Appendix B

Harrington Pond Water Quality Assessment

Updated October 13, 2016

Contents

Purpose and Background

Harrington Pond is located in the community of Harrington, has an upstream drainage area of 1200 hectares, and is located within the larger Trout Creek subwatershed. The headwaters flow into the pond through the Harrington-West Drain. Located in the headwaters are the Provincially Significant Wetland, the Lakeside/Wildwood Complex, as well as the Significant Natural Areas of Happy Hills and Lost Concession. The purpose of this study was to initiate monitoring in 2015 to give a general assessment of water quality conditions in the pond and immediately upstream and downstream. This monitoring gives us a snapshot of water quality and is limited to the conditions of 5 sampling occasions from April to October in 2015 and with one year of past monitoring data in 1989 being evaluated as well.

As part of an evaluation of water quality in Harrington Pond, 5 samples were taken in 2015 at 4 locations, one upstream, 2 in pond, and one downstream (see Figure 1). Harrington Pond also had one year of historical data (1989) and this was included in the evaluation of the results. Three of the five samples were taken during low flow conditions. The dry conditions in the summer and fall of 2015 resulted in minimal opportunity to monitor runoff conditions. There was some variation in flow based on minimal rain but only one date had rain with full runoff conditions (June 1) and one date had rain with partial runoff conditions (October 9). Samples were analysed at ALS Laboratories in London. Samples were analyzed for Nitrate, Nitrite, Total Kjeldahl Nitrogen, Total Phosphorus, Orthophosphate, *E. coli*, Chloride, and Suspended Solids. Field measurements were taken with a YSI multi-parameter meter for Dissolved Oxygen, pH, Conductivity, and Temperature. Continuous temperature measurements were taken from June 1 to July 22 using a datalogger recording in half hour intervals.

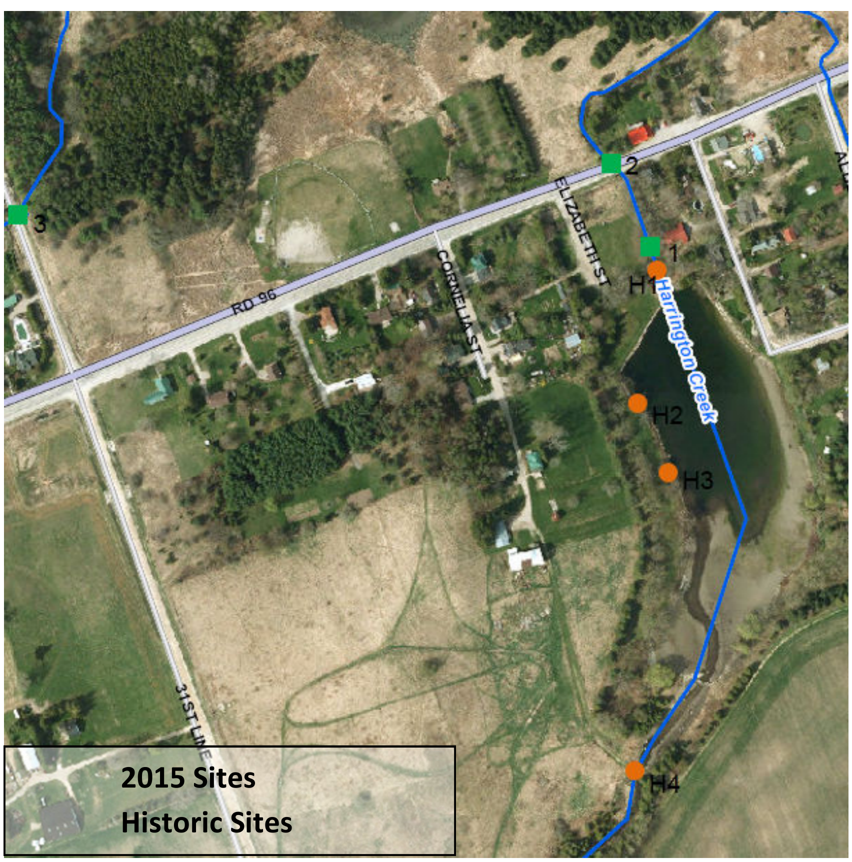


Figure 1: Harrington Pond water quality sampling sites

Results: Water Chemistry and Bacteria

Results are provided for 7 parameters which are related to land use activities. Pond samples were combined for analysis.

Temperature

Fate and Behaviour: Water temperature in the river system varies with seasonal changes and also throughout the day, warming in the daytime and cooling in the evening and overnight. Water temperature can have an effect on water quality and the water's ability to hold dissolved oxygen. As water warms, it has a reduced ability to retain oxygen. Optimizing cooler temperatures is desired to maintain oxygen levels and reduce excess algae growth. This can help to support diverse and healthy fish communities.

Sources: Water temperatures can be cooled by groundwater inputs, stream shading, and natural deeper channel flow. Water temperatures can be warmed by widened channelized streams, ponding, and reduced shading and tree cover.

Standards: There is no standard for temperature but the Ministry of Environment and Climate Change states that the natural thermal regime of any body of water shall not be altered so as to impair the quality of the natural environment. In particular, the diversity, distribution and abundance of plant and animal life shall not be significantly changed.

Monitoring Results:

- Stream temperature data for June and July 2015 were taken during periods in which the monthly air temperature averages (ref. Environment Canada – London Airport) were similar to historical monthly air temperature averages.
- The temperatures upstream are consistently cooler than downstream temperatures indicating the pond has a warming effect.
- The difference in temperature from upstream to downstream ranges from 0 to over 5C, with an average difference of 2.5C change and the difference becoming greater as the summer progresses.
- For both upstream and downstream, the stream temperature shows a diurnal pattern with day time highs and night time lows.
- The spot field measurements of temperature show the same pattern from upstream to downstream as the continuous dataloggers with upstream cooler than the pond and downstream.

Figure 2: Field Temperature 1989 and 2015

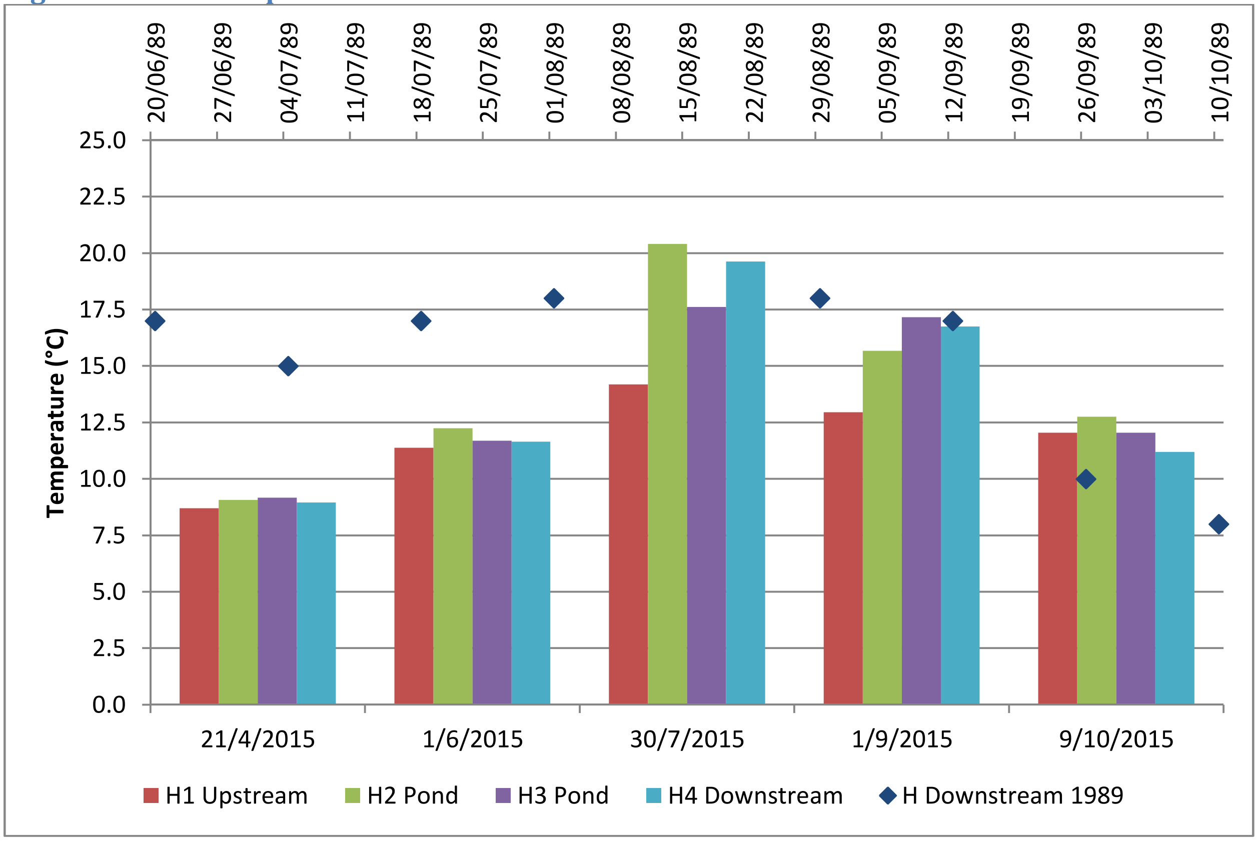
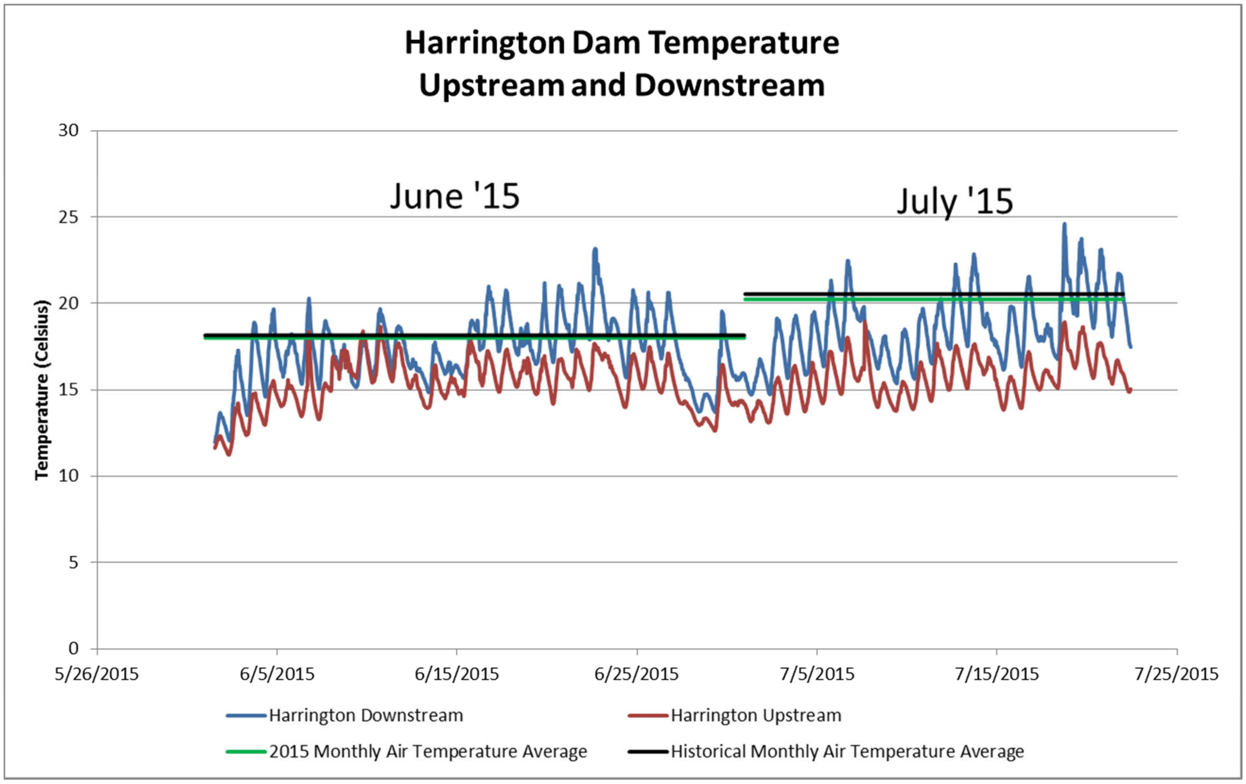


Figure 3: Harrington Pond continuous temperature upstream and downstream



E. coli Bacteria

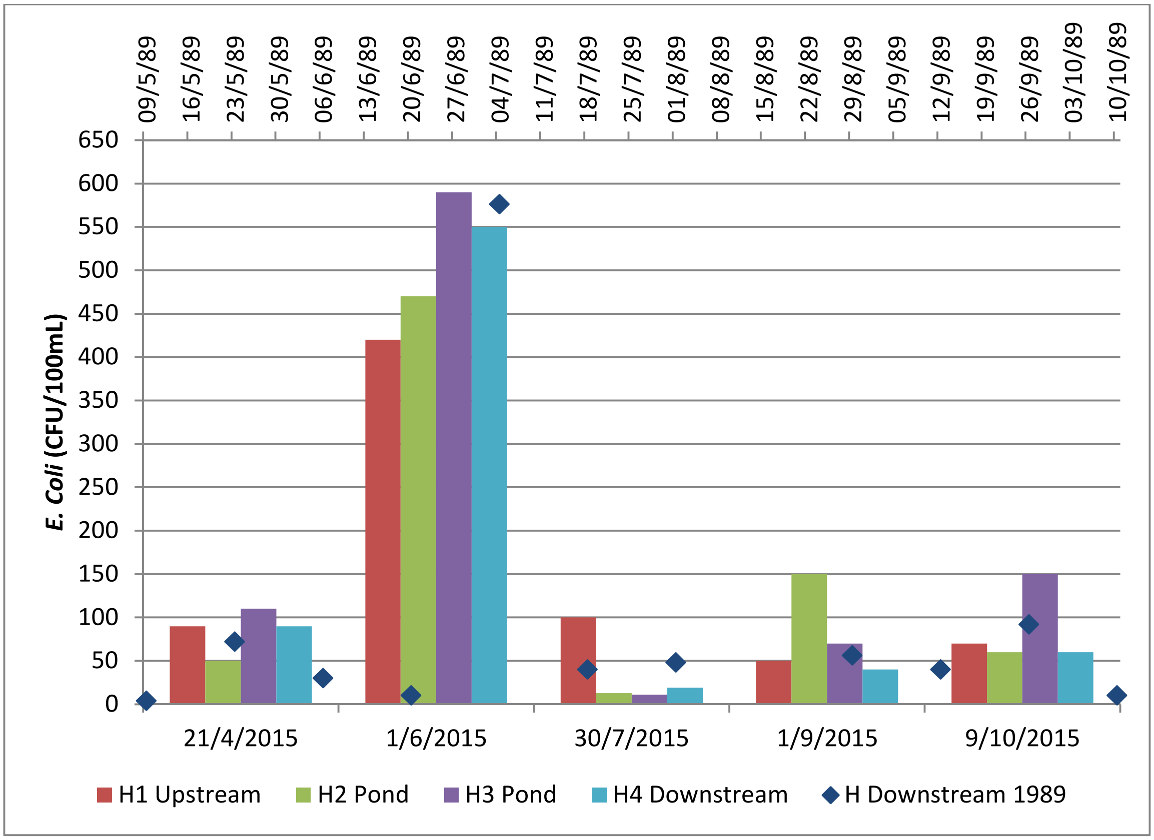
Fate and Behavior: *Escherichia coli* (*E. coli*) are a type of fecal bacteria found in human and animal waste. Their presence in water indicates fecal contamination. *E. coli* are a strong indicator for the presence of other pathogens found in human and animal waste.

Sources: Potential sources of fecal bacteria include upstream runoff from biosolids/sewage, livestock or wildlife waste, faulty private septic systems, and other stormwater runoff.

Standards: The Provincial Water Quality Objective (PWQO) for recreational waters is 100 *E. coli*/100 mL. This guideline is used as a target for comparison, recognizing that Harrington Pond is not monitored as recreational water.

Monitoring Results:
- Concentrations of *E. coli* bacteria are fairly low and fall below or close to the provincial recreational guideline for most sampling dates for both 1989 and 2015.
- Rain events show higher *E. coli* levels as expected.
- *E. coli* levels are similar at samples upstream, in the pond and downstream.

Figure 4: *E. coli* bacteria 1989 and 2015



Total Phosphorus and Orthophosphate

Fate and Behavior: Phosphorus is not directly toxic to aquatic life, but elevated concentrations can lead to undesirable changes in a watercourse including excess plant growth, reduced oxygen levels, reduced biodiversity, and harmful algae blooms. Orthophosphate, which is a form of phosphorus most biologically available to plants, was also measured.

Sources: Phosphorus sources can include commercial fertilizers, animal waste, and domestic and industrial wastewater including soaps and cleaning products. Phosphorus binds to soil and is readily transported to streams with eroding soil.

Standards: Ontario has an interim Provincial Water Quality Objective (PWQO) of 30 *u*g/L of total phosphorus to prevent the nuisance growth of algae.

Monitoring Results:

- For all dates, concentrations of total phosphorus were low and close to the Provincial Objective compared to typical numbers seen for Trout Creek and other parts of the Upper Thames watershed.
- Orthophosphate levels are also low with some samples below the detection limit for 2015. The lowest numbers are in the mid to late summer and early fall when plant uptake of this more biologically available form of phosphorus is at its peak.

Figure 5: Total Phosphorus 1989 and 2015

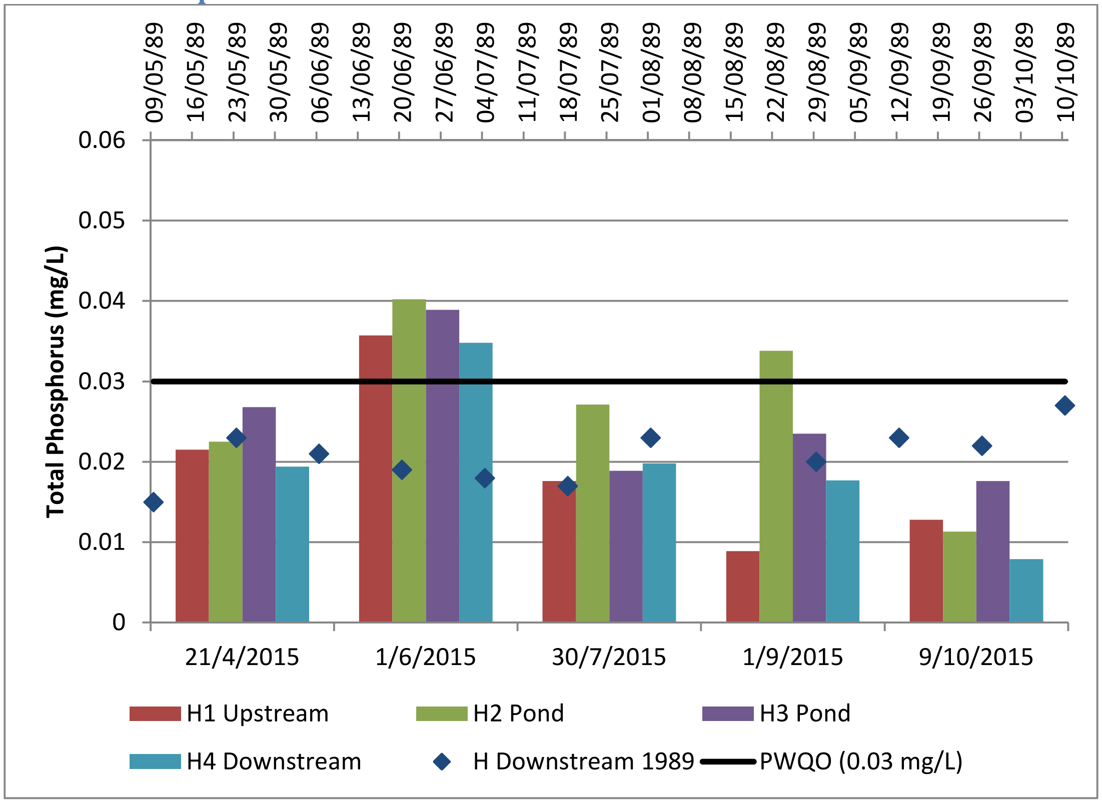
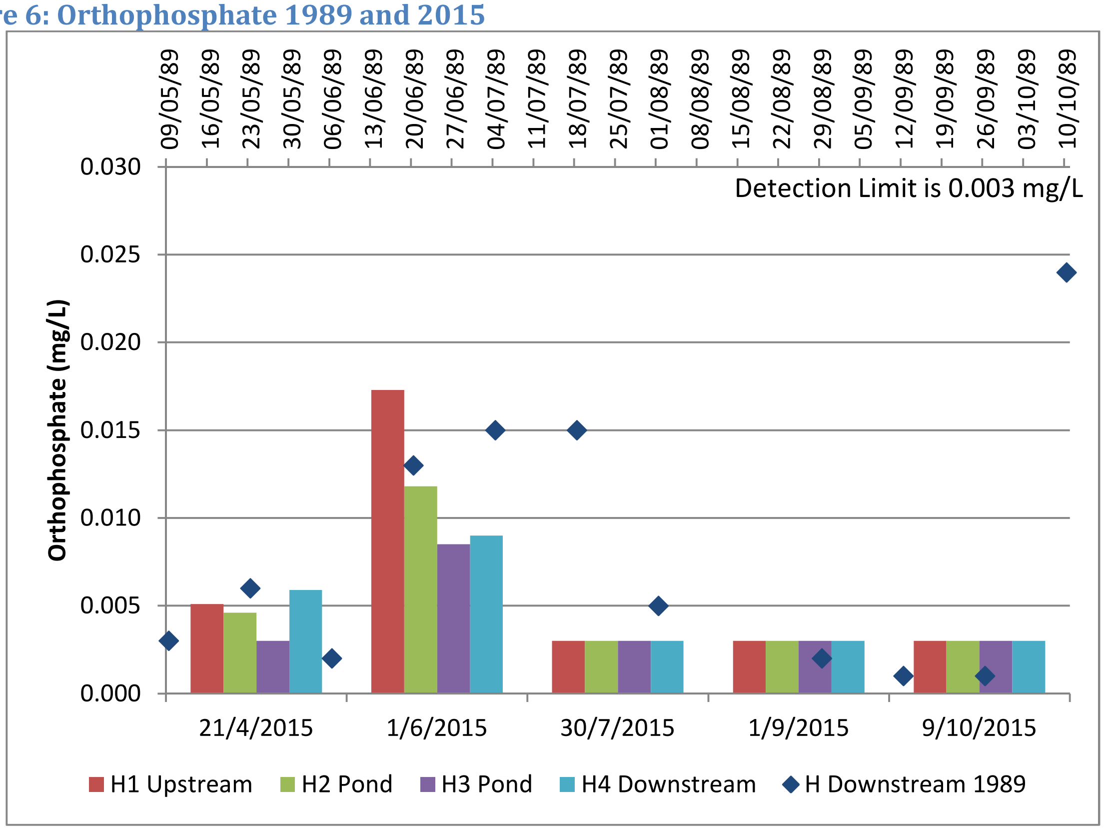


Figure 6: Orthophosphate 1989 and 2015



Nitrate

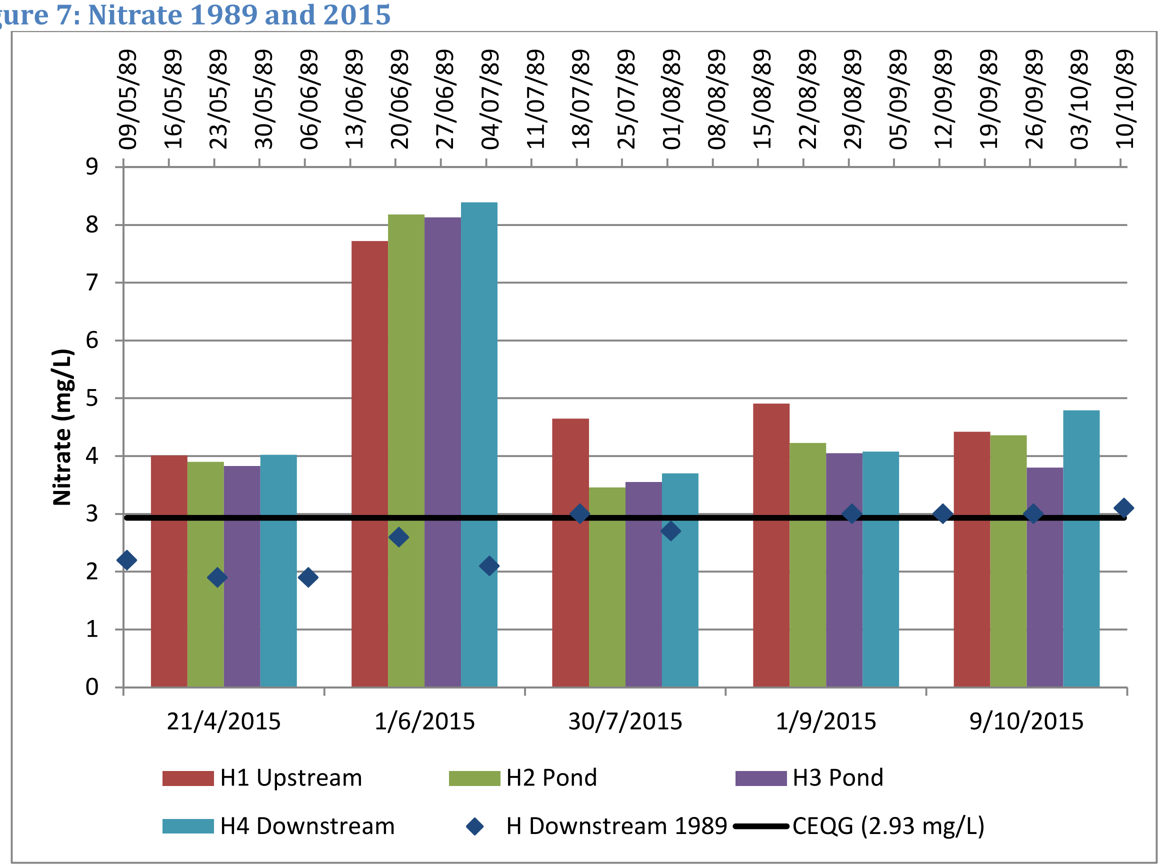
Fate and Behaviour: Nitrate is a nutrient that does not adsorb to sediment and moves readily through surface runoff to streams and through soil into groundwater. Elevated levels in a watercourse can be toxic to aquatic organisms, especially amphibians.

Sources: Nitrate sources can include sewage/animal waste, commercial fertilizers, septic systems, atmospheric deposition and natural decomposition of organic wastes.

Standards: Ontario does not have a Provincial Water Quality Objective for aquatic life but the Canadian Environmental Quality Guideline (CEQG) to protect aquatic life from direct toxicity to nitrate is 2.93 mg/L.

Monitoring Results:
- For 2015 the nitrate levels are consistently above the aquatic life guideline and in a range typical of the Trout Creek watershed and other Upper Thames sites.
- Nitrates were higher during the rain event sample in 2015 which is to be expected for a water soluble nutrient.
- Nitrates were lower in the 1989 samples which were below or close to the guideline.

Figure 7: Nitrate 1989 and 2015



Chloride

Fate and Behaviour: Chloride moves easily with water and persists in the river system. Nearly all chloride added to the environment will eventually migrate to surface water or groundwater. Chloride can be toxic to aquatic organisms at high concentrations, and affects growth and reproduction at lower concentrations.

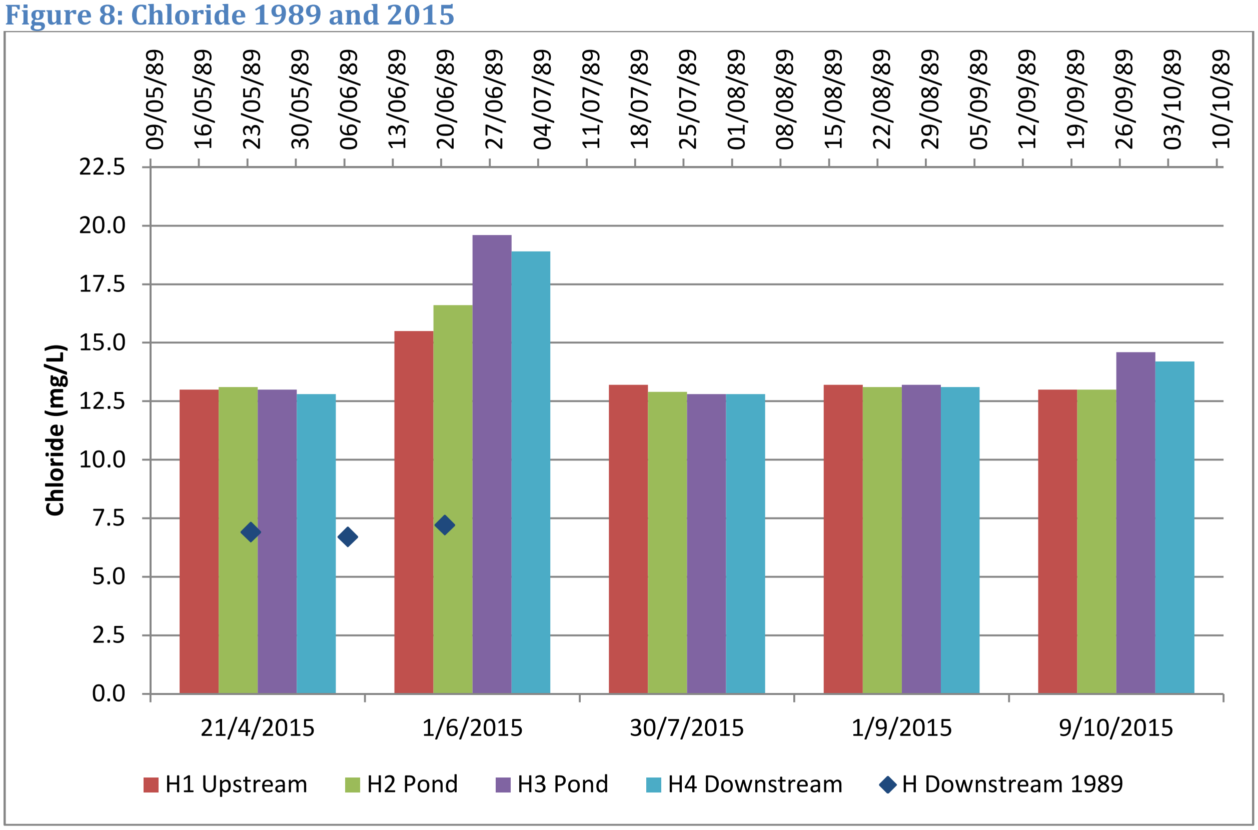
Sources: The highest loadings of chloride are typically associated with the application and storage of road salt (e.g.calcium chloride). Urban streams tend to have the highest chloride concentrations.

Standards: Ontario does not have a Provincial Water Quality Objective for aquatic life. A Canadian Environmental Quality Guideline (CEQG) for the long-term exposure of toxicity for sensitive aquatic species is 120 mg/L.

Monitoring Results:

- All samples are well below the guideline for chloride for both 2015 and 1989 which is expected in a rural area.
- The June rain event had somewhat higher levels than the dry weather samples but still very low compared to the guideline.
- The timing of sampling for this study did not provide data for winter or early spring runoff when chloride levels would be expected to be higher as a result of road salt runoff.

Figure 8: Chloride 1989 and 2015



Suspended Solids

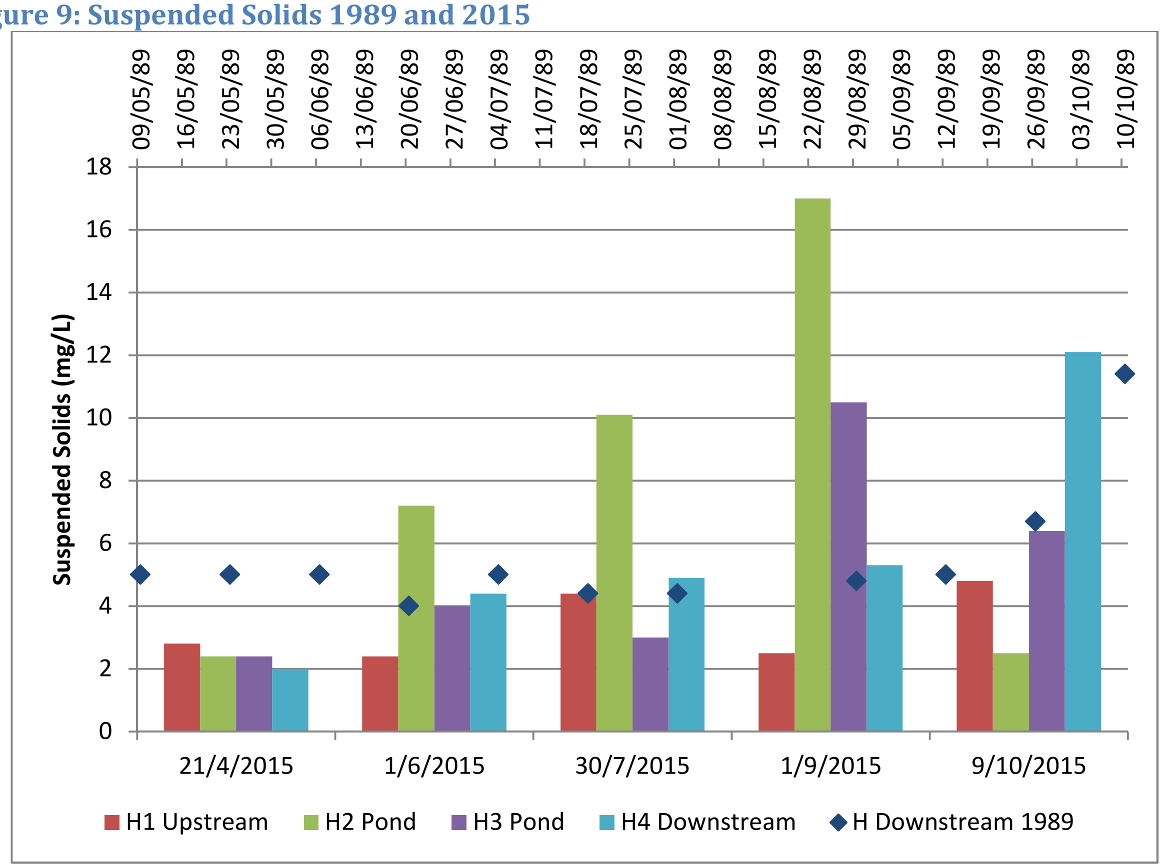
Fate and Behaviour: Suspended solids consist of silt, clay, and fine particles of organic and inorganic matter. These particles can be carriers of phosphorus, metals, and other contaminants. Suspended solids can be detrimental to aquatic organisms including fish.

Sources: Soil erosion is the most common source of suspended solids to a watercourse. This can be from cultivated land, construction, development, eroded stream banks or natural erosion of stream beds.

Standards: There is no established standard for suspended solids. However, turbid water is undesirable for healthy aquatic life, recreation, and aesthetics.

Monitoring Results:
- Suspended Solid levels are fairly low compared to other sites across the Upper Thames watershed.
- Samples in the pond for 2015 were somewhat higher than the upstream and downstream samples which can be related to the presence and capture of some accumulated bottom sediments during sampling.

Figure 9: Suspended Solids 1989 and 2015



Dissolved Oxygen

Dissolved oxygen is important for fish and other aquatic life. Dissolved oxygen levels below 4 mg/L can have an adverse effect on fish communities. Cooler water temperatures help to retain dissolved oxygen in water. Water flowing through natural stream channels with rock/riffles improves oxygen levels. Stagnant areas and decaying vegetation reduce oxygen levels.

Results: Spot field measurements were taken for dissolved oxygen using the YSI meter. This limited data gives a general indication of oxygen conditions at the time of sampling recognizing dissolved oxygen levels vary throughout the day. Readings showed good oxygen levels ranging from 7mg/l to 13 mg/l and upstream and downstream readings similar.

Metals

A suite of metals, including copper, lead, zinc and iron was tested in each sample as part of standard laboratory tests on two sample dates (April 21 and June 1). Metals are long lasting in the environment where they tend to accumulate in streambed sediments. Metals can bio-accumulate in fish and wildlife and can be toxic to aquatic life at elevated levels. Metals tend to be low in non-urban areas and are typically very low across the Upper Thames watershed.

Results: All sample results on both dates showed very low to non-existent metals in the samples. Only one pond site on the rain event date showed levels of copper above the guideline and zinc at the guideline. This could be a result of some metals in the bottom sediments being captured during sampling.

Discussion

- In general, the water quality in the Harrington-West Drain, where it was sampled upstream, downstream and in Harrington Pond, showed general low levels for the parameters measured in 2015 with numbers typically better than the average seen in Upper Thames watershed streams. The headwaters of this area including a significant wetland complex and natural areas would likely contribute to the quality of this stream.
- The results for 1989 and 2015 were very similar for all parameters with the exception of nitrate which is slightly higher in 2015 compared to the 1989 data.
- Temperature differences are apparent between upstream and downstream of the pond based on continuous measurements and show a greater difference as the summer progressed, likely as a result of the warming effect of the pond.
- Ponds can act as a settling basin for sediment and associated contaminants such as phosphorus, and these can accumulate in the bottom sediments. These contaminants can be resuspended when disturbed such as during more extreme flow conditions. Sampling of the bottom sediments would give an indication of any accumulation.