOTAL PHOSPHORUS - HYPOLIMNION



Summertime phosphorus averages in the hypolimnion of the south basin are notably higher than in the north basin. The 1992 - 2000 long-term average was 22 µg/l. The 2002 - 2010 long-term average is 18 µg/l. The 2002 – 2010 average is pushed upward by the high 2009 and 2010 values (2009 was based on a single September sample). The averages were also affected by shifting to deeper sampling depths in 2008 - 2010. As a result of the higher averages in recent years, there appears to be a statistically significant trend toward increasing phosphorus concentrations between 2002 and 2010. However, because of the changes in data collection methods, this trend should be viewed cautiously.

If phosphorus levels do continue to increase in the bottom waters of the south basin, this may be a sign of phosphorus being released from the lake sediments during periods of low dissolved oxygen. Any increases in phosphorus can ultimately lead to more nutrients being available to promote algal growth within the lake.

SOUTH BASIN TOTAL PHOSPHORUS - HYPOLIMNION



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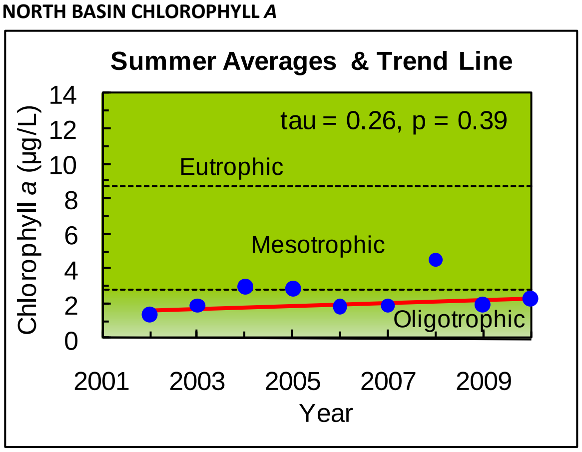
Chlorophyll a (Algae)

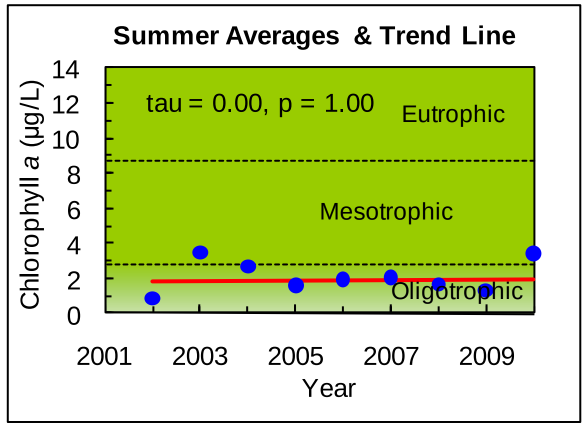
Chlorophyll *a* values show low to moderate levels of algae in both basins of the lake. From 2002 through 2010, the long-term summer average was 2.4 µg/l in the north basin and 2.1 µg/l in the south basin. Data from 1992 through 2000 collected by the Washington Department of Ecology showed similar algal levels. There is no evidence of statistical trends in chlorophyll *a* averages.

Lake Roesiger does have a history of occasional nuisance algal blooms. During the late spring of 2003, the lake experienced a severe algal bloom. The lake turned brown and smelled like dead fish. The bloom lasted for several weeks and was caused by a type of golden-brown algae, *Uroglenopsis.* This species is most prevalent in the spring and is less likely to cause problems during the summer months. Several other lakes in the region experienced similar blooms during the same time period. There was a similar, but much less dense, bloom of golden-brown algae in the spring of 2004. These blooms were likely the result of unique weather patterns that favored this particular type of algae rather than evidence of excess nutrients in the lake. No large-scale spring algal blooms have been reported in 2005 to 2010.

NORTH BASIN CHLOROPHYLL *A*



SOUTH BASIN CHLOROPHYLL *A*



Aquatic Plants

An invasion of Eurasian watermilfoil was discovered in Lake Roesiger in 1998. Milfoil is a non-native invasive aquatic plant that threatens the use and enjoyment of the lake. SWM worked with local residents to secure a grant from the Washington State Department of Ecology to provide initial response to the milfoil infestation.

The milfoil is concentrated in several spots in the south basin and in the middle of the middle basin. There are also scattered plants around the shoreline of the south basin, and to a lesser extent, around the north basin. Each year from 1998 through 2010, SWM has conducted diving surveys and performed hand removal of the milfoil. This effort has been able to keep the milfoil in check, but not eliminate it. In 2009, a large new patch was discovered in the south basin. Many of these plants were removed in 2010. However, there is not currently adequate funding to survey all areas and remove all the milfoil plants each year. Without more funding, it will not be possible to prevent milfoil from spreading around the lake.

SHORELINE CONDITION

The Lake Roesiger shoreline was surveyed in 2009 (see maps on page 6 and 7). The condition of the lake shoreline is important to understanding overall lake health. As development on a lake increases, lake shorelines typically are modified either through removal of natural vegetation, the installation of bulkheads or other hardening structures, and/or removal of partially submerged logs and branches. These types of alterations can be harmful to the lake ecosystem because natural shorelines protect the lake from harmful pollution, prevent bank erosion, and provide important habitat for fish and wildlife.

Most of the Lake Roesiger shoreline supports dense residential development. In the mid-90s there were 386 homes bordering the lake. Although homes were not surveyed in 2009, 453 docks were counted, indicating that development likely increased in the past decade. Over half of the lake shoreline (56%) has been armored or modified. Most of the armoring is bulkheads or rock and log revetments. Shoreline vegetation has also been greatly altered—only 20% is still classified as intact native vegetation. The remaining 80% has been altered and, in many cases, replaced by grass lawns down to the shore. Lawns can be a source of nutrients and do not protect the lake as well as a buffer of native vegetation. There is also only a low amount of large wood still remaining in Lake Roesiger (about 98 pieces). These old logs and branches are valuable for fish and wildlife habitat. The high level of shoreline modification leaves the lake susceptible to pollution from the watershed, eliminates the buffer of native vegetation that can filter out pollution, and limits the amount of habitat available for fish and wildlife. The loss of native vegetation along the shoreline can also lead to shoreline erosion.

SUMMARY

Trophic State

Based on high water clarity, low phosphorus, and low to moderate algae, Lake Roesiger may be classified as oligo-mesotrophic, meaning it has low to moderate productivity of plants and algae.

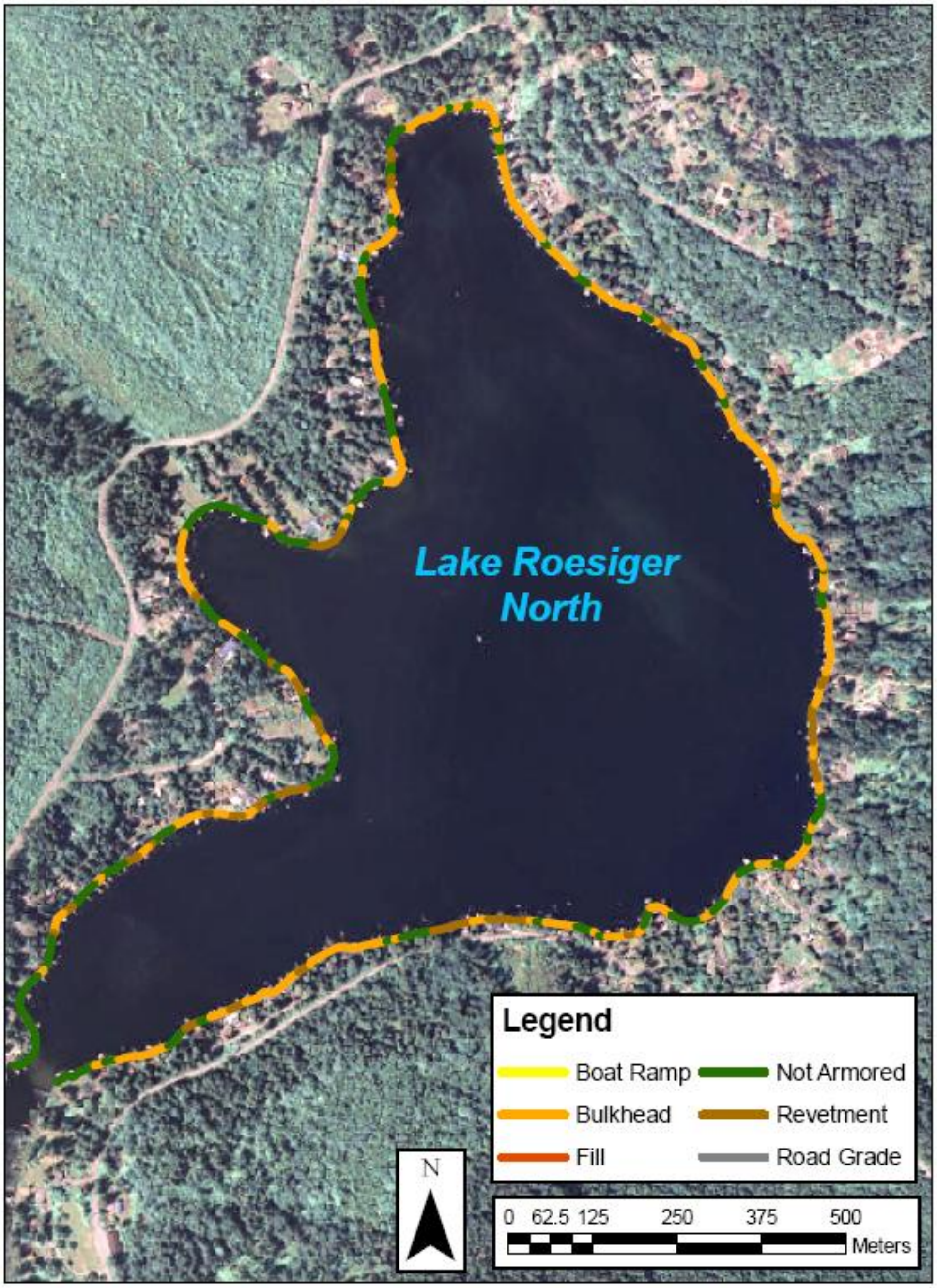
Condition and Trends

Lake Roesiger is meeting most of the targets set forth in the 2003 State of the Lakes Report of maintaining stable water clarity and phosphorus levels. Water clarity in the north basin has remained stable since the early 1990s. In the south basin, there appeared to be a decline in water clarity over the years. However, water clarity was better in 2009 and 2010, perhaps because the monitoring was performed by SWM staff. So, it is unclear if there have been any changes over time.

Overall, the lake also appears to be maintaining stable and low total phosphorus levels. Phosphorus levels in the epilimnion in both basins have shown little change over the years. Phosphorus concentrations in the hypolimnion are more variable, particularly in the south basin. In addition, there is a statistically significant trend toward increasing phosphorus in the south basin. However, this apparent trend may be influenced by changes in sampling methods and depths. Additional years of consistent data collection will help to determine if any changes are actually occurring.

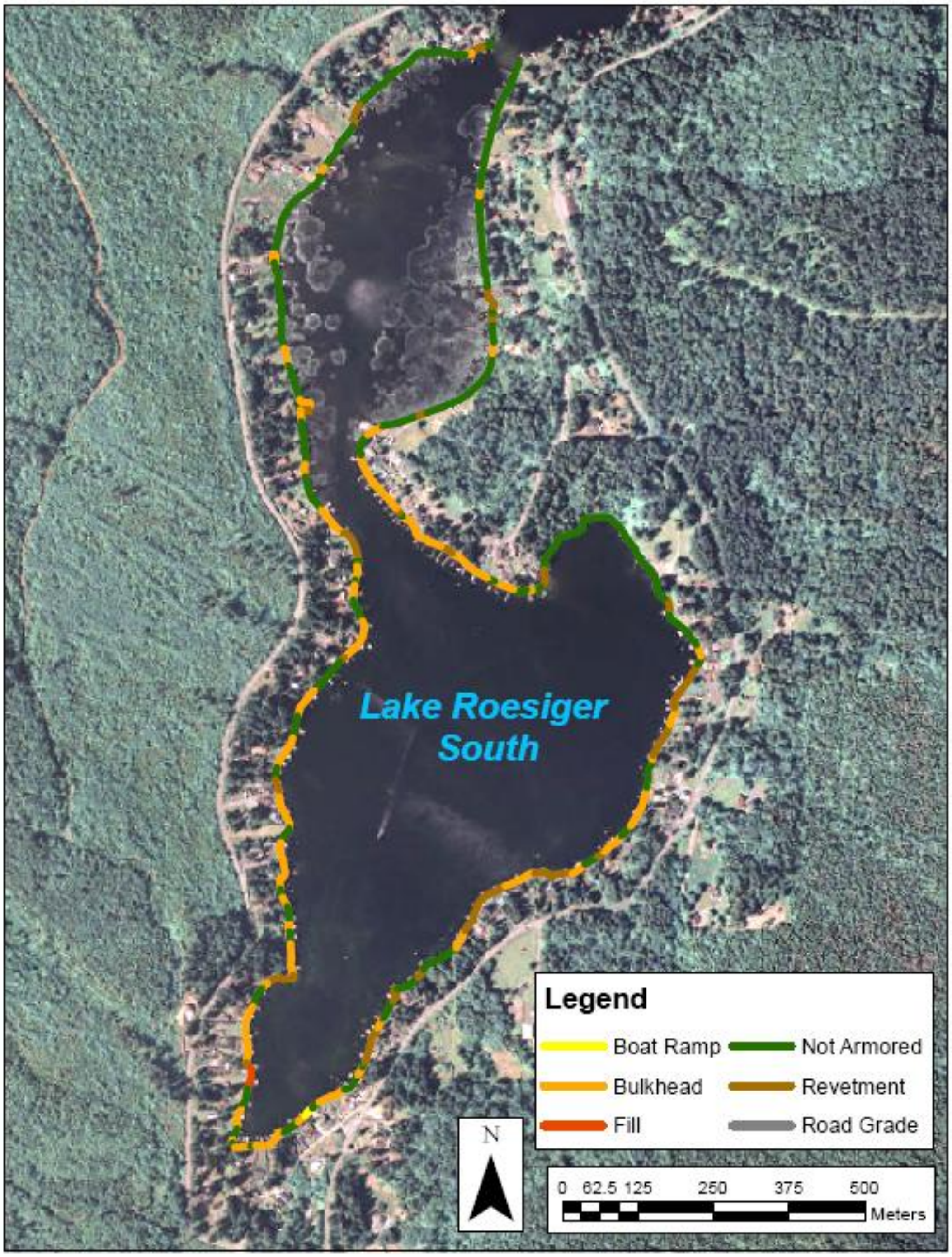
Overall, Lake Roesiger is in healthy condition. The potentially increasing phosphorus in the bottom waters of the south basin is a concern and should be watched closely. The primary threat to lake water quality is any increase of nutrients entering the lake, particularly through new development and from other human activities in the watershed. Nutrients enter the lake through stormwater runoff from the watershed. Sources of nutrients include fertilizers, pet wastes, runoff from roofs and driveways, 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.

2009 Lake Shoreline Survey Results – Lake Roesiger (north)



2009 Lake Shoreline Survey Results – Lake Roesiger (south)

LAKE ROESIGER



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DATA SUMMARY FOR LAKE ROESIGER - NORTH					
		Water Clarity (Secchi depth	**Total Phosphorus (*ug*/l)**		**Chlorophyll *a* (*ug*/l)**
Source	**Date**	**in meters)**	**Epi**	**Hypo**	**Epilimnion**
Bortleson, et al, 1976	**7/25/72**	3.0	29	33	-
Sumioka and Dion, 1985	**7/6/81**	5.2	10	10	2.3
KCM, 1989	**1988**	4.0 - 7.0 (5.7) *n = 10*	3 - 8 (5) *n = 10*	7 - 97 (22) *n = 10*	3.6 - 15 (6.7) *n = 10*
DOE	**1991**	3.4 - 7.0 (5.0) *n = 8*	-	-	-
LR Volunteer or DOE	**1992**	4.9 - 6.2 (5.4) *n = 15*	5 - 9 (7) *n = 12*	15 - 32 (21) *n = 10*	0.5 - 3.7 (2.2) *n = 12*
LR Volunteer or DOE	**1993**	4.0 - 8.2 (5.8) *n = 12*	2 - 16 (6) *n = 10*	3 - 36 (15) *n = 11*	0.7 - 5.9 (2.3) *n = 10*
LR Volunteer or DOE	**1994**	5.2 - 6.6 (5.8) *n = 20*	1 - 27 (5) *n = 12*	3 - 29 (14) *n = 12*	1.3 - 5.7 (2.4) *n = 11*
LR Volunteer or DOE	**1995**	4.6 - 7.6 (5.8) *n = 16*	2 - 9 (5) *n = 9*	2 - 22 (11) *n = 11*	1.2 - 4.2 (2.4) *n = 9*
LR Volunteer or DOE	**1996**	3.4 - 6.6 (5.4) *n = 16*	1 - 8 (4) *n = 9*	7 - 32 (14) *n = 12*	0.5 - 16 (4.3) *n = 9*
LR Volunteer or DOE	**1997**	4.9 - 6.1 (5.7) *n = 7*	3 - 9 (5) *n = 5*	5 - 30 (15) *n = 4*	1.5 - 3.6 (2.8) *n = 3*
LR Volunteer	**1998**	5.5 - 6.4 (5.9) *n = 2*	5 - 6 (6) *n = 2*	6	1.2 - 2.4 (1.8) *n = 2*
LR Volunteer or DOE	**1999**	4.4 - 6.1 (5.6) *n = 11*	4 - 8 (6) *n = 7*	5 - 16 (8) *n = 8*	1.1 - 7.1 (2.8) *n = 6*
LR Volunteer or DOE	**2000**	4.6 - 6.7 (5.7) *n = 5*	4 - 15 (10) *n = 2*	7 - 13 (10) *n = 2*	2.7 - 4.8 (3.6) *n = 3*
LR Volunteer or DOE	**2001**	6.1 - 6.2 (6.1) *n = 3*	-	-	-
Volunteer	**2002**	4.7 - 7.0 (6.0) *n = 8*	4 - 7 (5) *n = 4*	4 - 6 (5) *n = 4*	0.3 - 2.0 (1.4) *n = 4*
Volunteer or SWM Staff	**2003**	4.0 - 7.6 (6.0) *n = 6*	5 - 7 (6.0) *n = 3*	8 - 15 (11) *n = 3*	1.1 - 2.4 (1.9) *n = 3*
SWM Staff or Volunteer	**2004**	4.0 - 7.2 (5.8) *n = 7*	7 (7) *n = 4*	7 - 9 (8) *n = 4*	0.7 - 9.1 (3.0) *n = 5*

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DATA SUMMARY FOR LAKE ROESIGER - NORTH					
		Water Clarity (Secchi depth	**Total Phosphorus (*ug*/l)**		**Chlorophyll *a* (*ug*/l)**
Source	**Date**	**in meters)**	**Epi**	**Hypo**	**Epilimnion**
SWM Staff or Volunteer	**2005**	4.3 - 6.7 (5.6) *n = 7*	4 - 9 (6) *n = 4*	3 - 26 (10) *n = 4*	1.1 - 7.2 (2.9) *n = 4*
Volunteer	**2006**	4.9 - 6.5 (5.9) *n = 6*	3 - 8 (6) *n = 4*	3 - 8 (6) *n = 4*	1.3 - 2.7 (1.8) *n = 4*
SWM Staff or Volunteer	**2007**	4.6 - 6.8 (5.5) *n = 8*	6 (6) *n = 3*	7 - 33 (16) *n = 3*	1.6 - 2.1 (1.9) *n = 3*
Volunteer	**2008**	3.6 - 6.8 (5.5) *n = 9*	4 - 6 (5) *n = 4*	4 - 5 (5) *n = 4*	1.9 - 12 (4.5) *n = 4*
SWM Staff or Volunteer	**2009**	4.9 - 6.7 (5.6) *n = 10*	4 - 7 (6) *n = 4*	5 - 16 (8) *n = 4*	1.6 - 2.1 (1.9) *n = 4*
SWM Staff or Volunteer	**2010**	5.4 - 8.0 (6.2) *n = 10*	6 - 9 (8) *n = 4*	15 - 27 (22) *n = 4*	1.6 - 2.7 (2.3) *n = 4*
Long Term Avg		**5.7 (1991-2010)**	**6 (1992-2000) 6 (2002-2010)**	**13 (1992-2000) 10 (2002-2010)**	**2.4 (2002-2010)**
TRENDS		**None**	**None**	**None**	**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 from 1992 - 2000 are from **composite samples** taken at varied depths.
- Total phosphorus data from 2002 and later are from samples taken at discrete depths only.
- Epilimnion total phosphorus data from 2002-2007 are mostly taken at 1.5 meters
- DOE = Washington Department of Ecology
- LR Volunteer = Lake Roesiger Resident Monitors citizen volunteer monitoring program

LAKE ROESIGER

DATA SUMMARY FOR LAKE ROESIGER - SOUTH					
		Water Clarity (Secchi depth	**Total Phosphorus (*ug/l*)**		**Chlorophyll *a* (*ug/l*)**
Source	**Date**	**in meters)**	**Epi**	**Hypo**	**Epilimnion**
Bortleson, et al, 1976	**7/25/72**	3.0	5	18	-
KCM, 1989	**1988**	4.2 - 6.5 (4.9) *n = 10*	3 - 8 (6) *n = 10*	13 - 56 (35) *n = 10*	1.6 - 9.5 (5.3) *n = 10*
DOE	**1990**	-	7 - 13 (10) *n = 2*	-	-
LR Volunteer or DOE	**1992**	3.7 - 5.8 (4.6) *n = 11*	4 - 34 (12) *n = 9*	17 - 35 (22) *n = 10*	1.1 - 4.1 (2.5) *n = 11*
LR Volunteer	**1993**	4.9 - 7.0 (5.6) *n = 10*	2 - 20 (9) *n = 8*	2 - 27 (15) *n = 8*	1.7 - 5.7 (2.9) *n = 8*
LR Volunteer	**1994**	4.6 - 6.6 (5.7) *n = 18*	1 - 8 (4) *n = 10*	6 - 41 (24) *n = 10*	1.6 - 4.0 (2.9) *n = 7*
LR Volunteer or DOE	**1995**	4.7 - 6.6 (5.5) *n = 14*	2 - 8 (4) *n = 8*	5 - 42 (16) *n = 13*	1.1 - 5.2 (2.8) *n = 8*
LR Volunteer or DOE	**1996**	3.4 - 6.1 (5.1) *n = 14*	1 - 7 (4) *n = 8*	5 - 97 (42) *n = 9*	0.6 - 8.8 (3.0) *n = 9*
LR Volunteer or DOE	**1997**	5.0 - 6.2 (5.5) *n = 7*	3 - 5 (4) *n = 2*	5 - 55 (21) *n = 6*	2.8 - 5.6 (4.1) *n = 3*
LR Volunteer or DOE	**1998**	4.6 - 5.8 (5.1) *n = 8*	-	-	-
LR Volunteer or DOE	**1999**	4.6 - 6.4 (5.6) *n = 9*	4 - 15 (7) *n = 6*	9 - 26 (16) *n = 4*	0.7 - 2.7 (1.4) *n = 4*
LR Volunteer or DOE	**2000**	4.6 - 5.3 (5.1) *n = 3*	5 - 12 (7) *n = 3*	16	1.9 - 6.9 (4.4) *n = 2*
LR Volunteer or DOE	**2001**	4.6 - 6.1 (5.1) *n = 4*	-	-	-
Volunteer	**2002**	4.0 - 5.8 (5.0) *n = 9*	5 - 13 (8) *n = 4*	6 - 26 (12) *n = 4*	0.3 - 1.6 (0.9) *n = 4*
Volunteer or SWM Staff	**2003**	2.1 - 6.7 (5.3) *n = 7*	5 - 7 (6) *n = 3*	9 - 10 (9) *n = 3*	0.8 - 7.7 (3.5) *n = 3*
SWM Staff or Volunteer	**2004**	4.3 - 6.4 (5.2) *n = 8*	5 - 8 (6) *n = 4*	7 - 12 (10) *n = 4*	0.8 - 8.3 (2.7) *n = 5*
SWM Staff or Volunteer	**2005**	3.4 - 6.4 (4.8) *n = 6*	5 - 9 (6) *n = 4*	8 - 12 (9) *n = 4*	1.1 - 2.4 (1.6) *n = 4*

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DATA SUMMARY FOR LAKE ROESIGER - SOUTH					
		Water Clarity (Secchi depth	**Total Phosphorus (*ug/l*)**		**Chlorophyll *a* (*ug/l*)**
Source	**Date**	**in meters)**	**Epi**	**Hypo**	**Epilimnion**
Volunteer	**2006**	4.0 - 6.1 (4.8) *n = 7*	6 - 8 (7) *n = 4*	6 - 8 (7) *n = 4*	1.3 - 3.2 (1.9) *n = 4*
Volunteer	**2007**	4.0 - 6.1 (4.8) *n = 7*	5 - 8 (7) *n = 3*	7 - 23 (14) *n = 3*	1.6 - 2.7 (2.1) *n = 3*
Volunteer	**2008**	3.7 - 5.5 (4.6) *n = 9*	3 - 6 (5) *n = 3*	3 - 46 (18) *n = 3*	1.3 - 2.1 (1.7) *n = 3*
SWM Staff	**2009**	6.1 - 6.1 (6.1) *n = 1*	11 - 11 (11) *n = 1*	44 - 44 (44) *n = 1*	1.3 - 1.3 (1.3) *n = 1*
SWM Staff	**2010**	5.3 - 7.0 (5.8) *n = 4*	8 - 22 (13) *n = 4*	28 - 44 (35) *n = 4*	2.1 - 4.3 (3.4) *n = 4*
Long Term Avg		**5.2 (1992-2010)**	**6 (1992-2000) 8 (2002-2010)**	**22 (1992-2000) 18 (2002-2010)**	**2.1 (2002-2010)**
TRENDS		**None**	**None**	**Increasing**	**None**

NOTES

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