

Patterson Lake – The Lake and its Water

Drafted by Lorne Bowerman, December 2009

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There is little doubt that Patterson Lake is the centre of attention for all who live around the lake. And if we look a little more closely, the lake water itself is the central focus. If the lake were sludge filled, dirty, and smelled offensive, how many of us would be enjoying our summers there, or living there permanently?

Patterson Lake is a treasure. As a small headwater lake it has managed to survive as a lake upon and in which to enjoy lake activities. And the credit for much of this goes to those who use the lake.

This paper will look at the many aspects of the lake from a technical sense, which will include origins, growth, historical and current water quality, chemical make-up of the lake water, temperature, and things that can harm the lake water quality.

The Physical Lake Data in 2008

Latitude	45°00'
Longitude	76°32'
Surface Area	148.9 hectares (368 acres)
Volume	610 hectare metres (4.863 acre feet)
Height above sea level	200 metres (659 feet)
Perimeter	11.3 kilometres (7 miles)
Maximum Depth	18.9 metres (62 feet)
Mean Depth	4.1 metres (13.3 feet)
GPS of the Deepest area	N 45°00'25.7" W 76°31'37.3"

There are nine inlet creeks. There is one outlet creek. From the work done on lake testing in 2007, it appears that only three of the inlet creeks flow all summer.

The Political Lake Data in 2008

Patterson Lake straddles Concessions V, VI, and VII, and Lots 13, 14, and 15 of Dalhousie Township, now the Township of Lanark Highlands.

Except for Crown land, the entire shoreline is classified as Rural Area – Lake Development Area. The areas of Crown land are the three points in MacCrimmon Bay area (the large bay on the centre south side, the larger leftover point on the water between the end of Lakeside Rd and Hardwood Ridge Rd, and all of the four islands in the middle of the lake. All of these mainland Crown areas are small leftover isolated pieces of the concession and lot allocations. The map of the Official Plan is on the Township of Lanark Highlands website as:

http://www.lanarkhighlands.ca/PlanningZoning/plan/LH_OP_A2.pdf

The Official Plan of Dalhousie Township permitted 116 development lots on Patterson Lake, of which around 100 have been utilized in 2008. In particular, the area between Parsons Way and Fairs Lane along the south side is all classified as development lots.

The maximum development number of 116 has not been found in the Official Plan of Lanark Highlands, which could cause a concern for lake property owners.

Origin of Patterson Lake

When you look around the lake today, it is hard to realize that it was not that long ago in geological terms that it was part of a larger lake called the Champlain Sea. In human terms, it was 10,000 to 13,000 years ago, just a drop in the bucket of geological time. And further back than that, it was under a huge thick glacier that was part of the Ice Age. The weight of the glacier depressed the earth's crust so much that when the ice started to melt and retreat to the north, the salt water from the ocean filled the depression. The melting ice cap diluted the salty sea water.

So everything we see around us on the surface came here in the last 10,000 years as the earth's crust rebounded and the Sea drained back to the Ocean.

The ice cap that covered the area started in the Arctic and ground its way relentlessly southward, pushed from behind by the built-up of more glacial ice in the north. The ice age left its mark in shaping the earth's surface by grinding and wearing away the surface, scooping out anything that was movable on the surface and carrying it along with it, and finally when the ice cap started to melt, depositing all the debris on the earth's surface. Some debris was carried great distances and simply dropped to the surface during the melt. The debris forms the many gravel pits that are in the general area. In the lake area, the gravel is in the western end.

The two main lakes in our immediate area, Dalhousie and Patterson, give an indication of the direction of the growth of the ice cap in an east-west direction. A little further west and the lakes show a more north-south type of direction of ice cap growth. This can be readily seen if you view the many satellite maps available on the Internet.

If you were looking at Patterson Lake without any water in it, you would simply see more of the surrounding territory with small rocky ridges and small valleys. Nothing dramatic. You could walk or easily climb over the entire bottom surface of the lake as you can climb over the ridges and valleys that make up the area. In the centre of the lake running in an east-west direction there is a pronounced ridge with Mary's Island and its shoal rock on the west at the top of the ridge. The ridge falls off rapidly in a few metres to the north to form what would be a small valley if there were no water, but for the lake filled with water, it is the deepest part.

Both the eastern and the western ends of the lake are moderately deep in the centre and gradually rise to what is the shoreline. Even the eastern end which has the basin filled with floc has this bottom pattern.

The only outlet for the lake is Fairs Creek in the east. It was never deep and there is no evidence of a canyon being cut in the creek bottom when the land was draining from the run-off of the melting ice cap.

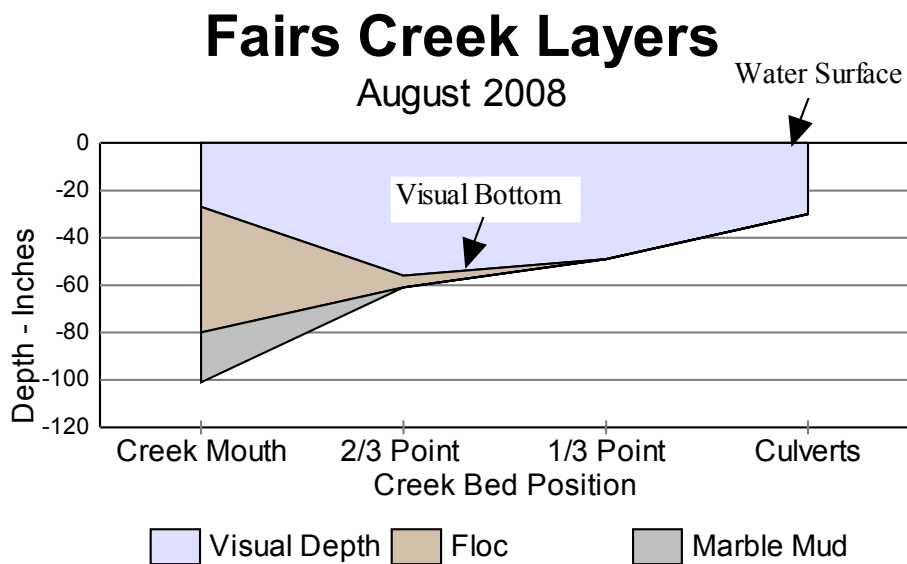
Patterson Lake is a low point in the surrounding area, that simply filled with water because the water had nowhere to run.

Further information on the Champlain Sea can be found at:
http://hoopermuseum.earthsci.carleton.ca/2001_champlain2_mb/history.htm

Bedrock Geology and Lake Acidity/Alkalinity

A major influence on the make up of the water in a lake is the bedrock which lies under the lake. Patterson Lake lies about 10 km inside the irregular line of the Canadian Shield so it is part of the transition land from the Shield to the deeper soils of the more fertile region to the south with its limestone and sandstone bedrock. The lake has marble bedrock under the north eastern and south western ends, and igneous and metamorphic rock around the rest of lake.

Of particular interest for the lake, there is a significant 20 inch layer of limestone/marble “mud” at the mouth of Fairs Creek (the lake's outlet). There is also the same “mud” off 151 Lakeside Rd. Where did this mud come from? It came with the ice as it ground its way south. The limestone/marble rocks were ground to a powder by the advancing glacier and was carried along or deposited. It was then left behind when the glacier retreated.



The limestone/marble mud was not found on the south-western or north-western shores of the lake when that part of the lake was sampled by Lorne & Connie Bowerman in September 2008. It may be elsewhere and just has not been found.

Typically, the igneous and metamorphic bedrock have soils on the neutral to acidic side while the limestone and sandstone bedrock have soils are on the neutral to basic side. The lake has a pH of 8.3, which is classed as slightly alkaline, indicating the predominate

influence of the marble, created by pressure or heat from limestone bedrock. A pH of 7 is neutral, while below 7 toward zero becomes increasingly acid and above 7 toward 14 becomes increasingly alkaline. The “mud” noted in the above paragraphs would undoubtedly contribute to the alkalinity.

Being slightly alkaline is nothing unusual for lakes in southern Ontario with the Great Lakes annual means falling in the 8.0 to 8.5 range. With the pH of typical rain in the area being 5.4, the alkaline water neutralises the acid rain and renders it more neutral. Our closest neighbouring lake, Dalhousie Lake, is reported in the 2006 Watershed Watch Report by the Mississippi Valley Conservation as being in the same pH range.

A good reference about the effects of pH of lake water is a book called *The Cottage Bible*, written by Gerry Mackie and Laura Elsie Taylor and published in 2007 by Boston Mills Press in Erin, ON. (www.bostonmillspress.com)

One major effect of having an acid or alkaline lake is the variety of plants that will grow in the lake. Some plants like the soil and lake on the acid side, while other plants like the soil and lake on the alkaline side. We have Chara species (which is actually an algae) growing in the lake and Chara likes alkaline water. It is a good indicator of whether the lake is acid or alkaline.

Water Clarity

Lakes start out as pristine lakes with no life living in them. They are very clear, and it is startling to look down five metres in a pristine lake and see the individual pebbles on the lake bottom. From a biology point of view, the lake is dead. Gradually from run-off from the surrounding land, nutrients are added to the water so some aquatic life can begin to live in the lake. The cycle continues gradually until it becomes so filled with nutrients that plants take over the lake and gradually turn the lake into land. The term used to describe this change is called “succession” which goes from Oligotrophic (pristine), Mesotrophic (moderate enrichment), and Eutrophic (organically enriched). Patterson Lake is in the Mesotrophic level.

One of the simplest methods to measure water clarity is with something called a Secchi disk. It is a 8 inch diameter flat plate painted alternately black and white in the four quadrants. The disk is lowered in the water on a rope and the point at which an observer cannot tell the difference between white and black is recorded. For an Oligotrophic lake the Secchi readings are greater than 5 metres (16.4 feet). For a Mesotrophic lake, the readings go from 2 to 5 metres (6.5 to 16.4 feet). Eutrophic lakes have Secchi readings of less than 2 metres (6.6 feet).

Patterson Lake has consistently been around 4 to 5 metres since 1960. 1960 is the earliest data that has been found.

The Watershed Watch data from Mississippi Valley Conservation are available at their website, <http://www.mvc.on.ca/water/watch.html>

Phosphorus and Chlorophyll

Mississippi Valley Conservation place considerable emphasis in their testing on phosphorus and chlorophyll and the relationship to water clarity. The 2006 published data in their Watershed Watch states the following: (1 microgram = 1000 milligrams)

Directly related to water clarity is the amount of nutrients, in particular phosphorus, entering the lake. The Provincial Water Quality Objective for Total Phosphorus for Patterson Lake is 20 micrograms/litre ($\mu\text{g/L}$). The mean for euphotic zone (penetration of light) for 2006 is 11.3 $\mu\text{g/L}$ indicating an moderately enriched lake and the mean for the sample taken one metre off the bottom is 15.0 $\mu\text{g/L}$, also indicating a moderately enriched (some nutrients) or mesotrophic lake.

Chlorophyll a is a measure of the algal density in the lake. The average chlorophyll a densities for the sampling station in 2006 was 3.1 micrograms/litre indicating, a moderate algal density for Patterson Lake.

The Watershed Watch data from Mississippi Valley Conservation are available at their website, <http://www.mvc.on.ca/water/watch.html>

The spring value trophic status for phosphorus given in The Cottage Bible (spring value because algae use up nutrients as the water warms up) are: Oligotrophic - < 10 $\mu\text{g/L}$; Mesotrophic – 10 to 30 $\mu\text{g/L}$; and Eutrophic -> 30 $\mu\text{g/L}$.

The conclusion is that Patterson Lake has good water, but watchfulness is required in the future to ensure that excessive nutrients do not enter the lake.

Water Hardness

The concept of water hardness is used to describe the resistance to lathering of a soap. In hard water, the calcium and magnesium ions in the water react with the soap to form a scum instead of a lather of soapy bubbles.

The concentration of calcium carbonate is used to describe the degree of water hardness. Soft water is classified as having less than 60 mg per litre (mg/L). Medium hard water has from 60 to 120 mg/L, hard water has from 120 to 240 mg/L, and very hard water has over 240 mg/L.

Three tests done at a commercial water testing lab during the summer of 2007 produced the following results for the lake: hardness as CaCO_3 : 83 to 110 mg/L, Calcium: 25 to 34 mg/L, and Magnesium: 0 to 6 mg/L.

The lake therefore is in the medium hard water classification. Two plant indicators of this hardness are Duckweed and Stonewort (Chara species). There is Stonewort in the lake but not too much Duckweed in 2008.

Nitrogen Levels

Another important chemical characteristic of lake water is the nitrogen content as it is an important nutrient for plant growth. High levels of nitrogen imply a rich medium for plant growth, which reduces the lake water quality that most humans desire.

Total nitrogen is obtained by adding the nitrates, nitrites, and the total Kjeldahl Nitrogen. Total Kjeldahl Nitrogen (TKN) is the sum of organic nitrogen and ammonia in a water body. Measured in milligrams per liter (mg/L). High measurements of TKN typically results from sewage and manure discharges to water bodies.

For Patterson Lake, it is safe to assume that the total Kjeldahl Nitrogen is close to zero as there is no agricultural land bordering the lake. This means that there is no run-off that would add significant quantities of nitrogen to the lake, nor are there farm animals around the lake that could add nitrogen from manure. That would leave the total nitrogen value as the addition of nitrites and nitrates.

The spring value trophic status for total nitrogen given in The Cottage Bible are:
Oligotrophic - < 300 µg/L; Mesotrophic – 300 to 650 µg/L; and Eutrophic -> 650 µg/L.

Mid-summer tests done at a commercial lab in 2007 of lake water samples gave nitrites as NO_2 - < 100 µg/L and nitrates as NO_3 - 130 µg/L. If these are added, and assuming the total Kjeldahl nitrogen as zero, it produces a total nitrogen of < 230 µg/L, which places the water in the Oligotrophic category.

Therefore for Patterson Lake, the nitrogen value in the lake water is not significant. Further, testing for nitrogen is not included in the Watershed Watch reports on the lake as phosphorus is usually considered the limiting nutrient for plant growth.

Floc

The water is shallow at the eastern end of the lake and the bottom is appears quite soft. At first glance one concludes that this is just a soft silty bottom. However on closer inspection you can observe that the “bottom” is not silty, but made up of a soft gelatinous mass. One is further confused if you try to reach bottom with a pole because the pole just keeps going down. If your pole is long enough, you will eventually hit solid bottom.

If you keep using the pole from shore to shore at the eastern end, you can get a profile of typical bottom with about 6 metres (19 feet) depth in the centre, and the bottom slowly rising to the north, south, and eastern shores. It is not that different from the western end of the lake. If you described the actual bottom as being a basin, you would not be far wrong.

However, the thing that make it different is that this basin is filled with something called floccules, or floc. If you search for floc or floccules on the Internet you will readily find that it occurs around the world, quite frequently in areas behind a dam.

The September 2005 newsletter from the Patterson Lake Association gave the following account of putting a name to this floc.

In the summer of 2005, Trevor Dee and Lorne Bowerman rigged up a 18' sapling with a small can and a plug. The sapling was forced down and samples were taken of the soft material at the 14', 7', and 5' depths below the surface.

The samples were a tinged pink gelatinous substance homogeneous in appearance from all levels. It has a faint swamp smell. There was no noticeable particulate such as from sawdust.

Samples were dropped off at the MVC for testing. Susan Lee (MVC) kept the subject alive until we had an answer.

A scientist from the Museum of Nature in Ottawa said that "this is an organic mat (floc), biologically created mainly by cyanobacteria. In the floc are many things from pollen to diatoms. Although you cannot see the cyanobacteria easily in these micrographs, they are small colonies of spherical cells contained within mucilage (organic floc). These colonies mass together to form the large mass you have collected. This type of matter is commonly found in the bottom of lakes. The "pink" colour is most likely the breakdown products from the biological matter and not Fe like I had suggested earlier. I don't know what the specific chemical is, but I can say that I have not read anything about this being toxic."

Floc or floccules are formed by the flocculation process which is defined in a reference as "the process by which suspended colloidal or very fine particles, are assembled into larger masses or floccules which eventually settle out of suspension."

The collective scientific staff at 151 Lakeside Rd think the algal floc has been there for hundreds, if not thousands, of years. In the ice age the lake bottom was probably dug out to over 18' at the eastern end, but the outlet, Fairs Creek, upstream from the present culverts is only 3' deep in mid-summer, and the bottom is very solid. This coupled with the absence of any hint of a gorge suggests that only the top of the lake drains leaving a basin at the bottom with little movement.

The algae is alive from top to bottom. The whole mass is quite porous.

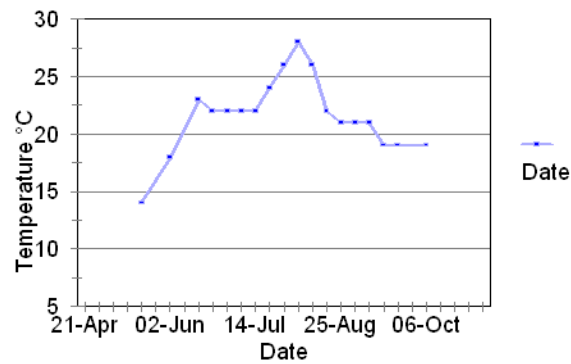
It poses no risk to fish or humans.

Water Temperature

Patterson Lake provides great swimming. The water is clear. The temperature in the summer is warm. And for those living on the lake, it is readily available.

The hearty souls usually make it in by the May long weekend. By July 1, the water is warm enough for everyone. By Labour Day, the temperature starts to lower, but it is still quite pleasant. By Thanksgiving, swimming is usually a

2007 Patterson Lake Water Temperature
Degrees Celsius



thing of the past, but as a notable exception, it was warm enough to swim on the Thanksgiving weekend in 2007. The 2007 water temperatures for Patterson Lake at a depth of 1 metre were recorded and published on the web, and are shown in the graph.

Water Quality, Lawns, and Septic Tanks

In 2008 we are very fortunate to have the lake in good condition. It may be the result of more good luck than good management. However, so far, so good.

Phosphorus and Nitrogen are the two common causes in the lowering of water quality in a lake. We do not have surrounding farms or farm animals, so the nitrogen is not a real problem.

A major source of Phosphorus for water systems is fertilizer and overflows or seepage from sewage lines or septic tanks.

We are fortunate that only a small percentage of the lake shore properties have lawns. The lawns alone are not a problem, but if fertilizer is applied and if there is runoff to the lake, then there is a problem because fertilizers contain both Nitrogen and Phosphorus compounds. The May 2007 Patterson Lake Association Newsletter had the following comment on the 2006 Watershed Report from the Mississippi Valley Conservation:

“Phosphorus is Mississippi Valley Conservation's "key nutrient of concern which can cause weed and algae growth and threatens fish habitat by reducing oxygen levels”.

One of the most startling bits of data in the 2006 Watershed Report was the amount of phosphorus that could be contributed to the lake by fertilizing lakeside lawns once per year - 1960 grams out of a total of 3355 grams in a high phosphorus lifestyle. If you do not fertilize, the value is zero. Septic tanks could add a little over 500 grams of the 3355 grams. So many times we think of septic tanks and the damage they might do, but rarely do we think of the fourfold damage from lawn fertilizers.”

Without going into details, sludge accumulates in septic tanks; liquids go on into the tile field to filter back to the ground. If the sludge builds up enough to go out into the tile field, it is bad news because a new tile field would have to be installed. Costly business.

Ontario has stringent conditions for the installation of a septic tanks. But the care and maintenance of the septic system once installed is not nearly so tightly controlled. There is a group working out of Mississippi Valley Conservation whose prime concern is the ongoing health of septic systems.

At the Annual General Meeting in August 2008, Jamie Saunders from the Septic Office provided the following advice:

“As a homeowner if you see a problem it is your responsibility to report it to Ron Flay, the septic inspector at the Leeds Grenville Lanark Health Unit. He is OBLIGATED to follow up on complaints, anonymous or personal.”

Ribbon of Life

The Patterson Lake Association received correspondence directed to area lake associations on the Official Plan of the Township in regard to lake properties. Specifically, the letter asked to spread the word about "The Ribbon of Life" concept in regard to the protection lake shores. Section 3.6.3.11 states:

*"It is the intent of Council to require the establishment and/or retention of a natural vegetation buffer on lands within 15 m (49.2 ft.) of the shoreline of a lake or a tributary (referred to as the "ribbon of life") which is developed or 30 m (98.4 ft.) on a lake trout lake, a sensitive lake or a lake which is undeveloped. In situations where the natural vegetation buffer will be reduced to accommodate the expansion of an existing building, the replanting of an area equivalent or greater than the area required for the expansion, will be required (see illustrations). [See also **Section 3.6.4 (4)**] In addition to the vegetation buffer, Council will encourage property owners and developers to retain as much of the lot in its natural state as is possible."*

A 9 metre lake access area is suggested for each property for docks, decks, boats, picnic areas, etc. .The plan can be viewed at:

<http://www.twpoflanarkhighlands.com/>

and using the Link to The Official Plan, then bringing up Section 3, pages 36 to 41

Air Photos of Patterson Lake

The following is a list of air photos from the National Air Photo Library that show Patterson Lake. This list was obtained by Ted Manning of the Patterson Lake Association. (<http://napl.cits.nrcan.gc.ca/portal/index.html>)

Date Acquired	Roll Number	Photo Number	Scale	Season
1934-08-11	A4751	24, 25	20000	Summer
1945-06-30	A8129	22, 23, 24, 25	25000	Summer
1945-09-10	A9233	71, 72, 73	20000	Summer
1945-09-10	A9264	90, 91, 92, 93	20000	Summer
1946-08-08	A10345	366, 368	30000	Summer
1959-05-31	A16527	34, 35	30000	Spring
1963-10-28	A18277	2, 4	20000	Fall
1963-10-28	A18251	3, 4, 5	20000	Fall
1969-06-09	A18854	207, 208	40000	Spring
1976-04-14	A24316	225, 226, 227	50000	Spring
1976-04-20	A24324	79, 80, 81	50000	Spring
1987-06-20	A27136	6, 7	50000	Spring
1987-07-16	A27171	59, 60	50000	Summer
1993-11-18	A27996	2, 3, 4	50000	Fall
1995-04-24	A28178	10, 11	50000	Spring