

**Leesville Lake
Water Quality Monitoring Report**

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Leesville Lake 2010 Water Quality Monitoring Report

Background

According to FERC staff, the primary water quality issues for Smith Mountain and Leesville lakes are related to nutrients and bacteria. The source of these nutrients and bacteria is not related to project operation, but rather to shoreline development around the lakes (e.g., erosion, wastewater and storm water runoff, treated lawns, etc.) and overall watershed development (e.g., sedimentation and agricultural run-off entering the lakes from tributary sources). Nonetheless, FERC staff concluded that (a) on-going monitoring of water quality on Smith Mountain Lake should continue, (b) establishing a water quality monitoring program on Leesville Lake is important; and (c) monitoring lake water quality would help ensure that the proposed changes in the operational strategy at the Smith Mountain development do not adversely affect water quality in Smith Mountain Lake, as well as the future health of the lakes (e.g., documenting trends in the lakes' water quality and identifying areas of concern that may lead to the degradation in water quality). Nutrients and organic matter may contribute to the development of low dissolved oxygen (DO) concentrations in the hypolimnion of Smith Mountain and Leesville Lakes.

Leesville Lake Water Quality Monitoring

In 2010, the Association partnered with Lynchburg College on water quality monitoring. This allowed for more data collection and laboratory analyses than the Association had done in prior years.

The goals of the Leesville Lake water monitoring program are to (1) assess compliance with water quality standards, (2) monitor nutrients and trophic status, and (3) supplement data collected by the Virginia DEQ (VDEQ). Conditions present at the inflow from the two primary water sources (Smith Mountain Lake and the Pigg River), the riverine section after confluence with the Pigg River, the transition zone, the lacustrine zone and other sites were assessed with a water monitoring probe and water samples were collected for laboratory analyses.

Lynchburg College Sampling/Testing

Sample Sites

- Smith Mountain Lake tailwaters
- Pigg River near its mouth
- Downstream of Toler Bridge (after confluence with Pigg River/riverine zone)
- Mile Mark 9 (mixing zone)
- Mile Mark 6 (end of mixing zone/beginning of lacustrine)
- Tri-County Marina
- Pit Stop Marina
- Near dam (end point of lacustrine)

Methods and Parameters

A combination of laboratory analyses and a water quality monitoring probe were used to assess these water quality parameters.

- A. Oxygen and temperature profiles – provides information of overall condition of the lake. If oxygen is not present at the bottom, options should be considered to improve this condition.
- B. pH profiles – indicates the softness/hardness of the water and overall biological activity taking place. Often an excellent indicator of eutrophication and other potential problems.
- C. Conductivity profiles – indicates inflow of varied water sources – used to pinpoint flow of water through reservoir.
- D. Turbidity profiles – indicate levels of sediment pollution. Helps pinpoint the problem.
- E. ORP (oxidation-reduction potential) profiles. ORP is a measure of the potential for reactions to take place, which is a good indicator of chemical activity in reservoir and developing eutrophication.
- F. Total Phosphorus (TP) (surface and hypolimnion) – indicates amount of this nutrient in the water. Increases in TP indicate potential for future/existing algae problems.
- G. Dissolved Phosphorus (surface and hypolimnion) – indicates amount of this nutrient available immediately for use. Again, indicates potential for algae problems.
- H. Fluorescence profiles – measurement of algal growth and algae blooms in the water column. Excellent indicator of phytoplankton productivity.
- I. Integrated Chlorophyll *a* samples – levels of productivity through the photic zone
- J. Secchi Depth – indicator of light transparency and eutrophication.
- K. *E. coli* – indicator of bacteria and other potential health hazards.

Biological communities were sampled and assessed. A zooplankton net was pulled through the water column to assess the community structure. Zooplankton are a good indicator of lake health and will respond to water quality changes.

The following is a list of water quality parameters assessed by Lynchburg College at each site.

- Smith Mountain Lake tailwaters
 - Total phosphorus (TP)
- Pigg River near its mouth
 - Bacteria (*E. coli*), TP and Secchi depth
- Downstream of Toler Bridge (after confluence with Pigg River/riverine zone)
 - Temperature, DO, pH, conductivity, turbidity, ORP, *E. coli*, chlorophyll *a*, TP, fluorescence, Secchi depth, zooplankton
- Mile Mark 9 (mixing zone)
 - Bacteria (*E. coli*), Secchi depth

- Mile Mark 6 (end of mixing zone/beginning of lacustrine)
 - Temperature, DO, pH, conductivity, turbidity, ORP, E. coli, chlorophyll a, TP, fluorescence, Secchi depth, zooplankton
- Tri-County Marina
 - Bacteria (E. coli), Secchi depth
- Pit Stop Marina (near mouth of Old Woman's Creek)
 - Bacteria (E. coli), TP, Secchi depth
- Near dam (end point of lacustrine)
 - Temperature, DO, pH, conductivity, turbidity, ORP, E. coli, chlorophyll a, TP, fluorescence, Secchi depth, zooplankton

Leesville Lake Association Volunteer Sampling/Testing

In addition to the above sampling/testing by Lynchburg College, Lake Association volunteers collected water samples for E. coli testing and Secchi depth data at the seven sites listed below under Sampling Dates and Frequency. The Association used Coliscan Easygel® test kits to measure E. coli levels in water samples.

Sampling Dates and Frequency

Monitoring was focused primarily during the summer when productivity is high. Below are the sampling dates:

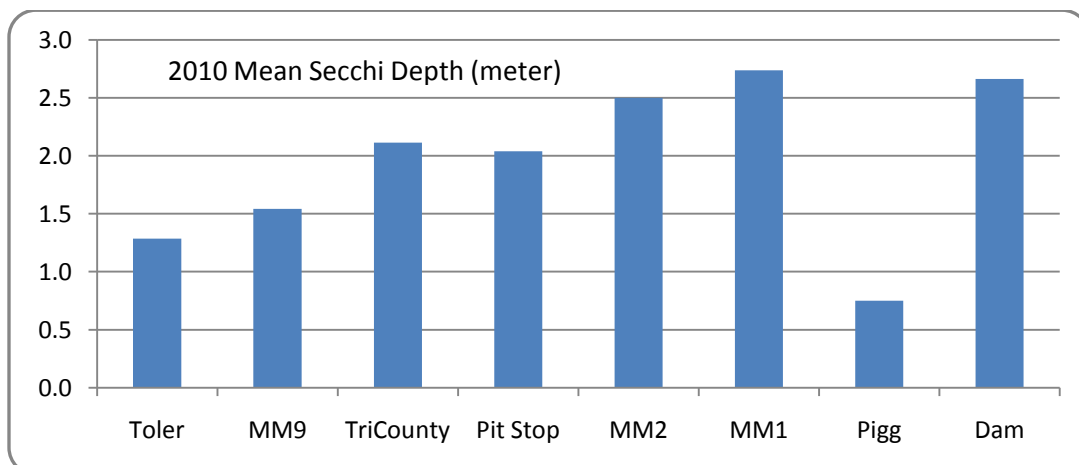
- Lynchburg College:
June 11, July 7, August 4, September 1 and October 11 and November 3 for a total of 6 sampling dates.
- Leesville Lake Association
May 21, June 19, July 14 & 16, August 7 & 21 and September 4 & 17.
Data was collected at the following sites.
 - A. Pigg River near its mouth
 - B. Downstream of Toler Bridge
 - C. Mile Mark 9
 - D. Tri-County Marina
 - E. Pit Stop Marina
 - F. Mile Mark 2
 - G. Mile Mark 1
 - H. Near Dam Picnic & Beach Area

LEESVILLE LAKE WATER MONITORING STATIONS

DEQ Data Upload Site ID	Assn. Station Number	DEQ Station ID	Station Location Description	Latitude	Longitude
1271	1	LVLAROA153.47	Toler's Bridge (downstream side)	37.0109	-79.4753
1272	2	LVLAROA149.94	Mile Mark 9	37.0399	-79.4823
1273	3	LVLATER000.33	Tri-County Marina	37.0594	-79.4449
1275	5	LVLAOWC000.58	Pit Stop Marina	37.0594	-79.3957
1276	6	LVLAROA142.50	Mile Mark 2	37.0664	-79.4033
1277	7	LVLAROA141.42	Mile Mark 1	37.0815	-79.4016
1373	8	LVLAROA146.87	Mile Mark 6	37.0664	-79.4033
1374	9	LVLAPGG000.47	Pigg River mouth	37.0043	-79.4879
2635	10	LVLAROA140.93	Dam: Pittsylvania Swim Area	37.0886	-79.4003
2636	11	LVLAROA140.66	Leesville Dam	37.0916	-79.4039
2637	12	LVLAROA157.92	Smith Mountain Tailwaters	37.0382	-79.5313

Secchi Depth

Below is a chart that shows the mean Secchi depth by monitoring station. The data collected in 2010 is typical of prior year data. Secchi depth (water clarity) is highest near the dam and declines as one travels upstream. The lowest Secchi depth readings are in the Pigg River. The lower upstream Secchi depth numbers are primarily a result of higher levels of silt in the water.



Leesville Lake Association Volunteer Secchi Depth Data -- 2010

Assn. Station Number	DEQ Station ID	Station Location Description	Collection Date	Secchi Depth (meters)
1	LVLAROA153.47	Toler Bridge	5/21/2010	1.8
2	LVLAROA149.94	Mile Mark 9	5/21/2010	1.3
3	LVLATER000.33	Tri-County Marina	5/21/2010	2.1
5	LVLAOWC000.58	Pit Stop Marina	5/21/2010	1.9
6	LVLAROA142.50	Mile Mark 2	5/21/2010	2.5
7	LVLAROA141.42	Mile Mark 1	5/21/2010	3.0
9	LVLAPGG000.47	Pigg River	5/21/2010	1.2
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	5/21/2010	3.0
1	LVLAROA153.47	Toler Bridge	6/19/2010	0.7
2	LVLAROA149.94	Mile Mark 9	6/19/2010	1.8
3	LVLATER000.33	Tri-County Marina	6/19/2010	2.5
5	LVLAOWC000.58	Pit Stop Marina	6/19/2010	2.5
6	LVLAROA142.50	Mile Mark 2	6/19/2010	3.0
7	LVLAROA141.42	Mile Mark 1	6/19/2010	3.5
9	LVLAPGG000.47	Pigg River	6/19/2010	
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	6/19/2010	3.8
1	LVLAROA153.47	Toler Bridge	7/4/2010	1.2
2	LVLAROA149.94	Mile Mark 9	7/4/2010	1.5
3	LVLATER000.33	Tri-County Marina	7/4/2010	1.7
5	LVLAOWC000.58	Pit Stop Marina	7/4/2010	1.9
6	LVLAROA142.50	Mile Mark 2	7/4/2010	2.2
7	LVLAROA141.42	Mile Mark 1	7/4/2010	2.8
9	LVLAPGG000.47	Pigg River	7/4/2010	0.7
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	7/4/2010	2.5
1	LVLAROA153.47	Toler Bridge	7/16/2010	
2	LVLAROA149.94	Mile Mark 9	7/16/2010	
3	LVLATER000.33	Tri-County Marina	7/16/2010	
5	LVLAOWC000.58	Pit Stop Marina	7/16/2010	2.0
6	LVLAROA142.50	Mile Mark 2	7/16/2010	2.5
7	LVLAROA141.42	Mile Mark 1	7/16/2010	2.5
9	LVLAPGG000.47	Pigg River	7/16/2010	
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	7/16/2010	2.5
1	LVLAROA153.47	Toler Bridge	8/7/2010	2.0
2	LVLAROA149.94	Mile Mark 9	8/7/2010	2.2
3	LVLATER000.33	Tri-County Marina	8/7/2010	2.9
5	LVLAOWC000.58	Pit Stop Marina	8/7/2010	2.8
6	LVLAROA142.50	Mile Mark 2	8/7/2010	3.2
7	LVLAROA141.42	Mile Mark 1	8/7/2010	3.8
9	LVLAPGG000.47	Pigg River	8/7/2010	1.0
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	8/7/2010	3.2
1	LVLAROA153.47	Toler Bridge	8/21/2010	1.1
2	LVLAROA149.94	Mile Mark 9	8/21/2010	1.8
3	LVLATER000.33	Tri-County Marina	8/21/2010	2.1
5	LVLAOWC000.58	Old Woman's Creek Mouth	8/21/2010	2.0
6	LVLAROA142.50	Mile Mark 2	8/21/2010	2.3
7	LVLAROA141.42	Mile Mark 1	8/21/2010	2.3
9	LVLAPGG000.47	Pigg River	8/21/2010	0.3
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	8/21/2010	2.3
1	LVLAROA153.47	Toler Bridge	9/4/2010	1.0
2	LVLAROA149.94	Mile Mark 9	9/4/2010	1.2
3	LVLATER000.33	Tri-County Marina	9/4/2010	1.7
5	LVLAOWC000.58	Pit Stop Marina	9/4/2010	1.7
6	LVLAROA142.50	Mile Mark 2	9/4/2010	2.3
7	LVLAROA141.42	Mile Mark 1	9/4/2010	2.1
9	LVLAPGG000.47	Pigg River	9/4/2010	0.8
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	9/4/2010	2.1
1	LVLAROA153.47	Toler Bridge	9/17/2010	1.2
2	LVLAROA149.94	Mile Mark 9	9/17/2010	1.0
3	LVLATER000.33	Tri-County Marina	9/17/2010	1.8
5	LVLAOWC000.58	Pit Stop Marina	9/17/2010	1.5
6	LVLAROA142.50	Mile Mark 2	9/17/2010	2.0
7	LVLAROA141.42	Mile Mark 1	9/17/2010	1.9
9	LVLAPGG000.47	Pigg River	9/17/2010	0.5
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	9/17/2010	1.9

Bacteria (Escherichia coli) Profiles

Below is a table with the E. coli data collected using Coliscan Easygel test kits. The minimum detectable level with the test kits is 25 CFUs (colony forming units)/100 ml, so even though the test result may have indicated 0 CFUs/100 ml, the data is reported as 25 CFUs/100ml. Only six of the samples had E. coli levels above the minimum detectable limit and only one Pigg River sample slightly exceeded the state instantaneous standard of 235 CFUs/100 ml.

Leesville Lake Association Volunteer E. coli Data -- 2010

Assn. Station Number	DEQ Station ID	Station Location Description	Collection Date	E. coli CFUs/100 ml
1	LVLAROA153.47	Toler Bridge	5/21/2010	25
2	LVLAROA149.94	Mile Mark 9	5/21/2010	25
3	LVLATER000.33	Tri-County Marina	5/21/2010	25
5	LVLAOWC000.58	Pit Stop Marina	5/21/2010	25
6	LVLAROA142.50	Mile Mark 2	5/21/2010	25
7	LVLAROA141.42	Mile Mark 1	5/21/2010	25
9	LVLAPGG000.47	Pigg River	5/21/2010	25
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	5/21/2010	25
1	LVLAROA153.47	Toler Bridge	6/19/2010	25
2	LVLAROA149.94	Mile Mark 9	6/19/2010	25
3	LVLATER000.33	Tri-County Marina	6/19/2010	25
5	LVLAOWC000.58	Old Woman's Creek Mouth	6/19/2010	25
6	LVLAROA142.50	Mile Mark 2	6/19/2010	25
7	LVLAROA141.42	Mile Mark 1	6/19/2010	25
9	LVLAPGG000.47	Pigg River	6/19/2010	25
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	6/19/2010	25
1	LVLAROA153.47	Toler Bridge	7/4/2010	25
2	LVLAROA149.94	Mile Mark 9	7/4/2010	25
3	LVLATER000.33	Tri-County Marina	7/4/2010	25
5	LVLAOWC000.58	Pit Stop Marina	7/4/2010	25
6	LVLAROA142.50	Mile Mark 2	7/4/2010	25
7	LVLAROA141.42	Mile Mark 1	7/4/2010	25
9	LVLAPGG000.47	Pigg River	7/4/2010	25
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	7/4/2010	25
5	LVLAOWC000.58	Pit Stop Marina	7/16/2010	25
6	LVLAROA142.50	Mile Mark 2	7/16/2010	25
7	LVLAROA141.42	Mile Mark 1	7/16/2010	25
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	7/16/2010	25
1	LVLAROA153.47	Toler Bridge	8/7/2010	25
2	LVLAROA149.94	Mile Mark 9	8/7/2010	25
3	LVLATER000.33	Tri-County Marina	8/7/2010	25
5	LVLAOWC000.58	Pit Stop Marina	8/7/2010	40
6	LVLAROA142.50	Mile Mark 2	8/7/2010	25
7	LVLAROA141.42	Mile Mark 1	8/7/2010	25
9	LVLAPGG000.47	Pigg River	8/7/2010	140
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	8/7/2010	25

Assn. Station No.	DEQ Station ID	Station Description	Collection Date	CFUs/100 ml
1	LVLAROA153.47	Toler Bridge	8/21/2010	40
2	LVLAROA149.94	Mile Mark 9	8/21/2010	25
3	LVLATER000.33	Tri-County Marina	8/21/2010	25
5	LVLAOWC000.58	Pit Stop Marina	8/21/2010	25
6	LVLAROA142.50	Mile Mark 2	8/21/2010	25
7	LVLAROA141.42	Mile Mark 1	8/21/2010	25
9	LVLAPGG000.47	Pigg River	8/21/2010	240
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	8/21/2010	25
1	LVLAROA153.47	Toler Bridge	9/4/2010	25
2	LVLAROA149.94	Mile Mark 9	9/4/2010	25
3	LVLATER000.33	Tri-County Marina	9/4/2010	25
5	LVLAOWC000.58	Pit Stop Marina	9/4/2010	25
6	LVLAROA142.50	Mile Mark 2	9/4/2010	60
7	LVLAROA141.42	Mile Mark 1	9/4/2010	25
9	LVLAPGG000.47	Pigg River	9/4/2010	200
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	9/4/2010	25
1	LVLAROA153.47	Toler Bridge	9/17/2010	25
2	LVLAROA149.94	Mile Mark 9	9/17/2010	25
3	LVLATER000.33	Tri-County Marina	9/17/2010	25
5	LVLAOWC000.58	Pit Stop Marina	9/17/2010	25
6	LVLAROA142.50	Mile Mark 2	9/17/2010	25
7	LVLAROA141.42	Mile Mark 1	9/17/2010	25
9	LVLAPGG000.47	Pigg River	9/17/2010	25
10	LVLAROA140.93	Dam: Pittsylvania Swim Area	9/17/2010	25

Sampling and Laboratory Testing Protocols

Lynchburg College (LC) field sampling and laboratory testing protocols are described in the attached Lynchburg College report.

Reporting

Data collected was uploaded to the VDEQ database and will be made available to all interested parties and stakeholders.

The 2010 report prepared by Lynchburg College is attached.