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# E. Coli Monitoring at the Lake of the Ozarks

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## **What is *E. coli*?**

*E. coli* or *Escherichia coli* is a type of bacteria commonly found in the intestines and feces of healthy warm-blooded animals and humans. There are more than 100 different strains of *E. coli*, and most are harmless.

## **Why test for *E. coli*?**

*E. coli* is a good indicator of the presence of fecal contamination and possible disease-causing bacteria or viruses in water. The test used for *E. coli* is far less expensive and more reliable than other bacterial tests. If high levels of *E. coli* are detected, the department can investigate the area further and work to correct any problems.

## **What is the state standard for *E. coli*?**

The state water quality standard for water bodies with whole body contact for recreation is a geometric mean of 126 *E. coli* colonies per 100 milliliters of water during the April 1 through October 31 recreation season. The geometric mean is a statistical method used to combine the data that reduces the effect of extremely high and low values that can bias the results. For samples taken during the 2007 monitoring project the geometric mean is 5.0, well below the state standard. However, there were some instances of high values which the department plans to investigate further.

Missouri's standard is consistent with the U.S. Environmental Protection Agency's recommendation for fresh-recreational waters, *Ambient Water Quality Criteria for Bacteria - 1986*, available on EPA's Web site at [www.epa.gov/waterscience/beaches/files/1986crit.pdf](http://www.epa.gov/waterscience/beaches/files/1986crit.pdf).

## **How is *E. coli* data reported?**

There are several ways in which *E. coli* data is reported, but most refer to the same thing. These include colonies, cells, most probable number or colony-forming units per 100 milliliters. The latter two are frequently identified in notations as MPN or CFU, respectively.

## **When and where will sampling for *E. coli* take place at the lake?**

Sampling will be conducted over a five-year period. Each year a different section of the lake will be sampled during a six-month period. When completed, the sampling will include coves from Bagnell Dam to Truman Dam. During 2007, three-hundred-fifty-six samples were collected and analyzed for *E. coli*. Twenty-eight coves from Bagnell Dam to the Community Bridge were sampled three times each. See Figure 1 for 2007 sampling locations.

## **Who conducts and funds the sampling?**

The Missouri Department of Natural Resources, the Missouri Department of Conservation and trained volunteers from the Lake of the Ozarks Watershed Alliance collect the samples. After the samples are collected, they are preserved and taken to the Missouri Department of Natural Resources' laboratory where they are tested using methods approved by EPA. Cost for the water testing runs about \$15,000 annually. With the help of trained volunteers the number of sites that can be sampled has more than doubled. The five-year project is funded through a settlement agreement with AmerenUE.

### **What are *E. coli* levels at Lake of the Ozarks?**

Only eight water samples showed levels higher than 126 colonies per 100 milliliters. See Table 1 for 2007 *E. coli* results.

### **Where does *E. coli* in the lake come from?**

There are a number of possibilities, and chances are no single source is the culprit. Faulty septic tanks or sewer systems, wastewater treatment facilities, large concentrations of waterfowl, and runoff from animal waste and manure are all possibilities.

### **Should I be concerned about swimming at Lake of the Ozarks because of *E. coli*?**

Samples collected so far indicate the chances of contracting an illness associated with bacteria are minimal at Lake of the Ozarks. You can further reduce your risk of contracting waterborne illnesses by not swallowing lake water.

### **Can fish from the lake be contaminated because of *E-coli*?**

Because fish are not warm-blooded they do not carry *E. coli* internally; however, the water covering the fish could contain *E. coli*. Fish may also carry other parasites not associated with *E. coli*. Wash and cook fish thoroughly before eating, and wash your hands after handling fish and lake-water to reduce your risk. According to the Missouri Department of Health and Senior Services, the single most important way to prevent the spread of the disease is careful handwashing. See the Missouri Department of Health and Senior Services fact sheet at [www.cdc.gov/nczved/divisions/dfbmd/diseases/ecoli\\_o157h7/index.html](http://www.cdc.gov/nczved/divisions/dfbmd/diseases/ecoli_o157h7/index.html). For more information about proper food handling and preparation contact the Missouri Department of Health and Senior Services toll-free at 866-628-9891.

### **What are the symptoms associated with bacteria-caused illnesses?**

Certain strains of *E. coli*, other bacteria, viruses, and parasites associated with fecal contamination can cause gastrointestinal illness. Symptoms can include, but are not limited to, diarrhea, stomach cramps and nausea. According to the Centers for Disease Control and Prevention, bloody diarrhea and stomach pain are the most common signs of *E. coli* O157:H7 sickness. For more information see the CDC Web page at [www.cdc.gov/ecoli/qa\\_ecoli\\_sickness.htm](http://www.cdc.gov/ecoli/qa_ecoli_sickness.htm).

### **What is *E. coli* O157:H7?**

This is one strain of *E. coli* that can cause serious illness. It is usually associated with cattle, but has also been found in the intestines of deer, goats and sheep. The CDC states that most illnesses from this strain are associated with eating undercooked, contaminated beef, but can also be contracted after eating contaminated sprouts, vegetables, drinking unpasteurized milk, or swimming in or drinking sewage-contaminated water. According to the CDC, all persons who suddenly have diarrhea with blood should get their stool tested for *E. coli* O157:H7, and most people recover without antibiotics or other specific treatment within five to 10 days. See the CDC Web page at [www.cdc.gov/ncidod/dbmd/diseaseinfo/escherichiacoli\\_g.htm](http://www.cdc.gov/ncidod/dbmd/diseaseinfo/escherichiacoli_g.htm).

For more information about the Lake of the Ozarks *E. coli* monitoring project, contact the Missouri Department of Natural Resources at 1-800-361-4827 or visit us on the Web at [www.dnr.mo.gov](http://www.dnr.mo.gov).

### **Other sources of information:**

Centers for Disease Control and Prevention, [www.cdc.gov](http://www.cdc.gov)

Environmental Protection Agency, [www.epa.gov](http://www.epa.gov)

Lake of the Ozarks Watershed Alliance, [www.soslowa.org](http://www.soslowa.org)

Lakes of Missouri Volunteer Program, [www.lmvp.org](http://www.lmvp.org)

Missouri Department of Conservation, [www.mdc.mo.gov](http://www.mdc.mo.gov)

Missouri Department of Health and Senior Services, [www.health.mo.gov](http://www.health.mo.gov)

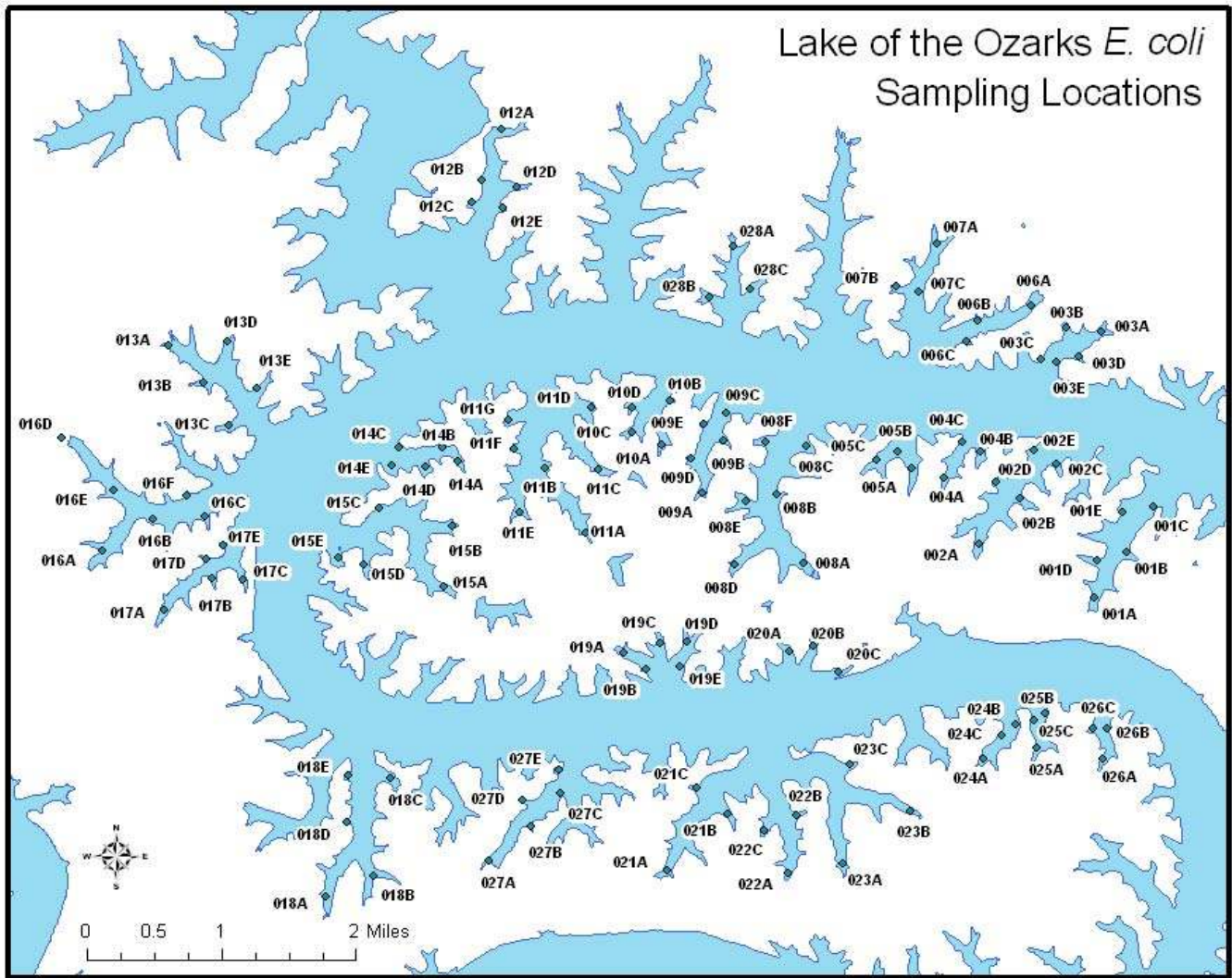


Table 1: 2007 *E. coli* results from Lake of the Ozarks. Results are in colonies per 100 milliliters of water. Results in gray boxes are greater than 126 colonies per 100 milliliters.

Jennings Branch	5/29/2007	6/11/2007	7/9/2007	8/6/2007	9/4/2007	10/9/2007	Geometric Mean
001A	866.4		8.6		1986.3		
001B	116.2		3.1		16.9		
001C	40.8		<1		6.3		
001D	143.9		3.0		128.1		
001E	30.5		<1		7.5		21.0
McCoy Branch Cove	5/29/2007	6/11/2007	7/9/2007	8/6/2007	9/4/2007	10/9/2007	Geometric Mean
002A		28.0		6.3		31.3	
002B		17.0		1.0		4.1	
002C		4.0		10.9		4.1	
002D		223.0		8.4		3.1	
002E		14.0		18.1		5.2	9.6
Lotell Hollow Cove	5/29/2007	6/11/2007	7/9/2007	8/6/2007	9/4/2007	10/9/2007	Geometric Mean
003A	1.0		34.5		14.6		
003B	2.0		<1		7.5		
003C	7.4		2.0		<1		
003D	2.0		1.0		2.0		
003E	2.0		<1		<1		2.1

<b>Cove 004</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
004A		7.0		9.8		18.5	
004B		19.0		2.0		3.0	
004C		3.0		2.0		1.0	4.6
<b>Cove 005</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
005A	2.0		2.0		<1		
005B	1.0		1.0		4.1		
005C	7.5		<1		4.1		1.6
<b>Birdsong Hollow Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
006A		12.0		7.4		1.0	
006B		1.0		<1		2.0	
006C		4.0		1.0		1.0	1.9
<b>Jobson Hollow Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
007A	4.1		3.1		12.2		
007B	9.6		12.2		8.6		
007C	16.9		3.1		95.9		9.6
<b>Downing Branch Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
008A		53.0		3.0		22.6	
008B		5.0		3.1		4.1	
008C		6.0		4.1		<1	
008D		10.0		10.8		13.0	
008E		7.0		6.3		4.1	
008F		5.0		2.0		1.0	5.2
<b>Cove 009</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
009A	81.3		20.1		4.1		
009B	111.9		59.1		14.5		
009C	488.4		228.2		14.2		
009D	13.2		3.1		18.5		
009E	24.3		6.3		6.3		24.6
<b>Cove 010</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
010A		8.0		*		5.2	
010B		2.0		<1		2.0	
010C		2.0		3.1		11.0	
010D		7.0		7.3		<1	2.9
<b>Cornett Branch Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
011A	17.1		21.6		5.2		
011B	13.1		10.9		6.3		
011C	3.1		2.0		3.1		
011D	22.8		1.0		18.3		
011E	4.1		1.0		5.2		
011F	5.2		2.0		2.0		
011G	6.3		6.3		6.3		5.2
<b>Raccoon Hollow Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
012A		<1		2.0		2.0	
012B		<1		<1		1.0	
012C		2.0		<1		2.0	
012D		5.0		1.0		1.0	
012E		3.0		<1		<1	1.1
<b>North Buck Creek</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
013A	35.5		12.0		10.9		
013B	24.6		1.0		1.0		
013C	6.3		3.0		3.1		
013D	6.3		1.0		5.2		
013E	10.9		39.9		6.3		6.0

<b>Cove 014</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
014A		6.0		23.8		5.2	
014B		4.0		20.1		7.3	
014C		1.0		4.1		1.0	
014D		3.0		33.2		2.0	
014E		2.0		4.1		<1	4.1
<b>Workman Hollow</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
015A	5.2		3.1		2.0		
015B	13.4		22.8		5.2		
015C	18.9		13.5		25.9		
015D	16.0		2.0		13.4		
015E	13.1		1.0		<1		6.2
<b>South Buck Creek</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
016A		15.0		6.3		7.3	
016B		<1		<1.0		24.9	
016C		4.0		4.1		2.0	
016D		12.0		2.0		13.4	
016E		2.0		2.0		8.5	
016F		7.0		3.1		10.9	4.4
<b>Cape Hollow Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
017A	6.3		2.0		30.9		
017B	13.5		6.3		5.2		
017C	8.5		2.0		<1		
017D	3.1		5.2		2.0		
017E	3.1		5.2		2.0		4.0
<b>Lynch Hollow Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
018A		39.0		13.2		4.1	
018B		13.0		2.0		4.1	
018C		4.0		14.8		9.8	
018D		4.0		2.0		37.9	
018E		4.0		1.0		2.0	5.8
<b>Cove 019</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
019A	41.4		5.2		115.3		
019B	30.9		<1		32.3		
019C	13.5		5.2		64.4		
019D	14.2		4.1		3.1		
019E	6.3		6.3		9.6		10.8
<b>Lodge of Four</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
020A		6.0		<1		2.0	
020B		35.0		5.2		6.2	
020C		17.0		6.3		3.1	5.1
<b>Chimney Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
021A	5.2		3.0		1.0		
021B	14.6		3.1		17.3		
021C	5.2		2.0		1.0		3.4
<b>Middle Hollow Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
022A		6.0		7.3		2.0	
022B		8.0		4.1		<1	
022C		3.0		3.1		5.2	3.5
<b>Forked Hollow Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
023A	3.1		29.3		9.7		
023B	8.5		3.1		8.6		
023C	7.3		<1		2.0		5.0

<b>Cove 024</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
024A		29.0		11.0		1.0	
024B		5.0		2.0		1.0	
024C		3.0		2.0		2.0	3.2
<b>Cove 025</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
025A	11.9		1.0		1.0		
025B	4.1		7.4		1.0		
025C	6.3		3.0		1.0		2.8
<b>Cove 026</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
026A		31.0		10.9		<1	
026B		4.0		1.0		2.0	
026C		7.0		1.0		2.0	3.0
<b>Davey Hollow Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
027A	37.3		21.8		10.8		
027B	6.3		9.6		410.6		
027C	2.0		4.1		2.0		
027D	10.8		8.6		5.2		
027E	25.9		3.1		2.0		9.1
<b>Dry Branch Cove</b>	<b>5/29/2007</b>	<b>6/11/2007</b>	<b>7/9/2007</b>	<b>8/6/2007</b>	<b>9/4/2007</b>	<b>10/9/2007</b>	<b>Geometric Mean</b>
028A		9.0		3.1		8.6	
028B		8.0		1.0		6.3	
028C		4.0		<1		3.0	3.5
						<b>Total</b>	<b>5.0</b>

\*Sample broken in transit, no result.

## For more information

Missouri Department of Natural Resources  
P.O. Box 176  
Jefferson City, MO 65102-0176

Environmental Services Program  
(573) 526-3315, (573) 526-3350 fax  
[www.dnr.mo.gov/services/index.html](http://www.dnr.mo.gov/services/index.html)

Water Protection Program  
(573) 751-1300, (573) 751-1146 fax  
[www.dnr.mo.gov/env/wpp/index.html](http://www.dnr.mo.gov/env/wpp/index.html)