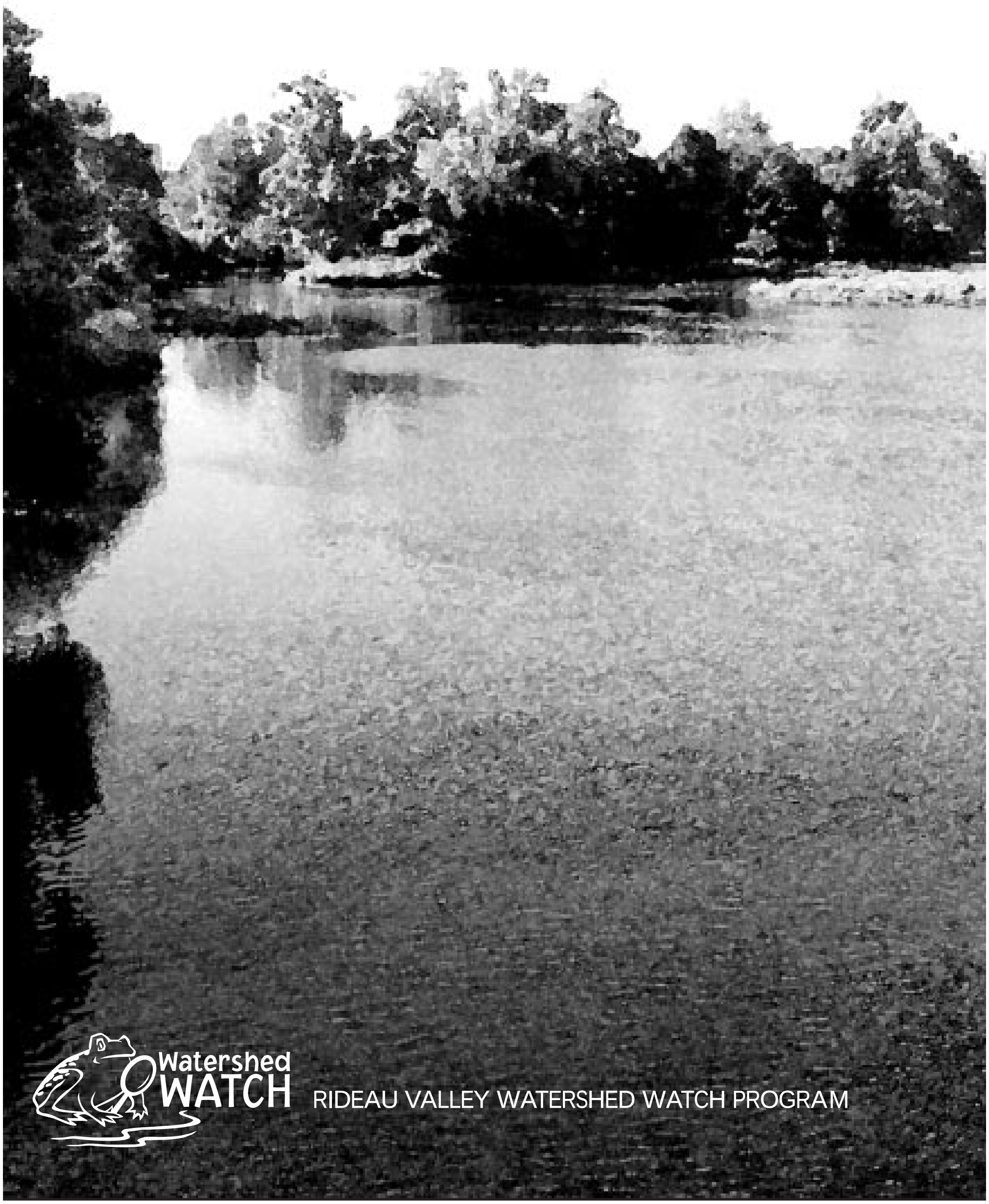
STATE OF THE

LAKE ENVIRONMENT REPORT-2001



THE ONTARIO TRILLIUM FOUNDATION
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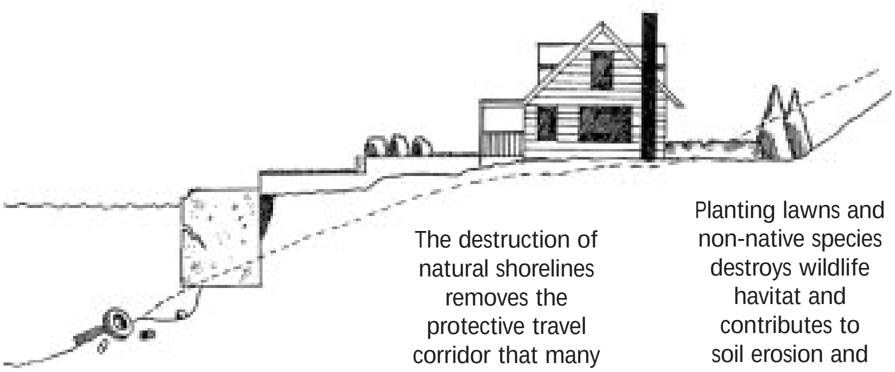
RIDEAU VALLEY
CONSERVATION AUTHORITY

Lanark
COMMUNITY STEWARDSHIP COUNCIL OF LANARK COUNTY

- Alliance of Rideau Lakes Associations
- Big Rideau Lake Association
- Farren Lake Property Owners Association
- Rideau Valley Conservation Foundation and its many donors
- Township of Bathurst Burgess Sherbrooke

"The Ribbon of Life" Where the Land Meets the Water

Water quality is affected by many things: natural processes of erosion and runoff accelerated by clearing of shorelines, the use of artificial fertilizers and leachate from sewage disposal systems. All result in too many nutrients reaching the lake.



Too many nutrients causes profuse weed and algae growth which affects the aquatic animal species makeup by altering habitat and food sources and by reducing oxygen and light penetration.

The shallow waters and first ten metres of shoreland area form a "Ribbon of Life" around lakes. This ribbon- where the land meets the water - is where much of the lake life is born, raised and fed. Many landowners, unaware of the importance of this area, have cleared the shorelines of native vegetation and replaced it with lawns, non-native ornamental vegetation, retaining walls and boathouses. This has a negative effect on fish and wildlife habitat and water quality. Natural vegetation retained or restored along the shoreline helps prevent erosion and improves water quality by binding nutrients before they can enter the lake.

The Rideau Valley Conservation Authority has long recognized the recreational and aesthetic value of lakes within the watershed and is committed to maintaining and protecting water quality and fish habitat. The Conservation Authority has joined together with volunteer Lake Stewards throughout the watershed to take steps to protect and restore water quality by launching the Watershed Watch program. 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 and use the data as an essential educational tool to encourage shoreline residents, both seasonal and permanent, to become personal stewards of their lake and to adopt sound stewardship practices aimed at preserving and protecting water quality. By taking an active role in restoring and enhancing their shoreline, they can help to maintain water quality and a healthy lake environment.

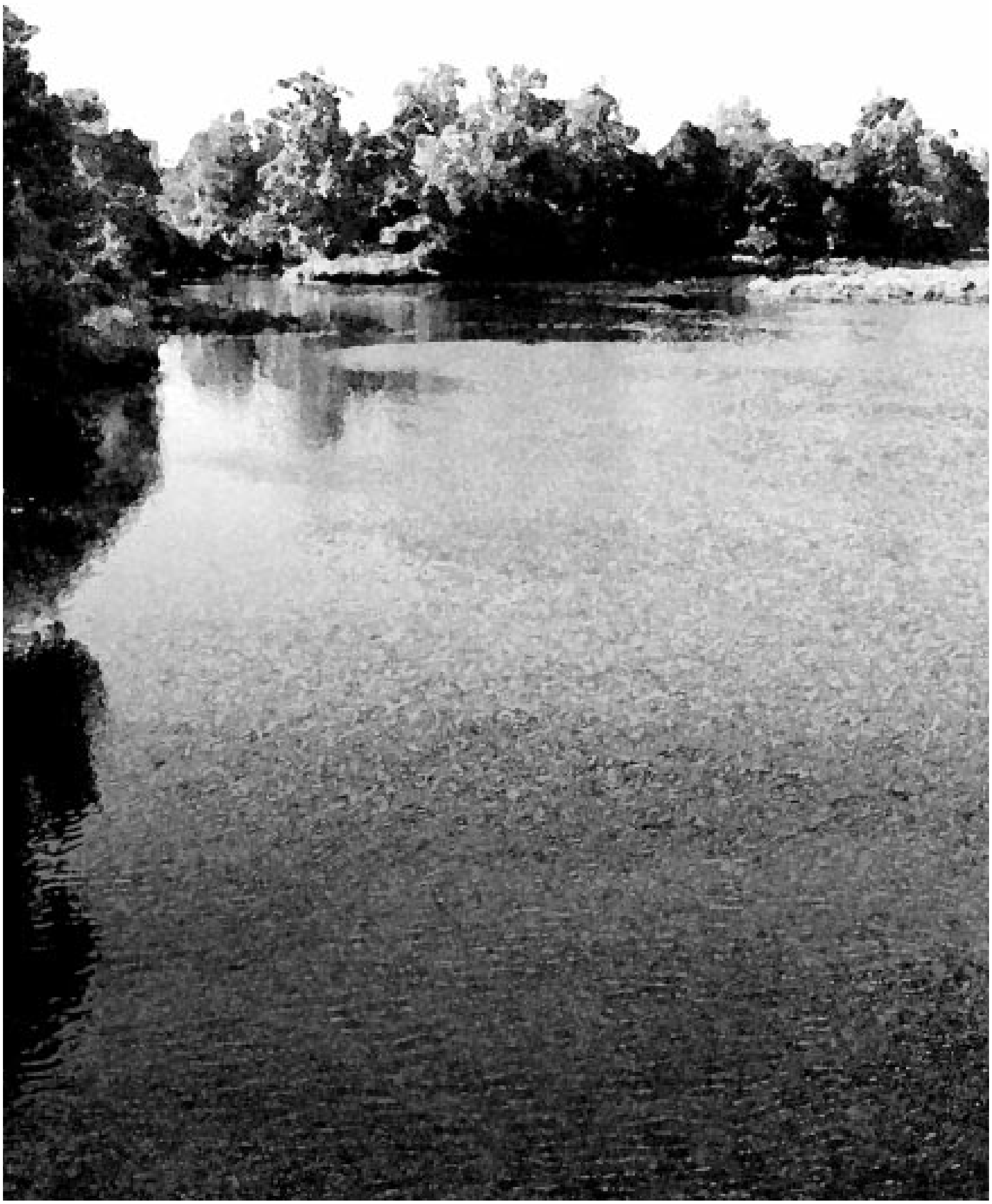
Recreational water quality can be expressed in terms of how clear the water appears. Water clarity is influenced by the amount of soil sediment and phytoplankton, or microscopic algae, present in the water. Clarity is measured by a simple visual test using a **Secchi Disk**, a 20 centimetre black and white disk attached to a measured line that is lowered into the lake until it is no longer visible. Analysis of water samples for **chlorophyll** a, which provides the green pigment in phytoplankton, gives a more specific measure of the abundance of small creatures in the water. Another perspective is gained through analysis of samples for nutrients, particularly **phosphorus** but also **nitrogen**, which tells how much food is available for the algae and aquatic plants. In the late summer when the algae drops to the bottom of the lake, its decomposition uses oxygen so, to find out how much oxygen is available for fish and other aquatic animals, **dissolved oxygen and temperature** profiles are done.

These tests combine to give an indication of the Aage@ of a lake and what can be expected. An Aold@ or **eutrophic** lake will have profuse plant growth and relatively few fish species because of the lack of open water and the competition for oxygen. A Amiddle-aged@ or mesotrophic lake will support the greatest diversity of fish species with a variety of habitats and sufficient oxygen available. AYoung@ or **oligotrophic** lakes have very little or no vegetation and are usually well oxygenated but will have relatively few fish species.

While lake users are interested in how weedy a lake is and what kind of fishing stories they can experience, they also want to know if the water is safe for drinking and swimming. Eschericia coli **(E.coli.)** are in a family of fecal coliform bacteria common to warm-blooded mammals. A few members of the family are harmful themselves but E.coli. are also a good indicator of the presence of pathogenic or other hazardous bacteria because where there is E.coli., the others will usually be present. Analysis of water samples for E.coli., which is relatively more abundant and easier to count than the other organisms, gives an indication of problems with leaking septic systems or other sources of contamination.

Through WATERSHED WATCH, lakes in the watershed will be monitored for these key water quality indicators. Knowing what is in the water will assist the lake stewards when devising a strategy to protect the Ribbon of Life which will reduce the human impact on the aging process and ensure that our lakes will endure for future generations to enjoy.

Pike Lake



PIKE LAKE - 2001

LOCATION:	Townships of Bathurst Burgess Sherbrooke and Rideau Lakes - part of the headwaters of Grants Creek, a major tributary of the Tay River
ELEVATION:	lake surface approximately 145 metres above mean sea level
DIMENSIONS:	perimeter: 24.2 kilometres; maximum depth: 32.6 metres.; area: 331.7 hectares
LAKE WATERSHED:	drainage area: 6,315 hectares; land use: 64.3% shield forest, 10.6% lake, 9.9% pasture, 8.6% wetlands, 3.7% crops, 2.8% successional lands, 0.1% mesic mixed hardwood
FISHERY:	warm water fishery - northern pike, walleye, bass.
DEVELOPMENT LEVEL:	230 cottages, 30 homes, two resorts (as of last count in mid 1990's)
BACKGROUND DATA:	Ministry of Environment Self-Help and Lake Partner Programs (1975-1999); Ministry of Environment Recreational Lakes Program (1975, 1983) - total phosphorus, chlorophyll a, secchi disk, dissolved oxygen profiles

The sampling component of the Watershed Watch program consisted of the following:

SITES:	one site at deepest point of lake, eight around shoreline adjacent to cottage groupings; three sites at access points (see map)
TOTAL PHOSPHORUS (TP):	samples from deepest point at the surface and one metre above the bottom; at eight shoreline sites at approximately half metre depth in one metre of water
TOTAL KJELDAHL NITROGEN (TKN):	samples from deepest point at the surface and one metre above the bottom; at eight shoreline sites at half metre depth in one metre of water
SECCHI DISK:	at deepest point – measurement is depth where disk can no longer be seen
DISSOLVED OXYGEN/TEMPERATURE (DO/Temp):	at deepest point readings taken at intervals from surface to bottom
CHLOROPHYLL a (Chl):	a composite sample taken in the euphotic zone (layer which light penetrates – twice the secchi disk depth) at deepest point
ESCHERICHIA COLI (E. coli):	at eight shoreline sites at approximately half metre depth in one metre of water
INVASIVE SPECIES (IS):	one near the public boat launchat the west end, one at the deep point and one toward the east end; samples for zebra mussel veligers and spiny water flea

How Pike Lake measured up in 2001:

Table 2: Grading Scheme:

TP	TKN	Secchi	DO	Chl	E.coli	IS	Score
.005 - .009	.1 - .2	> 5	> 5	0 - 0.00125	0 - 10	No	4
.009 -.013	.2 - .3	4 - 5	4 - 5	0.00125 - 0.0025	10 - 40		3
.013 - .017	.3 - .4	3 - 4	3 - 4	0.0025 - 0.00375	40 - 70		2
.017 - 0.02	.4 - .5	2 - 3	2 - 3	0.00375 - 0.005	70 - 100		1
> 0.02	< .1, > .5	< 2	< 2	> 0.005	> 100	Yes	0

Overall Grading	
Score Range	Grade
> 3.5	A
2.6 - 3.5	B
1.6 - 2.5	C
0.5 - 1.5	D
< 0.5	F

The scores in Table 2 below come from Table 1: Grading Scheme, above. The result or average value of sample results for 2001 for a particular parameter is compared to the range under that parameter in Table 1. Once the appropriate range is found, move in that row horizontally to the score column. For example, a value for TKN of .36 is in the range .3 - .4 for which the score is 2. The overall grade shown at the bottom of Table 2 is found by taking the average of the scores, finding the Score Range in Table 1 to get the grade from the right hand column e.g. an average score of 2.75 is in the range 2.6 - 3.5 which yields a grade of B.

This scoring/grading is not a scientifically rigourous scheme. It is based on schemes used by others but was derived specifically for this report to provide an indication of the overall status of the lake based on all the aspects included in the Rideau Valley Watershed Watch sampling program in 2001. The elements being compared here are not all directly related e.g. the presence of spiny flea has no direct bearing on the amount of TP in the lake and vice versa. Most of the scores are related to an accepted benchmark. The failing score of zero is given for anything above or below the benchmark, depending on the particular parameter, such as 0.02 for TP which is the concentration, expressed in milligrams per litre, used as the Provincial Water Quality Objective (PWQO) above which a marked impact can be expected. In the case of Invasive Species, IS, the presence or absence is what is important and only two scores are needed.

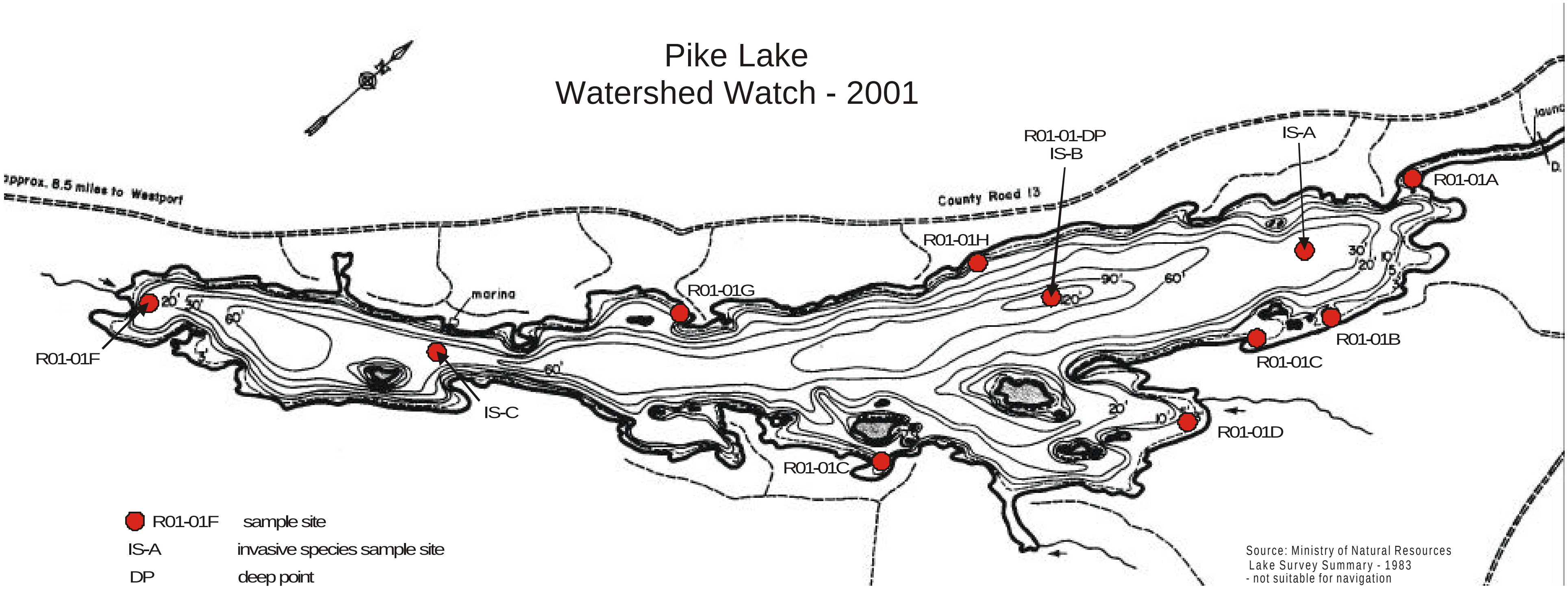
Table 2: Scoring

Parameter	Result	Score	
TP (milligrams/ Litre (mg/L))	0.02	1	Phosphorus comes from soaps, detergents, fertilizers and pesticides and is the main nutrient contributing to the growth of algae. The PWQO for lakes is to keep total phosphorus levels below 0.02 mg per litre of water to avoid excess algae and aquatic plant growth
TKN (mg/L)	0.605	0	Nitrogen contributes to the growth of algae and aquatic plants. Some of its forms can be toxic to aquatic animals in excess quantity and/or when an imbalance occurs. Nitrogen comes from fertilizers, pesticides and human and animal waste. There is no PWQO for Total Kjeldahl Nitrogen but a generally accepted guideline is that TKN levels less than 0.1 and greater than 0.5 mg/L can have harmful effects on the aquatic environment (some nitrogen is required hence the lower limit of the range)
Secchi (metres (m))	2.7	1	The secchi disk reading is a measurement of water clarity. The greater the depth that the disk remains visible indicates correspondingly lower quantities of suspended soil, debris and micro-organisms.
DO/Temp (mg/L)	1.97	0	Result is the average of the DO >4 mg/L at <25 and >10 degrees Celsius multiplied by the percentage of the depth of the lake with those conditions e.g. a lake 30 metres deep has oxygen concentrations that meet the conditions in 10 metres or 30% of the total depth.
Chl (mg/L)	0.0077	0	Chlorophyll a is the green pigment in microscopic algae that live in water. More than 0.005 milligrams of Chl in a litre of lake water indicates an excessive quantity of algae is present which will negatively affect the clarity and oxygen content of the lake.
E.coli (coliform units/ 100 millitres (CFU/100 mL))	3	4	E.coli bacteria is used to indicate the presence of harmful disease-causing organisms (bacteria, pathogens). It is present in human and animal waste. The PWQO for drinking water is 0 CFU/100 mL which means that using untreated lake water as a drinking water source is not recommended. The PWQO for swimming is 100 CFU/100 mL
Invasive Species	No	4	Invasive species can significantly alter the lake character. They are typically very aggressive and tend to overwhelm native species in various ways reducing the biodiversity throughout the food chain.
	average score	1.42	**Overall Grade: D**

Pike Lake had a relatively high nutrient load, low oxygen concentrations, no significant bacteria counts and no invasive animal species in 2001, which is good for a grade of D. This grade indicates that Pike Lake is tending toward poor health. It is on the verge of being eutrophic (advanced age) and an aggressive effort needs to be made to reduce the human impacts (nutrient loading) to slow that aging process. An obvious sign of nutrient loading is the persistent algal blooms experienced for much of the summer of 2001. Another is weed growth but, because Pike Lake is large, fairly deep and has mainly a steep rock shoreline, it does not generally suffer from profuse weed growth except in a few of the bays and the outlet stream above the dam. Good signs are that it appears that there is no bacterial pollution occurring and that zebra mussels and spiny water flea have not yet made it into the lake.

A special thank-you to Hal Lilly who volunteered his time and boat to the Watershed Watch Crew for the 2001 sampling season.

Pike Lake
Watershed Watch - 2001



PIKE LAKE – 2001
Looking a little deeper:

The basic characteristics of a lake depend on the physical properties (dimensions and geology) and climate. Six processes or actions further define an individual lake:

- Precipitation directly onto the lake surface deposits phosphorus and other chemicals and runoff from the lake watershed carry bacteria and pathogens, plant debris and soil particles which bear phosphorus and other chemical elements, into the water ;

- Use by aquatic plants of the nutrients (phosphorus, etc.) has two impacts:
  - plant communities develop in the lake becoming profuse over time which limits the development and diversity of other plants and aquatic animals, and
  - along with plant debris and sediment from the shoreline, dead phytoplankton and other plants settle to the lake bottom where it decomposes using up oxygen and releasing nutrients;

- Each spring and fall temperature changes in the lake cause a mixing or turnover of the waters which can bring phosphorus from bottom waters to the surface to be available for aquatic plant and microorganism growth;

- A "sink" of phosphorus is created by settling of phosphorus-bearing sediment and the decay process at the bottom of all lakes with the phosphorus either held adsorbed to the lake bed soil particles when dissolved oxygen levels are high or in solution when the dissolved oxygen levels decline.

- After the spring turnover, the lake warms and stratification occurs creating a warmer surface layer (epilimnion), a transition zone (metalimnion) and colder deep waters (hypolimnion). As water warms, the ability to hold dissolved oxygen decreases. While the warm waters of the epilimnion can hold less the air/water contact and wave action ensures that there is a constant supply. As the deep waters of the hypolimnion warm, there is no mechanism to get new oxygen. The demand for oxygen for the decay process can cause the hypolimnion to become anoxic (no dissolved oxygen);

- Lakeshore development affects the shoreline runoff/erosion characteristics which usually leads to increased sediment, bacterial and nutrient loading of lake waters by changes to the vegetation composition, hardening the surface (buildings, roads, retaining walls, etc.) and installation and sometimes poor maintenance of septic facilities;

There are several methods of measuring the impacts of these processes or actions. The common ones are:
- measurement of water clarity using a Secchi disk,
- dissolved oxygen (DO)/Temperature profiles to show what the extents of the aquatic habitat are (most fish species inhabit the warmer, oxygenated surface waters),
- analysis of samples for nutrients: Total Phosphorus (TP) - the limiting nutrient for plant and microorganism growth, and/or
- presence or concentration of phytoplankton indicated by the amount of chlorophyll a, a pigment in phytoplankton

Added for the Watershed Watch program were:
- Total Kjeldahl Nitrogen (TKN), a secondary nutrient, to see if the high counts found elsewhere in the watershed occur in the lakes, and
- Eschericia Coliform (E.Coli) sampling around the lake nearshore to check for bacterial pollution problems.

An obstacle to assessing the condition of lakes is the length of the historical data record. Compared to what is available for some lakes, there is a long dataset for Pike Lake (Table 1, below). The general nature of the parameters does not allow a detailed analysis of Pike Lake so what follows is a set of observations about the available data which should be of assistance in setting goals for future lake management.

Table 1: 1975 - 2001, Deep Point of Lake

Sample Year	Secchi Disk [Metres]	Total Phosphorus Surface Sample [mg/L]	Total Phosphorus Bottom Sample [mg/L]	Chlorophyll a [mg/L]
1975	3.9	0.0178	0.023	0.0045
1976	2.4			0.0066
1977	3.1			0.006
1978	4.2			0.0043
1979	3.7			0.006
1980	3.8			0.0065
1981	3.7			0.0054
1982	2.5			0.0054
1983	4.3	0.0468	0.082	0.0022
1984	3.0			0.0076
1985	2.6			0.0055
1986	3.2			0.0068
1987	3.2			0.0074
1988	5.5			0.002
1989	4.5			0.0042
1990	4.1			0.004
1991	5.1			0.0027
1992	4.3			0.0026
1993	2.9	0.052		0.006
1994	2.5	0.017		0.0053
1995				
1996	5.2	0.054		
1997	4.0	0.010		
1998	3.9	0.009		
1999	5.0	0.009		
2000	4.2	0.012		
2001	2.7	0.0187	0.0403	0.0077
Number	26	10	3	21
Minimum	2.4	0.009	0.023	0.002
Maximum	5.5	0.054	0.082	0.0077
Mean	**3.8**	**0.025**	**0.048**	**0.005**

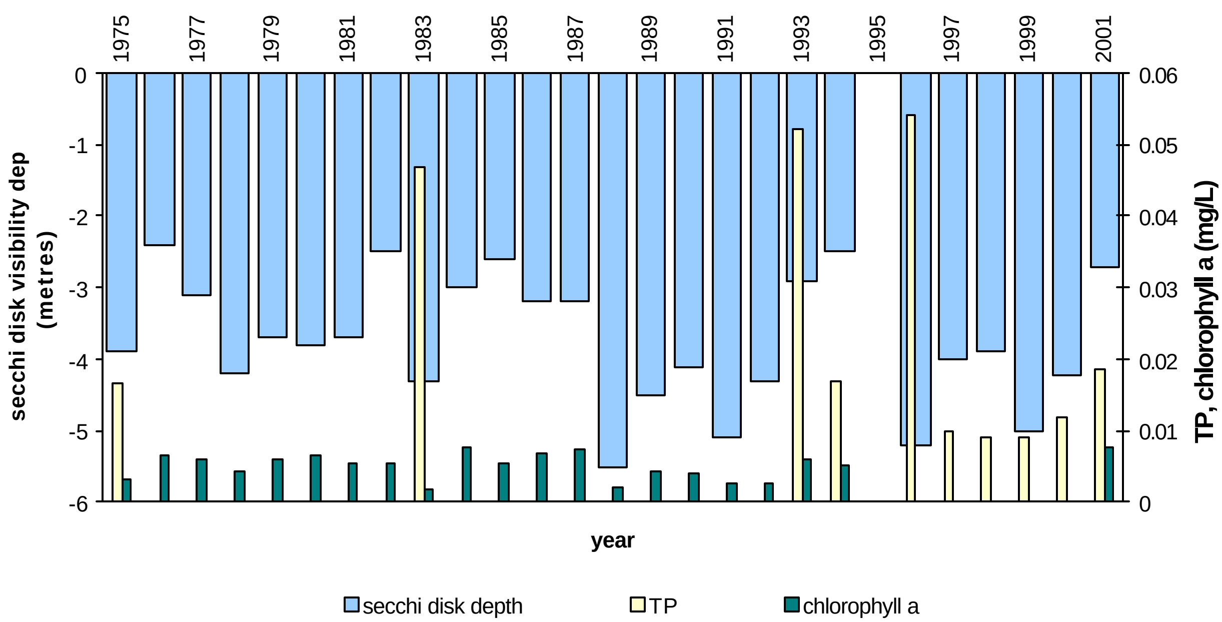
*****Includes MOE Recreational Lakes Program Data. Chlorophyll a data prior to 1985 has been adjusted to reflect new lab procedures in filtering resulting in an increase in chlorophyll a concentrations by 35%.

Chlorophyll a was used as the primary indicator of lake trophic state (age or nutrient level) until 1994 when it was replaced by total phosphorus because sampling and analysis for TP has been shown to be more reliable and more economical. The relationship between the two is that chlorophyll a is one of the pigments found in phytoplankton and phosphorus is the primary nutrient affecting the proliferation of phytoplankton. For comparison with the historical data, analysis for chlorophyll a was included in the Watershed Watch sampling in 2001

Figure 1, a graph of data from Table 1, shows a fairly close correlation between **Secchi disk** depth and chlorophyll a results over the 21 years of record (correlation coefficient = 0.74). That is to say that, for example, when chlorophyll a readings were high, the Secchi depth was usually correspondingly shallow. There was a trend toward lower chlorophyll a concentrations through 1992 but ’93 and ’94 data both had increases and the 2001 results were higher than any previously recorded. The arithmetic mean or average of the dataset is 0.005 milligrams per litre (mg/L) which is at the threshold for a lake to be considered eutrophic.

Figure 1: Pike Lake Water Clarity

Secchi disk, TP, Chlorophyll a



The ten years of **Total Phosphorus** data, as depicted in Figure 1, show that there is not such a direct correlation (correlation coefficient TP:Secchi disk = 0.12) between parameters as there was between water clarity and chlorophyll a. During the three years with particularly elevated TP concentrations, correspondingly high measurements of chlorophyll a were not produced and/or water clarity was reasonably good. These results may be due to particular combinations of weather and overall water chemistry that coincided to limit the impact of the phosphorus on the growth of phytoplankton.

The data shows a considerable variation in TP levels. The significant change in TP from 1993 to 1994 was repeated in 1996 and ’97. The low levels from 1997 through 1999 were countered by the rise through 2000 and 2001. The arithmetic mean of the TP data, shown in Table 1, was 0.025 mg/L for the ten years of record which exceeds the Provincial Water Quality Objective (PWQO). However, the averages for 1997 through 2001 are all below the PWQO which means that it is hard to state definitively that Pike Lake is eutrophic or overly nutrient laden but the data suggests that it is on the verge of becoming so.

Total phosphorus concentrations increased through 2000 and 2001 after three years of relatively lower values. 2000 was a wet year and it is reasonable to assume that a quantity of phosphorus entered the lake from rain and runoff from the land surface. The spring and summer of 2001 brought above normal temperatures and very little rain and, therefore, lower phosphorus amounts could have been expected. Instead, there was an increase that might simply mean that the phosphorus was concentrated in less water due to reduced inflow and higher evaporative losses but there is insufficient information on which to base a definitive conclusion. Being so dry as it was, meant that solar radiation was increased which appears to have worked in conjunction with the available nutrients to produce an excessive quantity of algae with correspondingly high chlorophyll a counts (Figure 2). As the various species of algae flourished and died-off, the water colour changed from a reported brown in June to green through July and August. The “spike” in TP in September and October is likely to have been as a result of runoff from the rain that fell in the fall as well as the onset of the fall turnover.

Another at least partial explanation for the brown colour of the water is that Pike Lake may have elevated concentrations of Dissolved Organic Carbon (DOC). DOC can affect water clarity and it can influence the way that nutrients work in the system. Instead of being considered in terms of aging or eutrophication, lakes with higher concentrations of DOC are referred to as being in stages of dystrophy. There is presently no DOC data available and it would be useful to include it in future sampling programs.

There are only three years of data for **TP at the bottom of the lake** (Table 1) and, while there has been a decline in the amount of TP measured in 2001 as compared to 1983, the quantity is still well above the PWQO. The data in Table 2 in column three, TP deep point – Bottom, shows the course of TP over the summer. The bottom TP in solution declined over the summer as it would have been adsorbed to the bottom sediment but increased through September and sharply in October as the oxygen levels declined and the bulk of the die-off/decay process occurred.

Figure 2: Pike Lake, 2001 - Water Clarity, Deep Point

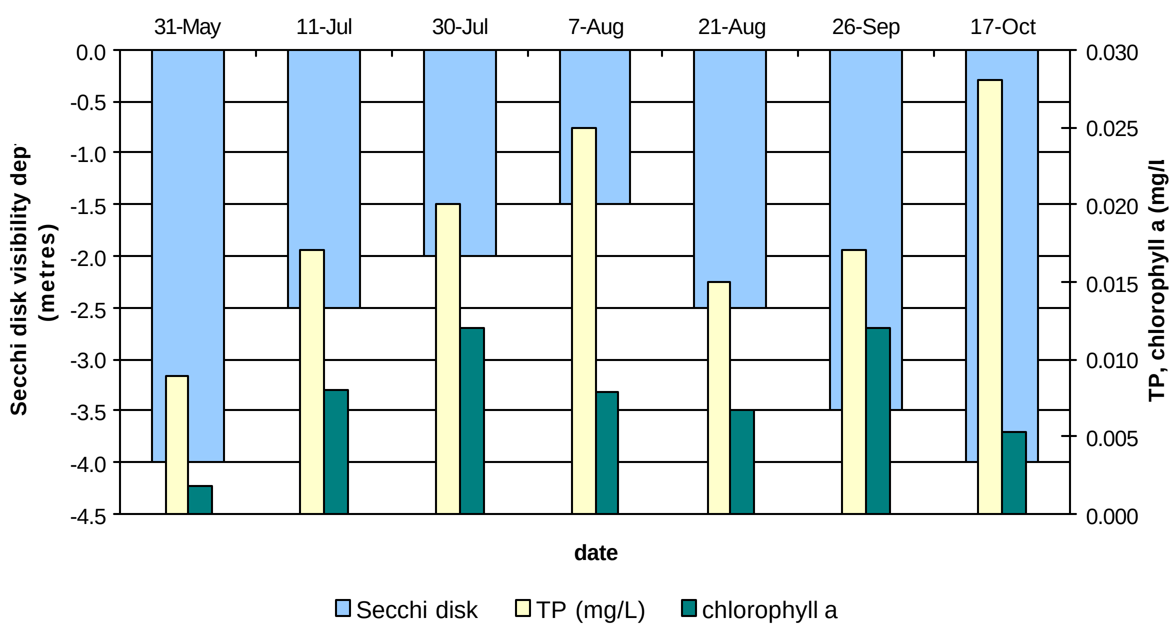


Table 2: Pike Lake, 2001 - Deep Point

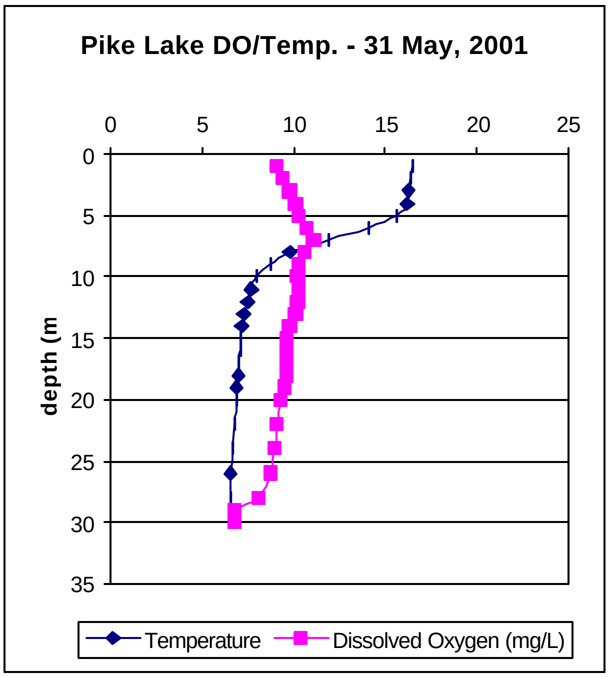
	TP deep point-Surface (mg/L)	TP deep point-Bottom (mg/L)	Chlorophyll a (mg/L)	Secchi (metres)
31-May	0.009	0.031	0.0018	4.0
11-Jul	0.017	0.034	0.0080	2.5
30-Jul	0.020	0.041	0.0120	2.0
7-Aug	0.025	0.025	0.0079	1.5
21-Aug	0.015	0.017	0.0067	2.5
26-Sep	0.017	0.047	0.0120	3.5
17-Oct	0.028	0.087	0.0053	4.0
average	0.0187	0.0403	0.0077	2.9

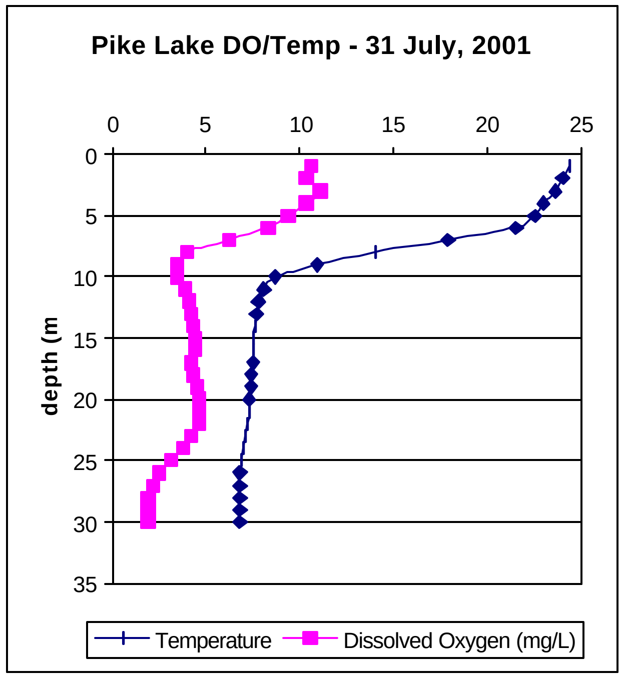
Note: TP DP-S and TP DP-B refer to the total phosphorus sample at the surface (S) and bottom (B) taken at the deep point (DP)

Table 3: Pike Lake, 2001 – Deep Point, Dissolved Oxygen/Temperature – 28 August (source: MNR)

Depth [Metres]	Temperature [Degrees Celsius]	Dissolved Oxygen [mg/L]	Percent Saturation [%]	Lake Stratification
0	24.1	8.2	97	Epilimnion
2	23.8	8.1	95	
4	23.6	7.8	91	
6	23.4	7.2	80	
8	16.9	0.5	4	Metalimnion or Thermocline
10	9.9	1.0	8	
12	8.4	1.7	15	
14	7.9	2.1	18	Hypolimnion
16	7.8	2.0	16	
18	7.6	1.5	13	
20	7.5	1.1	9	
22	7.4	1.1	8	
24	7.2	1.4	11	
26	7.0	1.1	8	
28	7.0	0.8	6	

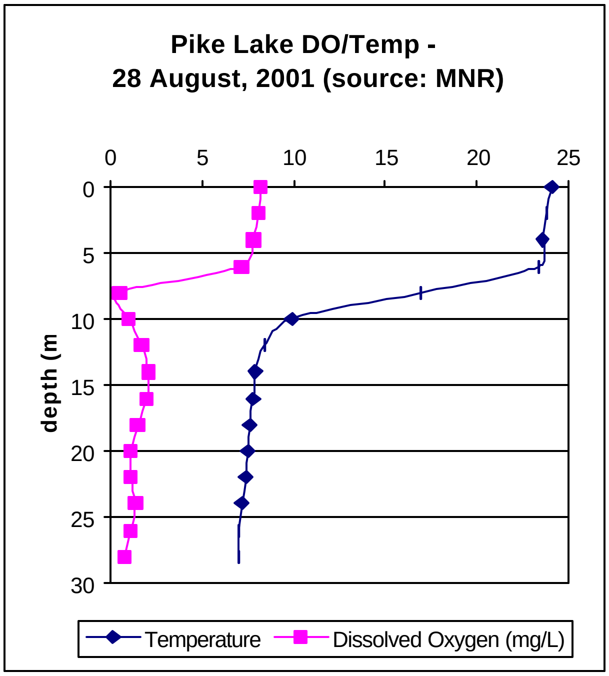
Figure 3, 4

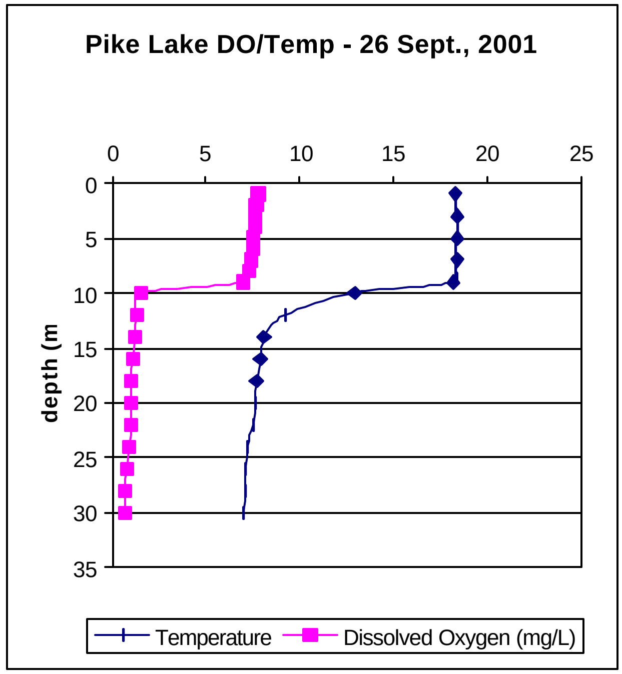




Dissolved oxygen and temperature profiling is important for all lakes because both parameters affect all aquatic organisms and the chemistry of the lake environment. As oxygen levels are lowered, phosphorus in the bottom sediments are more readily soluble adding to the loading available for plant growth. At the end of May, spring turnover was complete and stratification had occurred. Oxygen concentrations were still fairly uniform throughout the water column. Two months later the surface waters were much warmer and the oxygen content dropped off considerably below six metres. By the end of August, fish were confined to the top six metres in the main basin of Pike Lake but, while there was sufficient oxygen, temperatures were close to 25 degrees. At the end of September, surface water temperatures were lower but there were near anoxic (no oxygen) conditions below ten metres.

Figures 5, 6





Near the shore:

In addition to sampling at the deep point in the lake, the Watershed Watch program included sampling at a number of sites near the shore. The objectives were:

a) to look at the phosphorus and nitrogen distribution around the lake.
b) to do general sampling for bacterial pollution (E.Coli) in proximity to the larger groupings of cottages to see if there was a problem with septic and grey water entering the lake.

Table 4: TP - Pike Lake, 2001

SITE	31-May-01	11-Jul-01	30-Jul-01	7-Aug-01	21-Aug-01	26-Sep-01	17-Oct-01	Average
DP-B	0.031	0.034	0.041	0.025	0.017	0.047	0.087	0.040
DP-S	0.009	0.017	0.020	0.025	0.015	0.017	0.028	0.019
A		0.023	0.021	0.025	0.018	0.020	0.017	0.021
B		0.018	0.021	0.031	0.018	0.020	0.019	0.021
C		0.016	0.021	0.028	0.020	0.024	0.014	0.021
D		0.020	0.022	0.040	0.031	0.021	0.017	0.025
E		0.018	0.022	0.022	0.019	0.018	0.016	0.019
F		0.020	0.020	0.021	0.017	0.017		0.019
G		0.019	0.020	0.020	0.017	0.017	0.015	0.018
H		0.016	0.020	0.020	0.015	0.017	0.018	0.018
							2001 AVERAGE, SITES DP-S TO H	**0.020**

TP was fairly evenly distributed around the lake during the sampling period. Statistically, the majority of the data were within one standard deviation of the average (7 of 54 data equaled or exceeded one standard deviation, 3 of the 7 exceeded two standard deviations). Of the three samples that exceeded two standard deviations, one at site B in early August could have been as a result of some type of pollution but the concentration was in keeping with most other sites on the next sample data. Concentrations of TP at site D exceeded two standard deviations in both samples in August. TKN concentrations for the same times were also elevated (7 August sample greater than 2 standard deviations, 21 August higher than at other sites). E.Coli results were slightly elevated in September but not in August which indicates that a septic system leak is not likely to be the cause. Possible sources are increased cottage maintenance with fertilizer and pesticide application, a grey water source of some description, phosphorus and nitrogen accumulation of entrapment in the bay and/or nutrient laden inflow from the adjacent stream. Further investigation is recommended.

Table 5: TKN - Pike Lake, 2001

SITE	11-Jul-01	30-Jul-01	7-Aug-01	21-Aug-01	26-Sep-01	17-Oct-01	Average
DP-B	0.39	0.38	0.31	0.33	0.40	0.48	0.38
DP-S	0.52	0.66	0.72	0.52	0.60	0.53	0.59
A	0.90	0.71	0.71	0.59	0.66	0.53	0.68
B	0.57	0.66	0.94	0.56	0.68	0.48	0.65
C	0.53	0.70	0.79	0.55	0.74	0.42	0.62
D	0.53	0.64	0.88	0.63	0.58	0.42	0.61
E	0.51	0.65	0.69	0.55	0.58	0.41	0.57
F	0.54	0.64	0.64	0.49	0.57		0.58
G	0.53	0.65	0.72	0.54	0.59	0.41	0.57
H	0.51	0.66	0.67	0.50	0.59	0.47	0.57
						2001 AVERAGE, SITES DP-S TO H	**0.60**

The upper end of the range of the provincial guideline for **Total Kjeldahl Nitrogen** is 0.50 mg/L. Only one out of the forty-five surface samples was below that level through the July to September sampling (Table 5). The prevalence of high TKN values throughout the Tay River Watershed system suggests that there is a naturally occurring background level. Similar high counts were found in the Recreational Lakes program survey of Pike Lake in1983. As mentioned previously, total phosphorus is the primary or limiting nutrient in lake waters. In other words, without phosphorus, nitrogen cannot be used by the plants. Further, the right ratio of nitrogen to phosphorus must occur and the nitrogen has to be mainly in the nitrate form to produce plant growth. In 1983, when both TP and TKN were high, the lack of plant growth may have been because there was too much phosphorus to allow the nitrogen to have an impact. Similar conditions may have occurred in 1993 and '96. However, proportions appear to have been just right in 2001 with nitrogen complementing the phosphorus to produce persistent algae blooms. Rather than a dependence on the suitable proportions occurring from year to year, It would be better to reduce the available nitrogen in all forms (fertilizers, septic system effluent, pesticides) as much as possible. Also, a reduced and balanced nitrogen load lowers the risk of nitrogen toxicity for aquatic animals. Specific sampling might be done to determine what the proportions of the forms of nitrogen (ammonia, nitrites, nitrates) are.

The limited amount of data for the lake bottom shows that TP concentrations are typically higher in the deeper waters than at the surface. In 2001, TKN levels were lower at the bottom than at the surface over the summer. However, in 1983 the reverse situation prevailed with higher TKN values in the bottom waters throughout the sampling period. This suggests that there is not the same "sink" affect as with TP although there appears to have been some vertical movement in October with higher TKN concentrations at the bottom than at the surface. Horizontally, there appears to be a downstream movement of TKN and, to a lesser extent, TP with higher levels at site A in the outlet stream from the lake than at site F at the inlet from Little Crosby Lake which means there may typically be a potential for progressively greater algae and weed growth from the west to east ends of the lake.

Table 6: E.Coli - Pike Lake, 2001

SITE	11-Jul-01	30-Jul-01	7-Aug-01	21-Aug-01	26-Sep-01	17-Oct-01	Average
A	2	4	8	2	2	4	3.67
B	2	2	2	2	2	2	2.00
C	2	2	2	2	2	2	2.00
D	2	2	2	2	8	2	3.00
E	5	2	2	2	2	2	2.50
F	22	2	2	2	2	2	5.33
G	2	4	2	2	2	8	3.33
H	2	2	2	2	2	2	2.00
						2001 AVERAGE ALL SITES	**2.98**

Escherichia coliform (E.Coli) is used as an indicator of the potential presence of other harmful bacteria and pathogens in water. The main sources of bacteria are animal (decay of dead animals, defecation near and in the water) and human waste (septic systems, grey water). Levels above the PWQO of 100 counts/100 mL can mean that the water is unsafe for swimming. As a general precaution, lakes should not be used as the primary drinking water source and use for washing and cooking should be limited.

The relatively high E.Coli count at site F in early July may be due to something as simple as coincident bird droppings. As discussed previously, the slightly raised E.Coli count at site D in September cannot reasonably be combined with the elevated TP and TKN counts through August to conclude that there is a leaking septic system in the vicinity. Persistent occurrences over two or more sample dates of high counts would indicate that there was a bacteria pollution source which needed to be further investigated. Both TP and TKN concentrations could be expected to be elevated as well. The results for Pike Lake indicate that there are very low levels of E.Coli bacteria in the water. While all parts of the lake were not sampled, the E.Coli results can be considered to reasonably indicate that the waters of Pike Lake did not pose a health concern for cottagers and residents for swimming and other water contact recreational use in 2001.

(Note: Not all bacteria are harmful. Some can be a food source for macroscopic aquatic invertebrates. Also, what is commonly referred to as blue-green algae, is a bacteria which shares many characteristics with algae and can be toxic to aquatic species as well as cause reactions in humans).

Pike Lake was also tested for **invasive species** in 2001, in particular, for zebra mussels and spiny water flea, in partnership with the Ontario Federation of Anglers and Hunters (http://www.invadingspecies.com/ for more information). Neither species was found in Pike Lake or upstream in Crosby or Little Crosby Lakes. Residents need to take precautions to avoid bringing in invasive species as well as to ensure that all access points to the lake have posted signs indicating what boaters can do to avoid infesting the lake.

In conclusion:

The historical data and the results of Watershed Watch sampling through the summer of 2001 indicate that Pike Lake has a variable quantity of nutrients that are at and often in excess of the accepted threshold values. These nutrients caused and can be expected to continue to cause algae blooms, increased aquatic weed growth and low dissolved oxygen concentrations. This will eventually have a detrimental affect on the diversity of fish and other aquatic animal species and summer fish kills may become a common occurrence.

Of the six things in the list on the first page of this section of processes and actions that affect the character of a lake, the first point has to be addressed by society as a whole. The amount of phosphorus reaching lakes by airborne deposition can be reduced by controlling the amount which gets into the air from industrial and other emissions. It is the last point in that list which is entirely the responsibility of those who own property around the lake to act on. It is not possible to restore Pike Lake to a “youthful”, nutrient free condition nor should that be the objective because it would mean that the present degree of biodiversity would be lost. However, changing the style of use can be a factor in slowing the process of lake aging.

FIVE EASY STEPS TO IMPROVE WATER QUALITY

1. Build at least 30 metres away from the shoreline.
2. Keep your lot well treed and preserve or replant native vegetation along the shoreline.
3. Pump out your septic tank every three to five years and have the tank and tile field inspected periodically.
4. Reduce water use and use phosphate free soaps and detergents.
5. Keep the size of your lawn to a minimum; do not use fertilizers, herbicides or pesticides.

LOW PHOSPHORUS LIFESTYLE		**HIGH PHOSPHORUS LIFESTYLE**	
HUMAN WASTE	535 g	HUMAN WASTE	535 g
NO DISHWASHER	0 g	DISHWASHER USING POWDERED DETERGENT ONCE PER DAY	650 g
NO FERTILIZER	0 g	LAWN FERTILIZED ONCE/YEAR	1,960 g
TREES NOT CUT DOWN	20 g	LOT CLEARED OF TREES	30 g
USES PHOSPHATE-FREE PRODUCTS	20 g	USES PRODUCTS WITH PHOSPHATES	180 g
TOTAL	**575 g**		**3,355 g**

For more information regarding *Watershed Watch* or for free advice on how you can help protect or enhance your lake environment, contact the Landowner Resource Centre at (613) 692-2390 or lrc@rideauvalley.on.ca