

Amarugia Highlands Lake Ecoregional NNC Assessment



Comparison to 10 CSR 20-7.031(5)(N) Table L's Response Impairment Thresholds

Assessment

Table L

Lake Ecoregion	Chl-a Response Impairment Threshold (ug/L)		
Plains	30		
Ozark Border	22		
Ozark Highlands	15		
Plains ecoregion			
Name	WBID	Year	Chlorophyll-a (ug/L)
Amarugia Highlands Lake	7360	2012	10.56
	7360	2009	7.91
	7360	2007	17.27

1 or fewer exceedances of Table L value results in Table M assessment.

Table M

Lake Ecoregion	TP Nutrient Screening Threshold (mg/L)	TN Nutrient Screening Threshold (mg/L)	Chl-a Nutrient Screening Threshold (ug/L)
Plains	0.049	0.843	18
Ozark Border	0.040	0.733	13
Ozark Highlands	0.016	0.401	6

No data available for Microcystin comparison

Plains ecoregion lakes assessed with available data against Table M

Name	WBID	Year	Chlorophyll- a (ug/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Table M Assessment	Secchi depth (m)*	Chla_TP Ratio	Inorganic Sediment (mg/L)	Mineral Turbidity Assessment
Amarugia Highlands Lake	7360	2007	17.27	0.0416	0.5894	Acceptable	1.075	0.47	NA	NA
Amarugia Highlands Lake	7360	2009	7.91	0.0356	0.4549	Acceptable	1.018	0.239	3.525	NA
Amarugia Highlands Lake	7360	2012	10.56	0.0357	0.6833	Acceptable	1.522	0.322	NA	NA

Table M assessment results in no exceedances to Table M values. Lake is considered attaining for nutrients.



Missouri Department of Natural Resources

Amarugia Lake - WBID 7360.00

Univ. of Missouri, Columbia

HUC 8: 10290108 - Lake Ecoregion: Plains

Ecoregional Criteria Apply

Org	Site Code	Site Name	Sample Type	Yr	Mo	Di	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
UMC	7360	Amarugia Highlands Lake	Grab	1995	5	30	218122					13.1		0.3		980		104
UMC	7360	Amarugia Highlands Lake	Grab	1995	6	26	218123					17.0		0.3		900		104
UMC	7360	Amarugia Highlands Lake	Grab	1995	7	31	218124					1.6		1.8		610		36
1995 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												10.57		0.8				
								Plains Ecoregion Criteria (Table L):				0		0		0		0
								Plains Ecoregion Screening Threshold (Table M):								843		49
								Eutrophication Factors:				0.15		10		0.6		

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	1996	5	28	218125					7.4		0.3		930		72
UMC	7360	Amarugia Highlands Lake	Grab	1996	6	24	218126					2.2		1.1		700		32
UMC	7360	Amarugia Highlands Lake	Grab	1996	7	29	218127					3.2		1.0		670		32
1996 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												4.27		0.8				
								Plains Ecoregion Criteria (Table L):				0		0		0		0
								Plains Ecoregion Screening Threshold (Table M):								843		49
								Eutrophication Factors:				0.15		10		0.6		

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	1997	5	21	218128					16.1		0.2		700		72
UMC	7360	Amarugia Highlands Lake	Grab	1997	6	10	218129					14.5		0.2		660		118
UMC	7360	Amarugia Highlands Lake	Grab	1997	7	1	218130					5.4		0.5		700		49
UMC	7360	Amarugia Highlands Lake	Grab	1997	7	29	218131					2.6		1.2		650		26
1997 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												9.65		0.53		677		57
								Plains Ecoregion Criteria (Table L):				0		0		0		0
								Plains Ecoregion Screening Threshold (Table M):								843		49
								Eutrophication Factors:				0.15		10		0.6		

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	1999	5	18	218132					22.3		0.2		860		117
UMC	7360	Amarugia Highlands Lake	Grab	1999	6	8	218133					3.7		0.7		590		41
UMC	7360	Amarugia Highlands Lake	Grab	1999	6	29	218134					36.6		0.2		680		84
UMC	7360	Amarugia Highlands Lake	Grab	1999	8	3	218135					2.0		1.1		500		25
1999 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												16.15		0.55		644		56
								Plains Ecoregion Criteria (Table L):				0		0		0		0
								Plains Ecoregion Screening Threshold (Table M):								843		49
								Eutrophication Factors:				0.15		10		0.6		

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	2001	5	29	218136					6.9		0.5		770		52
UMC	7360	Amarugia Highlands Lake	Grab	2001	6	18	218137					15.31		0.17		650		102
UMC	7360	Amarugia Highlands Lake	Grab	2001	7	16	218138					2.4		1.36		420		27
UMC	7360	Amarugia Highlands Lake	Grab	2001	8	6	218139					1.3		1.55		480		22

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
2001 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio			ISS Summary	6.48	Secchi Summary	0.9	TN Summary	564	TP Summary	42
Plains Ecoregion Criteria (Table L):											0		0		0		0	
Plains Ecoregion Screening Threshold (Table M):															843		49	
Eutrophication Factors:								0.15			10		0.6					

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	2003	5	27	54669			39.6		3.4		0.59		1010		70	
UMC	7360	Amarugia Highlands Lake	Grab	2003	6	16	54670			2.7		0.8		2.57		620		19	
UMC	7360	Amarugia Highlands Lake	Grab	2003	7	14	54671			4.7		1.2		1.92		590		22	
UMC	7360	Amarugia Highlands Lake	Grab	2003	8	4	54672			7.0		0.6		1.63		580		23	
2003 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary	1.5	Secchi Summary	1.68	TN Summary	680	TP Summary	29
Plains Ecoregion Criteria (Table L):										0		0		0		0		0	
Plains Ecoregion Screening Threshold (Table M):										18					843		49		
Eutrophication Factors:								0.15			10		0.6						

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	2006	5	23	54673			3.1				1.38		650		35
UMC	7360	Amarugia Highlands Lake	Grab	2006	6	13	54674			10.8				1.5		820		32
UMC	7360	Amarugia Highlands Lake	Grab	2006	7	11	54675			14.2				1.32		580		45
UMC	7360	Amarugia Highlands Lake	Grab	2006	8	1	54676			7.8				1.43		610		33
2006 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary			Secchi Summary	1.41	TN Summary	659	TP Summary	36
Plains Ecoregion Criteria (Table L):										7.8		0		0		0		0
Plains Ecoregion Screening Threshold (Table M):										18					843		49	
Eutrophication Factors:								0.15				0.6						

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	2007	5	30	54677			26.2				0.7		640		67
UMC	7360	Amarugia Highlands Lake	Grab	2007	6	19	54678			34.6				1.1		820		38
UMC	7360	Amarugia Highlands Lake	Grab	2007	7	17	54679			15.1				0.6		500		51
UMC	7360	Amarugia Highlands Lake	Grab	2007	8	7	54680			6.5				1.9		460		23
2007 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary			Secchi Summary	1.08	TN Summary	589	TP Summary	42
Plains Ecoregion Criteria (Table L):										17.27		0		0		0		0
Plains Ecoregion Screening Threshold (Table M):										18					843		49	
Eutrophication Factors:								0.15				0.6						

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	2009	5	27	54681			7.1		3.3		0.82		590		39	
UMC	7360	Amarugia Highlands Lake	Grab	2009	6	17	54682			7.7		18.0		0.31		540		55	
UMC	7360	Amarugia Highlands Lake	Grab	2009	7	14	54683			7.4		2.0		1.42		280		30	
UMC	7360	Amarugia Highlands Lake	Grab	2009	8	5	54684			9.7		1.3		1.52		480		25	
2009 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary	6.15	Secchi Summary	1.02	TN Summary	455	TP Summary	36
Plains Ecoregion Criteria (Table L):										7.92		0		0		0		0	
Plains Ecoregion Screening Threshold (Table M):										18					843		49		
Eutrophication Factors:								0.15			10		0.6						

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	2012	6	5	240063			6.3				2.11		630		27
UMC	7360	Amarugia Highlands Lake	Grab	2012	6	26	240064			6.4				1.6		660		32

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
UMC	7360	Amarugia Highlands Lake	Grab	2012	7	24	240065			10.7				1.42		690		37
UMC	7360	Amarugia Highlands Lake	Grab	2012	8	14	240066			28.8				0.96		760		51
2012 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio	ChlA Summary			Secchi Summary			TN Summary		TP Summary	
									10.56			1.52			683		36	
Plains Ecoregion Criteria (Table L):									0			0			0		0	
Plains Ecoregion Screening Threshold (Table M):									18						843		49	
Eutrophication Factors:								0.15				0.6						

*Sample is the average of two or more duplicate samples.

Lake Nutrients

10 CSR 20-7.031(5)(N) defines by statute Missouri's numeric nutrient criteria. This analysis is for 10 CSR 20-7.031(5)(N)1.C.(I), the "Lake Ecoregion Criteria, a decision framework that integrates causal and response parameters into one water quality standard that accounts for uncertainty in linkages between causal and response parameters." Amarugia Lake - WBID 7360.00 is in the Plains ecoregion. The Lake Ecoregion Criteria, Screening Thresholds, and corresponding Eutrophication Factors are displayed in the table above.

If the Ecoregion Criteria (Table L) has been exceeded in the last three years of available data, then the lake is judged as impaired.

If any one Ecoregion Screening Thresholds (Table M) has been exceeded in the last three years of available data, then other eutrophication factors are examined (10 CSR 20-7.031(5)(N)6A-E). If these eutrophication factors have been exceeded within the same year as the Screening Thresholds then the lake is judged as impaired.

Eutrophication factors include:

- A) Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms (i.e. fish kills).
- B) Epilimnetic excursions from dissolved oxygen or pH criteria.
- C) Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL).

In absence of cell counts a surrogate is used. The surrogates used will be:

Microcystin	4.0 ug/l
Cylindrospermopsin	8.0 ug/l
Anatoxin-a	8.0 ug/l
Saxitoxin	4.0 ug/l

D) Observed Shifts in aquatic diversity attributed to eutrophication.

E) Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 - September 30 (i.e., light limitations). Yearly average Secchi depths less than 0.6 meters in the Plains, 0.7 meters in the Ozark Border, and 0.9 meters in the Ozark Highlands, will necessitate analysis of Chlorophyll-a/Total Phosphorus ratios. A mean Chlorophyll-a/TP ratio less than or equal to 0.15 and a mean inorganic suspended solids (ISS or NVSS) value greater than or equal to 10 mg/L is suggestive of excessive mineral turbidity which limits algal productivity.

Amarugia Lake - WBID 7360.00 is judged as unimpaired due to Chlorophyll-a or nutrients.

Missouri Department of Natural Resources, Water Protection Program, (573)751-1300, www.dnr.mo.gov

http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

02/08/2019



Missouri Department of Natural Resources

Amarugia Lake - WBID 7360.00

Univ. of Missouri, Columbia

HUC 8: 10290108 - Lake Ecoregion: Plains

Ecoregional Criteria Apply

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
UMC	7360	Amarugia Highlands Lake	Grab	2007	5	30	54677			26.2				0.7		640		67
UMC	7360	Amarugia Highlands Lake	Grab	2007	6	19	54678			34.6				1.1		820		38
UMC	7360	Amarugia Highlands Lake	Grab	2007	7	17	54679			15.1				0.6		500		51
UMC	7360	Amarugia Highlands Lake	Grab	2007	8	7	54680			6.5				1.9		460		23
2007 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary				Secchi Summary		TN Summary		TP Summary
										17.27				1.08		589		42
Plains Ecoregion Criteria (Table L):										0				0		0		0
Plains Ecoregion Screening Threshold (Table M):										18						843		49
Eutrophication Factors:								0.15					0.6					

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	2009	5	27	54681			7.1		3.3		0.82		590		39
UMC	7360	Amarugia Highlands Lake	Grab	2009	6	17	54682			7.7		18.0		0.31		540		55
UMC	7360	Amarugia Highlands Lake	Grab	2009	7	14	54683			7.4		2.0		1.42		280		30
UMC	7360	Amarugia Highlands Lake	Grab	2009	8	5	54684			9.7		1.3		1.52		480		25
2009 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary		Secchi Summary		TN Summary		TP Summary
										7.92		6.15		1.02		455		36
Plains Ecoregion Criteria (Table L):										0		0		0		0		0
Plains Ecoregion Screening Threshold (Table M):										18						843		49
Eutrophication Factors:								0.15				10		0.6				

*Sample is the average of two or more duplicate samples.

UMC	7360	Amarugia Highlands Lake	Grab	2012	6	5	240063			6.3				2.11		630		27
UMC	7360	Amarugia Highlands Lake	Grab	2012	6	26	240064			6.4				1.6		660		32
UMC	7360	Amarugia Highlands Lake	Grab	2012	7	24	240065			10.7				1.42		690		37
UMC	7360	Amarugia Highlands Lake	Grab	2012	8	14	240066			28.8				0.96		760		51
2012 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary				Secchi Summary		TN Summary		TP Summary
										10.56				1.52		683		36
Plains Ecoregion Criteria (Table L):										0				0		0		0
Plains Ecoregion Screening Threshold (Table M):										18						843		49
Eutrophication Factors:								0.15						0.6				

*Sample is the average of two or more duplicate samples.

Lake Nutrients

10 CSR 20-7.031(5)(N) defines by statute Missouri's numeric nutrient criteria. This analysis is for 10 CSR 20-7.031(5)(N)1.C.(I), the "Lake Ecoregion Criteria, a decision framework that integrates causal and response parameters into one water quality standard that accounts for uncertainty in linkages between causal and response parameters." Amarugia Lake - WBID 7360.00 is in the Plains ecoregion. The Lake Ecoregional Criteria, Screening Thresholds, and corresponding Eutrophication Factors are displayed in the table above.

If the Ecoregional Criteria (Table L) has been exceeded in the last three years of available data, then the lake is judged as impaired.

If any one Ecoregional Screening Thresholds (Table M) has been exceeded in the last three years of available data, then other eutrophication factors are examined (10 CSR 20-7.031(5)(N)6A-E). If these eutrophication factors have been exceeded within the same year as the Screening Thresholds then the lake is judged as impaired.

Eutrophication factors include:

A) Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms (i.e. fish kills).

B) Epilimnetic excursions from dissolved oxygen or pH criteria.

C) Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL).

In absence of cell counts a surrogate is used. The surrogates used will be:

Microcystin 4.0 ug/l

Cylindrospermopsin 8.0 ug/l

Anatoxin-a 8.0 ug/l

Saxitoxin 4.0 ug/l

D) Observed Shifts in aquatic diversity attributed to eutrophication.

E) Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 - September 30 (i.e., light limitations). Yearly average Secchi depths less than 0.6 meters in the Plains, 0.7 meters in the Ozark Border, and 0.9 meters in the Ozark Highlands, will necessitate analysis of Chlorophyll-a/Total Phosphorus ratios. A mean Chlorophyll-a/TP ratio less than or equal to 0.15 and a mean inorganic suspended solids (ISS or NVSS) value greater than or equal to 10 mg/L is suggestive of excessive mineral turbidity which limits algal productivity.

Amarugia Lake - WBID 7360.00 is judged as unimpaired due to Chlorophyll-a or nutrients.

Missouri Department of Natural Resources, Water Protection Program, (573)751-1300, www.dnr.mo.gov

http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

02/08/2019

Lake Springfield Ecoregional NNC Assessment



Comparison to 10 CSR 20-7.031(5)(N) Table L's Response Impairment Thresholds

Assessment

Table L

Lake Ecoregion	Chl-a Response Impairment Threshold (ug/L)
Plains	30
Ozark Border	22
Ozark Highlands	15

Ozark Highlands ecoregion

Name	WBID	Year	Chlorophyll-a (ug/L)
Lake Springfield nr Dam	7312	2017	20.08
	7312	2016	33.67
	7312	2015	16.19

2+ Exceedances in last 3 years of data results in Category 5 Impairment for nutrients.

Table M

Lake Ecoregion	TP Nutrient Screening Threshold (mg/L)	TN Nutrient Screening Threshold (mg/L)	Chl-a Nutrient Screening Threshold (ug/L)
Plains	0.049	0.843	18
Ozark Border	0.040	0.733	13
Ozark Highlands	0.016	0.401	6

Ozark Highlands ecoregion lakes assessed with available microcystin data and accompanying Table M parameters.

Name	WBID	Year	Chlorophyll-a (ug/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Table M Assessment	Date	Month	Day	Microcystin (ug/L)
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Name	WBID	Year	Chlorophyll-a (ug/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Table M Assessment	Date	Month	Day	Microcystin (ug/L)
Lake Springfield nr Dam	7312	2016	33.67	0.0579	0.8001	Exceedance	2016-07-18	7	18	0.07
Lake Springfield nr Dam	7312	2016	33.67	0.0579	0.8001	Exceedance	2016-09-03	9	3	0.07
Lake Springfield nr Dam	7312	2016	33.67	0.0579	0.8001	Exceedance	2016-06-27	6	27	0.07
Lake Springfield nr Dam	7312	2017	20.08	0.0434	0.8424	Exceedance	2017-06-08	6	8	0.39

Ozark Highlands ecoregion lakes assessed with available data against Table M

Name	WBID	Year	Chlorophyll-a (ug/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Table M Assessment	Secchi depth (m)*	Chla_TP Ratio	Inorganic Sediment (mg/L)	Mineral Turbidity Assessment
Lake Springfield nr Dam	7312	2015	16.19	0.039	1.1532	Exceedance	0.721	0.509	8.102	Category 3
Lake Springfield nr Dam	7312	2016	33.67	0.0579	0.8001	Exceedance	0.508	0.588	10.185	Category 3
Lake Springfield nr Dam	7312	2017	20.08	0.0434	0.8424	Exceedance	0.686	0.514	8.422	Category 3



Missouri Department of Natural Resources

Lake Springfield - WBID 7312.00

Univ. of Missouri, Columbia

HUC 8: 11010002 - Lake Ecoregion: Ozark Highlands

Ecoregional Criteria Apply

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Microcystin (ug/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2003	5	2	10983					6.6				0.9		800		44
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2003	5	22	10984					8.1				0.71		950		24
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2003	7	8	10985					17.3				0.51		720		72
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2003	7	25	10986					16.3				0.46		740		64
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2003	8	15	10987					12.0				0.61		810		49
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2003	9	8	10988					11.7				0.61		930		44
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2003	9	26	10989					10.7				0.53		690		46

2003 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ISS Summary					Secchi Summary		TN Summary		TP Summary	
										11.81					0.62		800		47	
Ozark Highlands Ecoregion Criteria (Table L):																				
Ozark Highlands Ecoregion Screening Threshold (Table M):																	401		16	
Eutrophication Factors:								0.15		10					0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2004	5	5	10991					11.2				0.56		1800		37
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2004	5	24	10992					11.6				0.69		1000		31
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2004	6	8	10993					11.9				0.53		750		50
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2004	6	29	10994					18.4				0.56		840		43
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2004	7	19	10995					9.9				0.56		850		61
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2004	8	10	10996					10.1				0.58		1220		47
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2004	9	14	10997					13.2				0.51		630		56
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2004	9	29	10998					9.3				0.46		720		60

2004 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ISS Summary					Secchi Summary		TN Summary		TP Summary	
										11.95					0.56		924		47	
Ozark Highlands Ecoregion Criteria (Table L):																				
Ozark Highlands Ecoregion Screening Threshold (Table M):																	401		16	
Eutrophication Factors:								0.15		10					0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2005	5	7	11000					8.7				0.81		810		21
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2005	6	2	11001					7.8				0.53		600		
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2005	6	30	11002					18.0				0.43		790		
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2005	7	18	11003					13.2				0.48		700		
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2005	8	8	11004					17.2				0.42		930		98
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2005	9	1	11005					11.6				0.56		890		70
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2005	9	26	11006					0.1				0.47		1100		56

2005 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ISS Summary					Secchi Summary		TN Summary		TP Summary	
										10.94					0.53		818		53	
Ozark Highlands Ecoregion Criteria (Table L):																				
Ozark Highlands Ecoregion Screening Threshold (Table M):																	401		16	
Eutrophication Factors:								0.15		10					0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2006	5	1	11007					15.9				0.36		1230		77
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2006	5	22	11008					11.9				0.69		1270		40
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2006	6	12	11009					12.3				0.58		780		61
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2006	6	26	11010					13.7				0.46		570		67
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2006	7	20	11011					14.4				0.46		910		67
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2006	8	12	11012					16.0				0.38		970		89
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2006	9	4	11013					22.2				0.3		1050		95
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2006	9	25	11014					13.3				0.51		750		66

2006 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ISS Summary					Secchi Summary		TN Summary		TP Summary	
										14.96					0.47		913		68	

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Microcystin (ug/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)	
Ozark Highlands Ecoregion Criteria (Table L):																					
Ozark Highlands Ecoregion Screening Threshold (Table M):																		401		16	
Eutrophication Factors:								0.15				10					0.9				

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2007	5	14	11016					8.0				0.7		930		32
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2007	6	18	11017					7.1				0.8		1790		42
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2007	6	26	11018					13.0				0.6		1220		41
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2007	7	12	11019					13.3				0.6		1040		40
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2007	8	8	11020					14.4				0.5		840		63
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2007	8	30	11021					13.0				0.6		1020		60
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2007	9	15	11022					9.1				0.7		1720		51
2007 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary				Secchi Summary		TN Summary		TP Summary
												11.13			0.64		1176		46	
Ozark Highlands Ecoregion Criteria (Table L):																				
Ozark Highlands Ecoregion Screening Threshold (Table M):																		401		16
Eutrophication Factors:								0.15				10			0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2008	5	13	11024					7.5				0.86		1180		28
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2008	6	4	11025					9.1				0.76		950		38
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2008	6	27	11026					6.2				0.69		1450		34
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2008	7	14	11027					9.7				0.66		1020		36
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2008	8	4	11028					15.7				0.56		930		53
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2008	8	26	11029					13.7				0.51		620		60
2008 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary				Secchi Summary		TN Summary		TP Summary
												10.32			0.67		993		40	
Ozark Highlands Ecoregion Criteria (Table L):																				
Ozark Highlands Ecoregion Screening Threshold (Table M):																		401		16
Eutrophication Factors:								0.15				10			0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2009	5	21	196095					7.3				0.8128		1070		24
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2009	6	1	196096					10.7				0.6604		1220		33
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2009	6	23	196097					10.1				0.6604		1160		41
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2009	7	16	196098					13.3				0.7112		900		48
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2009	8	4	196099					9.0				0.6604		850		35
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2009	8	28	196100					12.1				0.6858		870		45
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2009	9	14	196101					7.8				0.762		650		41
2009 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary				Secchi Summary		TN Summary		TP Summary
												10.04			0.71		941		37	
Ozark Highlands Ecoregion Criteria (Table L):																				
Ozark Highlands Ecoregion Screening Threshold (Table M):																		401		16
Eutrophication Factors:								0.15				10			0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2010	5	1	210336					6.2				0.9144		1100		34
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2010	5	18	210337					11.8				0.5588		1490		72
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2010	6	6	210338					10.0				0.762		1150		43
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2010	6	29	210339					14.6				0.6096		930		59
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2010	7	14	210340					11.2				0.4572		1620		112
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2010	8	10	210341					10.6				0.5334		670		54
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2010	8	29	210342					22.2				0.5334		640		74
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2010	9	21	210343					7.8				0.762		1980		42
2010 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary				Secchi Summary		TN Summary		TP Summary
												11.8			0.64		1116		57	
Ozark Highlands Ecoregion Criteria (Table L):																				
Ozark Highlands Ecoregion Screening Threshold (Table M):																		401		16
Eutrophication Factors:								0.15				10			0.9					

*Sample is the average of two or more duplicate samples.

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Microcystin (ug/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2011	5	5	241184					7.0				0.81		1160		44	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2011	5	17	241185					8.2				0.76		1210		29	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2011	6	9	241186					11.5				0.71		960		34	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2011	6	28	241187					10.0				0.64		630		56	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2011	7	21	241188					11.6				0.51		630		66	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2011	8	11	241189					17.0				0.46		680		70	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2011	8	27	241190					15.9				0.46		590		69	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2011	9	24	241191					13.3				0.56		780		54	
2011 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary				Secchi Summary		TN Summary		TP Summary	
												11.81				0.61		800		50	
Ozark Highlands Ecoregion Criteria (Table L):																					
Ozark Highlands Ecoregion Screening Threshold (Table M):																			401		16
Eutrophication Factors:								0.15				10			0.9						

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2012	5	14	242348					7.5				0.84		850		45	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2012	6	7	242349					16.0				0.46		670		66	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2012	6	25	242350					8.9				0.48		650		51	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2012	7	23	242351					26.4				0.46		2220		42	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2012	8	3	242352					22.9				0.51		2450		43	
2012 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary				Secchi Summary		TN Summary		TP Summary	
												16.34				0.55		1150		49	
Ozark Highlands Ecoregion Criteria (Table L):																					
Ozark Highlands Ecoregion Screening Threshold (Table M):																			401		16
Eutrophication Factors:								0.15				10			0.9						

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2013	5	14	241193					9.8				0.97		1200		27	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2013	6	7	241194					8.4				0.76		1760		41	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2013	6	26	241195					9.9				0.76		1410		46	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2013	7	25	241196					16.6				0.46		620		78	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2013	8	15	241197					9.9				0.61		1840		43	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2013	9	4	241198					14.4				0.53		1010		49	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2013	9	19	241199					10.2				0.66		870		45	
2013 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary				Secchi Summary		TN Summary		TP Summary	
												11.31				0.68		1169		45	
Ozark Highlands Ecoregion Criteria (Table L):																					
Ozark Highlands Ecoregion Screening Threshold (Table M):																			401		16
Eutrophication Factors:								0.15				10			0.9						

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2014	5	16	252886					11.2				0.53		960		38	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2014	7	1	252887					10.0				0.61		1040		45	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2014	7	14	252888					8.4				0.66		930		42	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2014	8	4	252889					14.9				0.56		720		68	
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2014	9	4	252890					13.9				0.56		740		66	
2014 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary				Secchi Summary		TN Summary		TP Summary	
												11.68				0.58		869		50	
Ozark Highlands Ecoregion Criteria (Table L):																					
Ozark Highlands Ecoregion Screening Threshold (Table M):																			401		16
Eutrophication Factors:								0.15				10			0.9						

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	5	7	259026			11.4		10.5				0.81		680		32
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	5	15	259027			12.8		5.2				0.86		900		26
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	6	11	259028			16.3		5.3				0.81		1400		28
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	6	25	259029			22.6		7.6				0.63		1690		45
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	7	14	259030			2.4		9.2				0.63		1580		47
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	8	1	259031			29.8		10.5				0.66		1010		48

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Microcystin (ug/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	8	21	259032			38.7		10.4				0.61		1340		53
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	9	14	259033			31.8		8.4				0.76		1010		43
2015 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary				Secchi Summary		TN Summary		TP Summary
										16.2		8.39				0.72		1153		39
Ozark Highlands Ecoregion Criteria (Table L):										15										
Ozark Highlands Ecoregion Screening Threshold (Table M):										6								401		16
Eutrophication Factors:								0.15				10			0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	5	15	270778			35.6		6.6				0.6096		760		57
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	6	16	270779			26.0		8.2				0.4826		840		58
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	6	27	270780			50.2		9.2	0.07			0.4826		930		73
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	7	18	270781			23.8		17.1	0.07			0.508		1150		47
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	9	3	270782			37.2		14.1	0.07			0.4572		630		64
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	9	22	270783			35.4		9.3				0.508		610		52
2016 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary		Microcystin Summary		Secchi Summary		TN Summary		TP Summary
										33.67		10.75				0.51		800		58
Ozark Highlands Ecoregion Criteria (Table L):										15										
Ozark Highlands Ecoregion Screening Threshold (Table M):										6								401		16
Eutrophication Factors:								0.15				10		4	0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	5	18	280233			6.1		13.3	<	0.07		0.71		1360		44
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	6	8	280234			26.1		6.6		0.39		0.71		980		32
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	6	27	280235			21.0		8.7	<	0.07		0.56		830		48
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	7	13	280236			24.6		7.5	<	0.07		0.91		610		48
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	8	12	280237			26.7		10.2	<	0.07		0.56		1080		44
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	8	28	280238			22.7		6.2	<	0.07		0.66		810		39
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	9	20	280239			26.4		8.3	<	0.07		0.69		510		52
2017 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary		Microcystin Summary		Secchi Summary		TN Summary		TP Summary
										20.08		8.69		0.09		0.69		842		43
Ozark Highlands Ecoregion Criteria (Table L):										15										
Ozark Highlands Ecoregion Screening Threshold (Table M):										6								401		16
Eutrophication Factors:								0.15				10		4	0.9					

*Sample is the average of two or more duplicate samples.

Lake Nutrients

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Microcystin (ug/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
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10 CSR 20-7.031(5)(N) defines by statute Missouri's numeric nutrient criteria. This analysis is for 10 CSR 20-7.031(5)(N)1.C.(I), the "Lake Ecoregion Criteria, a decision framework that integrates causal and response parameters into one water quality standard that accounts for uncertainty in linkages between causal and response parameters." Lake Springfield - WBID 7312.00 is in the Ozark Highlands ecoregion. The Lake Ecoregional Criteria, Screening Thresholds, and corresponding Eutrophication Factors are displayed in the table above.

If the Ecoregional Criteria (Table L) has been exceeded in the last three years of available data, then the lake is judged as impaired.

If any one Ecoregional Screening Thresholds (Table M) has been exceeded in the last three years of available data, then other eutrophication factors are examined (10 CSR 20-7.031(5)(N)6A-E). If these eutrophication factors have been exceeded within the same year as the Screening Thresholds then the lake is judged as impaired.

Eutrophication factors include:

- A) Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms (i.e. fish kills).
- B) Epilimnetic excursions from dissolved oxygen or pH criteria.
- C) Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL).

In absence of cell counts a surrogate is used. The surrogates used will be:

Microcystin	4.0 ug/l
Cylindrospermopsin	8.0 ug/l
Anatoxin-a	8.0 ug/l
Saxitoxin	4.0 ug/l

D) Observed Shifts in aquatic diversity attributed to eutrophication.

E) Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 - September 30 (i.e., light limitations). Yearly average Secchi depths less than 0.6 meters in the Plains, 0.7 meters in the Ozark Border, and 0.9 meters in the Ozark Highlands, will necessitate analysis of Chlorophyll-a/Total Phosphorus ratios. A mean Chlorophyll-a/TP ratio less than or equal to 0.15 and a mean inorganic suspended solids (ISS or NVSS) value greater than or equal to 10 mg/L is suggestive of excessive mineral turbidity which limits algal productivity.

Lake Springfield - WBID 7312.00 is judged as impaired due to Chlorophyll-a.

Missouri Department of Natural Resources, Water Protection Program, (573)751-1300, www.dnr.mo.gov

http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

02/08/2019



Missouri Department of Natural Resources

Lake Springfield - WBID 7312.00

Univ. of Missouri, Columbia

HUC 8: 11010002 - Lake Ecoregion: Ozark Highlands

Ecoregional Criteria Apply

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Microcystin (ug/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	5	7	259026			11.4		10.5				0.81		680		32
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	5	15	259027			12.8		5.2				0.86		900		26
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	6	11	259028			16.3		5.3				0.81		1400		28
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	6	25	259029			22.6		7.6				0.63		1690		45
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	7	14	259030			2.4		9.2				0.63		1580		47
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	8	1	259031			29.8		10.5				0.66		1010		48
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	8	21	259032			38.7		10.4				0.61		1340		53
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2015	9	14	259033			31.8		8.4				0.76		1010		43
2015 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary		Microcystin Summary		Secchi Summary		TN Summary		TP Summary
										16.2		8.39				0.72		1153		39
Ozark Highlands Ecoregion Criteria (Table L):										15										
Ozark Highlands Ecoregion Screening Threshold (Table M):										6								401		16
Eutrophication Factors:								0.15				10			0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	5	15	270778			35.6		6.6				0.6096		760		57
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	6	16	270779			26.0		8.2				0.4826		840		58
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	6	27	270780			50.2		9.2		0.07		0.4826		930		73
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	7	18	270781			23.8		17.1		0.07		0.508		1150		47
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	9	3	270782			37.2		14.1		0.07		0.4572		630		64
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2016	9	22	270783			35.4		9.3				0.508		610		52
2016 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary		Microcystin Summary		Secchi Summary		TN Summary		TP Summary
										33.67		10.75				0.51		800		58
Ozark Highlands Ecoregion Criteria (Table L):										15										
Ozark Highlands Ecoregion Screening Threshold (Table M):										6								401		16
Eutrophication Factors:								0.15				10		4	0.9					

*Sample is the average of two or more duplicate samples.

UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	5	18	280233			6.1		13.3	<	0.07		0.71		1360		44
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	6	8	280234			26.1		6.6		0.39		0.71		980		32
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	6	27	280235			21.0		8.7	<	0.07		0.56		830		48
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	7	13	280236			24.6		7.5	<	0.07		0.91		610		48
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	8	12	280237			26.7		10.2	<	0.07		0.56		1080		44
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	8	28	280238			22.7		6.2	<	0.07		0.66		810		39
UMC	7312/0.2	Lake Springfield nr Dam	Grab	2017	9	20	280239			26.4		8.3	<	0.07		0.69		510		52
2017 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary		ISS Summary		Microcystin Summary		Secchi Summary		TN Summary		TP Summary
										20.08		8.69		0.09		0.69		842		43
Ozark Highlands Ecoregion Criteria (Table L):										15										
Ozark Highlands Ecoregion Screening Threshold (Table M):										6								401		16
Eutrophication Factors:								0.15				10		4	0.9					

*Sample is the average of two or more duplicate samples.

Lake Nutrients

10 CSR 20-7.031(5)(N) defines by statute Missouri's numeric nutrient criteria. This analysis is for 10 CSR 20-7.031(5)(N)1.C.(I), the "Lake Ecoregion Criteria, a decision framework that integrates causal and response parameters into one water quality standard that accounts for uncertainty in linkages between causal and response parameters." Lake Springfield - WBID 7312.00 is in the Ozark Highlands ecoregion. The Lake Ecoregional Criteria, Screening Thresholds, and corresponding Eutrophication Factors are displayed in the table above.

If the Ecoregional Criteria (Table L) has been exceeded in the last three years of available data, then the lake is judged as impaired.

If any one Ecoregional Screening Thresholds (Table M) has been exceeded in the last three years of available data, then other eutrophication factors are examined (10 CSR 20-7.031(5)(N)6A-E). If these eutrophication factors have been exceeded within the same year as the Screening Thresholds then the lake is judged as impaired.

Eutrophication factors include:

A) Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms (i.e. fish kills).

B) Epilimnetic excursions from dissolved oxygen or pH criteria.

C) Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL).

In absence of cell counts a surrogate is used. The surrogates used will be:

Microcystin 4.0 ug/l

Cylindrospermopsin 8.0 ug/l

Anatoxin-a 8.0 ug/l

Saxitoxin 4.0 ug/l

D) Observed Shifts in aquatic diversity attributed to eutrophication.

E) Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 - September 30 (i.e., light limitations). Yearly average Secchi depths less than 0.6 meters in the Plains, 0.7 meters in the Ozark Border, and 0.9 meters in the Ozark Highlands, will necessitate analysis of Chlorophyll-a/Total Phosphorus ratios. A mean Chlorophyll-a/TP ratio less than or equal to 0.15 and a mean inorganic suspended solids (ISS or NVSS) value greater than or equal to 10 mg/L is suggestive of excessive mineral turbidity which limits algal productivity.

Lake Springfield - WBID 7312.00 is judged as impaired due to Chlorophyll-a.

Missouri Department of Natural Resources, Water Protection Program, (573)751-1300, www.dnr.mo.gov

http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

02/08/2019

Peters Lake Ecoregional NNC Assessment



Comparison to 10 CSR 20-7.031(5)(N) Table L's Response Impairment Thresholds

Assessment

Table L

Lake Ecoregion	Chl-a Response Impairment Threshold (ug/L)
Plains	30
Ozark Border	22
Ozark Highlands	15

Ozark Border ecoregion

Name	WBID	Year	Chlorophyll-a (ug/L)
Fayette Lake No.2	7183	2016	19.1
	7183	2008	21.76
	7183	2007	22.84

1 or fewer exceedances of Table L value results in Table M assessment.

Table M

Lake Ecoregion	TP Nutrient Screening Threshold (mg/L)	TN Nutrient Screening Threshold (mg/L)	Chl-a Nutrient Screening Threshold (ug/L)
Plains	0.049	0.843	18
Ozark Border	0.040	0.733	13
Ozark Highlands	0.016	0.401	6

No data available for Microcystin comparison

Ozark Border ecoregion lakes assessed with available data against Table M

Name	WBID	Year	Chlorophyll- a (ug/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Table M Assessment	Secchi depth (m)*	Chla_TP Ratio	Inorganic Sediment (mg/L)	Mineral Turbidity Assessment
Fayette Lake No.2	7183	2007	22.84	0.0493	0.6884	Exceedance	0.9	0.526	NA	<i>Category 3</i>
Fayette Lake No.2	7183	2008	21.76	0.0535	0.6589	Exceedance	0.665	0.461	NA	<i>Category 3</i>
Fayette Lake No.2	7183	2016	19.1	0.047	0.6936	Exceedance	0.58	0.507	6.043	<i>Category 3</i>

Table M assessment results in exceedance(s) of Table M value(s). Lake is considered Category 3 for nutrients.



Missouri Department of Natural Resources

Peters Lake - WBID 7183.00

Univ. of Missouri, Columbia

HUC 8: 10300102 - Lake Ecoregion: Ozark Border

Ecoregional Criteria Apply

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
UMC	7183	Peters Lake	Grab	1989	5	31	216146					1.8		1.5		850		31
UMC	7183	Peters Lake	Grab	1989	7	5	216147					2.6		1.7		620		39
UMC	7183	Peters Lake	Grab	1989	8	8	216148					10.8		0.4		1640		104
1989 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												5.07		1.2				
Ozark Border Ecoregion Criteria (Table L):																		
Ozark Border Ecoregion Screening Threshold (Table M):															733		40	
Eutrophication Factors:								0.15				10		0.7				

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	1990	5	30	216149					18.4		0.2		920		174
UMC	7183	Peters Lake	Grab	1990	7	2	216150					10.2		0.5		930		85
UMC	7183	Peters Lake	Grab	1990	8	1	216151					3.8		0.9		800		35
1990 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												10.8		0.53				
Ozark Border Ecoregion Criteria (Table L):																		
Ozark Border Ecoregion Screening Threshold (Table M):															733		40	
Eutrophication Factors:								0.15				10		0.7				

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	1991	5	28	216152					7.9		0.5		910		52
UMC	7183	Peters Lake	Grab	1991	7	1	216153					2.0		1.0		830		22
UMC	7183	Peters Lake	Grab	1991	7	23	216154					3.7		0.3		1990		51
1991 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												4.53		0.6				
Ozark Border Ecoregion Criteria (Table L):																		
Ozark Border Ecoregion Screening Threshold (Table M):															733		40	
Eutrophication Factors:								0.15				10		0.7				

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	1992	6	9	216155					3.0		1.8		740		22
UMC	7183	Peters Lake	Grab	1992	7	7	216156					5.0		1.1		800		31
UMC	7183	Peters Lake	Grab	1992	8	4	216157					4.4		0.6		1040		40
1992 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												4.13		1.17				
Ozark Border Ecoregion Criteria (Table L):																		
Ozark Border Ecoregion Screening Threshold (Table M):															733		40	
Eutrophication Factors:								0.15				10		0.7				

*Sample is the average of two or more duplicate samples.

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)	
UMC	7183	Peters Lake	Grab	1993	6	2	216158					10.5		0.5		820		65	
UMC	7183	Peters Lake	Grab	1993	6	28	216159					1.3		1.9		470		25	
UMC	7183	Peters Lake	Grab	1993	8	5	216160					3.7		1.2		460		27	
1993 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary	
												5.17		1.2					
Ozark Border Ecoregion Criteria (Table L):																			
Ozark Border Ecoregion Screening Threshold (Table M):																733		40	
Eutrophication Factors:								0.15				10		0.7					

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	1994	6	6	216161					6.9		0.7		590		44
UMC	7183	Peters Lake	Grab	1994	7	5	216162					3.4		1.0		770		27
UMC	7183	Peters Lake	Grab	1994	8	1	216163					3.8		0.6		1110		45
1994 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio				ISS Summary		Secchi Summary		TN Summary		TP Summary
												4.7		0.77				
Ozark Border Ecoregion Criteria (Table L):																		
Ozark Border Ecoregion Screening Threshold (Table M):																733		40
Eutrophication Factors:								0.15				10		0.7				

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	2005	6	2	64453	0.23		14.9				0.45		560		65
UMC	7183	Peters Lake	Grab	2005	6	22	64454	0.15		6.2				1.0		620		41
UMC	7183	Peters Lake	Grab	2005	7	21	64455	0.38		24.1				0.9		880		64
UMC	7183	Peters Lake	Grab	2005	8	10	64456	0.38		18.0				0.63		740		48
2005 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary			Secchi Summary		TN Summary		TP Summary	
								0.28		14.15			0.75		690		53	
Ozark Border Ecoregion Criteria (Table L):										22								
Ozark Border Ecoregion Screening Threshold (Table M):										13					733		40	
Eutrophication Factors:								0.15					0.7					

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	2007	5	29	64457	0.31		14.3				0.7		560		46
UMC	7183	Peters Lake	Grab	2007	6	18	64458	0.30		13.6				1.0		660		45
UMC	7183	Peters Lake	Grab	2007	7	16	64459	0.49		20.6				1.0		750		42
UMC	7183	Peters Lake	Grab	2007	8	6	64460	1.00		67.9				0.9		810		68
2007 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary			Secchi Summary		TN Summary		TP Summary	
								0.53		22.84			0.9		688		49	
Ozark Border Ecoregion Criteria (Table L):										22								
Ozark Border Ecoregion Screening Threshold (Table M):										13					733		40	
Eutrophication Factors:								0.15					0.7					

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	2008	6	12	64461	0.50		32.5				0.54		710		65
UMC	7183	Peters Lake	Grab	2008	6	27	64462	0.21		15.1				0.29		740		71
UMC	7183	Peters Lake	Grab	2008	7	18	64463	0.32		9.5				1.15		460		30
UMC	7183	Peters Lake	Grab	2008	8	19	64464	0.82		48.1				0.68		780		59
2008 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio		ChlA Summary			Secchi Summary		TN Summary		TP Summary	
								0.46		21.76			0.67		659		53	

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)	
Ozark Border Ecoregion Criteria (Table L):										22									
Ozark Border Ecoregion Screening Threshold (Table M):										13						733			40
Eutrophication Factors:								0.15						0.7					

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	2016	5	19	271273	0.13		6.53		8.5		0.6		650		49	
UMC	7183	Peters Lake	Grab	2016	6	8	271274	0.36		14.3		7.0		0.58		580		40	
UMC	7183	Peters Lake	Grab	2016	7	13	271275	0.62		32.47		7.14		0.55		660		52	
UMC	7183	Peters Lake	Grab	2016	8	3	271276	0.91		43.86		3.14		0.59		930		48	
2016 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio	ChlA Summary		ISS Summary		Secchi Summary		TN Summary		TP Summary		
								0.51	19.1		6.45		0.58		694		47		
Ozark Border Ecoregion Criteria (Table L):										22									
Ozark Border Ecoregion Screening Threshold (Table M):										13						733			40
Eutrophication Factors:								0.15				10		0.7					

*Sample is the average of two or more duplicate samples.

Lake Nutrients

10 CSR 20-7.031(5)(N) defines by statute Missouri's numeric nutrient criteria. This analysis is for 10 CSR 20-7.031(5)(N)1.C.(I), the "Lake Ecoregion Criteria, a decision framework that integrates causal and response parameters into one water quality standard that accounts for uncertainty in linkages between causal and response parameters." Peters Lake - WBID 7183.00 is in the Ozark Border ecoregion. The Lake Ecoregion Criteria, Screening Thresholds, and corresponding Eutrophication Factors are displayed in the table above.

If the Ecoregion Criteria (Table L) has been exceeded in the last three years of available data, then the lake is judged as impaired.

If any one Ecoregion Screening Thresholds (Table M) has been exceeded in the last three years of available data, then other eutrophication factors are examined (10 CSR 20-7.031(5)(N)6A-E). If these eutrophication factors have been exceeded within the same year as the Screening Thresholds then the lake is judged as impaired.

Eutrophication factors include:

A) Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms (i.e. fish kills).

B) Epilimnetic excursions from dissolved oxygen or pH criteria.

C) Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL).

In absence of cell counts a surrogate is used. The surrogates used will be:

Microcystin 4.0 ug/l

Cylindrospermopsin 8.0 ug/l

Anatoxin-a 8.0 ug/l

Saxitoxin 4.0 ug/l

D) Observed Shifts in aquatic diversity attributed to eutrophication.

E) Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 - September 30 (i.e., light limitations). Yearly average Secchi depths less than 0.6 meters in the Plains, 0.7 meters in the Ozark Border, and 0.9 meters in the Ozark Highlands, will necessitate analysis of Chlorophyll-a/Total Phosphorus ratios. A mean Chlorophyll-a/TP ratio less than or equal to 0.15 and a mean inorganic suspended solids (ISS or NVSS) value greater than or equal to 10 mg/L is suggestive of excessive mineral turbidity which limits algal productivity.

Peters Lake - WBID 7183.00 is judged as inconclusive for chlorophyll-a, nutrients, and eutrophication factors.

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http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

02/08/2019



Missouri Department of Natural Resources

Peters Lake - WBID 7183.00

Univ. of Missouri, Columbia

HUC 8: 10300102 - Lake Ecoregion: Ozark Border

Ecoregional Criteria Apply

Org	Site Code	Site Name	Sample Type	Yr	Mo	Dy	Sample ID	ChlA/TP Ratio	Qualifier	ChlA (ug/l)	Qualifier	ISS (mg/l)	Qualifier	Secchi (m)	Qualifier	TN (ug/l)	Qualifier	TP (ug/l)
UMC	7183	Peters Lake	Grab	2007	5	29	64457	0.31		14.3				0.7		560		46
UMC	7183	Peters Lake	Grab	2007	6	18	64458	0.30		13.6				1.0		660		45
UMC	7183	Peters Lake	Grab	2007	7	16	64459	0.49		20.6				1.0		750		42
UMC	7183	Peters Lake	Grab	2007	8	6	64460	1.00		67.9				0.9		810		68
2007 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio	ChlA Summary			Secchi Summary			TN Summary		TP Summary	
								0.53	22.84			0.9			688		49	
Ozark Border Ecoregion Criteria (Table L):																		
Ozark Border Ecoregion Screening Threshold (Table M):														733		40		
Eutrophication Factors:								0.15			0.7							

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	2008	6	12	64461	0.50		32.5				0.54		710		65
UMC	7183	Peters Lake	Grab	2008	6	27	64462	0.21		15.1				0.29		740		71
UMC	7183	Peters Lake	Grab	2008	7	18	64463	0.32		9.5				1.15		460		30
UMC	7183	Peters Lake	Grab	2008	8	19	64464	0.82		48.1				0.68		780		59
2008 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio	ChlA Summary			Secchi Summary			TN Summary		TP Summary	
								0.46	21.76			0.67			659		53	
Ozark Border Ecoregion Criteria (Table L):																		
Ozark Border Ecoregion Screening Threshold (Table M):														733		40		
Eutrophication Factors:								0.15			0.7							

*Sample is the average of two or more duplicate samples.

UMC	7183	Peters Lake	Grab	2016	5	19	271273	0.13		6.53		8.5		0.6		650		49	
UMC	7183	Peters Lake	Grab	2016	6	8	271274	0.36		14.3		7.0		0.58		580		40	
UMC	7183	Peters Lake	Grab	2016	7	13	271275	0.62		32.47		7.14		0.55		660		52	
UMC	7183	Peters Lake	Grab	2016	8	3	271276	0.91		43.86		3.14		0.59		930		48	
2016 May 1 - September 30 Geometric Mean or Arithmetic Mean:								ChlA/TP Ratio	ChlA Summary			ISS Summary		Secchi Summary		TN Summary		TP Summary	
								0.51	19.1			6.45		0.58		694		47	
Ozark Border Ecoregion Criteria (Table L):																			
Ozark Border Ecoregion Screening Threshold (Table M):															733		40		
Eutrophication Factors:								0.15			10		0.7						

*Sample is the average of two or more duplicate samples.

Lake Nutrients

10 CSR 20-7.031(5)(N) defines by statute Missouri's numeric nutrient criteria. This analysis is for 10 CSR 20-7.031(5)(N)1.C.(I), the "Lake Ecoregion Criteria, a decision framework that integrates causal and response parameters into one water quality standard that accounts for uncertainty in linkages between causal and response parameters." Peters Lake - WBID 7183.00 is in the Ozark Border ecoregion. The Lake Ecoregional Criteria, Screening Thresholds, and corresponding Eutrophication Factors are displayed in the table above.

If the Ecoregional Criteria (Table L) has been exceeded in the last three years of available data, then the lake is judged as impaired.

If any one Ecoregional Screening Thresholds (Table M) has been exceeded in the last three years of available data, then other eutrophication factors are examined (10 CSR 20-7.031(5)(N)6A-E). If these eutrophication factors have been exceeded within the same year as the Screening Thresholds then the lake is judged as impaired.

Eutrophication factors include:

A) Occurrence of eutrophication-related mortality or morbidity events for fish and other aquatic organisms (i.e. fish kills).

B) Epilimnetic excursions from dissolved oxygen or pH criteria.

C) Cyanobacteria counts in excess of one hundred thousand (100,000) cells per milliliter (cells/mL).

In absence of cell counts a surrogate is used. The surrogates used will be:

Microcystin 4.0 ug/l

Cylindrospermopsin 8.0 ug/l

Anatoxin-a 8.0 ug/l

Saxitoxin 4.0 ug/l

D) Observed Shifts in aquatic diversity attributed to eutrophication.

E) Excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 - September 30 (i.e., light limitations). Yearly average Secchi depths less than 0.6 meters in the Plains, 0.7 meters in the Ozark Border, and 0.9 meters in the Ozark Highlands, will necessitate analysis of Chlorophyll-a/Total Phosphorus ratios. A mean Chlorophyll-a/TP ratio less than or equal to 0.15 and a mean inorganic suspended solids (ISS or NVSS) value greater than or equal to 10 mg/L is suggestive of excessive mineral turbidity which limits algal productivity.

Peters Lake - WBID 7183.00 is judged as inconclusive for chlorophyll-a, nutrients, and eutrophication factors.

Missouri Department of Natural Resources, Water Protection Program, (573)751-1300, www.dnr.mo.gov

http://www.dnr.mo.gov/mocwis_public/wqa/waterbodySearch.do

<http://dnr.mo.gov/env/esp/wqm/biologicalassessments.htm>

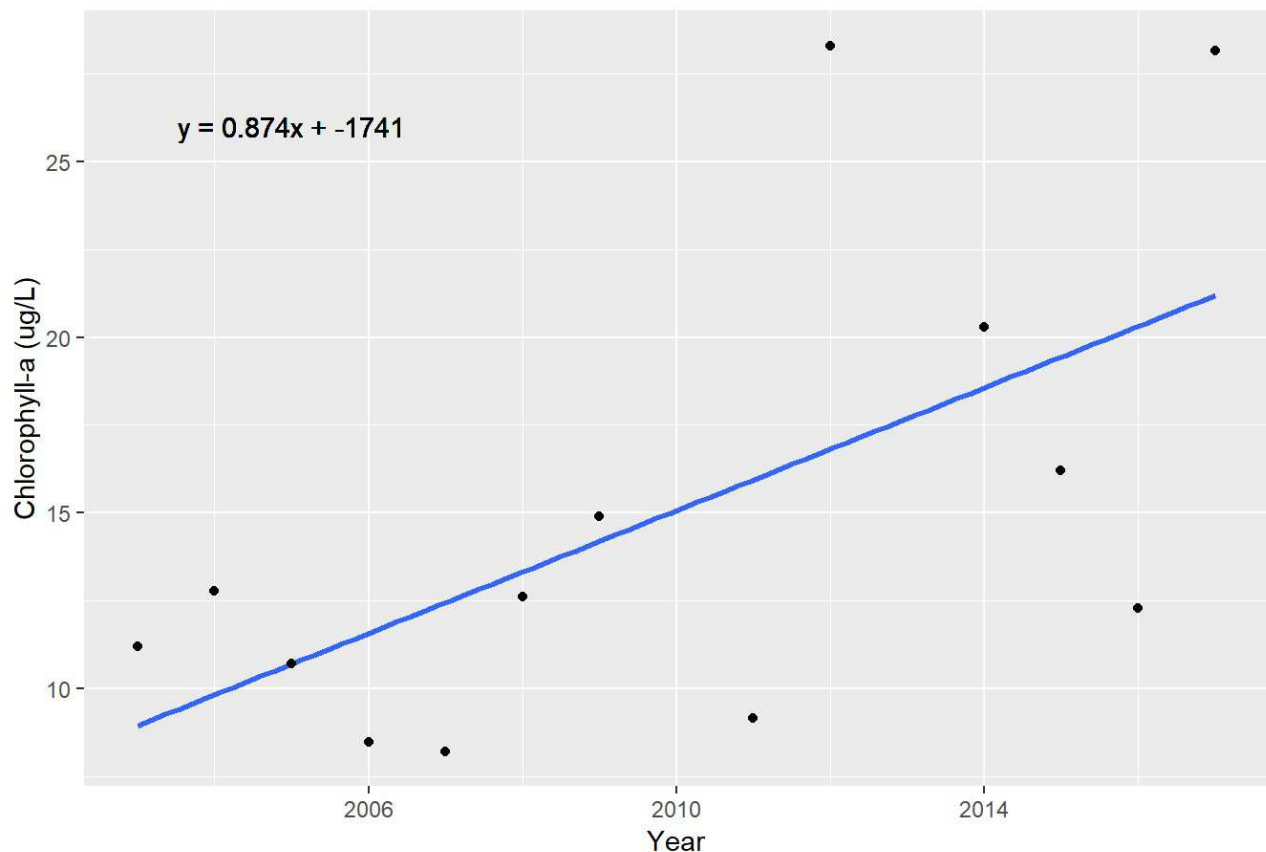
02/08/2019

Least Squares Regression Options



Least Squares Regression Geometric Means Options

Regression Trend Analysis Least Squares Geomeans



Based on the slope and most recent sample year's data of 2017, there will not be an exceedance (Chl-a > 30 ug/L) in the next 5 years.

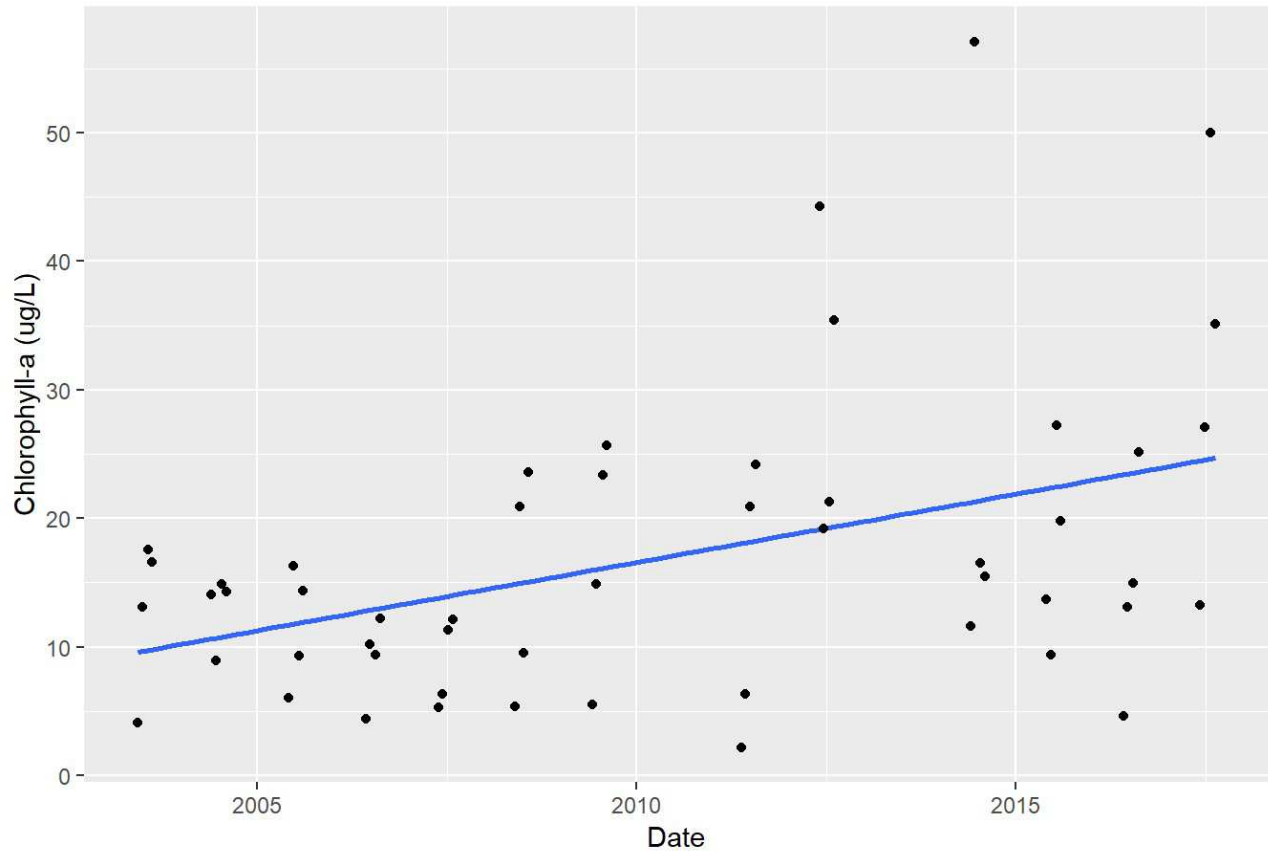
Using the slope, y-intercept, and criteria of 30 ug/L Chl-a, the trend predicts an exceedance in 2026.

This does not equate to stating the lake will exceed in that year, but serves as a reference point for when it would be expected to do so based on current trends. Variability is expected in future sampling just as was observed in previous results shown.

```
##
## Call:
## lm(formula = `Chlorophyll-a (ug/L)` ~ Year, data = sever)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -8.0206 -3.2248 -0.0027  2.2389 11.4833
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -1740.8658   686.1315  -2.537  0.0276 *
## Year          0.8736     0.3414   2.559  0.0266 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.613 on 11 degrees of freedom
## Multiple R-squared:  0.3731, Adjusted R-squared:  0.3162
## F-statistic: 6.548 on 1 and 11 DF,  p-value: 0.02657
```

Least Squares Regression All Data Option

Regression Trend Analysis Least Squares All Data



Based on the slope and most recent sample year's data of 2017, there will be an exceedance (Chl-a > 30 ug/L) in the next 5 years.

Using the slope, y-intercept, and criteria of 30 ug/L Chl-a, the trend predicts an exceedance in 2021. This does not equate to stating the lake will exceed in that year, but serves as a reference point for when it would be expected to do so based on current trends. Variability is expected in future sampling just as was observed in previous results shown.

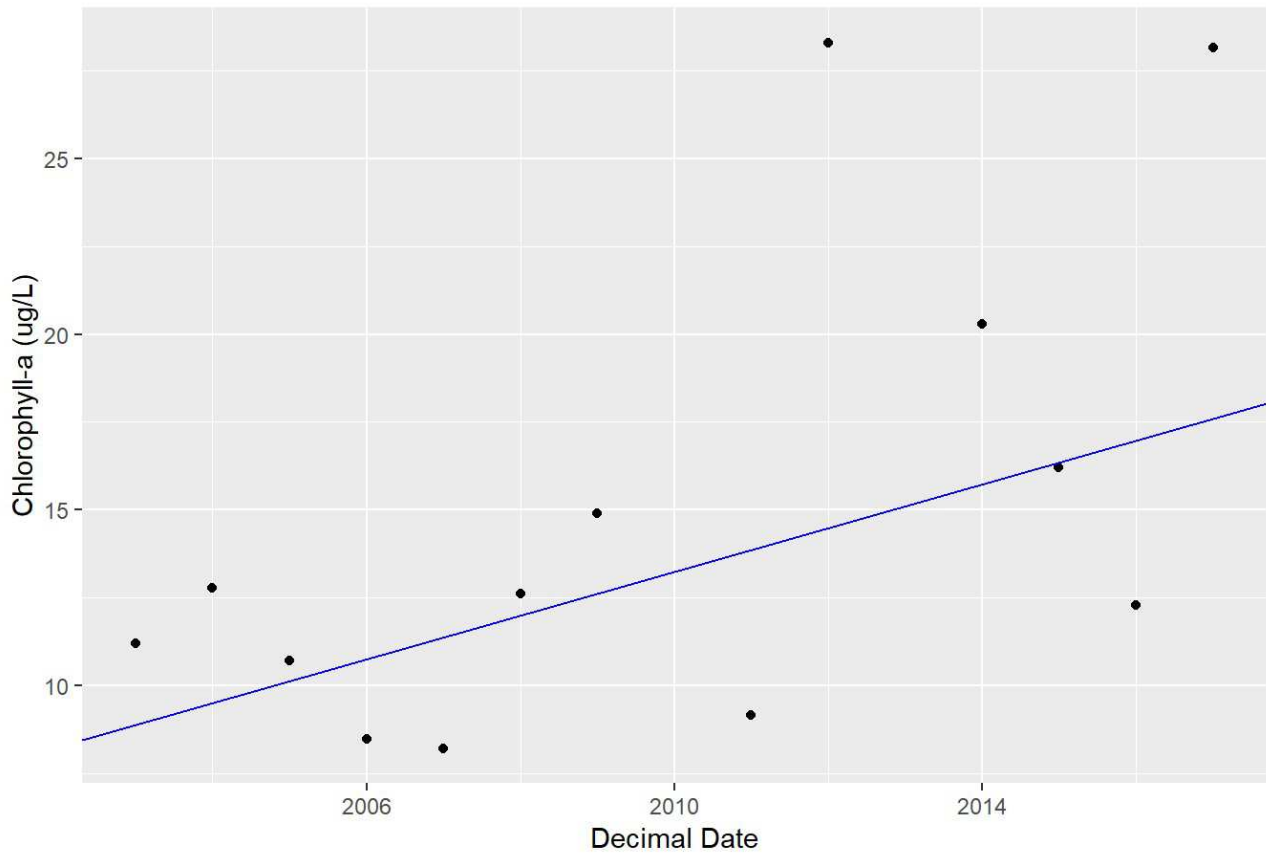
```
##
## Call:
## lm(formula = sever$`Chlorophyll-a (ug/L)` ~ sever$Date)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -18.769  -7.775  -1.461   4.593  35.781
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -2.590e+01  1.284e+01  -2.017  0.04907 *
## sever$Date   2.908e-03  8.674e-04   3.353  0.00153 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.42 on 50 degrees of freedom
## Multiple R-squared:  0.1835, Adjusted R-squared:  0.1672
## F-statistic: 11.24 on 1 and 50 DF,  p-value: 0.001532
```

Mann-Kendall Trend



Mann-Kendall

Theil-Sen Slope Analysis - Geometric Means



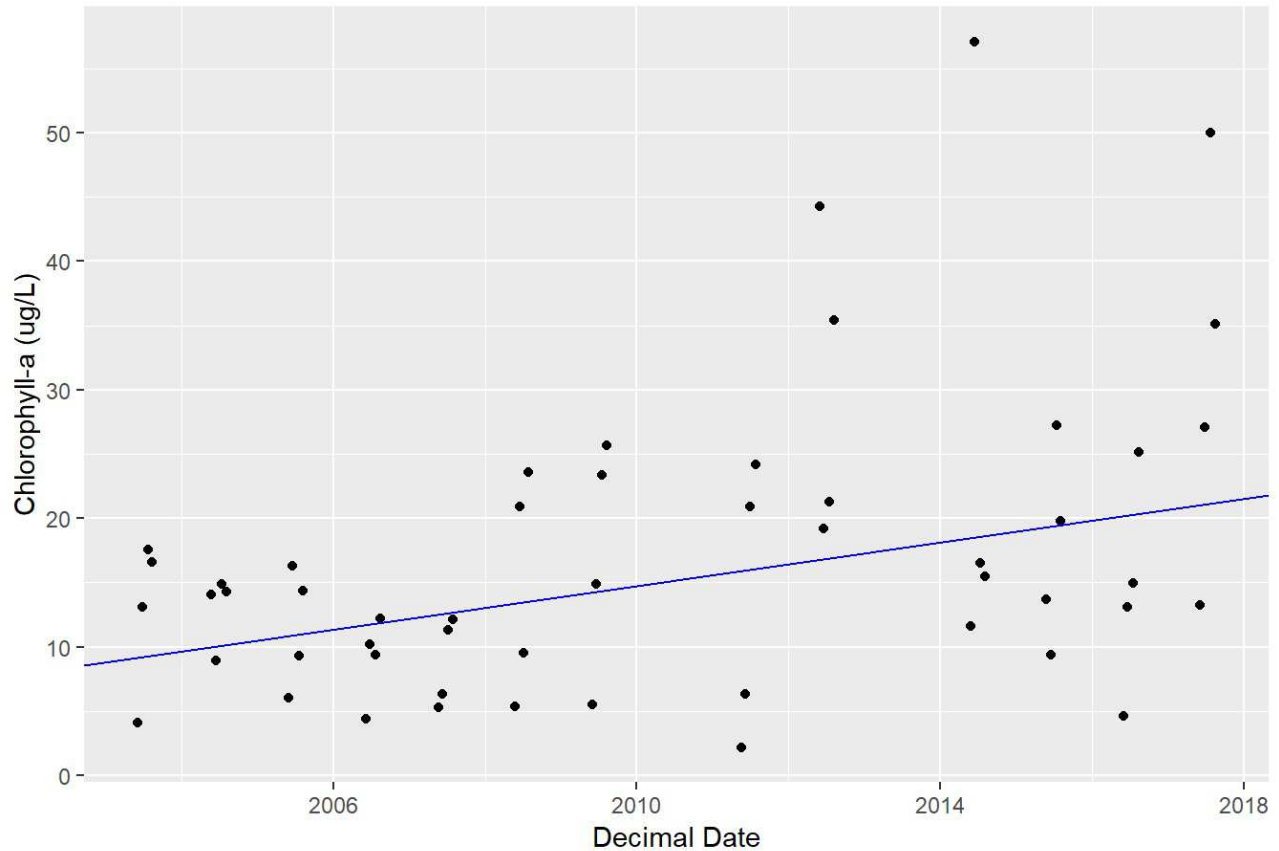
```
##  
## Mann-Kendall trend test  
##  
## data:  sevdatats  
## z = 1.6472, n = 13, p-value = 0.09951  
## alternative hypothesis: true S is not equal to 0  
## sample estimates:  
##           S           varS           tau  
## 28.0000000 268.6666667 0.3589744
```

The equation with Theil-Sen Slope and Intercept based on x and y medians is: $y = 0.623x + -1238.7$

Based on the slope and most recent year's data of 2017, there will not be an exceedance (Chl-a > 30 ug/L) in the next 5 years.

Using the slope, y-intercept, and criteria of 30 ug/L Chl-a, the trend predicts an exceedance in 2036. This does not equate to stating the lake will exceed in that year, but serves as a reference point for when it would be expected to do so based on current trends. Variability is expected in future sampling just as was observed in previous results shown.

Theil-Sen Slope Analysis - All data



```
##
## Mann-Kendall trend test
##
## data:  sevdatats
## z = 2.9753, n = 52, p-value = 0.002927
## alternative hypothesis: true S is not equal to 0
## sample estimates:
##           S           varS           tau
## 3.780000e+02 1.605533e+04 2.854988e-01
```

The equation with Theil-Sen Slope and Intercept based on x and y medians is: $y = 0.847 * x + -1687.6$

Based on the slope and most recent year's data of 2017, there will not be an exceedance (Chl-a > 30 ug/L) in the next 5 years.

Using the slope, y-intercept, and criteria of 30 ug/L Chl-a, the trend predicts an exceedance in 2027. This does not equate to stating the lake will exceed in that year, but serves as a reference point for when it would be expected to do so based on current trends. Variability is expected in future sampling just as was observed in previous results shown.

