Characterization of Effluent from Gander's Two Wastewater Treatment Plants: Beaverwood and Magee

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1.0 Introduction to the Canadian Counsel of Ministers of the Environment's *Canada-wide Strategy for the Management of Municipal Wastewater Effluent.*

The Canadian Counsel of Ministers of the Environment (CCME) has developed a strategy to protect Canada's aquatic environment as well as its biological dependants such as predatory fish, birds and mammals. The strategy is termed the *Canada-wide Strategy for the Management of Municipal Wastewater Effluent* (MWWE). The MWWE project was to be completed on November 2006 by the Development Committee (*Canada-wide Strategy for the Management of Municipal Wastewater Effluent,* n.d.), and has undergone review since then.

This program is designed to ensure proper treatment of effluent from all communities and a standard approach to the concentrations of contaminants such as *Escherichia coli,* polychlorinated biphenyls (PCBs), metals, and surfactants. There are 3500 communities in Canada with wastewater facilities that range from no treatment to state of the art technologies (*Canada-wide Strategy for the Management of Municipal Wastewater Effluent, Draft*, 2007). The goal is to upgrade these facilities so that treatment of all effluent delivered to fresh or marine waters is treated to the same National Performance Standards (NPS). NPS standards have been created for five day carbonaceous biochemical oxygen demand ($CBOD_5$), total dissolved solids (TSS) and total residual chlorine (TRC) with more guidelines to be released in December 2008 (Forth, Claude, 2007).

Communities are placed into categories based on their environmental impacts and the waste water's receiving environment to determine when they must reach the goals set out by the CCME. The timeline ranges from ten years for high risk, 20 years for medium risk and 30 years for low risk facilities. A risk assessment is conducted and the category the treatment plant falls in is based on a point system shown in Table 1 below; facility size, $CBOD_5$, TSS, Ammonia, TRC, and the receiving environment. Table 1 shows an example of the points system with small facilities receiving the lowest amount and very large treatment plants receiving the highest. The lower the amount of points, the longer the municipality has to improve their waste treatment system:

A total of 65 risk points or greater has only ten years to achieve NPS standards while a total of risk points between 50-64 have 20 years to achieve the standards and a risk point total equal to or less than 49 has 30 years (*Canada-wide Strategy for the Management of Municipal Wastewater Effluent, Draft*, 2007).

Table 1: Category of facility size and risk points for municipal wastewater systems.

Size Category	Flow [m^3/day]	Risk Points
Very small[1]	≤ 500	5
Small[1]	> 500 – 2,500	10
Medium	> 2,500 – 17,500	15
Large	> 17,500 – 50,000	25
Very Large	> 50,000	35

[1] Very small and small[1] facilities which have industrial input associated with wastewater will be considered in the medium size category. From (Canada-wide Strategy for the Management of Municipal Wastewater Effluent, Draft, 2007).Table modified with inclusion of points system.

The CCME decided that there needed to be something done to address the pollution issues associated with the country's growing population. Some of these issues include combined sewer systems, facilities being able to remove only portions of the pollutants present in the water, and aging infrastructure *(Canada-wide Strategy for the Management of Municipal Wastewater Effluent, Draft*, 2007). Many of these problems arise from the age of Canada's systems with older settlements having combined sewer systems in which overflows often occur sending untreated water directly into the environment.

For some areas where the receiving environment is sensitive, such as a river with a low flow, damage is caused not only to the water, but also to those who depend directly on it such as wildlife. The old piping system associated with sewage transport may have leaks that are damaging surrounding environments or running into sensitive areas like drinking water supplies. It is known that replacing combined sewers is expensive, and it is not required to replace these structures, but measures to reduce their impact through the creation of storage tanks for future treatment or some other measure may be put in place.

For Newfoundland and Labrador, many of the communities deposit their sewage, untreated, into marine waters. From the Department of Conservation, a Wastewater Treatment Systems Inventory is provided listing the type of treatment provided by Newfoundland and Labrador communities. Of the 35 communities listed as of April 2008, 19 had primary treatment using either a septic tank or sedimentation tank, while 16 had secondary treatment systems using activated sludge, hydro-dynamic separation, fixed film, soil adsorption, lagoon treatment or a wetlands treatment system. Newfoundland does not have a large number of communities that have treatment systems, with approximately 550 towns having no treatment, including the capital city, St. John's. St. John's is presently in the stages of finishing a secondary waste treatment plant that is scheduled to be completed in the fall of 2008 (St. John's Harbour Cleanup, 2008). This facility will collect waste from St. John's, Mount Pearl and Paradise with a total population of 130,000, 25% of the provinces population (St. John's Harbour Cleanup, 2008 and Statistics Canada, 2008). Although the majority of Newfoundland and Labrador communities do not have treatment for their waste, most rural areas have small populations that do not set their point status at a high risk. Newfoundland and Labrador's population is only 1.7% of the total Canadian population (Statistics Canada, 2008); the impact is minimal compared to that of larger provinces but just as important.

2.0 Introduction to Gander's Municipal Wastewater Treatment Plants.

The Town of Gander has two sewage treatment plants (STP), one operating as an extended aeration plant while the other is a hydro-dynamic separation plant. Both plants are coming close to their capacity load and the Town is presently looking into creating a new, larger plant (G. Horwood, personal communication, June 6, 2008).

The biological waste treatment plant, Magee, is composed of two circular tanks that have dual modes; extended aeration and contact stabilization (Maintenance and Operation Manual; Contact Stabilization Plant, n.d.). The raw sewage enters the system after being sent through a bar screen that removes any large pieces that could cause problems for the tank. These pieces are then sent to the landfill without treatment.

A comminutor is also located prior to sewage entering the system to ensure any particles present are small enough to be easily digested by the microbes present in the sludge. The sewage then enters the contact aeration portion of the tank which leads into the settling tank and finally the chlorine contact tank (Maintenance and Operation Manual; Contact Stabilization Plant, n.d.). Located before the sewage inlet and the contact aeration portion is an aerobic digester segment and a sludge reaeration section used to create and maintain the activated sludge used throughout the process. A portion of the sludge from the settling tank is returned to the sludge aeration chamber via central collection (Maintenance and Operation Manual; Contact stabilization plant, n.d.) while any excess sludge is removed and sent to the aerobic digester. The sludge is dried from constant aeration and sent to landfill with the supernatant returning to the sludge reaeration portion (Can Tex Industries Information Pamphlet Mineral Wells, Texas, n.d.). The effluent that leaves the chlorine contact segment of the tank is sent into the environment.

The hydrodynamic separation plant, Beaverwood, used in Gander is combined with a coagulant to induce better flocculation of the sediments present in the wastewater. This plant treats water from the residential and commercial sanitary sewer system, the James Paten Memorial Hospital, CHC Helicopter Corporation, and the Gander International Airport sanitary sewage as well as stormwater from these areas; its capacity is 21 million gallons per day (mgd). Because of the added water from stormwater, a second biological plant was not possible as it would not be able to sustain microbial life due to the dilution of incoming nutrients (G. Horwood, personal communication, June 6, 2008).

The sewage water first enters a pH neutralizing tank in which lime is added before being sent through a vortex to separate the solids from the liquid. The solids are then moved to a presser to be dewatered by a rotary mixer and sent to landfill while the supernatant is returned to the remaining water and sent for treatment. The water is disinfected by a chlorine contact chamber that uses baffles to increase its contact time (Wallace and Tiernan Model v-100 chlorinator as per section 15405, subsection 2.3.1. Cecon Limited, n.d.).

The chlorination system has automatic switchover; it switches from one tank containing chlorine to another to enable constant disinfection of the effluent (Wallace and Tiernan Model v-100 chlorinator as per section 15405, subsection 2.3.1. Cecon Limited).
The water is then released to the environment without dechlorination although there is a chamber built for this purpose if needed (G. Broomfield, June 6, 2008).

There are some typical problems associated with these two wastewater treatment plants. For the chemical system, during heavy rain or snowmelt there are overflows due to the storm system being incorporated into this section of piping within the town. The overflows are not frequent occurrences so at present nothing is being done to mediate the overflows (G. Broomfield, personal communication, June 6, 2008). There is also poor coagulation taking place from time to time in which solutions must be found for proper treatment to occur (G. Broomfield, personal communication, June 6, 2008). The Magee STP has not had too many problems other than mechanical malfunctions such as pump failure or material becoming caught in the central sludge collector.

When maintenance is being completed on one of the aerobic digestion tanks, the wastewater influent is diverted to the second tank; this occasionally causes a backup of sewage that needs to be stored, before treatment, within the second tank until the container is full. Once full, the influent flows through the system without reaching the required contact time in the aerobic digester and the chlorine chamber before being released into the environment. (L. Waterman, personal communication, July 24, 2008).

The receiving environment for a sewage treatment plant is a major concern for the CCME MWWE as mentioned previously. This is because the smaller the receiving environment, the larger the effect the sewage effluent may have upon it. Gander is classified as a medium risk community as it has a population of approximately 10000. The town is located centrally on the island, discarding its waste into a freshwater location rather than a large coastal area, adding risk points to the community according to the MWWE *Strategy* proposal.

The Beaverwood wastewater treatment facility sends its effluent into the environment through a series of brooks and streams that leads to Soulis Pond and then to the east end of Gander Lake via Soulis Brook (L. Waterman, personal communication, July 8, 2008).

This series of watercourses absorb the nutrients and other attributes that are released into the environment through various vegetation associated with the small waterways and marshland such as *Typha spp.* (or cattails), and grasses. Research is being conducted on wetland plants that are efficient at waste uptake such as heavy metals and various species of *Typha* such as *T. angustata*, are capable of absorbing heavy metals such as manganese (Mn), copper (Cu), zinc (Zn), lead (Pb), nickel(Ni) and chromium (Cr) (Bose, S., Vedamati J., Rai V. &. Ramanathan A.L., 2008) and *T. latifolia* is able to take up phosphorus (Gu, B., & Dreschel T., 2008). There has been monitoring of these streams to ensure there is no harmful effect on Gander Lake which is the town's drinking water supply. These tests have been completed throughout the system by the Department of Environment and Conservation (L. Waterman, personal communication, July 8, 2008).

The receiving environment for the Magee wastewater treatment plant has a similar environment in which it is released; small streams and brooks which are surrounded by marsh like vegetation which leads into Whitman's Pond, Jonathan's Pond and eventually empties into Gander Bay via Gander River (L. Waterman, personal communication, July 8, 2008).

3.0 Methods

The initial characterization of the two treatment plants include sampling of many parameters, located in Table 1, and occur over a period of one year. The actual characterization for the Canada-wide *Strategy* will not start until 2009, but the Town of Gander completed a preliminary test on both sewage treatment plants (STPs).

Table 2: Testing parameters required for the initial characterization of wastewater treatment plants and their frequency.

Daily Tests	Biweekly Tests	Quarterly Tests
Chlorine Residual	[1]$CBOD_5$	Fluoride
	Total Suspended Solids	Nitrate
	[2]Nutrients	Nitrate + Nitrite
	Nitrate	Total Cyanide
	Nitrate + Nitrite	Chemical Oxygen Demand
		[3]Metal Scan
		Organochloride pesticides
		Polychlorinated Biphenyls
		pH
		Volatile organic compounds
		Phenolic Compounds
		Acute Toxicity Test (Rainbow trout and *Daphnia magna* in single or multiple concentrations.)
		Chronic toxicity Test (Fathead Minnow and *ceriodaphnia dubia*.)
		Polycyclic Aromatic Hydrocarbons

[1]$CBOD_5$ – Five day carbonaceous biochemical oxygen demand.
[2]Nutrients – Includes ammonia, temperature and pH for ammonia toxicity, total kjeldahl nitrogen (ammonia + organic nitrogen), and total phosphorous.
[3]Metal Scan – Full range of total extractable metals and hydrides.
Source: CCME MWWE Draft document.

The parameters mentioned in Table 1 have been tested using an accredited laboratory, Maxxam Analytics, except for the toxicity, *Escherichia coli*, and chlorine residuals testing. The toxicity tests and *E. coli* were completed by the accredited laboratory, Jacques Whitford, while the chlorine residuals were tested within approximately one hour using the DR 2500 spectrophotometer. Maxxam sent bottles including the preservatives and other specific packaging requirements, needed for completing the tests.

The bottles were taken in coolers to the end-of-pipe locations of both plants, where the effluent comes in contact with the environment (Sample Area 1 of Figure 1 and 2); Beaverwood on June 30th and Magee on July 2nd, 2008. The samples were taken as grab samples using a rod with an attached container at the end to scoop the water as it exited the pipe.

The samples were then poured into containers following any specifications provided by the laboratory. Such specifications included leaving no head space for the VOCs, filling the bottle to the neck for PAHs and semi-volatile organics, and adding 15 drops of nitric acid to every 50mL of sample for the metal scan. The samples were then packaged as they were when received and shipped back to the lab the same day as sample collection to ensure enough time for the sampling procedures. The minimum holding time for the samples was five days as the nitrate + nitrite sample needed to be tested within this period (*Canada-wide Strategy for the Management of Municipal Wastewater Effluent, Draft*, 2007). The July 2nd sampling was taken a few days after rain with the water being more dilute than normal, possibly affecting the results.

The samples taken for the acute toxicity test and bacteriological test were taken on August 7, 2008 in the afternoon and sent to the Jacques Whitford Laboratory by the following morning. This was to ensure ample time for the testing of *E. coli* as it has a 24 hour holding time. The *D. magna* toxicity testing followed the Reference Method for Determining Acute Lethality of Effluents to *D. magna* (EPS/1/RM/14 Second Edition, December 2000) and the rainbow trout toxicity test following the Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout (Report 1/RM/13 Second Edition, December 2000 and May 2007 Amendment). The test procedure for the measurement of *Escherichia coli* was the most probable number (MPN) method.

Additional nutrient testing of the two sewage plants was conducted using Hach pillow packs for nitrate, nitrite, phosphorus, sulfate and ammonia for 10mL samples. These samples were taken on August 13, 20 and 23, 2008 using the same technique as mentioned above for collection in 200ml plastic bottles.

The samples were then tested using the DR 2500 spectrophotometer within 24 hours as per the *DR/2500 Spectrophotometer Procedure Manual*. Sampling sites for the nutrients present in the two wastewater effluents are seen in Figure 1 and Figure 2.

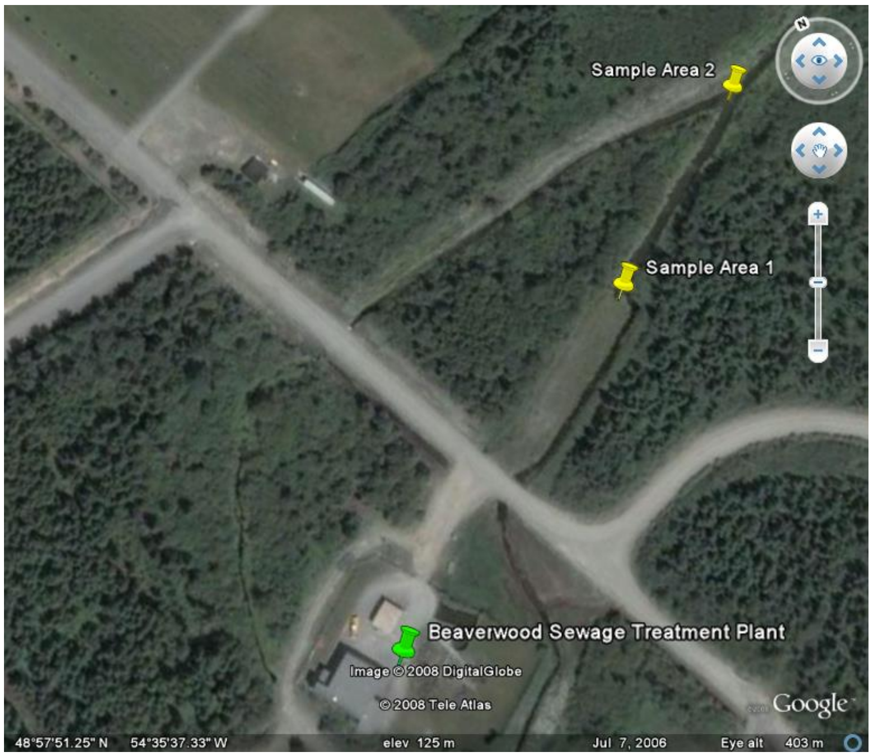


Figure 1: Sampling sites for nutrient content for the Beaverwood sewage plant. (From Google Earth.)

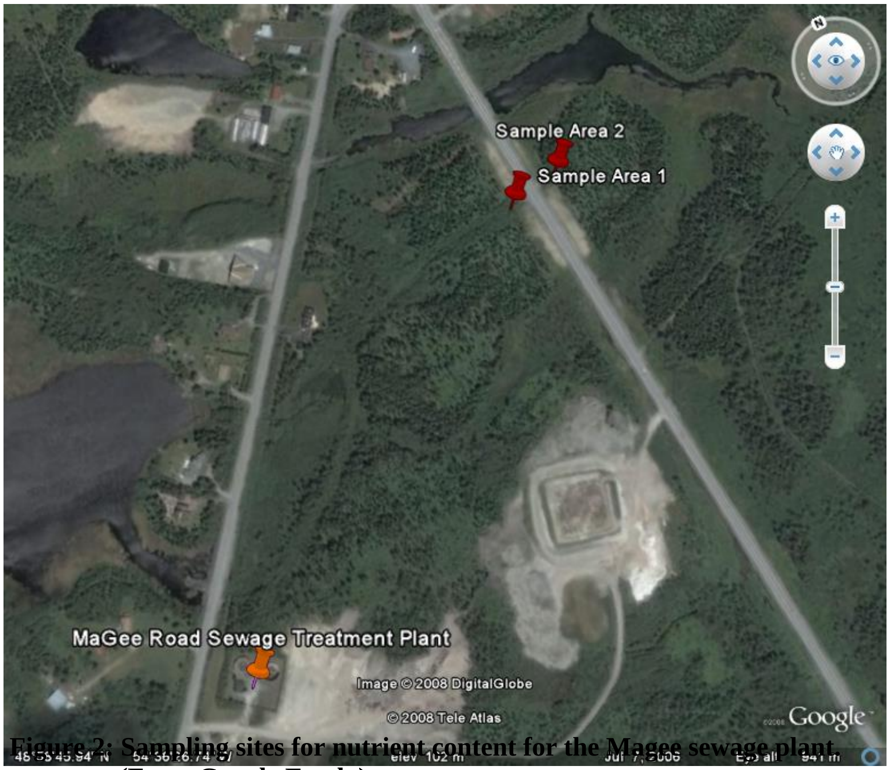


Figure 2: Sampling sites for nutrient content for the Magee sewage plant. (From Google Earth.)

4.0 Results and Discussion

Many inorganic factors were tested for in both sewage treatment plants' effluent; Table 3 lists these parameters and compares the two plants. The Magee plant has the higher values for most of the properties, including $CBOD_5$ and TSS. The $CBOD_5$ is the measure of oxygen depletion caused by microorganisms as they consume non-nitrogenous nutrients within the water system. The CCME has included a limit for $CBOD_5$ as it is a good measure of how wastewater will pollute its receiving environment (Brake, Perry F., 1998). The NPS developed for Canada by the MWWE development committee is 25 mg/L, with both plants being over at 38 mg/L and 30 mg/L for Magee and Beaverwood respectively. However, both plants fall into a common range of 5 – 60 mg/L range for secondary treatment plants (Brake, Perry F., 1998).

Without sufficient oxygen in the streams, the system is unable to support a large biodiversity. The amount of total suspended solids in the water affects the living conditions of aquatic life as well; it may cause water temperatures to rise and consequently lower the level of oxygen available to organisms, it may cover the bed of a system and in turn cover fish eggs and newly hatched insect larvae, and suspended solids may also clog the gills of fish possibly causing death (Brake, Perry F., 1998). The State of Michigan has limits in place of a monthly average of 30mg/L and a weekly average of 45 mg/L for wastewater. The new limit to be incorporated in Canada is below this value at 25mg/L; both of the plants in Gander are well above with 71 mg/L for Magee and 55 mg/L for the Beaverwood plant. The town will have approximately 20 years to reduce these values (*Canada-wide Strategy for the Management of Municipal Wastewater Effluent, Draft*, 2007).

Table 3: Inorganic properties present in the Beaverwood and Magee sewage plant effluents.

Inorganic Parameters	Beaverwood Waste Treatment Plant	Magee Waste Treatment Plant
Total Alkalinity (Total as CaCO3)	66 mg/L	110 mg/L
$CBOD_5$ *(NPS – 25 mg/L)*	30 mg/L	38 mg/L
Total COD	120 mg/L	190 mg/L
Dissolved Chloride (Cl)	53 mg/L	39 mg/L
Colour	33 TCU	95 TCU
Strong Acid Dissociated Cyanide (CN)	0.008mg/L	0.008 mg/L
Hardness (CaCO3)	46 mg/L	42 mg/L
Nitrate + Nitrite	0.62 mg/L	0.20 mg/L
Nitrate (N) *(MAC – 45 mg/L)*	0.57 mg/L	0.16 mg/L
Nitrite (N)	0.05 mg/L	0.04 mg/L
Nitrogen (Ammonia Nitrogen)	5.8 mg/L	16 mg/L
Total Organic Carbon (C)	15 mg/L	11 mg/L
Orthophosphate (P)	0.47 mg/L	2.5 mg/L
pH *(AO – 6.5 – 8.5)*	7.0	6.98
Reactive Silica (Si02)	5.6 mg/L	7.3 mg/L
TSS *(NPS – 25 mg/L)*	55 mg/L	71 mg/L
Dissolved Sulphate (SO4)	10 mg/L	19 mg/L
Total Kjeldahl Nitrogen	11 mg/L	24 mg/L
Turbidity	16 NTU	35 NTU
Conductivity	340 µS/cm	420 µS/cm

AO – Aesthetic objective for Canadian Drinking Water Guidelines.
MAC – Maximum acceptable concentration for Canadian Drinking Water Guidelines.

The other factor with a determined limit created by the CCME MWWE development committee is TRC. A level of 0.02 mg/L or better will be required. From the nutrient sampling dates, chlorine residuals were also tested showing an average of 0.076 and 0.04 for the Beaverwood sewage plant and 0.023 for the Magee sewage plant which can be seen in Table 7. The Magee plant does not need much work to reach this NPS while the Beaverwood plant needs to reduce its TRC by 380%.

Of the metals tested for both treatment plants, Table 4, only 19 out of 31 were detected for the Beaverwood plant and only 18 of 31 for the Magee plant; the differing metal being chromium.

Of the metals listed in the *Guidelines for Canadian Water Quality,* ten (Hg, Na, Ba, Cr, B, Cu, Mn, Pb, U and Zn) in the wastewater results for both plants are below the maximum acceptable concentration (MAC) or the aesthetic objective (AO). This indicates that no harmful affects should be seen by those metals as their concentration is fit for human consumption in daily drinking water.

Table 4: Metals present in the Beaverwood and Magee sewage plant effluents.

Metals	Beaverwood Waste Treatment Plant	Magee Waste Treatment Plant
Total Mercury (Hg) *(MAC – 1 μg/L)*	0.03 μg/L	0.04 μg/L
Total Calcium (Ca)	13 mg/L	11 mg/L
Total Magnesium (Mg)	3.2 mg/L	3.3 mg/L
Total Phosphorus (P)	1.3 mg/L	4.5 mg/L
Total Potassium (K)	3.4 mg/L	9.8 mg/L
Total Sodium (Na) *(AO - ≤ 200 mg/L)*	39 mg/L	45 mg/L
Total Aluminum (Al) *(AO – 0.1/0.2 mg/L)*	330 μg/L	910 μg/L
Total Barium (Ba) *(MAC – 1000 μg/L)*	17 μg/L	21 μg/L
Total Boron (B) *(MAC – 5000 μg/L)*	16 μg/L	150 μg/L
Total Chromium (Cr) (MAC – 50 μg/L)	2 μg/L	ND
Total Copper (Cu) *(AO - ≤ 1000 μg/L)*	94 μg/L	170 μg/L
Total Iron (Fe) *(AO – 300 μg/L)*	990 μg/L	650 μg/L
Total Lead (Pb) *(MAC – 10 μg/L)*	2.2 μg/L	2.6 μg/L
Total Manganese (Mn) *(AO - ≤ 50 μg/L)*	410 μg/L	130 μg/L
Total Nickel (Ni)	3 μg/L	4 μg/L
Total Strontium (Sr)	48 μg/L	31μg/L
Total Titanium (Ti)	3 μg/L	4 μg/L
Total Uranium (U) *(MAC – 10* μg/L)	0.3 μg/L	0.3 μg/L
Total Zinc (Zn) *(AO - ≤5000* μg/L)	31 μg/L	76 μg/L

ND – Not Detected
AO – Aesthetic objective for Canadian Drinking Water Guidelines.
MAC – Maximum acceptable concentration for Canadian Drinking Water Guidelines.

The two treatment plants were tested for the same parameters, only due to insufficient water samples, the Magee plant was not tested for PCB's and surfactants. It is thought that there would not be any of these factors found in its effluent as any chemical runoff is sent to the Beaverwood plant chemicals present in the sewage would not affect the plant's ability to treat the sewage as it would the microbial plant (G. Horwood, personal communication, June 6, 2008).

All semi-volatile and volatile components found in the wastewater of both plants are found in Table 5. The concentration level of each of the contaminants is not known to have any harmful affects at these levels (*Priority chemicals and chemical fact sheet*, n.d.). The majority of these pollutants arises from the burning of fossil fuels and wood and can be found naturally in waters (*Priority chemicals and chemical fact sheet*, n.d.).

Table 5: Semi-Volatile and volatile organic materials present in the Beaverwood and Magee sewage plant effluents.

Polyaromatic Hydrocarbons	**Beaverwood Waste Treatment Plant**	**Magee Waste Treatment Plant**
Anthracene	0.02 µg/L	0.02 µg/L
Chrysene	0.01 µg/L	0.01 µg/L
Fluoranthene	0.06 µg/L	0.07 µg/L
Fluorene	0.01 µg/L	0.03 µg/L
Phenanthrene	0.11 µg/L	0.17µg/L
Pyrene	0.04 µg/L	0.05 µg/L
Dibenz(a,h)anthracene	ND	0.01 µg/L
Phenolics		
2,4,6-Trichlorophenol	ND	0.1 µg/L
Phenol	ND	1.6 µg/L
Volatiles		
Chloroform	7 µg/L	5 µg/L
Toluene	24 µg/L	4 µg/L
1,4-Dichlorobenzene	1 µg/L	ND

ND – Not Detected

The biological testing was completed using toxicity testing methods mentioned previously and *E. coli*, seen in Table 6. The waters prove to be safe for large and small biodiversity as neither the rainbow trout or *D. magna* were killed during the testing period. The chronic toxicity procedure was not preformed hence no predictions can be made on the long term effects to biota living in the effluent receiving environment. The *E. coli* found in the water was 49 MPN/mL for Beaverwood and 70 MPN/mL for Magee.

Typical readings for sewage plants with 99% removal of bacteria can be anywhere from 100 MPN/mL to 1000 MPN/mL indicating that there is good removal of possible pathogens from the wastewater for Gander's treatment plants (*Canada-wide Strategy for the Management of Municipal Wastewater Effluent*, n.d.).

Table 6: Biological testing for Beaverwood and Magee sewage plants.

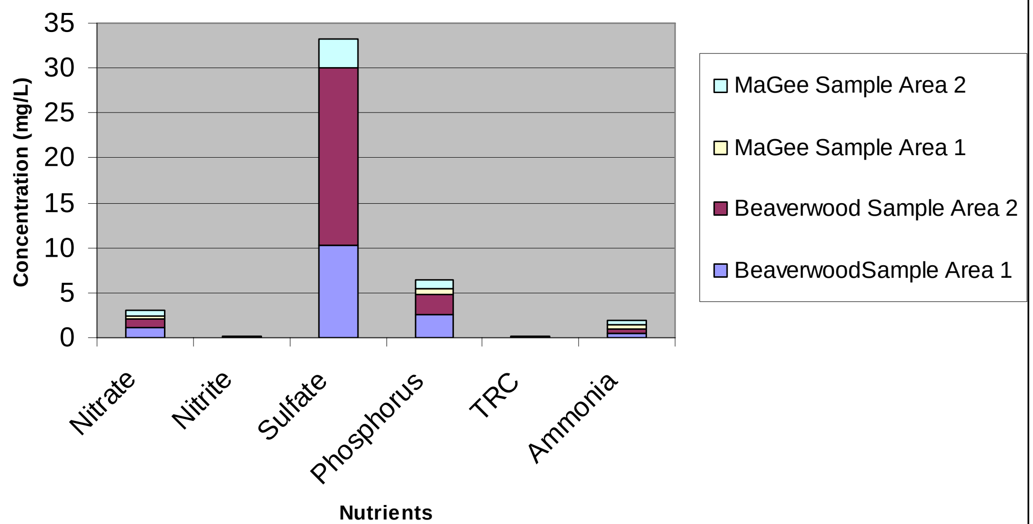
Test	Beaverwood Sewage Treatment Plant	Magee Sewage Treatment Plant
Acute toxicity test species rainbow trout (LT_{50})	Pass; No fish killed within the 96 hour test period	Pass; No fish killed within the 96 hour test period
Acute toxicity test species *Daphnia magna* (LT_{50})	Pass; No *D. Magna* killed within the 48 hour test period	Pass; No *D. Magna* killed within the 48 hour test period
Bacteriological test (MPN) *Escherichia coli* and coliforms	49 MPN/mL	70 MPN/mL

The nutrient testing over two weeks in August is comparable to those taken in late June and early July for the two sewage plants; the average nutrient concentration can be seen in Table 7. The ammonia testing procedure did not have a high enough range and values are unknown except that they exceeded 0.50 mg/L. Readings taken by Maxxam Analytics were 5.8 mg/L for Beaverwood and 16 mg/L for Magee, Table 3. Ammonia is toxic to fish in the un-ionized form at a concentration of 0.03 mg/L or higher (*Interpreting water analysis test results*, n.d.), but ionized ammonia is innocuous to aquatic habitat. Total nitrogen concentration (including all forms of nitrogen) range from 20 – 40 mg/L, within which both plants fall. A healthy concentrations of phosphorus for wastewater effluent is 1.0 mg/L (using phosphorus reducing agents), but the average reading is between 7 mg/L and 15 mg/L in which both sewage plant readings fall. Figure 3 visually compares the amount of nutrients present in the two plants showing a major difference in sulfate and phosphorus concentrations with Beaverwood having noticeably higher readings.

Table 7: Average values for nutrient testing during the month of August for the Beaverwood and Magee sewage plant.

Nutrient Test	Beaverwood Sewage Plant		Magee Sewage Plant	
	Sample Area 1	Sample Area 2	Sample Area 1	Sample Area 2
Nitrate	1.13	0.93	0.36	0.66
Nitrite	0.018	0.072	0.088	0.045
Sulfate	10.30	19.66	0	3.33
Phosphorus	>2.50	2.37	0.58	0.93
TRC	0.076	0.04	0.023	0.023
Ammonia	>0.50	>0.50	>0.50	>0.50

Figure 3: Comparison of Beaverwood and Magee Sewage Plant Effluent Nutrients



5.0 Conclusion

Through sampling throughout the summer, it can be stated that the quality of effluent for both treatment plants in Gander is producing no harmful affects on the receiving environment.

The concentration of TSS, $CBOD_5$ and TRC are not too far out of bounds and could possibly be reached if the plants were working at the optimum capacity rather than the maximum. With the installation of the dechlorination system, the concentration of TRC could possibly be obtained. The TSS may also be reduced if a fine screen was put in place prior to the water leaving the plant. With these two systems in operation, the wastewater facilities could reach the NPS well before the 20 year time period.

There were no major concerns present in the results of this report. The environment around the sewage effluent streams appears healthy as there are no extreme algal growths due to overabundant nutrients, the vegetation is healthy and there is plenty of waterfowl within the immediate area.

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