

CITY OF NORTH BATTLEFORD

2021 ANNUAL DRINKING

WATER QUALITY REPORT



WTP #1



FEH WTP

CITY OF NORTH BATTLEFORD

DRINKING WATER QUALITY

2021 ANNUAL REPORT

CITY OF NORTH BATTLEFORD

DEPARTMENT OF CITY OPERATIONS

2021

Executive Summary

This report provides a summary of the Drinking Water Quality of the water produced by the City of North Battleford and the results of the Distribution System monitoring.

The highlights of 2021 were as follows:

- A total of 324 samples were submitted as part of the routine monitoring of the distribution system. None of the routine samples tested positive for total coliforms. All routine samples were within the recommended chlorine residual guidelines set by the WSA.
- The annual average for samples submitted for Trihalomethanes and Haloacetic Acids was below the Maximum Acceptable Concentration.
- The online turbidity analyzers for Water Treatment Plant #1 ranged from 0.01 NTU to 0.39 NTU, meeting the guideline of less than 1.0 NTU for 95% of readings.
- The turbidity for the F.E. Holliday Treatment Plant filters ranged from 0.03 to 0.87 NTU for Filter #1, 0.02 to 0.65 NTU for Filter #2, 0.02 to 0.35 NTU for Filter #3, and 0.02 to 0.44 NTU for Filter #4. All filters were below the NTU guidelines of less than 0.3 NTU for 95% of readings and at no time exceeded the Absolute Maximum of 1.0 NTU.
- Monthly free chlorine readings were above the minimum guideline of 0.2 mg/L entering the distribution system. The monthly readings ranged from 0.21 mg/L to 2.32 mg/L at Water Treatment Plant #1 and 0.48 mg/L to 1.97mg/L at the F.E Holliday Treatment Plant.
- The highest iron reading recorded was 0.07 mg/L at Water Treatment Plant #1 which was below the aesthetic guidelines of 0.3 mg/L.
- The highest manganese reading recorded was 0.10 mg/L at Water Treatment Plant #1 which is above the aesthetic guidelines of 0.05 mg/L. The average readings were 0.01 mg/L.
- In 2021 the City produced 1.69 million m³ compared to 1.55 million m³ in 2020.

In conclusion, the City of North Battleford water treatment plants provided potable water that met the Water Security Agency guidelines.

Safe Drinking Water Policy

POLICY STATEMENT

The City of North Battleford Council and Administration are committed to providing the community with good quality and safe drinking water throughout the City distribution system.

KEY INDICATORS

Good and safe drinking water quality will be demonstrated by:

- Water that is free of pathogenic organisms and any harmful concentrations of chemicals or other substances as may be identified in provincial drinking water requirements, guidelines, objectives, or recommendations.
- Water that is adequately disinfected.
- Water that is aesthetically acceptable.

PRIORITY MEASURES

The following essential measures are undertaken to ensure the provision of good and safe drinking water:

- Protection of Water Sources and Watersheds within the City's Jurisdiction and Influence.
- Quality Control, Quality Assurance and Continuous Improvement Programs.
- Water Treatment, Transmission and Distribution System Maintenance and Renewal.
- Staff Training, Certification and Ongoing Learning.
- Regular and Timely Reporting to City Council.
- Water Quality Monitoring with Public Accountability for Verifying Quality Results.

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Introduction

The City of North Battleford Annual Drinking Water Report is designed to provide information to the public, government organizations, and internal management. Data that is presented in this report is collected from the water treatment plants and distribution system within the City of North Battleford.

Background

The City of North Battleford water supply system is comprised of two water treatment facilities, three reservoirs, one booster station, approximately 120 kilometres of water main, 580 fire hydrants and thousands of valves.

Approximately 5,500 residential, commercial, industrial and institutional customers utilize the North Battleford distribution system.

Between January 1, 2021, and December 31, 2021, the City of North Battleford water treatment plants produced approximately 1.69 million m³ of water. Tables and graphs showing water production per month, can be viewed in the results section of the report.

Water Treatment Plants

The City of North Battleford water treatment Facilities consists of two water treatment plants: Water Treatment Plant #1 (WTP #1) and F.E. Holliday Water Treatment Plant (FEH WTP). The WTPs utilize two sources of water to meet the customer demand.

Water Treatment Plant #1 (Figure 1) is currently designated as a Class 2 Water Treatment Facility. The plant draws water from a well field located in the River Valley southwest of the city. The water treatment process at WTP #1 consists of 'Train A' which utilizes four pressure filters and 'Train B' which utilizes two open filters. All six filters use greensand media to aid in the removal of manganese and iron. Chlorine gas is the main pre and post filtration disinfection method used at this plant. A liquid form of chlorine is used in pre-treatment when pre-chlorine residuals drop below an acceptable level during an upset condition. The 'Train B' expansion officially came online in September 2012.

In 2016, four new production wells were installed at WTP #1. The four new production wells began operating in the fall of 2016 after the Husky Energy oil spill which caused the City of North Battleford to shut down operations at FEH WTP. The new production wells increased the production capability of WTP #1 to offset lost production from FEH WTP. Husky Energy provided the funding for the four production wells and associated costs. The current treatment capacity of WTP #1 has increased from 180 m³/hr to approximately 320 m³/hr. The well field limits the production capability of this plant.



Figure 1. Water Treatment Plant #1

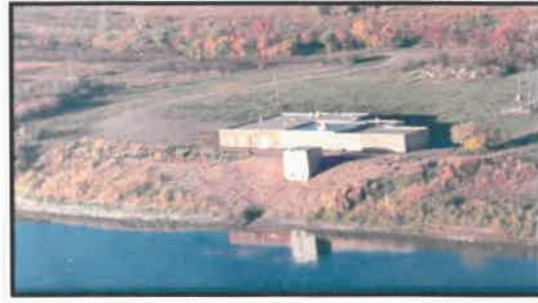


Figure 2. F.E. Holliday Water Treatment Plant

FEH WTP (Figure 2) is designated as a Class 3 Water Treatment Facility. The plant takes raw water directly from the North Saskatchewan River. Water is drawn from the river, sand is removed, and then the water is treated for inorganic and organic constituents and filtered. Chlorine gas is used as the primary disinfectant with ultraviolet energy (UV) providing additional disinfection. The production capability of this plant is affected by the turbidity of the North Saskatchewan River.

The untreated and treated water is monitored and tested daily at each WTP when operating to ensure that the finished product meets the standards set by the Water Security Agency (WSA). A summary of plant operations for each WTP can be found in the results section of this report.

Distribution System

The City of North Battleford has over 120 km of water mains. These mains are a combination of asbestos concrete, cast iron, PVC, HDPE, copper, and steel. In 2021, there were 18 water main leaks detected and repaired. Work was done on 34 hydrants (8 complete rebuilds, 7 repairs, 11 replacements and 8 thaws).

In 2019, the City of North Battleford installed pressure monitoring devices in 16 locations throughout the distribution system. These locations included: City Hall, Don Ross Center, Cuplex (Field House), Airport Terminal Building, John Paul II Collegiate High School, Lakeland Vet Clinic, Scott Campbell Dodge, Bready School, St. Mary School, Killdeer Signature Condo, City of North Battleford Parks Shop, Don Jerry's Bulk Foods, Civic Center, WWTP, and two at the pressure sustaining station at Douglas Avenue (one for pressure zone 1 and one for pressure zone 2). The pressure in the City's distribution system must be greater than 20 psi at all times. If any part of the water distribution system pressure drops below 20 psi that part of the distribution system is considered depressurized, and is vulnerable to contamination. If the system is considered depressurized, a drinking water advisory is issued to the affected section of the system while corrective actions are performed.

Water in the distribution system is regularly tested at seven monitoring locations per week throughout the City. A map showing the division of the City into 12 sampling zones can be found in **Appendix A**. Each monitoring location is sampled weekly or every other week. The Permit to Operate a Waterworks, set out by WSA, requires three samples are taken per week for a total of 156 per year. In 2021, a total of 324 routine monitoring

samples were submitted. Each sample is tested for coliforms, free chlorine, total chlorine, and turbidity.

'Other' samples are collected when there are new services, complaints about taste or odour, following water main repairs or after any construction activity where water distribution quality may be affected. In 2021, a total of 277 'other' samples were submitted. These are not considered 'routine' samples but do undergo the same tests. A summary of 'routine' and 'other' sampling can be found in the results section.

Tested Parameters

The City of North Battleford performs testing as required by the Permit to Operate a Waterworks and as directed by WSA. Additional testing may be done at the discretion of the City in advance of proposed changes to Drinking Water Quality Guidelines to determine the effect of potential changes in the treatment processes. Tested parameters may or may not be subject to a guideline limit. These limits can be health-based, Maximum Acceptable Concentration (MAC), interim Maximum Acceptable Concentration (iMAC), or based on Aesthetic Objectives (AO) such as taste or odor. These limits may be expressed as milligrams per litre (mg/L), micrograms per litre (µg/L), or counts per millilitre or litre (0 cts/100mL or 0 cts/100L). Each tested parameter is outlined in greater detail below. The results for these tested parameters can be found in the results section of this report.

Coliform Bacteria, Total

Total coliform bacteria are used as an operational tool to determine how well the drinking water treatment system is operating. Total coliforms include a variety of naturally occurring bacteria in water, soil, and vegetation as well as human and animal feces. The majority of these bacteria are harmless. The presence of total coliform bacteria indicates that the system is vulnerable to contamination and that additional actions need to be taken. Any exceedances should be investigated. Testing is used to ensure water quality meets permitted criteria. The guideline for the presence/absence of Total Coliforms is a health objective, and as such is expressed as a MAC. The WSA limit for total coliform bacteria is 0 cts/100mL of a sample.

Escherichia coli, (E. coli)

"E.coli is a type of coliform bacteria commonly found in the intestines of humans and warm-blooded animals. Most strains of E.coli do not cause illness in healthy humans and are actually beneficial to the synthesis of vitamins.

Some strains, however, cause cramps and diarrhea in humans. One particular strain named O157:H7 produces a powerful toxin that can cause severe illness. Health organizations across the world have selected E.coli as the most reliable indicator for the bacteriological quality of drinking water.

The presence of E.coli in water is a strong indication of recent sewage or animal waste contamination. Sewage may contain many other types of disease-causing organisms.” Saskatchewan Health Authority. (2022). *Drinking Water Quality Analysis*. Retrieved from the Saskatchewan Health Authority Website: [Drinking Water Quality Analysis | SaskHealthAuthority](#)

E. coli is not reported when total coliform is not detected. The E. coli limit set by WSA for drinking water is 0 cts/100 mL, which is also a MAC.

Chlorine

Chlorine is an oxidizing agent that is commonly used as a disinfectant. When chlorine is added to water, it reacts to form two disinfectants known as "free residual chlorine" and "combined residual chlorine." WSA has placed a limit of not less than 0.2 mg/L of free residual chlorine in the water entering the distribution system from the water treatment plants. Additionally, a minimum of 0.10 mg/L of free residual chlorine or 0.50 mg/L of total residual chlorine (free plus combined) must be maintained continuously throughout the distribution system.

As per the permit to operate, the City must test free residual chlorine in the water entering the distribution system continuously or at least once per hour. The WTPs use on-line analytical instruments to monitor the free chlorine. Additionally, Operators sample water and test for free and total chlorine at least once daily at WTP #1 and hourly at WTP #2 while the plant is in operation. These tests are used to confirm that the online instruments are operating properly.

Turbidity

Turbidity is an assessment of water clarity, and a measure of suspended inorganic and organic particles in the water. Turbidity can be caused by sediment, particles of dirt, clay, silt, air bubbles, vegetation, plankton, and other microscopic organisms suspended in the water. Turbid water may protect microorganisms from disinfection or prevent the removal of naturally occurring particles that the treatment process wants to control or eliminate.

As per the permit to operate, the limit for turbidity leaving WTP #1 is to be less than 1.0 NTU in 95% of readings and the limit leaving the filters at FEH WTP is to be less than 0.3 NTU in 95% of readings and never more than 1.0 NTU off each filter. WSA does not provide a limit for the turbidity within the distribution system. However, the City has implemented practices to maintain turbidity levels below 5.0 NTU in the distribution system.

Iron

Iron is an inorganic element and one of the most abundant metals in the earth's crust. Small quantities of iron are naturally found in many groundwater sources. An AO of less than 0.3 mg/L is used to minimize iron staining of laundry and plumbing fixtures, and to reduce undesirable tastes in consumption.

Manganese

Manganese is a naturally occurring inorganic element from the erosion and weathering of rocks and minerals. Water naturally contains small amounts of manganese; the guideline limit is based on taste and staining of laundry and plumbing fixtures. The AO for manganese in drinking water is less than 0.05 mg/L.

Additional Testing

Additional water quality parameters are tested as set out in the Permit to Operate a Waterworks as directed by WSA or at the discretion of the City of North Battleford.

General Chemical

A general water quality analysis is done semi-annually on the treated water from WTP #1 and quarterly from FEH WTP. Some of the parameters tested have guideline limits while others do not. The presence of some parameters may interfere with the removal of health-related parameters (such as bacteria). They may affect the treatment system's effectiveness and may be indicators of the overall water quality. Since 2013, general chemical analysis has been completed on the source waters for the WTP's to track changes in water quality that could affect the treatment processes.

Chemical Health and Toxicity

Trace elements in North Battleford's water are monitored annually. These elements can be naturally occurring or the result of leaching, runoff, or spills. Some parameters are subject to a MAC while others are subject to an AO.

Trihalomethanes/Haloacetic Acids

Trihalomethanes (THMs) and Haloacetic Acids (HAAs) are organic compounds formed in drinking water as a by-product of chlorine disinfection. THMs and HAAs may be linked to cancer or other health problems. The MAC of total THMs is 100 µg/L (0.1 mg/L) and total HAAs is 80 µg/L (0.08mg/L) based on an annual average of quarterly tests.

Pesticides

The City of North Battleford tests for pesticides in the treated water once every two years. Pesticides can enter source water (usually surface water) as a result of leaching and runoff from agricultural or other uses. Limits on pesticide concentrations are health-based and subject to a MAC.

Organics

The City of North Battleford tests for organics in the treated water once every two years. Organics, usually petroleum products, can enter source water through a variety of means. Limits on organics are mainly health-based and subject to a MAC. A few are subject to an AO.

Cryptosporidium and Giardia

Cryptosporidium and Giardia are pathogens commonly found in surface water. They are associated with gastrointestinal upset. They can cause nausea, vomiting and diarrhoea. Cryptosporidium oocysts and Giardia cysts are found in human and animal wastes, which sometimes wash into rivers and lakes.

The minimum treatment process goal is a 3 log (99.9%) reduction or inactivation of Cryptosporidium oocysts and Giardia cysts. The combination of physical removal (filtration) and the use of an ultraviolet treatment system allows FEH WTP to reach this goal. Cryptosporidium and Giardia are tested semi-annually for raw water entering FEH WTP and under upset conditions for treated water at FEH WTP.

Microcystin

Microcystins are tested in the treated water at FEH WTP by the City of North Battleford once a month from June to October (a total of 5 samples are collected). Microcystins are toxins produced by blue-green algae. Blue-green algae are commonly found in surface water when conditions are favourable for growth and the formation of algal blooms. The toxins are released when the algae die and may continue to be present in the water for weeks to months.

Most microcystins are liver toxins, but they are also a skin, eye and throat irritant. Blue-green algal blooms can occur with adequate levels of phosphorous and nitrogen, a temperature range of 5 to 30 degrees Celsius and pH between 6 and 9. Most blooms will occur in late summer and early fall.

The MAC for total microcystins is 1.5 µg/L.

Results

The summary of the sampling results at each of the WTPs, as well as the results for the tested parameters, are discussed below. All samples collected were submitted to accredited laboratories for appropriate analysis. Refer to **Appendix B** for detailed tables showing the sampling data.

WTP #1 Summary

The treated water leaving WTP #1 was tested for five parameters (turbidity, free chlorine, total chlorine, iron, and manganese) daily and met the guidelines set out by WSA.

The monthly turbidity readings ranged from 0.01 NTU to 0.39 NTU. The highest reading of 0.39 NTU is below the limit of 1.0 NTU set out by WSA. The monthly free chlorine readings from the on-line analyzer ranged from 0.21 to 2.32 mg/L. The low limit set by WSA is not less than 0.2 mg/L for the water leaving the plant.

Iron readings ranged from 0.00 mg/L to 0.07 mg/L. The AO for Iron is 0.3 mg/L.

Manganese readings ranged from 0.00 mg/L to 0.10 mg/L. The AO for Manganese is 0.05 mg/L. While the highest reading of 0.10 mg/L is above the AO, the average reading for manganese was 0.01 mg/L.

A summary of the results for WTP #1 can be found in **Table 1**.

FEH WTP (WTP #2) Summary

The treated water leaving FEH WTP was tested daily for turbidity and free chlorine and met the guidelines set out by WSA. Turbidity was tested leaving the filters and clear well, while the free chlorine was tested leaving the clear well.

The turbidity leaving the four filters:

Filter #1 ranged from 0.03 – 0.87 NTU,
Filter #2 ranged from 0.02 – 0.65 NTU,
Filter #3 ranged from 0.02 – 0.35 NTU, and
Filter #4 ranged from 0.02 – 0.44 NTU.

The highest turbidity reading recorded from the filters was 0.87 NTU while the lowest reading was 0.02 NTU (several months). The turbidity for Filters #1 and #2 occasionally spiked on filter start-up following long filter down-time periods. These spikes were believed to be associated with accumulated precipitates in the filter underdrain system and piping during the downtime periods and not a filter breakthrough event. WSA is informed of all events related to these turbidity spike events.

The monthly average free chlorine readings recorded entering the distribution system ranged from 0.80 mg/L to 1.31 mg/L. The highest chlorine reading recorded was 1.97 mg/L (June) while the lowest was 0.48 mg/L (April). The results are shown in **Table 2**.

Routine Sampling

In 2021, a total of 324 samples were submitted for analysis as part of the routine monitoring required by WSA. None of the routine samples tested positive for coliforms/E.coli. Free and total chlorine residuals and turbidity were measured in each routine sample. All samples were within applicable guidelines.

A total of 277 'other' samples were submitted for testing as a result of new services, complaints, water main breaks or any other construction activity which had the potential to impact the distribution water. Total coliforms were detected in one sample. Repeat samples for coliforms were within applicable guidelines. The results are shown in **Table 3**.

General Chemical

Two samples of the treated water from WTP#1 and four from FEH WTP (WTP #2) were submitted for analysis for General Chemical analysis in 2021. The parameters tested met all aesthetic and health objectives. The results are shown in **Tables 4 and 5**.

Chemical Health with Cyanide and Mercury

One sample of the treated water from each WTP was submitted for Chemical Health with Cyanide and Mercury in 2021. The parameters tested were either within guidelines or below detection limits. The results are shown in **Table 6**.

THMs

Samples were collected quarterly from two locations (eight samples in total) within the distribution system and were submitted for analysis for THMs in 2021. The total THM concentrations ranged from 37.2 µg/L to 67.0 µg/L. All samples tested below the MAC of 100 µg/L. The results are shown in **Table 7**.

HAAs

Samples were collected quarterly from two locations (eight samples in total) within the distribution system and were submitted for HAAs analysis in 2001. The total HAA concentrations ranged from 22.0 µg/L to 35.0 µg/L. All samples tested below the MAC of 80 µg/L. The results are shown in **Table 8**.

Cryptosporidium and Giardia

Two samples of the raw water from FEH WTP (WTP #2) were submitted for Cryptosporidium and Giardia analysis in June and November of 2021. No Cryptosporidium oocysts were detected in either of the sample results, while 6.80 Giardia cysts/100L were detected in the June sample results. The results are shown in **Table 9**.

Pesticides

One sample of the treated water from WTP #1 and FEH WTP was submitted for Pesticides analysis in 2021. All tested parameters were below detection limits. The results are shown in **Table 10**.

Organics

One sample of the treated water from WTP #1 and FEH WTP was submitted for Organics analysis in 2021. All tested parameters were below detection limits. The results are shown in **Table 11**.

Water Production

In 2021, just over 1.69 million m³ of potable water was produced by the two Water Treatment Plants. WTP #1 produced 1.5 million m³, while 0.190.05 million m³ of potable water was produced by the FEH WTP. FEH WTP is considered a peaking plant and is operated as needed. Due to low overall demand the plant was operated to manage peak water demands, maintain clearwell water chlorine levels, and control the age and quality of clearwells and the solids contact unit.

The water production results are shown in Appendix C, Table 12. Combined, the monthly amount of water produced by both water treatment plants ranged from a low of 100,680m³ (February) to a high of 211,910m³ (July). The average daily production was 4,631 m³. The peak average daily production was 6,836m³ in July, and the lowest average daily production was 3,499m³ in January.

Conclusion

The North Battleford water treatment plants and distribution system were able to provide potable water that met WSA guidelines as set out in the Permit to Operate. Chlorine levels in the distribution system exceeded the minimum level outlined by WSA for the City of North Battleford.

Acknowledgement

The City Operations Department of the City of North Battleford prepared this report. The dedication and commitment of civic staff in providing safe water during 2021 is acknowledged.

Also acknowledged is the ongoing assistance of WSA.

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City of North Battleford
Drinking Water Quality
2021 Report
Appendix A: Map of Sampling Zones

*City of North Battleford
Drinking Water Quality
2021 Report
Appendix B: Results Tables*

WTP #1 Summary									
Month	Train		CHLORINE			TURBIDITY		IRON mg/L	MANGANESE mg/L
			Free (Lab) mg/L	Free (SCADA) mg/L	Total mg/L	NTU (Lab)	NTU (SCADA)		
January	A	Average	1.08	1.05	1.43	0.08	0.05	0.01	0.02
		Max	1.51	1.39	1.99	0.11	0.07	0.03	0.03
		Min	0.89	0.90	1.16	0.04	0.03	0.00	0.01
	B	Average	1.11	1.17	1.47	0.07	0.04	0.01	0.02
		Max	1.46	1.53	2.00	0.13	0.06	0.03	0.03
		Min	0.80	0.82	1.07	0.05	0.02	0.00	0.01
February	A	Average	1.16	1.21	1.39	0.08	0.06	0.01	0.02
		Max	1.91	2.32	1.97	0.11	0.08	0.03	0.04
		Min	0.88	0.94	1.13	0.05	0.04	0.00	0.01
	B	Average	1.16	1.21	1.44	0.08	0.05	0.01	0.02
		Max	1.48	1.50	1.83	0.11	0.08	0.04	0.03
		Min	0.94	1.00	1.17	0.05	0.04	0.00	0.01
March	A	Average	1.13	1.11	1.43	0.08	0.07	0.01	0.02
		Max	1.33	1.28	1.80	0.11	0.10	0.05	0.04
		Min	0.97	0.95	1.24	0.05	0.01	0.00	0.00
	B	Average	1.17	1.19	1.47	0.08	0.04	0.01	0.01
		Max	1.38	1.40	1.81	0.13	0.08	0.04	0.03
		Min	0.95	0.97	1.21	0.01	0.03	0.00	0.00
April	A	Average	1.20	1.17	1.45	0.07	0.06	0.01	0.01
		Max	1.39	1.35	1.73	0.12	0.09	0.04	0.01
		Min	0.97	1.01	1.27	0.04	0.04	0.00	0.00
	B	Average	1.18	1.20	1.43	0.07	0.03	0.01	0.01
		Max	1.48	1.49	1.84	0.14	0.04	0.05	0.01
		Min	0.89	0.95	1.23	0.05	0.03	0.00	0.00
May	A	Average	1.24	1.29	1.46	0.09	0.07	0.01	0.01
		Max	1.62	1.63	1.78	0.16	0.09	0.03	0.08
		Min	1.05	1.03	1.16	0.05	0.04	0.00	0.00
	B	Average	1.22	1.25	1.48	0.09	0.03	0.01	0.01
		Max	1.53	1.50	1.72	0.15	0.06	0.04	0.01
		Min	1.03	1.02	1.27	0.05	0.02	0.00	0.00
June	A	Average	1.12	1.13	1.35	0.12	0.06	0.01	0.01
		Max	1.39	1.44	1.73	0.18	0.09	0.05	0.02
		Min	0.88	0.95	1.12	0.06	0.04	0.00	0.00
	B	Average	1.12	1.17	1.36	0.16	0.03	0.02	0.01
		Max	1.37	1.34	1.78	0.35	0.06	0.07	0.02
		Min	0.86	1.06	1.12	0.06	0.02	0.00	0.00

WTP #1 Summary Continued									
Month	Train		CHLORINE			TURBIDITY		IRON mg/L	MANGANESE mg/L
			Free (Lab) mg/L	Free (SCADA) mg/L	Total mg/L	NTU (Lab)	NTU (SCADA)		
July	A	Average	1.15	1.15	1.44	0.09	0.05	0.01	0.01
		Max	1.32	1.37	1.86	0.13	0.09	0.05	0.02
		Min	0.96	0.97	1.14	0.07	0.04	0.00	0.00
	B	Average	1.16	1.15	1.43	0.12	0.03	0.01	0.01
		Max	1.33	1.33	1.67	0.37	0.05	0.05	0.03
		Min	0.99	0.21	1.19	0.06	0.02	0.00	0.00
August	A	Average	1.17	1.16	1.46	0.09	0.05	0.01	0.01
		Max	1.44	1.62	1.85	0.22	0.07	0.04	0.10
		Min	1.05	0.99	1.19	0.06	0.03	0.00	0.00
	B	Average	1.17	1.18	1.50	0.11	0.05	0.01	0.01
		Max	1.51	1.48	1.84	0.23	0.39	0.03	0.02
		Min	0.89	0.92	1.14	0.06	0.02	0.00	0.00
September	A	Average	1.20	1.16	1.48	0.10	0.06	0.01	0.01
		Max	1.40	1.30	1.70	0.16	0.09	0.03	0.02
		Min	0.84	0.88	1.05	0.06	0.03	0.00	0.00
	B	Average	1.21	1.23	1.50	0.10	0.05	0.01	0.01
		Max	1.47	1.58	1.78	0.17	0.07	0.03	0.02
		Min	0.77	0.79	1.02	0.01	0.04	0.00	0.00
October	A	Average	1.23	1.20	1.56	0.09	0.08	0.02	0.01
		Max	1.45	1.45	1.93	0.13	0.11	0.06	0.02
		Min	1.00	0.95	1.22	0.07	0.01	0.00	0.00
	B	Average	1.25	1.26	1.58	0.09	0.05	0.02	0.01
		Max	1.42	1.42	1.76	0.14	0.07	0.06	0.02
		Min	0.98	1.00	1.19	0.06	0.04	0.00	0.00
November	A	Average	1.22	1.25	1.47	0.10	0.08	0.02	0.01
		Max	2.08	2.00	2.48	0.13	0.12	0.06	0.02
		Min	1.02	0.99	1.19	0.07	0.02	0.00	0.00
	B	Average	1.23	1.24	1.52	0.10	0.05	0.02	0.01
		Max	2.11	2.11	2.86	0.18	0.10	0.04	0.02
		Min	1.01	0.99	1.29	0.07	0.03	0.00	0.00
December	A	Average	1.22	1.19	1.43	0.13	0.12	0.03	0.01
		Max	1.48	1.47	1.78	0.19	0.08	0.05	0.02
		Min	1.01	0.98	1.15	0.08	0.06	0.00	0.00
	B	Average	1.23	1.24	1.44	0.12	0.06	0.02	0.01
		Max	1.59	1.58	1.89	0.20	0.09	0.04	0.04
		Min	0.99	0.96	1.12	0.08	0.04	0.00	0.00

Table 2. FEH WTP Summary										
Date	Raw Water		Filter Effluent - Turbidities (NTU)				Clearwell One		Clearwell Two	
	RATE (m3/hr)	TURBIDITY (NTU)	Filter 1 TURB	Filter 2 TURB	Filter 3 TURB	Filter 4 TURB	Turb (NTU)	Free Cl	Turb (NTU)	Free Cl
January										
Average	42	4.64	0.12	0.07	0.04	0.04	0.13	0.96	0.10	1.03
Max	178	5.66	0.54	0.25	0.09	0.07	0.37	1.21	0.25	1.20
Min	0	3.58	0.05	0.04	0.03	0.02	0.05	0.78	0.03	0.89
February										
Average	57	4.01	0.20	0.10	0.03	0.04	0.10	1.06	0.06	1.06
Max	230	6.05	0.67	0.27	0.05	0.05	0.29	1.31	0.13	1.25
Min	0	3.17	0.03	0.05	0.03	0.03	0.05	0.82	0.03	0.74
March										
Average	65	3.87	0.04	0.08	0.04	0.04	0.11	0.82	0.08	1.03
Max	243	5.03	0.21	0.43	0.09	0.10	0.46	1.09	0.26	1.33
Min	0	3.11	0.03	0.05	0.02	0.02	0.05	0.63	0.02	0.71
April										
Average	64	19.34	0.12	0.18	0.07	0.11	0.20	0.91	0.10	0.80
Max	303	34.00	0.69	0.65	0.28	0.44	0.43	1.34	0.20	1.10
Min	0	3.43	0.06	0.12	0.02	0.02	0.05	0.67	0.03	0.48
May										
Average	254	14.19	0.08	0.13	0.05	0.07	0.08	1.04	0.04	0.97
Max	649	35.80	0.21	0.33	0.08	0.14	0.17	1.51	0.08	1.36
Min	0	7.40	0.06	0.11	0.03	0.04	0.05	0.68	0.03	0.64
June										
Average	239	40.57	0.06	0.06	0.08	0.11	0.12	1.31	0.06	0.96
Max	673	97.00	0.17	0.25	0.35	0.42	0.25	1.97	0.12	1.24
Min	0	18.50	0.03	0.04	0.04	0.03	0.06	0.66	0.03	0.71
July										
Average	256.45	22.39	0.04	0.05	0.05	0.05	0.05	1.17	0.04	1.09
Max	505.82	44.80	0.24	0.16	0.09	0.08	0.11	1.40	0.09	1.26
Min	0.00	12.00	0.03	0.02	0.03	0.03	0.03	0.93	0.02	0.90
August										
Average	169	11.31	0.06	0.06	0.04	0.05	0.11	1.03	0.06	0.95
Max	392	18.80	0.87	0.56	0.09	0.19	0.24	1.43	0.22	1.08
Min	0	6.15	0.03	0.03	0.02	0.02	0.03	0.66	0.01	0.69
September										
Average	85	9.47	0.05	0.05	0.05	0.04	0.13	0.91	0.06	0.93
Max	312	14.30	0.24	0.36	0.10	0.08	0.24	1.12	0.16	1.17
Min	0	7.01	0.03	0.03	0.02	0.02	0.06	0.68	0.01	0.59
October										
Average	46	10.10	0.07	0.09	0.04	0.04	0.17	0.93	0.06	1.01
Max	185	15.50	0.16	0.30	0.12	0.09	0.25	1.24	0.10	1.33
Min	0	6.30	0.04	0.03	0.02	0.02	0.07	0.62	0.02	0.75

Table 2. FEH WTP Summary Continued										
November										
Average	43	5.31	0.07	0.06	0.08	0.07	0.09	1.03	0.07	0.91
Max	222	9.49	0.32	0.23	0.20	0.22	0.12	1.18	0.13	1.14
Min	0	2.99	0.04	0.04	0.02	0.02	0.07	0.87	0.02	0.77
December										
Average	42	3.57	0.06	0.05	0.03	0.03	0.10	0.98	0.07	0.99
Max	111	5.19	0.33	0.29	0.05	0.05	0.25	1.10	0.30	1.09
Min	0	2.66	0.04	0.04	0.02	0.02	0.05	0.84	0.02	0.80

Routine and Other Sampling						
LOCATION	SAMPLES	BACTERIOLOGICAL # of Positive Samples			CHLORINE # of Samples Below Guidelines	TURBIDITY
	# of Samples Collected	>200 Background Colonies	Total Coliform (MPN/100 mL)	E. Coli (MPN/100 mL)	Total < 0.5 mg/L Free < 0.1 mg/L	Average (NTU)
Killdeer Park	24	0	0	0	0	0.16
Fairview Heights	25	0	0	0	0	0.16
North Commercial (Fairview Heights)	50	0	0	0	0	0.17
McIntosh Park	27	0	0	0	0	0.14
Downtown	25	0	0	0	0	0.16
College Heights	23	0	0	0	0	0.13
Yellow Sky	51	0	0	0	0	0.14
Riverview	49	0	0	0	0	0.17
Parsons Industrial Park	50	0	0	0	0	0.15
Other ¹	277	0	1	0	1	0.32
Total Routine Samples	324	0	0	0	0	0.15
Total Other Samples²	277	0	1	0	1	0.32

¹ These samples are not part of the routine sampling

²The one samples taken with positive Total Coliform results tested negative for Total Coliforms with the Repeat sample.

²The one sample below chlorine guidelines was taken at a known low chlorine location.

Note:

In cases where the Free and Total Chlorine falls below the guidelines set out by the Water Security Agency, the lines are flushed and chlorine retested.

Table 4 - General Chemical for WTP #1				
Parameter	Units	11-Mar	31-Aug	AO
		Results	Results	
Bicarbonate	mg/L	259	245	
Calcium	mg/L	76	74	
Carbonate	mg/L	<1	<1	
Chloride	mg/L	20	20	250
Hydroxide	mg/L	<1	<1	
Magnesium	mg/L	25	24	200
pH	pH Units	7.9	8.03	6.5-9.0
Potassium	mg/L	2.4	2.2	
Sodium	mg/L	37	32	300
E.C.	uS/cm	703	668	
Sulphate	mg/L	140	130	500
Sum of Ions	mg/L	559	527	
Total Alkalinity	mg/L	212	201	500
Total Hardness	mg/L	292	283	800
Nitrate	mg/L	0.09	<0.04	
Fluoride	mg/L	0.13	0.10	1.5
TDS	mg/L	398	433	1500

Table 5 - General Chemical for FEH WTP#2						
Parameter	Units	11-Mar	22-Jun	31-Aug	2-Nov	AO
		Results	Results	Results	Results	
Bicarbonate	mg/L	172	146	126	151	
Calcium	mg/L	50	48	40	45	
Carbonate	mg/L	<1	<1	<1	<1	
Chloride	mg/L	18	34	25	17	250
Hydroxide	mg/L	<1	<1	<1	<1	
Magnesium	mg/L	16	14	12	14	200
pH	pH Units	7.94	7.49	7.8	7.72	6.5-9.0
Potassium	mg/L	1.5	2.5	1.2	1.1	
Sodium	mg/L	12	12	5.3	7.6	300
E.C.	uS/cm	430	432	327	372	
Sulfate	mg/L	56	53	42	51	500
Sum of Ions	mg/L	328	310	252	288	
Total Alkalinity	mg/L	141	120	103	124	500
Total Hardness	mg/L	190	177	149	170	800
Nitrate	mg/L	2.40	0.42	0.54	1.10	45*
Fluoride	mg/L	0.12	0.09	0.07	0.08	1.5
TDS	mg/L	219	279	189	214	1500

*MAC based on Nitrate as NO₃

Table 6 - Chemical Health + Cyanide and Mercury						
Parameter	Units	WTP#1	WTP#2	MAC (mg/L)	iMAC (mg/L)	AO (mg/L)
		17-Nov	17-Nov			
Aluminum	mg/L	0.001	0.019			
Arsenic	ug/L	0.1	<0.1	0.01	0.025	
Barium	mg/L	0.1	0.05	1		
Boron	mg/L	0.04	0.01		5	
Cadmium	mg/L	<0.00001	0.00001	0.005		
Chromium	mg/L	<0.0005	<0.0005	0.05		
Copper	mg/L	0.0009	0.0005			
Iron	mg/L	0.0093	0.0045			0.3
Lead	mg/L	<0.0001	<0.0001	0.01		
Manganese	mg/L	0.002	0.0036			0.05
Selenium	mg/L	<0.0001	0.0002	0.01		
Uranium	ug/L	0.2	<0.1	0.02		
Zinc	mg/L	0.0018	0.0022			5
Cyanide	ug/L	<1	1	0.2		
Mercury	ng/L	<1	3	0.001		

Table 7 - Trihalomethanes							
Location	Date	IMAC (ug/L)	Total THMs (ug/L)	Bromoform (ug/L)	Dibromo chloromethane (ug/L)	Dichloro bromomethane (ug/L)	Chloroform (ug/L)
Riverview	21-Jan-21		65.0	<2	2.0	10.0	53.0
	19-Apr-21		59.0	<2	1.0	9.0	49.0
	27-Jul-21		38.2	<2	1.0	6.2	31.0
	18-Oct-21		43.7	<2	6.7	<1	37.0
Downtown	21-Jan-21		65.0	<2	2.0	11.0	52.0
	19-Apr-21		67.0	<2	2.0	11.0	54.0
	27-Jul-21		37.2	<2	1.0	6.2	30.0
	18-Oct-21		41.1	<2	6.1	<1	35.0
Average		<100	52.0	<2	2.7	8.9	42.6
Max			67.0		6.7	11.0	54.0
Min			37.2		1.0	6.2	30.0

Table 8 - Halo Acetic Acids									
Location	Date	IMAC (ug/L)	Total HAAs (ug/L)	Monochloroacetic acid (ug/L)	Monobromoacetic acid (ug/L)	Dichloroacetic acid (ug/L)	Trichloroacetic acid (ug/L)	Dibromoacetic acid (ug/L)	Bromochloroacetic acid (ug/L)
Riverview	21-Jan-21		33.0	<10	<2	10.0	23.0	<3	<3
	19-Apr-21		25.0	<10	<2	8.0	17.0	<3	<3
	27-Jul-21		23.0	<10	<2	9.0	14.0	<3	<3
	18-Oct-21		35.0	<10	<2	11.0	21.0	<3	<2
Downtown	21-Jan-21		30.0	<10	<2	7.0	23.0	<3	<3
	19-Apr-21		26.0	<10	<2	7.0	19.0	<3	<3
	27-Jul-21		22.0	<10	<2	8.0	14.0	<3	<3
	18-Oct-21		34.0	<10	<2	7.0	20.0	<3	<2
Average		<80	28.5	<5	<2	8.4	18.9	<1	<2.75
Max			35.0	<5	<2	11.0	23.0	<1	<3
Min			22.0	<5	<2	7.0	14.0	<1	<2

Table 9. Crypto and Giardia			
Parameter	Units	Results	Results
		22-Jun-21	16-Nov-21
Volume Filtered	L	14.60	19.00
Giardia cysts	cysts/100L	6.80	0.00
Cryptosporidium oocysts	oocysts/100L	0.00	0.00
Risk Factor			
Risk of Surface Water Contamination			
20+	high risk		
10-19	moderate risk		
0-9	low risk		

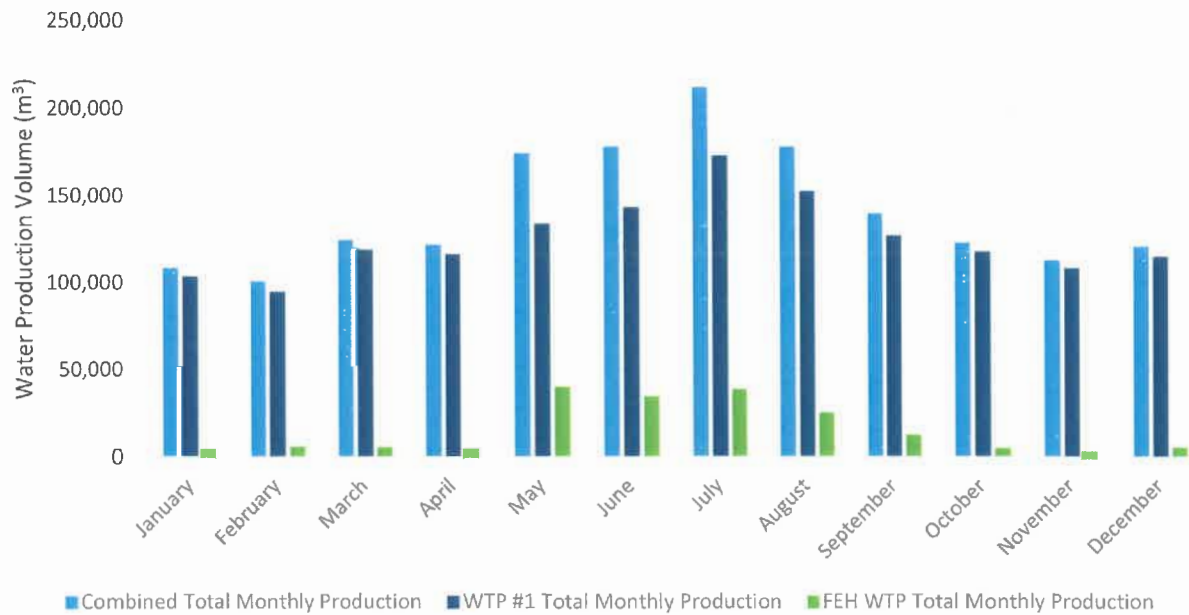
Table 10 - Pesticides					
Parameter	Units	WTP#1	WTP#2	MAC (mg/L)	IMAC (mg/L)
		17-Nov	17-Nov		
Atrazine	µg/L	<0.2	<0.2		0.005
Bromoxynil(Buctril)	µg/L	<2	<2		0.005
Carbofuran	µg/L	<0.2	<0.2	0.09	
Chlorpyrifos(Lorsban)	µg/L	<0.2	<0.2	0.09	
Dicamba(Banvel)	µg/L	<1	<1	0.12	
2,4 D	µg/L	<1	<1		0.1
Diclofop-methyl(HoeGrass)	µg/L	<1	<1	0.009	
Dimethoate(Cygon)	µg/L	<5	<5		0.02
Malathion	µg/L	<0.2	<0.2	0.19	
Pentachlorophenol(PCP)	µg/L	<0.5	<0.5	0.06	
Picloram(Tordon)	µg/L	<1	<1		0.19
Trifluralin(Treflan)	µg/L	<0.2	<0.2		0.045

Parameter	Units	WTP#1	WTP#2	MAC (mg/L)	iMAC (mg/L)	AO (mg/L)
		17-Nov	17-Nov			
BTEX						
Benzene	µg/L	<0.5	<0.5	0.005		
Toluene	µg/L	<0.5	<0.5	0.060		0.024
Ethylbenzene	µg/L	<0.5	<0.5	0.140		0.0016
Xylenes	µg/L	<0.5	<0.5	0.090		
Organochlorides						
Benzo(a)pyrene	µg/L	<0.01	<0.01	0.00001		
Carbon tetrachloride	µg/L	<2	<2	0.005		
Dichlorobenzene, 1,2	µg/L	<0.5	<0.5	0.2		
Dichlorobenzene, 1,4	µg/L	<0.5	<0.5	0.005		
Dichloroethane, 1,2	µg/L	<0.5	<0.5		0.005	
Dichloroethylene, 1,1	µg/L	<0.5	<0.5	0.014		
Dichloromethane	µg/L	<0.5	<0.5	0.05		
Dichlorophenol, 2,4	µg/L	<0.2	<0.2	0.9		
Monochlorobenzene	µg/L	<0.5	<0.5	0.08		
Tetrachlorophenol, 2,3,4,6	µg/L	<1	<1	0.1		
Trichloroethylene	µg/L	<0.5	<0.5	0.05		
Trichlorophenol, 2,4,6	µg/L	<2	<2	0.005		
Vinyl Chloride	µg/L	<0.5	<0.5	0.002		

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Appendix C: Water Production Volumes*

Table 12 - Water Production Volumes						
Month	WTP #1		FEH WTP		Combined	
	Total (m ³)	Average Daily Production (m ³)	Total (m ³)	Average Daily Production (m ³)	Total Monthly Production (m ³)	Average Daily Production (m ³)
January	103,551	3,340	4,929	159	108,480	3,499
February	94,784	3,385	5,896	211	100,680	3,596
March	118,721	3,830	5,792	187	124,513	4,017
April	116,259	3,875	5,465	182	121,724	4,057
May	133,939	4,321	40,284	1,299	174,223	5,620
June	143,206	4,774	34,891	1,163	178,097	5,937
July	172,719	5,572	39,191	1,264	211,910	6,836
August	152,341	4,914	25,626	827	177,967	5,741
September	126,862	4,229	12,717	424	139,579	4,653
October	117,710	3,797	5,046	163	122,756	3,960
November	108,250	3,608	4,599	153	112,849	3,762
December	115,156	3,715	5,636	182	120,792	3,897
Yearly Total	1,503,498	4,113	190,072	518	1,693,570	4,631

2021 Water Production Volumes



*City of North Battleford
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Appendix D: Glossary*

Glossary

AO – Aesthetic Objective and is based on taste, odour, or staining

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.

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 $\mu\text{S}/\text{cm}$ – 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

FEH WTP – F.E. Holliday Water Treatment Plant

iMAC – Interim Maximum Acceptable Limit and is health based

MAC - Maximum Acceptable Limit and is health based

Microcystins – are toxins produced by blue-green algae (cyanobacteria).

mg/L – milligrams per litre

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

OG – Operational Guidelines and is based on operational considerations (for example the water treatment process used)

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

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. 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.

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

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.

WTP – Water Treatment Plant

WTP #1- Water Treatment Plant #1, this is the groundwater plant

WTP #2 – Water Treatment Plant #2, also officially known as F.E.Holliday Water Treatment Plant, this is the surface water plant

µg/L – micrograms per litre; this is 1000 times smaller than a milligram (0.001mg/L)