

CITY OF NORTH BATTLEFORD 2023 ANNUAL DRINKING WATER QUALITY REPORT



WTP #1



FEH WTP

CITY OF NORTH BATTLEFORD

DRINKING WATER QUALITY

2023 ANNUAL REPORT

CITY OF NORTH BATTLEFORD

DEPARTMENT OF CITY OPERATIONS

2023

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 2023 were as follows:

- A total of 280 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 online turbidity analyzers for Water Treatment Plant #1 ranged from 0.09 NTU to 0.14 NTU monthly average, 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 0.02 to 1.81 NTU for Filter #1, 0.02 to 2.25 NTU for Filter #2, 0.02 to 0.63 NTU for Filter #3, and 0.02 to 0.38 NTU for Filter #4. Filters #3 and #4 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. The turbidity for Filters #1 and #2 occasionally spiked on filter start-ups following long filter down-time periods. These spikes were associated with accumulated precipitates in the filter underdrain system and piping during the downtime periods and not a filter breakthrough event. With these spike events at no time did we exceed 0.3 NTU for 95% of the readings on the filters or exceed 1.0 NTU in the clearwells;
- Monthly free chlorine readings were above the minimum guideline of 0.2 mg/L entering the distribution system. The monthly readings ranged from 0.81 mg/L to 2.15 mg/L at Water Treatment Plant #1 and 1.01 mg/L to 1.27 mg/L at the F.E Holliday Treatment Plant;
- The highest iron reading recorded was 0.09 mg/L at Water Treatment Plant #1 which was below the aesthetic guidelines of 0.3 mg/L;
- The highest manganese reading recorded was 0.09 mg/L at Water Treatment Plant #1 which is above the aesthetic guidelines of 0.05 mg/L. The average monthly readings were 0.01 mg/L for each month;
- As a result of human error, TSS values were not recorded for April and May of 2023; and
- In 2023 the City produced 1.60 million m³ compared to 1.59 million m³ in 2022.

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; and
- 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; and
- Water Quality Monitoring with Public Accountability for Verifying Quality Results.

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Introduction

The City of North Battleford Annual Drinking Water Quality Report is designed to provide information to City Council, 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.

The City of North Battleford services approximately 5,500 residential, commercial, industrial, and institutional properties. 1.60 million m³ of water was produced for the community in 2023.

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).

Water Treatment Plant #1 (Figure 1) is currently designated as a Class 2 Water Treatment Facility. The plant draws water from a groundwater well field located in the North Saskatchewan River's 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 gravity 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. The current maximum treatment capacity of WTP #1 has increased from 180 m³/hr to approximately 320 m³/hr, however 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 treats surface water directly from the North Saskatchewan River. Water is drawn from the river, sand is removed, and the water is treated for inorganic and organic constituents. 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 and sand bar formation near the plant intake.

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. Mains are a combination of asbestos concrete, cast iron, PVC, HDPE, copper, and steel. In 2023, there were 18 water main leaks detected and repaired. Work was done on 33 hydrants (19 repairs, 11 replacements and 3 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, Innovation Plex (Field House), Airport Terminal Building, John Paul II Collegiate High School, Lakeland Vet Clinic, FUNN Dodge, Bready School, St. Mary School, Killdeer Signature Condo, City of North Battleford Parks Shop, Don Jerry's Bulk Foods, Access Communications Centre, 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 sampled for the presence of bacteria at 12 routine sampling locations biweekly throughout the City. Each sample is field tested for free and total chlorine and turbidity and a sample is then collected in a 100mL bottle for analysis at an accredited laboratory. The Permit to Operate a Waterworks, set out by WSA, requires three samples to be taken per week for a total of 156 samples per year. In 2023, a total of 280 routine monitoring samples were taken.

'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 2023, a total of 152 'other' samples were submitted. These are not considered 'routine' samples, however, "other" samples are field screened and analyzed for the same testing parameters.

A map of the City's neighborhoods can be found in Appendix A and a summary of 'routine' and 'other' samples referencing the neighborhood location of these samples can be found in Appendix B, Table 3.

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 voluntarily in advance of proposed changes to Drinking Water Quality Guidelines to determine the 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 ($\mu\text{g/L}$), or counts per millilitre or litre (0 cts/100 mL or 0 cts/100 L). 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 the drinking water treatment system effectiveness. 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 action needs 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/100 mL 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, 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 a MAC of 0 cts/100 mL.

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 FEH WTP 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 sampled for and analyzed 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

Trace elements harmful to human health that may be present 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 for total THMs is 100 µg/L (0.1 mg/L) and total HAAs is 80 µg/L (0.08 mg/L) based on an annual average of quarterly tests. No samples were collected in 2023 with the next samples scheduled for collection in 2024.

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 requirement. Cryptosporidium and Giardia are tested semi-annually from 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 are present in 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. Microcystins are liver toxins and may be 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 in 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.

Wastewater Discharged to Environment

In 2022 the City's Permit to Operate was updated and now includes sampling requirements for Wastewater Discharged to Environment (WDE) for the protection of the receiving fresh water environment. All water that is released to the environment from the water treatment plants (filter backwash, plant maintenance/repairs) and does not enter the distribution system needs to be sampled for the following parameters:

- Chlorine Residual (on-site testing) – Daily
- Aluminum (off-site laboratory testing) – Monthly
- pH (on-site testing) – Weekly
- Dissolved Oxygen (on-site testing) – Weekly
- Total Suspended Solids (on-site testing) – Monthly
- Acute Lethality (off-site laboratory testing) – Annually

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 (excluding select WDE on-site testing) 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 average monthly turbidity readings were within the limits of the Permit to Operate and ranged from 0.09 NTU to 0.14 NTU. The highest average monthly reading of 0.14 NTU is below the limit of 1.0 NTU set by WSA. The monthly free chlorine readings for water leaving the plant from the on-line analyzer ranged from 0.81 to 2.15 mg/L. The low limit set by WSA is not less than 0.2 mg/L for the water leaving the plant.

Iron concentrations ranged from 0.00 mg/L to 0.09 mg/L.

Manganese concentrations ranged from 0.00 mg/L to 0.09 mg/L.

A summary of the results for WTP #1 can be found in Appendix B, Table 1.

FEH WTP Summary

The treated water leaving FEH WTP was tested daily for turbidity and free chlorine and met the guidelines set by WSA. Turbidity was tested leaving the filters and clear well, while the free chlorine was tested leaving the clear well. Turbidity exceeded the maximum limits set in the Permit to Operate in Filters 1 and 2 in March and April, however, averages were within the limits of the Permit to Operate.

The turbidity leaving the four filters:

Filter #1 ranged from 0.02 – 1.81 NTU,
Filter #2 ranged from 0.02 – 2.25 NTU,
Filter #3 ranged from 0.02 – 0.63 NTU, and
Filter #4 ranged from 0.00 – 0.38 NTU.

The highest turbidity readings recorded from the filters was 2.25 NTU while the lowest reading was 0.00 NTU (September). The turbidity for Filters #1 and #2 occasionally spiked beyond the 1.0 NTU limit (March and April) on filter start-up following long filter down-time periods. These spikes were associated with accumulated precipitates in the filter underdrain system and piping during the downtime periods and not a filter breakthrough event. With these spike events at no time did we exceed 0.3 NTU for 95% of the readings on the filters or exceed 1.0 NTU in the clearwells.

The monthly average free chlorine concentrations recorded entering the distribution system ranged from 1.01 mg/L to 1.27 mg/L. The highest chlorine concentration recorded was 5.00 mg/L (May) while the lowest was 0.30 mg/L (June).

A summary of the results for FEH WTP can be found in Appendix B, Table 2.

Routine Sampling

In 2023, a total of 280 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 152 'other' samples were submitted for testing. Free and total chlorine residuals and turbidity were measured in each routine sample. All samples were within applicable guidelines with the exception of two samples taken as part of filter maintenance at WTP #1. These two samples were expected to be below the chlorine guidelines. The results are shown in Appendix B, Table 3.

General Chemical

Two samples of the treated water from WTP#1 and four from FEH WTP were submitted for analysis for General Chemical analysis in 2023. The parameters tested met all aesthetic and health objectives. The results can be found in Appendix B, Table 4.

Chemical Health with Cyanide and Mercury

Two samples of the treated water from WTP#1 and four from FEH WTP were submitted for Chemical Health, and one sample of treated water from each plant was submitted for Cyanide and Mercury in 2023. The parameters tested were either within guidelines or below detection limits. The results can be found in Appendix B, Table 5 & 6.

Cryptosporidium and Giardia

Two samples of the raw water from FEH WTP were submitted for Cryptosporidium and Giardia analysis in March and August of 2023. Cryptosporidium oocysts were 0.00 oocysts/100 L (March and August). Giardia cysts were 45.9 cysts/100 L (March) and 3.10 cysts/100 L (August). There are no limits applied to Cryptosporidium and Giardia sampling. The results can be found in Appendix B, Table 7.

Pesticides

One sample of the treated water from WTP #1 and FEH WTP was submitted for Pesticides analysis in 2023. All tested parameters were below detection limits. The results are shown in Appendix B, Table 14.

Organics

One sample of the treated water from WTP #1 and FEH WTP was submitted for Organics analysis in 2023. All tested parameters were below detection limits. The results are shown in Appendix B, Table 15.

Wastewater Discharged to Environment

Chlorine Residual

The limit applied to Chlorine Residual is to be non-detectable. The Chlorine Residual from WTP #1 ranged from -0.567 mg/L to 0.36 mg/L and from FEH WTP ranged from -0.05 mg/L to 0.02 mg/L. This range falls within the expected error of a zero reading and is considered non-detectable. The results can be found in Appendix B, Table 8.

Aluminum

Aluminum does not have a limit applied. Aluminum results from WTP #1 ranged from 0.001 mg/L to 0.006 mg/L and from FEH WTP ranged from 0.029 mg/L to 3.54 mg/L. The results can be found in Appendix B, Table 9.

pH

pH does not have a limit applied. pH results from WTP #1 ranged from 6.01 pH to 8.01 pH and from FEH WTP ranged from 6.29 pH to 8.55 pH. The results can be found in Appendix B, Table 10.

Dissolved Oxygen

Dissolved Oxygen does not have a limit applied. Dissolved Oxygen results from WTP #1 ranged from 4.70 mg/L to 10.72 mg/L and from FEH WTP ranged from 7.14 mg/L to 12.46 mg/L. The results can be found in Appendix B, Table 11.

Total Suspended Solids (TSS)

The limit applied to TSS Shall be Determined by the Downstream Use and Impact Study. TSS results from WTP #1 ranged from 1.38 mg/L to 9.00 mg/L and from FEH WTP ranged from 0.25 mg/L to 474.00 mg/L. The results can be found in Appendix B, Table 12. As a result of staff changes and human error, samples were collected, however results were not recorded for April and May 2023.

Acute Lethality

The Limit applied to Acute Lethality Shall be Non-Lethal to Greater than 50% of test organisms at 100% effluent concentration. The results for both plants were 100% organism survival. The results can be found in Appendix B, Table 13.

Water Production

In 2023, 1.60 million m³ of potable water was produced by the two Water Treatment Plants. WTP #1 produced 1.25 million m³, while FEH WTP produced 0.35 million m³ of potable water. 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. Combined, the monthly water production by both water treatment plants ranged from a low of 101,536 m³ (February) to a high of 168,929 m³ (May). The average daily production was 4,371 m³. The peak average daily production was 5,450 m³ in June, and the lowest average daily production was 3,626 m³ in February.

Conclusion

A total of 280 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 online turbidity analyzers for Water Treatment Plant #1 ranged from 0.09 NTU to 0.14 NTU monthly average, 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 0.02 to 1.81 NTU for Filter #1, 0.02 to 2.25 NTU for Filter #2, 0.02 to 0.63 NTU for Filter #3, and 0.02 to 0.38 NTU for Filter #4. Filters #3 and #4 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. The turbidity for Filters #1 and #2 occasionally spiked on filter start-ups following long filter down-time periods. These spikes were associated with accumulated precipitates in the filter underdrain system and piping during the downtime periods and not a filter

breakthrough event. With these spike events at no time did we exceed 0.3 NTU for 95% of the readings on the filters or exceed 1.0 NTU in the clearwells.

Monthly free chlorine readings were above the minimum guideline of 0.2 mg/L entering the distribution system. The monthly readings ranged from 0.81 mg/L to 2.15 mg/L at Water Treatment Plant #1 and 1.01 mg/L to 1.27 mg/L at the F.E Holliday Treatment Plant.

The highest iron reading recorded was 0.09 mg/L at Water Treatment Plant #1 which was below the aesthetic guidelines of 0.3 mg/L.

The highest manganese reading recorded was 0.09 mg/L at Water Treatment Plant #1 which is above the aesthetic guidelines of 0.05 mg/L. The average monthly readings were 0.01 mg/L for each month.

As a result of human error, TSS values were not recorded for April and May of 2023.

In 2023 the City produced 1.60 million m³ compared to 1.59 million m³ in 2022.

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

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 2023 is acknowledged.

Also acknowledged is the ongoing assistance of WSA.

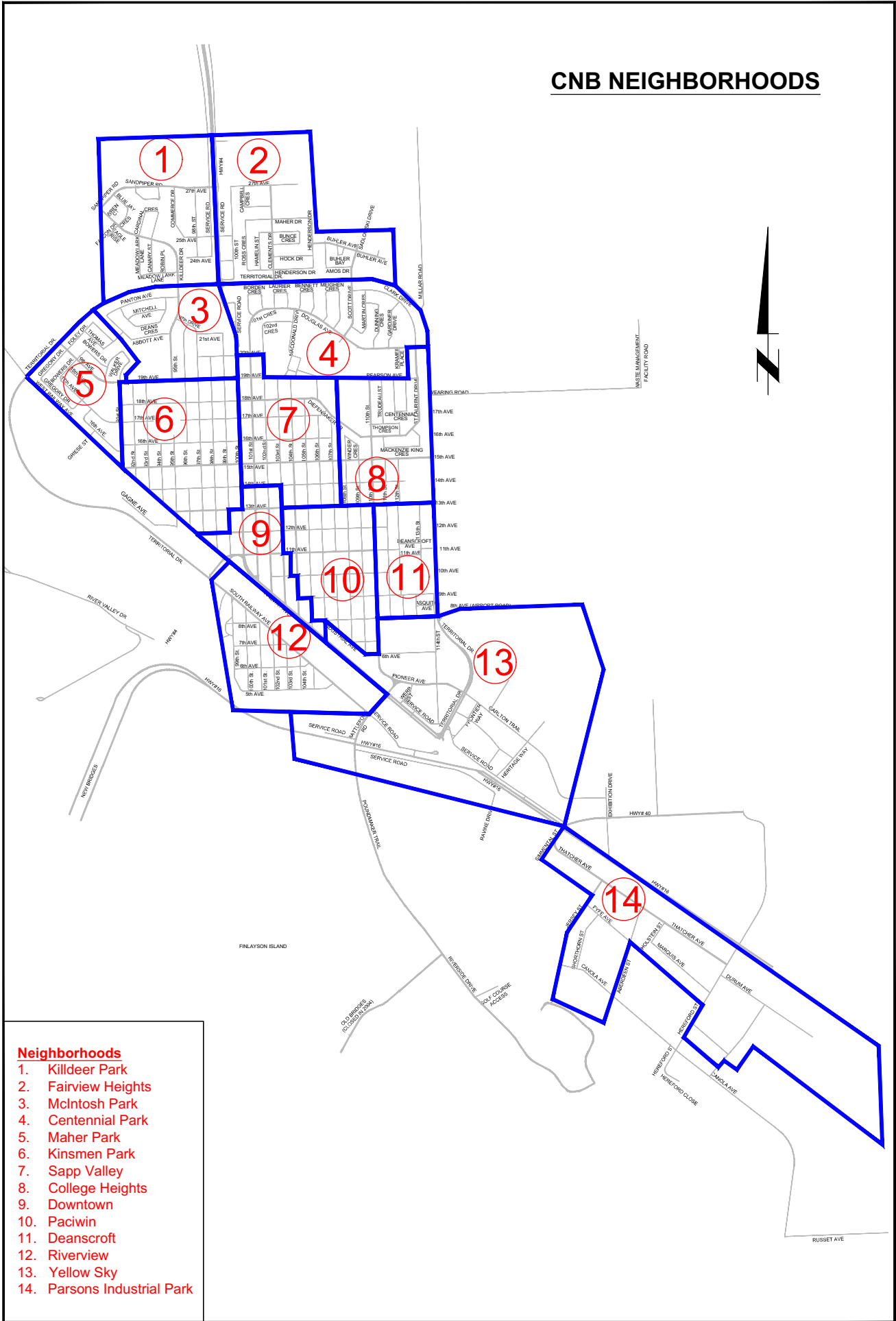
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*City of North Battleford
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Appendix A: Map of Sampling Zones*

CNB NEIGHBORHOODS



- Neighborhoods**
1. Killdeer Park
 2. Fairview Heights
 3. McIntosh Park
 4. Centennial Park
 5. Maher Park
 6. Kinsmen Park
 7. Sapp Valley
 8. College Heights
 9. Downtown
 10. Paciwinn
 11. Deanscroft
 12. Riverview
 13. Yellow Sky
 14. Parsons Industrial Park

*City of North Battleford
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Appendix B: Results Tables*

| WTP #1 Summary | | | | | | | | | |
|----------------|-------|---------|-------------------|-----------------|------------|-------------|-----------|-----------|----------------|
| Month | Train | | CHLORINE | | | TURBIDITY | | IRON mg/L | MANGANESE mg/L |
| | | | Free (SCADA) mg/L | Free (Lab) mg/L | Total mg/L | NTU (SCADA) | NTU (Lab) | | |
| January | A | Average | 1.17 | 1.15 | 1.38 | 0.07 | 0.11 | 0.02 | 0.01 |
| | | Max | 1.44 | 1.39 | 1.75 | 0.10 | 0.17 | 0.08 | 0.02 |
| | | Min | 0.92 | 0.82 | 0.99 | 0.05 | 0.09 | 0.00 | 0.01 |
| | B | Average | 1.16 | 1.17 | 1.41 | 0.07 | 0.11 | 0.03 | 0.01 |
| | | Max | 1.54 | 1.57 | 1.86 | 0.10 | 0.18 | 0.09 | 0.03 |
| | | Min | 0.86 | 0.92 | 0.99 | 0.05 | 0.08 | 0.00 | 0.00 |
| February | A | Average | 1.20 | 1.20 | 1.40 | 0.08 | 0.12 | 0.02 | 0.01 |
| | | Max | 1.38 | 1.38 | 1.61 | 0.11 | 0.17 | 0.05 | 0.02 |
| | | Min | 0.85 | 0.92 | 1.08 | 0.05 | 0.09 | 0.00 | 0.00 |
| | B | Average | 1.20 | 1.23 | 1.43 | 0.07 | 0.12 | 0.03 | 0.01 |
| | | Max | 1.48 | 1.60 | 1.76 | 0.09 | 0.18 | 0.08 | 0.04 |
| | | Min | 0.81 | 0.87 | 1.06 | 0.06 | 0.08 | 0.01 | 0.00 |
| March | A | Average | 1.22 | 1.16 | 1.40 | 0.09 | 0.10 | 0.02 | 0.01 |
| | | Max | 1.53 | 1.38 | 1.66 | 0.12 | 0.14 | 0.05 | 0.02 |
| | | Min | 0.95 | 0.28 | 0.99 | 0.07 | 0.07 | 0.01 | 0.00 |
| | B | Average | 1.13 | 1.15 | 1.37 | 0.08 | 0.09 | 0.02 | 0.01 |
| | | Max | 1.32 | 1.33 | 1.59 | 0.11 | 0.14 | 0.05 | 0.09 |
| | | Min | 0.91 | 0.91 | 1.02 | 0.06 | 0.01 | 0.00 | 0.01 |
| April | A | Average | 1.37 | 1.39 | 1.63 | 0.11 | 0.14 | 0.03 | 0.01 |
| | | Max | 2.15 | 2.36 | 2.70 | 0.36 | 0.44 | 0.09 | 0.02 |
| | | Min | 1.08 | 1.12 | 1.17 | 0.05 | 0.08 | 0.00 | 0.01 |
| | B | Average | 1.19 | 1.23 | 1.50 | 0.08 | 0.09 | 0.03 | 0.01 |
| | | Max | 1.61 | 1.63 | 1.91 | 0.11 | 0.12 | 0.06 | 0.02 |
| | | Min | 0.95 | 1.02 | 1.26 | 0.03 | 0.01 | 0.00 | 0.00 |
| May | A | Average | 1.32 | 1.29 | 1.54 | 0.06 | 0.10 | 0.02 | 0.01 |
| | | Max | 1.60 | 1.48 | 1.81 | 0.08 | 0.15 | 0.05 | 0.03 |
| | | Min | 0.98 | 0.98 | 1.24 | 0.05 | 0.08 | 0.01 | 0.01 |
| | B | Average | 1.25 | 1.24 | 1.58 | 0.14 | 0.12 | 0.02 | 0.01 |
| | | Max | 1.38 | 1.36 | 1.71 | 0.18 | 0.19 | 0.03 | 0.01 |
| | | Min | 1.06 | 1.01 | 1.31 | 0.09 | 0.08 | 0.01 | 0.01 |
| June | A | Average | 1.23 | 1.23 | 1.44 | 0.07 | 0.11 | 0.02 | 0.01 |
| | | Max | 1.45 | 1.44 | 1.71 | 0.10 | 0.19 | 0.05 | 0.03 |
| | | Min | 0.95 | 1.02 | 1.18 | 0.06 | 0.07 | 0.00 | 0.00 |
| | B | Average | 1.19 | 1.21 | 1.48 | 0.17 | 0.12 | 0.03 | 0.01 |
| | | Max | 1.59 | 1.58 | 1.93 | 1.37 | 0.20 | 0.05 | 0.02 |
| | | Min | 0.82 | 0.91 | 1.18 | 0.06 | 0.06 | 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 | 1.26 | 1.25 | 1.48 | 0.07 | 0.11 | 0.02 | 0.01 |
| | | Max | 1.80 | 1.74 | 1.99 | 0.11 | 0.14 | 0.06 | 0.03 |
| | | Min | 1.08 | 1.01 | 1.18 | 0.06 | 0.08 | 0.00 | 0.00 |
| | B | Average | 1.14 | 1.19 | 1.43 | 0.12 | 0.11 | 0.02 | 0.01 |
| | | Max | 1.45 | 1.40 | 1.69 | 0.19 | 0.16 | 0.07 | 0.02 |
| | | Min | 0.99 | 1.00 | 1.15 | 0.06 | 0.08 | 0.00 | 0.00 |
| August | A | Average | 1.24 | 1.22 | 1.47 | 0.08 | 0.12 | 0.02 | 0.01 |
| | | Max | 1.52 | 1.50 | 1.92 | 0.10 | 0.19 | 0.05 | 0.02 |
| | | Min | 1.01 | 0.89 | 1.04 | 0.06 | 0.09 | 0.00 | 0.00 |
| | B | Average | 1.13 | 1.15 | 1.42 | 0.08 | 0.11 | 0.03 | 0.01 |
| | | Max | 1.51 | 1.55 | 1.88 | 0.10 | 0.19 | 0.06 | 0.02 |
| | | Min | 0.97 | 0.96 | 1.00 | 0.06 | 0.01 | 0.00 | 0.00 |
| September | A | Average | 1.31 | 1.30 | 1.56 | 0.05 | 0.10 | 0.02 | 0.01 |
| | | Max | 1.53 | 1.48 | 1.93 | 0.07 | 0.17 | 0.07 | 0.03 |
| | | Min | 1.14 | 1.13 | 1.20 | 0.04 | 0.06 | 0.00 | 0.00 |
| | B | Average | 1.16 | 1.18 | 1.43 | 0.07 | 0.09 | 0.02 | 0.01 |
| | | Max | 1.39 | 1.46 | 1.90 | 0.12 | 0.16 | 0.05 | 0.02 |
| | | Min | 0.88 | 0.92 | 1.00 | 0.06 | 0.02 | 0.00 | 0.00 |
| October | A | Average | 1.33 | 1.30 | 1.55 | 0.04 | 0.09 | 0.02 | 0.01 |
| | | Max | 1.53 | 1.50 | 1.84 | 0.06 | 0.15 | 0.06 | 0.02 |
| | | Min | 1.17 | 1.16 | 1.39 | 0.04 | 0.06 | 0.00 | 0.00 |
| | B | Average | 1.22 | 1.20 | 1.44 | 0.05 | 0.09 | 0.02 | 0.01 |
| | | Max | 1.51 | 1.48 | 1.82 | 0.08 | 0.15 | 0.04 | 0.02 |
| | | Min | 0.93 | 0.94 | 1.20 | 0.01 | 0.07 | 0.01 | 0.00 |
| November | A | Average | 1.33 | 1.28 | 1.50 | 0.05 | 0.10 | 0.01 | 0.01 |
| | | Max | 1.54 | 1.48 | 1.81 | 0.07 | 0.19 | 0.03 | 0.04 |
| | | Min | 1.18 | 1.13 | 1.20 | 0.03 | 0.06 | 0.00 | 0.00 |
| | B | Average | 1.23 | 1.23 | 1.46 | 0.05 | 0.11 | 0.02 | 0.01 |
| | | Max | 1.42 | 1.42 | 1.73 | 0.06 | 0.19 | 0.05 | 0.04 |
| | | Min | 0.92 | 0.91 | 1.15 | 0.04 | 0.06 | 0.00 | 0.00 |
| December | A | Average | 1.29 | 1.25 | 1.45 | 0.05 | 0.09 | 0.02 | 0.01 |
| | | Max | 1.57 | 1.64 | 1.71 | 0.07 | 0.15 | 0.04 | 0.02 |
| | | Min | 1.14 | 1.03 | 1.25 | 0.05 | 0.05 | 0.00 | 0.00 |
| | B | Average | 1.15 | 1.16 | 1.39 | 0.06 | 0.09 | 0.02 | 0.01 |
| | | Max | 1.36 | 1.35 | 1.64 | 0.08 | 0.13 | 0.05 | 0.02 |
| | | Min | 0.88 | 0.90 | 1.08 | 0.05 | 0.06 | 0.00 | 0.00 |

| FEH WTP Summary | | | | | | | | | | |
|------------------|--------------|-----------------|-------------------------------------|---------------|---------------|---------------|-------------|---------|-------------|---------|
| Date | Raw Water | | Filter Effluent - Turbidities (NTU) | | | | Clearwell A | | Clearwell B | |
| | RATE (m3/hr) | TURBIDITY (NTU) | Filter A TURB | Filter B TURB | Filter C TURB | Filter D TURB | Turb (NTU) | Free Cl | Turb (NTU) | Free Cl |
| January | | | | | | | | | | |
| Average | 182 | 3.22 | 0.04 | 0.04 | 0.02 | 0.02 | 0.07 | 1.13 | 0.05 | 1.04 |
| Max | 200 | 4.40 | 0.23 | 0.43 | 0.03 | 0.02 | 0.15 | 1.58 | 0.11 | 1.34 |
| Min | 167 | 2.73 | 0.02 | 0.03 | 0.02 | 0.02 | 0.03 | 0.90 | 0.02 | 0.86 |
| February | | | | | | | | | | |
| Average | 188 | 3.33 | 0.05 | 0.04 | 0.03 | 0.03 | 0.05 | 1.24 | 0.06 | 1.08 |
| Max | 217 | 3.75 | 0.09 | 0.08 | 0.63 | 0.38 | 0.15 | 2.09 | 0.15 | 1.66 |
| Min | 171 | 2.80 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.94 | 0.04 | 0.76 |
| March | | | | | | | | | | |
| Average | 172 | 2.61 | 0.05 | 0.03 | Filter Off | Filter Off | 0.04 | 1.21 | 0.05 | 1.10 |
| Max | 207 | 3.25 | 1.81 | 0.85 | Filter Off | Filter Off | 0.32 | 1.92 | 0.34 | 1.75 |
| Min | 153 | 2.30 | 0.03 | 0.02 | Filter Off | Filter Off | 0.02 | 0.74 | 0.02 | 0.69 |
| April | | | | | | | | | | |
| Average | 196 | 12.71 | 0.04 | 0.05 | 0.03 | 0.04 | 0.04 | 1.09 | 0.04 | 1.05 |
| Max | 257 | 59.10 | 0.31 | 2.25 | 0.09 | 0.09 | 0.49 | 3.82 | 0.87 | 1.74 |
| Min | 174 | 2.90 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.66 | 0.02 | 0.56 |
| May | | | | | | | | | | |
| Average | 196 | 14.21 | 0.05 | 0.04 | 0.03 | 0.04 | 0.16 | 1.13 | 0.04 | 1.12 |
| Max | 320 | 45.38 | 0.68 | 0.19 | 0.08 | 0.07 | 5.00 | 5.00 | 1.30 | 2.24 |
| Min | 160 | 5.94 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.49 | 0.02 | 0.58 |
| June | | | | | | | | | | |
| Average | 220 | 95.69 | 0.06 | 0.05 | 0.04 | 0.05 | 0.06 | 1.01 | 0.06 | 1.07 |
| Max | 314 | 775.00 | 0.13 | 0.09 | 0.08 | 0.09 | 3.70 | 5.00 | 0.59 | 2.32 |
| Min | 148 | 9.25 | 0.03 | 0.03 | 0.02 | 0.03 | 0.02 | 0.37 | 0.02 | 0.30 |
| July | | | | | | | | | | |
| Average | 180 | 61.08 | 0.05 | 0.05 | 0.03 | 0.04 | 0.06 | 1.08 | 0.05 | 1.03 |
| Max | 244 | 158.00 | 0.19 | 0.10 | 0.07 | 0.07 | 2.47 | 2.42 | 1.44 | 1.98 |
| Min | 154 | 10.50 | 0.04 | 0.04 | 0.02 | 0.02 | 0.02 | 0.69 | 0.02 | 0.60 |
| August | | | | | | | | | | |
| Average | 254 | 11.30 | 0.06 | 0.06 | 0.04 | 0.04 | 0.05 | 1.12 | 0.05 | 1.08 |
| Max | 348 | 21.70 | 0.23 | 0.10 | 0.08 | 0.09 | 0.57 | 2.22 | 0.23 | 1.64 |
| Min | 152 | 7.76 | 0.03 | 0.04 | 0.02 | 0.03 | 0.02 | 0.67 | 0.02 | 0.69 |
| September | | | | | | | | | | |
| Average | 253 | 13.16 | 0.06 | 0.07 | 0.04 | 0.02 | 0.07 | 1.07 | 0.07 | 1.01 |
| Max | 352 | 32.40 | 0.14 | 0.90 | 0.09 | 0.06 | 2.40 | 3.81 | 0.31 | 1.52 |
| Min | 178 | 5.95 | 0.04 | 0.05 | 0.02 | 0.00 | 0.02 | 0.66 | 0.02 | 0.48 |
| October | | | | | | | | | | |
| Average | 255 | 4.65 | 0.06 | 0.06 | 0.03 | 0.03 | 0.06 | 1.19 | 0.06 | 1.21 |
| Max | 315 | 8.98 | 0.11 | 0.10 | 0.14 | 0.13 | 2.59 | 2.27 | 0.49 | 1.81 |
| Min | 184 | 3.02 | 0.03 | 0.03 | 0.02 | 0.01 | 0.02 | 0.40 | 0.02 | 0.38 |

| FEH WTP Summary Continued | | | | | | | | | | |
|---------------------------|--------------|-----------------|-------------------------------------|---------------|---------------|---------------|---------------|---------|---------------|---------|
| 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 |
| November | | | | | | | | | | |
| Average | 217 | 5.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.09 | 1.27 | 0.09 | 1.21 |
| Max | 272 | 10.50 | 0.34 | 0.39 | 0.07 | 0.09 | 0.21 | 2.35 | 0.23 | 1.62 |
| Min | 162 | 2.29 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.62 | 0.02 | 0.79 |
| December | | | | | | | | | | |
| Average | 210 | 3.63 | Filter Off | Filter Off | 0.03 | 0.03 | 0.08 | 1.08 | 0.06 | 1.12 |
| Max | 306 | 4.40 | Filter Off | Filter Off | 0.05 | 0.23 | 1.00 | 1.41 | 0.35 | 1.50 |
| Min | 190 | 3.08 | Filter Off | Filter Off | 0.02 | 0.02 | 0.02 | 0.80 | 0.02 | 0.74 |

| 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 | 21 | 0 | 0 | 0 | 0 | 0.18 |
| Fairview Heights | 48 | 0 | 0 | 0 | 0 | 0.25 |
| McIntosh Park | 50 | 0 | 0 | 0 | 0 | 0.20 |
| Downtown | 25 | 0 | 0 | 0 | 0 | 0.24 |
| College Heights | 14 | 0 | 0 | 0 | 0 | 0.32 |
| Yellow Sky | 73 | 0 | 0 | 0 | 0 | 0.16 |
| Riverview | 25 | 0 | 0 | 0 | 0 | 0.20 |
| Parsons Industrial Park | 24 | 0 | 0 | 0 | 0 | 0.15 |
| Other ¹ | 152 | 0 | 0 | 0 | 0 | 0.45 |
| Total Routine Samples | 280 | 0 | 0 | 0 | 0 | 0.24 |
| Total Other Samples² | 152 | 0 | 0 | 0 | 0 | 0.45 |

¹ These samples are not part of the routine sampling

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

² The two samples below chlorine guidelines was taken as part of filter maintenance and chlorine levels were as expected.

| Table 4 - General Chemical for WTP #1 | | | | |
|---------------------------------------|----------|---------|---------|---------|
| Parameter | Units | 6-Mar | 12-Sep | AO |
| | | Results | Results | |
| Bicarbonate | mg/L | 242 | 245 | |
| Calcium | mg/L | 69 | 70 | |
| Carbonate | mg/L | <1 | <1 | |
| Chloride | mg/L | 16 | 18 | 250 |
| Hydroxide | mg/L | <1 | <1 | |
| Magnesium | mg/L | 22 | 0.0025 | 200 |
| pH | pH Units | 7.47 | 7.81 | 6.5-9.0 |
| Potassium | mg/L | 1.7 | 2.4 | |
| Sodium | mg/L | 29 | 30 | 300 |
| E.C. | uS/cm | 600 | 645 | |
| Sulphate | mg/L | 110 | 120 | 500 |
| Sum of Ions | mg/L | 490 | 510 | |
| Total Alkalinity | mg/L | 198 | 201 | 500 |
| Total Hardness | mg/L | 262 | 273 | 800 |
| Nitrate | mg/L | <0.04 | <0.4 | |
| Fluoride | mg/L | 0.12 | 0.12 | 1.5 |
| TDS | mg/L | 393 | 382 | 1500 |

| Table 4 - General Chemical for FEH WTP#2 | | | | | | |
|--|----------|---------|---------|---------|---------|---------|
| Parameter | Units | 6-Mar | 13-Jun | 12-Sep | 21-Nov | AO |
| | | Results | Results | Results | Results | |
| Bicarbonate | mg/L | 171 | 167 | 139 | 150 | |
| Calcium | mg/L | 54 | 53 | 47 | 48 | |
| Carbonate | mg/L | <1 | <1 | <1 | <1 | |
| Chloride | mg/L | 23 | 30 | 28 | 18 | 250 |
| Hydroxide | mg/L | <1 | <1 | <1 | <1 | |
| Magnesium | mg/L | 17 | 18 | 14 | 15 | 200 |
| pH | pH Units | 7.51 | 7.82 | 7.69 | 7.78 | 6.5-9.0 |
| Potassium | mg/L | 1 | 3.1 | 1.9 | 1.4 | |
| Sodium | mg/L | 13 | 19 | 9.8 | 9.7 | 300 |
| E.C. | uS/cm | 458 | 512 | 410 | 408 | |
| Sulfate | mg/L | 65 | 78 | 53 | 55 | 500 |
| Sum of Ions | mg/L | 346 | 369 | 293 | 298 | |
| Total Alkalinity | mg/L | 140 | 137 | 114 | 123 | 500 |
| Total Hardness | mg/L | 204 | 206 | 175 | 181 | 800 |
| Nitrate | mg/L | 2.20 | 1.10 | <0.04 | 1.30 | 45* |
| Fluoride | mg/L | 0.08 | 0.11 | 0.08 | 0.1 | 1.5 |
| TDS | mg/L | 285 | 318 | 241 | 222 | 1500 |

*MAC based on Nitrate as NO₃

| Chemical Health for WTP #1 | | | | | | |
|----------------------------|-------|----------|----------|---------------|----------------|--------------|
| Parameter | Units | WTP#1 | WTP#1 | MAC (mg/L) | iMAC (mg/L) | AO (mg/L) |
| | | 6-Mar | 12-Sep | | | |
| Aluminum | mg/L | 0.0008 | <0.0005 | | | |
| Arsenic | ug/L | 0.5 | 0.1 | 0.01 | 0.025 | |
| Barium | mg/L | 0.12 | 0.095 | 1 | | |
| Boron | mg/L | 0.03 | 0.03 | | 5 | |
| Cadmium | mg/L | <0.00001 | <0.00001 | 0.005 | | |
| Chromium | mg/L | <0.0005 | <0.0005 | 0.05 | | |
| Copper | mg/L | <0.0002 | 0.0003 | | | |
| Iron | mg/L | 0.21 | 0.015 | | | 0.3 |
| Lead | mg/L | <0.0001 | <0.0001 | 0.01 | | |
| Manganese | mg/L | 0.047 | 0.0025 | | | 0.05 |
| Selenium | mg/L | <0.0001 | <0.0001 | 0.01 | | |
| Uranium | ug/L | 0.2 | 0.2 | 0.02 | | |
| Zinc | mg/L | 0.0007 | <0.0005 | | | 5 |

| Chemical Health for FEH | | | | | | | | |
|-------------------------|-------|---------|---------|---------|---------|---------------|----------------|--------------|
| Parameter | Units | WTP#2 | WTP#2 | WTP#2 | WTP#2 | MAC (mg/L) | iMAC (mg/L) | AO (mg/L) |
| | | 6-Mar | 13-Jun | 12-Sep | 21-Nov | | | |
| Aluminum | mg/L | 0.016 | 0.095 | 0.033 | 0.019 | | | |
| Arsenic | ug/L | <0.1 | 0.2 | 0.2 | 0.1 | 0.01 | 0.025 | |
| Barium | mg/L | 0.056 | 0.058 | 0.056 | 0.053 | 1 | | |
| Boron | mg/L | 0.02 | 0.02 | 0.02 | 0.02 | | 5 | |
| Cadmium | mg/L | 0.00001 | 0.00002 | 0.00001 | 0.00001 | 0.005 | | |
| Chromium | mg/L | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.05 | | |
| Copper | mg/L | 0.0007 | 0.001 | 0.001 | 0.0012 | | | |
| Iron | mg/L | 0.007 | 0.0007 | 0.0019 | 0.0011 | | | 0.3 |
| Lead | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.01 | | |
| Manganese | mg/L | 0.0053 | 0.0069 | <0.011 | 0.014 | | | 0.05 |
| Selenium | mg/L | 0.0003 | 0.0003 | 0.0003 | 0.0002 | 0.01 | | |
| Uranium | ug/L | 0.1 | 0.1 | <0.1 | 0.1 | 0.02 | | |
| Zinc | mg/L | 0.0015 | <0.0005 | 0.0007 | 0.0012 | | | 5 |

| Table 6 - Cyanide and Mercury for WTP #1 and FEH | | | | |
|--|-------|--------|--------|---------------|
| Parameter | Units | WTP#1 | WTP#2 | MAC (mg/L) |
| | | 13-Jun | 13-Jun | |
| Cyanide | ug/L | 1 | 2 | 0.2 |
| Mercury | ng/L | <1 | 1 | 0.001 |

| Crypto and Giardia | | | |
|-------------------------|--------------|-----------|-----------|
| Parameter | Units | Results | Results |
| | | 28-Mar-23 | 25-Aug-23 |
| Volume Filtered | L | 37.00 | 39.00 |
| Giardia cysts | cysts/100L | 45.90 | 3.10 |
| Cryptosporidium oocysts | oocysts/100L | 0.00 | 0.00 |

| Waste to Discharge - Chlorine Residual (mg/L) | | | |
|--|---------|---------------|----------------|
| Month | | WTP #1 | FEH WTP |
| January | Average | -0.001 | -0.001 |
| | Min | -0.020 | -0.010 |
| | Max | 0.012 | 0.010 |
| February | Average | -0.001 | 0.004 |
| | Min | -0.019 | -0.010 |
| | Max | 0.009 | 0.010 |
| March | Average | 0.000 | 0.004 |
| | Min | -0.019 | -0.010 |
| | Max | 0.007 | 0.010 |
| April | Average | -0.024 | 0.001 |
| | Min | -0.567 | -0.010 |
| | Max | 0.010 | 0.010 |
| May | Average | -0.001 | 0.002 |
| | Min | -0.010 | -0.010 |
| | Max | 0.009 | 0.020 |
| June | Average | -0.004 | 0.005 |
| | Min | -0.055 | -0.050 |
| | Max | 0.006 | 0.020 |
| July | Average | -0.001 | 0.006 |
| | Min | -0.027 | -0.010 |
| | Max | 0.011 | 0.020 |
| August | Average | -0.009 | 0.007 |
| | Min | -0.050 | -0.010 |
| | Max | 0.036 | 0.020 |
| September | Average | -0.005 | 0.004 |
| | Min | -0.051 | -0.020 |
| | Max | 0.014 | 0.020 |
| October | Average | -0.001 | 0.005 |
| | Min | -0.044 | -0.010 |
| | Max | 0.020 | 0.020 |
| November | Average | -0.001 | -0.001 |
| | Min | -0.027 | -0.010 |
| | Max | 0.017 | 0.010 |
| December | Average | -0.004 | -0.007 |
| | Min | -0.059 | -0.030 |
| | Max | 0.021 | 0.010 |

| Waste to Discharge - Aluminum | | | |
|-------------------------------|-------|---------|---------|
| Date | Units | Results | |
| | | WTP#1 | FEH WTP |
| 18-Jan-23 | mg/L | 0.003 | 3.540 |
| 14-Feb-23 | mg/L | 0.002 | 0.034 |
| 15-Mar-23 | mg/L | 0.002 | 1.510 |
| 19-Apr-23 | mg/L | 0.006 | 0.036 |
| 18-May-23 | mg/L | 0.002 | 0.640 |
| 21-Jun-23 | mg/L | 0.002 | 0.570 |
| 19-Jul-23 | mg/L | 0.003 | 0.800 |
| 16-Aug-23 | mg/L | 0.004 | 0.079 |
| 13-Sep-23 | mg/L | 0.002 | 0.038 |
| 18-Oct-23 | mg/L | 0.002 | 0.210 |
| 22-Nov-23 | mg/L | 0.001 | 0.029 |
| 20-Dec-23 | mg/L | 0.002 | 0.041 |

| Waste to Discharge - pH | | | |
|-------------------------|---------|--------|---------|
| Month | | WTP #1 | FEH WTP |
| January | Average | 7.038 | 7.57 |
| | Min | 6.010 | 7.08 |
| | Max | 7.790 | 7.76 |
| February | Average | 7.415 | 7.16 |
| | Min | 7.080 | 6.96 |
| | Max | 7.600 | 7.67 |
| March | Average | 7.415 | 7.49 |
| | Min | 7.080 | 7.17 |
| | Max | 7.600 | 7.66 |
| April | Average | 7.480 | 7.77 |
| | Min | 7.250 | 7.20 |
| | Max | 7.710 | 8.43 |
| May | Average | 6.728 | 7.54 |
| | Min | 6.290 | 7.03 |
| | Max | 7.380 | 8.27 |
| June | Average | 7.513 | 7.31 |
| | Min | 7.340 | 7.08 |
| | Max | 7.690 | 7.79 |
| July | Average | 7.485 | 7.29 |
| | Min | 7.360 | 7.03 |
| | Max | 7.690 | 7.53 |
| August | Average | 7.558 | 7.61 |
| | Min | 7.470 | 6.78 |
| | Max | 7.630 | 8.55 |
| September | Average | 7.578 | 7.05 |
| | Min | 7.170 | 6.73 |
| | Max | 7.910 | 7.27 |
| October | Average | 7.768 | 7.18 |
| | Min | 7.500 | 6.88 |
| | Max | 7.930 | 7.38 |
| November | Average | 7.546 | 6.85 |
| | Min | 7.160 | 6.29 |
| | Max | 7.970 | 7.34 |
| December | Average | 7.633 | 7.03 |
| | Min | 7.400 | 6.62 |
| | Max | 8.010 | 7.44 |

| Waste to Discharge - Dissolved Oxygen (mg/L) | | | |
|---|---------|---------------|----------------|
| Month | | WTP #1 | FEH WTP |
| January | Average | 8.328 | 10.62 |
| | Min | 7.460 | 9.45 |
| | Max | 9.920 | 11.53 |
| February | Average | 8.563 | 9.48 |
| | Min | 6.060 | 8.63 |
| | Max | 9.660 | 10.22 |
| March | Average | 7.702 | 10.48 |
| | Min | 6.620 | 9.51 |
| | Max | 9.750 | 11.13 |
| April | Average | 9.445 | 10.30 |
| | Min | 8.890 | 9.98 |
| | Max | 10.160 | 11.08 |
| May | Average | 6.978 | 8.82 |
| | Min | 6.350 | 7.88 |
| | Max | 7.480 | 9.84 |
| June | Average | 7.408 | 8.22 |
| | Min | 6.780 | 7.79 |
| | Max | 8.250 | 8.68 |
| July | Average | 8.193 | 7.83 |
| | Min | 5.990 | 7.14 |
| | Max | 9.880 | 8.46 |
| August | Average | 8.670 | 7.80 |
| | Min | 6.680 | 7.34 |
| | Max | 10.590 | 8.22 |
| September | Average | 7.878 | 8.53 |
| | Min | 4.700 | 7.98 |
| | Max | 10.720 | 8.97 |
| October | Average | 9.070 | 9.43 |
| | Min | 6.220 | 8.42 |
| | Max | 10.610 | 10.41 |
| November | Average | 6.440 | 10.48 |
| | Min | 5.770 | 8.01 |
| | Max | 6.990 | 12.07 |
| December | Average | 5.220 | 12.30 |
| | Min | 5.010 | 12.14 |
| | Max | 5.380 | 12.46 |

| Waste to Discharge - TSS (mg/L) | | | |
|---------------------------------|-------|---------------|---------------|
| Date | Units | Results | |
| | | WTP#1 | FEH WTP |
| 18-Jan-23 | mg/L | 9.500 | 26.500 |
| 14-Feb-23 | mg/L | 4.500 | 0.670 |
| 15-Mar-23 | mg/L | 3.130 | 0.380 |
| Apr-23 | mg/L | Missed Sample | Missed Sample |
| May-23 | mg/L | Missed Sample | Missed Sample |
| 21-Jun-23 | mg/L | 9.125 | 4.125 |
| 19-Jul-23 | mg/L | 5.500 | 9.500 |
| 16-Aug-23 | mg/L | 44.000 | 3.000 |
| 13-Sep-23 | mg/L | 5.250 | 2.000 |
| 18-Oct-23 | mg/L | 4.500 | 2.250 |
| 22-Nov-23 | mg/L | 7.000 | 1.630 |
| 20-Dec-23 | mg/L | 2.750 | 0.125 |

| Waste to Discharge - Acute Lethality | | | | | |
|--|---------|------|-------|---------|-------|
| Parameter | Species | Unit | 4-Oct | | Limit |
| | | | WTP#1 | FEH WTP | |
| Acute (96 hr LC ₅₀ - survival) | Trout | % | >100 | >100 | >50 |

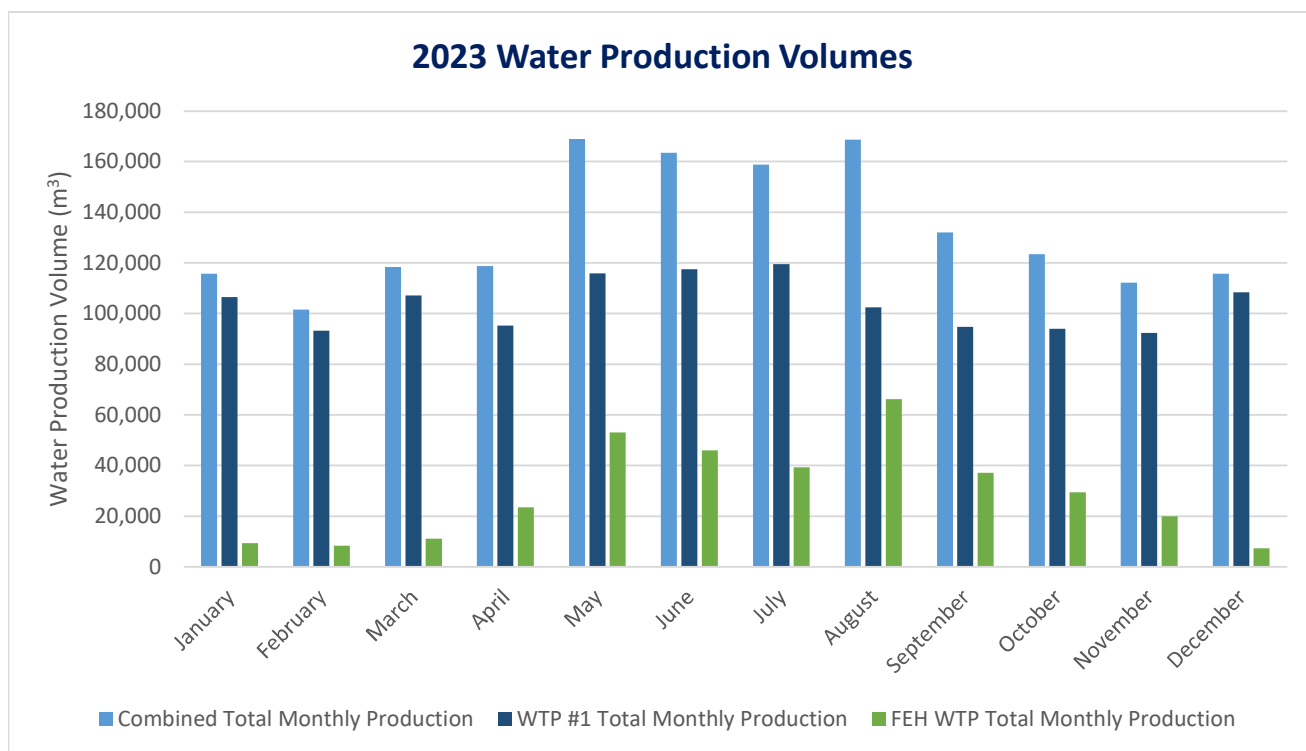
| Table 14 - Pesticides | | | | | |
|---------------------------|-------|--------|--------|---------------|----------------|
| Parameter | Units | WTP#1 | WTP#2 | MAC (mg/L) | iMAC (mg/L) |
| | | 28-Nov | 28-Nov | | |
| Atrazine | µg/L | <0.2 | <0.2 | | 0.005 |
| Bromoxynil(Buctril) | µg/L | <2 | <2 | | 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 | |
| MCPA | µg/L | <1 | <1 | 0.1 | |
| Pentachlorophenol(PCP) | µg/L | <2 | <2 | 0.06 | |
| Picloram(Tordon) | µg/L | <1 | <1 | | 0.19 |
| Trifluralin(Treflan) | µg/L | <0.2 | <0.2 | | 0.045 |

| Table 10 - Organics | | | | | | |
|----------------------------------|-------|----------|--------|---------------|----------------|--------------|
| Parameter | Units | WTP#1 | WTP#2 | MAC (mg/L) | iMAC (mg/L) | AO (mg/L) |
| | | 28-Nov | 28-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 | | |
| Perfluorooctane Sulfonate (PFOS) | µg/L | *<0.0010 | | 0.0006 | | |
| Perfluorooctanoic Acid (PFOA) | µg/L | *<0.0010 | | 0.0002 | | |
| 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 | | |

*Samples for PFOS/PFOA requires separate sampling from a different lab, a lab error was made on the first set of samples taken on December 20, 2023, the samples needed to be retaken, the second set of samples were taken on January 2, 2024.

City of North Battleford
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Appendix C: Water Production Volumes

| 2023 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 | 106,429 | 3,433 | 9,312 | 300 | 115,741 | 3,734 |
| February | 93,175 | 3,328 | 8,361 | 299 | 101,536 | 3,626 |
| March | 107,146 | 3,456 | 11,168 | 360 | 118,314 | 3,817 |
| April | 95,274 | 3,176 | 23,472 | 782 | 118,746 | 3,958 |
| May | 115,836 | 3,737 | 53,092 | 1,713 | 168,928 | 5,449 |
| June | 117,480 | 3,916 | 46,028 | 1,534 | 163,508 | 5,450 |
| July | 119,495 | 3,855 | 39,331 | 1,269 | 158,826 | 5,123 |
| August | 102,452 | 3,305 | 66,246 | 2,137 | 168,698 | 5,442 |
| September | 94,799 | 3,160 | 37,148 | 1,238 | 131,947 | 4,398 |
| October | 93,927 | 3,030 | 29,481 | 951 | 123,408 | 3,981 |
| November | 92,279 | 3,076 | 19,923 | 664 | 112,202 | 3,740 |
| December | 108,410 | 3,497 | 7,265 | 234 | 115,675 | 3,731 |
| Yearly Total | 1,246,702 | 3,414 | 350,827 | 957 | 1,597,529 | 4,371 |



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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)