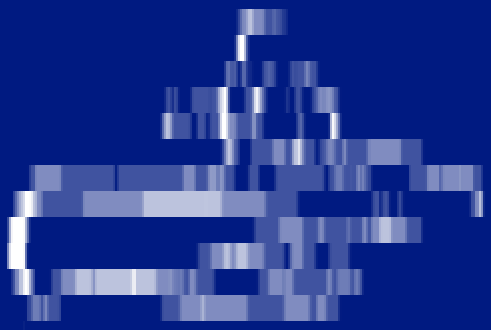
STATE OF THE LAKE
Environment Report
2015



MISSISSIPPI LAKE

WATERSHED WATCH

Mississippi Valley Conservation Authority

WHY WATERSHED WATCH?

A lake monitoring program of the Mississippi Valley Conservation

Mississippi Valley Conservation Authority (MVCA) has long recognized the recreational and aesthetic value of lakes within the watershed and is committed to preserving and protecting water quality and fish habitat. Watershed Watch is an environmental monitoring and awareness program. The objectives of the program are to collect reliable environmental data to document current water quality conditions. This data is used as an essential educational tool to encourage residents to adopt sound stewardship practices aimed at maintaining water quality.

The primary impact of residential development along lake front properties on water quality is increased nutrient inputs to the lake. Increased nutrients such as phosphorous and nitrogen in the water enhance algal and other plant growth in the lake. As excess algal and plant growth decomposes it can consume large amounts of oxygen in the bottom of the lake. This depletion of oxygen at the lake bottom can cause problems as many aquatic organisms including fish require oxygen to survive. The loss of oxygen at the bottom of the lake limits or can completely remove the usable habitat for sensitive species such as Lake Trout.

We will assist shoreline residents, both seasonal and permanent, to become personal stewards of their lake by encouraging them to take an active role in restoring and enhancing their shorelines. In this way, we will work together to maintain healthy lake environments throughout the watershed.

ABOUT MISSISSIPPI LAKE

Mississippi lake is located in three townships, Mississippi Mills, Beckwith and Drummond North Elmsley. Mississippi Lake has an area of 24.5km^2 and a perimeter of 67.6km. At its deepest point Mississippi lake is 9.2m deep. As of 2012 there were 1044 properties within 35m of the lake. Mississippi lake supports a warm water fishery of Walleye, Northern Pike, Largemouth Bass, Smallmouth Bass and Yellow Perch.

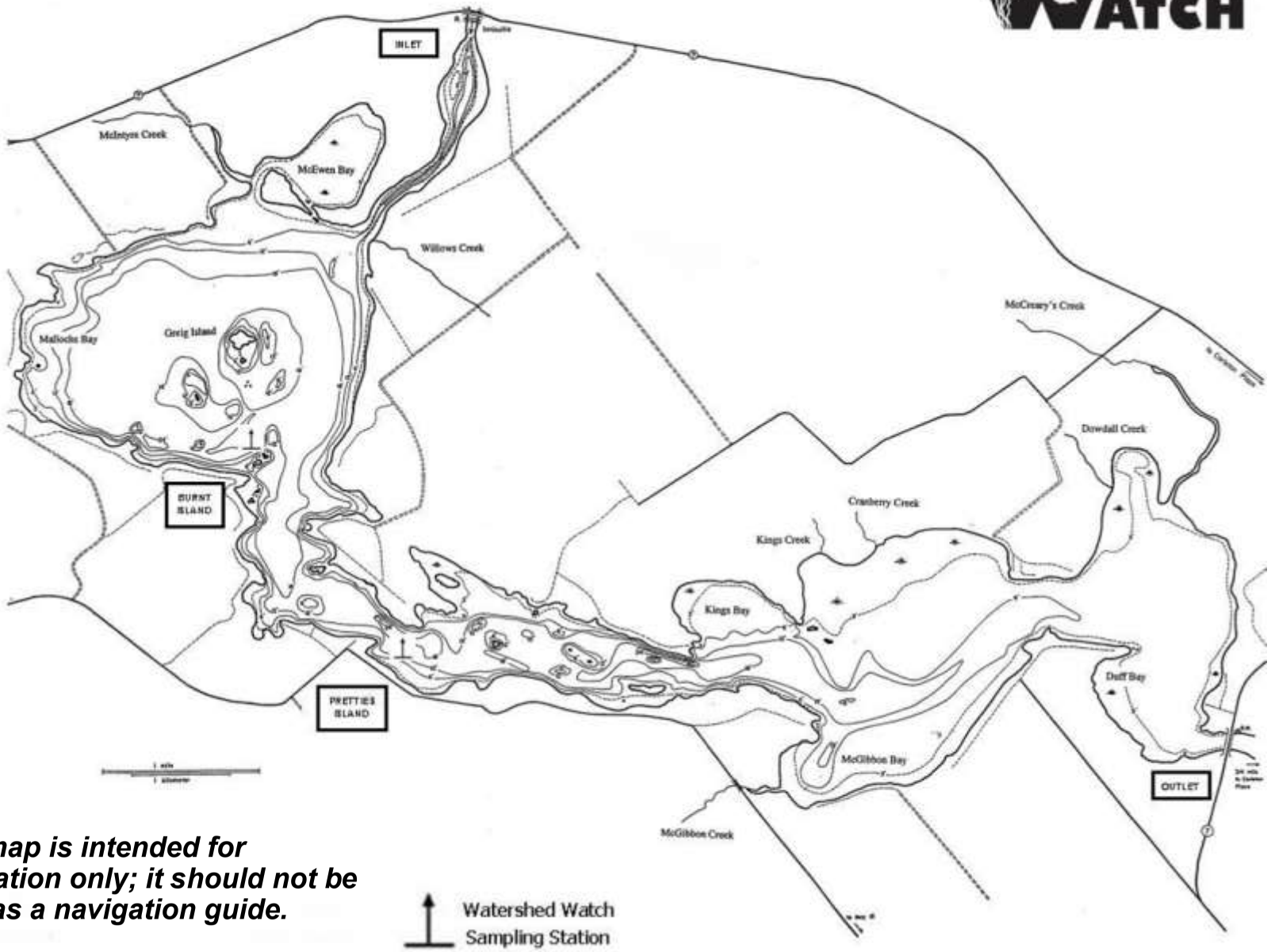
WHAT DO WE MEASURE?

The Watershed Watch program uses four sampling procedures to measure nutrient levels and their effects on lakes. This allows for the classification of lakes based on their level of nutrient enrichment or trophic state.

On one end of the scale, oligotrophic lakes have the lowest concentration of nutrients and are often characterized by low plant and algal growth. On the other end of the scale, eutrophic lakes have the highest concentrations of nutrients and typically have dense populations of aquatic plants and algae. Mesotrophic lakes fall in between these two extremes with a moderate level of nutrient enrichment.

The trophic state of a lake can be impacted by a variety of factors including lake shape and depth, the amount of shoreline development and the surficial geology of the surrounding area. Understanding the current conditions of our lakes can help us to identify trends and changes in the future.

Mississippi Lake



This map is intended for illustration only; it should not be used as a navigation guide.

HOW DOES MISSISSIPPI LAKE MEASURE UP?

Sampling occurs on Mississippi Lake at Burnt Island, Pretties Island, the Inlet at Innisville and the Outlet upstream of Hwy 7. Both the Inlet and Outlet sampling sites are more stream like than lake like in many ways and are very different than the lake basins near Pretties and Burnt Islands. For this reason Inlet and Outlet data should not be used to classify the trophic status of the lake and have not been included in the graphs with Pretties and Burnt Island. Inlet and Outlet data can be useful to help indicate changes in water quality as water flows through the system.

Phosphorous samples taken on Mississippi lake ranged from 10µg/L to 30µg/L in 2015. During the spring and summer samplings all fell between 10µg/L and 20µg/L, below the Provincial Water Quality Objective of 20µg/L, but samples taken in the fall were as high as 30µg/L. Phosphorous concentration on Mississippi lake indicate a potential for nuisance algal blooms to form.

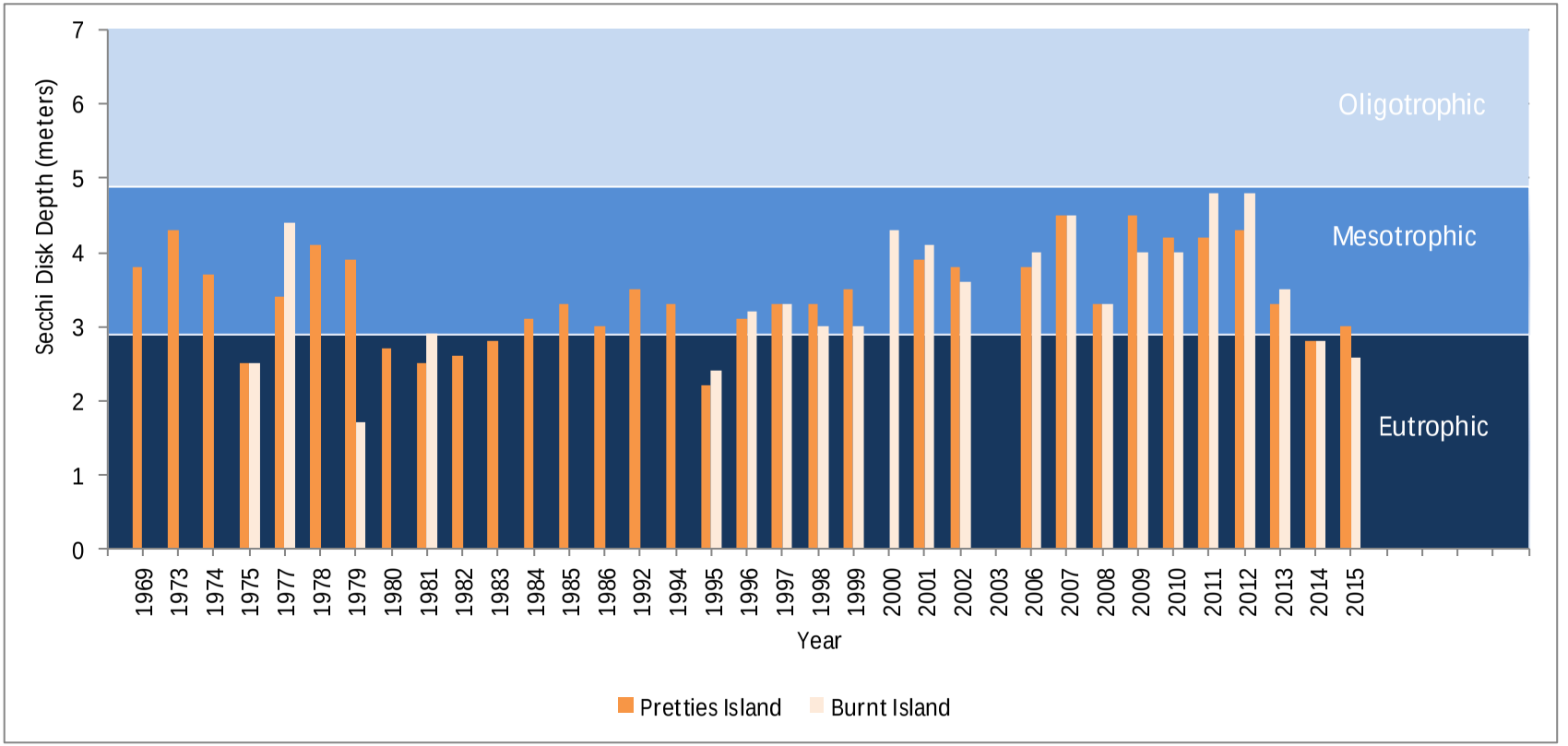
On Mississippi lake chlorophyll a concentrations were highest during the fall samplings when they were as high as 4.5µg/L (Pretties Island). Algal blooms were visible while taking the fall samples. Since 2009 fall chlorophyll a concentrations on the lake have had a mean value of 3.1µg/L indicating that this fall was slightly above average. Aside from the fall samples chlorophyll a concentrations were lower than typical in in 2015. Low chlorophyll a concentrations were seen in all lakes sampled during 2015 suggesting that weather maybe the cause of the lower algal biomass.

Water clarity was fair during spring and summer sampling with Secchi depths ranging from 3.3m to 3.5m. Water clarity was poor during fall sampling with Secchi depths of 2.25m and 1.25m at Pretties and Burnt Island respectively. The low water clarity in the fall can be attributed to algal blooms during sampling. Interestingly at the Inlet sampling point the Secchi depth was 4.5m during the fall. This could be due to the increase turnover in water from upstream mixing the algae and increasing water clarity. In general Secchi depth has shown a decreasing trend since 2012 which does not seem to be related to chlorophyll a concentrations. This trend could be related to zebra mussel abundance on the lake.

Of the four sampling points only the inlet regularly thermal stratifies. Dissolved oxygen shows a steady decline through the epilimnion (top lake layer) before a rapid oxygen depletion at the thermocline (the depth at which water temperature rapidly declines). Very little dissolved oxygen was present in the hypolimnion (bottom lake layer). Sampling at Burnt and Pretties islands did not show stratification this year but have stratified weakly in the past. When stratification in these basins occurs similar dissolved oxygen trends to those at the inlet are seen. This is typical of lakes with a fair amount of algal production.

Looking at sampling data from 2005-2015 show a high degree of variability is seen across all parameters sampled. In general Mississippi lake falls within the mesotrophic lake status but some years samples has also fallen in the oligotrophic or eutrophic range. Variability in sampling results is likely due to variation in weather from year to year as well as the high degree of development on Mississippi lake. Continued sampling on Mississippi lake will help to clarify trends and changes on Mississippi lake.

Burnt Island and Pretties Island
Annual Mean Secchi Depth



A Secchi Disc is a black and white coloured disc used to determine water clarity. The disc is lowered into the water on the shady side of the boat. As the disk is lowered the point when it is no longer visible is noted as well as the point at which it reappears when you bring it up. The average of these two depths is the Secchi depth. The greater the Secchi Disc measurement, the clearer your lake. Secchi depth is influenced by the concentration of algae in the water column; greater concentrations of algae in the water results in a smaller Secchi depth.

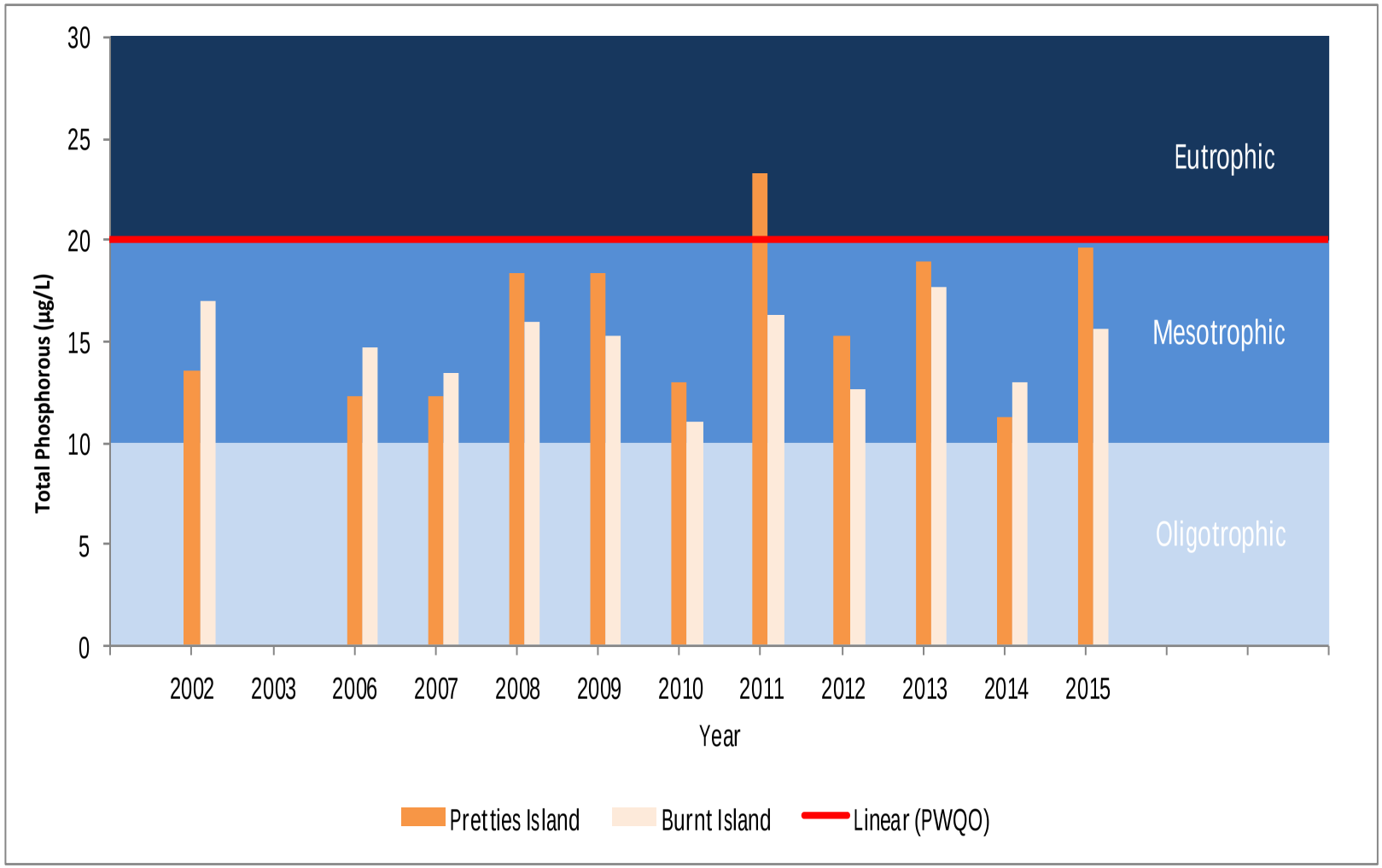
TOTAL PHOSPHORUS CONCENTRATION

Phosphorus is the nutrient that controls the growth of algae in most Ontario lakes. For this reason increases in phosphorus levels in the lake can result in an increase in the quantity of aquatic plants and algae. High levels of phosphorus can lead to algal blooms which, along with being unsightly, can in some cases affect the habitat of cold water fish such as lake trout. A general guideline exists to characterize a lake's trophic status based on the total phosphorus that is measured.

The PWQO (Provincial water quality objective) is 20µg/L of total phosphorous for lakes. This goal is to help ensure aquatic health and maintain the recreational value of our lakes.

A Kremmerer Bottle (pictured to the right) is used to sample water at specific depths. The bottle is lowered to the required depth with both ends open. A weight on the rope is dropped. When the weight hits the bottle it causes both ends to close, sealing the sample water in the bottle.

Mississippi Lake Burnt and Pretties Island Sampling Points
Total Phosphorous Concentrations



CHLOROPHYLL a

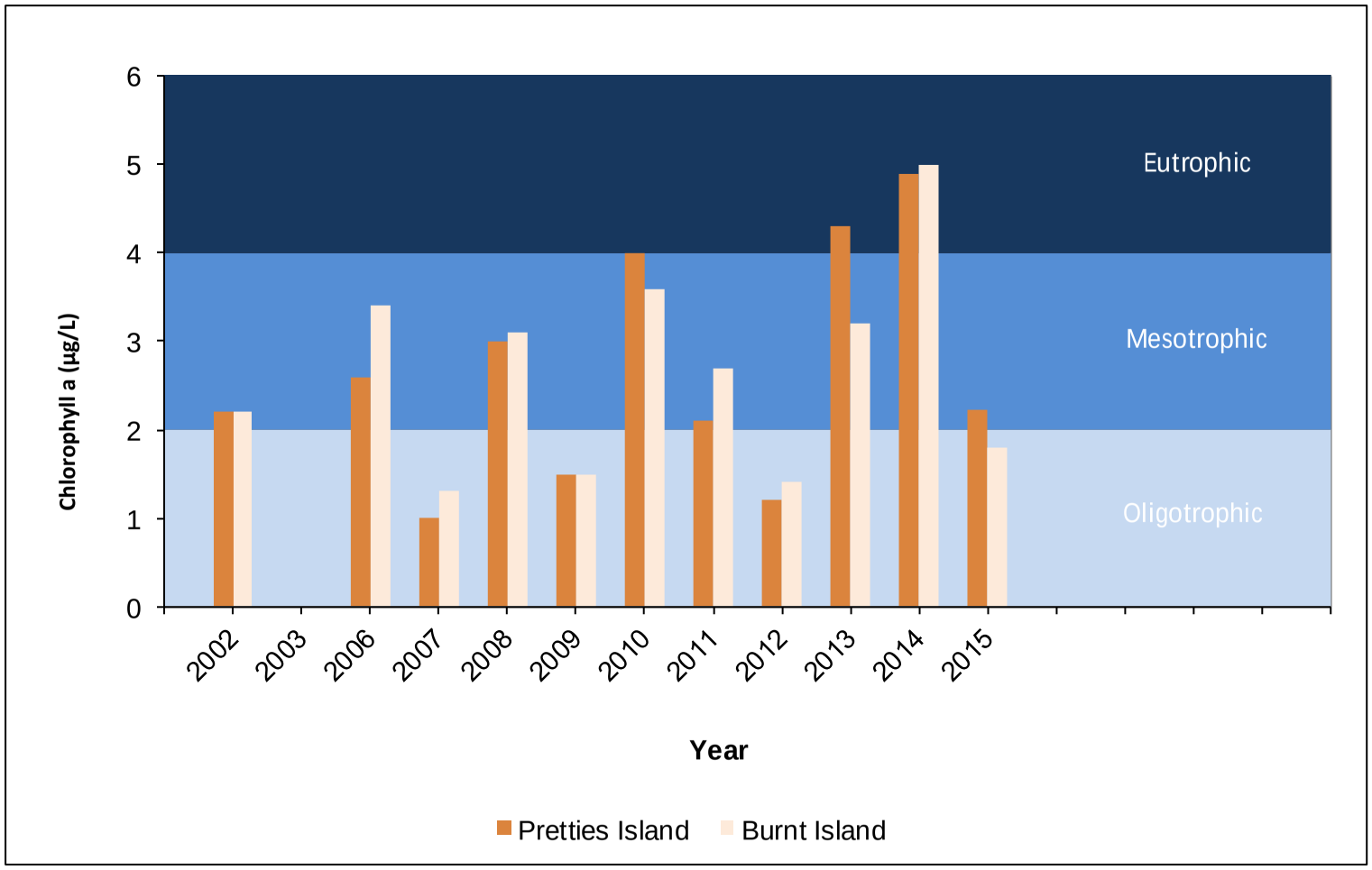
Water clarity is influenced by a number of factors one of which is the amount of phytoplankton or microscopic algae present in the water. Chlorophyll a is the green pigment in phytoplankton. The lower the chlorophyll a density in your lake, the lower the phytoplankton concentration and, the clearer your lake is.

Chlorophyll a and phytoplankton concentration is directly affected by the amount of phosphorus in your lake. The more phosphorus there is in the water, the greater the potential for phytoplankton growth to occur.

A Composite Sampler (pictured above) is used by dropping the tin container into the water. When it reaches the required depth it is slowly pulled back to the surface. The tin is filled as water enters one tube and air escapes the other. Some air remains in the tin to ensure collection throughout the haul to the surface.

Interpreting CHLOROPHYLL a Results	
Chlorophyll a Reading	**Lake Nutrient Status**
Up to 2 ug/L – low algal density	Oligotrophic – unenriched, few nutrients
2 – 4 ug/L – moderate algal density	Mesotrophic – moderately enriched, some nutrients
More than 4 ug/L – high algal density	Eutrophic – enriched, higher levels of nutrients

Mississippi Lake All Sampling Points
Chlorophyll a Concentrations



DISSOLVED OXYGEN (D.O.)

Dissolved Oxygen (DO) is a dissolved form of oxygen vital for all underwater plants and animals to survive; it's what they need to breath. By monitoring DO levels in our lakes we can develop lake profiles showing the lake stratification and the state of the lake. Lake stratification is the separation of lakes into three layers:

Epilimnion (top layer of the lake)	Warmer water with higher D.O. concentrations.
Thermocline (middle layer of the lake)	Distinct layer in which temperature changes more rapidly with depth than it does in the layers above and below.
Hypolimnion (bottom layer of the lake)	Typically the denser and colder water at the bottom of the lake.

The inlet basin of Mississippi lake is the only sampling point that shows stable stratification through the summer. For this reason it is the only sampling point included in this analysis.

Adequate dissolved oxygen is important for good water quality and necessary to all forms of life. Poor (low) D.O. levels will cause stress on fish and may result in fish kills (mass death of a species in a season). DO is at its lowest during the late summer and early fall as water in the hypolimnion cannot recharge its oxygen since it is isolated from the atmosphere by the epilimnion and thermocline.

DO can also play a key role in binding phosphorous to iron in lake sediments. When D.O. levels get too low at the bottom of the lake phosphorous that was bound in lake sediments (removed from the water column) can get released and once again becomes available for plant and algal growth. This process is referred to as internal loading.

Increases in phosphorous near the lake bottom coinciding with low dissolved oxygen in the hypolimnion can indicate the occurrence of internal loading.

The Dissolved Oxygen Meter is used to gather D.O. and temperature readings. The probe is lowered into the lake at its deepest point and readings are taken at every metre from the hand-held screen.

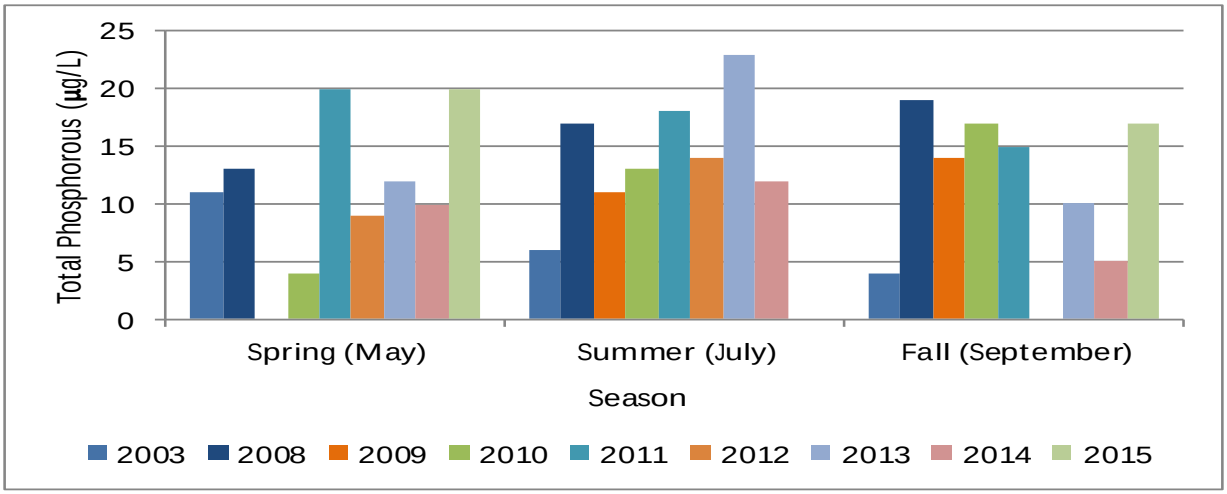
Mississippi Lake Inlet Late Stratification
Dissolved Oxygen Profiles

Depth (m)	18-Jul-10		31-Jul-11		07-Sep-12		16-Jul-13		21-Sep-15	
	Temp °C	DO mg/L	Temp °C	DO mg/L	Temp °C	DO mg/L	Temp °C	DO mg/L	Temp °C	DO mg/L
0.1	26.5	7.00	25.7	8.49	23.5	7.85	28.7	6.45	20.5	8.6
1	26.7	6.92	25.5	7.94	23.5	7.82	27.5	5.79	20.7	8.49
2	26.7	6.84	25.4	7.81	23.3	7.76	27.0	5.67	20.5	8.41
3	26.7	6.82	25.3	7.64	23.2	7.45	26.8	5.71	20.4	8.34
4	26.6	6.53	25.0	6.86	22.9	6.75	26.7	5.76	20.3	8.29
5	23.2	2.54	24.4	4.25	22.5	5.63	26.4	6.01	20.1	8.36
6	20.8	1.99	21.5	0.72	21.1	2.8	26.2	5.79	20	8.01
7	16.8	0.50	19.9	0.51	17.7	0.39	25.9	5.34	19.7	6.39
8	13.2	0.41	18.7	0.43	14.7	0.15	25.2	5.00	17.8	0.68
9	Bottom	Bottom	17.7	0.49	13.3	0.05	24.5	4.36	14.5	0.3
10			17.1	0.39	12.7	0.02	23.8	1.83	Bottom	Bottom
11			16.8	0.33	Bottom	Bottom	Bottom	Bottom		
12			Bottom	Bottom						

Warm Water Fisheries Habitat (Bass, Walleye, Pike, Perch) defined as Dissolved Oxygen Concentrations greater than 4 mg/L at temperatures less than 25°C.

On Mississippi lake only the inlet sampling point consistently shows thermal stratification from year to year. Above are the dissolved oxygen and temperature profiles for the inlet sampling point. Some summer sampling profiles are included when fall sampling was undertaken after the lake had lost stratification.

Mississippi Lake Inlet Late Seasonal
Total Phosphorous Concentrations 1m Off of Bottom



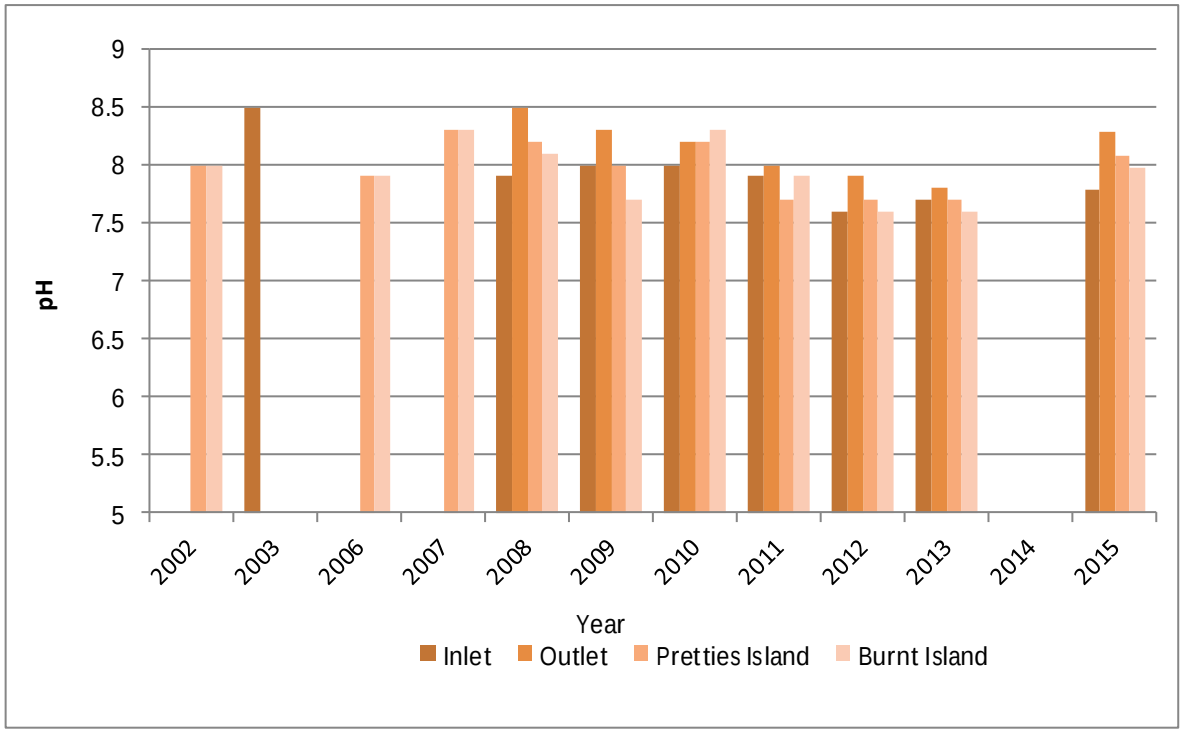
ACIDITY

Acidity of a water body can change the availability of metals such as Calcium and Aluminum. This has been shown to change zooplankton (small planktonic invertebrates) communities which are an important food source for many baitfish species.

The acidity of a solution is measured on the pH scale. The pH scale is a logarithmic measure of the concentration of hydrogen ions in solution. This means that a change from pH 7 to pH 8 is a ten-fold change in the concentration of hydrogen ions in solution.

Monitoring the pH of our lakes allows us to identify when changes are occurring. The Provincial Water Quality Objective for pH is between 6.5-8.5 in order to protect aquatic life.

Mississippi Lake All Basins
Annual Average pH



*pH results from 2014 were not included due to a probe malfunction

Help MVCA and the Ontario Federation of Anglers and Hunters

Stop the Invasion!

Mississippi Lake was tested for invasive species, particularly zebra mussels and spiny water flea, in partnership with the Ontario Federation of Anglers and Hunters (OFAH). Sampling results from 2015 can be found in Ontario's Invading Species Awareness Program Annual report which will be available in the Spring of 2016 (www.invadingspecies.com).

Residents and property owners need to ensure that all access points to the lake have posted signs indicating the precautions that boaters and anglers can take to prevent the spread of invasive species into Mississippi Lake. Residents are also invited to participate in the Invading Species Awareness Program (www.invadingspecies.com) through MVCA and OFAH.

Pictured Top left—Rusty Crayfish Photo; Doug Watkinson, DFO
Middle left—Zebra Mussels Photo; Amy J. Benson
Bottom left– Spiny Waterflea Photo: Cathy Darnell

Check and clean watercraft every time it is moved to a different water body!

For more information on these and other invasive species, visit www.invadingspecies.com/invaders or call the Invading Species Hotline at 1-800-563-7711. If you would like to help monitor and prevent the spread of invasive species in the Mississippi Valley watershed, email monitoring@mvc.on.ca or call us at 613-253-0006.

MVCA and OFAH promote a proactive approach to invasive species management. This includes education and outreach about invasive species and how they are transported. Stop signs such as the one pictured above remind boaters to Inspect, Clean and Drain their boats so that they don't give invasive species a free ride.

HOW DOES MISSISSIPI LAKE MEASURE UP?

WATER QUALITY RESULTS (2003 - 2015) - MISSISSIPPI LAKE - INLET BASIN

Sample Year	Secchi Disc Depth (Metres)	Total Phosphorus Euphotic Zone (Micrograms/litre)	Chlorophyll a Composite (Micrograms/litre)
2003	3.3	17.3	2
2008	6	6	1.6
2009	3.7	20.3	0.7
2010	3.8	12	3.6
2011	3.3	32	2
2012	4.2	13.3	1.7
2013	3.8	16	1.4
2014	3.7	13.3	1.7
2015	3.7	14.5	1.1
N	9	9	9
Mean	3.9	16.1	1.8
Standard Deviation	0.82	7.15	0.81

WATER QUALITY RESULTS (2008 - 2015) - MISSISSIPPI LAKE - OUTLET

Sample Year	Secchi Disc Depth (Metres)	Total Phosphorus Euphotic Zone (Micrograms/litre)	Chlorophyll a Composite (Micrograms/litre)
2008	2.7	18.3	10.7
2009	2.3	11.0	2.5
2010	2.5	16.0	1.2
2011	2.0	22.7	2
2012	1.9	11.0	1.1
2013	2.5	19.3	2.3
2014	2.1	11.0	2
2015	2.2	14.3	0.47
N	8	8	8
Mean	2.3	15.5	2.8
Standard Deviation	0.28	4.42	3.27

HOW DOES MISSISSIPPI LAKE MEASURE UP?

WATER QUALITY RESULTS (1975 - 2015) - MISSISSIPPI LAKE - BURNT BASIN

Sample Year	Secchi Disc Depth (Metres)	Total Phosphorus Euphotic Zone (Micrograms/litre)	Chlorophyll a Composite (Micrograms/litre)
2002	3.3	17.0	3.9
2006	4.0	14.7	3.4
2007	4.3	13.5	1.4
2008	3.3	16.0	3.1
2009	4.5	15.3	1.5
2010	4.0	11.0	3.6
2011	4.0	16.3	2.7
2012	4.8	12.7	1.4
2013	3.5	17.1	3.2
2014	2.8	13.0	5.0
2015	2.6	15.7	1.8
N	23	16	17
Mean	3.5	16.5	4.6
Standard Deviation	0.80	6.68	3.71

Interpreting SECCHI DISC Results	
Secchi Depth	**Lake Nutrient Status**
Over 5 metres	Oligotrophic – unenriched, few nutrients
3.0 to 4.9 metres	Mesotrophic – moderately enriched, some nutrients
Less than 2.9 metres	Eutrophic – enriched, higher levels of nutrients

Interpreting TOTAL PHOSPHORUS Results	
Total Phosphorus	**Lake Nutrient Status**
10 ug/L or less	Oligotrophic – unenriched, few nutrients
11 to 20 ug/L	Mesotrophic – moderately enriched, some nutrients
21 ug/L or more	Eutrophic – enriched, higher levels of nutrients

Interpreting CHLOROPHYLL a Results	
Chlorophyll a Reading	**Lake Nutrient Status**
Up to 2 ug/L – low algal density	Oligotrophic – unenriched, few nutrients
2 – 4 ug/L – moderate algal density	Mesotrophic – moderately enriched, some nutrients
More than 4 ug/L – high algal density	Eutrophic – enriched, higher levels of nutrients

HOW DOES MISSISSIPPI LAKE MEASURE UP?

WATER QUALITY RESULTS (1958 - 2015) - MISSISSIPPI LAKE - PRETTIES ISLAND

Sample Year	Secchi Disc Depth (Metres)	Total Phosphorus Euphotic Zone (Micrograms/litre)	Chlorophyll a Composite (Micrograms/litre)
2002	3.9	13.6	2.0
2006	3.8	12.3	2.6
2007	4.3	12.3	1.0
2008	3.3	18.3	3.0
2009	4.5	18.3	1.5
2010	4.2	13.0	4.0
2011	4.2	23.3	2.1
2012	4.3	13.3	1.2
2013	3.3	19.0	4.3
2014	2.8	11.3	4.9
2015	3.0	19.7	2.2
N	34	16	27.0
Mean	3.4	16.1	4.0
Standard Deviation	0.65	5.03	2.71

Interpreting SECCHI DISC Results	
Secchi Depth	**Lake Nutrient Status**
Over 5 metres	Oligotrophic – unenriched, few nutrients
3.0 to 4.9 metres	Mesotrophic – moderately enriched, some nutrients
Less than 2.9 metres	Eutrophic – enriched, higher levels of nutrients

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SEINE NETTING

Seine netting by hand is a way of sampling fish species that may live or visit the near shore areas of a waterbody. A seine net is a type of fishing net that has floats along one edge and weights along the other edge, to keep it upright in the water. It is then dragged through a section of water, encircling it, thus collecting all the fish within that area. The depth of the testing area is limited to areas wadeable by the field crew. This method has a very limited impact on the health of the fish sampled and is affordable, easy to do, and portable.

Seine netting was conducted at the boat launch sites of all the Watershed Watch lakes of the 2015 field season to help expand our knowledge of each lake beyond just its chemistry. Netting was conducted in August to avoid disturbing sensitive nesting and breeding sites.

The majority of the individual fish captured with the seine net are bait fish such as minnows and cyprinids, however some juvenile and adult game fish were also caught. Both groups (bait fish and juvenile game fish) tend to stick close to shore to avoid predation from larger fish that can be found in deeper waters. Near shore areas may also contain aquatic vegetation which is ideal camouflage for all sizes of fish that are either hiding from predators or waiting to surprise prey, explaining why some adult game fish were caught.

It is important to note that if something was not caught in the seine we cannot conclude that the fish species is not in the lake, rather that the species was not in the sampling zone when the sampling was done.

Most stakeholder interest in fish species within a water body has to do with game fish. However, baitfish far outnumber game fish and thus play a critical role within their ecosystem and the food chain. It is important to take note of their presence and provide them the same consideration you would for larger fish. If you are interested in learning more about baitfish, and how to identify the different species, please refer to the Department of Fisheries and Oceans *Baitfish Primer*. It is available online and at the MVCA office.

MISSISSIPPI LAKE SEINE NETTING RESULTS - FISH SPECIES CAUGHT

- Smallmouth bass

LOOKING TO HELP COLLECT LAKE DATA?

Please help the Mississippi Valley Conservation Authority (MVCA) track ice-in and ice-out dates for your lake.

The MVCA collects information about when lakes freeze over in the fall or winter (ice-in), and when the ice melts in the spring (ice-out). Historically most people have only noted ice-out, but increasingly we are recognizing the importance of knowing how long lakes are under ice cover, and therefore ice-in is becoming more widely tracked as well. This is an important trend to monitor, especially considering the unusual weather conditions that have occurred in recent years.

While ice in and ice out dates change somewhat from year to year depending on local weather conditions, we are interested in seeing whether there are notable changing trends over the long term. The more years of data we have for each of the lakes, the better we can adapt our water management regimes, particularly in terms of timing the fill-up of the reservoir lakes in the spring. It will also help to increase our understanding of the effects changing ice cover has on lake health, local wildlife and recreational lake use.

Volunteers are asked to record ice-on and ice-off dates for your lake, based on what you can see from shore, and submit the data to MVCA by e-mail. Ice-out is determined when the lake becomes clear of ice in the spring. Ice-in occurs when the lake is completely or nearly completely covered with ice.

If you're interested in helping MVCA track ice-in and ice-out please contact:
Alyson Symon (613) 253-0006 ext 227 or email asymon@mvc.on.ca

VOLUNTEERS NEEDED TO MONITOR RAINFALL

MVCA is looking for volunteers to help collect rainfall data throughout the Mississippi Watershed. By participating you will help to gather a larger amount and broader range of data than would otherwise be collected. Your observations will give us a better picture of differences in the amount and distribution of rainfall through our watershed. This type of data is extremely valuable in helping us to monitor and manage for changes in the river system.

Volunteer are provided with a 10" rain gauge that they will install on their property by attaching it to a fixed structure such as a deck or a fence post. Rainfall is read and recorded during or after each rainfall.

The data that is collected will be shared with municipal and government agencies, environmental organizations and researchers, and will be available to the general public.

If you are interested please contact Alyson Symon (613) 253-0006 ext 227 or email asymon@mvc.on.ca

ALGAE WATCH

Dense algae blooms can reduce water clarity and create changes in how a lake functions.

Over the last few decades algae and plant growth appears to be increasing in our lakes. MVCA in partnership with Friends of the Tay Watershed Association, Carleton University and Rideau Valley Conservation, are trying to better understand aquatic plant and algae growth in Eastern Ontario lakes. Phosphorus, climate change and zebra mussels are all being examined for their possible effects.

You can help us get a handle on this issue by reporting algae blooms and excessive plant growth on your lake at www.citizenwaterwatch.ca.

SITE EVALUATION GUIDELINES

Water front development can introduce nutrients and suspended solids into surface water through migration from septic systems and runoff from cleared areas. Through lake stewardship, proper planning and education the negative effects of shoreline development on lake health can be greatly reduced. Mississippi Valley Conservation Authority (MVCA) along with Rideau Valley Conservation Authority (RVCA) and Cataraqui Region Conservation Authority (CRCA) have released Site Evaluation Guidelines for water front property which will help to address potential impacts on the aquatic environment for the review of development proposals.

For more information on these guidelines please contact Mississippi Valley Conservation Authority at 613-253-0006.

PLANT YOUR LAND

Our **free** shoreline planting service helps you restore the natural look of your shoreline while combating erosion, cleaning your water and creating a healthy habitat for fish, birds and wildlife. It'll save you time and money for lawn maintenance too.

Naturalizing your shoreline does not mean you lose your view or your shore access. MVCA staff will look at your property and create a planting layout that suits your needs. The designs will maintain open areas and let you enjoy your waterfront property while gaining the benefits of naturalization.

Contact Caleb about planting your land by phone at 613-253-0006ext.253 or by email at stewardship@mvc.on.ca

For more information about MVC Monitoring Programs
please call: Susan Lee at
613.253.0006 ext. 253 or
email: cyee@mvc.on.ca
or
visit: www.mvc.on.ca

10970 Hwy 7
Carleton Place, Ontario
K7C 3P1

Mississippi Valley Conservation Authority