Peterborough
Utilities
Commission

2007 WATER QUALITY REPORT

On the Cover Aerial photo of the Water St. Pumphouse.

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INTRODUCTION

With minimal disruptions to the plant process for construction or maintenance, the Peterborough Water Treatment Plant continued to produce an excellent quality of drinking water for the consumers in Peterborough during 2007. The weather in Peterborough was a major influence on the water flow and water quality for the Otonabee River (our water source). A long hot, dry summer followed by a mild winter affected water quality by promoting algae growth. Environment Canada stated that southern Ontario's warm spell was the worst since the 1930's. There was a string of 95 consecutive days without a significant rainfall (above 12 mm) in the middle of summer. It was so dry at times that the Ontario Ministry of Natural Resources asked anglers not to fish in some creeks, because water levels were so low it stressed fish.

The highest pumpage day was on July 31, 2007 (72,990 m^3). This was 24.7% less that the historical daily high of 91,008 m^3 (obtained in 2005). Over 15,718,883 m^3 (cubic metres) were treated during 2007 (compared to an annual total flow of 15,045,051 m^3 during 2006) – a 4.5 % increase over 2006. The Otonabee River water temperature varied over the year from 0.0 °C to 26.6 °C.

The drier weather during the summer months gave us lower Otonabee River flows, which seemed to help with raw water turbidity. It appears that the many dams on the river act like multiple settling basins, which help lower overall raw water turbidity. Higher water temperatures, however, have contributed to an increase in the amount of blue-green algae, which were observed in the Kawartha Lakes (the head waters for the Otonabee River). This is further described in the blue-green algae section.

The following are items of interest from 2007.

In 2007 the Ministry of the Environment issued a 'Provincial Officer's Order' to 36 municipalities to test for lead in the distribution system. The City of Peterborough received an order to test 30 distribution samples. The sampling was done in May of 2007 concentrating on homes with the potential to have lead plumbing, it was determined that the level of lead in the drinking water was below the MOE guideline in all but one home. This home was known to have both a municipal and private lead service. It should be noted that this home is the only known one to still have a municipal lead service since the homeowner choose not to have the services replaced in 1995 when the replacement project was ongoing. Since the recent lead testing results both the municipal and private lead portion of the service have been replaced.

In June 2007, the Ministry of Environment made a few changes to Ontario Regulation 170/03. The most notable change to this regulation was having a more intense sampling protocol for lead. Based on the population of the city or town, a number of residential locations, distribution locations, and non-residential locations will have to be sampled during two periods a year. For Peterborough, 80 samples will have to be collected from private residential locations, 8 samples from non-residential locations and 16 samples taken from distribution locations during the first period of December 15, 2007 to April 15th,

2008. The next period of sample will occur from June 15, 2008 to October 15th, 2008. The lead sampling regime will have to continue for every year using the same schedule. If, after two years of sampling (4 sampling periods), and if less than 10 % of the samples collected are found to be less than the MOE standard for lead (0.01 mg/L) then a reduced sampling protocol can be initiated.

Since June 2006, other amendments were made to O. Reg. 170/03. Most notable was the removal of prescribed corrective actions for adverse fecal coliforms, background colony counts, and heterotrophic plate counts (HPC) results. Another notable amendment to 170/03 was a new filtered water guideline for turbidity. The new maximum acceptable concentration (MAC) for filtered water is now 0.30 NTU (Nephelometric Turbidity Unit) for 95% of the time. This value was previously set at 1.0 NTU. The average filtered water level in the Peterborough's drinking water was 0.03 NTU for 2007.

TEMPERATURE

The long hot summer weather (higher air temperatures, higher water temperatures and greater sunlight) affected how we treat the water. For example, higher raw water temperatures affect how much chlorine is used and the speed at which chemical reactions take place (more chlorine is used in higher temperatures to achieve the same disinfection results).

Higher water temperatures also contribute to a higher population of algae in the Otonabee River, which in term can contribute to an elevated level of taste and odour causing compounds (geosmin and 2MIB). A higher population of algae can contribute to a higher population of zebra mussels, which can further increase the taste and odour problem. A greater amount of sunlight reaching down into the water column also affects (increases) the algae activity of many species of algae – including taste and odour causing algae.
During 2007, raw water temperature varied from 0.0 ℃ to 26.6 ℃ (Figure 1).

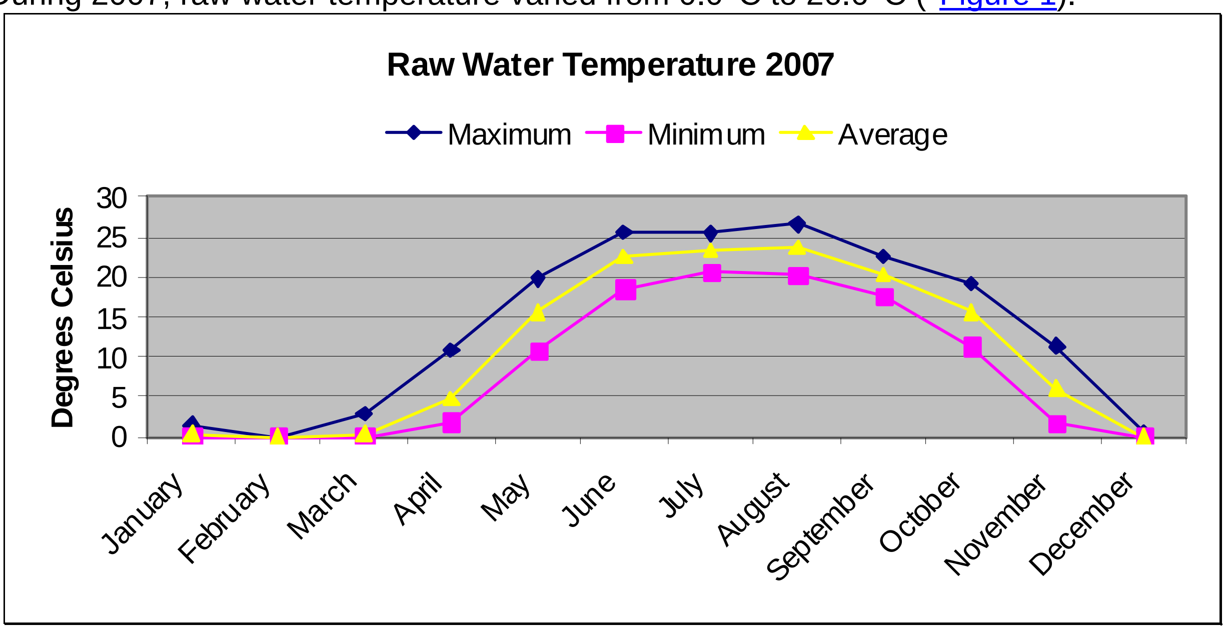

Figure 1

BLUE-GREEN ALGAE

Blue-green algae are technically known as cyanobacteria**,** a microscopic organism that is naturally present in lakes and streams. Usually present in low numbers, however blue-green algae can become very abundant in warm, shallow, undisturbed surface water that receives a lot of sunlight. These conditions existed in the Kawartha Lakes region during May and August with hot dry air, low river and lake flows (undisturbed water), warmer weather (with higher than normal raw water temperatures) these are ideal conditions for blue-green algae to proliferate.

When this occurs, they can form blooms that discolour the water or produce floating rafts or scum on the surface of the water. Blue-green algae can also produce toxins of concern when present in large enough numbers.

The high numbers of blue-green algae is probably the largest contributor to the drinking water taste and odour levels. 2-methylisoborneol (2MIB) and geosmin, are by-products of blue-green algae degradation, and are found in the water when we experience taste and odour complaints. Please see page 9 for geosmin and 2MIB graph.

ZEBRA MUSSELS

During 2007, zebra mussel populations appeared to be stable, with a slight increase in raw water turbidities. Since the introduction of zebra mussels (an invasive species) into Ontario in and later into the Otonabee River system in 1997, the effects continue to cause noticeable changes in raw water turbidity. The Ontario Federation of Anglers and Hunters had their first confirmed sighting of zebra mussels in this area at Lock 19 in 1997. According to the literature, one zebra mussel can clear 1 litre of water per day. Large numbers of zebra mussels can actually clear a water body. Sunlight is then able to penetrate further down into the water column allowing other species of algae (possibly taste and odour algae) to flourish.

As with many unbalances in a river eco-system, there appears to be a cyclic change in zebra mussel population and raw water turbidity. When zebra mussel populations flourish the average level of turbidity decreases (Figure 2).

TURBIDITY

Even though the 2007 average raw water turbidity decreased slightly from 2006 (from 0.59 to 0.56 NTU), sunlight is still able to penetrate further into the water column thus allowing certain species of algae to proliferate. Over the last 10 years it appears that the water is clearer due to zebra mussels. This may be a contributing factor to an increase in cyanobacteria and other taste and odour producing algae. A 20-year trend of Otonabee River (raw water), and finished treated water (plant effluent) turbidity is shown in Figure 2 while Figure 3 illustrates the 2007 turbidity average. The annual turbidity peak occurred in July (average monthly turbidity 0.82 NTU) with higher than normal water temperatures (average August temperature at 26.6 ℃.) and averag e river flows - good conditions for algae growth. The yearly average plant effluent turbidity was 0.11 NTU (for 2006 the values were: raw water at 0.59 NTU, and plant effluent was 0.08 NTU). A new filtered water guideline for turbidity was initiated in June 2006, from the Ministry of the Environment. The new Maximum Acceptable Concentration for filtered water is now 0.3 NTU for 95% of the time, and never exceeding 1.0 NTU - this is lower than the previous limit of 1.0 NTU.

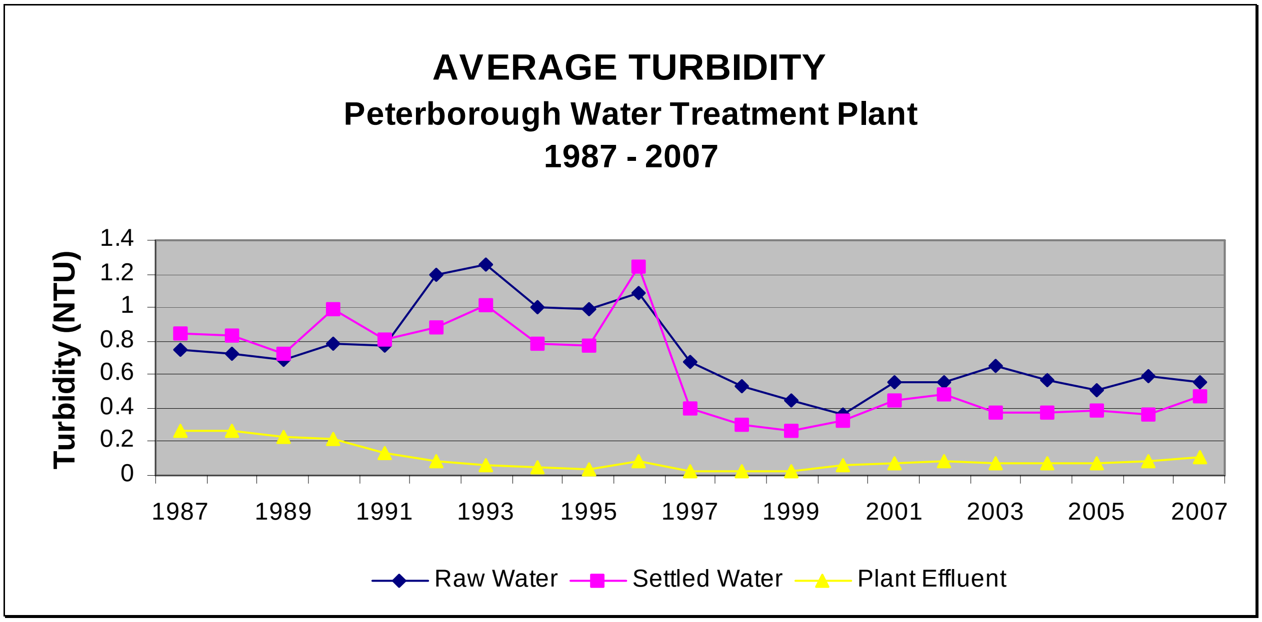

Figure 2

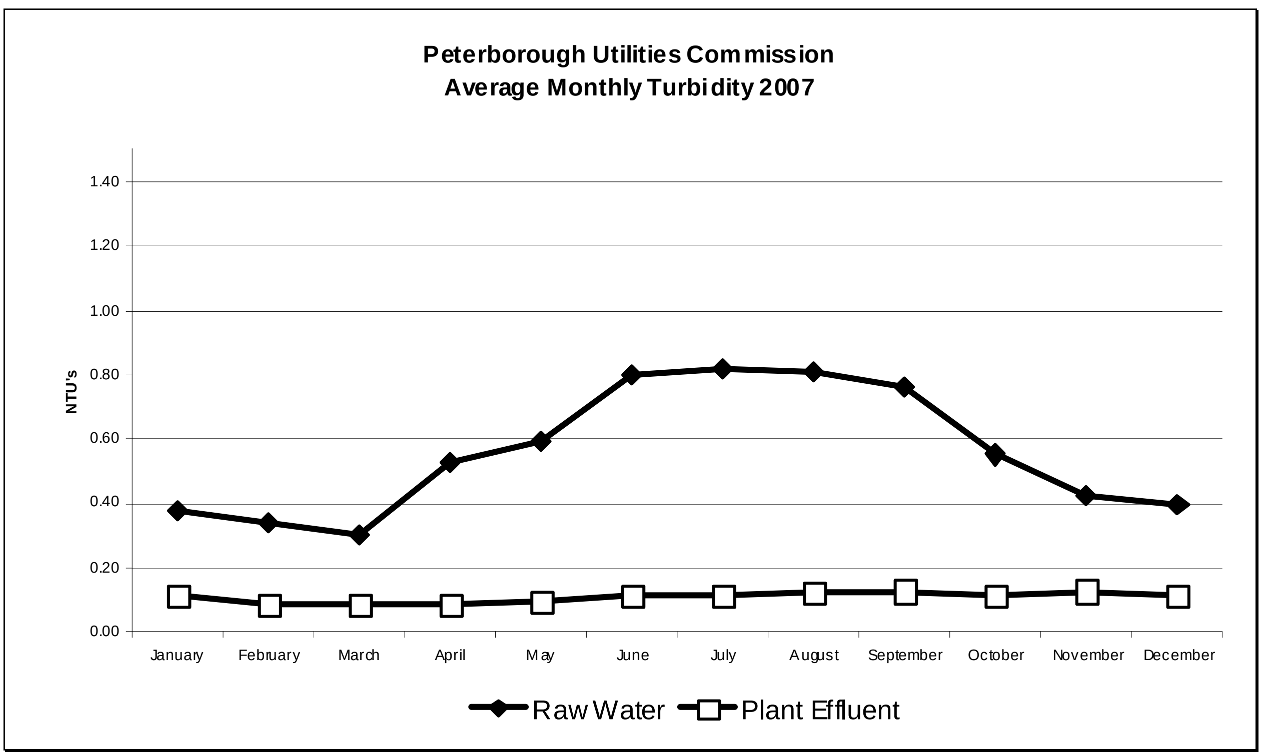

Figure 3

TASTE AND ODOUR

During 2007, one of the main sources of taste and odour in our raw water are the naturally occurring compounds geosmin and 2-methylisoborneol (2MIB). These compounds can be detected by humans at very low levels (less than 10 ηg/L). A ηg/L is equal to one billionth of a gram per litre. Geosmin and 2MIB can be produced by the bacteria actinomycetes, zebra mussels, and some species of blue-green algae, though the exact organisms are not known. Geosmin was detectable from May to December during 2007. This is unusual since geosmin and 2MIB are normally undetected during the colder winter months showing values less than the laboratory detectable limits of 3 ηg/L. It appears that geosmin was produced in large amounts during the summer that had a higher than usual amount of sunlight – a primary condition for algae growth and geosmin production (when algae decays).

Previous years data indicated that geosmin and 2MIB would hit peaks at the same time during the summer months – usually a large peak near the end of the summer when the water temperature is the highest. During 2007, geosmin peaked in July while 2MIB peaked in May. Taste and odour during 2007 persisted for most of the summer with the worst being the period when geosmin was second peaking (late October). Slow moving river with high water temperatures and abundant nutrients contributed to higher than usual taste and odours in our finished water.

Many species of algae grow rapidly when there is little or no movement of water with abundant sunlight and nutrients. Perfect conditions to grow algae, a major source of taste and odour compounds (geosmin and 2MIB). These compounds can be detected by most people when the values are greater than 10 ηg/L.

Geosmin

Geosmin is thought to originate in the higher water column and produce an earthy odour – the average raw water value during 2007 was 15.4 ηg/L and the average plant effluent was 13 ηg/L Figure 4 (both lower than 2006, which were 21 and 17.6 ηg/L respectively). Values were not necessarily higher in 2007, but the longevity of the taste and odour episodes lasted longer, especially with respect to geosmin. A summer with plenty of sunlight (high water column algae) would contribute to higher amounts of this compound. During 2007 two peaks occurred; one July 31th with a value of 32 ηg/L, and the other at November 26th with a value of 26 ηg/L. The reduction of geosmin due to water treatment processes (coagulation, sedimentation, filtration and chlorination) was only 16 % (same as 2006). This is not a significant reduction in taste and odour caused by geosmin.

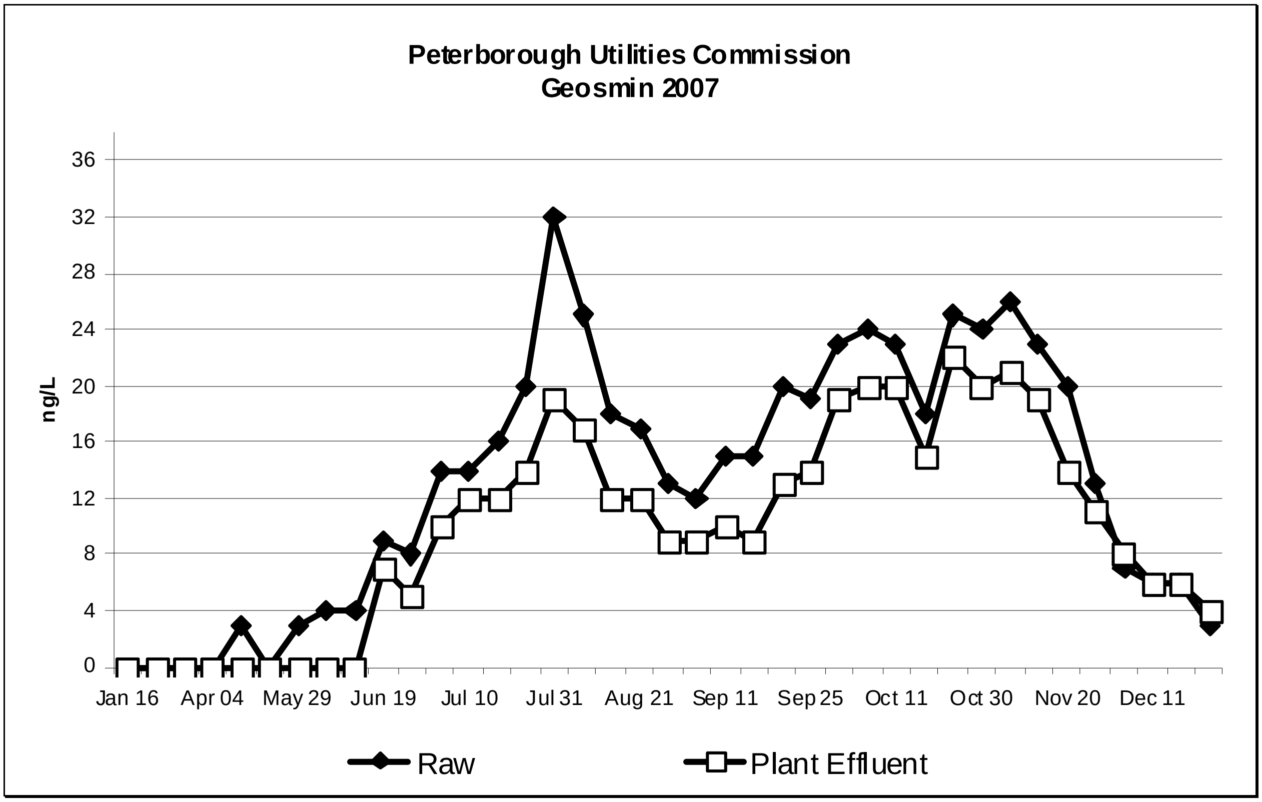

Figure 4

2-Methylisoborneol

2-Methylisoborneol (2MIB) is produced in the sediment or benthic layer and gives off a musty odour. 2MIB can reproduce well when sunlight can penetrate down to the bottom of lakes and streams. Zebra mussels may be clearing the water to allow sunlight to penetrate further down to these benthic layers.

The average raw water value during 2007 was 9.7 ηg/L, the average plant effluent was 8.3 ηg/L, annual average for 2006 were 7.0 and 6.7 ηg/L respectively (Figure 5). Peaks for 2MIB lasted for a three-month period during July to October. The reduction of 2MIB due to water treatment processes (coagulation, sedimentation, filtration and chlorination) was 15%. This is not a significant reduction in taste and odour caused by 2MIB.

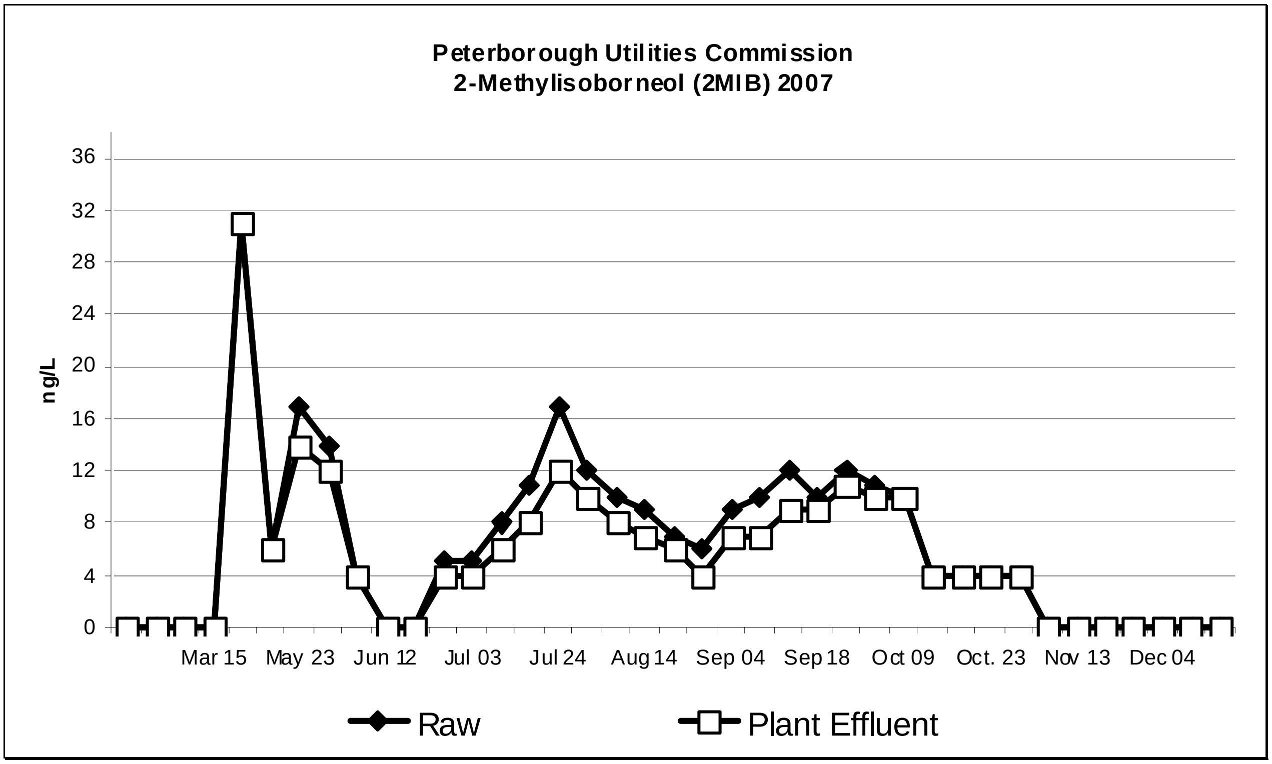

Figure 5

Both geosmin and 2MIB compounds resist oxidation (disinfection) and are difficult to remove by standard treatment in water filtration plants. If we continue to experience elevated summer temperatures (with warm waters), low flows, and abundant sunlight then taste and odours will continue to be a problem. Typically, elevated levels of these compounds are present when algae are found in abundance, and are frequently associated with high nutrient levels in warm and calm water. Experience tells us that abundant sunlight during the summer of 2007 would contribute to elevated values of geosmin and 2MIB. It was surprising to find geosmin detected long into the winter of 2007 – these compounds were probably formed higher up in the Kawartha Lakes and were now 'draining' into the lower reaches of the water system, eventually into the Ottonabee River.

COAGULANT AIDS

Sodium Silicate (Activated Silica)

Two forms of sodium silicate are applied at the water treatment plant. Activated silica is applied as a coagulant aid and BW46M is added for pH correction and corrosion control.

Depending upon the raw water flows, turbidity, settled water turbidity, and water temperature the activated silica system was used dosages of 0.5 mg/L to 1.5 mg/L (CO_2 activated sodium silicate, N-silicate). N-Silicate was only used for 78 days during 2007.

Activated silica aided the settling of alum (aluminum sulphate) formed floc, and helped to produce slightly lower settled and plant effluent turbidities. Activated silica can be used during the colder months since alum does not form the heavy floc needed to remove turbidity effectively in cold water. Activated silica may also help with settling of floc when we experience higher than normal water treatment plant flows.

Experimentation with jar tests are employed to help determine the most efficient dosages and rations of alum and activated silica. These tests are conducted throughout the year since water quality and water temperatures change seasonally.

CORROSION CONTROL

Sodium Silicate (BW46M)

Sodium silicate (BW46M) is added to the plant effluent for corrosion control within the distribution system as well as plant effluent pH adjustment. The average sodium silicate dosage for 2007 was 10.7 mg/L (as SiO_2) compared to 8.3 mg/L in 2006. The use of chlorine and alum during the water treatment process lowers the pH level causing the water to be slightly acidic/corrosive. Before the addition of sodium silicate the average pH level was 7.05. The addition of BW46M increases the pH to a more acceptable value of 7.1.

Silica

Both N-Silicate (for activated silica) and BW46 (sodium silicate for corrosion control) may contribute to a total silica level found in the water. Silica levels throughout the distribution system generally ranged between 1.9 mg/L and 18.5 mg/L with an annual average of 12.1 mg/L. The annual average silica level found leaving the Water Treatment Plant was 10.8 mg/L

ALUMINUM

Aluminium residual found in the plant effluent can be a by-product of the addition of alum. Alum is used as our primary coagulant causing particles (silt, sand, algae, bacteria, etc.) to coagulate or 'clump' to form a floc, which can settle in the settled basins. The water is further clarified by filtration. A properly balanced/optimized treatment with coagulation (using activated silica), sedimentation, and filtration resulted in reduced aluminium residuals in the plant effluent sample, (Figure 6). Province of Ontario operational guideline for Aluminium residual is 100 μg/L.

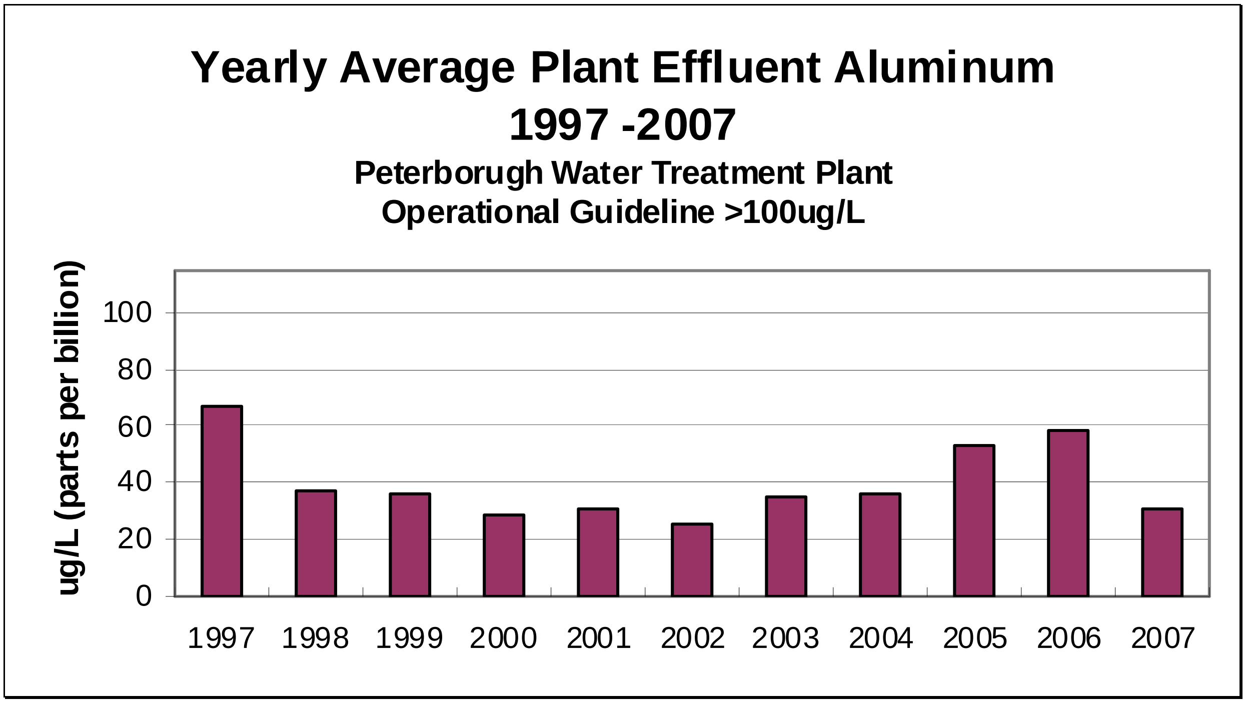

Figure 6

TRIHALOMETHANES

Trihalomethanes (THM) are formed as a by-product when chlorine is used to disinfect water for drinking. The reaction of chlorine and/or bromine with organic matter in the water produce THMs. The THMs may have adverse health effects at high concentrations, and many governments set limits on the amount permissible in drinking water. In Ontario, the Ministry of the Environment's MAC (maximum allowable concentration) for total THM's (total concentration of chloroform, bromoform, bromodichloromethane, and dibromochloromethane) are set to 100 µg/L (sliding yearly average) for the distribution system (Figure 7). According to Reg. 170/03, THM samples must be collected and analyzed at least quarterly.

There are many factors which contribute to the formation of THM's, with the more notable being water temperature, amount of organic material present, chlorine residual present, and time at which these chemicals are in contact with each other.

The 2007 average raw water TOC (total organic carbon) was the lowest it has been in 5 years with a value of 4.7 mg/L compared to the 5 year average of 5.1 mg/L. This may be another contributing factor to lower THM formation. There was a 44.7% reduction in TOC during 2007 which may reduce the formation of THM in the distribution system (Figure 10).

With the continued removal of the majority of THM organic precursors through optimized coagulation, flocculation, sedimentation processes, and lowering the chlorine dosages, 2007 levels were almost 68% lower than previous year's data. The average plant effluent THM level for 2007 was 36.5 µg/L (2006 value was 61.3 µg/L).

Distribution levels are always found to be higher than those leaving the Water Treatment Plant since THM's continue to form as the water travels through the system. The average 2007 THM level in the distribution system was 71.3 μg/L, almost a 10% improvement over 2006 values of 78.25 μg/L.

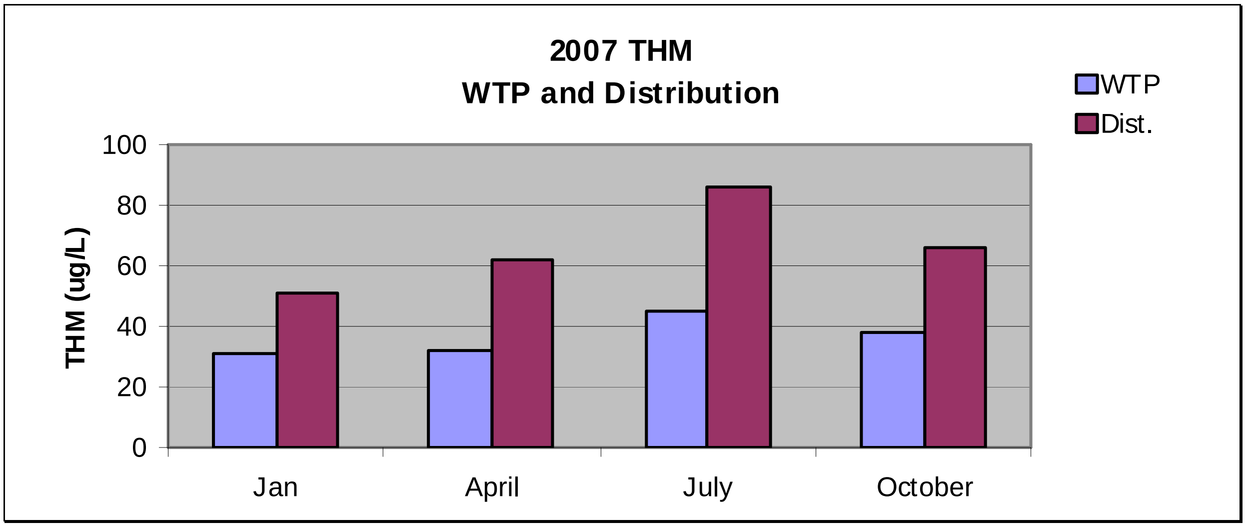

Figure 7

Since there are many factors that affect the formation of THM's in the distribution system. It will be difficult to explain why THM's appear to be decreasing in the last 3 years (Figure 8). A few explanations can be that the summers since 2005 have been warmer and the amount of chlorine used for primary disinfection (and free chlorine residuals leaving the WTP) have been higher since Walkerton (2000). Pipe retention time (the time that water is traveling in the pipes to our customers) may be another factor that can influence the THM formation. If more water is being used by our customers, then the reaction time that organics and chlorine can react is reduced. Less time that chlorine and organics are in contact with each other means that a lower concentration of THM's.

Surprisingly, the raw water temperature, during the summer, only hit a maximum of 26.6℃. (27.7 ℃. maximum in 2006, and 27.5 ℃ maximum in 2 005). This may be another reason why THM levels are lower in 2007 than other years. THM formation is slower when the water is cooler.

Another factor associated with warmer weather has been the increase abundance of algae – benefiting from warmer waters and abundant sunlight. Increased algae populations will also increase the amount of organic material entering the water treatment plant – and when chlorinated, will support the formation of THM's.

2007 was unusual since 51% of the THM formation occurred in the water treatment plant, and the remaining 49% was formed in the distribution system (Figure 8). In other years approximately 60% of the total THM formation takes place at the Water Treatment Plant and the remaining 40% is formed in the distribution system.

The maximum amount of chlorine dosed during 2007 summer months was 2.9 mg/L (3.1 mg/L dosed during summer 2006). A lower amount of chlorine used will also decrease the amount of THM formation.

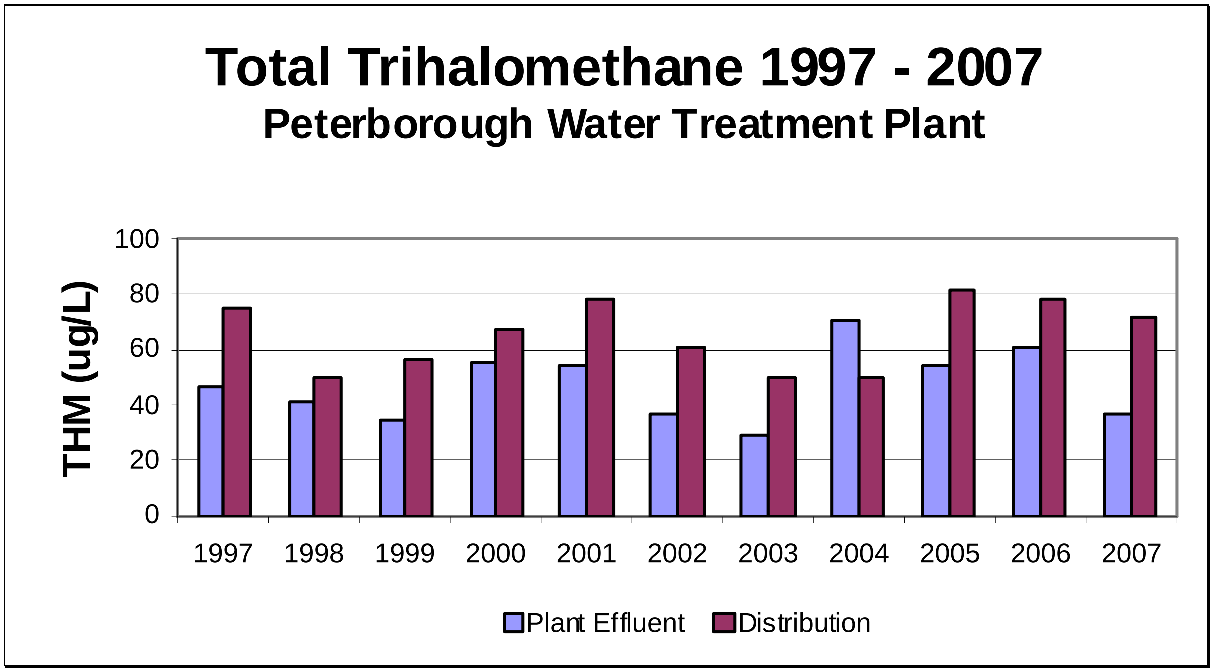

Figure 8

CHLORINE

The primary disinfection dosage of chlorine for 2007 ranged between 2.25 mg/L and 2.9 mg/L. Please see THM formation with respect to lower chlorine dosages – page 14. During the summer months the primary chlorine dosage could be as high as 2.9 mg/L due to warm water temperatures and also to maintain the chlorine residual throughout the distribution system to comply with the Ontario Drinking Water Standards.

Zebra mussel control for the Water Treatment Plant included adding approximately 0.6 mg/L of chlorine into the Water Treatment Plant intakes for the whole year. Normally, the addition of zebra mussel chlorine was dosed only during the months when we experienced warmer water temperatures (usually when water temperature is above 12 °C). The continual addition of zebra mussel chlorine throughout the year assisted in optimizing coagulation, flocculation and filtration in the plant process by slightly lowering the raw water pH.

The post chlorine (or trim chlorination) added approximately 0.1 to 0.3 mg/L of chlorine to the finished water (plant effluent) in order to maintain a proper disinfection leaving the water treatment plant and to insure that free chlorine residuals in the distribution system are within M.O.E. guidelines (minimum of 0.05 mg/L free chlorine).

ULTRAVIOLET ABSORPTION

An Ultraviolet Absorption or UV test was introduced in 2005. This test was carried out daily on raw, filter #1, and plant effluent samples to determine how well UV (at a wavelength of 253.7 nm) can penetrate our coloured waters, especially our filtered water. UV was studied since it may be a viable disinfection complement with chlorine.

At a wavelength of 253.7 nm UV can be absorbed by a micro-organism and disrupt it's DNA thereby preventing them from reproducing. UV can be effective on bacteria, viruses, and parasites such as Giardia and Cryptosporidium. One main drawback to using chlorine as a disinfectant is that it produces THM's. Using UV as a disinfectant with chlorine provides better disinfection protection and may allow us to use less chlorine, and therefore produce less THM's. UV however does not provide a disinfection residual to meet the requirements for the distribution system.

UV absorbance can be calculated to show the UV transmittance – which is the amount of UV light that can penetrate the sample of 1 cm width. In 2007, the average UV transmittance for raw water was 72.39 %, the average UV transmittance for Filter number 1 was 88.44 %, and the average UV transmittance for plant effluent was 90.30 %.

The inability for UV to penetrate the water sample would indicate the presence of organic material. A higher UV transmittance would indicate that there is a lower amount of organic material present – less organic material to absorb the UV radiation. A higher UV transmittance in the plant effluent and filtered water indicates that most of the organic material has been removed during flocculation, sedimentation, and filtration (Figure 9).

The UV results would indicate that the WTP process of flocculation, coagulation, sedimentation, and filtration removes enough organic material to possibly utilize UV as an alternative disinfectant, provided that this technology is used after filtration. A high UV transmittance in our filtered and finished waters shows great promise to this technology as an alternative or complimentary disinfectant.

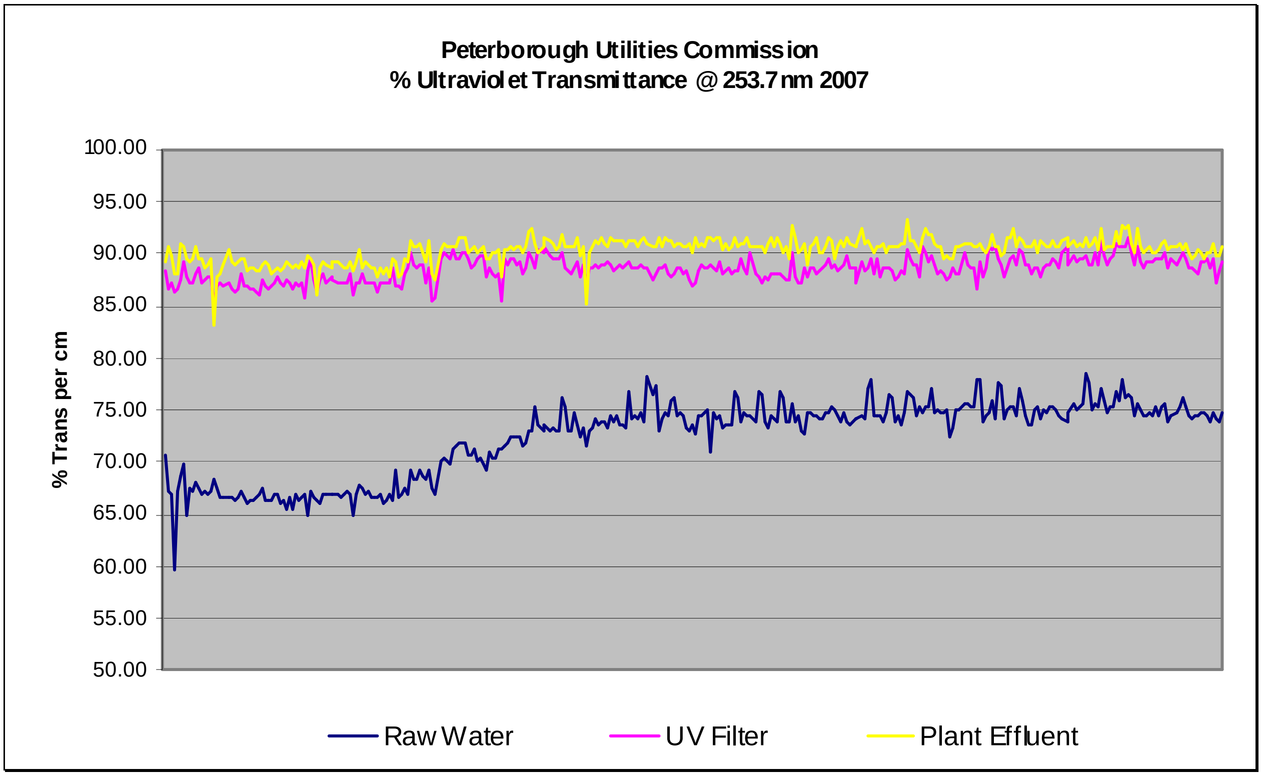

Figure 9

TOTAL ORGANIC CARBON

Another test that indicates the amount of organic matter in the raw and treated water is Total Organic Carbon (TOC). The overall health of the natural river environment can be determined by TOC since these compounds can consume more oxygen. Sources for TOC are organic contaminants (natural organic substances, insecticides, herbicides, and other agricultural chemicals) that enter waterways in a rainfall runoff. Domestic and industrial wastewaters also contribute organic contaminants in various amounts. Some of the contaminants may not be completely removed by treatment processes; therefore, they could become a problem for drinking water sources. Higher amounts of TOC in the treated water can contribute to the formation of THM's in the distribution system.

The difference between TOC raw water and TOC treated water; would indicate the amount of organic matter that has be removed through the water treatment process. The Water Treatment Plant removed 44.6% of TOC from the raw water during 2007 (removed 34.9 % in 2006). During 2007, we have seen a decrease in TOC which may contribute to a lower THM formation.

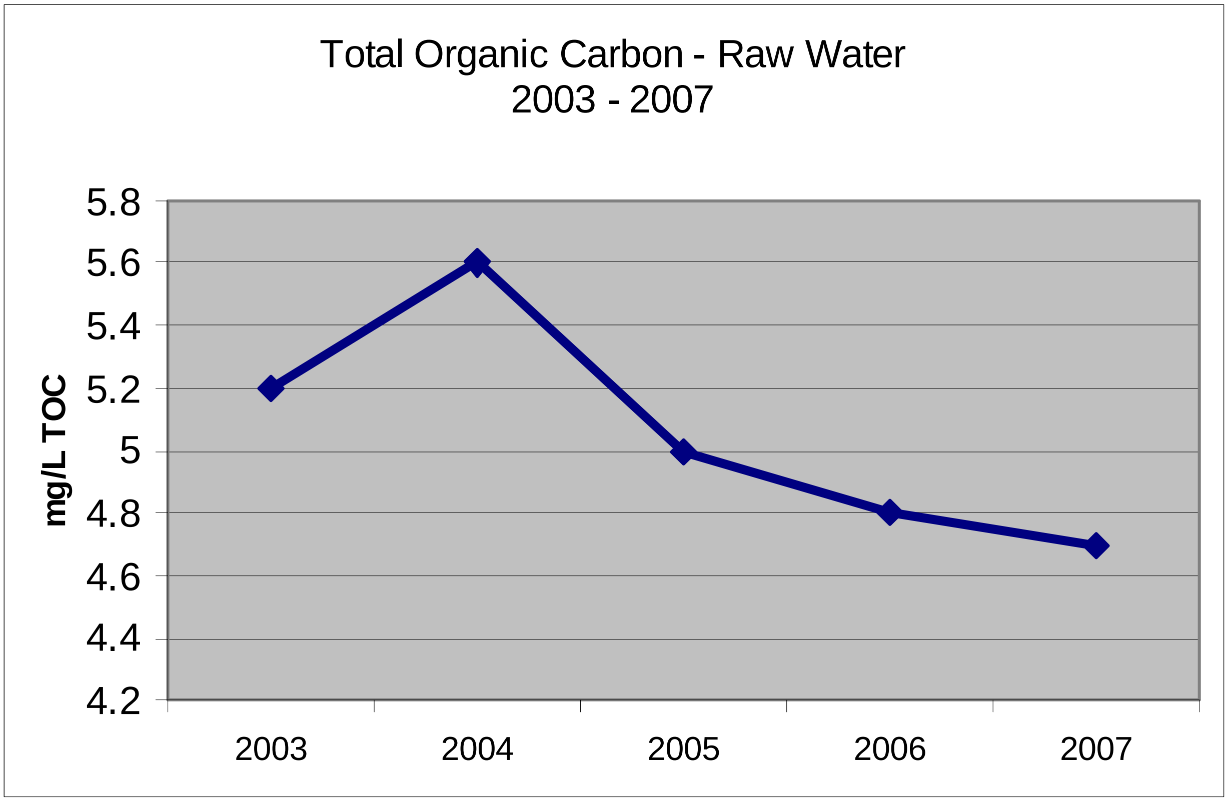

Figure 10

HARDNESS

Average hardness values for raw water in 2007, was found to be 93.6 mg/L as $CaCO_3$ and 92.8 mg/L in the treated water (Figure11). Hardness at this level is considered to be moderately hard. The values for 2006 were: raw water 91.7 mg/L and plant effluent 92.1 mg/L. Hardness does not appear to change from year to year substantially.

Hardness is caused by the presence of certain dissolved chemical compounds, with calcium and magnesium being the primary elements. The amount of hardness varies significantly depending on the source. Source water in areas where there are higher amounts of limestone and dolomite will have higher amounts of hardness. Calcium is dissolved as water passes over limestone deposits. Magnesium is dissolved as water passes over dolomite and other magnesium bearing minerals.

According to the Ontario Ministry of Environment, the recommended operational guideline for hardness is 80 to 100 mg/L expressed as calcium carbonate. Levels between 80 and 100 mg/L as $CaCO_3$ are considered to provide an acceptable balance between corrosion and incrustation.

Groundwater usually has higher amounts of hardness due to the fact that groundwater will be in contact with these geologic formations for a longer period of time than surface waters.

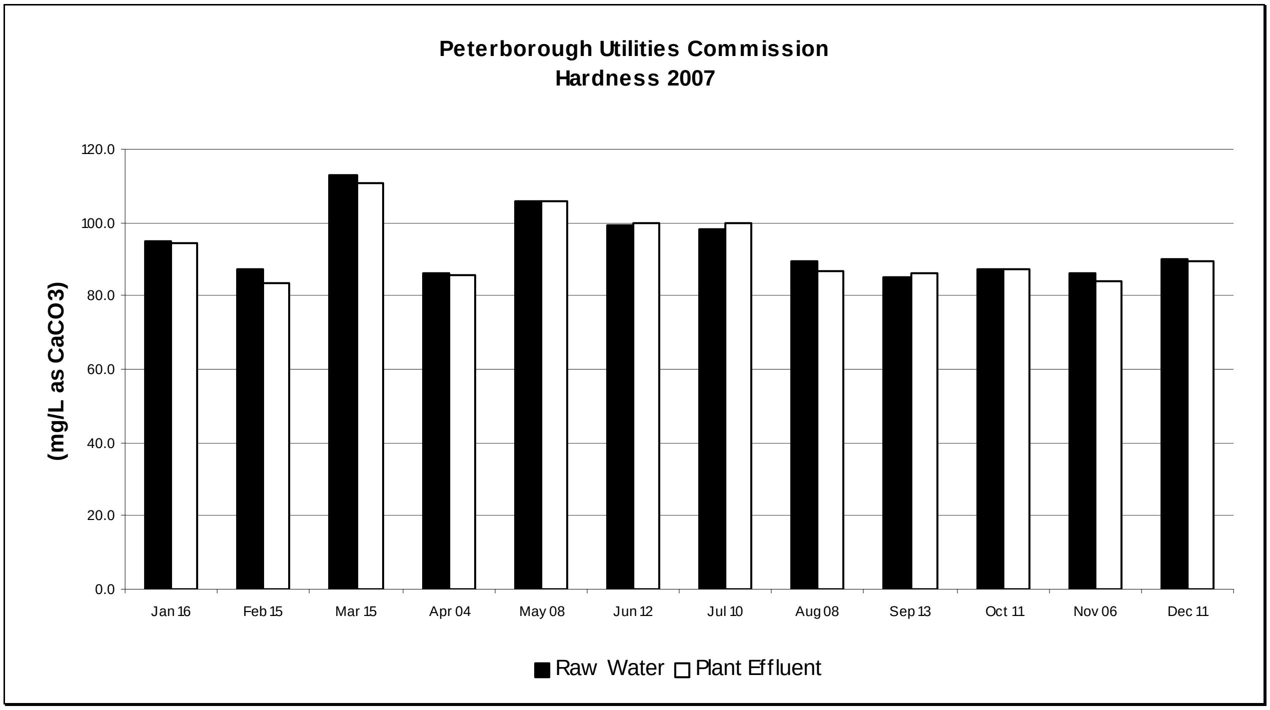

Figure 11

ALKALINITY

Alkalinity is a measure of the capacity of water to neutralize acids and is also known as the buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate, and hydroxide ions.

Average alkalinity values in 2007 for the raw water were 79.3 mg/L and 61.9 mg/L in the plant effluent (Figure 12). 2006 values for raw water were 77.0 mg/L and plant effluent 60.9 mg/L. Alkalinity generally decreases as water is in contact with alum.

Because alkalinity varies greatly due to differences in geology, there are not general standards for alkalinity. Levels of 20-200 mg/L are typical for fresh water.

According to the Ontario Ministry of Environment, the recommended operational range for alkalinity in coagulant-treated drinking water is 30 to 500 mg/L as $CaCO_3$. Alkalinity over 30 mg/L assists floc formation during the coagulation process (using alum).

A total alkalinity level of 100-200 mg/L will stabilize the pH level in a stream. Levels below 10 mg/L indicate that the system is poorly buffered, and is very susceptible to changes in pH from natural and human-caused sources.

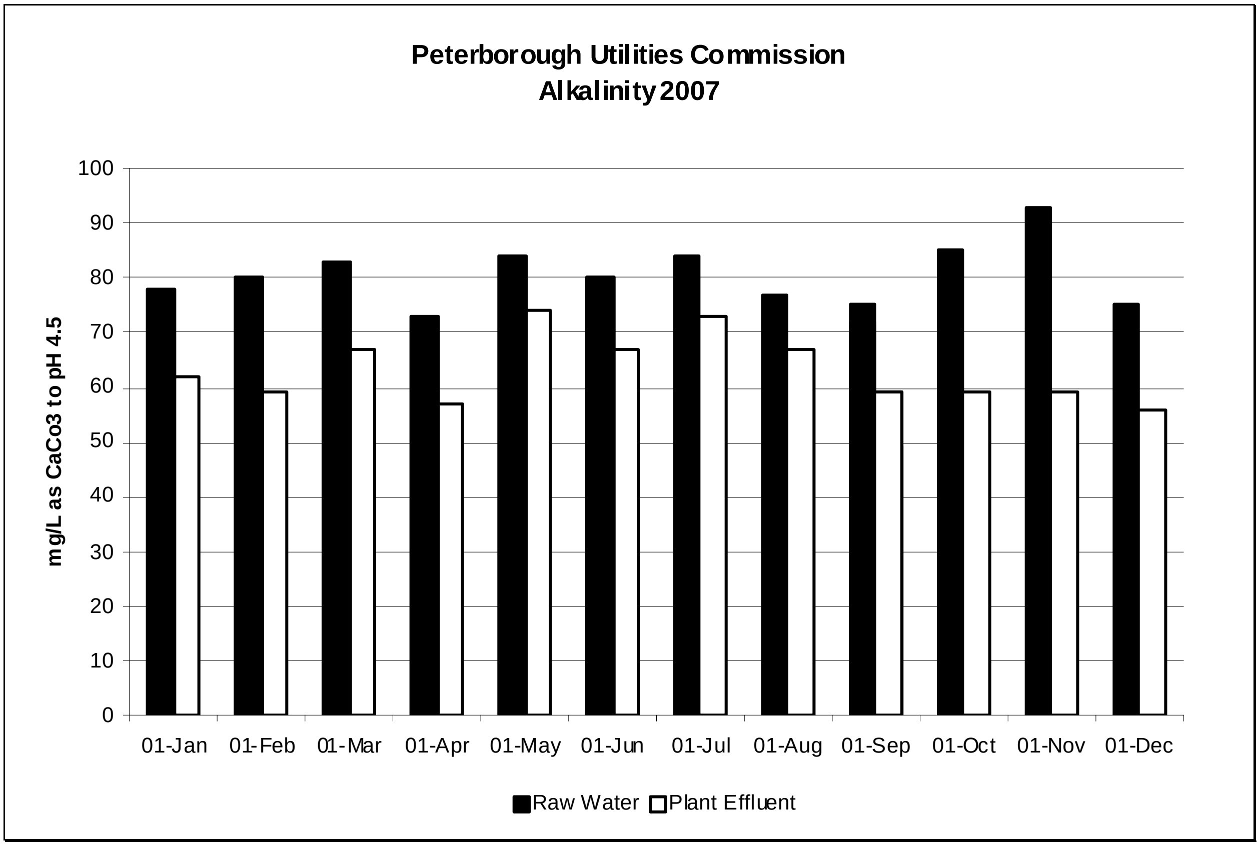

Figure 12

WENONAH STORMWATER RETENTION POND

The Wenonah Stormwater Retention Pond, found north of the Zoo property (upstream of the Water Treatment Plant) was tested during the summer months for bacteria and turbidity to determine if there was any contamination that may impact on the water treatment plant operation. This area was found to contain high bacterial counts and high turbidity values (Figure 13 & 14 especially after a rainfall. The retention pond may be a contributing factor for elevated coliform bacteria concentrations found in the raw water at the water treatment plant. The following chart displays the 2007 average test results between the Wenonah Pond and the Water Treatment Plant. This area will be further studied to determine if it has an impact on water treatment. Please note; CFU = Colony forming units.

	Wenonah Pond	Water Treatment Plant Raw Water
Turbidity	21.1 NTU	0.57 NTU
Coliform bacterial	6940 CFU/100mL	131 CFU/100mL
E. coli	403 CFU/100L	17 CFU/100mL
Fecal streptococcus	500 CFU/100mL	26 CFU/100mL
Heterotrophic Plate Count	873 CFU/100mL	201 CFU/100mL

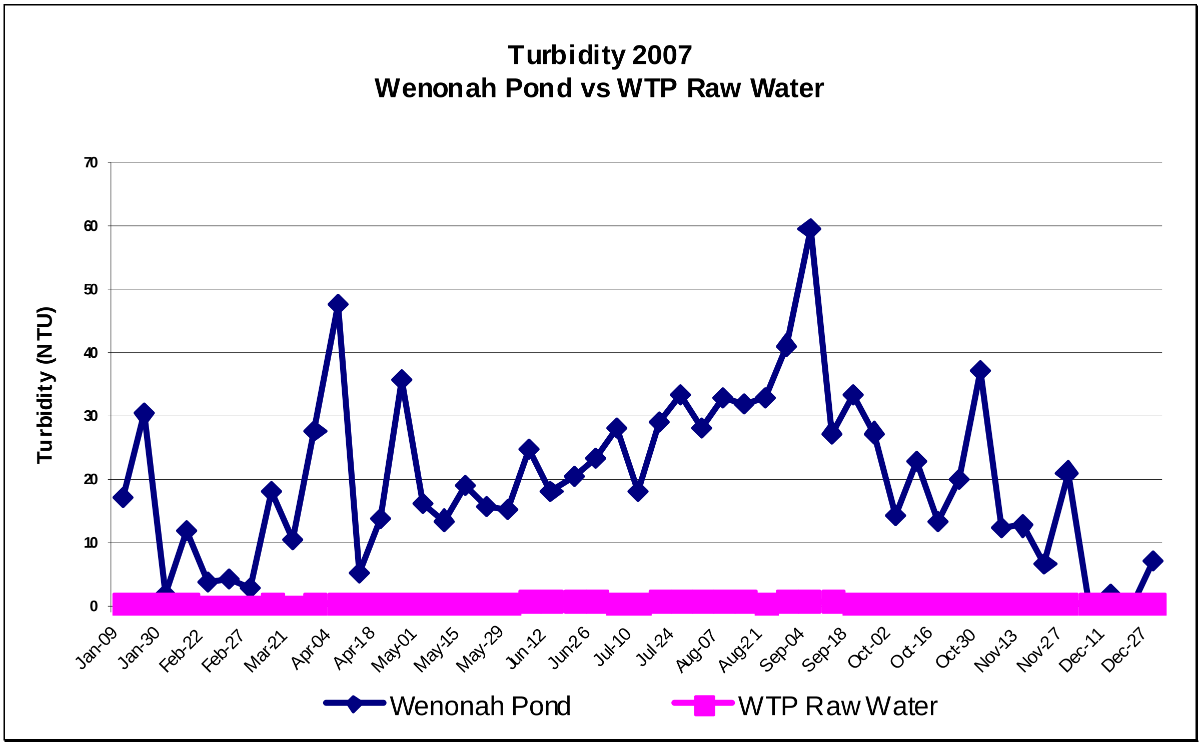

Figure 13

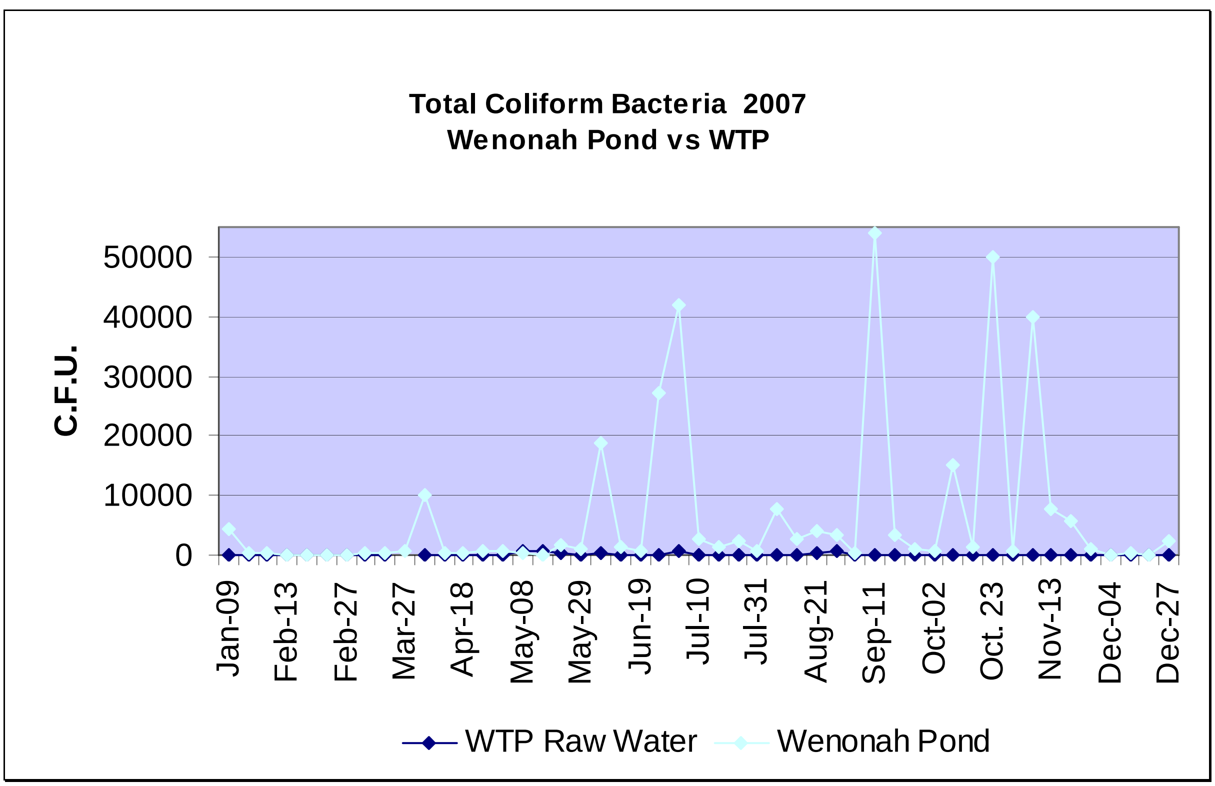

Figure 14

HYDROFLUOSILICIC ACID

Hydrofluosilicic acid (for fluoride) was added to the treated water to attain an average concentration of 0.65 mg/L. The fluoride feed system was off for a total of 51 days during 2007 due to preventative maintenance of the fluoridation feed and test equipment.

The Ministry of the Environment recommends that the fluoride residual be between 0.5 mg/L and 0.8 mg/L with a Maximum Acceptable Concentration of 1.5 mg/L. Approximately 1,500 samples taken at the Water Treatment Plant, raw water, and the distribution system were tested for fluoride concentration during 2007.

IRON

During 2007, over 25 distribution locations were sampled per month and tested for iron. The 2007 average distribution iron levels were 0.031 mg/L (Figure 15). The average iron residual in 2006 was found to be 0.041 mg/L. The MOE aesthetic objective (for appearance effects only) is 0.300 mg/L.

Excessive levels of iron in drinking water supplies may impart a brownish colour to laundered goods, plumbing fixtures and the water itself; it may produce a bitter, astringent taste in water and beverages; and the precipitation of iron can also promote the growth of bacteria in water mains and pipes.

Sodium silicate (BW46) is added to the plant effluent in order to coat the distribution pipes and reduce any rusting or corrosion and provide sequestration of iron. Another benefit of adding BW46 to the plant effluent water is to adjust the pH and alkalinity to decrease the corrosiveness of the water.

The iron residual leaving the Water Treatment Plant during 2007 was found to be 0.013 mg/L. In 2006 the iron residuals leaving the WTP were 0.011 mg/L.

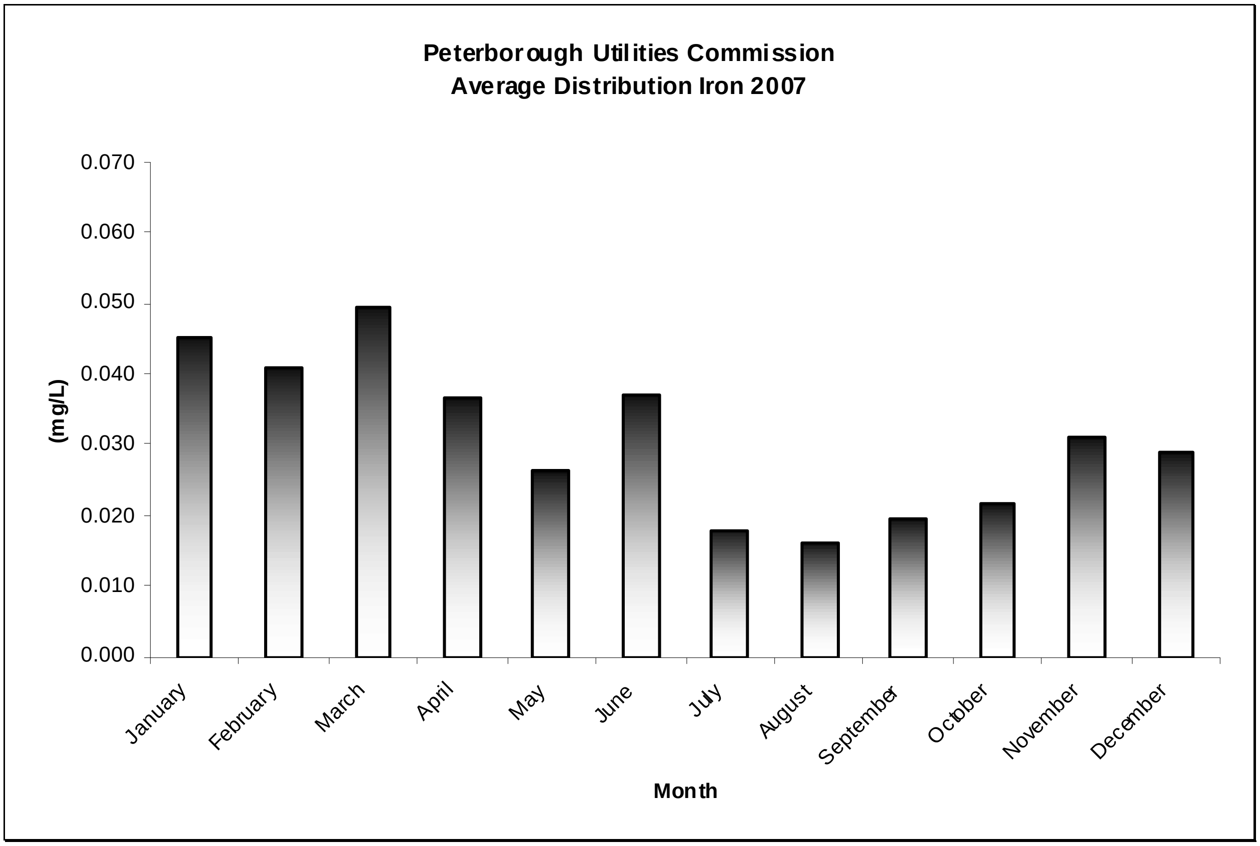

Figure 15

pH

In 2007, the average raw water pH was 7.89 (7.92 in 2006), figure 16 With the addition of alum the pH is lowered to 7.05 (in the settled basins). With the addition of chlorine, pH is lowered further to 6.84 (in the chlorine contact tank). A pH of 6.84 is considered slightly corrosive. Therefore sodium silicate (BW46M) is added to the plant effluent in order to raise the pH to an annual average of 7.07 and to deposit a thin silicate coating to the distribution piping for corrosion protection. In 2006, the average raw water pH was 7.92, and the average plant effluent was 7.03.

The Ontario Ministry of Environment operational guideline recommended in drinking water is to maintain a pH between 6.5 and 8.5. The principal objective in controlling pH is to produce a water that is neither corrosive nor produces incrustations.

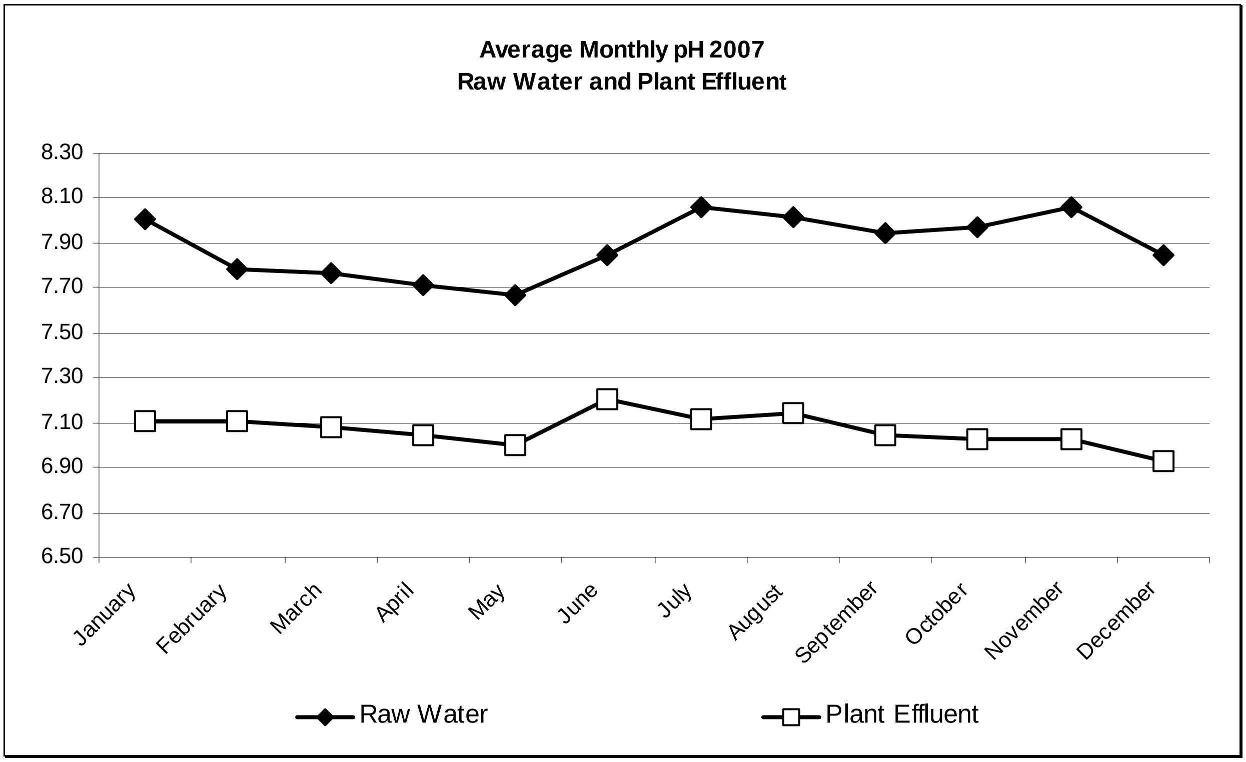

Figure 16

BACTERIA

Clostridium Perfringens

The bacteria Clostridium perfringens is analyzed as an indicator to the possible presence of the parasitic protozoans Giardia and Crytposporidium. Clostridium perfringens frequent the intestines of humans and many domestic and feral animals. Spores of the organism persist in soil, sediments, and areas subject to human or animal fecal pollution. Since this organism is spore forming, it can be used to mimic other organisms that can be found in an oocyst stage such as Giardia and Cryptosporidium. Giardia and Cryptosporidium are resistant to disinfection treatment and only through optimum coagulation, flocculation, sedimentation and filtration can these organisms be removed. If Clostridium perfringens can be effectively removed from the water treatment strain then there is a very low probability that Giardia and Cryptosporidium are present in the plant effluent. The relative sizes are as follows: Clostridium perfringens 1 – 2 µm, Cryptosporidium 4 – 5 p.m., and Giardia 8 – 14 p.m.

The theory is if you can remove Clostridium perfringens, then you most certainly will remove Cryptosporidium and Giardia. The MOE guidelines for Clostridium perfringens is to have all samples collected from the plant effluent to be zero C.F.U. (colony forming units per litre of water sampled). All samples taken in 2007 from the plant effluent were zero C.F.U. (Figure 17) indicating an ineffective treatment process.

The raw water, settled water and plant effluent were all monitored for Clostridium perfringens during 2007. The raw water contained on average of 19 C.F.U./L of Clostridium perfringens.

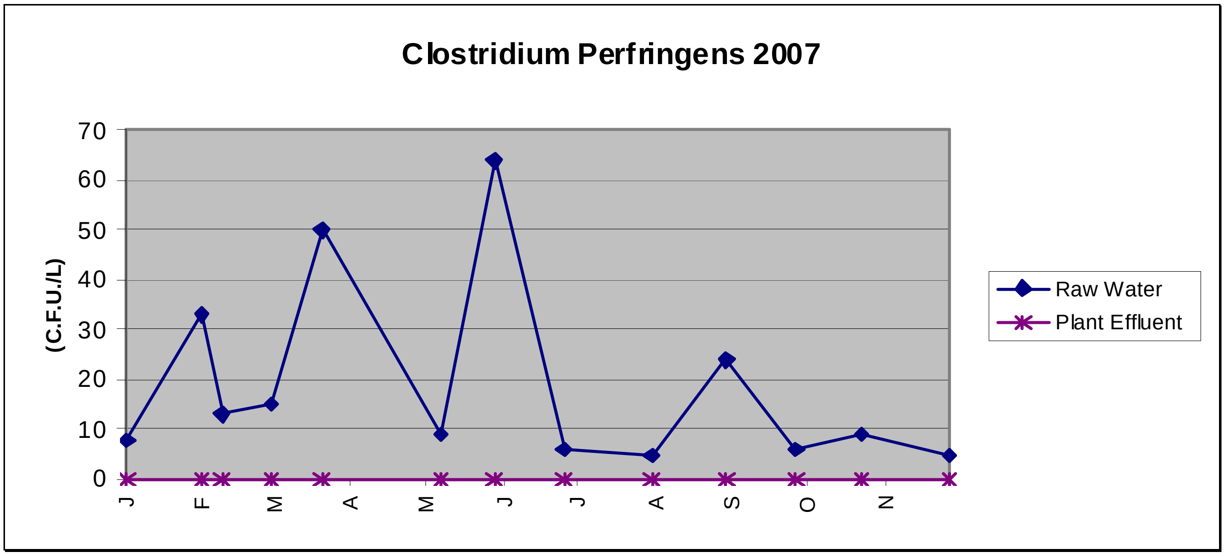

Figure 17

Fecal Streptococci & E. Coli Ratios

During 2007, a total of 54 fecal streptococci samples were analyzed from the Otonabee River (at the WTP intake) to assist in determining the source of fecal contamination within our source water (Figure 18). Fecal streptococci is another species of bacteria (similar to E. coli) that can be found from warm-blooded animals.

A ratio between fecal streptococci and E. coli can assist in determining the species source of contamination. The ratio between 2007 average E. coli to fecal strep. bacteria populations in the WTP raw water were found to be 0.69 C.F.U.. This would indicate that the majority of fecal contamination in the Otonabee River found at the WTP was from ducks or geese.

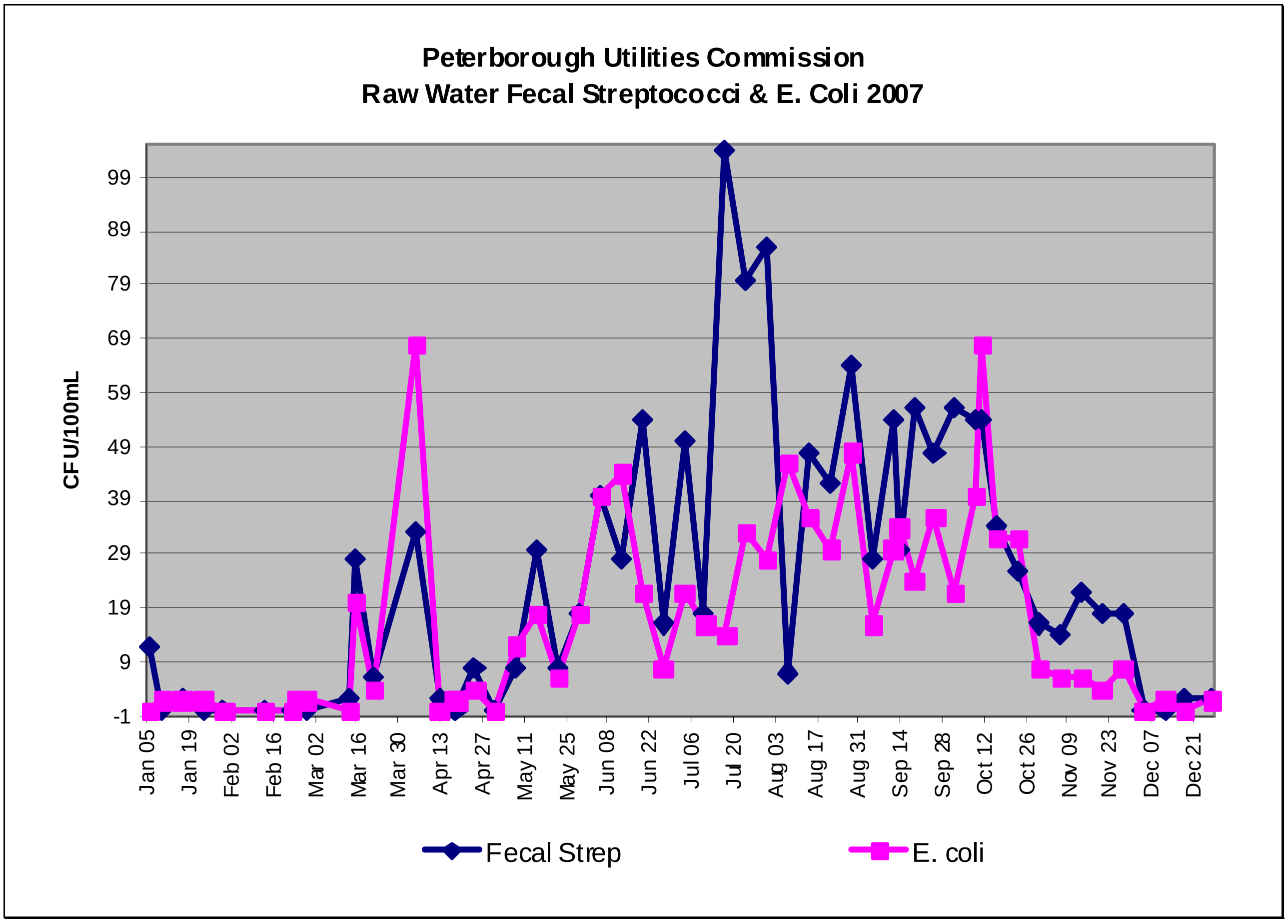

Figure 18

TESTING

The Peterborough Water Treatment Plant fully complied with the quarterly and annual testing and reports required under the Ministry of the Environment's Drinking Water Systems Regulations 170/03 made under the Safe Drinking Water Act, 2002. .Schedule 23& 24 list the annual parameters required under the Drinking Water Standards, Regulations 170/03.

During 2007, there was one adverse water quality report; a low free chlorine value (free chlorine lower than 0.05 mg/L). This sampling location was flushed and resampled. The resample test results were in compliance to the MOE standards.

During 2007, there were over 20,000 individual water quality tests performed on samples taken from the Peterborough Water Treatment Plant and the distribution system. Approximately 13,000 tests were performed at the Peterborough Water Treatment Plant laboratory. SGS Lakefield Research Analytical Laboratory performed approximately 6,000 microbiological and chemical tests. The Ministry of the Environment laboratories performed approximately 1,000 tests including inorganic and organic parameters taken as part of the Drinking Water Surveillance Program.

The Peterborough Water Treatment Plant effluent and distribution sample test results for

inorganic and organic parameters in 2007 met present health-related Ministry of the Environment Drinking Water Standards; Schedule 23 and Schedule 24 as per the MOE Reg. 170/03.
Please note that the majority of results indicated '< MDL' meaning that the results were below the Method Detection Limit (i.e. test could not detect any concentration). All tested parameters were found to be below the Ontario Drinking Water Standards, MAC.

Lead is not part of Schedule 23 or schedule 24 but is required to be sampled and tested annually. This sample must be taken from a location in the city's distribution system that may have the oldest water mains. Sherbrooke Street Sampling Station was selected as this location since it was indicated that the water mains in this area are over 100 years old.

Sodium is not part of schedule 23 or 24 but is required to be tested at least once every 5 years. It was sampled January 2006 and was found to be below the ODWS (Ontario Drinking Water Standards), aesthetic objective of 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L, so that this information may be passed on to local physicians.

Records of individual test results are kept on file at the Peterborough Water Treatment Plant laboratory. An updated copy of the Peterborough Water Treatment Plant annual report can be found on the Peterborough Utilities web site at www.peterboroughutilities.ca .

In conclusion, the Peterborough Water Treatment Plant continued to produce an excellent quality of water for its consumers and once again exceeded the quality required in the Drinking Water Standards. This is largely due to the optimization of the facilities and the continuing expertise and dedication of the staff to produce and maintain an excellent quality product.

SUMMARY OF ANNUAL ANALYTICAL TEST REQUIRED UNDER REGU LATIONS 170/03

Schedule 23 – Inorganic Parameters

Antimony	Chromium
Arsenic	Mercury
Barium	Selenium
Boron	Uranium
Cadmium	

Note: Copper, Iron, and Manganese are not required with the new regulations (after June, 2003). Lead must be sampled in the distribution system (reg. 170/03).

Schedule 24 – Organic Parameters

Alachlor	DDT	Paraquat
Aldicarb	1,2 – dichloroethane	Parathion
Aldrin+Dieldrin	1,1 – Dichloroethylene	Pentachlorophenol
Atrazine	Dichloromethane	Phorate
Azinphos-methyl	2,4 – Dichlorophenol	Picloram

Bendiocarb Benzene Benzopyrene Bromoxynil Carbaryl Carbofuran Carbon Tetrachloride Chlordane Chlorpyrifos Cyanazine Diazinon Dicamba 1,2 - Dichlorobenzene 1,4 - Dichlorobenzene	2,4 – Dichlorophenoxy acetic acid Diclofop-methyl Dimethoate Dinoseb Diquat Diuron Glyphosate Heptachlor+heptachlor epoxide Lindane (Total) Malathion Methoxychlor Metolachlor Metribuzin Monochlorobenzene	PCB Prometryne Simazine Temephos Terbufos Tetrachloroethylene 2,3,4,6-Tetrachlorophenol Triallate Trichloroethylene 2,4,6-Trichlorophenol 2,4,5 – Trichlorophenoxy acetic acid (2,4,5 –T) Trifluralin Vinyl Chloride

Note: If any parameter from Schedules 23 and 24 were found to exceed half of the prescribed standard for the parameter, the frequency of sampling and testing for that parameter shall be increased so that at least one water sample is taken and tested every three months.

Peterborough Water Treatment Plant
Peterborough Utilities Commission

PLANT EFFLUENT - Treated Water Analysis 2007

Annual Analysis beginning June 2003 as per Regulations 170/03 and PUC Certificate of Approval (7-0073-95-006)

Note: all units are ug/L unless otherwise stated
Note: <MDL = Less Than SGS Method Detection Limits

Ontario Drinking Water Standards - Schedule 23 - Inorganic Parameters

Parameter	Date: Jan 18		ODWS MAC
Antimony	0.2	<MDL	6
Arsenic	0.2	<MDL	25
Barium	26.2		1000
Boron	8		5000
Cadmium	0.06	<MDL	5
Chromium	0.5		50
Mercury	0.02	<MDL	1
Selenium	1	<MDL	10
Uranium	0.05		20
Fluoride			1.5
Lead* (Sampled at Sherbrooke Sampling Station Jan 29)	0.81		10
Sodium** mg/L			20

Ontario Drinking Water Standards - Schedule 24 - Organic Parameters

Parameter	Jan 18		MAC/IMAC
Alachlor	0.11	<MDL	5
Aldicarb	0.30	<MDL	9
Aldrin + Dieldrin	0.067	<MDL	0.7
Aldrin	0.060	<MDL	
Atrazine + N-dealkylated metabolites	0.12	<MDL	5
Atrazine	0.11	<MDL	
De-ethylated atrazine	0.12	<MDL	
Azinphos-methyl	0.21	<MDL	20
Bendiocarb	0.13	<MDL	40
Benzene	0.37	<MDL	5
Benzo(a)pyrene	0.004	<MDL	0.01
Bromoxynil	0.33	<MDL	5
Carbaryl	0.16	<MDL	90
Carbofuran	0.37	<MDL	90
Carbon Tetrachloride	0.41	<MDL	5
Chlordane (total)	0.11	<MDL	7
a-chlordane	0.069	<MDL	
g-chlordane	0.063	<MDL	
Chlorpyrifos	0.18	<MDL	90
Cyanazine	0.18	<MDL	10
Diazinon	0.081	<MDL	20
Dicamba	0.2	<MDL	120
1,2-Dichlorobenzene	0.5	<MDL	200
1,4-Dichlorobenzene	0.21	<MDL	5
Dichlorodiphenyltrichloroethane (DDT) & Metabolites	0.14	<MDL	30
op-DDT	0.095	<MDL	
pp-DDD	0.098	<MDL	
pp-DDE	0.075	<MDL	
pp-DDT	0.14	<MDL	
1,2-dichloroethane	0.43	<MDL	5
1,1-Dichloroethylene (vinylidene chloride)	0.41	<MDL	14
Dichloromethane	0.34	<MDL	50
2-4-Dichlorophenol	0.15	<MDL	900
2,4-Dichlorophenoxy acetic acid (2,4-D)	0.19	<MDL	100
Diclofop-methyl	0.4	<MDL	9
Dimethoate	0.12	<MDL	20
Dinoseb	0.36	<MDL	10
Diquat	1	<MDL	70
Diuron	0.087	<MDL	150
Glyphosate	6	<MDL	280
Heptachlor + Heptachlor Epoxide	0.11	<MDL	3
Heptachlor	0.061	<MDL	
Heptachlor epoxide	0.11	<MDL	
Lindane (total)	0.056	<MDL	4
Malathion	0.091	<MDL	190
Methoxychlor	0.14	<MDL	900

Metolachlor	0.092 <MDL	50
Metribuzin	0.12 <MDL	80
Monochlorobenzene	0.58 <MDL	80
Oxychlordane	0.11 <MDL	
Paraquat	1 <MDL	10
Parathion	0.18 <MDL	50
Pentachlorophenol	0.15 <MDL	60
Phorate	0.11 <MDL	2
Picloram	0.25 <MDL	190
Polychlorinated Biphenyls (PCB)	0.04 <MDL	3
Prometryne	0.23 <MDL	1
Simazine	0.15 <MDL	10
Temephos	0.31 <MDL	280
Terbufos	0.12 <MDL	1
Tetrachloroethylene (perchloroethylene)	0.45 <MDL	30
2,3,4,6 - Tetrachlorophenol	0.14 <MDL	100
Triallate	0.10 <MDL	230
Trichloroethylene	0.38 <MDL	5
2,4,6 - Trichlorophenol	0.25 <MDL	5
2,4,5 - Trichlorophenoxy acetic acid (2,4,5-T)	0.22 <MDL	280
Trifluralin	0.12 <MDL	45
Vinyl Chloride	0.17 <MDL	2
Dieldrin	0.067 <MDL	

TOURS

Tours have been an important part of public education at the Peterborough Water Treatment Plant. Over 175 people have had a tour of the water plant process during 2007 - an increase of 20% over 2006. WTP staff have educated over 100 students at various schools on the topic of water conservation.

CUSTOMER CALLS

A new customer concern computer program was initiated during 2006 to track all questions and concerns relating to water. Some questions and concerns that were asked from our WTP staff were; taste and odour questions, colour, hardness, general water quality, information on water treatment, sampling, operations, questions on ground water systems, and questions to assist with school projects on water treatment.

In 2007 the staff at the Water Treatment Plant responded to a total of 198 inquiries (Figure 19). There were 25 requests for information, such as hardness results, water quality reports, and how the water treatment plant operates. 17% of customer concern calls were related to taste and odours (earthy/musty or chlorine). This may be due to the warmer summer where taste and odours are more noticeable and more prevalent. Another 77% of customer concern calls were relating to colour concerns (usually rusty coloured water). Some of these concerns were mainly due to water main construction or rehabilitation and routine water main maintenance.

Customer Concern Calls

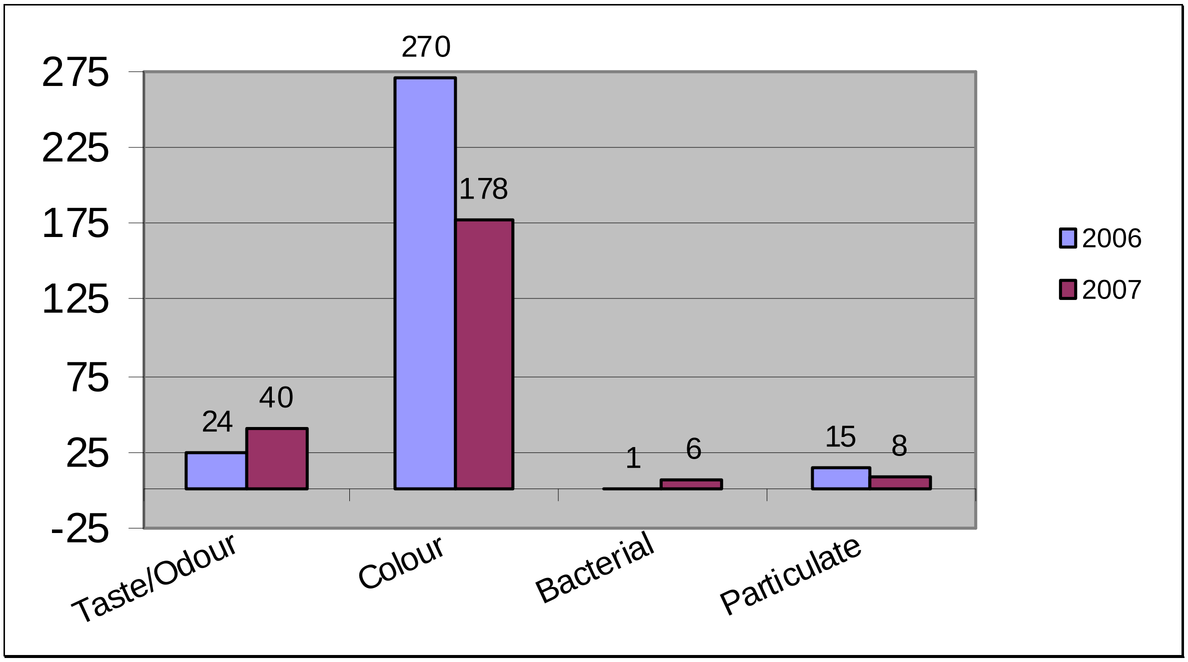

Figure 19

Abbreviations

2MIB	2-Methylisoborneol
HPC	Hetertrophic Plate Count
MAC	Maximum Acceptable Concentration
<MDL	Less than Method Detection Limit
MOE	Ministry of Environment
ηg/L	nano gram (one billionth) per liter
NTU	Nephelometric Turbidity Units
ODWS	Ontario Drinking Water Standards
THM	Trihalomethanes
µg/L	Micro gram per liter
TOC	Total Organic Carbon
WTP	Water Treatment Plant