Annual Report

Balmertown, Cochenour & McKenzie Island Drinking Water System

2022

Prepared by **Northern Waterworks Inc.**
on behalf of the **Municipality of Red Lake**

NORTHERN WATERWORKS INC.

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Contents

1 Introduction

1.1 Annual Reporting Requirements

This consolidated Annual Report (the Report) has been prepared in accordance with both section 11 (Annual Reports) and Schedule 22 (Summary Reports for Municipalities) of Ontario Regulation 170/03 (Drinking Water Systems Regulation). This Report is intended to inform both the public and Municipal Council about the operation of the system over the previous calendar year (January 1 to December 31, 2022).

Section 11 of O. Reg. 170/03 requires the development and distribution to the public of an annual report summarizing water quality monitoring results, adverse water quality incidents, system expenses and chemicals used in the water treatment process.

Schedule 22 of O. Reg. 170/03 requires the development and distribution to Council of an annual report summarizing incidents of regulatory non-compliance and associated corrective actions, in addition to providing flow monitoring results for the purpose of enabling the Owner to assess the capability of the system to meet existing and planned demand.

1.2 Report Availability

In accordance with section 11 of O. Reg. 170/03, this Report must be given, without charge, to every person who requests a copy. Effective steps must also be taken to advise users of water from the system that copies of the report are available, without charge, and of how a copy may be obtained. This Annual Report shall be made available for inspection by the public at the Red Lake Municipal Office and on the Municipality's website.

In accordance with Schedule 22 of O. Reg. 170/03, this Report must be given to the members of Municipal Council. Section 19 (Standard of care, municipal drinking-water system) of Ontario's *Safe Drinking Water Act* (SDWA) also places certain responsibilities upon those municipal officials who oversee an accredited operating authority or exercise decision-making authority over a system. The examination of this Report is one of the methods by which municipal officials may fulfil the obligations required by section 19 of the SDWA.

System users and members of Council should contact a representative of NWI for assistance in interpreting this Report. Questions and comments may be directed to the local NWI Operations Manager or by email to compliance@nwi.ca.

2 System Overview & Expenses

2.1 System Description

The Balmertown, Cochenour & McKenzie Island (BCMI) Drinking Water System must meet extensive treatment and testing requirements to ensure that human health is protected. The operation and maintenance of the system is governed by Ontario's *Safe Drinking Water Act* and the regulations therein, in addition to requirements within system-specific environmental approvals. Important system information is summarized in Table 1.

Table 1: System information

Drinking-Water System Name:	Balmertown, Cochenour & McKenzie Island (BCMI) Drinking Water System
DWS Number:	210000522
DWS Category:	Large Municipal Residential
DWS Owner:	The Corporation of the Municipality of Red Lake
DWS Operating Authority:	Northern Waterworks Inc.
DWS Components:	• Raw water pumping station • Cochenour Water Treatment Plant • Balmertown Reservoir Pumping Station • Cochenour & McKenzie Island water distribution system • Balmertown water distribution system
Treatment Processes:	• Chemical coagulation, flocculation and clarification • Dual media (rapid sand) filtration • Free chlorine disinfection • pH adjustment

Water production begins as raw water flows by gravity from the intake structure located in Bruce Channel (Red Lake) and into an underground reservoir located at the raw water pumping station. Pumps at the station transfer water from the reservoir and through a transmission line directly to the treatment units at the Cochenour Water Treatment Plant. Aluminum sulphate (coagulant) and sodium carbonate solution (pH/alkalinity adjustment) are injected and rapidly mixed into the raw water immediately upstream from the three package treatment units, which each include a two-stage flocculation tank, clarifier and filter.

To promote floc formation water is gently mixed as it passes through the flocculation basins. Polymer solution (flocculant) is also added to the water at this stage of treatment to form larger and more stable floc aggregates. Process water then enters the clarifier where its velocity is reduced to allow for the separation and settling of floc. Supernatant overflows into the clarifier effluent launders and is directed to the filter unit; settled floc (sludge) is automatically removed from the bottom of the clarifier.

Impurities that were not captured and settled as floc in the clarifier are removed by passing water through a dual media filter composed of anthracite and silica sand. Chlorine gas (disinfectant) and sodium carbonate solution are added to the filtrate as it is directed from the filters to the treated water storage reservoir. The filters are periodically cleaned by using an air scour to agitate the entire media bed and reversing the flow of water through the filter.

A majority of the water produced is transferred through a transmission line from the Cochenour Water Treatment Plant (WTP) to the reservoir at the Balmertown Reservoir Pumping Station (RPS). Primary disinfection is achieved as disinfectant mixes with the water in the reservoirs at both facilities. Pumps located at the Balmertown RPS and Cochenour WTP then transfer treated water from the facility reservoirs to the Balmertown and Cochenour/McKenzie Island water distribution systems, respectively. Secondary disinfection requirements in the distribution systems are achieved by maintaining a free chlorine residual at all locations.

2.2 Water Treatment Chemicals

In accordance with section 11 of O. Reg. 170/03, this Report must include a list of all water treatment chemicals used by the system during the period covered by the report (summarized in Table 2). All chemicals used in the treatment process are NSF/ANSI 60 certified for use in potable water, as required by system approvals.

Table 2: Water treatment chemicals used in 2022

Treatment Chemical	Application
aluminum sulphate	coagulant
sodium carbonate	pH/alkalinity adjustment
polymer (Polyfloc CP1160P)	flocculant
chlorine gas	disinfectant

2.3 System Expenses

In accordance with section 11 of O. Reg. 170/03, this Report must describe any major expenses incurred during the reporting period to install, repair, or replace required equipment. This Report also summarizes those expenses related to strengthening equipment inventories and to maintenance activities undertaken by subcontracted service providers. Major expenses incurred in 2022 are summarized in Table 3.

Table 3: Major expenses incurred in 2022

Category	Description	Expense
Inventory	Industrial Shelving	$10,000
Maintenance/Repairs/Inventory	Heating	$9,300
Maintenance/Repairs	SCADA PLC programming and upgrades	$9,000
Replace/Upgrade	Videographic Chart Recorder	$6,190
Inventory/Replace	Post Soda Metering Pump	$6,000
Maintenance	Generator Tri-Annual Load Testing and Servicing	$3290
Maintenance	Flow meter calibration verifications	$1,500
Maintenance/Repairs	Lighting	$1,500
Inventory/Replace	Assorted tools	$1,000
Maintenance	Backflow prevention device inspection and testing	$800

3 Water Quality

3.1 Overview

Water quality monitoring is conducted to determine and confirm that drinking water delivered to the consumer is safe and aesthetically pleasing. Monitoring is also required to assess compliance with legislation and to control the treatment process. In accordance with section 11 of O. Reg. 170/03, this Report must summarize the results of water quality tests required by regulations, approvals, and orders. The following sections summarize the results of all required water quality tests and compare the results to applicable water quality standards.

3.2 Microbiological Parameters

Microbiological sampling and testing requirements are provided in Schedule 10 (Microbiological sampling and testing) of O. Reg. 170/03. In 2022, a total of 311 routine source, treated and distribution water samples were collected for microbiological analysis by an accredited laboratory. Samples were collected on a weekly basis and included tests for E. coli (EC), total coliforms (TC) and heterotrophic plate counts (HPC). Results from microbiological analyses are summarized in Table 4. All results were below the associated Ontario Drinking Water Quality Standards.

Table 4: Results summary for microbiological parameters

Sample Type	# of Samples	EC Results Range[1] (MPN/ 100mL)	TC Results Range[1] (MPN/ 100mL)	# of HPC Samples	HPC Results Range (CFU/mL)
Raw Water	52	0 to 4	0 to 1300	---	---
Treated Water (CWTP)	52	absent	absent	52	0 to 1
Balmertown (BRPS)	51	absent	absent	51	0 to 3
Treated Water (CWTP non routine)	4	absent	absent	---	---
Distribution (routine)	156	absent	absent	53	0 to > 10
Distribution (nonroutine)	19	absent	absent	---	---

1. The Ontario Drinking Water Quality Standard for E. Coli and Total Coliforms in a treated or distribution sample is 'not detectable'. The presence of either parameter in a treated or distribution sample constitutes an exceedance.

3.3 Operational Parameters

In accordance with Schedule 7 (Operational checks) of O. Reg. 170/03, regulated operational parameters that must be monitored include raw water turbidity, filtrate turbidity and the free chlorine residuals associated with primary and secondary disinfection. Table 5 summarizes water quality results for regulated and selected unregulated operational parameters. In accordance with Schedule 6 (Operational checks, sampling, and testing – general) of O. Reg. 170/03, certain operational parameters are continuously monitored. No Adverse Water Quality Incidents (AWQIs) pertaining to operational parameters occurred during the reporting period.

Table 5: Results summary for operational parameters

Parameter (Sample Type)[1]	Number of Samples	Units	Min. Result	Max. Result	Annual Avg.	Adverse Result
Turbidity (Raw Water)	83	NTU	0.47	3.64	1.11	n/a
Turbidity (Filter 1)	Continuous	NTU	0.035	0.520	0.104	>1.0
Turbidity (Filter 2)	Continuous	NTU	0.040	0.320	0.089	>1.0
Turbidity (Filter 3)	Continuous	NTU	0.037	0.690	0.115	>1.0
Turbidity (Treated)	365	NTU	0.05	0.25	0.13	n/a
pH (Treated)	365	---	6.5	8.3	7.4	n/a
Alkalinity (Treated)	243	mg/L	23	64	47	n/a
Aluminum Residual (Treated)	237	mg/L	0.020	0.089	0.041	n/a
FCR (Treated - CWTP)[2]	Continuous	mg/L	0.85	3.64	1.93	n/a
FCR (Treated - BRPS)[2]	Continuous	mg/L	0.63	2.15	1.53	n/a
FCR (CMI Distribution)[3]	350+	mg/L	0.68	2.16	n/a	<0.05
FCR (Balm. Distribution)[3]	400+	mg/L	0.72	2.05	n/a	<0.05

1. FCR = free chlorine residual; CMI = Cochenour & McKenzie Island; Balm. = Balmertown.
2. There is no adverse result corresponding to the treated water free chlorine residual. However, an observation of adverse water quality occurs if the residual is low enough such that water has not been disinfected in accordance with the system's *Municipal Drinking Water Licence*.
3. Free chlorine residuals are tested at various locations in the distribution systems. The free chlorine residual varies with water age and distribution system location, and the values in the table pertain to the minimum and maximum results collected across all locations in the calendar year.

3.4 Conventional Filtration Performance

In accordance with the system's *Municipal Drinking Water Licence*, conventional filtration facilities must meet certain performance criteria in order to claim removal credits for Cryptosporidium oocysts and Giardia cysts. In addition to continuously monitoring filtrate turbidity and other requirements, filtrate turbidity must be less than or equal to 0.3 NTU in at least 95% of the measurements each month. Table 6 summarizes filtrate turbidity compliance against the <0.3 NTU/95% performance criterion. Minimum and maximum values in the table correspond to the proportion of time that filtered water turbidity was less than or equal to 0.3 NTU in a calendar month in 2022. No AWQIs related to conventional filtration performance occurred during the reporting period.

Table 6: Filtration performance summary

Filter	Minimum Result	Maximum Result	Adverse Result
Filter 1	100%	100%	<95%
Filter 2	100%	100%	<95%
Filter 3	100%	100%	<95%

3.5 Nitrate & Nitrite

Treated water is tested for nitrate and nitrite concentrations on a quarterly basis in accordance with Schedule 13 (Chemical sampling and testing) of O. Reg. 170/03. Nitrate and nitrite results are provided in Table 7. All results were below the Ontario Drinking Water Quality Standards.

Table 7: Nitrate and nitrite results

Sample Date	Nitrate		Nitrite	
	Result (mg/L)	ODWQS (mg/L)	Result (mg/L)	ODWQS (mg/L)
16-Feb-2022	0.147	10	<0.010	1
16-May-2022	0.112		<0.010	
16-Aug-2022	<0.020		<0.010	
14-Nov-2022	0.063		<0.010	

3.6 Trihalomethanes & Haloacetic Acids

Trihalomethanes (THMs) and haloacetic acids (HAAs) are sampled on a quarterly basis from a distribution system location that is likely to have an elevated potential for their formation, in accordance with Schedule 13 (Chemical sampling and testing) of O. Reg. 170/03. Total THM and HAA results are provided in Table 8 and Table 9, respectively. Compliance with the provincial standards for trihalomethane and haloacetic acid concentrations is determined by calculating a running annual average (RAA). The 2022 RAA for THMs were below the Ontario Drinking Water Quality Standards. The 2022 RAA for HAAs exceeded the Ontario Drinking Water Quality Standards and is associated with AWQI #161078. Refer to the *Compliance* section of this report for more details.

Table 8: Total THM results

Sample Date	Result (µg/L)
16-Feb-2022	61.6
16-May-2022	59.0
16-Aug-2022	86.2
14-Nov-2022	60.5
---	---
Regulatory Average (RAA)	66.8
ODWQS (RAA)	100

Table 9: Total HAA results

Sample Date	Result (µg/L)
16-Feb-2022	66.3
16-May-2022	71.8
16-Aug-2022	110
14-Nov-2022	84.6
05-Dec-2022	69.5
Regulatory Average (RAA)	81.3
ODWQS (RAA)	80

3.7 Lead Sampling

Based upon favourable sampling results in the community, the BCMI DWS previously qualified for reduced lead sampling and ultimately became exempt from sampling at plumbing locations in accordance with Schedule 15.1 (Lead) of O. Reg. 170/03. Four (4) distribution system samples must now be collected every year and analyzed for pH and alkalinity. Additionally, these distribution system samples must be analyzed for lead in every third 12-month period after the plumbing sample exemption was activated. Table 10 summarizes the results of community lead sampling and related required tests.

Table 10: Distribution pH, alkalinity, and lead sampling results

Sample Date	Distribution Sampling Location	pH	Alkalinity (mg/L)	Lead Result (µg/L)	Lead ODWQS (µg/L)
05-Apr-2022	McMarmac Bleeder	7.40	46.2	---	10
05-Apr-2022	Balmertown Waste Plant	7.50	49.6	---	
06-Sep-2022	Balmertown Waste Plant	7.28	50.6	---	
06-Sep-2022	McMarmac Bleeder	7.27	43.3	---	

1. Lead will next be tested in distribution samples during the Winter 2024 sampling period.

3.8 Environmental Discharge Sampling

The *Municipal Drinking Water Licence* for the BCMI Drinking Water System requires additional sampling associated with discharges to the natural environment. Specifically, samples must be collected from settling tank effluent on a monthly basis and tested for the parameter total suspended solids (TSS). This effluent is discharged to Bruce Channel and originates from the onsite treatment of the wastewater produced during plant operation. The *Licence* also requires that the effluent discharged to the environment has an annual average TSS concentration below 25 mg/L. Table 11 summarizes 2022 environmental discharge sampling results.

Table 11: Environmental discharge sampling results summary

Number of Samples	Minimum TSS Result (mg/L)	Maximum TSS Result (mg/L)	TSS Annual Average (mg/L)
12	<3.0	34.8	11.1

3.9 Inorganic & Organic Parameters

Most inorganic parameters are sampled on an annual basis in treated water in accordance with Schedules 13 (Chemical sampling and testing) and 23 (Inorganic parameters) of O. Reg. 170/03. The inorganic parameters sodium and fluoride are sampled every five (5) years in treated water in accordance with Schedules 13 and 23 of O. Reg. 170/03. The most recent inorganic parameter sampling results are provided in Table 12. All results were below the associated Ontario Drinking Water Quality Standards.

Table 12: Inorganic parameter sampling results

Parameter	Most Recent Sample Date	Units	Result	ODWQS
Antimony	16-Aug-2022	µg/L	<0.60	6
Arsenic	16-Aug-2022	µg/L	<1.0	10
Barium	16-Aug-2022	µg/L	<10	1000
Boron	16-Aug-2022	µg/L	<50	5000
Cadmium	16-Aug-2022	µg/L	<0.10	5
Chromium	16-Aug-2022	µg/L	<1.0	50
Fluoride	15-Feb-2018	mg/L	0.028	1.5
Mercury	16-Aug-2022	µg/L	<0.10	1
Selenium	16-Aug-2022	µg/L	<1.0	50
Sodium	16-Aug-2022	mg/L	25.2[1]	20
Uranium	16-Aug-2022	µg/L	<2.0	20

1. The parameter sodium is not considered a toxic element and is not associated with a Standard as prescribed in O. Reg. 169/03, although an exceedance of 20 mg/L requires reporting and corrective actions. The result in the table was reported as an Adverse Water Quality Incident. See the *Compliance* section of this report for more information.

Organic parameters are sampled on an annual basis in treated water in accordance with Schedules 13 (Chemical sampling and testing) and 24 (Organic parameters) of O. Reg. 170/03. These parameters include various organic acids, pesticides, herbicides, PCBs, volatile organics, and other chemicals. Sampling for all organic parameters was conducted on August 26, 2022, total PCBs was collected September 6, 2022, and results are provided in Table 13. All results were below the associated Ontario Drinking Water Quality Standards.

Table 13: Organic parameter sampling results

Parameter	Result (µg/L)	ODWQS (µg/L)	Parameter	Result (µg/L)	ODWQS (µg/L)
Alachlor	<0.10	5	Diuron	<1.0	150
Atrazine & Metabolites	<0.20	5	Glyphosate	<5.0	280
Azinphos-methyl	<0.10	20	Malathion	<0.10	190
Benzene	<0.50	1	MCPA	<0.20	100
Benzo(a)pyrene	<0.005	0.01	Metolachlor	<0.10	50
Bromoxynil	<0.20	5	Metribuzin	<0.10	80
Carbaryl	<0.20	90	Monochlorobenzene	<0.50	80
Carbofuran	<0.20	90	Paraquat	<1.0	10
Carbon Tetrachloride	<0.20	2	Pentachlorophenol	<0.50	60
Chlorpyrifos	<0.10	90	Phorate	<0.10	2
Diazinon	<0.10	20	Picloram	<0.20	190
Dicamba	<0.20	120	Total PCBs	<0.035	3
1,2-Dichlorobenzene	<0.50	200	Prometryne	<0.10	1
1,4-Dichlorobenzene	<0.50	5	Simazine	<0.10	10
1,2-Dichloroethane	<0.50	5	Terbufos	<0.20	1
1,1-Dichloroethylene	<0.50	14	Tetrachloroethylene	<0.50	10
Dichloromethane	<5.0	50	2,3,4,6-Tetrachlorophenol	<0.50	100
2,4-Dichlorophenol	<0.30	900	Triallate	<0.10	230
2,4-D	<0.20	100	Trichloroethylene	<0.50	5
Diclofop-methyl	<0.20	9	2,4,6-Trichlorophenol	<0.50	5
Dimethoate	<0.10	20	Trifluralin	<0.10	45
Diquat	<1.0	70	Vinyl Chloride	<0.20	1

4 Water Production

4.1 Overview

In accordance with Schedule 22 (Summary Reports for Municipalities) of O. Reg. 170/03, this Annual Report must include certain information for the purpose of enabling the Owner to assess the capability of the system to meet existing and planned uses. Specifically, this Report must include a summary of the quantities and flow rates of the water supplied during the reporting period, including monthly average and maximum daily flows. The Report must also include a comparison of flow monitoring results to the rated capacity and flow rates approved in the system's *Municipal Drinking Water Licence*.

4.2 Flow Monitoring Results

Throughout the reporting period the BCMI DWS operated within its rated capacity and supplied a total of 376,897 m^3 of treated water. On an average day in 2022, 1,033 m^3 of treated water was supplied to the communities of Balmertown, Cochenour & McKenzie Island, which represents 17% of the rated capacity of the Cochenour Water Treatment Plant (6,065 m^3/day). The maximum daily flow in 2022 was 2,201 m^3/day, which represents 36% of the rated capacity of the treatment facility. Flow monitoring results are summarized in Figure 1 and Table 14. The capacity assessments provided in the table compare the average and maximum daily treated water flows to the rated capacity of the treatment facility.

Figure 1: 2022 average and maximum daily treated water flows

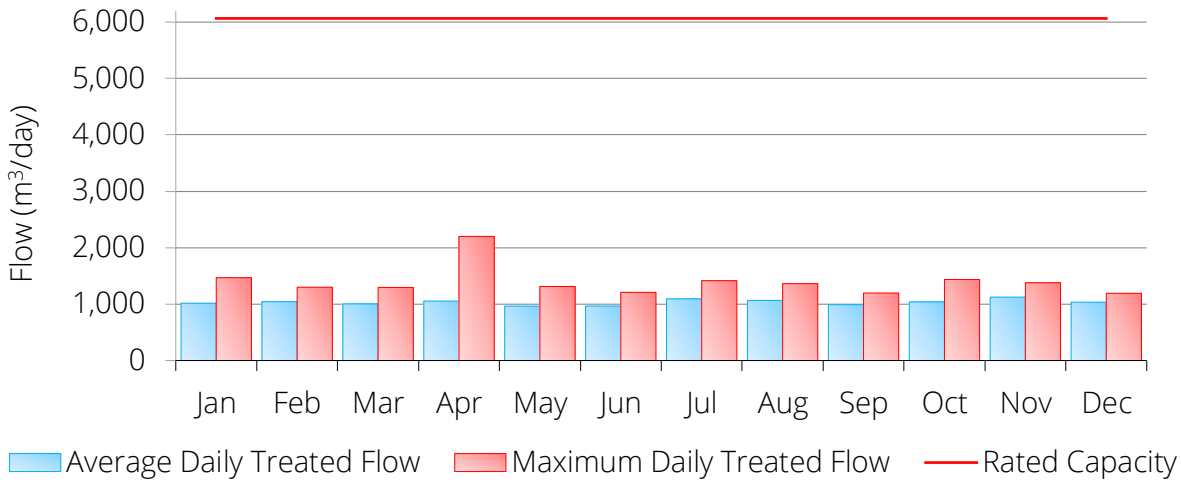


Table 14: 2022 water production summary

Month	Total Volumes (m^3)		Daily Flows (m^3/day)		Capacity Assessments	
	Raw Water	Treated Water	Average - Treated	Maximum - Treated	Average - Treated	Maximum - Treated
Jan	35,600	31,507	1,016	1,468	17%	24%
Feb	35,069	29,213	1,043	1,300	17%	21%
Mar	38,259	31,115	1,004	1,296	17%	21%
Apr	36,758	31,620	1,054	2,201	17%	36%
May	34,302	29,923	965	1,313	16%	22%
Jun	33,446	28,979	966	1,210	16%	20%
Jul	38,952	33,862	1,092	1,415	18%	23%
Aug	38,414	33,035	1,066	1,363	18%	22%
Sep	33,930	29,696	990	1,197	16%	20%
Oct	37,072	32,166	1,038	1,436	17%	24%
Nov	39,718	33,728	1,124	1,379	19%	23%
Dec	37,140	32,053	1,034	1,192	17%	20%
Total	438,660	376,897	---	---	---	---
Average	36,555	31,408	1,033	---	17%	---

Over the reporting period, 67% (252,813 m^3) of the total amount of treated water produced was distributed to the community of Balmertown, with the remaining 33% (124,084 m^3) being distributed to the communities of Cochenour and McKenzie Island. On an average day in 2022, 693 m^3 of treated water was supplied to Balmertown and 340 m^3 was supplied to Cochenour & McKenzie Island. Table 15 provides a summary of flow monitoring results organized by the respective water distribution systems.

Table 15: 2022 water production summary – results by water distribution system

Month	Balmertown			Cochenour & McKenzie Island		
	Total Volume (m^3)	Average Daily Flow (m^3/day)	Proportion of Total (%)	Total Volume (m^3)	Average Daily Flow (m^3/day)	Proportion of Total (%)
Jan	22,610	729	72%	8,897	287	28%
Feb	20,797	743	71%	8,416	301	29%
Mar	21,485	693	69%	9,630	311	31%
Apr	19,715	657	62%	11,905	397	38%
May	20,140	650	67%	9,783	316	33%
Jun	19,607	654	68%	9,372	312	32%
Jul	24,220	781	72%	9,642	311	28%
Aug	23,387	754	71%	9,648	311	29%
Sep	20,439	681	69%	9,257	309	31%
Oct	20,503	661	64%	11,663	376	36%
Nov	19,842	661	59%	13,886	463	41%
Dec	20,068	647	63%	11,985	387	37%
Total	252,813	---	---	124,084	---	---
Average	21,068	693	67%	10,340	296	33%

4.3 Recent Historical Flows

Table 16 summarizes recent historical flow monitoring results for the BCMI DWS. There was a moderate decrease in the volume treated water supplied in 2022 when compared to 2021, and flows have generally remained stable over the previous decade. Total annual volumes of treated water supplied in the near future may be expected to be between 300,000 m^3 and 450,000 m^3, which represents approximately 14% to 20% of the rated capacity of the Cochenour Water Treatment Plant.

Table 16: Recent historical water production summary

Year	Total Volumes (m^3)		Daily Flows (m^3/day)		Annual % Change	
	Raw Water	Treated Water	Average – Treated Water	Maximum – Treated Water	Raw Water	Treated Water
2009	481,351	406,151	1,113	2,007	-13.8%	-9.3%
2010	515,274	424,549	1,163	2,232	+7.0%	+4.5%
2011	471,032	409,384	1,122	2,240	-8.6%	-3.6%
2012	439,530	389,828	1,065	2,007	-6.7%	-4.8%
2013	443,266	408,492	1,119	2,369	+0.8%	+4.8%
2014	412,234	360,120	987	2,061	-7.0%	-11.8%
2015	439,868	390,982	1,071	1,878	+6.7%	+8.6%
2016	419,949	337,245	921	1,557	-4.5%	-13.7%
2017	436,670	341,391	935	2,015	+4.0%	+1.2%
2018	425,326	358,995	984	1,947	-2.6%	+5.2%
2019	422,149	363,215	995	1,874	-0.7%	+1.2%
2020	473,891	386,712	1,057	2,009	+12.3%	+6.5%
2021	477,708	419,903	1,150	2,213	+0.8%	+8.6%
2022	438,660	376,897	1,033	2,201	-8.2%	-10.2%

5 Compliance

5.1 Overview

Northern Waterworks Inc. and the Municipality of Red Lake employ an operational strategy that is committed to achieving the following goals:

- Providing a safe and reliable supply of drinking water to the communities of Balmertown, Cochenour & McKenzie Island;
- Meeting or exceeding all applicable legislative and regulatory requirements; and,
- Maintaining and continually improving the operation and maintenance of the system.

The following sections will summarize incidents of adverse water quality and regulatory noncompliance that occurred during the reporting period. NWI is committed to employing timely and effective corrective actions to prevent the recurrence of identified incidents of adverse water quality and noncompliance.

5.3 Regulatory Compliance

In accordance with Schedule 22 (Summary Reports for Municipalities) of O. Reg. 170/03, this Report must list any requirements of the *Act*, the regulations, the system's approval, drinking water works permit, municipal drinking water licence, and any orders applicable to the system that were not met at any time during the period covered by the report (i.e., an incident of regulatory noncompliance). Additionally, this Report must specify the duration of the failure and the measures that were taken to correct the failure.

The most recent inspection by Ontario's Ministry of the Environment, Conservation and Parks was conducted on August 10, 2022. The final inspection rating was 93.37%, and four (4) incidents of noncompliance were identified. Information concerning the incidents is provided below.

- Noncompliance item no. 1

The requirement for treatment equipment to be operated in a manner that achieved the design capabilities required under O. Reg. 170/03 or a DWWP and/or MDWL issued under Part V of the SDWA at all times that water was being supplied to consumers was not met in one instance. The Procedure for Disinfection of Drinking Water in Ontario states that in order to be considered conventional filtration and to meet the log removal credits, the filtration process must "use a chemical coagulant at all times when the treatment plant is in operation". If a chemical coagulant is not used for a period of time while the filters are in production and that

water is directed to the next stage of treatment (e.g. to the clear well for chlorination), it is deemed to be improper disinfection.

The drinking water inspector verified that primary disinfection was met, apart from the following loss of chemical coagulant event. On June 27, 2022, at approximately 21:00, an operator was called to the Cochenour water treatment plant in response to a coagulant alarm. The operator troubleshooted the issues and restored chemical coagulation. Throughout the response it was determined that over a period of approximately 13 minutes the water treatment plant was in production, directing water to the next stage of treatment, without dosing chemical coagulant. Approximately 29 m^3 of raw water was produced during this time, which was ultimately directed to the clear well. While coagulant was not dosed to the water coming into the flocculation tank during this period, a concentration of coagulant would still exist in the tank, meaning the overall concentration of coagulation would be decreased, rather than entirely absent. There were no turbidity issues following this event.

Northern Waterworks shall continue to ensure that a chemical coagulant is added upstream of the treatment trains at all times while water is being directed to the next stage of treatment. In addition, Northern Waterworks provided training to their operators on October 24, 2022, on their internal Chemical Feed System Failure procedure, as well as the Adverse Test Results and Observations contingency plans. Issues pertaining to the lack of reporting of this event are outlined under non-compliance 4 of this report.

- Noncompliance item no. 2

Operators responded to an alarm call out at the Balmertown RPS and upon arrival noticed another alarm that had been active for 8 hours but had not called out an operator. In accordance with O. Reg. 170/03, all continuous monitoring equipment utilized for sampling and testing must be equipped with alarms or shut-off mechanisms that satisfy the standards in Schedule 6. The Cochenour water treatment plant and the Balmertown RPS are both set to alarm and call an operator in the event of a chlorine residual falling below 0.80mg/L or above 4.00mg/L.

On May 11, 2022, an operator was called to the Balmertown RPS for fluctuating pressure in the distribution system. Upon arrival the operator noticed that a low chlorine alarm had been triggered approximately 8 hours ago but failed to call out an operator. The auto-dialler was found to be locked out, and that an operator had failed to test the auto-dialler system during operational rounds that day. Typically, operators perform the daily task of testing the alarms at each facility, but it is not consistently documented.

As a corrective action, Northern Waterworks has ensured that the routine operational procedure has been updated to indicate that testing the auto-dialler system and alarm

function is a mandatory daily task. Additionally, the daily operational spreadsheet has been updated to include a field for operators to record that these checks have been completed.

- Noncompliance item no. 3

Operators that responded to the loss of chemical coagulation alarm (see noncompliance item no.1) failed to follow written procedures pertaining to that emergency event. The Municipal Drinking Water Licence, Schedule B, Condition 16.4 states: “All of the of the procedures included or referenced within the operations and maintenance manual must be implemented.". The Chemical Feed System Failure emergency response procedure that was developed by Northern Waterworks states in Step 1B that “The following events associated with chemical feed system failures would be immediately reportable as an AWQI: a) A failure to use a chemical coagulant (alum or SternPAC) at all times when the plant is in operation (reportable under Schedule 16-4., "Duty to report other observations")”.

On June 27th, 2022, when the operator responded to the Cochenour water treatment facility for the loss of coagulant alarm, they failed to immediately report the event as an Adverse Water Quality Incident, as per the procedure. While the operator resolved the issue and restored coagulation, they did not satisfy the requirement in the MDWL to implement all procedures.

Operators were familiarized and trained on the implementation of the Emergency Response Procedure: Chemical Feed System Failure. Confirmation of the training, with a list of operators in attendance, was forwarded to the water inspector.

- Noncompliance item no. 4

When operators failed to report the loss of coagulant, the required notifications of Adverse Water Quality Incidents were not immediately reported per O. Reg. 170/03, Schedule 16, sections 16-4 and 16-6. There is a duty to report observations immediately to the ministry, medical officer of health and the owner of the system when water that has been directed to users of the system has not been disinfected in accordance with the Ministry’s procedure for Disinfection of Drinking Water in Ontario. The Procedure for Disinfection of Drinking Water in Ontario states that in order to be considered conventional filtration and to meet the log removal credits, the filtration process must "use a chemical coagulant at all times when the treatment plant is in operation".

On June 27th, 2022, when the operator responded to the Cochenour water treatment facility for the loss of coagulant alarm, they failed to immediately report the event as an Adverse Water Quality Incident to the ministry, the medical officer of health or to the system owner.

The failure to report the observation of improper disinfection has been forwarded to the MECP's Environmental Investigation and Enforcement Branch for follow up. Northern Waterworks shall ensure that for all future observations of improper disinfection an immediate report shall be made in accordance with O. Reg. 170/03. Additionally, Northern Waterworks has applied to the ministry for relief from reporting the loss of coagulation of a short duration to accommodate for maintenance, minor process upsets and troubleshooting emergency events.

5.2 Adverse Water Quality Incidents

In accordance with section 11 (Annual Reports) of O. Reg. 170/03, this Report must summarize any reports made to the Ministry under subsection 18(1) (Duty to report adverse test results) of *the Act* or section 16-4 (Duty to report other observations) of Schedule 16 of O. Reg. 170/03. Additionally, this Report must describe any corrective actions taken under Schedule 17 of O. Reg. 170/03 during the period covered by the report. The seven (7) adverse water quality incidents that occurred during the reporting period are summarized below.

- AWQI No. 158159 (April 8, 2022)

  As per Ontario's *Watermain Disinfection Procedure*, an emergency water distribution system repair on McMarmac Road was classified as a Category 2 repair and resulted in a localized loss of pressure.

  Corrective actions included completing the repair, restoring pressure, issuing a localized and precautionary Boil Water Advisory, and collecting drinking-water samples for microbiological testing. The samples tested absent for E. coli and total coliform parameters and the Boil Water Advisory was subsequently rescinded April 21, 2022.

- AWQI No. 158259 (April 26, 2022)

  On April 26, 2022, a watermain break was evident. A precautionary Adverse Water Quality Incident was reported, and a Boil Water Advisory was issued, prior to discovering that the break occurred on a private service in the trailer park. The owner was advised to repair the break and following repairs Northern Waterworks flushed the main line and collected microbiological samples. When the sample tested absent for microbiological parameters the BWA was rescinded May 3, 2022.

- AWQI No. 158880 (June 27, 2022)

  A sustained loss of pressure in the distribution system occurred due to an interruption in the power supply. The power failure caused faults to the high lift pumps and as a result the Balmertown Reservoir Pumping Station (RPS), as well as the Cochenour McKenzie Island distribution system lost pressure. The municipality issued a Boil Water Advisory to the effected system users.

In response to this event, Northern Waterworks collected two sets of microbiological samples (one in each distribution system), and the Boil Water Advisory was rescinded upon the receipt of sample results absent of E. coli and total coliform parameters.

- AWQI No. 159115 (July 12, 2022)

  A sustained loss of pressure in the distribution system occurred due to an interruption in the power supply. The power failure caused faults to the high lift pumps and as a result the Balmertown Reservoir Pumping Station (RPS), as well as the Cochenour McKenzie Island distribution system lost pressure. The municipality issued a Boil Water Advisory to the effected system users.

  In response to this event, Northern Waterworks collected two sets of microbiological samples (one in each distribution system), and the Boil Water Advisory was rescinded upon the receipt of sample results absent of E. coli and total coliform parameters.

- AWQI No. 159692 (August 24, 2022)

  Northern Waterworks received notification from the lab that a sample had resulted in a high sodium level. While sodium is not considered a toxic element and is not associated with a Standard as prescribed in O. Reg. 169/03, an exceedance of 20 mg/L requires reporting and corrective actions.

  The Northwestern Health Unit has put into place a high sodium advisory for the Balmertown, Cochenour, McKenzie Island community. Additionally, Northern Waterworks resampled and tested for sodium on September 15, 2022, with a result of 20.0mg/L, which does not exceed the limit.

- AWQI No. 160906 (December 6, 2022)

  Operators were notified of a coagulant low flow alarm, and immediately reported to the ministry, the medical officer of health, and the system owners. The electrical connection was corroded and gave a false signal, which triggered an alarm, and the treatment units were shut down. Therefore, water was not produced, or directed to the next stage of treatment and no adverse result was observed. Operators repaired the electrical and restarted water production. No other corrective actions were prescribed by the health unit.

- AWQI No. 161078 (January 1, 2023)

  Haloacetic acids (HAAs) are sampled on a quarterly basis from a location that is likely to have an elevated potential for their formation, in accordance with Schedule 13 (Chemical sampling and testing) of O. Reg. 170/03. HAAs form when the chlorine used to disinfect the water reacts with naturally occurring organic material in the water. Compliance with the provincial standards for haloacetic acid concentrations is determined by calculating a running annual average (RAA). The 2022 RAA for HAAs exceeded the Ontario Drinking Water Quality Standards. In the fourth (4) quarter of the year, HAAs were resampled, which brought the running annual average down, but the result still exceeded the standard. This AWQI will be resolved when the running average falls below the standard of 80 µg/L. Northern Waterworks has started sampling for Haloacetic acids monthly, as opposed to quarterly, to monitor the situation, in addition to maintaining a residual of chlorine in the distribution system that maintains disinfection but does not promote HAA formation.

Annual Report

Red Lake Drinking Water System

2022

Prepared by **Northern Waterworks Inc.**
on behalf of the **Municipality of Red Lake**

NORTHERN WATERWORKS INC.

RED LAKE
Opportunity...it's our Nature

Contents

1 Introduction

1.1 Annual Reporting Requirements

This consolidated Annual Report (the Report) has been prepared in accordance with both section 11 (Annual Reports) and Schedule 22 (Summary Reports for Municipalities) of Ontario Regulation 170/03 (Drinking Water Systems Regulation). This Report is intended to inform both the public and Municipal Council about the operation of the system over the previous calendar year (January 1 to December 31, 2022).

Section 11 of O. Reg. 170/03 requires the development and distribution to the public of an annual report summarizing water quality monitoring results, adverse water quality incidents, system expenses and chemicals used in the water treatment process.

Schedule 22 of O. Reg. 170/03 requires the development and distribution to Council of an annual report summarizing incidents of regulatory non-compliance and associated corrective actions, in addition to providing flow monitoring results for the purpose of enabling the Owner to assess the capability of the system to meet existing and planned demand.

1.2 Report Availability

In accordance with section 11 of O. Reg. 170/03, this Report must be given, without charge, to every person who requests a copy. Effective steps must also be taken to advise users of water from the system that copies of the report are available, without charge, and of how a copy may be obtained. This Annual Report shall be made available for inspection by the public at the Red Lake Municipal Office and on the Municipality's website.

In accordance with Schedule 22 of O. Reg. 170/03, this Annual Report must be given to the members of Municipal Council. Section 19 (Standard of care, municipal drinking-water system) of Ontario's *Safe Drinking Water Act* (SDWA) also places certain responsibilities upon those municipal officials who oversee an accredited operating authority or exercise decision-making authority over a system. The examination of this Report is one of the methods by which municipal officials may fulfil the obligations required by section 19 of the SDWA.

System users and members of Council should contact a representative of NWI for assistance in interpreting this Report. Questions and comments may be directed to the local NWI Operations Manager or by email to compliance@nwi.ca.

2 System Overview & Expenses

2.1 System Description

The Red Lake Drinking Water System must meet extensive treatment and testing requirements to ensure that human health is protected. The operation and maintenance of the system is governed by Ontario's *Safe Drinking Water Act* and the regulations therein, in addition to requirements within system-specific environmental approvals. Important system information is summarized in Table 1.

Table 1: System information

Drinking-Water System Name:	Red Lake Drinking Water System
DWS Number:	210000265
DWS Category:	Large Municipal Residential
DWS Owner:	The Corporation of the Municipality of Red Lake
DWS Operating Authority:	Northern Waterworks Inc.
DWS Components:	• Red Lake Water Treatment Plant • Red Lake water distribution system and standpipe
Treatment Processes:	• Chemical coagulation, flocculation and clarification • Dual media (rapid sand) filtration • Free chlorine disinfection • pH adjustment

Water production begins as raw water flows by gravity from the intake structure located in Skookum Bay (Red Lake) to underground reservoirs located at the Red Lake Water Treatment Plant. Pumps then transfer water from the reservoirs directly to the treatment units. Aluminum sulphate (coagulant) and sodium carbonate solution (pH/alkalinity adjustment) are injected and rapidly mixed into the raw water immediately upstream from the two package treatment units, which each include a four-chambered flocculation basin, clarifier and filter.

To promote floc formation water is gently mixed as it passes through the flocculation basins. Polymer (flocculant) is also added to the water at this stage of treatment to form larger and more stable floc aggregates. Water then enters the clarifier where its velocity is reduced to allow for the separation and settling of floc. Supernatant overflows into effluent launders and is directed to the filter unit. Settled floc is periodically removed from the bottom of the clarifier.

Impurities that were not captured and settled as floc in the clarifier are removed by passing water through a dual media filter composed of anthracite and silica sand on a layer of support gravel. Chlorine gas (disinfectant) and sodium carbonate solution are added to the filtrate as it is directed from the filters to the treated water storage reservoir. The filters are periodically cleaned by using an air scour to agitate the entire media bed and reversing the flow of water through the filter.

Primary disinfection is achieved as disinfectant mixes with the water in the reservoir. Treated water is then delivered from the reservoir to the community standpipe and water distribution system using pumps located at the treatment facility. The standpipe is used to regulate system pressure and to provide a reserve volume of water for emergency situations. Secondary disinfection requirements in the water distribution system are achieved by maintaining a free chlorine residual at all locations.

2.2 Water Treatment Chemicals

In accordance with section 11 of O. Reg. 170/03, this Report must include a list of all water treatment chemicals used by the system during the period covered by the report (summarized in Table 2). All chemicals used in the treatment process are NSF/ANSI 60 certified for use in potable water, as required by system approvals.

Table 2: Water treatment chemicals used in 2022

Treatment Chemical	Application
aluminum sulphate	coagulant
sodium carbonate	pH/alkalinity adjustment
polymer (Polyfloc CP1160P)	flocculant
chlorine gas	disinfectant

2.3 System Expenses

In accordance with section 11 of O. Reg. 170/03, this Report must describe any major expenses incurred during the reporting period to install, repair or replace required equipment. This report also summarizes those expenses related to strengthening equipment inventories and to maintenance activities undertaken by subcontracted service providers. Major expenses incurred in 2022 are summarized in Table 3.

Table 3: Major expenses incurred in 2022

Category	Description	Expense
Replace	Low lift pump wet ends	$36,332
Inventory	Transfer Switch	$18,000
Maintenance	New Hydrant Installation	$11,000
Maintenance/Repairs	SCADA PLC programming and upgrades	$9,000
New Equipment	Portable generator	$4,200
Replace/Upgrade	Digital chart recorder	$3,290
Upgrade/Repair	Concrete loading dock and ramp	$2,400
Maintenance	Flow meter calibration verifications	$1,500
Maintenance	Lighting	$1,200
Maintenance	Generator tri-annual load testing and servicing	$1,066
Inventory	Assorted tools	$1,000

3 Water Quality

3.1 Overview

Water quality monitoring is conducted to determine and confirm that drinking water delivered to the consumer is safe and aesthetically pleasing. Monitoring is also required to assess compliance with legislation and to control the treatment process. In accordance with section 11 of O. Reg. 170/03, this Report must summarize the results of water quality tests required by regulations, approvals and orders. The following sections summarize the results of all required water quality tests and compare the results to applicable water quality standards.

3.2 Microbiological Parameters

Microbiological sampling and testing requirements are provided in Schedule 10 (Microbiological sampling and testing) of O. Reg. 170/03. In 2022, a total of 260 routine source, treated and distribution water samples were collected for microbiological analysis by an accredited laboratory. Samples were collected on a weekly basis and included tests for E. coli (EC), total coliforms (TC) and heterotrophic plate counts (HPC). Results from microbiological analyses are summarized in Table 4. All results were below the associated Ontario Drinking Water Quality Standards.

Table 4: Results summary for microbiological parameters

Sample Type	# of Samples	EC Results Range[1] (MPN/ 100mL)	TC Results Range[1] (MPN/ 100mL)	# of HPC Samples	HPC Results Range (CFU/mL)
Raw Water	52	0 to 2	0 to 387	---	---
Treated Water	52	absent	absent	51	0 to 1
Distribution	156	absent	154 absent *2 present	49	0 to 14
Distribution (nonroutine)	6	absent	absent	---	---

1. The Ontario Drinking Water Quality Standard for E. Coli and Total Coliforms in a treated or distribution sample is 'not detectable'. The presence of either parameter in a treated or distribution sample constitutes an exceedance.

* The presence of Total coliforms was detected in routine samples. These two (2) samples resulted in Adverse Water Quality Incidents. Refer to the compliance section of this report for more information.

3.3 Operational Parameters

In accordance with Schedule 7 (Operational checks) of O. Reg. 170/03, regulated operational parameters that must be monitored include raw water turbidity, filtrate turbidity and the free chlorine residuals associated with primary and secondary disinfection. In accordance with the system's *Municipal Drinking Water Licence*, additional parameters that must be monitored include treated water pH and alkalinity. Table 5 summarizes water quality results for regulated and selected unregulated operational parameters. In accordance with Schedule 6 (Operational checks, sampling and testing – general) of O. Reg. 170/03, certain operational parameters are continuously monitored.

Table 5: Results summary for operational parameters

Parameter (Sample Type)	Number of Samples	Units	Min. Result	Max. Result	Annual Avg.	Adverse Result[1]
Turbidity (Raw Water)	62	NTU	0.25	1.72	0.87	n/a
Turbidity (Filter 1)	Continuous	NTU	0.040	>2.0[1]	0.052	>1.0
Turbidity (Filter 2)	Continuous	NTU	0.041	>2.0[1]	0.066	>1.0
Turbidity (Treated)	365	NTU	0.035	0.20	0.062	n/a
pH (Treated)	365	---	6.66	8.80	7.76	n/a
Alkalinity (Treated)	257	mg/L	31.5	65.0	51.9	n/a
Aluminum Residual (Treated)	220	mg/L	0.018	0.100	0.048	n/a
FCR[2] (Treated)[3]	Continuous	mg/L	0.46	2.64	1.96	n/a
FCR[2] (Distribution)[4]	450+	mg/L	0.70	2.11	1.29	<0.05

1. Adverse results for filtrate turbidity are prescribed within Schedule 16 of O. Reg. 170/03. There are additional factors not included in the table that are necessary to determine whether a result is adverse, such as the duration of the result.
2. FCR = free chlorine residual.
3. There is no adverse result corresponding to the treated water free chlorine residual. However, an observation of adverse water quality occurs if the residual is low enough such that water has not been disinfected in accordance with the system's *Municipal Drinking Water Licence*.
4. Free chlorine residuals are tested at various locations in the distribution system, and the values in the table pertain to the minimum and maximum results collected across all locations in the calendar year.

3.4 Conventional Filtration Performance

In accordance with the system's *Municipal Drinking Water Licence*, conventional filtration facilities must meet certain performance criteria in order to claim removal credits for Cryptosporidium oocysts and Giardia cysts. In addition to continuously monitoring filtrate turbidity and other requirements, filtrate turbidity must be less than or equal to 0.3 NTU in at least 95% of the measurements each month. Table 6 summarizes filtrate turbidity compliance against the <0.3 NTU/95% performance criterion. Minimum and maximum values in the table correspond to the proportion of time that filtered water turbidity was less than or equal to 0.3 NTU in a calendar month in 2022. One (1) AWQI pertaining to conventional filtration performance occurred during the reporting period, refer to the compliance section of this report for more information.

Table 6: Filtration performance summary

Filter	Minimum Result	Maximum Result	Adverse Result
Filter 1	99.9%	100%	<95%
Filter 2	99.8%	100%	<95%

3.5 Nitrate & Nitrite

Treated water is tested for nitrate and nitrite concentrations on a quarterly basis in accordance with Schedule 13 (Chemical sampling and testing) of O. Reg. 170/03. Nitrate and nitrite results are provided in Table 7. All results were below the Ontario Drinking Water Quality Standards.

Table 7: Nitrate and nitrite results

Sample Date	Nitrate		Nitrite	
	Result (mg/L)	ODWQS (mg/L)	Result (mg/L)	ODWQS (mg/L)
16-Feb-2022	0.088	10	<0.010	1
16-May-2022	0.091		<0.010	
16-Aug-2022	0.027		<0.010	
14-Nov-2022	0.074		<0.010	

3.6 Trihalomethanes & Haloacetic Acids

Trihalomethanes (THMs) and haloacetic acids (HAAs) are sampled on a quarterly basis from a distribution system location that is likely to have an elevated potential for their formation, in accordance with Schedule 13 (Chemical sampling and testing) of O. Reg. 170/03. Total THM and HAA results are provided in Table 8 and Table 9, respectively. Compliance with the provincial standards for trihalomethane and haloacetic acid concentrations is determined by calculating a running annual average (RAA). The 2022 running annual averages for THMs and HAAs were below the respective Ontario Drinking Water Quality Standards.

Table 8: Total THM results

Sample Date	Result (µg/L)
16-Feb-2022	65.5
16-May-2022	78.7
16-Aug-2022	105.0
14-Nov-2022	79.1
Regulatory Average (RAA)	82.1
ODWQS (RAA)	100

Table 9: Total HAA results

Sample Date	Result (µg/L)
16-Feb-2022	54.4
16-May-2022	70
16-Aug-2022	86.2
14-Nov-2022	65.1
Regulatory Average (RAA)	68.9
ODWQS (RAA)	80

3.7 Lead Sampling

In 2011 and in accordance with Schedule 15.1 (Lead) of O. Reg. 170/03, a *Corrosion Control Plan* was required to be developed for the Red Lake Drinking Water System following unfavourable results associated with the community lead sampling program. Corrosion control measures were implemented at this time and involved maintaining treated water pH at a value of 7.8 +/- 0.2 units using a sodium carbonate chemical feed system. Corrosion control has been effective and has resulted in a 90% reduction in average lead levels and an 82% reduction in the 90th percentile lead concentration. The ODWQS exceedance rate has also been significantly reduced from 20.6% to 1.4% (i.e., 20.6% of plumbing samples collected prior to corrosion control exceeded the standard for lead in drinking-water), and there have been no lead exceedances in plumbing samples since 2011.

The system now adheres to the lead monitoring program outlined in its *Municipal Drinking Water Licence*, which requires the collection of distribution and plumbing samples on an annual basis. Table 10 summarizes the results of community lead sampling conducted in 2022. Distribution and plumbing samples were collected on September 6, 2022, and all results were below the Ontario Drinking Water Quality Standard for lead in drinking water.

Table 10: Lead sampling results summary

Sample Type	No. of Sample Points	No. of Samples	Min. Result (µg/L)	Max. Result (µg/L)	ODWQS (µg/L)	No. of Sample Point Exceedances
Distribution	2	2	1.7	5.6	10	0
Plumbing[1]	12	24	<1.0	3.7[2]		0

1. In accordance with the sampling protocol outlined in Schedule 15.1 of O. Reg. 170/03, two samples are collected and analyzed for lead at each sample point for plumbing samples.
2. Only five (5) samples tested above the lower analytical detection limit for lead in drinking water.

3.8 Inorganic & Organic Parameters

Most inorganic parameters are sampled on an annual basis in treated water in accordance with Schedules 13 (Chemical sampling and testing) and 23 (Inorganic parameters) of O. Reg. 170/03. The inorganic parameters sodium and fluoride are sampled every five (5) years in treated water in accordance with Schedules 13 and 23 of O. Reg. 170/03. The most recent inorganic parameter sampling results are provided in Table 11. All results were below the associated Ontario Drinking Water Quality Standards.

Table 11: Inorganic parameter sampling results

Parameter	Most Recent Sample Date	Units	Result	ODWQS
Antimony	16-Aug-2022	µg/L	<0.60	6
Arsenic	16-Aug-2022	µg/L	<1.0	10
Barium	16-Aug-2022	µg/L	<10	1000
Boron	16-Aug-2022	µg/L	<50	5000
Cadmium	16-Aug-2022	µg/L	<0.10	5
Chromium	16-Aug-2022	µg/L	<1.0	50
Fluoride	15-Feb-2018	mg/L	0.021	1.5
Mercury	16-Aug-2022	µg/L	<0.10	1
Selenium	16-Aug-2022	µg/L	<1.0	50
Sodium	15-Feb-2018	mg/L	24.3[1]	20
Uranium	16-Aug-2022	µg/L	<2.0	20

1. The parameter sodium is not considered a toxic element and is not associated with a Standard as prescribed in O. Reg. 169/03, although an exceedance of 20 mg/L requires reporting and corrective actions. The result in the table is associated with Adverse Water Quality Incident no. 138780, and a resample collected on February 26, 2018, yielded a sodium result of 23.2 mg/L.

Organic parameters are sampled on an annual basis in treated water in accordance with Schedules 13 (Chemical sampling and testing) and 24 (Organic parameters) of O. Reg. 170/03. These parameters include various organic acids, pesticides, herbicides, PCBs, volatile organics and other chemicals. Sampling for all organic parameters was conducted on August 16, 2022, and results are provided in Table 12. All results were below the associated Ontario Drinking Water Quality Standards.

Table 12: Organic parameter sampling results

Parameter	Result (µg/L)	ODWQS (µg/L)	Parameter	Result (µg/L)	ODWQS (µg/L)
Alachlor	<0.10	5	Diuron	<1.0	150
Atrazine & Metabolites	<0.20	5	Glyphosate	<5.0	280
Azinphos-methyl	<0.10	20	Malathion	<0.10	190
Benzene	<0.50	1	MCPA	<0.20	100
Benzo(a)pyrene	<0.005	0.01	Metolachlor	<0.10	50
Bromoxynil	<0.20	5	Metribuzin	<0.10	80
Carbaryl	<0.20	90	Monochlorobenzene	<0.50	80
Carbofuran	<0.20	90	Paraquat	<1.0	10
Carbon Tetrachloride	<0.20	2	Pentachlorophenol	<0.50	60
Chlorpyrifos	<0.10	90	Phorate	<0.10	2
Diazinon	<0.10	20	Picloram	<0.20	190
Dicamba	<0.20	120	Total PCBs	<0.035	3
1,2-Dichlorobenzene	<0.50	200	Prometryne	<0.10	1
1,4-Dichlorobenzene	<0.50	5	Simazine	<0.10	10
1,2-Dichloroethane	<0.50	5	Terbufos	<0.20	1
1,1-Dichloroethylene	<0.50	14	Tetrachloroethylene	<0.50	10
Dichloromethane	<5.0	50	2,3,4,6-Tetrachlorophenol	<0.50	100
2,4-Dichlorophenol	<0.30	900	Triallate	<0.10	230
2,4-D	<0.20	100	Trichloroethylene	<0.50	5
Diclofop-methyl	<0.20	9	2,4,6-Trichlorophenol	<0.50	5
Dimethoate	<0.10	20	Trifluralin	<0.10	45
Diquat	<1.0	70	Vinyl Chloride	<0.20	1

3.9 Environmental Discharge Sampling

The *Municipal Drinking Water Licence* for the Red Lake Drinking Water System requires additional sampling associated with discharges to the natural environment. Specifically, samples must be collected from settling tank effluent on a monthly basis and tested for the parameter total suspended solids (TSS). This effluent is discharged to Red Lake and originates from the onsite treatment of the wastewater produced during plant operation (e.g., filter backwashing and clarifier solids removal). The *Licence* also requires that the effluent discharged to the natural environment has an annual average TSS concentration below 25 mg/L. Table 13 summarizes 2022 environmental discharge sampling results.

Table 13: Environmental discharge sampling results summary

Number of Samples	Minimum TSS Result (mg/L)	Maximum TSS Result (mg/L)	TSS Annual Average (mg/L)
12	5.9	59.0	24.0

4 Water Production

4.1 Overview

In accordance with Schedule 22 (Summary Reports for Municipalities) of O. Reg. 170/03, this Annual Report must include certain information for the purpose of enabling the Owner to assess the capability of the system to meet existing and planned uses. Specifically, this Report must include a summary of the quantities and flow rates of the water supplied during the reporting period, including monthly average and maximum daily flows. The Report must also include a comparison of flow monitoring results to the rated capacity and flow rates approved in the system's *Municipal Drinking Water Licence*.

4.2 Flow Monitoring Results

Throughout the reporting period the Red Lake Drinking Water System operated within its rated capacity and supplied a total of 401,942 m^3 of treated water. On an average day in 2022, 1,101 m^3 of treated water was supplied to the community, which represents 18% of the rated capacity of the Red Lake Water Treatment Plant (6,048 m^3/day). The maximum daily flow in 2022 was 2,074 m^3/day, which represents 34% of the rated capacity of the treatment facility. Flow monitoring results are summarized in Figure 1 and Table 14. The capacity assessments provided in the table compare the average and maximum daily treated water flows to the rated capacity of the treatment facility.

Figure 1: 2022 average and maximum daily treated water flows

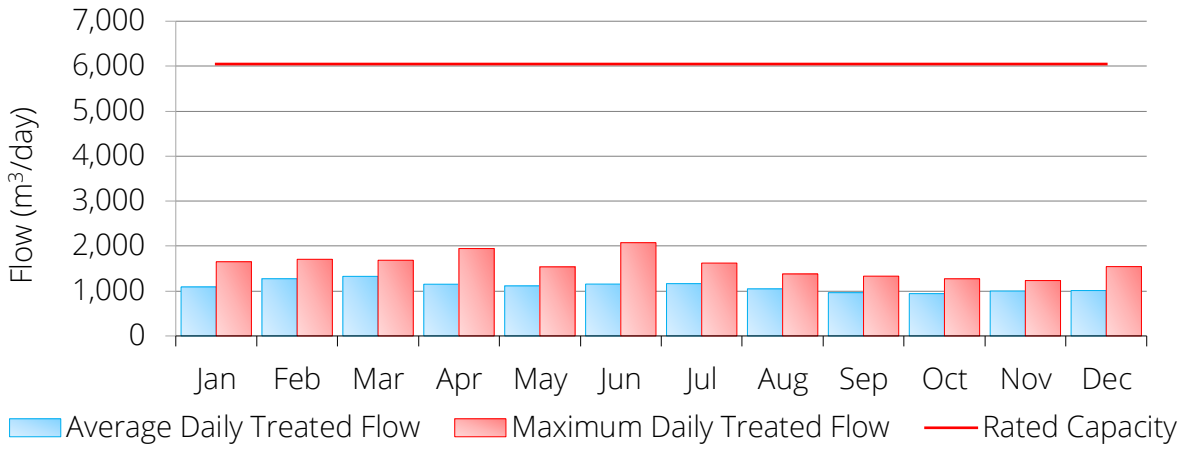
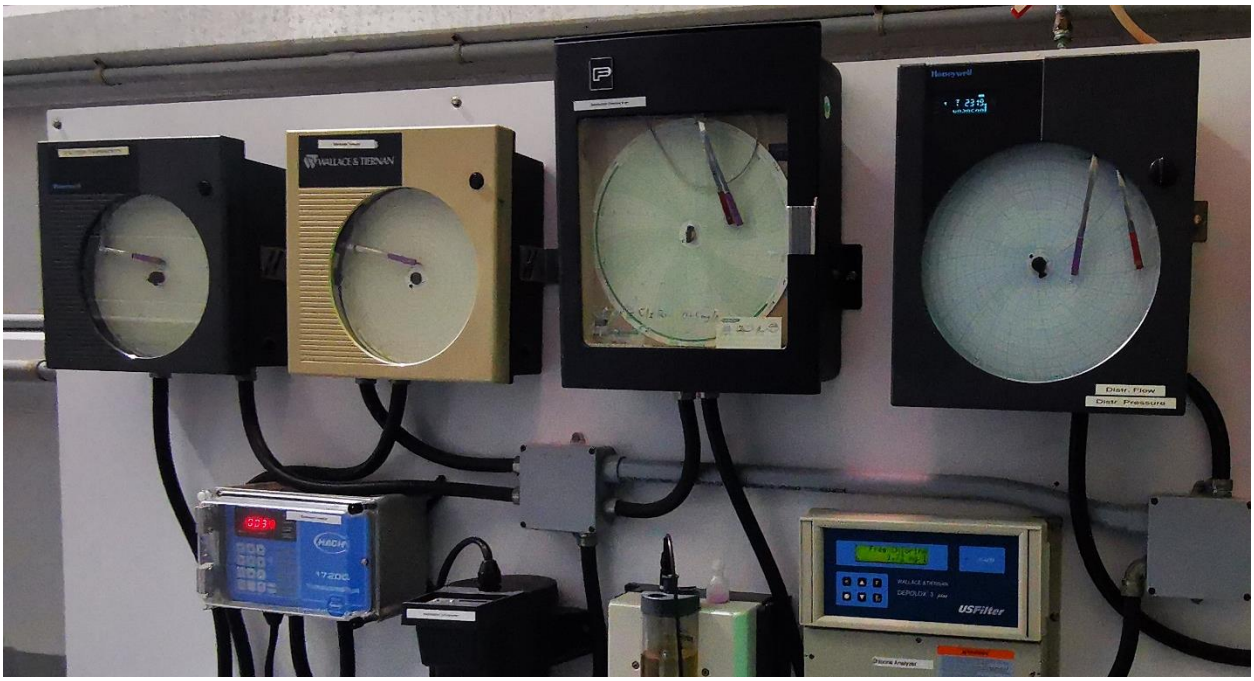


Table 14: 2022 water production summary

Month	Total Volumes (m^3)		Daily Flows (m^3/day)		Capacity Assessments	
	Raw Water	Treated Water	Average - Treated	Maximum - Treated	Average - Treated	Maximum - Treated
Jan	38,860	33,779	1,090	1,650	18%	27%
Feb	40,464	35,617	1,272	1,705	21%	28%
Mar	46,306	41,091	1,326	1,684	22%	28%
Apr	39,022	34,530	1,151	1,944	19%	32%
May	39,299	34,494	1,113	1,536	18%	25%
Jun	39,905	34,622	1,154	2,074	19%	34%
Jul	41,610	36,058	1,163	1,621	19%	27%
Aug	36,637	32,440	1,046	1,378	17%	23%
Sep	32,665	28,869	962	1,330	16%	22%
Oct	32,813	29,172	941	1,271	16%	21%
Nov	33,061	29,968	999	1,232	17%	20%
Dec	35,030	31,302	1,010	1,542	17%	25%
Total	455,672	401,942	---	---	---	---
Average	37,973	33,495	1,101	---	18%	---



4.3 Recent Historical Flows

Table 15 summarizes recent historical flow monitoring results for the Red Lake Drinking Water System. There were slight increases in the volumes of source water withdrawn and treated water supplied in 2022 when compared to 2021, and flows have generally remained stable over the previous decade. Total annual volumes of treated water supplied in the near future may be expected to be between 300,000 m^3 and 450,000 m^3, which represents approximately 14% to 20% of the rated capacity of the Red Lake Water Treatment Plant.

Table 15: Recent historical water production summary

Year	Total Volumes (m^3)		Daily Flows (m^3/day)		Annual % Change	
	Raw Water	Treated Water	Average – Treated	Maximum – Treated	Raw Water	Treated Water
2008	633,689	543,403	1,485	3,567	-18.3%	-14.2%
2009	548,288	472,192	1,294	3,157	-13.5%	-13.1%
2010	477,015	369,761	1,013	2,465	-13.0%	-21.7%
2011	429,785	295,498	810	2,112	-9.9%	-20.1%
2012	355,397	297,396	813	1,654	-17.3%	+0.6%
2013	350,834	304,087	833	1,567	-1.3%	+2.2%
2014	389,092	331,219	907	1,645	+10.9%	+8.9%
2015	413,969	357,230	979	1,886	+6.4%	+7.9%
2016	396,239	345,746	945	2,231	-4.3%	-3.2%
2017	381,516	334,669	917	1,700	-3.7%	-3.2%
2018	439,388	379,157	1,039	2,290	+15.2%	+13.3%
2019	410,962	358,997	984	1,917	-6.5%	-5.3%
2020	451,078	402,134	1,099	2,036	+9.8%	+12.0%
2021	439,893	394,204	1,080	1,943	-2.5%	-2.0%
2022	455,672	401,942	1101	2074	+3.6%	+2.0%

5 Compliance

5.1 Overview

Northern Waterworks Inc. and the Municipality of Red Lake employ an operational strategy that is committed to achieving the following goals:

- Providing a safe and reliable supply of drinking water to the community of Red Lake;
- Meeting or exceeding all applicable legislative and regulatory requirements; and,
- Maintaining and continually improving the operation and maintenance of the system.

The following sections will summarize incidents of adverse water quality and regulatory noncompliance that occurred during the reporting period. NWI is committed to employing timely and effective corrective actions to prevent the recurrence of identified incidents of adverse water quality and noncompliance.

5.2 Adverse Water Quality Incidents

In accordance with section 11 (Annual Reports) of O. Reg. 170/03, this Report must summarize any reports made to the Ministry under subsection 18(1) (Duty to report adverse test results) of *the Act* or section 16-4 (Duty to report other observations) of Schedule 16 of O. Reg. 170/03. Additionally, this Report must describe any corrective actions taken under Schedule 17 of O. Reg. 170/03 during the period covered by the report. Three (3) adverse water quality incidents were reported in 2022 and are summarized below.

- AWQI No. 158708 (June 13, 2022) & AWQI No. 158919 (June 27, 2022)

Two (2) separate incidents of adverse water quality were reported to the ministry after routine microbiological samples, collected June 13, 2022, at the Super 8 Hotel, and another on June 27, 2022, at the Red Lake water tower, indicated the presence of Total Coliforms. Any presence of Total Coliforms constitutes an exceedance.

Corrective action was performed for each event in accordance with Schedule 18 of O. Reg. 170/03 and included resampling at the location that indicated the presence of Total Coliforms, as well as at a location upstream, and downstream of the initial sample point. Resampled results came back absent of microbiological parameters.

- AWQI No. 158177 (April 11, 2022)

Adverse results for filtrate turbidity are prescribed within Schedule 16 of O. Reg. 170/03. While filters are in production, and directing water to the next stage of treatment, filtrate turbidity must be continually monitored and must be less than 0.3 NTU in at least 95% of the measurements in each calendar month. In addition, filtrate turbidity cannot exceed 1.0 NTU for more than 15 minutes.

Polymer is a coagulant aid and is added upstream of the filter units. On April 11, 2022, it was discovered that the polymer line had come apart and had stopped dosing into the floc tank preceding filter 2. Filter #2 turbidity went over 1.0 NTU while water was being directed to the next stage of treatment. Turbidity exceeded 1.0 NTU between 6:10:21 PM and 6:11:25 PM, and again between 6:26:11 PM and 6:27:29 PM. The first reading taken 15 minutes after the reading at 6:11:25 PM exceeded 1.0 NTU, and the event was therefore reportable. The polymer line was repaired, and no further corrective action was required.

5.3 Regulatory Compliance

In accordance with Schedule 22 (Summary Reports for Municipalities) of O. Reg. 170/03, this Report must list any requirements of the *Act*, the regulations, the system's approval, drinking water works permit, municipal drinking water licence, and any orders applicable to the system that were not met at any time during the period covered by the report (i.e., an incident of regulatory noncompliance). Additionally, this Report must specify the duration of the failure and the measures that were taken to correct the failure.

The most recent inspection by Ontario's Ministry of the Environment, Conservation and Parks was conducted on July 7, 2022. The final inspection rating was 92.94%, and two (2) incidents of regulatory noncompliance were identified. Information concerning the duration of failures and the measures taken to address those failures is provided below.

- Noncompliance item no. 1

  Operators were not examining continuous monitoring test results, or they were not examining the results within 72 hours of the test. O. Reg. 170/03, Schedule 6, section 6-5(1)3 requires that continuous filter effluent turbidity and treated water chlorine data be examined within 72 hours after the tests are conducted. Daily, operators document in the logbook that they reviewed the filter effluent turbidity and post clearwell chlorine trending for the previous day; however, on several occasions, anomalies in the trending were not documented; therefore, it cannot be confirmed if the continuous data was examined within 72 hours.

  On March 31, 2022, a loss of SCADA trending occurred from 09:45 to 17:00. While there was backup trending available for the duration of the data loss, the logbooks did not reference that there was missing data, or that operators reviewed the back up data.

  On June 16, 2022, a low chlorine alarm was triggered to do a loss of power in the Red Lake Drinking Water System. While the operator responded to the alarm, they did not document the response. When the data review was completed the next day, the operator did not include information of the low chlorine event or the cause of the alarm from the previous day. Therefore, it cannot be confirmed that monitoring data was reviewed adequately, as the intent of data review is to capture abnormalities and in trending.

  As a corrective action the daily operational spreadsheets were amended to include fields that indicate if any data was missing from the SCADA trends. Further fields prompt operators to confirm the availability of backup trending for the missing data periods. Additionally, Northern Waterworks provided additional training to operators reviewing the requirements of trending and data review within 72 hours, as well as documenting abnormalities in the facility logbook.

- Noncompliance item no. 2

All continuous monitoring equipment utilized for sampling and testing required by O. Reg.170/03, or Municipal Drinking Water Licence or Drinking Water Works Permit or order, were not equipped with alarms or shut-off mechanisms that satisfy the standards described in Schedule 6.

On April 10, 2022, filter 2 turbidity exceeded the alarm set point of 0.6 NTU, however an alarm did not call out to an operator, but rather the high turbidity event was discovered the next day and was reported as an adverse water quality incident (see AWQI 158177 for more information). There was an 'alarm delay inhibit' feature that was not engaged, therefore failing to shut down the treatment process or call out an operator when the alarm setpoint was reached. Additionally, there was a 300 second delay on the alarm.

As a result of this event the alarm delay inhibit feature was engaged and the alarm delay was set to zero (0) seconds. This will shut down the filters and call an operator to respond immediately when turbidity reached 0.6 NTU. In addition, the facilities monthly maintenance procedures have been updated to include testing the functionality of alarms and verifying that there are no alarm delays for all regulatory alarm parameters.

Annual Report

Madsen Drinking Water System

2022

Prepared by **Northern Waterworks Inc.**
on behalf of the **Municipality of Red Lake**

NORTHERN WATERWORKS INC.

RED LAKE
Opportunity...it's our Nature

Contents

1 Introduction

1.1 Annual Reporting Requirements

This consolidated Annual Report (the Report) has been prepared in accordance with both section 11 (Annual Reports) and Schedule 22 (Summary Reports for Municipalities) of Ontario Regulation 170/03 (Drinking Water Systems Regulation). This Report is intended to inform both the public and Municipal Council about the operation of the system over the previous calendar year (January 1 to December 31, 2022).

Section 11 of O. Reg. 170/03 requires the development and distribution to the public of an annual report summarizing water quality monitoring results, adverse water quality incidents, system expenses and chemicals used in the water treatment process.

Schedule 22 of O. Reg. 170/03 requires the development and distribution to Council of an annual report summarizing incidents of regulatory non-compliance and associated corrective actions, in addition to providing flow monitoring results for the purpose of enabling the Owner to assess the capability of the system to meet existing and planned demand.

1.2 Report Availability

In accordance with section 11 of O. Reg. 170/03, this Report must be given, without charge, to every person who requests a copy. Effective steps must also be taken to advise users of water from the system that copies of the report are available, without charge, and of how a copy may be obtained. This Annual Report shall be made available for inspection by the public at the Red Lake Municipal Office and on the Municipality's website.

In accordance with Schedule 22 of O. Reg. 170/03, this Annual Report must be given to the members of Municipal Council. Section 19 (Standard of care, municipal drinking-water system) of Ontario's *Safe Drinking Water Act* (SDWA) also places certain responsibilities upon those municipal officials who oversee an accredited operating authority or exercise decision-making authority over a system. The examination of this Report is one of the methods by which municipal officials may fulfil the obligations required by section 19 of the SDWA.

System users and members of Council should contact a representative of NWI for assistance in interpreting this Report. Questions and comments may be directed to the local NWI Operations Manager or by email to compliance@nwi.ca.

2 System Overview & Expenses

2.1 System Description

The Madsen Drinking Water System must meet extensive treatment and testing requirements to ensure that human health is protected. The operation and maintenance of the system is governed by Ontario's *Safe Drinking Water Act* and the regulations therein, in addition to requirements within system-specific environmental approvals. Important system information is summarized in Table 1.

Table 1: System information

Drinking-Water System Name:	Madsen Drinking Water System
DWS Number:	210001479
DWS Category:	Small Municipal Residential
DWS Owner:	The Corporation of the Municipality of Red Lake
DWS Operating Authority:	Northern Waterworks Inc.
DWS Components:	• Raw water pumping station • Madsen Water Treatment Plant • Madsen water distribution system
Treatment Processes:	• Pre-oxidation • Chemical coagulation, flocculation and clarification • Dual media (rapid sand) filtration • Free chlorine disinfection • pH adjustment

Water production begins as pumps at the raw water pumping station transfer raw water from its source at Russett Lake to a storage reservoir located at the Madsen Water Treatment Plant. Upon transfer, potassium permanganate is added to the raw water to oxidize iron and manganese for precipitation and removal in downstream treatment processes. Pumps at the treatment facility then deliver the raw water from the storage reservoir directly to the package treatment units. Polyaluminum chloride (coagulant) is injected and rapidly mixed into the raw water immediately upstream from the two package treatment units, which each include a three-chambered flocculation basin, clarifier and filter.

To promote floc formation water is gently mixed as it passes through the flocculation basins. Polymer solution (flocculant) is also added to the water at this stage of treatment to form larger and more stable floc aggregates. Process water then enters the clarifier where its velocity is reduced to allow for the separation and settling of floc. Supernatant overflows into the clarifier effluent launders and is directed to the filter unit; settled floc (sludge) is automatically removed from the bottom of the clarifier.

Impurities that were not captured and settled as floc in the clarifier are removed by passing water through a dual media filter composed of anthracite and silica sand on a layer of support gravel. Sodium hypochlorite (disinfectant) and sodium carbonate solution (pH/alkalinity adjustment) are added to the filtrate as it is directed from the filters to the treated water storage reservoir. The filters are periodically cleaned by using an air scour to agitate the entire media bed and reversing the flow of water through the filter using pumps.

Primary disinfection is achieved as disinfectant mixes with the water in the reservoir. Treated water is then delivered from the reservoir to the water distribution system using pumps. Secondary disinfection requirements in the distribution system are achieved by maintaining a free chlorine residual at all locations.

2.2 Water Treatment Chemicals

In accordance with section 11 of O. Reg. 170/03, this Report must include a list of all water treatment chemicals used by the system during the period covered by the report (summarized in Table 2). All chemicals used in the treatment process are NSF/ANSI 60 certified for use in potable water, as required by system approvals.

Table 2: Water treatment chemicals used in 2022

Treatment Chemical	Application
potassium permanganate	oxidizing agent
polyaluminum chloride	coagulant
polymer (Polyfloc CP1160P)	flocculant
sodium hypochlorite	disinfectant
sodium carbonate (soda ash)	pH/alkalinity adjustment

2.3 System Expenses

In accordance with section 11 of O. Reg. 170/03, this Report must describe any major expenses incurred during the reporting period to install, repair, or replace required equipment. This Report also summarizes those expenses related to strengthening equipment inventories and to maintenance activities undertaken by subcontracted service providers. Major expenses incurred in 2022 are summarized in Table 3.

Table 3: Major expenses incurred in 2022

Category	Description	Expense
Replace/Upgrade	Digital Chart Recorder	$3,290
Maintenance	Programming upgrades	$2,000
Replace/Maintenance	Lighting	$1,600
Maintenance	Flow meter calibration verifications	$1,500
Inventory/Replace	Assorted tools	$1,000
Maintenance	Generator Tri-Annual Load Testing and Servicing	$946

3 Water Quality

3.1 Overview

Water quality monitoring is conducted to determine and confirm that drinking water delivered to the consumer is safe and aesthetically pleasing. Monitoring is also required to assess compliance with legislation and to control the treatment process. In accordance with section 11 of O. Reg. 170/03, this Report must summarize the results of water quality tests required by regulations, approvals, and orders. The following sections summarize the results of all required water quality tests and compare the results to applicable water quality standards.

3.2 Microbiological Parameters

Microbiological sampling and testing requirements are provided in Schedule 11 (Microbiological sampling and testing) of O. Reg. 170/03. In 2022, a total of 164 source, treated and distribution water samples were collected for microbiological analysis by an accredited laboratory. Samples were collected on a weekly basis and included tests for E. coli (EC), total coliforms (TC) and heterotrophic plate counts (HPC). Results from microbiological analyses are summarized in Table 4. Two (2) Adverse Water Quality Incidents associated with the presence of Total Coliforms occurred during the reporting period. Refer to the *Compliance* section of this report for more information.

Table 4: Results summary for microbiological parameters

Sample Type	# of Samples	EC Results Range[1] (MPN/ 100mL)	TC Results Range[1] (MPN/ 100mL)	# of HPC Samples	HPC Results Range (CFU/mL)
Raw Water	52	0 to 3	1 to >1120	---	---
Treated Water	52	absent	absent	50	0 to 4
Distribution	52	absent	51Absent * 1 present	50	0 to 4
Distribution (nonroutine)	8	absent	7 Absent * 1 present	2	0

1. The Ontario Drinking Water Quality Standard for E. Coli and Total Coliforms in a treated or distribution sample is 'not detectable'. The presence of either parameter in a treated or distribution sample constitutes an exceedance.

*The Presence of Total Coliforms was detected in one routine sample, and one non-routine sample. These two (2) samples resulted in Adverse Water Quality Incidents. Refer to the compliance section for more information.

3.3 Operational Parameters

In accordance with Schedule 7 (Operational checks) of O. Reg. 170/03, regulated operational parameters that must be monitored include raw water turbidity, filtrate turbidity and the free chlorine residuals associated with primary and secondary disinfection. Table 5 summarizes water quality results for regulated and selected unregulated operational parameters. In accordance with Schedule 6 (Operational checks, sampling, and testing – general) of O. Reg. 170/03, certain operational parameters are continuously monitored.

Table 5: Results summary for operational parameters

Parameter (Sample Type)	Number of Samples	Units	Min. Result	Max. Result	Annual Avg	Adverse Result
Turbidity (Raw Water)	49	NTU	0.18	1.57	0.72	n/a
Turbidity (Filter 1)	Continuous	NTU	0.025	0.278	0.034	>1.0
Turbidity (Filter 2)	Continuous	NTU	0.021	0.290	0.033	>1.0
Turbidity (Treated)	365	NTU	0.054	1.711	0.215	n/a
pH (Treated)	365	---	6.7	8.5	7.7	n/a
Alkalinity (Treated)	242	mg/L	33.7	66.0	51.3	n/a
Alum Residual (Treated)	225	mg/L	0.010	0.043	0.018	n/a
FCR[1] (Treated)[2]	Continuous	mg/L	0.60	3.69	1.95	n/a
FCR[1] (Distribution)[3]	365	mg/L	0.45	3.71	n/a	<0.05

1. FCR = free chlorine residual.
2. There is no adverse result corresponding to the treated water free chlorine residual. However, an observation of adverse water quality occurs if the residual is low enough such that water has not been disinfected in accordance with the system's *Municipal Drinking Water Licence*.
3. Free chlorine residuals are tested at various locations in the distribution system. The free chlorine residual varies with water age and distribution system location, and values in the table pertain to the minimum and maximum results collected across all locations in the calendar year.

3.4 Conventional Filtration Performance

In accordance with the system's *Municipal Drinking Water Licence*, conventional filtration must meet certain performance criteria in order to claim removal credits for Cryptosporidium oocysts and Giardia cysts. In addition to continuously monitoring filtrate turbidity and other requirements, filtrate turbidity must be less than or equal to 0.3 NTU in at least 95% of the measurements each month. Table 6 summarizes filtrate turbidity compliance against the <0.3 NTU/95% performance criterion. Minimum and maximum values in the table correspond to the proportion of time that filtered water turbidity was less than or equal to 0.3 NTU in a calendar month in 2022. No AWQIs pertaining to conventional filtration performance occurred during the reporting period.

Table 6: Filtration performance summary

Filter	Minimum Result	Maximum Result	Adverse Result
Filter 1	100%	100%	<95%
Filter 2	100%	100%	<95%

3.5 Nitrate & Nitrite

Treated water is tested for nitrate and nitrite concentrations on a quarterly basis in accordance with Schedule 13 (Chemical sampling and testing) of O. Reg. 170/03. Nitrate and nitrite results are provided in Table 7. All results were below the Ontario Drinking Water Quality Standards.

Table 7: Nitrate and nitrite results

Sample Date	Nitrate		Nitrite	
	Result (mg/L)	ODWQS (mg/L)	Result (mg/L)	ODWQS (mg/L)
16-Feb-2022	0.116	10	<0.010	1
16-May-2022	0.123		<0.010	
16-Aug-2022	0.023		<0.010	
14-Nov-2022	0.059		<0.010	

3.6 Trihalomethanes & Haloacetic Acids

Trihalomethanes (THMs) and haloacetic acids (HAAs) are sampled on a quarterly basis from a distribution system location that is likely to have an elevated potential for their formation, in accordance with Schedule 13 (Chemical sampling and testing) of O. Reg. 170/03. Total THM and HAA results are provided in Table 8 and Table 9, respectively. Compliance with the provincial standards for trihalomethane and haloacetic acid concentrations is determined by calculating a running annual average (RAA). The 2022 running annual averages for THMs and HAAs were below the respective Ontario Drinking Water Quality Standards.

Table 8: Total THM results

Sample Date	Result (µg/L)
16-Feb-2022	40.0
16-May-2022	52.8
16-Aug-2022	43.3
14-Nov-2022	47.6
Regulatory Average (RAA)	45.9
ODWQS (RAA)	100

Table 9: Total HAA results

Sample Date	Result (µg/L)
16-Feb-2022	40.8
16-May-2022	47.1
16-Aug-2022	63.1
14-Nov-2022	46.0
Regulatory Average (RAA)	49.3
ODWQS (RAA)	80

3.7 Lead Sampling

Based upon favourable lead sampling results in the community and in accordance with Schedule 15.1 (Lead) of O. Reg. 170/03, the Madsen Drinking Water System previously qualified for reduced lead sampling in the second half of 2017. Favourable results from reduced lead sampling conducted in 2019 and 2020 have allowed the system to qualify for an exemption from sampling at plumbing locations. Two (2) distribution samples must now be collected every year and analyzed for pH and alkalinity. Additionally, these distribution system samples must be analyzed for lead in every third 12-month period after the plumbing sample exemption was activated. Table 10 summarizes the results of lead sampling and related required tests.

Table 10: Distribution pH, alkalinity, and lead sampling results

Sample Date	Distribution Sample Location	pH	Alkalinity (mg/L)	Lead Result (µg/L)	Lead ODWQS (µg/L)
06-Apr-2022	Main Street Bleeder	8.03	55.9	N/A[1]	10
06-Sep-2022	Main Street Bleeder	7.40	54.0	<1.0	

1. Lead will next be tested in distribution samples during the Winter 2023 sampling period.

3.8 Inorganic & Organic Parameters

Most inorganic parameters are sampled on an annual basis in treated water in accordance with Schedules 13 (Chemical sampling and testing) and 23 (Inorganic parameters) of O. Reg. 170/03. The inorganic parameters sodium and fluoride are sampled every five (5) years in treated water in accordance with Schedules 13 and 23 of O. Reg. 170/03. The most recent inorganic parameter sampling results are provided in Table 11. All results were below the associated Ontario Drinking Water Quality Standards.

Table 11: Inorganic parameter sampling results

Parameter	Most Recent Sample Date	Units	Result	ODWQS
Antimony	16-Aug-2022	µg/L	<0.60	6
Arsenic	16-Aug-2022	µg/L	<1.0	10
Barium	16-Aug-2022	µg/L	<10	1000
Boron	16-Aug-2022	µg/L	<50	5000
Cadmium	16-Aug-2022	µg/L	<0.10	5
Chromium	16-Aug-2022	µg/L	<1.0	50
Fluoride	11-Feb-2019	mg/L	<0.020	1.5
Mercury	16-Aug-2022	µg/L	<0.10	1
Selenium	16-Aug-2022	µg/L	<1.0	50
Sodium	16-Aug-2022	mg/L	22.2[1]	20
Uranium	16-Aug-2022	µg/L	<2.0	20

1. The parameter sodium is not considered a toxic element and is not associated with a Standard as prescribed in O. Reg. 169/03, although an exceedance of 20 mg/L requires reporting and corrective actions. The result in the table was not reported as an Adverse Water Quality Incident as there is already a Sodium advisory in place.

Organic parameters are sampled on an annual basis in treated water in accordance with Schedules 13 (Chemical sampling and testing) and 24 (Organic parameters) of O. Reg. 170/03. These parameters include various organic acids, pesticides, herbicides, PCBs, volatile organics and other chemicals. Sampling for organic parameters was conducted on August 16 & September 6, 2022, and results are provided in Table 12. All results were below the associated Ontario Drinking Water Quality Standards.

Table 12: Organic parameter sampling results

Parameter	Result (µg/L)	ODWQS (µg/L)	Parameter	Result (µg/L)	ODWQS (µg/L)
Alachlor	<0.10	5	Diuron	<1.0	150
Atrazine & Metabolites	<0.20	5	Glyphosate	<5.0	280
Azinphos-methyl	<0.10	20	Malathion	<0.10	190
Benzene	<0.50	1	MCPA	<0.20	100
Benzo(a)pyrene	<0.005	0.01	Metolachlor	<0.10	50
Bromoxynil	<0.20	5	Metribuzin	<0.10	80
Carbaryl	<0.20	90	Monochlorobenzene	<0.50	80
Carbofuran	<0.20	90	Paraquat	<1.0	10
Carbon Tetrachloride	<0.20	2	Pentachlorophenol	<0.50	60
Chlorpyrifos	<0.10	90	Phorate	<0.10	2
Diazinon	<0.10	20	Picloram	<0.20	190
Dicamba	<0.20	120	Total PCBs	<0.035	3
1,2-Dichlorobenzene	<0.50	200	Prometryne	<0.10	1
1,4-Dichlorobenzene	<0.50	5	Simazine	<0.10	10
1,2-Dichloroethane	<0.50	5	Terbufos	<0.20	1
1,1-Dichloroethylene	<0.50	14	Tetrachloroethylene	<0.50	10
Dichloromethane	<5.0	50	2,3,4,6-Tetrachlorophenol	<0.50	100
2,4-Dichlorophenol	<0.30	900	Triallate	<0.10	230
2,4-D	<0.20	100	Trichloroethylene	<0.50	5
Diclofop-methyl	<0.20	9	2,4,6-Trichlorophenol	<0.50	5
Dimethoate	<0.10	20	Trifluralin	<0.10	45
Diquat	<1.0	70	Vinyl Chloride	<0.20	1

4 Water Production

4.1 Overview

In accordance with Schedule 22 (Summary Reports for Municipalities) of O. Reg. 170/03, this Annual Report must include certain information for the purpose of enabling the Owner to assess the capability of the system to meet existing and planned uses. Specifically, this Report must include a summary of the quantities and flow rates of the water supplied during the reporting period, including monthly average and maximum daily flows. The Report must also include a comparison of flow monitoring results to the rated capacity and flow rates approved in the system's *Municipal Drinking Water Licence*.

4.2 Flow Monitoring Results

Throughout the reporting period the Madsen Drinking Water System operated within its rated capacity and supplied a total of 46,221 m^3 of treated water. On an average day in 2022, 127 m^3 of treated water was supplied to the community, which represents 18% of the rated capacity of the Madsen Water Treatment Plant (691 m^3/day). The maximum daily flow in 2022 was 257 m^3/day, which represents 37% of the rated capacity of the treatment facility. Flow monitoring results are summarized in Figure 1 and Table 13. The capacity assessments provided in the table compare the average and maximum daily flows to the rated capacity of the facility.

Figure 1: 2022 average and maximum daily treated water flows

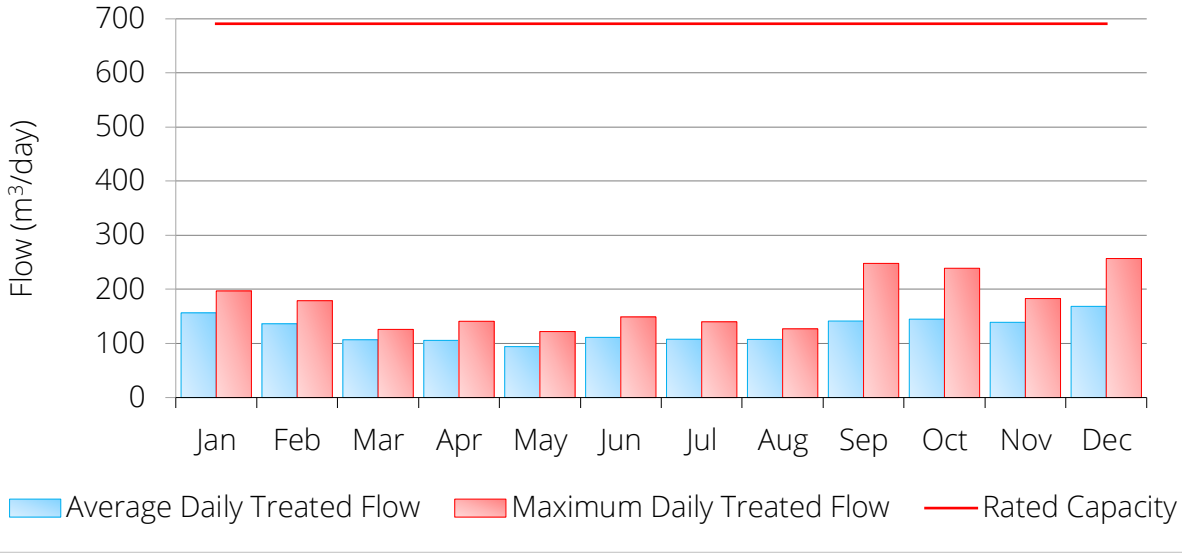
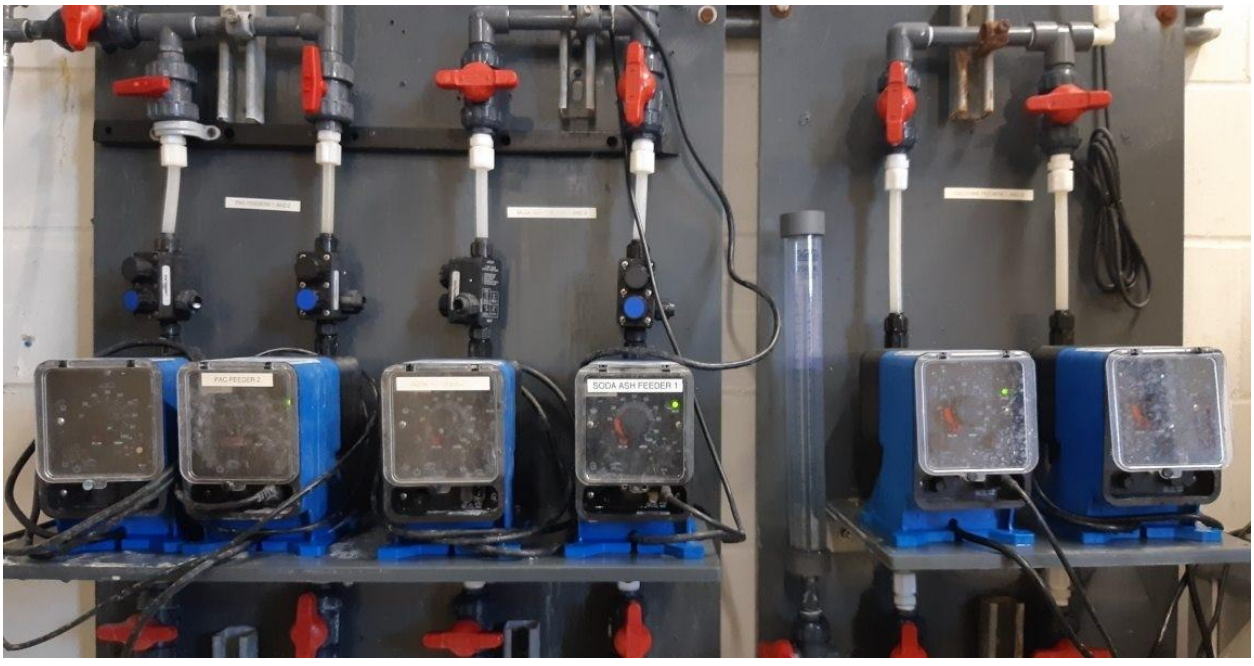


Table 13: 2022 water production summary

Month	Total Volumes (m^3)		Daily Flows (m^3/day)		Capacity Assessments	
	Raw Water	Treated Water	Average - Treated	Maximum - Treated	Average - Treated	Maximum - Treated
Jan	5,780	4,853	157	197	23%	29%
Feb	4,566	3,818	136	179	20%	26%
Mar	3,915	3,311	107	126	15%	18%
Apr	3,681	3,171	106	141	15%	20%
May	3,463	2,919	94	122	14%	18%
Jun	3,940	3,338	111	149	16%	22%
Jul	4,129	3,343	108	140	16%	20%
Aug	4,091	3,332	107	127	16%	18%
Sep	5,183	4,244	141	248	20%	36%
Oct	5,243	4,493	145	239	21%	35%
Nov	4,804	4,173	139	183	20%	26%
Dec	6,271	5,226	169	257	24%	37%
Total	55,066	46,221	---	--	---	--
Average	4,589	3,852	127	--	18%	--



4.3 Recent Historical Flows

Table 14 summarizes recent historical flow monitoring results for the Madsen Drinking Water System. While there was not a drastic increase in flows from 2021 to 2022, there were increases in the volumes of source water withdrawn and treated water supplied in 2022 when compared to 2021. As a small system, average daily flows and annual total volumes in Madsen can be disproportionately affected by events such as a significant watermain break or a heavy user. Total annual volumes of treated water supplied in the near future may be expected to be between 25,000 m^3 and 65,000 m^3, which represents approximately 10% to 26% of the rated capacity of the Madsen Water Treatment Plant

Table 14: Recent historical water production summary

Year	Total Volumes (m^3)		Daily Flows (m^3/day)		Annual % Change	
	Raw Water	Treated Water	Average – Treated	Maximum – Treated	Raw Water	Treated Water
2008	44,172	35,959	98	321	+20.2%	+22.2%
2009	47,489	37,576	103	255	+7.5%	+4.5%
2010	37,619	29,256	80	179	-20.8%	-22.1%
2011	32,282	26,739	73	234	-14.2%	-8.6%
2012	50,859	43,989	120	324	+57.5%	+64.5%
2013	40,656	32,605	89	211	-20.1%	-25.9%
2014	36,440	29,334	80	264	-10.4%	-10.0%
2015	40,124	33,852	93	323	+10.1%	+15.4%
2016	60,597	47,244	129	436	+51.0%	+39.6%
2017	72,569	57,113	156	305	+19.8%	+20.9%
2018	38,325	30,958	85	190	-47.2%	-45.8%
2019	45,910	37,036	101	212	+19.8%	+19.6%
2020	41,770	35,132	96	348	-9.0%	-5.1%
2021	53,624	45,450	125	308	+28.4%	+29.4%
2022	55,066	46,221	127	257	+2.7%	+1.7%

5 Compliance

5.1 Overview

Northern Waterworks Inc. and the Municipality of Red Lake employ an operational strategy that is committed to achieving the following goals:

- Providing a safe and reliable supply of drinking water to the community of Madsen;
- Meeting or exceeding all applicable legislative and regulatory requirements; and,
- Maintaining and continually improving the operation and maintenance of the system.

The following sections will summarize incidents of adverse water quality and regulatory noncompliance that occurred during the reporting period. NWI is committed to employing timely and effective corrective actions to prevent the recurrence of identified incidents of adverse water quality and noncompliance.

5.2 Adverse Water Quality Incidents

In accordance with section 11 (Annual Reports) of O. Reg. 170/03, this Report must summarize any reports made to the Ministry under subsection 18 (1) (Duty to report adverse test results) of *the Act* or section 16-4 (Duty to report other observations) of Schedule 16 of O. Reg. 170/03. Additionally, this Report must describe any corrective actions taken under Schedule 17 of O. Reg. 170/03 during the period covered by the report.

The two (2) adverse water quality incidents that occurred during the reporting period are summarized below.

- AWQI No. 158710 (June 15, 2022)

  An adverse water quality incident was reported to the ministry after a routine microbiological sample collected June 13, 2022, from the hydrant bleeder on main street, indicated the presence of Total Coliforms. Any presence of Total Coliforms constitutes an exceedance.

  Corrective action was performed in accordance with Schedule 18 of O. Reg. 170/03 and included flushing the distribution system and resampling at the location that indicated the presence of Total Coliforms, as well as at a location upstream, and downstream of the initial sample point. Samples were collected June 15, 2022.

- AWQI No. 158748 (June 18, 2022)

  An adverse water quality incident was reported to the ministry June 18, 2022, after resampling for microbiological parameters for the previous AWQI issued June 15, 2022, again indicated the presence of Total Coliforms at the main street hydrant. Any presence of total coliforms constitutes an exceedance.

  Corrective action was performed in accordance with Schedule 18 of O. Reg. 170/03 and included replacing pipes and taps of the hydrant bleeder, flushing the distribution system and resampling two consecutive sets of samples at the location that indicated the presence of Total Coliforms, as well as at a location upstream, and downstream of the initial sample point. All samples collected June 18, 2022, and June 20, 2022, tested absent for E. coli and total coliform parameters, and both AWQI 158710 and 158748 were resolved July 6, 2022.

5.3 Regulatory Compliance

In accordance with Schedule 22 (Summary Reports for Municipalities) of O. Reg. 170/03, this Report must list any requirements of the *Act*, the regulations, the system's approval, drinking water works permit, municipal drinking water licence, and any orders applicable to the system that were not met at any time during the period covered by the report. Additionally, this Report must specify the duration of the failure and the measures that were taken to correct the failure.

The most recent inspection by Ontario's Ministry of the Environment, Conservation and Parks was initiated on May 18, 2022. The final inspection rating was 100% and one (1) incident of regulatory noncompliance was identified. Information concerning the duration of failures and the measures taken to address those failures is provided below.

- Noncompliance item no. 1

A regulatory alarm at the treatment facility is immediately activated and transmitted to an on-call operator in the event that filtered water turbidity exceeds 0.60 NTU. On November 22, 2021, filter 2 turbidity spiked to 0.68 NTU, and on December 8, 2021, filter 2 spiked above 1.0 NTU. Adequate disinfection was maintained during each of the events; however, the operational logbook did not include a record of either event in respect to the turbidity. The event on December 8, 2021, was logged with details related to filter maintenance, but nothing directly related to the elevated turbidity observed.

In accordance with O. Reg 128, Condition 27., section (5), subsection 5., the OIC (Operator in Charge) is responsible for recording "any unusual or abnormal conditions that were observed in the subsystem during the shift, any action that was taken and any conclusions drawn from the observation". Current procedures exist that outline the requirement for operators to document any and all alarms, unusual, or abnormal conditions and all corrective actions undertaken. Annually, training is delivered to operators on preventing common incidents of regulatory non-compliance; the 2021 and 2022 training sessions included the requirement for documenting abnormal/unusual conditions. Daily operational spreadsheets were modified, effective April 27, 2021, requiring operators to confirm that any and all alarms, unusual or abnormal events had a corresponding logbook entry. Additionally, on June 22, 2022, a daily requirement in the operational spreadsheets specific to identifying unusual and/or abnormal conditions was included.