

# **2014 Lake Monitoring Report**

## Mecklenburg County Water Quality Program SWIM Phase I Part 2-CO

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Final Report for FY2014-2015



## **PURPOSE AND BACKGROUND**

The Mecklenburg County Water Quality Program (MCWQP) has an ongoing program to monitor the water quality in the three Catawba Lakes bordering the county: Lake Norman, Mountain Island Lake and Lake Wylie. Samples are also routinely collected at the two water bodies in the northern end of Mecklenburg County cut off from Lake Norman proper by I-77: Lake Cornelius and Lake Davidson. Data collected from all lake sites are used to screen for environmental problems using MCWQP Action and Watch levels for various pollutants and also to rate the overall water quality at sampling locations in the lakes using a water quality index. Additional objectives are to describe seasonal trends and address spatial variability in the data. This report presents the lake monitoring data for the calendar year 2014.

## **ACTIVITIES AND METHODS**

Regular lake sampling was conducted every other month in 2014 beginning in January (January, March, May, July, September and November). Five locations were sampled in Lake Norman, one location each on Lake Cornelius and Lake Davidson, ten locations in Mountain Island Lake and eleven sampling locations in Lake Wylie (Appendices A, B and C). These regular locations were also sampled in June and August 2014 for fecal coliform and *E. coli* bacteria. Additional monitoring sites were also sampled for fecal coliform and *E. coli* bacteria during the summer months (May through September) for all lakes.

During all regular lake runs, field measurements were collected using a calibrated YSI 6600 multiprobe. Depth profiles of physical-chemical measurements (temperature, dissolved oxygen, pH, conductivity, turbidity and chlorophyll *a*) were collected at each regular site starting near the surface (0.2 m) and at 1 meter intervals to the bottom. Water transparency was measured in the field using a Secchi disk.

Water samples were collected using a Labline composite sampler to a depth of twice the Secchi depth. During the July sampling run a discrete bottom sample was collected about 1.5 m off the bottom at forebay locations near the dams of all three lakes: LN1, MI1 and LW1 as well as LC2 in Lake Cornelius.

Water samples collected for laboratory analysis were placed on ice and transported back to the Charlotte Mecklenburg Utilities (CMU) Laboratory where they were analyzed by standard methods. Water chemistry samples collected at all regular monitoring sites were analyzed for the following parameters: nutrients (total phosphorus, TKN, NH<sub>3</sub>, and NO<sub>2</sub>-NO<sub>3</sub>), chlorophyll *a*, turbidity, alkalinity and fecal coliform bacteria. Volatile organic compound (VOC) samples were collected at selected sites in all lakes during the July run as in the past.

Metals samples were collected at all sites during the January and July sampling runs and also at bottom samples during the July sampling run. Two metals sites near the ash basin discharges at Riverbend Steam Station (RB1 and RB2) in Mountain Island Lake and one

in upper Lake Wylie at Allen Steam Station (AL1) were sampled during every lake run including the June and August fecal runs. Twelve metals parameters are currently analyzed: mineral metals (copper, iron, manganese and zinc) and toxic metals (arsenic, barium, cadmium, chromium, lead, nickel, mercury and selenium).

All lab data were extracted from CMU Laboratory Services LABWORKS database and reviewed by the designated Environmental Analyst for QA/QC purposes before being entered into the Water Quality Data Repository. The North Carolina Trophic State Index (NCTSI) was calculated using total phosphorus, Secchi depth and organic nitrogen using a formula developed as part of North Carolina’s original Clean Lakes Classification Survey (NCDEM 1982). The NCTSI score for each lake was calculated by averaging the scores from all sites for each lake during the growing season (May through September).

The Lake Use Support Index or LUSI was calculated for all regular sampling sites using EXCEL. A significant revision to how the lake data and LUSI maps are presented was made in late 2014. Changes included: replacing the fish consumption advisory box for each site with the NC Trophic State Index and having one fish consumption box for the whole lake, the swimmer box now represents the yearly LUSI subscore, adding a table with current bacteriological results and adding a line graph with historical NC Trophic State Index values. Maps were generated using WORD, put on the LUESA web site and presented to their respective lake marine commissions. Since November is the last sampling event of the calendar year and includes data for the entire year starting in January, November LUSI maps are presented in this report.

## RESULTS AND DISCUSSION

### North Carolina Trophic State Index

The North Carolina Trophic State Index (NCTSI) was calculated for each lake by averaging all sites during the growing season (May through September) and comparing this with results from past years to assess the degree of eutrophication of the reservoirs. Eutrophication is the process of physical, chemical and biological changes associated with nutrient, organic matter and silt enrichment that cause a water body to age (Holdren, Jones and Taggart 2001). While most of the lake classifications remained the same in 2014 as in 2013, Mountain Island Lake returned to oligotrophic after scoring in the mesotrophic range in 2013. Lake Norman and Lake Davidson remained as oligotrophic in 2014 and Lake Wylie and Lake Cornelius remained in the mesotrophic range.

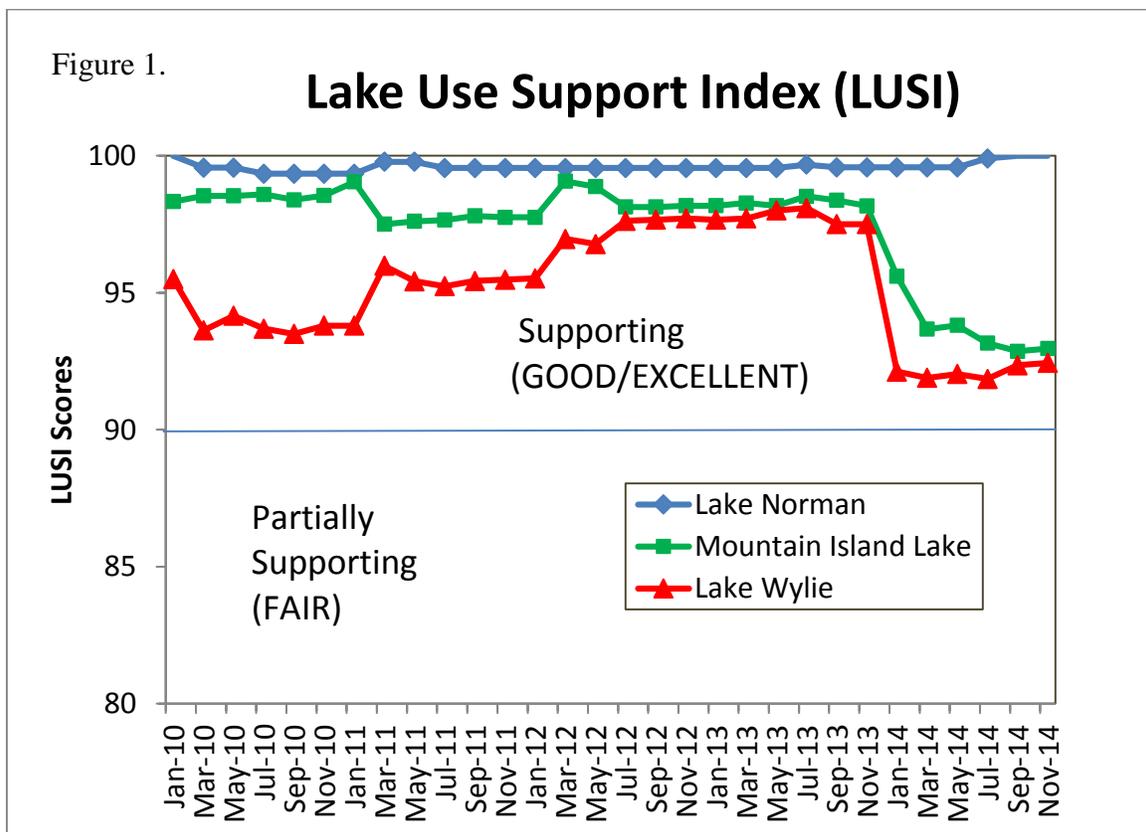
Table 1. Mean summer NCTSI values by lake for 2012, 2013 and 2014.

Lake	2012		2013		2014	
	NCTSI Score	Trophic Classification	NCTSI Score	Trophic Classification	NCTSI Score	Trophic Classification
Norman	-4.072	Oligotrophic	-3.0803	Oligotrophic	-3.8016	Oligotrophic
Mt. Island	-2.494	Oligotrophic	-1.8322	<b>Mesotrophic</b>	-2.9700	Oligotrophic
Wylie	-1.285	<b>Mesotrophic</b>	-0.8951	<b>Mesotrophic</b>	-1.2527	<b>Mesotrophic</b>
Cornelius	-0.462	<b>Mesotrophic</b>	-0.2309	<b>Mesotrophic</b>	-0.4972	<b>Mesotrophic</b>
Davidson	-2.550	Oligotrophic	-2.3998	Oligotrophic	-2.8131	Oligotrophic

## Lake Use Support Index (LUSI)

### *Historical Values*

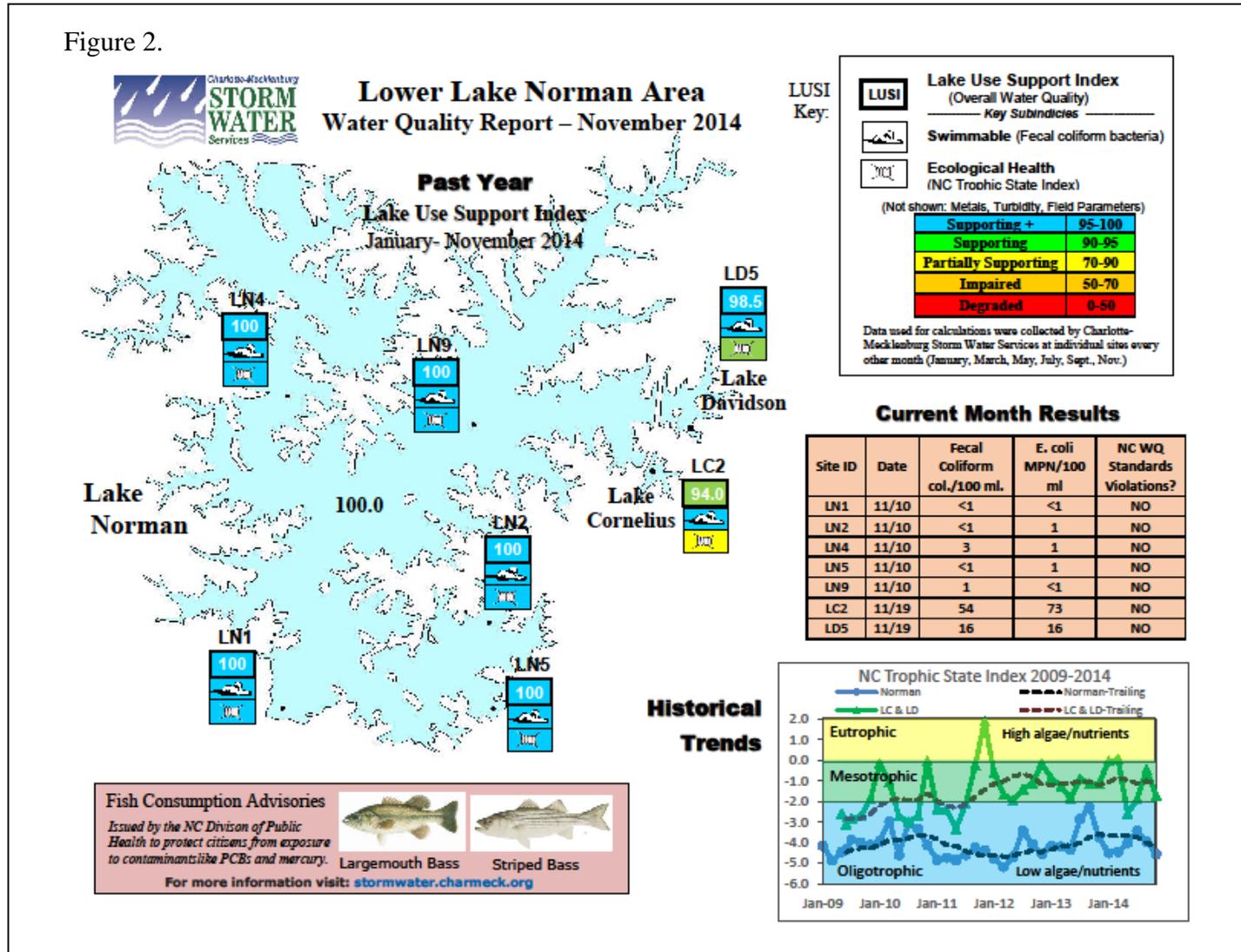
The Lake Use Support Index (LUSI) was started in mid 2009 for all regularly monitored lake sites. Lakewide averages of LUSI scores for the first five years since inception show differences between the major lakes (Figure 1). The monthly average for Lake Norman sites rates the highest with scores near 100 followed by the monthly average for Mountain Island Lake and Lake Wylie. Both lakewide average LUSI scores for Mountain Island Lake and Lake Wylie declined sharply in January 2014 when the monitoring runs followed large storm events. However, even with the decline the average lakewide LUSI scores for all three lakes rate in the Supporting range.



### *LUSI Maps*

The following section presents Lake Use Support Index (LUSI) results from November 2014. Since LUSI is scored using an annual trailing average, the November maps represent the six sampling results from the calendar year starting in January. LUSI scores are color coded and shown as the top box (labeled LUSI) in the stack of three boxes for regular monitoring sites. The box with the swimmer shows the fecal coliform subindex for the past year. The bottom box with alga indicates the trophic state at that site. Specific fish consumption advisories for the lake are shown at the bottom of each map.

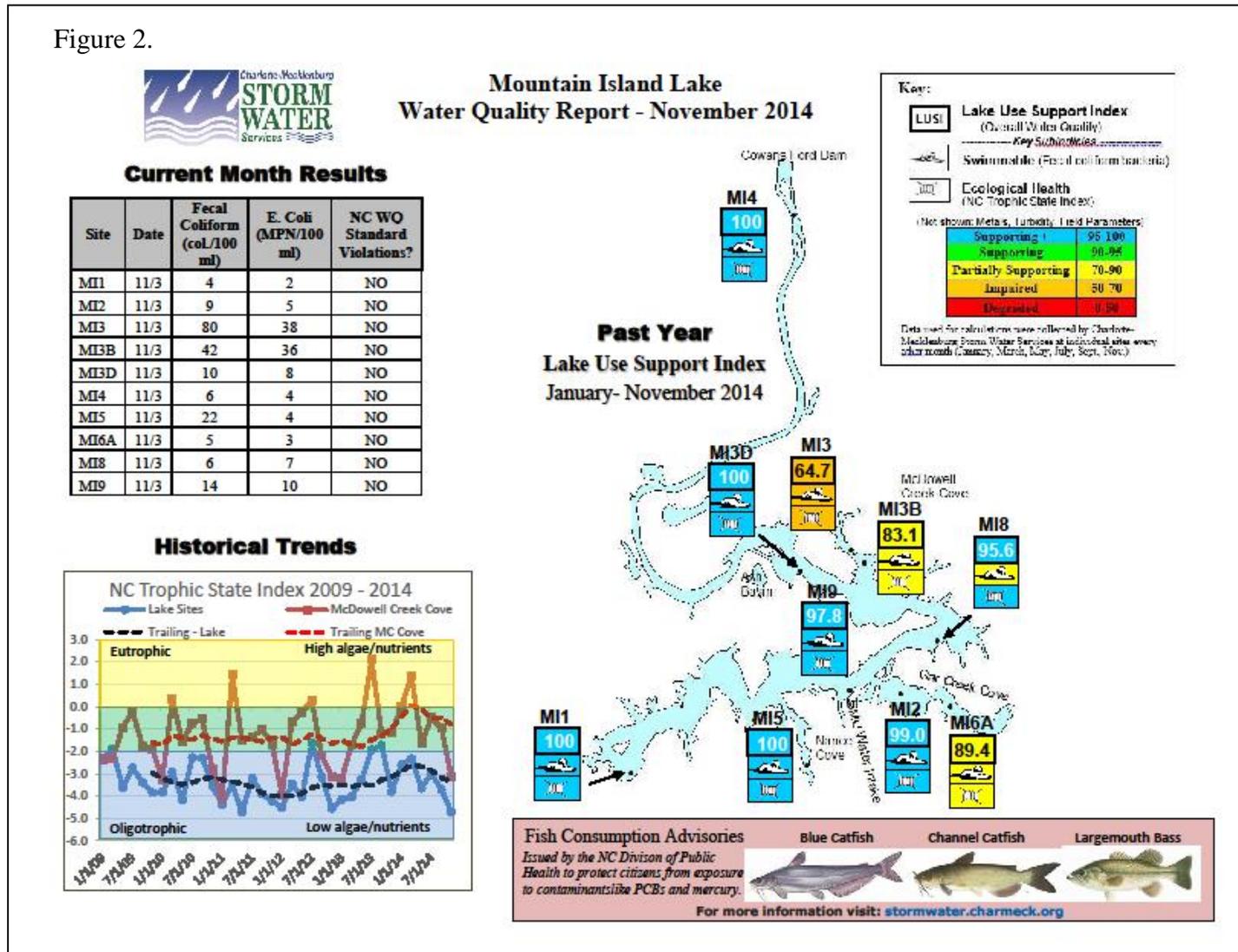
Figure 2.



**Lake Norman**

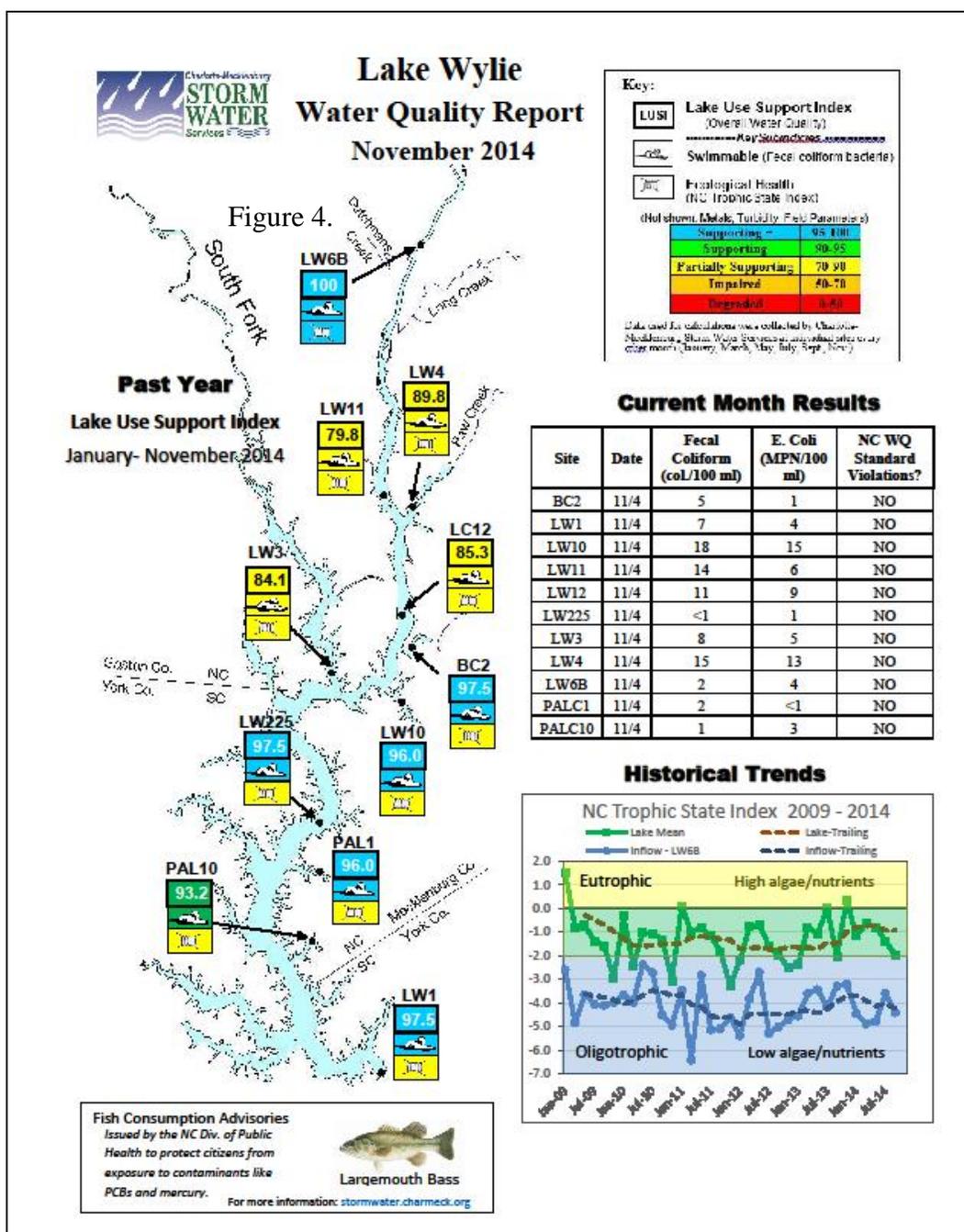
LUSI scores for January - November 2014 at all Lower Lake Norman monitoring sites and Lake Davidson were in the Supporting + range (Figure 2). Lake Cornelius LUSI scores for the year were in the Supporting range. Fecal coliform levels Lower Lake Norman as well as Lake Cornelius and Davidson were all in the Supporting + range for 2014. NC Trophic State Index scores in 2014 for Lower Lake Norman sites were all Supporting + while Lake Davidson rated as Supporting and Lake Cornelius rated as Partially Supporting.

Figure 2.



### Mountain Island Lake

While LUSI scores in 2014 for main lake Mountain Island Lake sites and MI2 remained in the Supporting + as last year, LUSI scores in McDowell Creek Cove and upper Gar Creek Cove declined significantly (Figure 3). The LUSI score for the year at MI3 was in the Impaired range and both MI3B and MI6A declined to Partially Supporting due to storm water impacts. Fecal coliform subindex and NC Trophic State Index values similarly declined at these sites compared with 2013 and contributed to the decline in overall LUSI scores.



### Lake Wylie

LUSI scores and fecal coliform subscores at sampling sites in upper Lake Wylie (LW11, LW12, LW4 and BC2) all declined in 2014 due primarily to the influence of a large storm event prior to sampling in January which pushed sediment, bacteria and nutrients from the Long Creek and Dutchman’s Creek watersheds into the upper part of the lake (Figure 4). Other sites in the lower end of the lake as well as LW6B above the confluence with Dutchmans Creek were not as affected. The NCTSI ratings for all sites in the lake except LW6B all rated as Partially Supporting.

## Exceedances of Water Quality Standards and Action Levels

Water quality values collected from all regular lake sampling sites in 2014 were compared with NC state water quality standards and MCWQP Action Levels (Table 3).

Table 3. Exceedances of Selected NC Water Quality Standards and MCWQP Action Levels - 2014

Site ID		NC Water Quality Standards						MCWQP Action Levels			
		Chl a > 40 ug/l	Turbid. > 25 ntu	Temp. > 32 Deg. C	D. O. < 5.0 ppm	pH <6.0 or > 9.0	Metals	Total No. NC Stand. Exceed.	Tot P > 0.04 ppm	NOX > 0.65 ppm	Fecal col > 200 col. /100ml
<b>Lake Norman</b>											
LN1	Cowans Ford Dam	0	0	0	0	0	0	0	0	0	
LN2	Ramsey Creek Arm	0	0	0	0	0	0	0	0	0	
LN4	Main Channel Lake Norman	0	0	0	0	0	0	0	0	0	
LN5	North Meck Water Intake	0	0	0	0	0	0	0	0	0	
LN9	Davidson Creek/Reeds Creek Arm	0	0	0	0	0	0	0	0	0	
<b>Lake Cornelius &amp; Davidson</b>											
LC2	Lake Cornelius	0	0	0	0	0	0	0	0	1	
LD5	Lake Davidson	0	0	0	0	0	0	0	0	0	
<b>Mountain Island Lake</b>											
MI1	Mt. Island Dam	0	0	0	0	0	0	0	0	0	
MI2	Gar Creek Cove	0	0	0	0	0	0	0	0	0	
MI3	McDowell Creek Cove	0	3	0	0	0	2	5	2	2	
MI3B	McDowell Creek Cove - Lower	0	1	0	0	0	1	2	0	1	
MI3D	Uplake McDowell Creek Cove	0	0	0	0	0	0	0	0	0	
MI4	Headwaters MI Lake	0	0	0	0	0	0	0	0	0	
MI5	Nance Cove	0	0	0	0	0	0	0	0	0	
MI6A	Upper Gar Creek Cove	0	0	0	0	0	0	1	0	2	
MI8	Downlake McDowell Creek Cove	0	0	0	0	0	0	0	0	1	
MI9	City of Charlotte Water Intake	0	0	0	0	0	0	0	0	0	
<b>Lake Wylie</b>											
LW1	Lake Wylie Dam (SC)	0	0	0	0	0	0	0	1	0	
LW3	South Fork Catawba River	0	1	0	0	0	1	2	1	1	
LW4	Paw Creek Cove	0	0	0	0	0	0	0	0	1	
LW6B	Headwaters above Dutchmans	0	0	0	0	0	0	0	0	0	
LW10	Withers Cove	0	0	0	0	0	0	2	0	0	
LW225	Buster Boyd Bridge	0	0	0	0	0	0	0	0	0	
BC2	Browns Cove - Middle	0	0	0	0	0	0	0	0	0	
PALC1	Boyds Cove	0	0	0	0	0	0	1	0	0	
PALC10	Snug Harbor Cove	0	0	0	0	0	0	1	0	1	
LW11	Uplake Paw Creek Cove	0	1	0	0	0	2	3	2	1	
LW12	Uplake Browns Cove	0	1	0	0	0	1	2	1	1	
<b>Total</b>	<b>Lake Norman</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	
<b>Total</b>	<b>Lake Cornelius &amp; Davidson</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	
<b>Total</b>	<b>Mountain Island Lake</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>7</b>	<b>2</b>	<b>6</b>	
<b>Total</b>	<b>Lake Wylie</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>6</b>	<b>10</b>	<b>5</b>	
<b>Total</b>	<b>No. of Exceedances</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>13</b>	<b>18</b>	<b>3</b>	<b>12</b>

No exceedances of the state standards for any temperature, pH or dissolved oxygen were observed at any sites during full lake runs in 2014. Seven exceedances of the turbidity standard were observed in 2014 (4 in Mountain Island Lake and 3 in Lake Wylie) due to impacts of recent storm events. No exceedances of the chlorophyll *a* standard were observed in 2014 as was the case in 2012 and 2013.

A number of exceedances (18) of the MCWQP action level for total phosphorus were observed in 2014 up from 11 observed in 2013. All of the total phosphorus exceedances in Mountain Island Lake were observed in coves: McDowell Creek Cove (MI3 and MI3B) and Gar Creek Cove (MI6A). Exceedances in Lake Wylie were found in coves throughout the lake, near the dam (LW1), the South Fork (LW3) and at uplake sites (LW11 and LW12) especially in January following a large storm event. Total phosphorus levels in lower Lake Norman were well below the MCWQP Action Level during all sampling events as in previous years.

**Exceedances of Fecal Coliform Action Levels**

Sixteen exceedances of the MCWQP Action Level for fecal coliform bacteria were observed at regular and summer fecal sampling sites in 2014 (Table 4). Five of the six exceedances observed in Lake Wylie were from samples collected on January 13, 2014 following a large storm event. Exceedances of the fecal coliform Action Level in Mountain Island Lake were also observed following storm events in January, March and July. Several exceedance of the fecal coliform Action Level were observed at LC2 in Lake Cornelius during the summer time.

Site	Lake	Sampling	
		Date	Result
YMCA	Cornelius	5/22/14	400
LC2	Cornelius	6/23/14	200
YMCA	Cornelius	7/24/14	240
MI6A	Mt. Island	1/15/14	270
MI6A	Mt. Island	3/10/14	270
MI8	Mt. Island	3/10/14	350
MI3	Mt. Island	3/10/14	310
MF12	Mt. Island	7/16/14	>600
MI3B	Mt. Island	7/16/14	540
MI3	Mt. Island	7/16/14	>760
LW11	Wylie	1/13/14	760
LW12	Wylie	1/13/14	460
LW3	Wylie	1/13/14	380
LW4	Wylie	1/13/14	790
PALC10	Wylie	1/13/14	200
WF75	Wylie	8/13/14	290

## MTBE and other VOCs

Volatile Organic Compounds (VOCs) were sampled at selected lakes sites in July 2014. July was chosen as the month to collect VOCs as it is during the peak time of motor boating and recreational use of the reservoirs. Methyl *tert*-Butyl Ether (MTBE) plus 50 other VOCs including benzene and toluene were analyzed from the samples collected. Results from all of the 51 VOCs analyzed for all the samples were below their respective reporting limits (Table 6).

Table 6. Volatile Organic Compounds (VOCs) Results for lake sites sampled in July 2014

Lake	Sampling Date	Site ID	Description	MTBE ug/l	All Other VOCs
Norman	7/23/14	LN1	Near Cowans Ford Dam	< 0.50*	< RL**
		LN2	Ramsey Creek Arm	< 0.50	< RL
		LN4	Main Channel	< 0.50	< RL
		LN5	CMU Water Intake	< 0.50	< RL
		LN9	Davidson Creek/Reeds Creek Arm	< 0.50	< RL
		BLY	Blythe Landing	< 0.50	< RL
Cornelius	7/24/14	LC2	Center of Lake	< 0.50	< RL
Davidson	7/24/14	LD5	Dock off Viewlake Street	< 0.50	< RL
Mt. Island	7/16/14	MI1	Near Mountain Island Dam	< 0.50	< RL
		MI3	McDowell Creek Cove	< 0.50	< RL
		MI4	Headwaters	< 0.50	< RL
		MI9	City of Charlotte Water Intake	< 0.50	< RL
		MF3	Riverbend Boat Landing	< 0.50	< RL
Wylie	7/14/14	RHWI	Rock Hill Water Intake	< 0.50	< RL
		LW1	Near Lake Wylie Dam	< 0.50	< RL
		LW3	South Fork of the Catawba	< 0.50	< RL
		LW4	Paw Creek Cove	< 0.50	< RL
		LW6B	Headwaters	< 0.50	< RL
		LW10	Withers Cove	< 0.50	< RL
		BC2	Browns Cove, Middle	< 0.50	< RL
		LW225	Buster Boyd Bridge	< 0.50	< RL
		BLWI	Bemont Water Intake	< 0.50	< RL
		WF37	Buster Boyd Landing	< 0.50	< RL

\* Reporting limit for MTBE is 0.50 ug/l

\*\* RL = Reporting Limit

## Metals Sampling in the Vicinity of Ash Basin Discharges

Metals samples were collected at the ash basin discharges of Riverbend (RB1) and Allen (AL1) Steam Stations in Mountain Island Lake and upper Lake Wylie, respectively, during regular and summer fecal sampling runs (Table 6). No arsenic exceedances were observed at RB1 in 2014 although manganese exceeded its standard on June 5, 2014. The water quality standard for iron was slightly exceeded at AL1 on January 13, 2014 in Lake Wylie due to the effects of the previously mentioned storm event (Table 7).

Table 6. Metals results from RB1 near the Riverbend Ash Basin discharge in 2014 (in ug/l).

Analyte	NC Standard	1/15/14	3/10/14	5/8/14	6/5/14	7/16/14	8/6/14	9/3/14	11/3/14
Arsenic	<b>10.0</b>	<5	<5	<5	<5	<5	<5	<5	<5
Barium	<b>1000</b>	<100	<100	<100	<100	<100	<100	<100	<100
Cadmium	<b>2.0</b>	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<b>50.0</b>	<5	<5	<5	<5	<5	<5	<5	<5
Copper	<b>7.0</b>	<2	3.2	2.0	<2	<2	<2	<2	1.5
Iron	<b>1000</b>	410	640	340	430	140	150	210	390
Lead	<b>25.0</b>	<5	<5	<5	<5	<5	<5	<5	<5
Manganese	<b>200</b>	54	33	62	220	45	40	79	140
Mercury	<b>0.012</b>	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Nickel	<b>25.0</b>	<2	<2	<2	<2	<2	<2	<2	<2
Selenium	<b>5.0</b>	<2	<2	<2	<2	<2	<2	<2	<5
Zinc	<b>50.0</b>	<10	<10	<10	<10	<10	<10	<10	<10

Exceedances of water quality standards are highlighted in yellow

Table 7. Metals results from AL1 near the Allen Steam Station Ash Basin discharge in 2014 (in ug/l).

Analyte	NC Standard	1/13/14	3/31/14	5/20/14	6/4/14	7/14/14	8/18/14	9/2/14	11/4/14
Arsenic	<b>10.0</b>	<5	<5	<5	<5	<5	<5	<5	<5
Barium	<b>1000</b>	<100	<100	<100	<100	<100	<100	<100	<100
Cadmium	<b>2.0</b>	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	<b>50.0</b>	<5	<5	<5	<5	<5	<5	<5	<5
Copper	<b>7.0</b>	2.4	<2	3.3	2.2	3.4	<2	<2	1.4
Iron	<b>1000</b>	1100	390	700	340	270	140	130	310
Lead	<b>25.0</b>	<5	<5	<5	<5	<5	<5	<5	<5
Manganese	<b>200</b>	46	36	82	44	46	32	32	51
Mercury	<b>0.012</b>	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Nickel	<b>25.0</b>	<2	<2	12	<2	<2	<2	<2	<2
Selenium	<b>5.0</b>	<2	<2	<2	<2	<2	<2	2.8	<5
Zinc	<b>50.0</b>	<10	<10	<10	<10	<10	<10	<10	<10

## SUMMARY AND CONCLUSIONS

1. Lake Norman, Mountain Island Lake and Lake Davidson all rated as oligotrophic by the NC Trophic State Index. Lake Wylie and Lake Cornelius rated as mesotrophic as in 2013. The NCTSI for Mountain Island Lake was the only one that changed categories in 2014 moving up to oligotrophic in 2014 from mesotrophic in 2013.
2. Lake Use Support Index (LUSI) scores for both Mountain Island Lake and Lake Wylie declined sharply in January 2014 due to impacts of storm events at that time. While no sites in 2013 rated below Supporting, in 2014 there were 6 sites that rated as Partially Supporting and one (MI3 in McDowell Creek Cove) that rated as Impaired. Most sites (19) rated as Supporting + although the number was down from 25 sites which had this rating in 2013.
3. No chlorophyll *a* values were observed in regular lake runs in 2014 which exceeded the state standards.
4. The turbidity standard was exceeded 7 times in 2014 at sites in Mountain Island Lake and Lake Wylie due to storm impacts. This compares with no turbidity exceedances at any lake sites during regular sampling in 2013.
5. Exceedances of the state standard for fecal coliform bacteria more than doubled in 2014 (16) compared with 2013 (9). This was again mainly due to the previously mentioned storm impacts in Mountain Island Lake and Lake Wylie. Several exceedances of the fecal standard were also observed in Lake Cornelius in summer (June, July and August).
6. Five exceedances of the state standard for iron were observed in January 2014: two at McDowell Creek sites in Mountain Island Lake and three from Lake Wylie in the upper lake and South Fork. One exceedance of the state standard for copper was observed at the uplake LW11 site in Lake Wylie. All were again storm due to storm impacts.
7. No exceedances of the state standard for arsenic were observed in 2014 in the immediate vicinity of the Riverbend Steam Station ash basin discharge (RB1) although the standard for manganese was exceeded in June. The state standard for iron was exceeded at the Allen Steam Station ash basin discharge (AL1) in January 2014 although this was due to the impacts of stormwater inflow which affected the entire upper part of the lake at that time.
8. Results from all 51 VOCs analyzed in samples collected in July 2014 including MTBE were below their respective reporting limits.

## REFERENCES

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Lake Program Review and LUSI Document. MCSWS, Charlotte, NC.

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June 30, 2015

# Appendix A

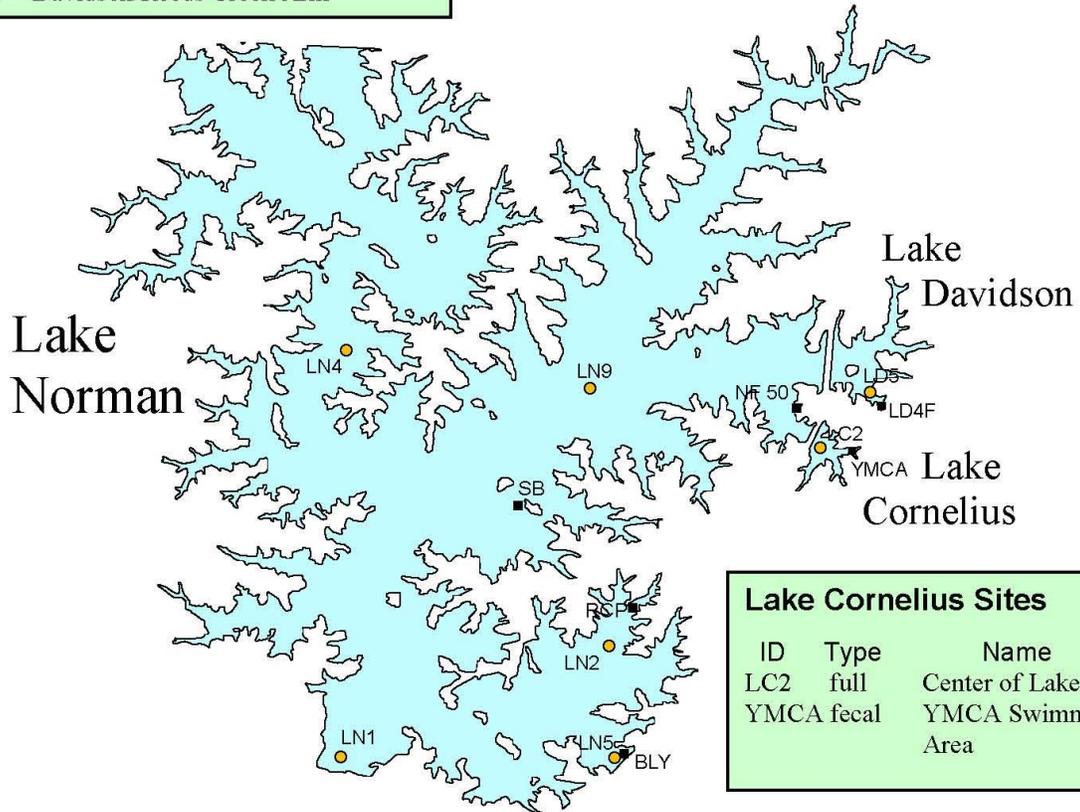
## Lower Lake Norman Lake Cornelius and Davidson Monitoring Locations

### Lake Norman Monitoring Sites

ID	Name
LN1	Cowans Ford Dam
LN2	Ramsey Creek Arm
LN4	Main Channel
LN5	North Meck Water Intake
LN9	Davidson/Reeds Creek Arm

### Lake Davidson Sites

ID	Type	Name
LD5	full	Off Viewlake St.
LD4F	fecal	Near Griffith St. Lift Station



### Lake Cornelius Sites

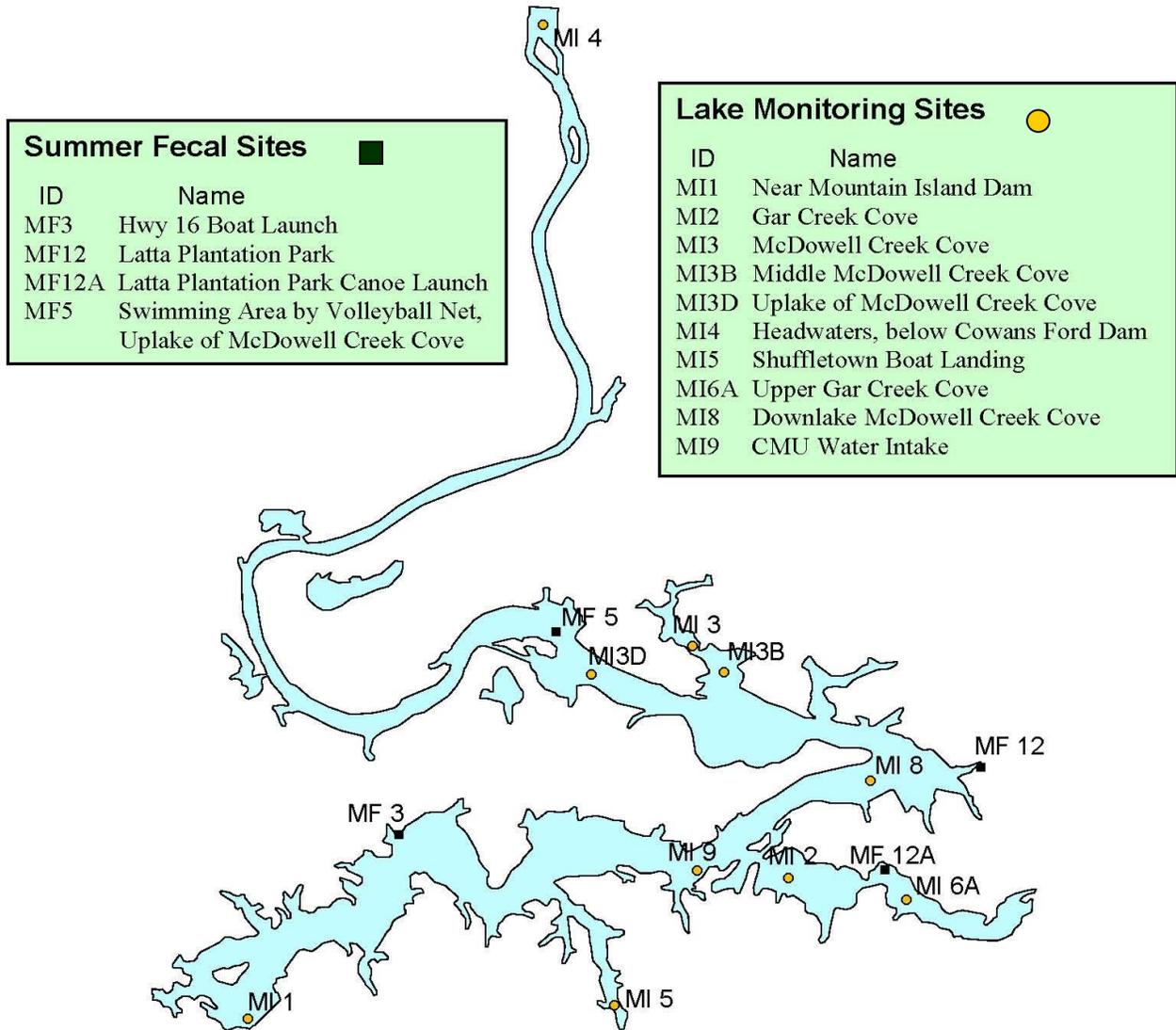
ID	Type	Name
LC2	full	Center of Lake
YMCA	fecal	YMCA Swimming Area

### Lake Norman Summer Fecal Sites

ID	Name
BLY	Blythe Landing
NF50	Davidson Landing Boat Slips (North)
RCP	Ramsey Creek Park
SB	Sand Bar off Island, Hager Creek Arm

# Appendix B

## Mountain Island Lake Monitoring Locations



# Appendix C

## Lake Wylie Monitoring Locations

**Lake Monitoring Sites:** ●

ID	Name
LW1	Near Lake Wylie Dam
LW3	South Fork of the Catawba
LW4	Paw Creek Cove
LW6B	Headwaters, Upstream of Dutchman's Creek
LW10	Withers Cove
LW11	Uplake Paw Creek Cove
LW12	Uplake Browns Cove
BC2	Browns Cove, Middle
PALC1	Boyd's Cove
PALC10	Snug Harbor Cove
LW225	Buster Boyd Bridge

**Summer Fecal Sites:** ■

ID	Name
WF39	Camp Thunderbird
WF42	Sand Bar
WF51	Queens Gate WWTP
WF67	Belmont WWTP
WF72A	Sandoz WWTP
WF72B	Mt. Holly WWTP
WF73	Long Creek
WF75	Whitewater Center

