The Reynolds Protocol
Lake Water Quality Testing

1.0 OVERVIEW

The real value in monitoring your lake water quality becomes obvious over a period of several years. You are not strictly focused on the quality at any given time, but trying to determine long-term water quality trends in the lake.

Water clarity is an indirect measure of the algal density in the lake. Water clarity (algal density) is affected by total phosphorus (TP), the principal nutrient that makes lakes more fertile. Since algae are plants and TP is a fertilizer, more TP in the water will mean more algae and lower water clarity. By taking both TP and water clarity readings, we track two trends that confirm each other. If the TP reading is decreasing and the Secchi disc reading is increasing, we can say that the lake is becoming less fertile, and that there is less potential for algal blooms and fouled water. Water clarity is also affected by swamp and watershed runoff. Some lakes are tea-colored because of this.

Clarity is just one of the many water quality indicators. It is affected by the colour of the water, suspended sediments or, in most cases, algal levels. As it can be influenced by activities around a lake, water clarity can be an indicator of land use impacts or acidic precipitation.

Water clarity can change weekly or yearly as a result of weather, length of winter ice cover, shoreline development, natural seasonal trends or other impacts. In general terms, water clarity decreases as nutrients from the surrounding watershed enter and enrich the lake. Like grass, algae grows best with more nutrients.

Large amounts of algae result in reduced water clarity. Lakes with minimal nutrients input, and correspondingly low nutrient concentrations, often support only small amounts of suspended algae and consequently, are clear water lakes.

If the lake is getting more fertile and less clear, the fish community can change. For example, lake trout prefer the well oxygenated conditions of a really clear lake and may be harmed if the lake gets too fertile. But the issue is complex.

The Ontario Ministry of Environment is presently using the following scheme to interpret the quality of lake water based on average annual total phosphorus and average Secchi disc readings.

If Your Readings Are:	Your Lake Can be Classified As:
Total Phosphorus: less than 0.010 mg/L Secchi Disk Reading 5.0m or over	**Oligotrophic:** Clear water with very low levels of phosphorus, algae and nutrients.
Total Phosphorus: 0.010 to 0.020 mg/L Secchi Disk Reading 3.0m to 4.9m.	**Mesotrophic:** Moderately clear water with moderate levels of phosphorus, algae and nutrients.
Total Phosphorus over 0.020 mg/L Secchi Disk Reading less than 3m	**Eutrophic:** Very low water clarity with high of phosphorus, algae and nutrients.

Please note that these are general categorizations. Each lake has a unique environment and history. Thus, comparing values from lake- to-lake can, in some cases, be misleading. The most important information is gained by observing long-term trends in the annual averages for your lake over a number of years. If your phosphorus readings are stable or decreasing, this would indicate that the health of your lake, from the standpoint of unwanted nutrient loading, is stable. If phosphorus readings are increasing from year-to-year, action on the part of your lake association might be warranted. Such action would include identification of the human activities which might be causing the increase in nutrient loading. Then strategies designed to reverse the trend could be undertaken.

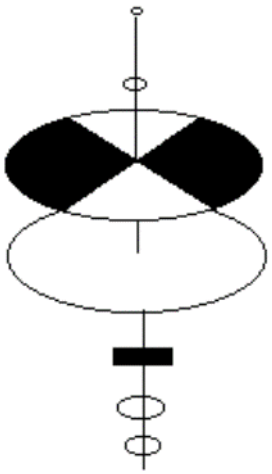
As well, a given lake may naturally experience a variation in readings from mont- to-month due to environmental factors specific to that lake. If a lake experiences significantly higher phosphorus in the Spring, for example, this might be a regular and natural yearly occurrence. This lake could be quite healthy, with low overall phosphorus readings. For this reason, an average of the readings taken in May and August would be better than only the one reading in May. The most useful indication of a lake's health would be determined from an average of readings taken from all six months of the ice-free season. (See Section 3.0, Phosphorus Analysis Procedures.)

2.0 SECCHI DISCS

What is it? It is a round, flat disc with alternating black and white quadrants which can be lowered into the lake to visually measure water clarity. The depth at which the Secchi disc disappears, provides an indication of the level of nutrients and algae growth in the lake.

Secchi disc dipping is a simple do-it-yourself water clarity test that is one important indicator of the health of your lake. Participation is easy. Just follow the instruction for building a Secchi disc, lower it into the lake and record the depth at which it disappears.

How to Build a Secchi Disc



Attach a Secchi disc sticker to a paint can lid or a weighted plastic disc. Two floor tiles stuck together with contact cement make an excellent base. A hockey puck works well as a weight.

- Drill a hole in the centre of the disc and the hockey puck for an eye bolt and secure with washers and nut as illustrated.
- Mark a 1/4" rope in metres using a waterproof felt pen. The rope should be a minimum of 10 metres in length.
- Tie the rope to the eye bolt.

How to Take a Secchi Disc Reading

- Take the reading away from shore in the deep parts of the lake, over the shady side of the boat. Do not wear sunglasses.
- Lower the Secchi disc into the water, making sure the line is straight. Record the depth at which it disappears (Reading A).
- Slowly raise the disc a few centimetres, recording the depth at which it reappears (Reading B).
- Average the two readings using the formula (A + B) ÷ 2. The result is your Secchi disc, or water clarity, reading.
- Take the first Secchi readings soon (approxixmately 1 week) after ice-out and future readings at the same locations each time.
- Spread the Secchi readings as evenly as possible throughout the season. This will give a more accurate mean annual reading.
- Taking regular Secchi readings for one person is a large undertaking. If approached as a team effort, the project becomes more manageable.
- A key factor is to maintain the same sample sites year after year. This is necessary to monitor an accurate long-term trend which is crucial to understanding water quality trends.
- How often? While a single Secchi disc reading can provide an indication of lake health, regular readings recorded over several years will identify trends and allow early detection of changes. For example, suddent water clarity increases could be a warning of zebra mussels.
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3.0 PHOSPHORUS ANALYSIS PROCEDURES

3.1 THE LABORATORY
(Approximate Cost: $15.00 per sample)

Ensure that the selected laboratory will test **total phosphorus** (not just phosphates) and has the ability to detect concentrations of 0.001 to 0.002 mg/l (many laboratories cannot detect below 0.02 mg/l). The more precise reading is necessary to observe variations between readings. Make sure the laboratory is aware of this requirement or they may test to 0.010 only.

3.2 THE METHOD

3.2.1 Timing

Opinions differ on frequency of sampling, number of locations to be sampled, and the number of tests to be conducted on the samples.

All agree that a sample must be taken at Spring "lake turnover" (one week or so after ice-out). For some, that is the only sample taken, while others sample again in August; others in August and October. The Federation of Ontario Cottages Association Inc. recommends additional sampling in all ice-free months (May to October).

For the first year of total phosphorus testing, it would be practical to sample at the "lake turnover" time plus in August and October. If these results are favorable, perhaps sampling at the lake turnover time would be adequate in future years; at least until/unless conditions deteriorated.

Spring "lake turnover" occurs each year about one week after "ice-out". At this time the water may be somewhat murky. It is at this time that the water temperature is the same from top to bottom of the lake.

3.2.2 Location

Most choose one location only. Some select additional location(s) in major bays. All agree that the locations must remain the same, year after year.

3.2.3 Quantity -- Samples / Analysis

Some take two samples at the selected location(s) once a year and average the test results. Others take one sample only, once a year, but have the laboratory conduct three tests on that sample and average any differing results.

One sample, taken at one or more sites and taken three times during the first year, with one laboratory analysis on each sample, should provide a very thorough indication of total phosphorus of the lake for that year.

How to Collect Samples

The following advice, augments the specific sample instructions you will receive from your selected test laboratory regarding the taking, care and handling of water sampling.

Collecting a water sample is a simple procedure, and takes longer to explain than to do. The first step is to select a sampling location in the deep, open-water area of the lake away from islands, docks or

projecting shorelines. Station locations should remain the same from year-to-year to determine trends in water quality.

Next, you will need a one-litre wine bottle or other glass bottle that has been thoroughly cleaned. There are several ways to make the glass bottle sink. One way is to attach an old hammer or other heavy weight to the side of the bottle using duct tape. Then, securely tie a rope to the hammer. Alternatively, you can make a bucket-shaped carrier, into which the glass bottle will fit. Punch holes in the bottom of a 48 oz juice can (to allow water to drain) and put in some flat stones or other weights. Add a wire handle, to which your rope will be tied. Finally, securely wedge the wine bottle into the can with thin pieces of wood.

After determining the Secchi disc depth, measure out twice this amount of rope and mark it with a clip or knot. This is the depth of the euphotic zone (depth of light penetration) through which the water sample for phosphorus is collected. In shallow lakes where twice the Secchi disc depth would be deeper than the bottom, the water sample is collected to within 1 metre above bottom, taking care not to disturb the bottom sediments. You want the bottle to fill with water all the way down and all the way back up. This composite sample will then represent all levels of the lake water in the euphotic zone.

The glass bottle should be rinsed thoroughly before each sampling and between sample locations. Allow the sample bottle to be lowered as quickly as possible to the measured sampling depth and then raised to the surface. If the bottle is not filled, or if it has completely filled before coming back to the surface, empty the bottle and repeat. Adjust the rate of retrieval such that the bottle just fills as it reaches the surface.

In the case of any transparent lake (Secchi depth greater than 5 metres) it may be necessary to reduce the size of the opening in the bottle. This may be done by using a bottle cap in which a 1/2" hole has been drilled.

Finally, the water from the glass bottle is poured into the sample bottle supplied by the laboratory, and the sample is sent away. And that's really all there is to it!

Samples should be refrigerated (or kept cool) until transported to the laboratory. For people collecting samples on weekends, Sunday is preferred to Saturday. To the extent possible, samples should be collected at a time convenient for delivery to the laboratory to minimize sample storage and transit time.

4.0 ZEBRA MUSSELS

The introduction of this species is believed to have been made in the mid 1980's in the Great Lakes and it has spread rapidly into many waterways, including the local Ottawa River. They are extremely prolific and cause a great deal of damage.

The Quebec Ministry of Environment has provided the following table which depicts the probability of zebra mussel survival in various ph (acidity) and total calcium levels which are the most significant factors effecting their lives. Additionally, zebra mussels cannot reproduce unless the temperature is over 12°C.

Diagnostic on:

1) survival of larvae and adults; and

2) maintaining a viable population according to pH and concentration of total calcium.

Analysis Chart

Maximum Values Held	Survival Larvae and Adults	To Maintain Population
pH <7.0 (less or equal to) Ca < 10 mg/l (less or equal to)	Unlikely survival of adult Impossible larvae development	Impossible
pH > 7.4 and (greater than or equal to) 10 < Ca < 20 mg/l (less than)	Assured survival, growth and reproduction	Probable establishment and maintaining of population
pH > 7.4 and (greater than or equal to) Ca > 20 mg/l (greater than or equal to)	Assured growth and reproduction	Very probable establishment and maintaining of population
7.0 < pH < 7.4 and (less than) Ca > 10 mg/l (great than)	Grey Zone: difficult to establish growth and reproduction success. It could depend on the variability of physico-chemical conditions	Unlikely establishment and maintaining of population

4.1 Testing

Some experts suggest collection at one to three locations (include near sources, creeks, etc.) twice a year **but** if your first testing reveals a -7.0 ph and a -10.0 mg/l calcium, mussels cannot survive, so multiple testing would appear excessive.

a) PH Analysis
(Approximate Cost: $10.00 per test or do-it-yourself)

Samples are collected at 0 to 1 metre depth and sent to a laboratory, or you can do this simple test with a good quality fish tank water test kit (or a very specific pool kit). If utilizing a laboratory, follow their instructions.

b) Total Calcium
(Approximate Cost: $10.00 per sample)

As calcium concentrations are not normally subject to significant fluctuation during the year or at various lake locations, one or two sample sites should provide adequate confidence to compare to the above "Analysis Chart". Follow the laboratory's instructions regarding collection and handling of samples.

How can you help?

To help prevent or slow the spread of zebra mussels:

- Always clean your boat thoroughly before moving it from one waterway to another. (Especially from the Ottawa River or the Great Lakes..
- If your boat hull or trailer has a grainy surface, it could contain zebra mussels or larvae. Wash it thoroughly with a household bleach solution -- 15 mL (one tablespoon) bleach per 4.5 litres (one

gallon) of hot, soapy water. **Do not use the bleach solution near any water body as the aquatic life in that water body could be adversely affected.**

- If you see zebra mussels on any part of your boat, scrape them off with a paint scraper or use high-pressure water (250 p.s.i.) **before** leaving the infested lake.

- If it is hot and dry, leave your boat out of water for at least three days and the mussels will die. Some may drop off, but others may need scraping. Dispose of mussels in a garbage container or waste disposal site away from any water body or sewer.

- **Never** use lake or river water to transport live bait, and never transfer water from one body of water to another body of water as you could be transporting zebra mussel larvae which are invisible to the human eye.

- Rinse live wells, bilges and pumping systems in your boat with the household bleach solution.

- **If you are already inland** and have a boat or other equipment that may contain water from another waterway (and therefore possibly zebra mussels), ensure that you clean the equipment and dump the water on dry land, well away from any lake, river, stream or sewer system.

5.0 FECAL COLIFORM (E-coli)
(Approximate Cost: $6.00 per sample)

Most lake associations are probably already conducting water tests for the presence of this bacteria.

Untreated surface water can never be certified as drinkable. The testing for fecal coliform is to determine whether or not the water is safe for swimming.

It should be noted that samples taken at spring run-off and immediately following rainfall can be expected to produce less favorable results. Contamination is also more probable near the shoreline.

Samples are normally taken during the swimming season and at places where people swim. The Quebec Ministry of Environment suggests samples be taken at "knee to chest".

Test Results (in parts per 100 ml)

0 - 20	Excellent
21 - 100	Good
101 - 200	Mediocre
200 +	Not fit for swimming

Note: Carefully follow the laboratory's instruction regarding collection of samples and handling of sampling bottles.
