Annual Report

Lake Lansing
Special Assessment District
2013 Annual Report

Prepared for:

Charter Township of Meridian
and
Lake Lansing Special Assessment District Advisory Committee

Prepared by:

Progressive AE
1811 4 Mile Road, NE
Grand Rapids, MI 49525-2442
616/361-2664

October 2013

Project No: 53260102

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Executive Summary

The Lake Lansing Special Assessment District (SAD) was formed in 1998 to improve conditions in Lake Lansing. In 2007, public hearings were held and Meridian Township approved continuing the project for a ten-year period. The project includes an update of the lake and watershed management plan, water quality sampling, nuisance aquatic plant control, watershed improvements, educational programs, and grant applications. The project is overseen by the Lake Lansing SAD Advisory Committee, whose members include representatives of residents within the SAD, Meridian Township, Ingham County Parks, and the Ingham County Drain Commissioner's Office. A summary of project activities is as follows:

Water Quality Sampling: In 2013, samples were collected from Lake Lansing and from tributary streams in spring and late summer. Lake Lansing is borderline between mesotrophic (moderately productive) and eutrophic (nutrient-enriched and productive). During the 2013 sampling period, phosphorus levels were generally low with a few exceptions. Water clarity was good in spring and modeerate in late summer. Algae growth was low in spring and late summer. Tributary streams carry only a small volume of water into Lake Lansing, but nutrients in the streams likely stimulate localized aquatic plant growth.

Nuisance Aquatic Plant Control: On May 1, 2013, the herbicide fluridone was applied throughout Lake Lansing at 6 parts per billion in order to control Eurasian milfoil (*Myriophyllum spicatum*). On May 21, the lake was re-treated to bring the concentration of fluridone in the lake back up to 6 parts per billion. In early July, 35 acres of Lake Lansing were harvested to control nuisance growth of primarily Elodea (*Elodea canadensis*). The fluridone treatment successfully controlled Eurasian milfoil in Lake Lansing and none was found during the August plant survey.

Watershed Improvements: In late September, a bioswale was installed to replace stormwater pipe that empties into Lake Lansing at the south end of Lake Lansing Park South (Figure 1). A bioswale is a shallow drainage ditch that uses plants to uptake nutrients from runoff, and uses check dams to slow the rate of runoff. Thus, instead of nutrients and sediments draining directly to Lake Lansing, the runoff is now filtered before it makes its way to the lake. In addition, the Advisory Committee supported the Mid-Michigan Stewardship Initiative and Ingham County Parks in their ongoing efforts to control the invasive non-native wetland plant Phragmites (*Phragmites australis*) in the Lake Lansing watershed. During the summer of 2013, the Clinton County portion of Perry Road was paved thus reducing the quantity of sediments and nutrients that emanated from unpaved gravel road and previously flowed into the Lake Lansing via a storm drain.

Meetings: The Advisory Committee meets monthly to oversee activities for the Lake Lansing improvement project.

Figure 1. Installed bioswale at Lake Lansing Park South.

Introduction

Lake Lansing is located in Meridian Township, Ingham County, Michigan (Figure 2). The lake is 456 acres in surface area with a maximum depth of 35 feet and a mean (average) depth of 8.7 feet. In 1998, Meridian Township established a special assessment district (SAD) under provisions of Public Act 188 of 1954 for the purposes of studying water quality, planning and implementing aquatic plant control, and developing a watershed management plan for Lake Lansing. In March of 2002, a management plan was prepared for Lake Lansing and its watershed. Public hearings were held in the summers of 2002 and 2007 to continue the management program for Lake Lansing. Ongoing management is overseen by the Lake Lansing Special Assessment District Advisory Committee (hereinafter, the Advisory Committee) with assistance from the Advisory Committee's professional consultant. The Advisory Committee includes representatives from each of the tiers in the special assessment district, Lake Lansing Property Owners Association, Meridian Township Engineering Department, Ingham County Parks Department, and Ingham County Drain Commissioner's Office. This report includes information on 2013 Lake Lansing management activities.

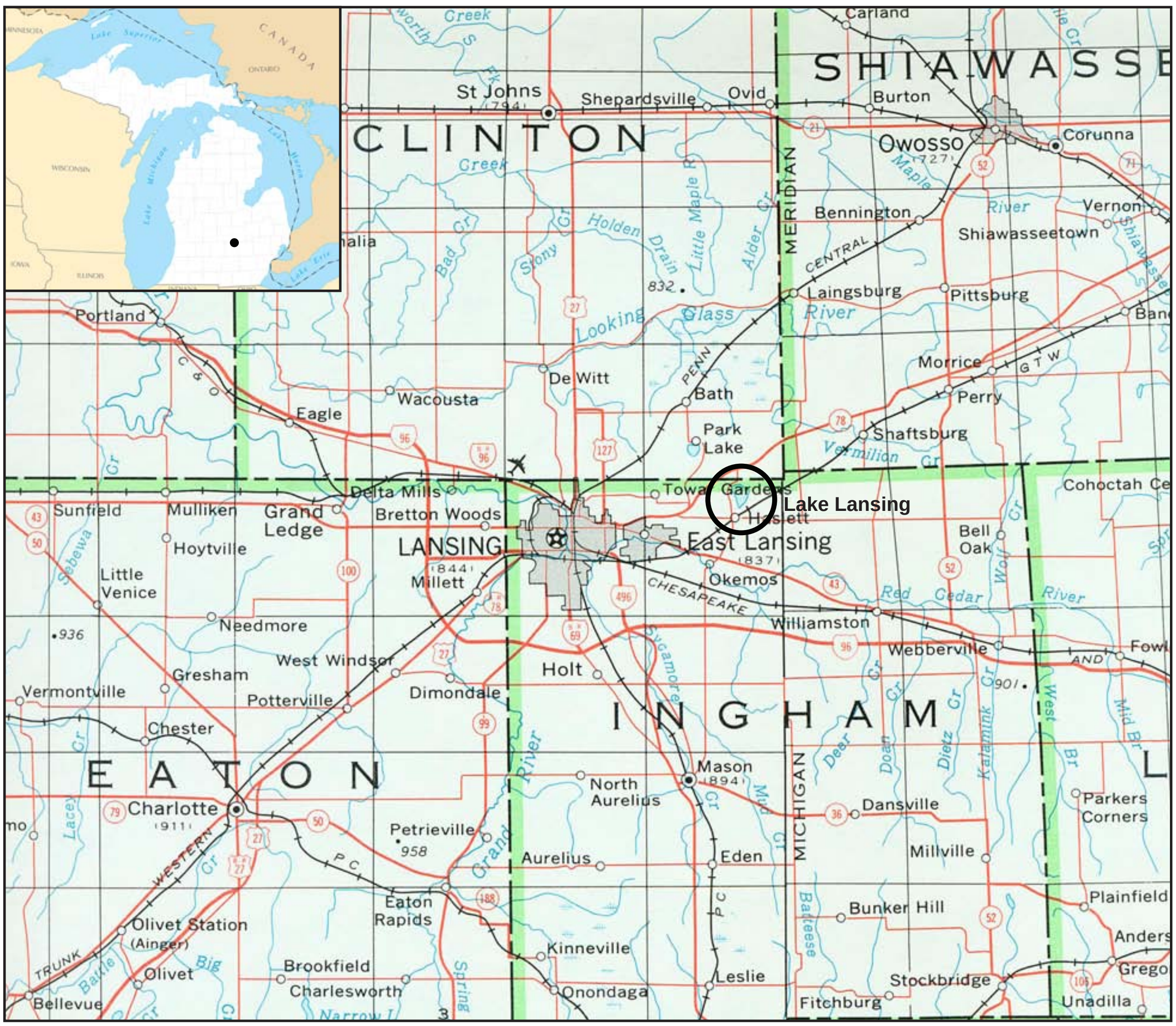

Figure 2. Lake Lansing location map. Source: United States Geological Survey.

Water Quality Sampling

Lake Water Quality

Lake water quality is determined by a unique combination of processes that occur both within and outside of the lake. In order to make sound management decisions, it is necessary to have an understanding of the current physical, chemical, and biological condition of the lake, and the potential impact of drainage from the surrounding watershed.

Lakes are commonly classified as oligotrophic, mesotrophic, or eutrophic (Figure 3). Oligotrophic lakes are generally deep and clear with little aquatic plant growth. These lakes maintain sufficient dissolved oxygen in the cool, deep bottom waters during late summer to support cold water fish such as trout and whitefish. By contrast, eutrophic lakes are generally shallow, turbid, and support abundant aquatic plant growth. In deep eutrophic lakes, the cool bottom waters usually contain little or no dissolved oxygen. Therefore, these lakes can only support warm water fish such as bass and pike. Lakes that fall between these two extremes are called mesotrophic lakes.

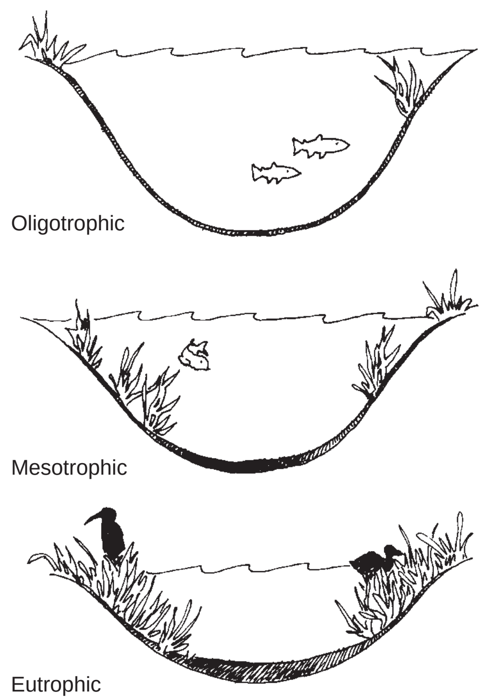

Figure 3. Lake classification.

Under natural conditions, most lakes will ultimately evolve to a eutrophic state as they gradually fill with sediment and organic matter transported to the lake from the surrounding watershed. As the lake becomes shallower, the process accelerates. When aquatic plants become abundant, the lake slowly begins to fill in as sediment and decaying plant matter accumulate on the lake bottom. Eventually, terrestrial plants become established and the lake is transformed to a marshland. The aging process in lakes is called "eutrophication" and may take anywhere from a few hundred to several thousand years, generally depending on the size of the lake and its watershed. The natural lake aging process can be greatly accelerated if excessive amounts of sediment and nutrients (which stimulate aquatic plant growth) enter the lake from the surrounding watershed. Because these added inputs are usually associated with human activity, this accelerated lake aging process is often referred to as "cultural eutrophication." The problem of cultural eutrophication can be managed by identifying sources of sediment and nutrient loading (i.e., inputs) to the lake and developing strategies to halt or slow the inputs. Thus, in developing a management plan, it is necessary to determine the limnological (i.e., the physical, chemical, and biological) condition of the lake and the physical characteristics of the watershed as well. Key parameters used to evaluate the limnological condition of a lake include temperature, dissolved oxygen, total phosphorus, pH and alkalinity, chlorophyll-*a*, fecal coliform bacteria, and Secchi transparency.

TEMPERATURE

Temperature is important in determining the type of organisms which may live in a lake. For example, trout prefer temperatures below 68°F. Temperature also determines how water mixes in a lake. As the ice cover breaks up on a lake in the spring, the water temperature becomes uniform from the surface to the bottom. This period is referred to as "spring turnover" because water mixes throughout the entire water column. As the surface waters warm, they are underlain by a colder, more dense strata of water. This process is called thermal stratification (Figure 4). Once thermal stratification occurs, there is little mixing of the warm surface waters with the cooler bottom waters. The transition layer that separates these layers is referred to as the "thermocline." The thermocline is characterized as the zone where temperature drops rapidly with depth. As fall approaches, the warm surface waters begin to cool and become more dense. Eventually, the surface temperature drops to a point that allows the lake to undergo complete mixing. This period is referred to as "fall turnover." As the season progresses and ice begins to form on the lake, the lake may stratify again. However, during winter stratification, the surface waters (at or near 32°F) are underlain by slightly warmer water (about 39°F). This is sometimes referred to as "inverse stratification" and occurs because water is most dense at a temperature of about 39°F. As the lake ice melts in the spring, these stratification cycles are repeated.

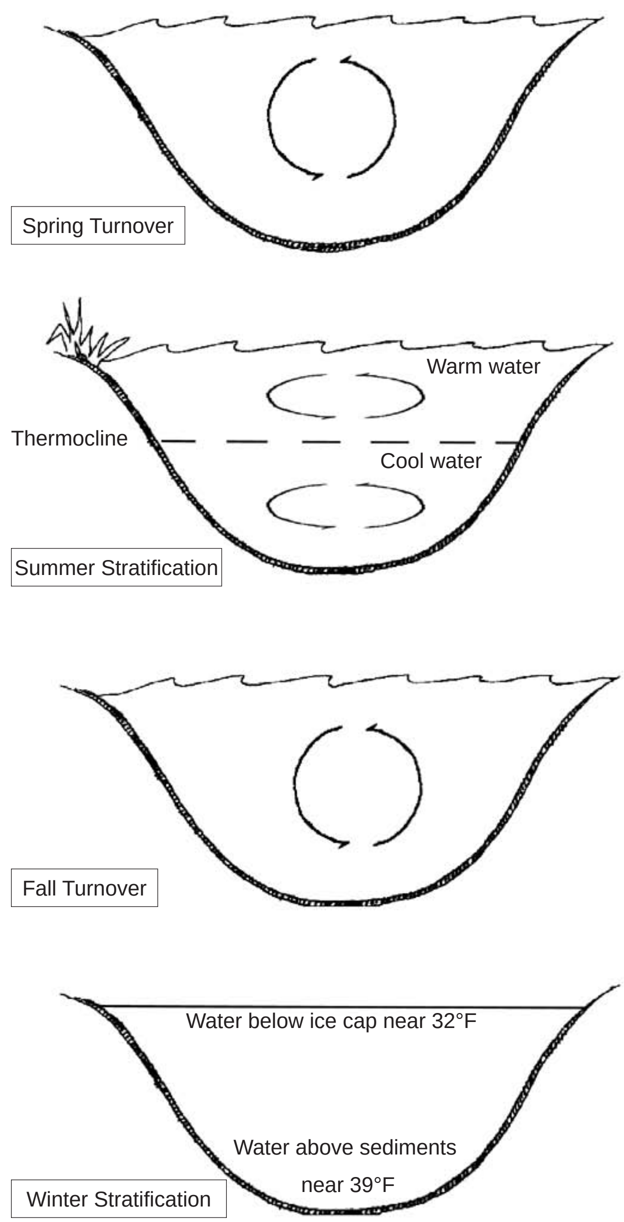

Figure 4. Seasonal thermal stratification cycles.

DISSOLVED OXYGEN

An important factor influencing lake water quality is the quantity of **dissolved oxygen** in the water column. The major inputs of dissolved oxygen to lakes are the atmosphere and photosynthetic activity by aquatic plants. An oxygen level of about 5 mg/L (milligrams per liter, or parts per million) is required to support warm water fish. In lakes deep enough to exhibit thermal stratification, oxygen levels are often reduced or depleted below the thermocline once the lake has stratified. This is because the oxygen has been consumed, in large part, by bacteria that use oxygen as they decompose organic matter (plant and animal remains) at the bottom of the lake. Bottom-water oxygen depletion is a common occurrence in eutrophic and some mesotrophic lakes. Thus, eutrophic and most mesotrophic lakes cannot support cold water fish because the cool, deep water (that the fish require to live) does not contain sufficient oxygen.

PHOSPHORUS

The quantity of **phosphorus** present in the water column is especially important since phosphorus is the nutrient that most often controls aquatic plant growth and the rate at which a lake ages and becomes more eutrophic. By reducing the availability of phosphorus in a lake, it is often possible to control the amount of aquatic plant growth. In general, lakes with a phosphorus concentration of 20 µg/L (micrograms per liter, or parts per billion) or greater are able to support abundant plant growth and are classified as nutrient-enriched or eutrophic.

Phosphorus enters the lake water either from the surrounding watershed, or from the sediments in the lake itself, or both. The input of phosphorus from the watershed is called "external loading," and from the sediments is called "internal loading." External loading occurs when phosphorus washes into the lake from sources such as fertilizers, septic systems, and eroding land. Internal loading occurs when bottom-water oxygen is depleted, resulting in a chemical change in the water near the sediments. The chemical change causes phosphorus to be released from the sediments into the lake where it becomes available as a nutrient for aquatic plants.

CHLOROPHYLL-*a*

Chlorophyll-*a* is a pigment that imparts the green color to plants and algae. A rough estimate of the quantity of algae present in lake water can be made by measuring the amount of chlorophyll-*a* in the water column. A chlorophyll-*a* concentration greater than 6 µg/L is considered characteristic of a eutrophic condition.

SECCHI TRANSPARENCY

A **Secchi disk** is often used to estimate water clarity. The measurement is made by fastening a round, black and white, 8-inch disk to a calibrated line (Figure 5). The disk is lowered over the deepest point of the lake until it is no longer visible, and the depth is noted. The disk is then raised until it reappears. The average between these two depths is the Secchi transparency. Generally, it has been found that aquatic plants can grow at a depth of at least twice the Secchi transparency measurement. In eutrophic lakes, water clarity is often reduced by algae growth in the water column, and Secchi disk readings of 7.5 feet or less are common.

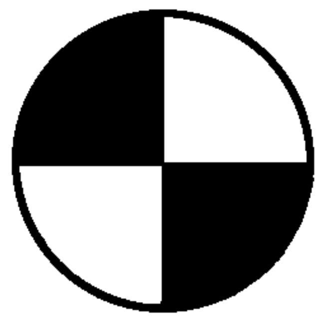

Figure 5. Secchi disk.

Ordinarily, as phosphorus inputs (both internal and external) to a lake increase, the amount of algae the lake can support will also increase. Thus, the lake will exhibit increased chlorophyll-*a* levels and decreased transparency. A summary of lake classification criteria developed by the Michigan Department of Environmental Quality is shown in Table 1.

TABLE 1
LAKE CLASSIFICATION CRITERIA

Lake Classification	Total Phosphorus (µg/L)[1]	Chlorophyll-*a* (µg/L)[1]	Secchi Transparency (feet)
Oligotrophic	Less than 10	Less than 2.2	Greater than 15.0
Mesotrophic	10 to 20	2.2 to 6.0	7.5 to 15.0
Eutrophic	Greater than 20	Greater than 6.0	Less than 7.5

[1] µg/L = micrograms per liter = parts per billion.

pH and TOTAL ALKALINITY

pH is a measure of the amount of acid or base in the water. The pH scale ranges from 0 (acidic) to 14 (alkaline or basic) with neutrality at 7. The pH of most lakes generally ranges from 6 to 9 (Wetzel 1983). Alkalinity is the measure of the pH-buffering capacity of water in that it is the quantitative capacity of water to neutralize an acid.

SAMPLING METHODS

Water quality sampling was conducted in the spring and late summer of 2013 at the two deep basins within Lake Lansing (Figure 6). Temperature was measured using a YSI Model 550A probe. Samples were collected at the surface, mid-depth, and just above the lake bottom with a Kemmerer bottle to be analyzed for dissolved oxygen, pH, total alkalinity, and total phosphorus. Dissolved oxygen samples were fixed in the field and then transported to Progressive AE for analysis using the modified Winkler method (Standard Methods procedure 4500-O C). pH was measured in the field using a YSI EcoSense pH meter. Total alkalinity and total phosphorus samples were placed on ice and transported to Progressive AE and to Prein and Newhof[1], respectively, for analysis. Total alkalinity was titrated at Progressive AE using Standard Methods procedure 2320 B, and total phosphorus was analyzed at Prein and Newhof using Standard Methods procedure 4500-P E. In addition to the depth-interval samples at each deep basin, Secchi transparency was measured and composite chlorophyll-*a* samples were collected from the surface to a depth equal to twice the Secchi transparency. Chlorophyll-*a* samples were analyzed by Prein and Newhof using Standard Methods procedure 10200 H.

Tributary monitoring was conducted in spring for the most significant storm drains and inlet streams (Figure 6). Tributary stream discharge was estimated using the U.S. Geological Survey midsection method (Buchanan and Somers 1969). Stream velocity was measured with a Pygmy Gurley flow meter. Prein and Newhof analyzed samples for total phosphorus.

1 Prein and Newhof Environmental and Soils Laboratory, 3260 Evergreen, NE, Grand Rapids, MI.

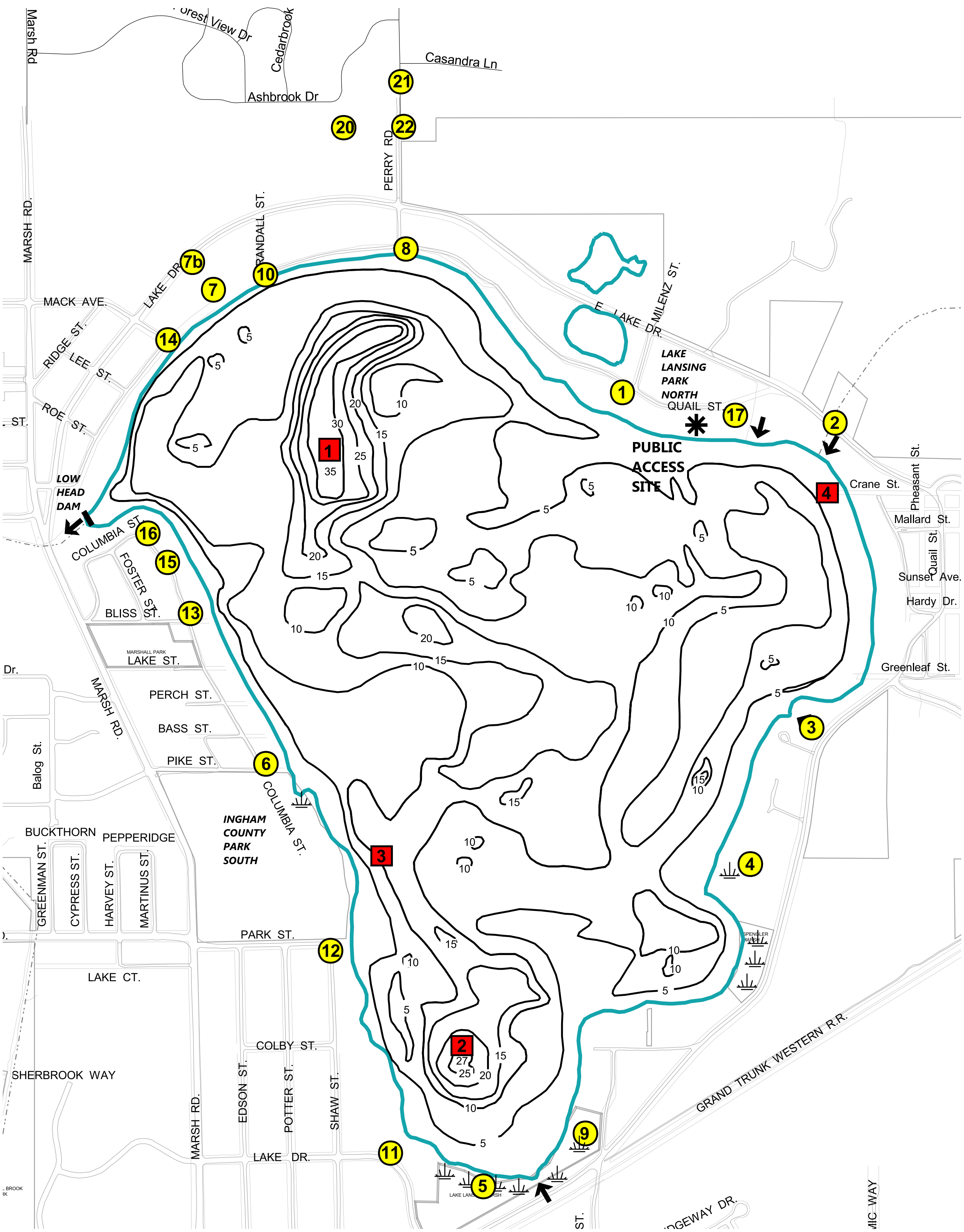

Figure 6. Lake Lansing sampling location map**.** Since 2003, deep basin samples were collected only from sites 1 and 2; storm drain samples were collected from sites 1, 2, 3, 5, and 8.

Sampling Results and Discussion

Sampling results are provided in Tables 2 through 4. A graphic summary of water quality data compiled to date is shown in Figures 7 through 9 and summary statistics are included in Table 5. Historical data for Lake Lansing is contained in Appendix A.

TABLE 2
LAKE LANSING
2013 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L)[1]	pH (S.U.)[2]	Total Alkalinity (mg/L $CaCO_3$)[3]	Total Phosphorus (µg/L)[4]
22-Apr-13	1	1	48	11.1	8.0	113	<5
22-Apr-13	1	15	47	9.5	8.0	114	<5
22-Apr-13	1	30	47	11.0	7.9	112	<5
22-Apr-13	2	1	48	11.6	8.0	114	<5
22-Apr-13	2	12	47	11.5	8.0	118	<5
22-Apr-13	2	24	46	10.5	7.9	109	<5
13-Aug-13	1	1	73	8.0	8.9	115	8
13-Aug-13	1	15	73	7.6	9.0	113	<5
13-Aug-13	1	30	54	3.7	8.3	131	90
13-Aug-13	2	1	72	7.8	9.1	114	23
13-Aug-13	2	10	73	7.7	9.0	114	30
13-Aug-13	2	20	58	2.8	8.2	134	68

TABLE 3
LAKE LANSING
2013 SURFACE WATER QUALITY DATA

Date	Station	Secchi Transparency (feet)	Chlorophyll-*a* (µg/L)[4]
22-Apr-13	1	9.5	0
22-Apr-13	2	9.5	0
13-Aug-13	1	8.5	0
13-Aug-13	2	7.0	1

[1] mg/L = milligrams per liter = parts per million.
[2] S.U. = standard units.
[3] mg/L $CaCO_3$ = milligrams per liter as calcium carbonate.
[4] µg/L = micrograms per liter = parts per billion.

TABLE 4
LAKE LANSING
2013 STORM DRAIN MONITORING DATA

Date	Number	Name	Discharge (cfs)[1]	Total Phosph. (µg/L)[2]	Total Solids (mg/L)[3]	Total Suspended Solids (mg/L)[3]
18-Apr-13	1	Barnhart	1.4	69	204	<4
18-Apr-13	2	Milliman	2.0	52	196	5
18-Apr-13	3	Wallace	1.9	32	208	<4
18-Apr-13	5	South End	1.9	57	180	<4
18-Apr-13	8	Perry Road	0.5	96	480	31
18-Apr-13	18	Marshall Upstream	0.03	178	292	13
18-Apr-13	19	Marshall Downstream	0	69	380	8
13-Aug-13	1	Barnhart	0			
13-Aug-13	2	Milliman	0			
13-Aug-13	3	Wallace	0			
13-Aug-13	5	South End	0			
13-Aug-13	8	Perry Road	0			
13-Aug-13	18	Marshall Upstream	0			
13-Aug-13	19	Marshall Downstream	0			

1 cfs = cubic feet per second.
2 µg/L = micrograms per liter = parts per billion.
3 mg/L = milligrams per liter = parts per million.

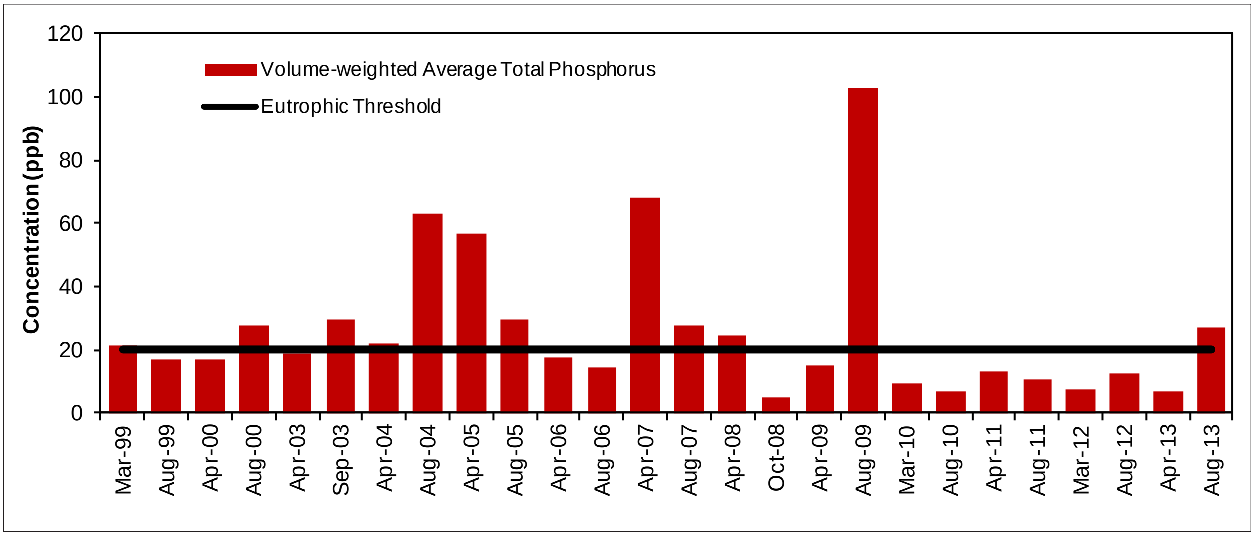

Figure 7. Volume-weighted average total phosphorus concentrations, 1999-2013.

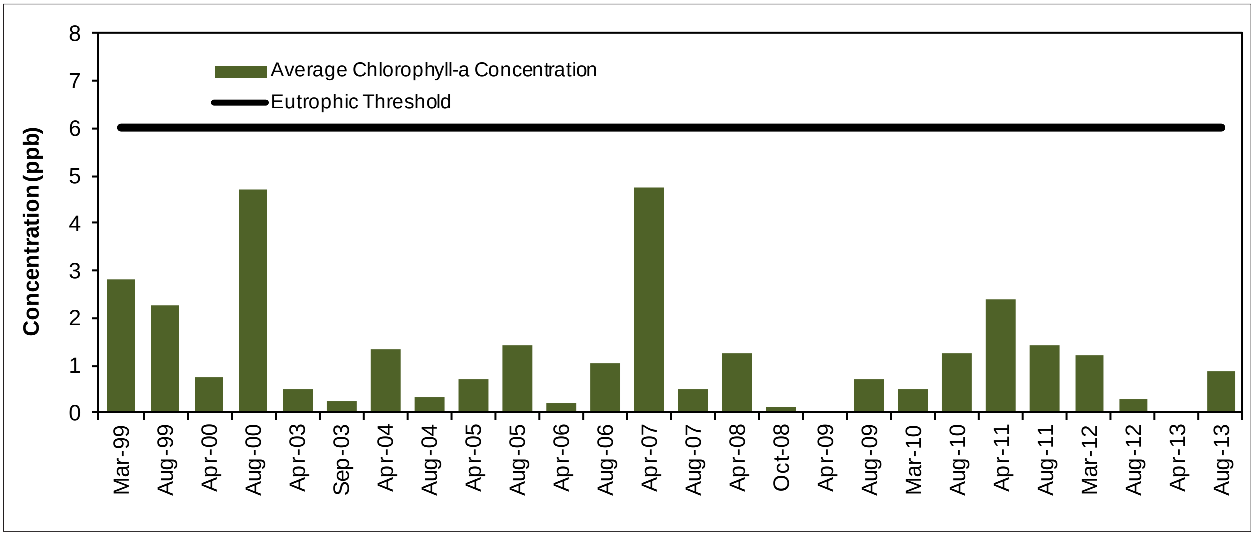

Figure 8. Chlorophyll-*a* concentrations, 1999-2013.

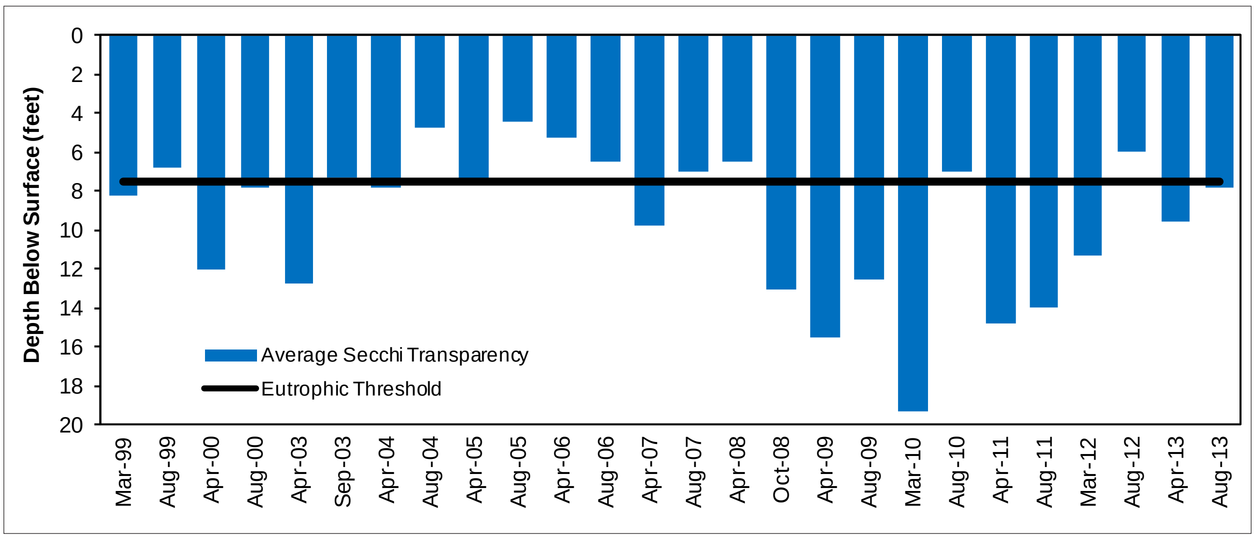

Figure 9. Secchi transparency measurements, 1999-2013.

TABLE 5
LAKE LANSING
SUMMARY STATISTICS (1999-2013)[1]

	Total Phosphorus (µg/L)[2]	Chlorophyll-*a* (µg/L)[2]	Secchi Transparency (feet)
Mean	35	1	9.4
Standard deviation	53	2	3.8
Median	20	1	8.0
Minimum	5	0	4.3
Maximum	364	9	19.5
Number of samples	167	52	52

In April of 2013, sampling was conducted during spring turnover when water temperatures were cool and dissolved oxygen was high. During the August sampling period, Lake Lansing was stratified with the warm surface waters underlain by cool water with lower dissolved oxygen content in the deepest portions of the lake. With the exception of the deep basins in the lake, dissolved oxygen levels throughout the water column of Lake Lansing appear sufficient to sustain warm-water fish during ice-free periods.

Total phosphorus concentrations were generally moderate with elevated concentrations in the bottom of the deep basins in late summer. The elevated bottom-water phosphorus is likely due to internal release of phosphorus from the lake sediments. However, sediment phosphorus release occurs in only the very small portion of the lake and therefore it is unlikely to be a significant loading source to Lake Lansing. Chlorophyll-*a* levels indicate algae growth was low during both sampling periods in 2013, which has generally been the case since sampling began in 1999. Water clarity was good in spring and moderate in late summer. Water clarity steadily improved in Lake Lansing from 2005 through the spring of 2010, and while still good, has declined since 2010. The improved clarity is likely related to the presence of zebra mussels which consume algae and often increase water clarity. It may be that zebra mussels are in decline resulting in reduced clarity. In general, plants can grow to a depth of about twice the Secchi transparency reading. With a median Secchi transparency of 8 feet, the clarity of Lake Lansing is sufficient to allow sunlight to penetrate to about 16 feet of depth, which is over 90 percent of the lake bottom, making nearly all of Lake Lansing habitable for plant growth.

Tributary samples were collected in spring of 2013, but all tributary in-flow to Lake Lansing ceased by late summer. During spring, phosphorus levels were elevated at all sites, likely due to increased precipitation which resulted in the slightly elevated discharge (flow) rates. Although springtime discharge was higher than in previous years, the maximum discharge measured was only 2 cubic feet per second indicating only a small volume of water drains to Lake Lansing from the tributary streams and drains. Thus, the overall load of pollutants into Lake Lansing from the inlets is low. Nevertheless, nutrients carried to the lake likely stimulate localized aquatic plant growth.

Summary statistics indicate Lake Lansing is borderline between mesotrophic (moderately productive) and eutrophic (nutrient-enriched and productive). Phosphorus levels range from moderate to high with the median phosphorus concentration at the eutrophic threshold of 20 parts per billion. Bottom-water oxygen is reduced, and water clarity is moderate but has been improving in recent years as discussed above. Rooted plant growth in Lake Lansing is generally dense and algae growth is generally moderate or low, thus it would appear that phosphorus is more readily used by rooted plants in the lake rather than algae.

[1] Summary statistics include data from sampling stations 1 and 2 only. Historically, samples were also collected from two additional stations near the shoreline, but only deep basin data is included in this analysis.
[2] µg/L = micrograms per liter = parts per billion.

Nuisance Aquatic Plant Control

The focus of the plant control program in Lake Lansing is control of exotic (i.e., non-native) plants such as Eurasian milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*), and control of native plants that reach nuisance densities. On May 1, 2013, the herbicide fluridone was applied throughout Lake Lansing at 6 parts per billion in order to control Eurasian milfoil. On May 21, the lake was re-treated to bring the concentration of fluridone in the lake back up to 6 parts per billion. In early July, 35 acres of Lake Lansing were harvested to control nuisance growth of primarily Elodea (*Elodea canadensis*).

On August 13, the lake was surveyed using the Department of Natural Resources and Environment's *Procedures for Aquatic Vegetation Surveys*. Lake Lansing was segmented into 70 survey sites and the type and density of plants at each site was recorded (Table 6). The fluridone treatment successfully controlled Eurasian milfoil in Lake Lansing and none was found during the August survey.

TABLE 6
LAKE LANSING AQUATIC PLANT FREQUENCY AND DENSITY
AUGUST 13, 2013

		Number of Survey Sites Where Plant Was Found by Density			
Common Name	**Scientific Name**	**Rare**	**Sparse**	**Common**	**Dense**
Wild celery	*Vallisneria americana*	1	37	22	1
Chara	*Chara* sp.	1	37	18	
Flat-stem pondweed	*Potamogeton zosteriformis*	1	30	4	
Thin-leaf pondweed	*Potamogeton* sp.		23	5	
Elodea	*Elodea canadensis*		14	2	
Cattail	*Typha* sp.		1	5	6
Large-leaf pondweed	*Potamogeton amplifolius*	3	8		
Illinois pondweed	*Potamogeton illinoensis*	2	8		
Yellow waterlily	*Nuphar* sp.	1	4	3	
Coontail	*Ceratophyllum demersum*	3	2		
Starry stonewort	*Nitellopsis obtusa*		4		
Robbins pondweed	*Potamogeton robbinsii*		1	2	
Richardson's pondweed	*Potamogeton richardsonii*	2	1		
Naiad	*Najas* sp.		3		
Arrowhead	*Sagittaria latifolia*		2	1	
White waterlily	*Nymphaea odorata*	1	1		
Curly-leaf pondweed	*Potamogeton crispus*	1			
Whitestem pondweed	*Potamogeton praelongus*		1		
Floating-leaf pondweed	*Potamogeton natans*		1		

During the August survey, nineteen aquatic plant species were found. Wild celery, Chara, flat-stem pondweed, thin-leaf pondweed, and Elodea were the most common plants. Of concern was the occurrence of non-native plant starry stonewort which has become a severe nuisance plant in several Michigan lakes. Starry stonewort looks like a rooted plant but is actually an algae, similar in appearance to the native plant Chara (Figure 10). However, unlike Chara, starry stonewort can grow in mats several feet thick which can interfere with navigation, recreational use, and may interfere with fish spawning habitat. It will be important to monitor and control the spread of starry stonewort in the future.

Figure 10. Chara (left) and starry stonewort (right).

Watershed Improvements

In recent years, several storm drain modifications have been implemented to reduce watershed pollution inputs. In 2013, storm drain improvements was directed toward a pipe that runs along the south side of Lake Lansing Road, continues across the lawn toward the south end of Lake Lansing Park South before emptying into Lake Lansing (Figure 11). In order to treat the stormwater before it drains to the lake, the pipe was removed and replaced with a bioswale (Figure 12). A bioswale is a shallow drainage ditch that uses plants to uptake nutrients from runoff, and uses check dams to slow the rate of runoff. Thus, instead of nutrients and sediments draining directly to Lake Lansing, the runoff is now filtered before it makes its way to the lake.

Figure 11. Lake Lansing Park South area before bioswale construction.

Figure 12. Lake Lansing Park South installed bioswale.

In 2013, the Advisory Committee supported the Mid-Michigan Stewardship Initiative and Ingham County Parks in their ongoing efforts to control the invasive non-native wetland plant Phragmites (*Phragmites australis*) in the Lake Lansing watershed (Figure 13). Seventy sites were treated with herbicides to control Phragmites. The Mid-Michigan Stewardship Initiative has reported almost one-third of the of the treated sites have reduced Phragmites occurence to less than five percent of the original infestation.

The Advisory Committee is also continuing to work with Meridian Township and Clinton County to reduce runoff from Perry Road. The Clinton County portion of Perry Road was paved during the summer of 2013. Although pavement can hasten the rate at which water flows downstream, it is expected that the amount of sediment and phosphorus that is transported to Lake Lansing from the Perry Road storm drains will be reduced from the previously unpaved portions of the road. Ingham County also intends to pave the Meridian Township portion of Perry Road in the future.

Figure 13. Phragmites control in Lake Lansing watershed.

Appendix A

Lake Lansing

Historical Water Quality Data

TABLE A1
LAKE LANSING
1999-2012 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L)[1]	pH (S.U.)[2]	Total Alkalinity (mg/L $CaCO_3$)[3]	Total Phosphorus (µg/L)[4]
29-Mar-99	1	1	44.0	12.9	8.4	124	20
29-Mar-99	1	5	44.0	11.9			
29-Mar-99	1	10	44.0	11.6			
29-Mar-99	1	15	44.5	12.9	8.3	122	20
29-Mar-99	1	20	44.5	13.4			
29-Mar-99	1	25	44.5	12.5			
29-Mar-99	1	30	44.5	13.8	8.3	127	22
29-Mar-99	2	1	44.5	12.2	8.2	127	22
29-Mar-99	2	6	44.5	13.4			
29-Mar-99	2	12	44.5	12.6	8.4	128	23
29-Mar-99	2	18	44.5	12.6			
29-Mar-99	2	23	44.5	12.3	8.2	126	23
29-Mar-99	3	1	44.0	12.6	7.9	130	25
29-Mar-99	4	1	44.5	12.7	8.4	126	27
11-Aug-99	1	1	73.1	8.0	8.3	114	14
11-Aug-99	1	5	72.8	8.0			
11-Aug-99	1	10	72.5	7.3			
11-Aug-99	1	15	72.0	7.4	8.4	116	20
11-Aug-99	1	20	71.0	6.6			
11-Aug-99	1	25	60.0	1.3			
11-Aug-99	1	30	58.0	0.8	7.2	172	56
11-Aug-99	2	1	73.2	8.2	8.4	104	17
11-Aug-99	2	6	72.5	8.4			
11-Aug-99	2	12	72.0	7.0	8.3	115	20
11-Aug-99	2	18	69.0	2.4			
11-Aug-99	2	23	56.5	1.1	7.5	130	40
11-Aug-99	3	1	72.5	8.0	8.5	115	22
11-Aug-99	4	1	74.0	8.1	8.4	118	18

1 mg/L = milligrams per liter = parts per million.
2 S.U. = standard units.
3 mg/L $CaCO_3$ = milligrams per liter as calcium carbonate.
4 µg/L = micrograms per liter = parts per billion.

TABLE A1 (continued)
LAKE LANSING
1999-2012 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L)[1]	pH (S.U.)[2]	Total Alkalinity (mg/L $CaCO_3$)[3]	Total Phosphorus (µg/L)[4]
17-Apr-00	1	1	50.0	10.9	8.7	132	14
17-Apr-00	1	5	50.0	10.8			24
17-Apr-00	1	10	50.0	10.9			28
17-Apr-00	1	15	50.0	10.8	8.4	133	27
17-Apr-00	1	20	50.0	10.8			19
17-Apr-00	1	25	50.0	10.7			19
17-Apr-00	1	30	50.0	10.8	8.4	130	13
17-Apr-00	2	1	50.7	10.7	8.4	119	11
17-Apr-00	2	6	50.9	10.6			15
17-Apr-00	2	12	50.7	10.4	8.4	131	29
17-Apr-00	2	18	50.7	10.3			13
17-Apr-00	2	23	50.5	10.6	8.5	127	11
10-Aug-00	1	1	75.9	7.9	8.8	132	25
10-Aug-00	1	5	75.9	7.7			27
10-Aug-00	1	10	75.7	7.9			20
10-Aug-00	1	15	75.2	7.5	7.9	110	20
10-Aug-00	1	20	71.8	3.5			35
10-Aug-00	1	25	61.9	0.4			184
10-Aug-00	1	30	58.3	0.5	7.6	160	71
10-Aug-00	2	1	76.1	8.4	8.8	143	20
10-Aug-00	2	6	75.9	8.3			20
10-Aug-00	2	12	74.1	6.2	8.6	128	27
10-Aug-00	2	18	67.1	0.9			232
10-Aug-00	2	24	57.2	1.2	7.6	169	93
7-Apr-03	1	1	40.5	12.2			16
7-Apr-03	1	14	40.3	12.4			
7-Apr-03	1	28	40.6	11.8			23
7-Apr-03	2	1	39.7	11.8			23
7-Apr-03	2	9	39.7	11.7			28
7-Apr-03	2	18	39.6	11.7			34

1 mg/L = milligrams per liter = parts per million.
2 S.U. = standard units.
3 mg/L $CaCO_3$ = milligrams per liter as calcium carbonate.
4 µg/L = micrograms per liter = parts per billion.

TABLE A1 (continued)
LAKE LANSING
1999-2012 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L)[1]	pH (S.U.)[2]	Total Alkalinity (mg/L $CaCO_3$)[3]	Total Phosphorus (µg/L)[4]
11-Sept-03	1	1	74.8	8.1			28
11-Sept-03	1	13	70.7	6.7			36
11-Sept-03	1	25	63.5	0.0			198
11-Sept-03	2	1	74.3	8.5			18
11-Sept-03	2	11	70.5	8.1			41
11-Sept-03	2	21	65.3	0.0			79
12-Apr-04	1	1	47	11.9	8.6	123	26
12-Apr-04	1	15	47	11.8	8.6	121	32
12-Apr-04	1	30	47	11.6	8.7	122	31
12-Apr-04	2	1	47	12.1	8.7	125	17
12-Apr-04	2	11	47	12.1	8.7	120	17
12-Apr-04	2	22	46	11.5	8.6	125	27
30-Aug-04	1	1	73	7.3			11
30-Aug-04	1	15	73	7.1			12
30-Aug-04	1	30	59	1.2			39
30-Aug-04	2	1	72	7.3			116
30-Aug-04	2	10	72	7.3			127
30-Aug-04	2	21	62	0.5			9
5-Apr-05	1	1	47	10.8		149	71
5-Apr-05	1	14	46	10.4		149	44
5-Apr-05	1	28	44	10.8		151	37
5-Apr-05	2	1	47	11.0		137	44
5-Apr-05	2	11	47	10.6		151	44
5-Apr-05	2	22	44	10.6		154	123

1 mg/L = milligrams per liter = parts per million.
2 S.U. = standard units.
3 mg/L $CaCO_3$ = milligrams per liter as calcium carbonate.
4 µg/L = micrograms per liter = parts per billion.

TABLE A1 (continued)
LAKE LANSING
1999-2012 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L)[1]	pH (S.U.)[2]	Total Alkalinity (mg/L $CaCO_3$)[3]	Total Phosphorus (µg/L)[4]
26-Aug-05	1	1	75	8.5	9.3	106	30
26-Aug-05	1	14	72	7.0	8.8	118	30
26-Aug-05	1	28	57	2.3	8.1	169	53
26-Aug-05	2	1	75	9.6	9.4	105	30
26-Aug-05	2	12	72	7.1	9.3	126	29
26-Aug-05	2	23	61	0.3	8.9	134	29
3-Apr-06	1	1	46	11.4	8.1	125	15
3-Apr-06	1	15	46	8.6	8.2	121	12
3-Apr-06	1	29	45	9.3	8.1	125	38
3-Apr-06	2	1	47	9.9	8.2	123	22
3-Apr-06	2	11	46	9.8	8.1	125	19
3-Apr-06	2	22	46	10.6	8.4	123	22
11-Aug-06	1	1	75	7.0	8.8	108	12
11-Aug-06	1	15	74	5.6	8.6	113	23
11-Aug-06	1	30	64	1.7	7.9	130	17
11-Aug-06	2	1	75	7.5	8.8	106	11
11-Aug-06	2	12	72	6.8	8.7	104	21
11-Aug-06	2	24	65	1.1	7.8	130	47

1 mg/L = milligrams per liter = parts per million.
2 S.U. = standard units.
3 mg/L $CaCO_3$ = milligrams per liter as calcium carbonate.
4 µg/L = micrograms per liter = parts per billion.

TABLE A1 (continued)
LAKE LANSING
1999-2012 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L)[1]	pH (S.U.)[2]	Total Alkalinity (mg/L $CaCO_3$)[3]	Total Phosphorus (µg/L)[4]
16-Apr-07	1	1	42	12.9	8.1	128	73
16-Apr-07	1	15	43	12.6	7.9	128	60
16-Apr-07	1	30	42	10.5	8.0	125	67
16-Apr-07	2	1	43	10.9	8.0	128	63
16-Apr-07	2	11	43	11.1	7.9	130	73
16-Apr-07	2	22	43	12.0	7.9	127	64
30-Aug-07	1	1	77	8.8	9.1	127	19
30-Aug-07	1	14	74	6.7	8.7	128	23
30-Aug-07	1	28	58	0.5	8.1	148	35
30-Aug-07	2	1	77	8.4	9.0	124	37
30-Aug-07	2	12	76	8.2	8.9	121	31
30-Aug-07	2	23	60	0.2	7.9	142	39
7-Apr-08	1	1	50	11.0	8.4	139	28
7-Apr-08	1	15	49	11.2	8.3	135	30
7-Apr-08	1	30	48	11.5	8.3	137	19
7-Apr-08	2	1	48	11.4	8.3	135	20
7-Apr-08	2	12	48	11.3	8.3	138	23
7-Apr-08	2	24	46	11.5	8.2	135	23
14-Oct-08	1	1	63	9.4	9.2	112	<5
14-Oct-08	1	15	60	9.3	9.2	113	<5
14-Oct-08	1	30	58	7.0	8.8	116	<5
14-Oct-08	2	1	62	9.3	9.2	111	<5
14-Oct-08	2	12	61	9.6	9.2	109	<5
14-Oct-08	2	24	59	8.5	9.0	108	<5

1 mg/L = milligrams per liter = parts per million.
2 S.U. = standard units.
3 mg/L $CaCO_3$ = milligrams per liter as calcium carbonate.
4 µg/L = micrograms per liter = parts per billion.

TABLE A1 (continued)
LAKE LANSING
1999-2012 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L)[1]	pH (S.U.)[2]	Total Alkalinity (mg/L $CaCO_3$)[3]	Total Phosphorus (µg/L)[4]
14-Apr-09	1	1	46	11.3	9.3	123	29
14-Apr-09	1	16	46	11.3	9.3	123	6
14-Apr-09	1	32	46	9.4	9.3	123	<5
14-Apr-09	2	1	47	11.5	9.3	124	<5
14-Apr-09	2	13	47	11.5	9.3	123	<5
14-Apr-09	2	26	47	11.4	9.3	125	14
26-Aug-09	1	1	74	8.1	8.6	115	20
26-Aug-09	1	16	74	8.3	8.5	112	20
26-Aug-09	1	32	73	1.6	7.7	115	208
26-Aug-09	2	1	74	7.8	8.4	106	274
26-Aug-09	2	10	74	8.0	8.5	113	6
26-Aug-09	2	20	71	2.5	8.1	119	16
30-Mar-10	1	1	46	10.6	8.1	127	6
30-Mar-10	1	15	44	11.0	7.8	129	14
30-Mar-10	1	30	44	10.8	7.5	128	6
30-Mar-10	2	1	45	11.2	7.9	128	12
30-Mar-10	2	12	44	10.3	7.9	130	11
30-Mar-10	2	24	43	10.7	7.9	129	6
31-Aug-10	1	1	78	8.6	8.2	125	<5
31-Aug-10	1	15	75	7.3	8.3	125	<5
31-Aug-10	1	30	58	1.1	7.3	160	327
31-Aug-10	2	1	77	9.4	8.2	120	<5
31-Aug-10	2	12	74	8.4	8.3	124	<5
31-Aug-10	2	24	59	0.5	6.9	176	26

1 mg/L = milligrams per liter = parts per million.
2 S.U. = standard units.
3 mg/L $CaCO_3$ = milligrams per liter as calcium carbonate.
4 µg/L = micrograms per liter = parts per billion.

TABLE A1 (continued)
LAKE LANSING
1999-2012 DEEP BASIN WATER QUALITY DATA

Date	Station	Sample Depth (feet)	Temperature (°F)	Dissolved Oxygen (mg/L)[1]	pH (S.U.)[2]	Total Alkalinity (mg/L $CaCO_3$)[3]	Total Phosphorus (µg/L)[4]
13-Apr-11	1	1	52	11.3	8.6	112	15
13-Apr-11	1	15	51	11.0	8.6	113	7
13-Apr-11	1	30	51	11.0	8.6	118	20
13-Apr-11	2	1	51	10.8	8.5	117	17
13-Apr-11	2	13	51	10.7	8.5	116	<5
13-Apr-11	2	26	50	11.0	8.5	119	8
22-Aug-11	1	1	76	7.9	8.7	97	9
22-Aug-11	1	15	76	6.9	8.5	107	<5
22-Aug-11	1	30	59	4.8	8.1	112	40
22-Aug-11	2	1	76	7.8	8.6	99	13
22-Aug-11	2	11	75	7.8	8.2	106	8
22-Aug-11	2	22	61	4.1	8.0	97	32
19-Mar-12	1	1	59	10.4	8.5	108	10
19-Mar-12	1	15	49	12.3	8.6	113	8
19-Mar-12	1	30	46	10.3	8.4	119	<5
19-Mar-12	2	1	57	11.6	8.6	105	<5
19-Mar-12	2	11	49	12.3	8.6	114	<5
19-Mar-12	2	22	45	11.6	8.5	105	<5
16-Aug-12	1	1	74	8.8	9.0	115	12
16-Aug-12	1	15	72	6.0	8.5	118	13
16-Aug-12	1	30	56	0.3	7.7	146	364
16-Aug-12	2	1	75	8.8	9.0	115	6
16-Aug-12	2	11	72	6.0	8.5	117	9
16-Aug-12	2	22	67	2.1	7.9	122	73

1 mg/L = milligrams per liter = parts per million.
2 S.U. = standard units.
3 mg/L $CaCO_3$ = milligrams per liter as calcium carbonate.
4 µg/L = micrograms per liter = parts per billion.

TABLE A2
LAKE LANSING
1999-2012 SURFACE WATER QUALITY DATA

Date	Station	Secchi Transparency (feet)	Chlorophyll-*a* (µg/L)[1]
29-Mar-99	1	9.0	3.8
29-Mar-99	2	7.5	1.8
29-Mar-99	3	5.0	2.8
29-Mar-99	4	5.0	
11-Aug-99	1	7.0	3.8
11-Aug-99	2	6.5	0.8
11-Aug-99	3	7.0	1.1
11-Aug-99	4	6.0	1.3
17-Apr-00	1	13.5	1.1
17-Apr-00	2	10.5	0.5
10-Aug-00	1	8.5	2.9
10-Aug-00	2	7.0	6.5
07-Apr-03	1	13.5	1.1
07-Apr-03	2	12.0	0
11-Sept-03	1	7.0	0.5
11-Sept-03	2	7.5	0
12-Apr-04	1	8.0	1
12-Apr-04	2	7.5	2
30-Aug-04	1	4.5	1
30-Aug-04	2	5.0	0
5-Apr-05	1	8.0	1
5-Apr-05	2	7.0	0
26-Aug-05	1	4.3	2
26-Aug-05	2	4.5	1

1 µg/L = micrograms per liter = parts per billion.

TABLE A2 (continued)
LAKE LANSING
1999-2012 SURFACE WATER QUALITY DATA

Date	Station	Secchi Transparency (feet)	Chlorophyll-*a* (µg/L)[1]
3-Apr-06	1	5.5	0
3-Apr-06	2	5.0	0
11-Aug-06	1	6.0	1
11-Aug-06	2	7.0	1
10-Apr-07	1	10.0	0
10-Apr-07	2	9.5	9
30-Aug-07	1	6.5	1
30-Aug-07	2	7.5	0
7-Apr-08	1	6.0	1
7-Apr-08	2	7.0	2
14-Oct-08	1	12.5	0
14-Oct-08	2	13.5	0
14-Apr-09	1	13.0	0
14-Apr-09	2	18.0	0
26-Aug-09	1	12.0	1
26-Aug-09	2	13.0	0
30-Mar-10	1	19.5	1
30-Mar-10	2	19.0	0
31-Aug-10	1	7.0	2
31-Aug-10	2	7.0	1
13-Apr-11	1	13.5	3
13-Apr-11	2	16.0	2
22-Aug-11	1	14.0	0
22-Aug-11	2	14.0	3
19-Mar-12	1	11.0	1
19-Mar-12	2	11.5	2
16-Aug-12	1	6.0	0
16-Aug-12	2	6.0	1

1 µg/L = micrograms per liter = parts per billion.

TABLE A3
LAKE LANSING
1999-2012 STORM DRAIN MONITORING DATA

Date	Number	Name	Discharge (cfs)[1]	Total Phosphorus (µg/L)[2]	*E. coli* per 100 mL[3]
22-Apr-99	1	Barnhart		51	120
22-Apr-99	2	Milliman			40
22-Apr-99	3	Wallace		71	280
22-Apr-99	5	South End			460
22-Apr-99	7	Condos		100	60
22-Apr-99	7b	Condos Upstream			10
22-Apr-99	8	Perry Road			320
22-Apr-99	9	Carlton		43	80
22-Apr-99	14	Mack Street		190	34,000
12-Apr-00	1	Barnhart	0.1		4
12-Apr-00	2	Milliman	1.1		12
12-Apr-00	3	Wallace	0.03		4
12-Apr-00	8	Perry Road	0		3
12-Apr-00	9	Carlton	0		2
12-Apr-00	11	New Condos	0		19
23-Apr-00	1	Barnhart		65	
23-Apr-00	2	Milliman		41	60
23-Apr-00	3	Wallace		23	40
23-Apr-00	5	South End		53	50
23-Apr-00	8	Perry Road		44	110
23-Apr-00	9	Carlton		16	60
23-Apr-00	11	New Condos			10
10-Apr-03	1	Barnhart	0	249	25
10-Apr-03	2	Milliman	1.2	92	20
10-Apr-03	3	Wallace	2.2	50	21
10-Apr-03	5	South End	0	77	9
10-Apr-03	8	Perry Road	0.04	71	91

1 cfs = cubic feet per second.
2 µg/L = micrograms per liter = parts per billion.
3 mL = milliliters.

TABLE A3 (continued)
LAKE LANSING
1999-2012 STORM DRAIN MONITORING DATA

Date	Number	Name	Discharge (cfs)[1]	Total Phosphorus (µg/L)[2]	*E. coli* per 100 mL[3]
12-Apr-04	1	Barnhart	0.2	36	14
12-Apr-04	2	Milliman	0.4	34	23
12-Apr-04	3	Wallace	0.2	53	<1
12-Apr-04	5	South End	0	44	<1
12-Apr-04	8	Perry Road	0	165	<1
11-May-04	1	Barnhart	4.8	131	249
11-May-04	2	Milliman	1.3	109	157
11-May-04	3	Wallace	0.8	203	816
11-May-04	5	South End	0.7	161	99
11-May-04	8	Perry Road	0.4	195	2,420
29-Jun-04	1	Barnhart	0.9	164	15
29-Jun-04	2	Milliman	0		
29-Jun-04	3	Wallace	0.1	29	62
29-Jun-04	5	South End	0		
29-Jun-04	8	Perry Road	0		
5-Apr-05	1	Barnhart	1.4	141	<1
5-Apr-05	2	Milliman	1.2	62	27
5-Apr-05	3	Wallace	1.2	55	16
5-Apr-05	5	South End	0.5	214	14
5-Apr-05	7	Condos	0		
5-Apr-05	8	Perry Road	0		
5-Apr-05	14	Mack Avenue	0		

1 cfs = cubic feet per second.
2 µg/L = micrograms per liter = parts per billion.
3 mL = milliliters.

TABLE A3 (continued)
LAKE LANSING
1999-2012 STORM DRAIN MONITORING DATA

Date	Number	Name	Discharge (cfs)[1]	Total Phosphorus (µg/L)[2]	*E. coli* per 100 mL[3]
27-Apr-05	1	Barnhart	0.5	58	17
27-Apr-05	2	Milliman	2.3	39	98
27-Apr-05	3	Wallace	0.7	45	29
27-Apr-05	5	South End	0	45	91
27-Apr-05	7	Condos	0		
27-Apr-05	8	Perry Road	0	78	17
28-Mar-06	1	Barnhart	1.8	24	40
28-Mar-06	2	Milliman	0.9	19	11
28-Mar-06	3	Wallace	0.2	19	4
28-Mar-06	5	South End	0	35	1
28-Mar-06	8	Perry Road	0	48	99
3-Apr-06	1	Barnhart	0.5	33	54
3-Apr-06	2	Milliman	1.0	31	3
3-Apr-06	3	Wallace	0.2	21	41
3-Apr-06	5	South End	0	48	
3-Apr-06	8	Perry Road	0	79	
27-Apr-06	1	Barnhart	0.1	51	82
27-Apr-06	2	Milliman	0.1	63	24
27-Apr-06	3	Wallace	0.1	13	199
27-Apr-06	5	South End	0	86	1
27-Apr-06	8	Perry Road	0	27	26
12-Sep-06	1	Barnhart	0		
12-Sep-06	2	Milliman	0		
12-Sep-06	3	Wallace	0		
12-Sep-06	5	South End	0	21	34
12-Sep-06	8	Perry Road	0	336	525

1 cfs = cubic feet per second.
2 µg/L = micrograms per liter = parts per billion.
3 mL = milliliters.

TABLE A3 (continued)
LAKE LANSING
1999-2012 STORM DRAIN MONITORING DATA

Date	Number	Name	Discharge (cfs)[1]	Total Phosphorus (µg/L)[2]	*E. coli* per 100 mL[3]
26-Mar-07	1	Barnhart	1.4	61	7
26-Mar-07	2	Milliman	2.6	80	12
26-Mar-07	3	Wallace	1.6	56	10
26-Mar-07	5	South End	0.9	77	21
26-Mar-07	8	Perry Road	0	99	866
10-Apr-07	1	Barnhart	1.2	62	1
10-Apr-07	2	Milliman	0.7	75	4
10-Apr-07	3	Wallace	0.4	61	8
10-Apr-07	5	South End	0	115	11
10-Apr-07	8	Perry Road	0	80	16
16-Apr-07	1	Barnhart		85	
16-Apr-07	2	Milliman		63	
16-Apr-07	3	Wallace		62	
16-Apr-07	5	South End	0	87	
16-Apr-07	8	Perry Road	0	87	
30-Aug-07	1	Barnhart	0		
30-Aug-07	2	Milliman	0		
30-Aug-07	3	Wallace	0		
30-Aug-07	5	South End	0	281	42
30-Aug-07	8	Perry Road	0	178	249

1 cfs = cubic feet per second.
2 µg/L = micrograms per liter = parts per billion.
3 mL = milliliters.

TABLE A3 (continued)
LAKE LANSING
1999-2012 STORM DRAIN MONITORING DATA

Date	Number	Name	Discharge (cfs)[1]	Total Phosphorus (µg/L)[2]	*E. coli* per 100 mL[3]
7-Apr-08	1	Barnhart	0.6	62	6
7-Apr-08	2	Milliman	0.8	37	11
7-Apr-08	3	Wallace	1.4	23	26
7-Apr-08	5	South End	0	37	11
7-Apr-08	8	Perry Road	0	59	33
14-Apr-08	1	Barnhart		14	22
14-Apr-08	2	Milliman	1.4	16	15
14-Apr-08	3	Wallace	2.4	5	23
14-Apr-08	5	South End		16	6
14-Apr-08	8	Perry Road	0	23	16
12-May-08	1	Barnhart	0.7	61	26
12-May-08	2	Milliman	0.8	46	326
12-May-08	3	Wallace	0.3	6	205
12-May-08	5	South End	0	110	53
12-May-08	8	Perry Road	0	69	147
12-May-08	18	Marshall Upstream	0	67	461
12-May-08	19	Marshall Downstream	0		
14-Oct-08	1	Barnhart	0.1	123	33
14-Oct-08	2	Milliman	0	276	108
14-Oct-08	3	Wallace	0	83	12
14-Oct-08	5	South End	0	526	91
14-Oct-08	8	Perry Road	0	134	194
14-Oct-08	18	Marshall Upstream	0	276	206
14-Oct-08	19	Marshall Downstream	0	5	37

1 cfs = cubic feet per second.
2 µg/L = micrograms per liter = parts per billion.
3 mL = milliliters.

TABLE A3 (continued)
LAKE LANSING
1999-2012 STORM DRAIN MONITORING DATA

Date	**Number**	**Name**	**Discharge (cfs)**[1]	**Total Phosphorus (µg/L)**[2]	***E. coli* per 100 mL**[3]
14-Apr-09	1	Barnhart	0.2	<5	16
14-Apr-09	2	Milliman	0.4	5	10
14-Apr-09	3	Wallace	0.4	<5	50
14-Apr-09	5	South End	0.2	14	1
14-Apr-09	8	Perry Road	0	25	41
14-Apr-09	14	Mack Avenue	0	146	81
14-Apr-09	18	Marshall Upstream	0	111	345
14-Apr-09	19	Marshall Downstream	0	76	28
20-Aug-09	1	Barnhart		37	290.9
20-Aug-09	2	Milliman		349	
20-Aug-09	3	Wallace		38	
20-Aug-09	5	South End		137	
20-Aug-09	8	Perry Road		27	78.5
20-Aug-09	18	Marshall Upstream		94	2419.2
20-Aug-09	19	Marshall Downstream		<5	
23-Oct-09	20	Meadowbrook Sub Ashbrook Dr		<5	
23-Oct-09	21	Perry Road between county line and Ashbrook Dr		374	

1 cfs = cubic feet per second.
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TABLE A3 (continued)
LAKE LANSING
1999-2012 STORM DRAIN MONITORING DATA

Date	Site	Name	Discharge (cfs)[1]	Total Phos. (μg/L)[2]	Total Solids (mg/L)[3]	Total Susp. Solids (mg/L)
30-Mar-10	1	Barnhart		27	392	<4
30-Mar-10	2	Milliman	0.5	21	336	<4
30-Mar-10	3	Wallace	0.6	9	316	<4
30-Mar-10	5	South End	0	32	360	<4
30-Mar-10	8	Perry Road	0	33	452	14
6-Apr-10	20	Meadowbrook Sub.		98		
7-Apr-10	20	Meadowbrook Sub.		37	228	7.27
7-Apr-10	21	Perry Road between county line and Ashbrook		54		
16-Sep-10	20	Meadowbrook Sub.		583		24
22-Sep-10	20	Meadowbrook Sub.		162		10
22-Sep-10	22	Perry Road Buried Manhole #107		218		20
13-Apr-11	1	Barnhart	1.6	67		
13-Apr-11	2	Milliman	0.6	26		
13-Apr-11	3	Wallace	0.6	33		
13-Apr-11	5	South End	0	92		
13-Apr-11	8	Perry Road	0	30		
22-Aug-11	1	Barnhart	0	9980		
22-Aug-11	2	Milliman	0	166		
22-Aug-11	3	Wallace	0			
22-Aug-11	5	South End	0	1260		
22-Aug-11	8	Perry Road	0	38		
22-Aug-11	18	Marshall Upstream				
22-Aug-11	19	Marshall Downstream				

1 cfs = cubic feet per second.
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3 mg/L = milligrams per liter.

TABLE A3 (continued)
LAKE LANSING
1999-2012 STORM DRAIN MONITORING DATA

Date	Site	Name	Discharge (cfs)[1]	Total Phos. (µg/L)[2]	Total Solids (mg/L)[3]	Total Susp. Solids (mg/L)
19-Mar-12	1	Barnhart	0.4	100	836	28
19-Mar-12	2	Milliman	1.6	25	192	<4
19-Mar-12	3	Wallace	0.2	20	524	<4
19-Mar-12	5	South End	0	56	488	5
19-Mar-12	8	Perry Road	0	56	580	6
19-Mar-12	18	Marshall Upstream	0			
19-Mar-12	19	Marshall Downstream	0			
16-Aug-12	1	Barnhart	0			
16-Aug-12	2	Milliman	0			
16-Aug-12	3	Wallace	0			
16-Aug-12	5	South End	0			
16-Aug-12	8	Perry Road	0			
16-Aug-12	18	Marshall Upstream	0			
16-Aug-12	19	Marshall Downstream	0			

1 cfs = cubic feet per second.
2 µg/L = micrograms per liter = parts per billion.
3 mg/L = milligrams per liter.

References

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