

# **Bear Lake Beach Monitoring Project Manistee County, Michigan 2015**



**Prepared by:**

**District Health Department #10**



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*Healthy People, Healthy Communities*

## Background

In 2013, District Health Department #10 was approached by two civic organizations – the Bear Lake Property Owners Association (BLPOA) and the Greater Bear Watershed (GBW) – to conduct bi-weekly water sampling at public swimming or water contact areas (boat launches) on Bear Lake. Annual water quality testing is done by volunteers for the Michigan Clean Water Corps/Cooperative Lakes Monitoring Program (CLMP) who monitor the lake for phosphorus, chlorophyll and visibility levels. In addition to information on the health of the lake, there was an interest in the safety of those who use the water. As a result, it was decided that the public access area of the lake should be monitored for *Escherichia coli* (E. coli). The State of Michigan has set a standard that surface water for swimming (body contact) should not exceed a level of 300 E. coli cfu/100 ml. or no more than 130 as a 30-day geometric mean. If so, contact with the water should be prevented until levels drop. When swimming or conducting other water activities during periods of high bacterial levels, the risk of becoming ill from contamination increases. Children, the elderly and individuals with weakened immune systems are the most at risk. Flu-



like systems such as diarrhea, abdominal cramping, fever and dehydration can occur from exposure to contaminated water. Upper respiratory illnesses, such as ear, nose and throat infections, may also occur in addition to skin infections if an open wound is not properly protected.

Prior to 2013, the lake was sampled for total coliform. Total coliform, which is harmless and has no public health concerns, has been used as an indicator species for human pathogens. Unfortunately it has fallen out of favor for this use since additional research is showing little relationship between E. coli numbers and total coliform.

In 2015, water sampling has continued on Bear Lake for E. coli through funding from the Bear Lake Watershed Alliance (BLWA).

## Area of the Project

The Bear Lake subwatershed is part of the Greater Bear watershed which is dominated by the Big Bear Creek. The Bear Lake subwatershed encompasses roughly 7,543 acres (Michigan Department of Natural Resources, 2000). There are no significant tributary streams to Bear Lake. Therefore it is most spring-fed. The Little Bear Creek does exit from the east shore of the lake. The soil surrounding the lake are primarily sand (Kalkaska series) with a few isolated clay lens. Bear Lake is a popular recreational lake and the majority of the lakeshore is developed with homes and cottages. Wetlands are located along the northwest shore of the lake near Big Bay and near the Little Bear Creek outlet (Michigan Department of Natural Resources, 1999). The actual size of Bear Lake varies from 1,843 acres to 1,744 acres and has a maximum depth of 24 feet, although about two-thirds of the lake is shallower than 20 feet. The flushing rate of the lake is approximately 2.19 years (Water Quality Investigators, 1994).

**Process**

In 2015, the BLWA decided to continue to have the same six sampling locations on Bear Lake as they had in 2014. The six sample locations were sampled twice a month on June 8<sup>th</sup>, June 22<sup>nd</sup>, July 6<sup>th</sup>, July 20<sup>th</sup>, August 3<sup>rd</sup> and August 17<sup>th</sup>. Three water samples were collected at each site – one at each end of the water access area and one in the middle – for each sampling date (a total of 108 samples). Water samples are taken 1 foot below the surface in water that is 3 to 6 feet deep. The samples were then placed in a cooler with ice and taken to our water laboratory in Ludington, Michigan. They are immediately processed on arrival to the laboratory and incubated for 18-24 hours, after which they are checked for the presence of *Escherichia coli* (E. coli).



**Results**

The results of the sampling are as follows:

**DHD #10 2015 Bear Lake Monitoring Results  
E. coli Colony Count, Geometric Daily Mean for Weeks 1-6**

Site #	Location	Week 1 June 8	Week 2 June 22	Week 3 July 6	Week 4 July 20	Week 5 August 3	Week 6 August 17	Seasonal GDM 2015	Seasonal GDM 2014
1	Hopkins Park	12.8	2.3	2.3	3.7	2.6	1.0	2.9	4.2
2	South Shore	13.7	10.1	5.5	4.9	4.4	1.0	5.0	9.1
3	7 <sup>th</sup> Street	35.4	2.0	1.8	7.7	18.0	3.1	6.2	6.3
4	13-Mile Road	2.7	2.3	1.0	1.8	1.0	3.4	1.8	2.1
5	Myers Road	1.6	1.0	10.7	38.6	9.0	3.7	5.3	1.3
6	Pleasanton Twp. Park	1.0	1.6	1.3	1.8	1.5	4.4	1.7	1.5
	Wind Direction	West	SSE	South	SW	West	SW		
	Speed (mph)	6-20	5-21	4-16	5-17	3-10	4-17		
	Precipitation	0.7	0.3	0.1	No rain	1.7	0.1		

All results are expressed as: E. coli colonies/100 ml MPN  
Precipitation amount is for a 24-hour time frame prior to sampling

Overall, the sample results show excellent water quality in Bear Lake and a significant improvement in E. coli numbers from the past two years. The 2015 sampling season saw much more rain than in past years. For 2014, three of the six sampling events occurred during rain episodes, while five of the six sampling events this year had rain. Rain episodes typically will result in a decline in water quality since contaminants on the ground surface will often be washed into the lake in the form of runoff. Generally, this does not appear to be the case in Bear Lake where rain episodes appear to be improving water quality. Some runoff issues would seem to exist on the south shore of the lake, but the amount of runoff does appear to be minimal. Wind speed and direction were fairly consistent during the sampling dates so there were few comparisons that could be made. One area of the lake that did show some deterioration was the Myers Road area on the north shore. Since this area showed the highest bacterial levels at a time

when there was no precipitation, it would be beneficial to look for a point source of contamination, versus a runoff issue. Boating waste or deteriorating septic systems would be possible areas of consideration.

The quality of the lake water is further confirmed by the testing done by the Michigan Clean Water Corps for chlorophyll-a and phosphorus. The Michigan Clean Water Corps monitor over 200 lakes in Michigan for water quality parameters. Chlorophyll-a is the measure of the amount of food available in the lake for aquatic life. Too little chlorophyll-a indicated that there may not be enough food to support an abundant biological community. On the other hand, too much chlorophyll-a indicates that nutrient levels in the lake may be too high which may deplete the amount of dissolved oxygen in the water. There is disagreement as to the best level of chlorophyll-a but the State of North Carolina has set a level of 40 ppb as the maximum for a lake, while the State of Colorado has set a level of 15 ppb as the maximum for a reservoir. For the lakes monitored in Michigan, the median level of chlorophyll-a was 2.0 part per billion (ppb). Fortunately the levels of chlorophyll-a in Bear Lake are declining. For the six year period of 2008-2013, the chlorophyll-a median level for Bear Lake was 3.1 ppb while it was 2.8 ppb in 2014.



Both nitrates and phosphorus are nutrients that can result in a rapid growth of aquatic plants which in turn can greatly accelerate the aging of a lake. In addition, the growth of aquatic plants will typically deplete the level of oxygen in the water. In a fresh water environment, phosphorus is the most important nutrient to monitor. The U.S. Environmental Protection Agency has recommended a limit for controlling eutrophication (aging) of 50 ppb for phosphorus. In Bear Lake the phosphorus levels for the time frame of 2008-2013 averaged 9 ppb. In 2014 it increased slightly to 10 ppb.

On-site septic systems can leach both nitrates and phosphorus into the lake environment. For this reason, the District established isolation distances to surface waters in 1989 in order to lessen their impact. Septic tanks need to be at least 50 feet from surface waters while drainfields need to be at least 100 feet. In addition, the septic system has to be kept at least 4 feet from groundwater. Nevertheless, few of the septic systems that were installed prior to 1989 meet these requirements and may very well be a source of nutrients to the lake. The District does not require compliance with the isolation distances unless the existing on-site septic system fails (surfaces to the ground or backs-up into the house) and a new septic system needs to be installed.

## **Recommendations**

- 1) Continue to reassess the locations for the beach monitoring for next year. Determine if there are any particular areas of concern that your organization would like to monitor, such as areas with large concentrations of animals (wildlife such as geese or domestic such as cattle or horses), urban areas (street run-off), heavy residential developments (septic systems and lawn fertilizers), and large agricultural operations (run-off) should be considered. Any sampling site should have easy access to water depths of at least 4 ft.

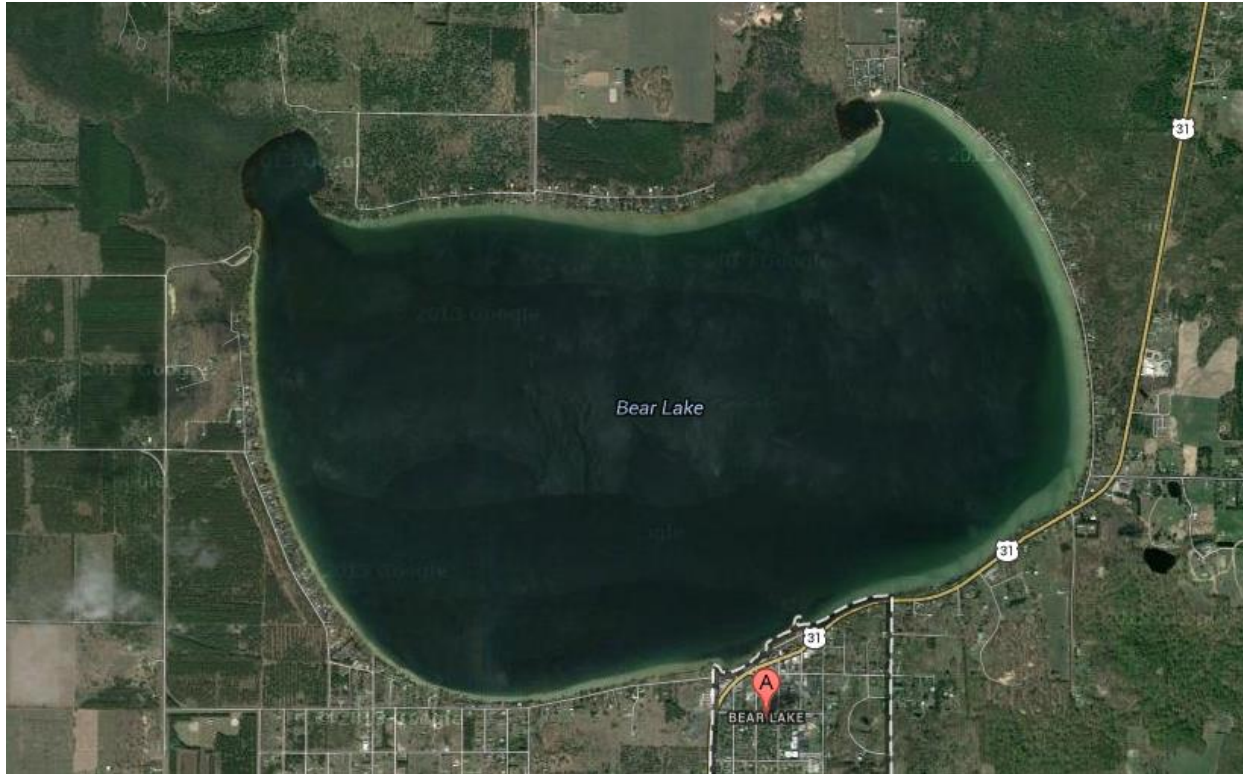
- 2) Efforts should continue to control runoff along the southern shore of the lake. Maintaining and creating planting on the shoreline and riparian areas offer an excellent buffer during rain and snow-melt periods.
- 3) Monitor the south and north shores of the lake for possible sources of contamination, such as aging septic systems, fertilizing of lawns down to the water edge, disposal of lawn chippings into the lake, discharge for boats and drains directly into the lake.

### **Additional Sampling**

In coordination with the Michigan Department of Environmental Quality (DEQ) we had hoped to do polymerase chain reaction (PCR) testing in 2015. This is a new method that does not require incubation of the water samples but instead analyze the DNA. This will allow us to provide results faster and to provide more accurate numbers. In the future, it may also allow for the to determine if the E. coli source is from humans, cows, pigs, birds, chickens, gulls, geese, deer, dogs or horses. District Health Department #10 developed an agreement with the city of Cadillac to do PCR testing. The District had secured a grant from DEQ for the laboratory equipment to do PCR testing. Unfortunately, the District does not the adequate facilities to house the equipment so we provided the equipment to the city of Cadillac with the understanding that we would be able to get a PCR test for each of our sampling locations. Since this is the pilot year for the project and processes are still experimental, laboratory errors were made and the test results were not correctly calibrated. Therefore, the results were not usable. We intend to attempt the project again next year and hope for some valid – and significant - results.



## Aerial View of Bear Lake

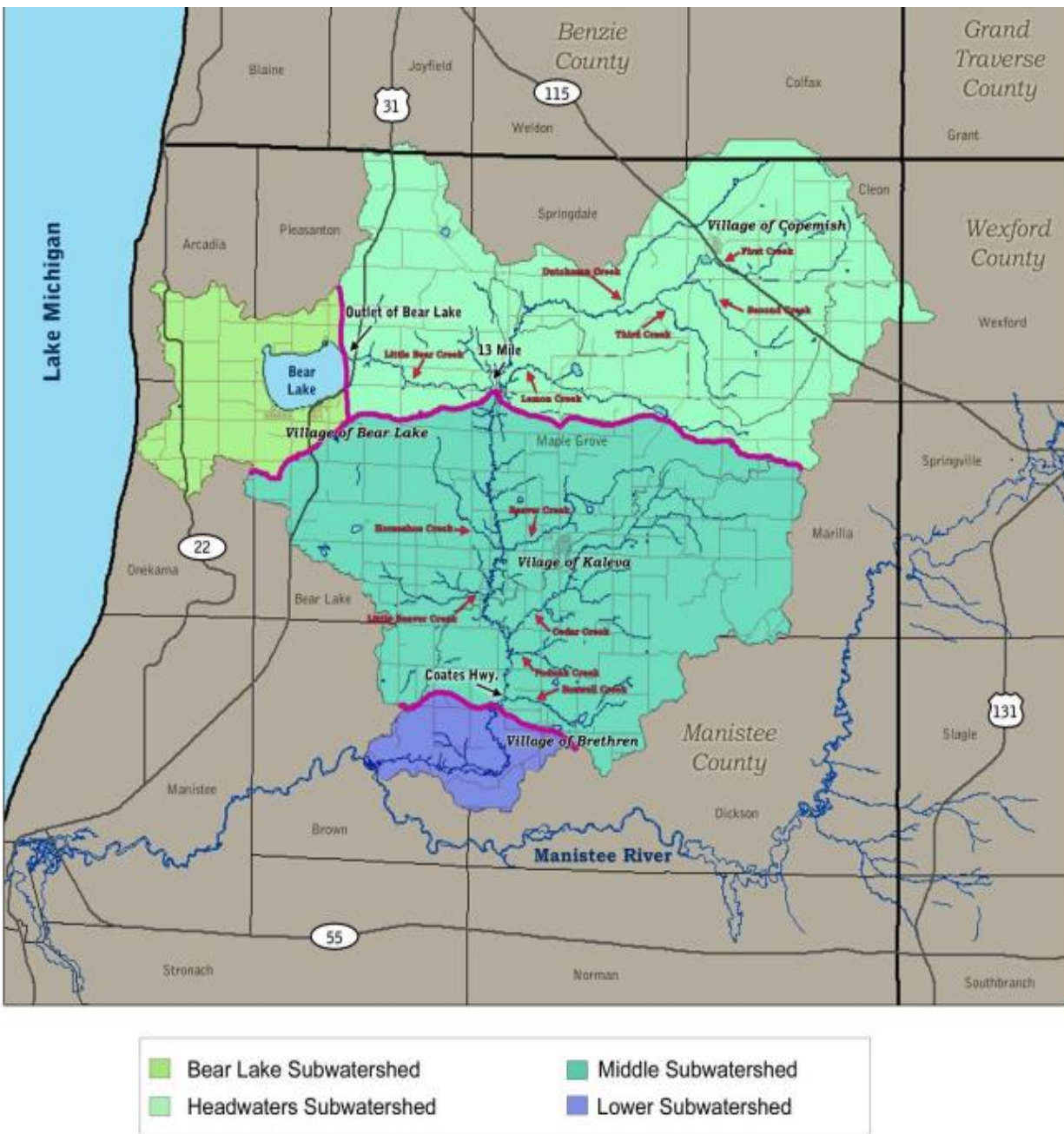


## Watersheds

## Greater Bear Watershed

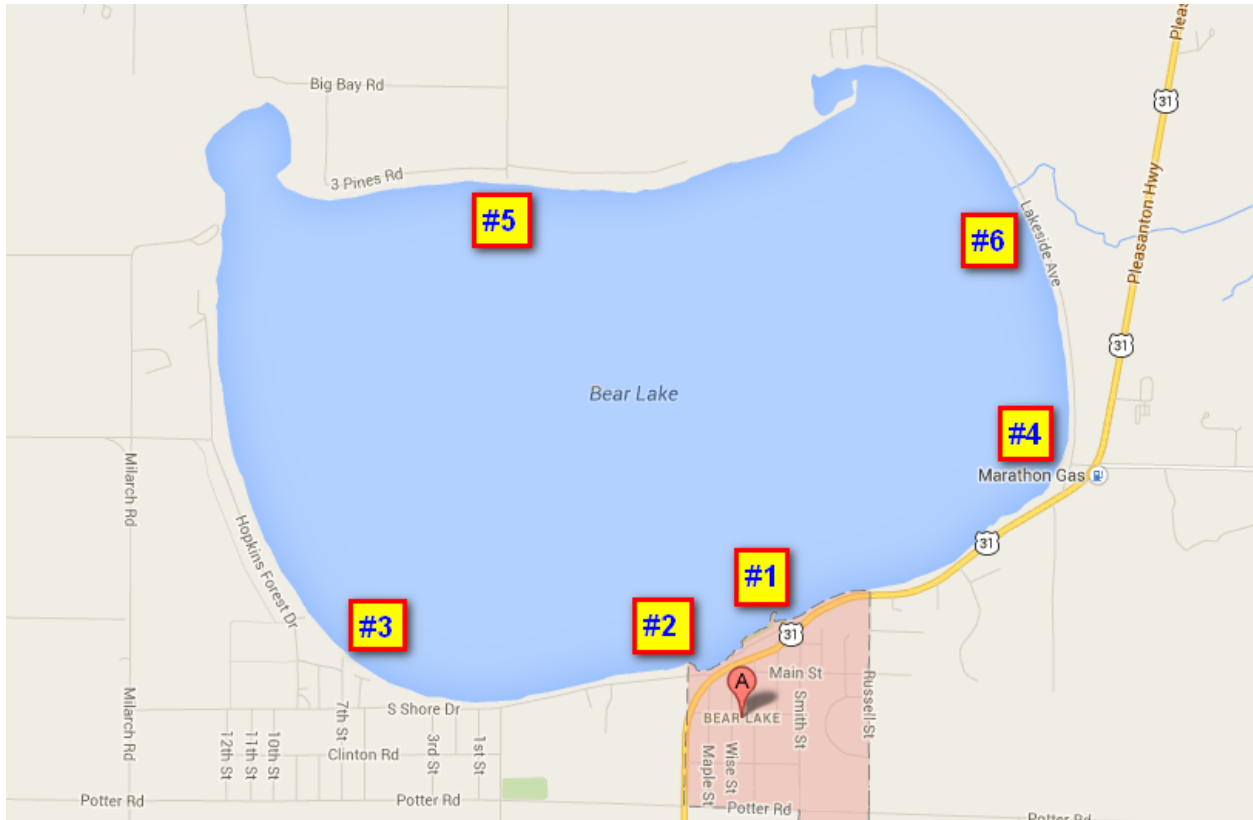


## Greater Bear Subwatersheds



SOURCE: Public Sector Consultants Inc., 2012, using data from MDIT/CGI and information from the Greater Bear Watershed Steering Committee, 2011.

## Sampling Sites for the 2015 Monitoring Project



- #1 Hopkins Park Beach**
- #2 South Shore Beach**
- #3 7<sup>th</sup> Street Beach**
- #4 13-Mile Road Beach**
- #5 Myers Road Beach**
- #6 Pleasanton Township Park Beach**



## Sampling Sites on Bear Lake - 2015

### Site #1 – Hopkins Park Beach



### Site #2 – South Shore Beach



Site #3 – 7<sup>th</sup> Street Beach



Site #4 – 13-Mile Road Beach



**Site #5 – Myers Road Beach**



**Site #6 – Pleasanton Township Park Beach**

