

CITY OF NORTH BATTLEFORD
WASTEWATER TREATMENT PLANT
2014 REPORT



Executive Summary

This report provides an analysis of the Wastewater Treatment Plant for the City of North Battleford.

A summary of the results are as follows:

- cBOD results were below the Water Security Agency (WSA) permit limit of 20 mg/L
- TSS results were below the WSA permit limit of 20 mg/L
- Ammonia results were below the WSA permit limits of 3 mg/L (June through September) and 7 mg/L (October through May)
- Over 2.6 million kgs of biosolids were disposed of in the North Battleford Waste Management Facility
- A single sample for biosolids was submitted for analysis. All parameters with the exception of copper were below the Maximum Acceptable Concentration
- The geometric mean densities for E.coli/fecal coliforms were below the WSA permit limit of 200 organisms/100 mL
- The Wastewater Treatment Plant (WWTP) did not exceed the WSA permit limit of less than 400 organisms/100 mL in any two consecutive weeks
- The WWTP treated over 2.1 million m³ of domestic waste water in 2014

In conclusion, operations at the North Battleford WWTP proceeded smoothly. The WWTP was able to meet the guidelines set forth by the Water Security Agency and the Ministry of the Environment.

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Introduction

Data represented within this annual report is taken from operations, samples, and general data collected from the City of North Battleford Waste Water Treatment Plant, (WWTP). The goal of the North Battleford Wastewater Treatment Plant is to produce effluent water that meets or exceeds the operating permit set by Saskatchewan Water Security Agency (SWSA) and is environmentally acceptable.

Background

WWTP

The WWTP began operating in 2006 and is a Level 4 plant. The plant is located approximately 5 km to the south east of the City. The treated effluent is discharged to the North Saskatchewan River, downstream of the F.E. Holliday Water Treatment Plant. The Plant is designed to treat an average flow of 7,320 m³/day, a maximum flow of 7,617 m³/day and a peak flow of 11,950 m³/day.

Quality Assurance/Quality Control

Since 2006, the WWTP laboratory staff have been conducting QA/QC tests on their laboratory testing. These tests include a duplicate/standard program. The staff attend seminars and take training courses to stay up to date on laboratory testing standards. All TSS, BOD, CBOD and VSS tests are conducted twice a week to ensure accurate and reliable data.

Biweekly, samples of regularly tested parameters, such as cBOD, TSS, and VSS are submitted to an accredited lab. A comparison between the accredited lab and the WWTP results can be found in **TABLES 1A and 2A, Appendix A.**

Tested Parameters

Monthly Data

The following parameters are tested daily or weekly but reported as monthly averages since the limits set out by the SWSA are based on a calendar monthly arithmetic average. The exception to this is coliforms which are based on monthly geometric averages. The data is collected and reported from January 1 to December 31 of 2014. Each of the following ten parameters are tested for on the basis that each effect the final quality of river water and may be detrimental to aquatic life if higher than the permitted levels.

Ammonia - Total

Ammonia as N (NH₃-N) is an inorganic, dissolved form of nitrogen that can be found in water and is the preferred form for algae and plant growth. The discharge of wastewater high in ammonia to receiving waters like rivers may result in oxygen-depleted conditions. The term ammonia refers to two chemical species which are in equilibrium in

water. They are NH_4^+ (ionized) and NH_3 (un-ionized). Tests for ammonia usually measure total ammonia. A composite effluent sample is tested daily, while a composite of the raw sewage is tested every Wednesday and Thursday. A grab sample of the raw is tested daily. Only the effluent is regulated for ammonia. SWSA limits for ammonia – N is as follows: from October until May of each year, the limit is 7 mg/L. The limit between June and September of each year is 3 mg/L.

Un-ionized Ammonia

The toxicity of ammonia is primarily attributed to the un-ionized form (NH_3) as opposed to the ionized form. In general, the un-ionized ammonia is highly toxic to fish and other aquatic life. Toxicity increases as pH and temperature increase. Weekly testing for un-ionized ammonia is now a requirement for the Permit to Operate a Sewage Works. The limit has been set at 1.25 mg/L at 15°C.

Total Phosphate

Like nitrogen, phosphorus is essential for the growth of plants and animals. Total Phosphate tests are conducted twice a week from a composite sample of the effluent entering the river as well as twice a week on a grab sample of the raw sewage. SWSA has set no value to achieve for Total Phosphate.

Coliforms

Total Coliform

Coliforms can be found in water, in soil, and on vegetation. They are divided into fecal and nonfecal coliforms. Samples are analyzed for the presence of the coliform group of bacteria which serve as indicator organisms for other pathogens. These bacteria are generally not pathogenic, but are usually present when pathogens are present. There is no limit for Total Coliforms.

E.Coli/Fecal Coliforms

Escherichia Coli (also known as E.Coli) is a Fecal Coliform. Their presence indicates the potential presence of microorganisms capable of causing gastrointestinal illnesses. The effluent is treated to minimize the number of microorganisms released into the environment.

The effluent from the WWTP is tested weekly for Total Coliform (fecal + non-fecal) and E. Coli. E.Coli/Fecal is not to exceed a monthly geometric mean density of 200 organisms per 100 ml or exceed 400 organisms in any two consecutive weekly samples.

pH

pH tests are performed to determine if the wastewater effluent is acidic or basic. The pH scale ranges from 0 to 14 with substance less than 7.0 being acidic while pH greater than 7.0 are considered basic. A pH of 7.0 is considered neutral.

Grab samples of the wastewater effluent leaving the WWTP are performed daily. Although this test is a requirement of the permit, limits are not applied. While a pH range of 6.5 to 9.0 has been set as the guideline for the Protection of Aquatic Life, there is no enforced limit.

Temperature

Temperature is tested on a daily basis using grab samples. This test is only conducted on the effluent. Temperature ranges from 6.7° Celsius in the winter to 18.3° Celsius in the summer.

Turbidity

Turbidity is used to assess the clarity of water. It is a measure of suspended inorganic and organic particles in the water. Effluent turbidity is tested once per day using a grab sample. Generally speaking, effluent turbidity stays fairly consistent. SWSA has set no limit for effluent turbidity. An online turbidimeter installed in the UV channel monitors turbidity continuously.

BOD

Biochemical Oxygen Demand (BOD) is a chemical process used for determining how fast biological organisms use up oxygen in a body of water. Even though SWSA does not regulate BOD testing in the raw sewage, the plant does perform weekly influent BOD tests. Weekly composite samples are taken for this test. The higher BOD influent & effluent values correspond to spring thaws and heavy rain events.

CBOD

Carbonaceous Biochemical Oxygen Demand (CBOD) measures the amount of oxygen consumed by living organisms (bacteria) in decomposing the organic portion of waste. CBOD is tested weekly using again the composite effluent sample. SWSA requires that CBOD values not exceed 20 mg/L on a monthly basis.

Suspended Solids

TSS

Total Suspended Solids (TSS) is as the name suggests, particles suspended in a fluid. The TSS test measures both the active bacterial mass and the inert material in effluent. TSS tests are performed weekly using composite samples of the influent and effluent. According to the SWSA permit to operate, the plant must not exceed a TSS of 20 mg/L on a monthly basis of the effluent sample. Influent (raw sewage) TSS values are tested for internal use but not required by SWSA.

VSS

The Volatile Suspended Solids (VSS) test measures the mass of the organic component of the TSS. In the waste water setting most of this will be active microorganisms in the effluent. SWSA does not place a permit value on VSS; however this test is conducted to monitor the efficiency of the WWTP.

River Analysis

Samples are taken quarterly from upstream and downstream of the WWTP. These samples are compared to each other to gauge what effect, if any, the effluent from the WWTP has on the river. The upstream sample is taken from the intake at the F.E. Holliday WTP, while the downstream one is taken downstream of the outfall of the WWTP. The results from Quarterly River testing are shown in the results section.

Heavy Metal Sampling

Heavy metals in large quantities can be detrimental to aquatic life. Heavy metals such as lead, mercury, and cadmium are considered toxic metals and exposure to these metals over time can cause serious illness due to the body's inability to process these metals. The sewage lagoon and biosolids are tested for metals. There is no limit on these as they are not released into the river.

Biosolids

Biosolids

Biosolids, also known as sewage sludge, is a solid, semi-solid, or liquid residue generated during treatment of domestic sewage in a treatment works. It consists mainly of water (90 to 99%) and settleable solids. The solids are mostly organics that are removed during primary, secondary or advanced wastewater treatment processes. The City of North Battleford saw the commissioning of its new Lystek system in December 2014 which converts biosolids and other organics into a pathogen free, Canadian Food Inspection Agency (CFIA) Class A registered biofertilizer product.

Volume Produced

According to SWSA, each day that the WWTP has centrifuge operation, a record of the percent solids and total volume of biosolids produced is kept. Transporting of the biosolids to the Waste Management Facility began in January of 2006. Typically two truckloads were taken per day, with an average weight of approximately 6,976 kg per day. The total amount taken to the waste management facility between January 1 and December 31, 2014 was 2,783,257 kg.

Biosolids Analysis

One sample is submitted annually for metals, mercury and cyanide testing. Until December 2014, the biosolids from the WWTP were disposed of in the Waste Management Facility (WMF) where it was covered within four hours of being deposited into the landfill pit.

Toxicity

Toxicity refers to the ability of a substance to cause harm to an organism as a result of exposure. The exposure can be over a long or short period of time. For WWTPs, the effluent is sent to a lab which tests the effluent on common fish species to determine whether or not it is toxic.

Chronic Toxicity

Chronic Toxicity refers to the ability of a substance to cause harm to an organism as a result of repeated exposures for long periods of time. This test is performed every three years, with the next test scheduled for 2015.

Acute Toxicity

Acute toxicity refers to the ability of a substance to cause harm to an organism as a result of a relatively short one-time exposure. This test is performed every three years with the next test scheduled for 2016. However new Federal guidelines require the City of North Battleford to conduct this testing in 2015.

Lagoon Analysis

The two lagoons located at the WWTP, are storage areas for the wastewater materials that cannot be processed by the WWTP. These lagoons are evaporation lagoons as liquids from the lagoons can only evaporate. There is no direct connection from the lagoon to the river. Materials that are hauled to the lagoons include carwash sumpage, grease, sludge and grit from cleaning the tanks at the WWTP. The liquid in these lagoons is tested in May and October for characterization purposes and to check that only approved material has been disposed of.

Results Section

Bimonthly, composite samples of the raw sewage and sewage effluent are tested by an outside lab and the WWTP. Results from the outside lab tended to be higher than those from the WWTP. The results for the sewage effluent and raw sewage can be found in **Tables 1A and 2A, Appendix A.**

CBOD

All of the results for CBOD for 2014 were below the limit of 20 mg/L set by the SWSA. The average CBOD ranged from 3.00 mg/L (July) to 6.50 mg/L (April). The lowest result was 3.00 mg/L (July) and the highest was 8.0 mg/L (April and May). The results can be found in **Table 1B, Appendix B**.

TSS

The monthly averages for TSS were below the limit of 20 mg/L set by the SWSA. The average ranged from 3.33 mg/L (November) to 9.65 mg/l (February). The lowest result was 2.38 mg/L (October) and the highest was 25.19 mg/L (February). The results can be found in **Table 2B, Appendix B**.

Ammonia

Ammonia - Total

The monthly averages for Total Ammonia were below the limits of <7 mg/L October to May and <3 mg/L June to September. The average ranged from 0.04 mg/L (July) to 1.56 mg/L (May). The lowest result was 0.00 mg/L (multiple months) and the highest was 11.10 mg/L (February). The results can be found in **Table 3B, Appendix B**.

Ammonia – Un-ionized

The monthly averages for Unionized Ammonia were below the limits of 1.25 mg/L at 15°C. The average ranged from 0.00 mg/L (multiple months) to 0.02 mg/L (multiple months). The lowest result was 0.00 mg/L (all months) and the highest was 0.10 mg/L (February). The results can be found in **Table 4B, Appendix B**.

Coliforms

The monthly geometric mean densities for E.coli were below the limit of <200 organisms/100mL. The geometric mean density ranged from 2.24 organisms/100mL (November) to 153.38 organisms/100mL (March). The WWTP was able to maintain an E.coli count of less than 400 organisms/100mL in any two consecutive weekly samples. The results can be found in **Table 5B, Appendix B**.

River Samples

Two samples were taken quarterly from the North Saskatchewan River and submitted for analysis. These samples were taken from upstream and downstream of the WWTP. The parameters tested show that the WWTP had little to no impact on the raw water quality. The results can be found in **Table 1C, Appendix C**.

Biosolids

One sample was submitted in 2014; as a requirement of the City's Permit to Operate a Sewage Works. All parameters with the exception of copper were below the Maximum Acceptable Concentration (MAC) guidelines set out by the SWSA. Copper was 810 µg/g while the MAC is <760 µg/g. The results can be found in **Table 2C, Appendix C**.

Toxicity

No toxicity sampling was conducted in 2014.

Lagoon

There were two samples submitted from the lagoon for testing in 2014. The results from these tests are to characterize the contents of the lagoon and to monitor the liquid waste being placed in the lagoon. The results can be found in **Tables 3C, 4C, and 5C, Appendix C**.

Flows

In 2014, the WWTP treated over 2.1 million m³ of domestic wastewater. The monthly flows ranged from 133,187 m³ (February) to 219,782.3 m³ (July). The lowest average daily flow was 4,756.68 m³ (February) and the highest was 6,868.20 m³ (July). Flow data for 2014 can be found in **Tables 1D and 2D, Appendix D**.

Conclusion

Overall, the Wastewater Treatment Plant operations went very well in 2014.

In general, the results reported by the accredited lab were in line with the results reported by the WWTP.

Northland Power Energy Center, NBEC has continued to take treated sewage effluent to use in their power process.

Looking into the future, the major capital projects that have been identified in the 2015 budget include:

- Funding has been set forth in the 2015 budget for AECOM to review possible solutions to resolve all problems identified in the 2014 Wastewater Collection Report about the prime wastewater gravity sewer main.
- The on-going expansion of the surge pond from 4,100 m³ to 15,662 m³ will give the facility more capacity in high flow events minimizing the risk of a bypass situation to the North Saskatchewan River keeping the WWTP within its permit.
- A master plan of the WWTP will be submitted to the City of North Battleford in 2015.

- MPE Engineering will be updating the SCADA system throughout the WWTP.

ACKNOWLEDGEMENTS

The Department of Operations & Maintenance of the City of North Battleford prepared this report. The dedication and commitment of civic staff in providing safe water during 2014 is acknowledged.

Also acknowledged is the ongoing assistance of the SWSA.

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Appendix A: Comparison of Lab Results*

Sewage Effluent

Date	pH	Specific Conductance		Ammonia		Un-ionized Ammonia		Total Phosphate		Kjedahl Nitrogen		cBOD		TSS		VSS	
		(µS/cm)		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
		LAB	WWTP	LAB	WWTP	Lab	WWTP	LAB	WWTP	LAB	WWTP	LAB	WWTP	LAB	WWTP	LAB	WWTP
2-Jan	7.90	1600	n/m	0.090	0.15	<0.01	0.00	0.7	*1.6	0.70	n/m	4.0	4.04	6.0	4.7	3	5.3
15-Jan	8.00	1660	n/m	0.120	0.24	<0.01	0.00	0.41	3.19	1.30	n/m	5	1.33	6.0	4.5	3	5.3
29-Jan	7.71	1610	n/m	0.200	0.10	<0.01	0.00	0.38	2.45	2.00	n/m	6.0	3.72	4.0	4.3	3.0	4.9
12-Feb	8.02	1550	n/m	0.100	0.69	<0.01	0.00	0.37	0.3	2.00	n/m	4.0	1.72	3.0	4.2	2.0	4.6
26-Feb	7.85	1480	n/m	28.0	0.13	0.1900	0.00	0.33	1.2	53.00	n/m	4.0	2.49	5.0	5	8.0	4.6
12-Mar	8.04	1880	n/m	1.10	1.27	<0.01	0.02	0.42	0.5	3.20	n/m	6.0	3.61	10.0	10.3	6.0	8.8
26-Mar	7.78	180	n/m	2.40	1.90	0.0100	0.00	0.42	1.1	2.80	n/m	6.0	6.27	8.0	9.6	4.0	7.6
9-Apr	7.80	1500	n/m	2.80	2.88	0.0200	0.04	1.20	4	4.50	n/m	5.0	3.77	5.0	5.8	4.0	4.9
23-Apr	7.84	1580	n/m	0.19	0.15	<0.01	0.03	0.9	2.3	2.80	n/m	8.0	4.96	6.0	9.6	4.0	8.6
7-May	7.71	1770	n/m	0.23	0.18	<0.01	0.02	1.50	4.7	2.40	n/m	8.0	6.56	10.0	12.1	7.0	10.2
21-May	7.88	1800	n/m	0.12	0.02	<0.01	0.00	0.69	2.610	2.20	n/m	3.0	3.60	5.0	5.2	3.0	4.8
4-Jun	8.27	2150	n/m	0.12	0.02	<0.01	0.00	0.65	2.74	2.30	n/m	6.0	3.42	9.0	9.1	6.0	7.4
18-Jun	8.12	2190	n/m	0.08	0.04	<0.01	0.00	0.90	2.70	1.10	n/m	4.0	1.94	3.0	5.1	4.0	4.8
2-Jul	8.34	2430	n/m	0.07	0.03	<0.01	0.00	1.30	3.95	2.00	n/m	3.0	2.5	2.0	4.1	2.0	3.5
16-Jul	8.13	2250	n/m	0.10	0.20	<0.01	0.00	1.40	4.06	1.50	n/m	<3	2.27	5.0	4.8	3.0	5.3
30-Jul	7.96	2280	n/m	0.16	0.09	<0.01	0.00	1.10	3.73	1.80	n/m	3.0	1.9	5.0	5.4	4.0	5.4
13-Aug	7.99	2290	n/m	0.14	0.11	<0.01	0.00	1.30	4.1	2.40	n/m	4.0	2.8	6.0	6.7	4.0	6.2
27-Aug	8.15	2230	n/m	0.18	0.11	<0.01	0.00	1.30	4.17	2.60	n/m	5.0	3.27	7.0	8.4	4.0	7.6
10-Sep	7.91	2020	n/m	0.19	0.22	<0.01	0.00	0.89	3.260	2.20	n/m	5.0	3.68	5.0	10.2	3.0	8.8
24-Sep	8.02	2030	n/m	0.14	0.09	<0.01	0.00	1.20	0.000	1.80	n/m	4.0	2.13	7.0	4.6	3.0	4.3
8-Oct	7.95	1910	n/m	0.12	0.09	0.02	0.00	1.30	3.72	1.80	n/m	4.0	2.59	4.0	4.3	2.0	4.8
22-Oct	7.92	1880	n/m	0.16	0.09	<0.01	0.00	1.2	3.87	1.90	n/m	4.0	2.80	4.0	5.2	4.0	4.8
6-Nov	7.89	1820	n/m	0.13	0.08	<0.01	0.00	1.6	*5.17	1.40	n/m	6.0	3.9	3.0	6.3	3.0	5.1
19-Nov	7.94	2040	n/m	0.12	0.08	<0.01	0.00	0.76	2.4	1.10	n/m	4.0	3.64	6.0	5.5	5.0	5.3
3-Dec	8.29	2030	n/m	0.12	0.08	<0.01	<0.01	0.48	1.4	1.70	n/m	5.0	3.31	4.0	3.5	2.0	3.9
17-Dec	8.00	1960	n/m	0.12	0.08	<0.01	<0.01	0.50	2.5	1.50	n/m	4.0	2.72	4.0	3.6	2.0	3.3
31-Dec	7.90	1900	n/m	0.48	0.13	<0.02	0.13	0.56	1.2	1.20	n/m	3.7	*3.31	5.0	5.6	4.0	5.1

n/m these parameters are not measured at the WWTP

N/R Not Reported by lab

*Alternate sample taken within 48 hours of date

Raw Sewage

Date	Biochemical		TSS (mg/L)		VSS (mg/L)	
	O ₂ Demand(mg/L)		Lab	WWTP	Lab	WWTP
	Lab	WWTP	Lab	WWTP	Lab	WWTP
2-Jan	284	187	282	228	241	225
15-Jan	221	239	275	322	215	279
29-Jan	314	225	338	329	263	253
12-Feb	149	236	344	404	293	355
26-Feb	275	141	378	356	348	321
12-Mar	236	91	432	362	274	236
26-Mar	262	265	360	436	266	305
9-Apr	233	212	262	347	184	263
23-Apr	170	138	426	264	351	219
7-May	260	198	242	264	177	208
21-May	175	209	243	250	165	194
4-Jun	204	208	266	339	188	248
18-Jun	195	102	242	377	200	343
2-Jul	198	20	201	229	154	190
16-Jul	166	154	189	214	141	182
30-Jul	209	95	366	252	290	204
13-Aug	202	181	293	230	241	196
27-Aug	228	117	314	257	253	214
10-Sep	248	205	386	364	221	214
24-Sep	210	143	205	244	162	166
8-Oct	248	198	326	290	223	208
22-Oct	327	271	1340	347	258	300
6-Nov	234	229	1240	272	354	190
19-Nov	201	164	244	324	193	271
3-Dec	220	277	269	314	234	267
17-Dec	284	296	598	337	512	282
30-Dec	59	337	118	366	99	320

N/R- Not Reported by lab

Figure 1A

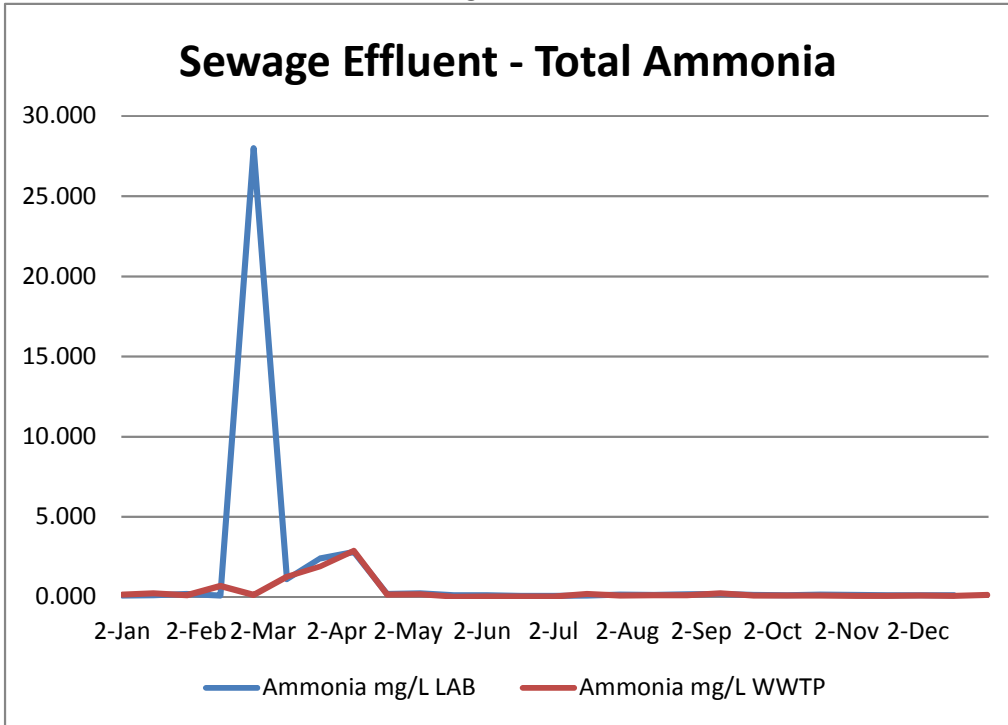
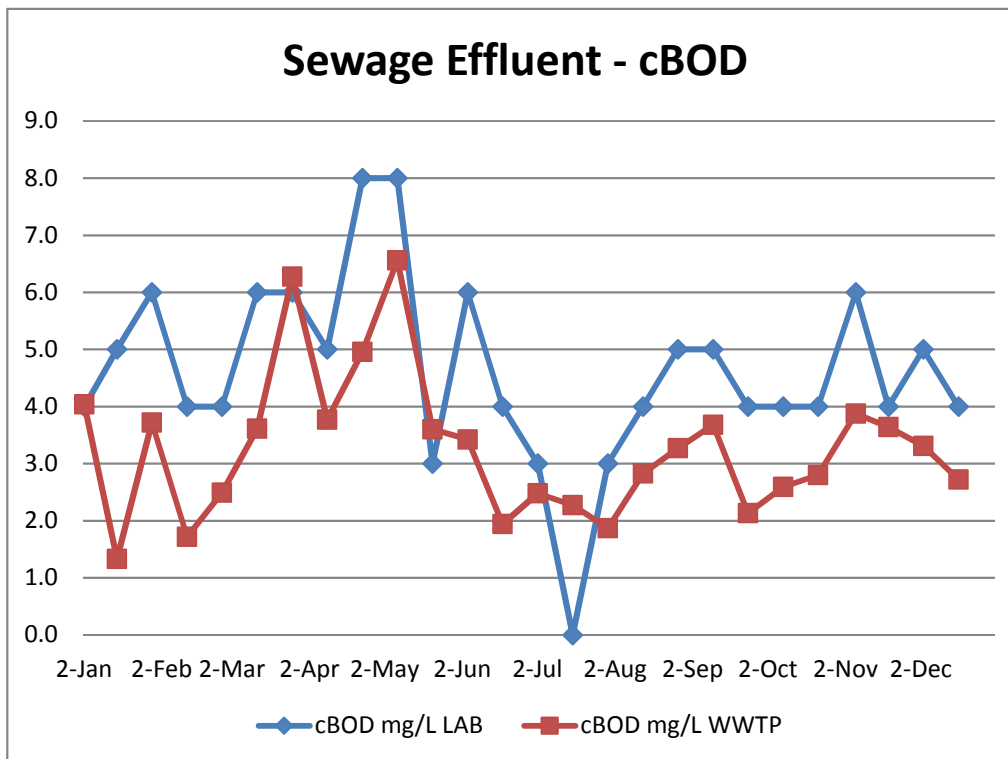


Figure 2A

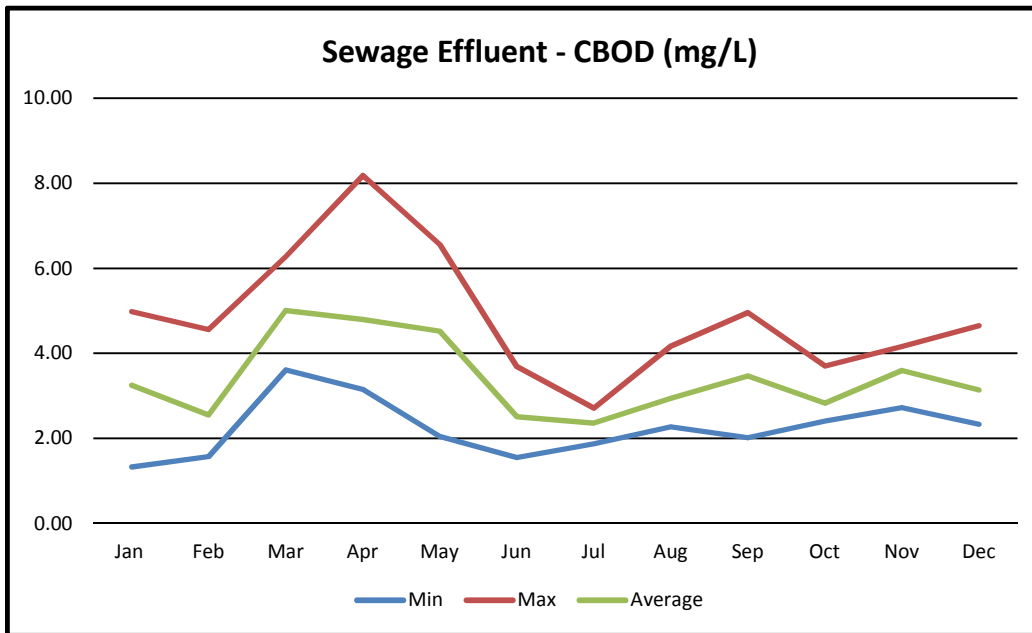


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Appendix B: Results Tables*

Sewage Effluent - CBOD

Month	units	Min	Max	Average	Limit for Monthly
Jan	mg/L	1.33	4.98	3.25	<20
Feb	mg/L	1.58	4.56	2.55	<20
Mar	mg/L	3.61	6.27	5.01	<20
Apr	mg/L	3.15	8.18	4.79	<20
May	mg/L	2.05	6.56	4.52	<20
Jun	mg/L	1.55	3.69	2.51	<20
Jul	mg/L	1.87	2.71	2.36	<20
Aug	mg/L	2.27	4.17	2.94	<20
Sep	mg/L	2.02	4.96	3.47	<20
Oct	mg/L	2.41	3.70	2.83	<20
Nov	mg/L	2.72	4.16	3.60	<20
Dec	mg/L	2.33	4.65	3.14	<20

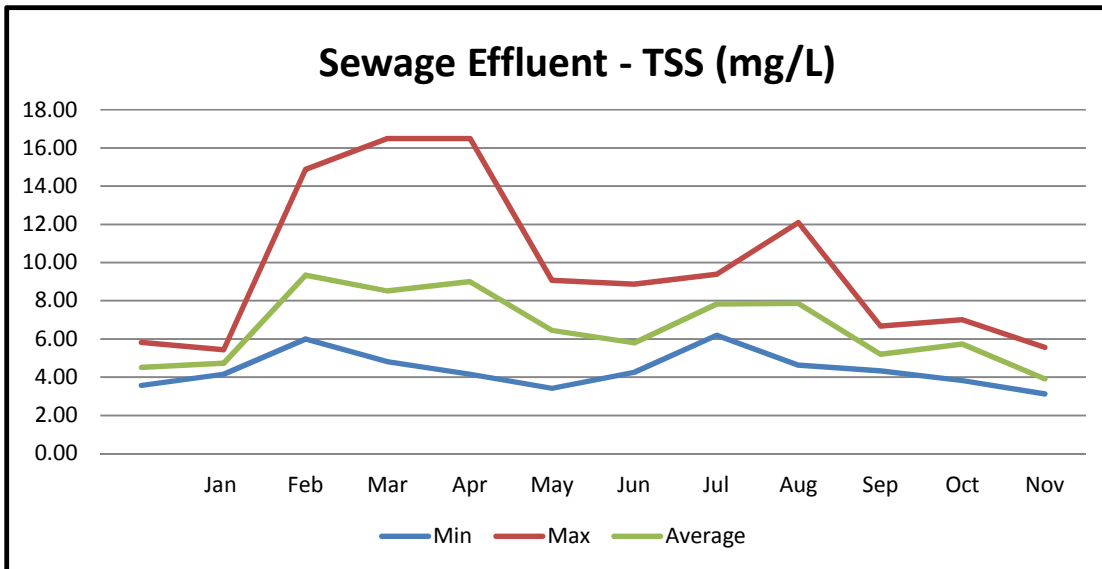
Figure 1B



Sewage Effluent - TSS

Month	units	Min	Max	Average	Limit
Jan	mg/L	3.58	5.81	4.50	<20
Feb	mg/L	4.16	5.44	4.73	<20
Mar	mg/L	6.00	14.88	9.34	<20
Apr	mg/L	4.81	16.50	8.51	<20
May	mg/L	4.15	16.50	8.99	<20
Jun	mg/L	3.41	9.06	6.45	<20
Jul	mg/L	4.25	8.87	5.80	<20
Aug	mg/L	6.19	9.38	7.83	<20
Sep	mg/L	4.63	12.09	7.85	<20
Oct	mg/L	4.32	6.66	5.20	<20
Nov	mg/L	3.82	7.00	5.73	<20
Dec	mg/L	3.13	5.56	3.91	<20

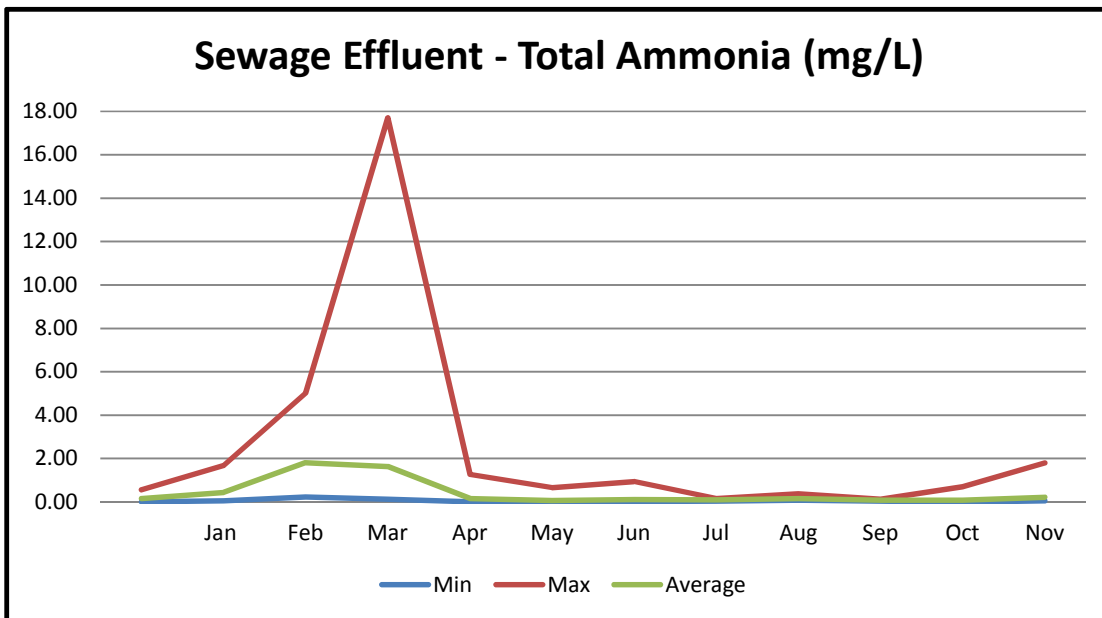
Figure 2B



Sewage Effluent - Total Ammonia

Month	units	Min	Max	Average	Limit
Jan	mg/L	0.00	0.56	0.16	<7 mg/L
Feb	mg/L	0.06	1.68	0.44	<7 mg/L
Mar	mg/L	0.22	5.02	1.81	<7 mg/L
Apr	mg/L	0.13	17.70	1.64	<7 mg/L
May	mg/L	0.00	1.26	0.16	<7 mg/L
Jun	mg/L	0.01	0.66	0.07	<3 mg/L
Jul	mg/L	0.02	0.93	0.11	<3 mg/L
Aug	mg/L	0.05	0.16	0.09	<3 mg/L
Sep	mg/L	0.09	0.38	0.15	<3 mg/L
Oct	mg/L	0.04	0.13	0.08	<7 mg/L
Nov	mg/L	0.00	0.71	0.09	<7 mg/L
Dec	mg/L	0.05	1.80	0.22	<7 mg/L

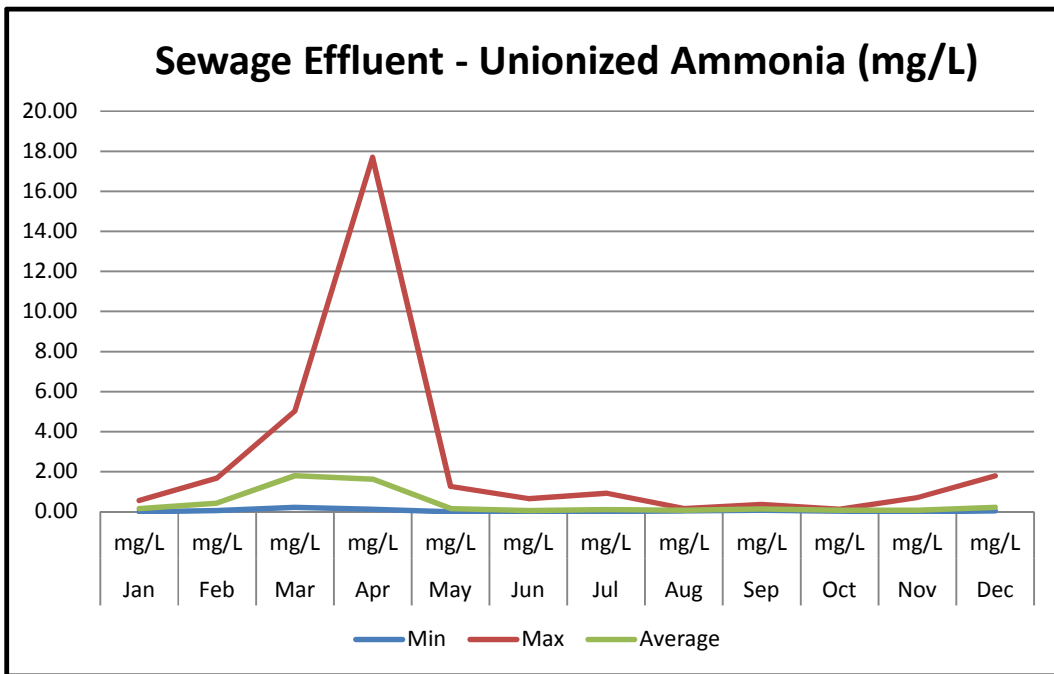
Figure 3B



Sewage Effluent - Unionized Ammonia

Month	Units	Min	Max	Average	Limit
Jan	mg/L	0.00	0.56	0.16	< 1.25 mg/L
Feb	mg/L	0.06	1.68	0.44	< 1.25 mg/L
Mar	mg/L	0.22	5.02	1.80	< 1.25 mg/L
Apr	mg/L	0.13	17.70	1.63	< 1.25 mg/L
May	mg/L	0.00	1.26	0.16	< 1.25 mg/L
Jun	mg/L	0.01	0.66	0.06	< 1.25 mg/L
Jul	mg/L	0.02	0.93	0.11	< 1.25 mg/L
Aug	mg/L	0.05	0.16	0.09	< 1.25 mg/L
Sep	mg/L	0.09	0.38	0.15	< 1.25 mg/L
Oct	mg/L	0.04	0.13	0.08	< 1.25 mg/L
Nov	mg/L	0.00	0.71	0.09	< 1.25 mg/L
Dec	mg/L	0.05	1.80	0.22	< 1.25 mg/L

Figure 4B



Sewage Effluent - Coliforms

Date	Total Coliform	E.Coli	E. Coli Limit		Notes
			per 100 ml	2 consecutive weeks	
January					
2-Jan	7	1		<400	Note 1
8-Jan	50	7		<400	
15-Jan	23	8		<400	
22-Jan	5	1		<400	Note 1
29-Jan	40	4			
Geo-Mean	17.43	2.74	<200		
February					
5-Feb	24	8		<400	
12-Feb	38	7		<400	
19-Feb	42	5		<400	
26-Feb	18	3		<400	
Geo-Mean	28.82	5.38	<200		
March					
5-Mar	15	1		<400	
12-Mar	4100	820		<400	
19-Mar	50	6		<400	
26-Mar	180	37		<400	
Geo-Mean	153.38	20.66	<200		
April					
2-Apr	11	4		<400	
9-Apr	140	23		<400	
16-Apr	18	4		<400	
23-Apr	56	11		<400	
30-Apr	43	8			
Geo-Mean	36.72	7.98	<200		
May					
7-May	29	5		<400	
14-May	19	3		<400	
21-May	78	11		<400	
28-May	39	5		<400	
Geo-Mean	35.98	5.36	<200		
June					
4-Jun	140	10		<400	
12-Jun	77	8		<400	
19-Jun	18	3		<400	
25-Jun	62	4		<400	
Geo-Mean	58.89	5.57	<200		

Date	Total Coliform	E.Coli	E. Coli Limit		Notes
			per 100 ml	2 consecutive weeks	
July					
2-Jul	8	1		<400	
9-Jul	7	4		<400	
16-Jul	2	1		<400	Note 1
23-Jul	12	1		<400	
30-Jul	39	18			
Geo-Mean	8.79	2.35	<200		
August					
6-Aug	31	7		<400	
13-Aug	28	2			
20-Aug	34	7		<400	
27-Aug	41	6		<400	
Geo-Mean	33.17	4.92	<200		
September					
3-Sep	260	28		<400	
10-Sep	133	8		<400	
17-Sep	34	6		<400	
24-Sep	26	8	4	<400	
Geo-Mean	74.36	10.18	<200		
October					
1-Oct	24000	13000		<400	
6-Oct	59	7		<400	Note 2
8-Oct	10	5		<400	
15-Oct	16	3		<400	
22-Oct	20	4		<400	
29-Oct	11	0		<400	
Geo-Mean	60.66	22.26	<200		
November					
6-Nov	11	1		<400	
13-Nov	13	1		<400	
20-Nov	29	5		<400	
26-Nov	24	5		<400	
Geo-Mean	17.76	2.24	<200		
December					
3-Dec	11	3		<400	
10-Dec	2	1		<400	
17-Dec	2	11		<400	
22-Dec	11	1		<400	Note 1
29-Dec	109	31		<400	
Geo-Mean	8.80	4.00	<200		

Note 1: For consistency, all results below 1 MPN/100 ml was entered as 1

Note 2: This sample is a follow-up sample for October 1, 2014. The original sample was uncharacteristically high. The follow-up sample was within normal operating parameters. This indicates the first sample most likely contained a contaminant.

*City of North Battleford
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Appendix C: River, Biosolids, Lagoon*

River Samples

Month		January		May		August		November	
Parameter	Units	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
pH	pH Units	7.94	7.97	8.47	8.40	8.17	8.16	8.23	8.28
Specific Conductivity	uS/cm	466	407	516	506	426	504	467	458
Ammonia as N	mg/L	0.2	0.14	0.02	0.02	0.02	0.35	0.05	0.05
Un-ionized Ammonia	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Total -P	mg/L	0.04	0.04	0.04	0.03	0.03	0.07	0.01	0.03
Chloride	mg/L	24	18	8	8	6	14	7	8
TKN	mg/L	0.56	0.33	0.63	0.61	0.32	0.35	0.24	0.25
BOD	mg/L	3	<3	<3	<3	3	3	<3	3
TSS	mg/L	5	7	52	36	37	16	3	6
VSS	mg/L	<1	<1	6	5	5	3	<1	1
Fecal Coliforms	ct/100mL	4	15	11	2	10	14	2	4
Total Coliforms	ct/100mL	19000	310000	96	320	3500	14000	70	91

Biosolids

Parameter	Units	Results	
<u>Inorganic</u>		June	MAC
Cyanide	µg/g	0.2	
Mercury	µg/g	0.82	<5
Silicon	µg/g	54000	
<u>Metals</u>			
Aluminum	µg/g	11100	
Barium	µg/g	240	
Beryllium	µg/g	<0.50	
Boron	µg/g	23	
Cadmium	µg/g	0.8	<20
Calcium	µg/g	22900	
Chromium	µg/g	24	<1060
Cobalt	µg/g	51	<150
Copper	µg/g	810	<760
Iron	µg/g	13000	
Manganese	µg/g	390	
Molybdenum	µg/g	5.6	<20
Nickel	µg/g	16	<180
Lead	µg/g	17	<500
Silver	µg/g	4.8	
Strontium	µg/g	120	
Thallium	µg/g	<0.10	
Zinc	µg/g	230	<1850
Zirconium	µg/g	51	

MAC - Maximum Allowable Concentration

Table 3C

Lagoon - Metals			
Analyte	Units	Results	
		May	October
Aluminum	mg/L	0.55	0.43
Antimony (Sb)	mg/L	0.0022	0.0022
Arsenic (As)	µg/L	5.3	8.6
Barium	mg/L	0.056	0.034
Boron	mg/L	0.3	0.34
Cadmium	mg/L	0.00004	0.00009
Chromium	mg/L	0.0013	0.001
Cobalt	mg/L	0.0026	0.0022
Copper	mg/L	0.0037	0.038
Iron	mg/L	0.6	0.71
Lead	mg/L	0.0007	0.0008
Manganese	mg/L	0.57	0.23
Molybdenum	mg/L	0.0041	0.0078
Silicon	mg/L	5.2	8
Silver	mg/L	0.00006	0.00009
Strontium	mg/L	0.36	0.23
Thallium	mg/L	<0.0002	<0.0002
Tin	mg/L	0.0001	0.0008
Titanium	mg/L	0.027	0.019
Uranium	mg/L	1.1	2.5
Vanadium	mg/L	0.0043	0.0048
Zinc	mg/L	0.0074	0.023

Table 5C

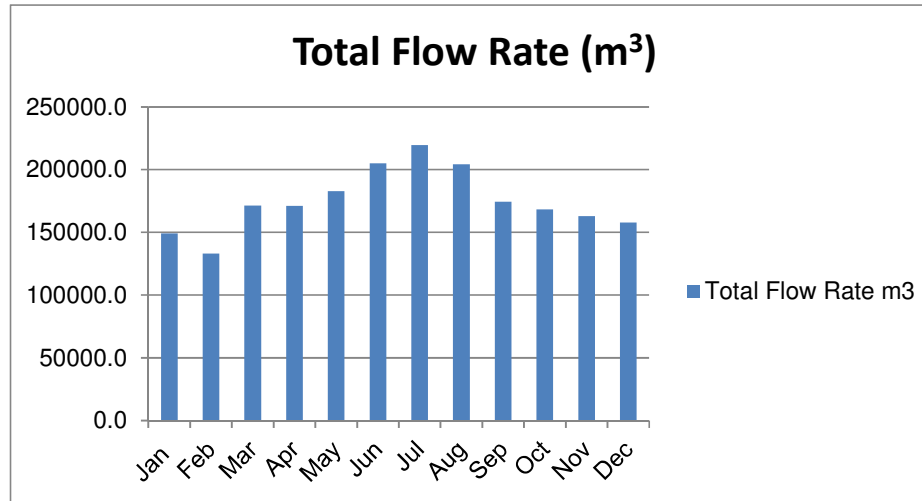
Lagoon - BTEX			
Analyte	Units	Results	
		May	October
Benzene	mg/L	<0.2	<0.2
Toluene	mg/L	<0.2	<0.2
EthylBenzene	mg/L	<0.2	<0.2
Xylenes	mg/L	<0.2	<0.2
F1 (C6-C10)	µg/L	<5	<5
Glycol			
Diethylene Glycol	mg/L	<50	<50
Ethylene Glycol	mg/L	<50	<50
Propylene Glycol	mg/L	<50	<50
Triethylene Glycol	mg/L	<50	<50

Table 4C

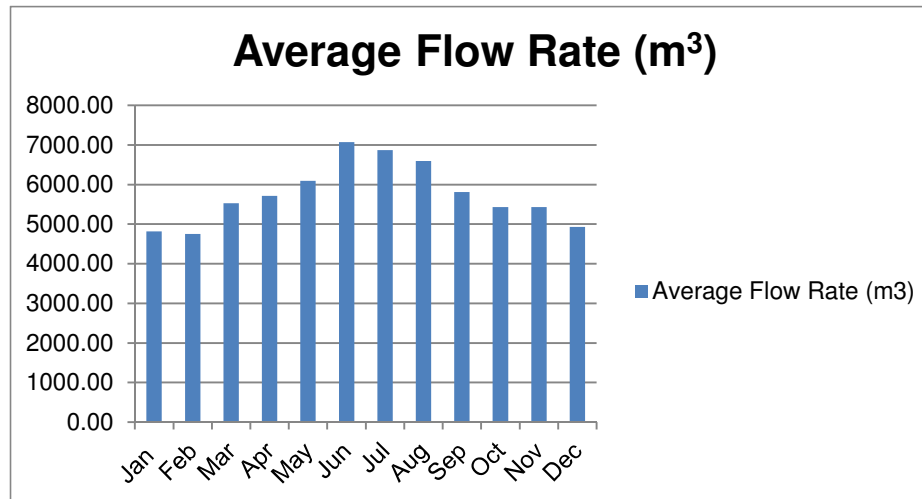
Lagoon - Inorganic Chemistry			
Analyte	Units	Results	
		May	October
pH	mg/L	8.57	8.16
Chloride	mg/L	398	451
Conductivity	µS/cm	1910	2010
Flashpoint	°C	>100	>100
TDS	mg/L	1020	1100
Cyanide	µg/L	2	<1
Mercury	µg/L	<0.01	<0.02
Phosphorus	mg/L	4.8	9.5
Sodium	mg/L	268	290
Surfactants (MBAS)	mg/L	0.1	0.5
Phenolics	mg/L	1.6	1.2

*City of North Battleford
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Appendix D: Flow*

Total Flow Rate	
Table 1D	
Month	Total Flow Rate m ³
Jan	149361.2
Feb	133187.0
Mar	171400.3
Apr	171368.2
May	182881.6
Jun	205216.8
Jul	219782.3
Aug	204477.1
Sep	174478.6
Oct	168476.8
Nov	163046.0
Dec	157920.9
Total	2101596.8



Average Flow Rate	
Table 2D	
Month	Average Flow/ Day m ³
Jan	4818.10
Feb	4756.68
Mar	5529.04
Apr	5712.27
May	6096.05
Jun	7076.44
Jul	6868.20
Aug	6596.04
Sep	5815.95
Oct	5434.74
Nov	5434.87
Dec	4935.03
Average	5756.12



*City of North Battleford
Wastewater Treatment Plant
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Appendix E: Glossary*

Glossary

Ammonia – Ammonia as N ($\text{NH}_3\text{-N}$) – Ammonia as N is an inorganic, dissolved form of nitrogen that can be found in water and is the preferred form for algae and plant growth. The term ammonia refers to two chemical species which are in equilibrium in water. They are NH_4^+ (ionized) and NH_3 (un-ionized). Tests for ammonia usually measure total ammonia.

Biosolids – also known as sewage sludge, is a solid, semi-solid, or liquid residue generated during treatment of domestic sewage in a treatment works. It consists mainly of water (90 to 99%) and settleable solids. The solids are mostly organics that are removed during primary, secondary or advanced wastewater treatment processes.

BOD – Biochemical Oxygen Demand is the amount of dissolved oxygen needed by aerobic organisms in water to break down organic material present.

BTEX – Benzene, Toluene, Ethylbenzene, and Xylene are volatile organic compounds typically found in petroleum products such as gasoline and diesel.

CBOD – Carbonaceous Biochemical Demand measures the amount of oxygen consumed by living organisms (bacteria) in decomposing the organic waste.

EC – is a measure of water's ability to conduct electricity, the higher the concentration of dissolved ions, the higher the conductivity. It is most often measured in $\mu\text{S/cm}$ – microSiemens per centimetre.

E. coli – is the only member of the total coliform group of bacteria that is found only in the intestines of mammals. The presence of E. coli in water indicates recent fecal contamination and may indicate the possible presence of disease-causing pathogens

MAC - Maximum Acceptable Limit and is health based

mg/L – milligrams per litre

NTU – Nephelometric Turbidity Unit is based on the amount of light that is scattered by particles

Pathogen – is a disease causing microorganism such as a virus or bacterium.

pH – is a measure of how acidic or basic a solution is. It ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is acidic while a pH greater than 7 is basic.

S.E. – Saskatchewan Ministry of the Environment is the department that oversees solid waste disposal

SWSA – The Saskatchewan Water Security Agency was created on October 1, 2012. The former Saskatchewan Watershed Authority is now part of this new provincial water organization. This agency regulates and monitors waterworks and wastewaterworks.

THMs – Trihalomethanes are disinfection by-products that form when chlorine is added to water that contains natural organic matter.

TKN – Total Kjeldahl nitrogen is the sum of organic nitrogen, ammonia, and ammonium.

Total Coliforms – are a group of bacteria commonly found in the environment. They are not likely to cause illness, but their presence indicates the water supply may be vulnerable to contamination by more harmful microorganisms.

Total P – Total Phosphorus is a measure of all the forms of phosphorus in a sample

TSS – Total Suspended Solids includes all particles suspended in water which will not pass through a filter.

Turbidity – is a measure of relative clarity of a liquid. Guidelines for turbidity are a safeguard against pathogens in drinking water.

Un-ionized Ammonia – NH_3 is the un-ionized form of ammonia. It is the toxic form of ammonia. In general, the un-ionized ammonia is highly toxic to fish and other aquatic life. Toxicity increases as pH and temperature increase.

VSS – Volatile Suspended Solids is the portion of Total Suspended Solids that can be ignited and is made up of organic material.

WMF – Waste Management Facility

WSA – The Water Security Agency was created on October 1, 2012. The former Saskatchewan Watershed Authority is now part of this new provincial water organization.

WWTP – Wastewater Treatment Plant