Outback Water Utility
2023 Annual Report

Regional District of North Okanagan
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Prepared for: Interior Health & RDNO
Prepared by: RDNO Utility Department
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ACRONYMS

AO	Aesthetic Objectives
AWWA	American Water Works Association
BCAWQ	British Columbia Approved Water Quality Guidelines
BCDWPA	*British Columbia Drinking Water Protection Act*
BPMS	Backflow Prevention Management Software
Caro	Caro Analytical Services
CCC	Cross Connection Control
CCCO	Cross Connection Control Officer
CCCP	Cross Connection Control Program
COP	Conditions on Permit
CoV	City of Vernon
CT	Contact Time
DBP	Disinfection By-Product
DoC	District of Coldstream
DOC	Dissolved Organic Carbon
DWO	Drinking Water Officer
DWPA	*Drinking Water Protection Act*
DWTO	Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies
E.coli	*Escherichia coli*
ENKI	Internet based data software system with centralized information management
EOCP	Environmental Operators Certification Program
ERP	Emergency Response Plan
DWPR	Drinking Water Protection Regulation
GCDWQ	Guidelines for Canadian Drinking Water Quality
GUDI	Groundwater under Direct Influence
GVW	Greater Vernon Water
IH	Interior Health
IMAC	Interim Maximum Acceptable Concentration
MAC	Maximum Acceptable Concentrations
MF	Membrane Filtration
MPN	Most Probable Number
NTU	Nephelometric Turbidity Units
OBWB	Okanagan Basin Water Board
ONPG	Ortho-nitrophenyl-b-D-galactopyranoside
OP	Operating Permit
P/A	Presence/ Absence
PAC	Poly Aluminum Chloride
PRV	Pressure-Reducing Valve
RDL	Read Detection Limit
RDNO	Regional District of North Okanagan
RP	Reduced Pressure Principle Assembly

RPD	Relative Percent Difference
SCADA	Supervisory Control and Data Acquisition software
SDWQG	Surface Drinking Water Quality Guidelines
TAC	Technical Advisory Committee
TCU	True Color Units
THM	Trihalomethane
TOC	Total Organic Carbon
UVT	Ultra Violet Transmissivity
WQI	Water Quality Indicators

1.0 INTRODUCTION

As required by the *British Columbia Drinking Water Protection Act (*BCDWPA*)*, the Regional District of North Okanagan (RDNO) provides the following annual report in accordance with our Conditions on Permit (COP) for the Outback Water Utility (OBW).

This report provides an overview of the following:

- the water system of the OBW,
- the operations of the OBW system including management, Environmental Operator Certification Program (EOCP) classification, and operations programs,
- the annual water quality monitoring program and a summary of the 2023 water quality analysis,
- water consumption,
- emergency response,
- reporting requirements,
- annual completed works, and
- long term plans.

The annual reports are available to the public on the RDNO website.

2.0 WATER SYSTEM OVERVIEW

2.1. SYSTEM OVERVIEW

The OBW is located within the Greater Vernon Water (GVW) service area. The OBW is classified as a small water system in its permit to operate, Facility # 13-098-005778. The Water Supply & Treatment Operators are responsible for the day-to-day operation and maintenance of the source and treatment of this system with oversight provided by the General Manager, Utilities and the RDNO Board of Directors. The water quality monitoring program, before the distribution system, is coordinated and monitored by RDNO water quality staff.

The distribution system is a private system contained on the Outback Resort strata property and is maintained by the Resort. The Outback Resort supplies water to customers living at the resort. RDNO operators complete day to day operation and maintenance tasks of the water supply system. The operators are required to respond to emergencies, 24 hours a day, seven days a week.

The OBW system owned and operated by the RDNO includes the following:

- intake - located in Okanagan Lake, 220 meters from shore and at a depth of 23 meters,
- 1.4 km transmission main:
    - 270 meters from intake to the screens,
    - 550 meters from lake station to booster station,
    - 300 meters from booster station to the reservoir, and
    - 300 meters from the reservoir to the strata.
- lake pump station - with submersible pumps at the lake level, pumps raw water through a screened intake up to the booster pump station, which is 28 m (92 ft.) higher in elevation,
- booster station - the raw water is chlorinated with sodium hypochlorite and ultra-violet (UV) treated, then pumped to the two celled reservoir,
- enclosed reservoir - stores 2.0 ML of water. The reservoir is at an elevation 443 m (1453 ft.) above sea level which provides water to one pressure zone in the entire strata complex, and
- OBW system - treats and delivers approximately 30 ML of water to customers annually.

3.0 WATER SOURCE

The water source for the OWU is Okanagan Lake.

3.1. TREATMENT REQUIREMENTS

The treated water quality objectives for all BC water systems using a surface water source need to meet the Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies (DWTO) in BC which include the following:

- 4 log removal or inactivation for viruses,
- 3 log removal or inactivation for protozoa (*Giardia* and *Cryptosporidium*),
- 2 treatment processes for surface water,
- 1 Nephelometric turbidity units (NTU) maximum turbidity, and
- 0 *Escherichia coli* (*E.coli*).

The treatment levels at the OBW are compliant with these standards. The source water is treated with chlorination and UV at the booster station. Chlorination of the water is completed to ensure efficient contact Time (CT) to provide 4 log removal or inactivation of viruses. UV is completed to

provide 3 log removal or inactivation of protozoa. The UV, turbidity and free chlorine residual are monitored continuously after disinfection using SCADA. Chlorine is dosed for a goal of a minimum of 0.2 mg/L free chlorine throughout the system to achieve the 0 *E.coli* condition.

3.2. DISTRIBUTION SYSTEM

The Outback resort manages their private distribution system on the strata property.

4.0 OPERATIONS

4.1. MANAGEMENT

The overall management of the OBW treatment system lies with the RDNO Utilities department (Table 1). Operations and maintenance of the water supply and treatment is completed by RDNO operators.

4.2. EOCP CLASSIFICATION

Section 12 of the *Drinking Water Protection Regulations* (DWPR) refers to qualification standards for persons operating water supply systems. In this section, EOCP certification is a requirement of operators operating a water system. A person is qualified to operate, maintain, or repair a water supply must be certified by the EOCP for the water system as classified under the EOCP.

A list of the operators certified through the EOCP employed by RDNO can be found in Table 2. The RDNO operators are responsible for operating and maintaining the source, reservoir, and chlorination facility.

4.3. OPERATIONS PROGRAMS

4.3.1. FLUSHING AND HYDRANT MAINTENANCE

The distribution system and hydrant maintenance within the resort are completed by the Outback resort.

4.3.2. CROSS CONNECTION CONTROL PROGRAM

The *Regional District of North Okanagan Cross Connection Control Regulation Bylaw No. 2651, 2014* was amended in 2014 to include utilities owned by the RDNO including the OBW. More information on this bylaw can be found at: www.rdno.ca/bylaws/BL_2651_C1.pdf.

4.3.3. SYSTEM CONTROL – SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SOFTWARE

The operation and maintenance monitoring of reservoir water levels, operating pumps, monitoring quality control equipment and maintaining a historical data file of the water systems operations is made easier by SCADA, a comprehensive monitoring software program used by RDNO.

Connected by wireless links, the SCADA software monitors sensors at all RDNO owned reservoirs and pump stations. The system is automated and used SCADA software for monitoring and alarms. When a problem is detected within the system, the SCADA system issues alarms and RDNO operators respond.

5.0 SOURCE ASSESSMENT AND WATERSHED PROTECTION PLANNING

Currently, the watershed area surrounding the OBW is minimally developed. With respect to activities on Okanagan Lake, RDNO participates in the Okanagan Collaborative Conservation Program (OCCP) projects around Okanagan Lake and the Okanagan Basin Water Board (OBWB).

6.0 WATER QUALITY MONITORING

The Outback water quality program references the following legislation, regulation, and guidelines to develop a Reporting and Monitoring Plan:

1. Guidelines for Canadian Drinking Water Quality (GCDWQ)
2. British Columbia Drinking Water Protection Act and Regulation (DWPA and DWPR)
3. British Columbia Source Drinking Water Quality Guidelines (WQG-01)
4. Drinking Water Treatment Objectives for Surface Water (DWTO) in BC, and
5. Decision Tree for Responding to Turbidity Event in Unfiltered Drinking Water.

The water quality program is designed to monitor weekly and monthly variations in water quality and provide statistics for yearly trending from the source to the tap.

The Interior Health (IH) small water systems Drinking Water Health Officer oversees the OBW independently from the larger Greater Vernon Water system.

Source water quality monitoring is an important component of the multi-barrier approach to drinking water management. The source water quality program compares source water with guidelines, criteria, and regulations set for both health and aesthetic reasons. The program also tracks seasonal trends that may affect chlorine demand.

The water quality program is designed to meet the community water system regulations prescribed by the *British Columbia Drinking Water Protection Regulation (*BCDWPR*) (*Schedules A and B). Supporting the program is also the Canadian Drinking Water Guidelines which provide Maximum Acceptable Concentrations (MAC) and Aesthetic Objectives (AO), for health and

aesthetic reasons. Other parameters may be monitored if they are known to create problems within water distribution systems.

Drinking water quality is a function of source water quality and what occurs within the distribution system post disinfection (UV and chlorination). Monitoring drinking water quality consists of four (4) components in the *Source to Tap Approach*:

1. Source (Source) water monitoring,
2. Monitoring after chlorination (at outflow reservoir),
3. Monitoring in the distribution system, and
4. Customer concerns.

For more information regarding testing parameters and MAC levels, please visit Health Canada's website at: www.canada.ca/en/health-canada/services/environmental-workplace-health/water-quality/drinking-water/canadian-drinking-water-guidelines.html.

6.1. PROGRAM AND SCHEDULE

Water quality monitoring for the OBW is based on the requirements of the DWPR, Schedules A and B (Government of BC, 2003), the GCDWQ (Health Canada, 2017), and the *Source Drinking Water Quality Guidelines* (SDWQG) (MoE, 2017).

The Water Quality Monitoring Program for the OBW is reviewed annually in the fall for implementation of the following year. The sampling program and schedules are provided in Appendix A and Table 3 for 2023. RDNO provides this updated Water Quality Monitoring Plan to IH at the beginning of each year.

To meet Schedule B requirements in the DWPR for populations less than 5,000, a minimum of four microbiological samples are required per month following treatment. In 2023, the OBW met this requirement. This was accomplished by taking one sample every Monday.

6.2. SOURCE WATER QUALITY MONITORING

This section outlines the bacterial, turbidity, ultraviolet transmissivity (UVT), pH, temperature and annual chemical results for 2023 on the source water at the OBW.

6.2.1. BACTERIA

The DWTO states source water must meet:

- the number of *E.coli* in source water does not exceed 20/100 mL, or
- if *E.coli* data are not available (less than 100/100 mL of TC) in at least 90% of the weekly samples from the previous six (6) months.

Total Coliform is also monitored as an indicator bacteria to assess changes in source water.

In 2023, Caro analytical and RDNO laboratory analyzed 12 bacterial samples. Caro Analytical results had a maximum Total Coliform count of 727 MPN/100 mL and a maximum E.coli count was <1.0 MPN/100 mL. RDNO Laboratory results had a maximum Total Coliform count of 980 MPN/100mL and a maximum E.coli count of 1 MPN/100 mL (Table 4). The bacterial results are displayed in Figures 1 and 2.

OBW met the DWTO requirement for *E.coli* but not for Total Coliforms during the summer months (July, August and September).Total Coliforms are an indicator parameter and the OBW has two forms of disinfection. In addition, the reservoir samples show this is sufficient treatment as there are no samples with Total Coliforms going into the distribution system.

6.2.2. TURBIDITY

Turbidity measurements relate to the optical properties of water. Turbidity is caused by suspended matter such as clay, silt, finely divided organic and inorganic maters, soluble coloured organic compounds, plankton and other microscopic organisms. Excessively high turbidity can have a negative effect on disinfection techniques. A provincial guidance document issued in April 2013, *the Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water* (BC Ministry of Health, 2013) assists the RDNO during turbidity events and communication with the water customers.

Table 5 summarizes the source water field parameters for turbidity taken from the Outback Intake. All grab samples were less than 1 NTU and meet the DWTO requirements noted above. The turbidity results are displayed in Figure 3.

Monthly water quality reports and the GVW Water Quality Deviation Response Plan, provided further details regarding turbidity events and/or trigger levels for response and notification. When turbidity trends above 1 NTU on a 24-hour average, a Water Quality Advisory (WQA) is issued.

6.2.3. FIELD PARAMETERS

Table 5 summarizes the source water field parameters for pH, temperature, and conductivity in 2023. All results, except temperature, were within the guidelines. The average pH reading was 7.4, a minimum of 7.0 and a maximum of 8.0. The average temperature reading was 11.4 degrees Temperature ranged from a minimum of 4.6 degrees Celsius and a maximum of 18.2 degrees Celsius. Typically when the lake temperature is higher, it corresponds to higher Total Coliforms.

The average conductivity reading was 293 µS/cm, a minimum of 270 µS/cm and a maximum of 300 µS/cm.

6.2.4. UV TRANSMISSIVITY

Ultraviolet Transmissivity (UVT) is important to measure as ultraviolet treatment (disinfection) is one of the primary treatment method for the OBW with the other being chlorine. Measuring UV light at the specified wavelength of 254nm measures the effectiveness of the UV light for disinfection of the drinking water. UV Transmittance (UVT) is not turbidity. The water's clarity is not an effective indicator, because both solid and dissolved material can absorb and diffract UV light.

Water is pumped from Okanagan Lake to the Outback booster station for disinfection treatment using a Wedeco UV reactor. The UV reactors design flow is 24 l/sec, operates with a minimum sensor intensity and UVT is used to determine the dose. The dose calculation given in the specs for this unit takes a minimum UV intensity read from the sensor to create a curve plotting flow vs UVT. If UVT goes below 86%, operations reduce flow to the reactors with an upgraded pressure reducer (PR) at the lake station to stay on the treatment curve. 81% is the lower end of that style of sensor where the measurement is considered not reliable below. Operators follow the Deviation Response Plan when there are changes from acceptable levels.

Continuous online UVT monitoring is completed with an analyzer at the booster station. The monthly average for UVT was 90.59%, a minimum of 89.07% and a maximum of 92.93% (Table 6). When the UVT is less than 86% it doesn't meet the UV reactor specifications at design flow. Therefore, when UVT is less than 86%, flow is reduced to meet UV reactor design. The data reported in September that shows UVT is less than 86% is due to analyzer cleaning mechanism failing. Onsite grab samples were greater than 86%. The UVT SCADA data for 2023 is displayed in Figure 4.

6.2.5. ORGANIC CARBON

Total Organic Carbon (TOC) is a measure of suspended carbon bound in organic molecules and organisms. This is an important parameter as it is a precursor for disinfection by-products (this is discussed further in Section 5.4.5 Disinfection By-Products (DBP)). Organics can interfere with the effectiveness of UV disinfection by reducing the UVT. The SDWQG Maximum Acceptable Concentration (MAC) for TOC is 4.0 mg/L.

In 2023, the average TOC was 4.38 mg/L, the minimum was 3.37 mg/L and the maximum was 5.37 mg/L (Table 7). The TOC results were over 4.00 mg/L in January, March, April, May, July, August, September, and November (Figure 5). Based on the 2023 sampling results, TOC exceeds

the SDWQG MAC guideline, however it is measured as an indicator parameter for DBP potential and for trending for future treatment options and does not have a direct health impact.

6.2.6. ANNUAL COMPREHENSIVE

Comprehensive sampling is completed annually in July or August each year. The 2023 comprehensive samples were taken on August 23 and all parameters were well within the GCDWQ limits (Appendix B).

6.3. TREATMENT PROCESS

OBW is sourced from surface water from Okanagan Lake. Treatment requirements at OBW occur as per Section 3.1.

6.3.1. CHLORINE

Under normal operations, the target residual after chlorine injection is normally between 1.00 to 2.50 mg/L. The large range is due to the size of the reservoir and turnover rate, which is different in the summer and winter. In the winter, the chlorine injection must be higher due to the water sitting longer in the pipes.

Continuous online chlorine monitoring is completed with an analyzer that monitors the free chlorine just past the injection point at the booster station. In the event of a low-level chlorine alarm, the system is programed through SCADA to shut off the lake pumps automatically and notify the operator. This ensures that unchlorinated water is not pumped into the distribution system.

The average monthly SCADA free chlorine in 2023 was 1.49 mg/L with a minimum of 1.22 mg/L and a maximum of 1.76 mg/L (Table 8).

Table 9 summarized monthly grab samples for chlorine taken at the Outback Reservoir. The free chlorine monthly average was 1.44 mg/L, the minimum was 1.17 mg/L and the maximum was 1.61 mg/L.

6.3.2. BACTERIAL

The GCDWQ and the DWPA and DWPR have established the following microbiological criteria for drinking water distribution systems, as provided in Schedule A of the DWPR:

1. **No detectable Escherichia coli (*E.coli*) per 100 ml.**

   In 2023, all samples were non-detectable for *E.coli* (Table 10).

2. **At least 90% of samples have no detectable Total Coliform bacteria per 100 ml.**

In 2023, all samples were non-detect for Total Coliform (Table 10).

3. **No sample has more than 10 Total Coliform per 100 ml.**

   In 2023, no samples had more than 10 Total Coliform (Table 10).

Bacterial samples analysed by Caro are taken at the Outback reservoir before entering the distribution system with the results summarized in Table 10. The results met the GCDWQ and the DWPR criteria.

6.3.3. TURBIDITY

Currently, the OBW is disinfected with chlorine and UV treatment to provide inactivation of protozoa and viruses (3 log and 4 log reduction respectively). Turbidity is continuously monitored by SCADA after disinfection with an online turbidity analyzer at the reservoir. The reservoir is also tested with a hand-held turbidity meter weekly to ensure the turbidity analyzer is reading correctly. Field parameters are also recorded on the submitted requisition sheets sent to Caro with bacterial samples. The field parameters are entered into ENKI by RDNO water quality staff.

Table 11 summarizes the SCADA monthly average. The monthly average was 0.21 NTU, the monthly minimum was 0.11 NTU and the monthly maximum was 0.43 NTU. This is well below the guideline of 1.0 NTU.

Table 12 summaries the handheld turbidity results. The average was 0.28 NTU, the minimum was 0.10 NTU and the maximum was 0.78 NTU.

6.3.4. FIELD PARAMETERS

Table 12 summarizes the field chlorine, temperature and turbidity measured using a handheld meters for the Outback Reservoir. Turbidity and chlorine results are discussed in the proceeding sections. The average temperature reading was 8.84 degrees Celsius, with a minimum of 4.0 degrees Celsius and a maximum of 13.5 degrees Celsius. All results were within guidelines.

6.3.5. DISINFECTION BY-PRODUCTS

Trihalomethanes (THMs) and Haloacetic acids (HAAs) are a disinfection by-product formed when organic compounds naturally present in the source water react with chlorine. The level of THMs and HAAs in treated water depends on numerous factors including: TOC, temperature, pH, water age, and chlorination dose (Health Canada, 2017). The DWPA requires that THM’s and HAA’s be monitored in drinking water due to their potential health impacts.

Ten distinct THM compounds are possible but only four occur to any significant degree in treated drinking water:

- Chloroform,
- Bromodichloromethane,
- Dibromochloromethane, and
- Bromoform.

Collectively the above THM compounds are referred to as total Trihalomethanes (TTHMs). Further in this text, TTHMs will refer to sample site averages of all four compounds, not the individual parameters. The GCDWQ MAC for TTHM's is 0.1 mg/L and is based on a locational running average of a minimum of quarterly samples taken at the point in the distribution system with the highest potential THM levels. The Outback distribution system is operated by the Outback strata, therefore the THM's are taken at the Outback reservoir. In 2023, THM's were taken three times, March, June, and November. September's samples were not taken due to a miscommunication. Table 13 provides the TTHM results which were above the MAC with a TTHM average of 0.1040 mg/L. The THM results are displayed in Figure 6.

Several distinct HAA compounds are possible but only five occur to any significant degree in treated drinking water:

- Monochloroacetic acid,
- Monobromoacetic acid,
- Dichloroacetic acid,
- Trichloroacetic acid, and
- Dibromoacetic acid.

Collectively the above HAA compounds are referred to as total Haloacetic acids (THAAs). Going forward in this report, THAAs will refer to sample site averages of all five compounds, not the individual parameters.

The GCDWQ MAC for THAA's is 0.08 mg/L and is based on a locational running average of a minimum of quarterly samples taken at the point in the distribution system with the highest potential THM levels. In 2023, HAA's were taken three times, March, June and November. September's samples were not taken due to a miscommunication. Table 14 provides the THAA results which were above the MAC with a THAA average of 0.0850 mg/L. The THM results are displayed in Figure 7.

Figure 8 displays the distribution annual average of Total THM's since 2010. Trending demonstrates that the TTHM's have been historically below standards with an increase in 2017

and 2018, likely due to the historic flooding in the area and an increase in TOC and organics in the source water. Since 2020 there has been a reduction, but it has not returned consistently to historic values. Operations has installed reservoir mixers, one in 2022 and one in 2023, in an effort to improve water quality and mixing that can reduce water age and dead zones in the reservoir in an effort to improve upon the THMs.

Figure 9 displays the distribution annual average of Total HAA's since 2010. The trending of THAA's is more difficult to attribute to events and fluctuations around the GCDWQ MAC but has been more consistently below than above.

6.4. DISTRIBUTION

The Outback resort maintains the distribution system and the RDNO monitors the water leaving the reservoir before entering the distribution system.

7.0 WATER CONSUMPTION

Figure 10 displays the 2023 monthly water consumption for the OBW in 2023. Table 15 provides the monthly consumption data for the OBW in 2023. Water consumption begins to significantly increase in April with peak flows usually observed in July, while September shows a decrease in monthly flows. As the Outback is a seasonal resort community these flow patterns align with the highest occupancy occurring the summer months.

The total consumption for 2023 was just below 29 ML. Figure 11 shows the historic annual water consumption from 2015 to 2023.

8.0 EMERGENCY RESPONSE PLANNING

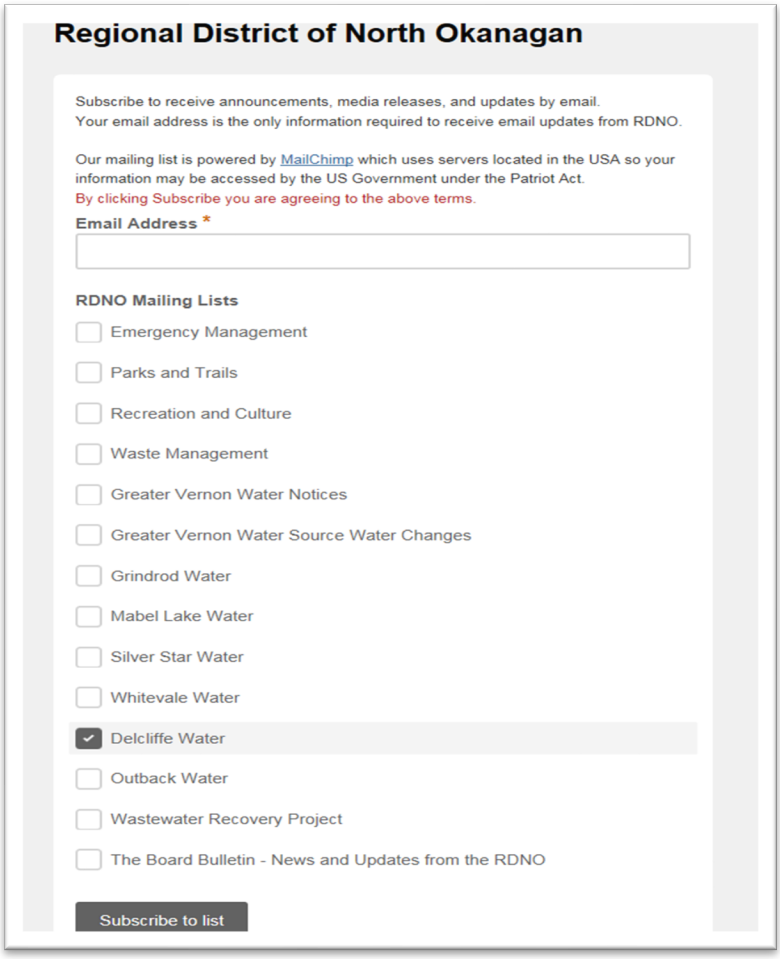
8.1. THE EMERGENCY RESPONSE PLAN

RDNO Utilities staff are all instructed on how to use the following supporting documents in times of water quality changes or emergencies:

1. GVW Emergency Response Plan, and
2. GVW Water Quality Deviation Response Plan.

The above documents contain the contacts, criteria, and procedures necessary to assist operators and staff to make timely, informed decisions. Staff participate in mock emergency training scenarios annually. The 2023 response plans have been provided to IH.

When required, a WQA or Boil Water Notice (BWN) are delivered as quickly and efficiently as possible. Notification may include road signs, radio and/or media releases. Under specific circumstances notifications are hand delivered. In 2018, the RDNO developed a new method to provide notification to its customers about announcements, media releases and updates via email. Customers are advised to subscribe to the OBW mailing list by going to www.rdno.ca/subscribe and clicking on “Subscribe for Updates” and subscribe to the OBW email updates (shown below).



8.2. INCIDENTS AND NOTIFICATIONS

In 2023, there were no incidents that occurred at the OBW. Reporting of incidents is required by the RDNO when there is a deviation from normal operating procedure or a water quality issue. Incident reporting allows staff to track and review issues to assess if improvements could reduce the risks from each issue.

In 2023, there were no notifications sent out to the customers of the Outback resort.

9.0 REPORTING REQUIREMENTS

Monthly and annual reports are submitted to IH as per the COP and are available to the public on the RDNO website (www.rdno.ca). Monthly reports for the last twelve months are available on the website and if historical reports are wanted please contact RDNO at 250-550-3700.

10.0 PLANNED WORKS

10.1. 2023 WORK COMPLETED

Operational changes and improvement projects have been completed to increase the safety and reliability of the OBW system. These include:

- programming change to change flow setpoint if required at booster station
- new chlorine injection quill
- cleaned reservoir
- installed mixer in cell of reservoir

10.2. LONG TERM PLANS

Long term plans are required for utilities that do not meet Provincial standards. Currently the OBW has sufficient capacity to service its customers with no plans on expansion. Treatment does not meet standards as filtration is required unless a filtration deferral is approved by IH which is dependant on source water quality. The RDNO in reviewing water quality trends and intends to apply for filtration deferral. The following are the long term plans for the OBW:

- Improve asset renewal plans for the utility;

11.0 CLOSING

RDNO strives to implement the DWPA and DWPR.

RDNO is pleased to present the 2023 OBW Annual Report, detailing the health and direction of our water system. If you have any questions about this report or want more information about water consumption and production, please contact the RDNO at 250-550-3700 or email utilities@rdno.ca.

TABLES

Table 1: RDNO Utilities Staff

RDNO Utilities	
Zee Marcolin, P.Eng	General Manager, Utilities
John Lord, P.Eng	Manager, Water Distribution
Sandy Edwards, AScT	Manager, Projects
Tricia Brett, MSc., PAg.	Manager, Water Quality
Connie Hewitt, AScT	Water Quality Technologist
Jamie Ferris	Water Quality Technician
Chris Cannon	Water Quality Technician
Nathan Betz	Engineering Technician
Kimberly Berndt	Engineering Technician
Mike Philips, AScT	Engineering Technologist / Bylaw Officer
Skyler Ganz, AScT	Engineering Technologist
Alec Busby, EIT	Assistant Utilities Engineer
Keiko Parker, AScT	Manager, Small Utilities
Jonathn McLuskie	Utilities Quality Assurance Inspector

Table 2: RDNO Water Operators EOCP Certifications

RDNO Operators			
Last Name	First Name	Certification #	Certification Held
Heidt	Dustin	4498	WDIII, WTIV
Hartwig	Corey	9378	WTI
Mykytuk	Becky	9086	WTIII
Beckett	Jemma	1001610	WTI
Cimon	Caroline	1001075	WTII
Lockwood	Ryan	1000755	WDI, WTII
Tucker	Chris	6489	WTIV, WDII
Radu	David	1002040	WTII

Table 3: Outback Lake Station Parameter sample frequency

Physical / Chemical Parameters	Accredited Lab Analysis	RDNO Lab Analysis	Sampling		
			Weekly	Monthly	Quarterly
Turbidity		X		X	
pH		X		X	
Temperature		X		X	
Conductivity		X		X	
Alkalinity		X			X
Chlorophyll a	X			X**	
Colour (Apparent)		X			X
Hardness		X			X
Nitrogen	X				X
Total Organic Carbon	X			X	
UVF - Filtered	X*				
UVT - Unfiltered	X*				
Total Phosphorous	X			X	
Sulfphate		X*			
Biological Parameters	**Accredited Lab Analysis**	**RDNO Lab Analysis**	**Sampling**		
			Weekly	**Monthly**	**Quarterly**
Total Coliform	X	X		X	
E.coli	X	X		X	
Iron Related Bacteria	X*			X	
Sulfur Reducing Bacteria	X*			X	

* These parameters were sometimes sampled less frequently.

** This parameter was sampled monthly during the spring and summer months.

Table 4 Outback Lake Station Bacterial Summary

Total Coliform MPN/100 mL	Accredited Lab	RDNO Lab
Min	<1	<1
Max	727	980.4
# of Samples	12	19
Counts ≥ 100 MPN/100 mL	3	5
Counts <1 MPN/100 mL	4	6
E. *coli* CF/100 mL	**Accredited Lab**	**RDNO Lab**
Min	<1.0	<1
Max	<1.0	1
# of Samples	12	19
Counts ≥ 20 MPN/100 mL	0	0
Counts <1 MPN/100 mL	12	18

Table 5 Outback Lake Station Field Parameters

Outback Lake Station Field Parameter Results				
Sample Date	**Turbidity NTU**	**pH**	**Temperature Degrees C**	**Conductivity (uS/cm)**
January 23, 2023	0.38	7.6	4.6	270
February 27, 2023	0.31	7.5	6.7	290
March 27, 2023	0.34	7.7	5.1	300
April 24, 2023	0.17	7.6	8.7	300
May 25, 2023	0.87	7.1	14.3	280
June 26, 2023	0.33	7	14.9	290
July 24, 2023	0.54	7.7	16.8	290
August 23, 2023	0.59	6.9	18.2	300
September 28, 2023	0.71	7.1	16.9	294
October 30, 2023	0.76	7.4	11.9	300
November 27, 2023	0.5	8	8.8	297
December 18, 2023	0.43	7.7	9.5	299
Minimum	0.17	6.9	4.6	270
Maximum	0.87	8.0	18.2	300
Average	0.49	7.4	11.4	293
# of Samples	12	12	12	12
# of Samples> 1 NTU	0	na	na	na
# of sample > 15 degrees C	na	na	3	na

Table 6 UVT SCADA

Outback SCADA UV Transmissivity (%)	
Month	**SCADA Monthly Average**
January	92.47
February	89.58
March	90.87
April	91.00
May	89.79
June	89.20
July	90.20
August	89.71
September	89.07
October	90.59
November	91.68
December	92.93
Monthly Min	89.07
Monthly Max	92.93
Monthly Average	90.59

Table 7 Source TOC Results

Outback Lake Station TOC Results	
Sample Date	**Total Organic Carbon (mg/L)**
January 23, 2023	5.19
February 27, 2023	3.37
March 27, 2023	4.11
April 24, 2023	4.22
May 25, 2023	4.44
June 26, 2023	3.91
July 24, 2023	5.37
August 23, 2023	5.14
September 28, 2023	4.8
October 30, 2023	3.66
November 27, 2023	4.95
December 18, 2023	3.37
Minimum	3.37
Maximum	5.37
Average	4.38
# of Samples	12

Table 8 Reservoir SCADA Chlorine

Outback Reservoir Free Chlorine (mg/L)	
Month	**SCADA Monthly Average**
January	1.76
February	1.7
March	1.5
April	1.36
May	1.46
June	1.64
July	1.55
August	1.5
September	1.22
October	1.31
November	1.64
December	1.28
Monthly Min	1.22
Monthly Max	1.76
Monthly Average	1.49

Table 9 Reservoir Chlorine Grab Samples Summary

Outback Reservoir Grab Sample		
Month	**Monthly Average Free Chlorine (mg/L)**	**Monthly Average Total Chlorine (mg/L)**
January	1.54	1.74
February	1.60	1.78
March	1.43	1.58
April	1.38	1.59
May	1.45	1.69
June	1.61	1.76
July	1.53	1.74
August	1.50	1.66
September	1.32	1.49
October	1.29	1.45
November	1.49	1.68
December	1.17	1.30
Monthly Min	**1.17**	**1.30**
Monthly Max	**1.61**	**1.78**
Monthly Average	**1.44**	**1.62**

Table 10 Reservoir Bacterial Summary from Caro

Outback Reservoir		
Sample Date	**Total Coliform CFU/100 mL**	**E.coli CFU/100 mL**
Minimum	<1	<1
Maximum	<1	<1
Average	<1	<1
Counts >1	0	0
Count	53	53

Table 11 Reservoir SCADA Turbidity Daily Average

Outback Reservoir SCADA Turbidity (NTU)	
Month	**SCADA Monthly Average**
January	0.12
February	0.11
March	0.11
April	0.13
May	0.42
June	0.43
July	0.27
August	0.21
September	0.18
October	0.16
November	0.18
December	0.15
Monthly Min	0.11
Monthly Max	0.43
Monthly Average	0.21

Table 12 Reservoir Field Parameter Grab Samples

Outback Lake Reservoir Field Parameter Results				
Sample Date	**Free Chlorine mg/L**	**Total Chlorine mg/L**	**Turbidity (NTU**	**Temperature Degrees C**
Minimum	1.00	1.14	0.10	4.0
Maximum	2.20	2.40	0.78	13.5
Average	1.46	1.63	0.28	8.84
# of Samples	56	56	56	56
# of samples <0.20 mg/L	0	0	na	na
# of samples> 1 NTU	na	na	0	na
# of sample > 15 degrees C	na	na	na	0

Table 13 THM's

Outback Reservoir THM Results				
Sample Date	**THMs (mg/L)**			
	Bromodichloromethane	Bromoform	Chloroform	Dibromochloromethane
March 27	0.007	<0.001	0.0729	<0.001
June 26	0.0078	<0.001	0.134	<0.001
November 27	0.0081	<0.001	0.0818	<0.001
TTHM 1	0.0799			
TTHM 2	0.1418			
TTHM 3	0.0899			
TTHM 1-3	**0.104**			

Table 14 HAA's

Outback Reservoir HAA Results					
Sample Date	**HAAs (mg/L)**				
	Monochloroacetic Acid	Monobromoacetic Acid	Dichloroacetic Acid	Trichloroacetic Acid	Dibromoacetic Acid
March 27	<0.002	<0.002	0.0375	0.036	<0.002
June 26	<0.002	<0.002	0.0478	0.043	<0.002
November 27	<0.002	<0.002	0.0507	0.0401	<0.002
THAA 1	0.0735				
THAA 2	0.0908				
THAA 3	0.0908				
THAA 1-3	**0.0850**				

Table 15 Water Consumption

Outback Water Consumption	
Month	**Outback (ML/month)**
January	0.99
February	1.03
March	1.01
April	1.51
May	3.45
June	4.72
July	4.95
August	4.93
September	2.42
October	1.24
November	1.44
December	1.17
Annual Total (ML)	28.86

FIGURES

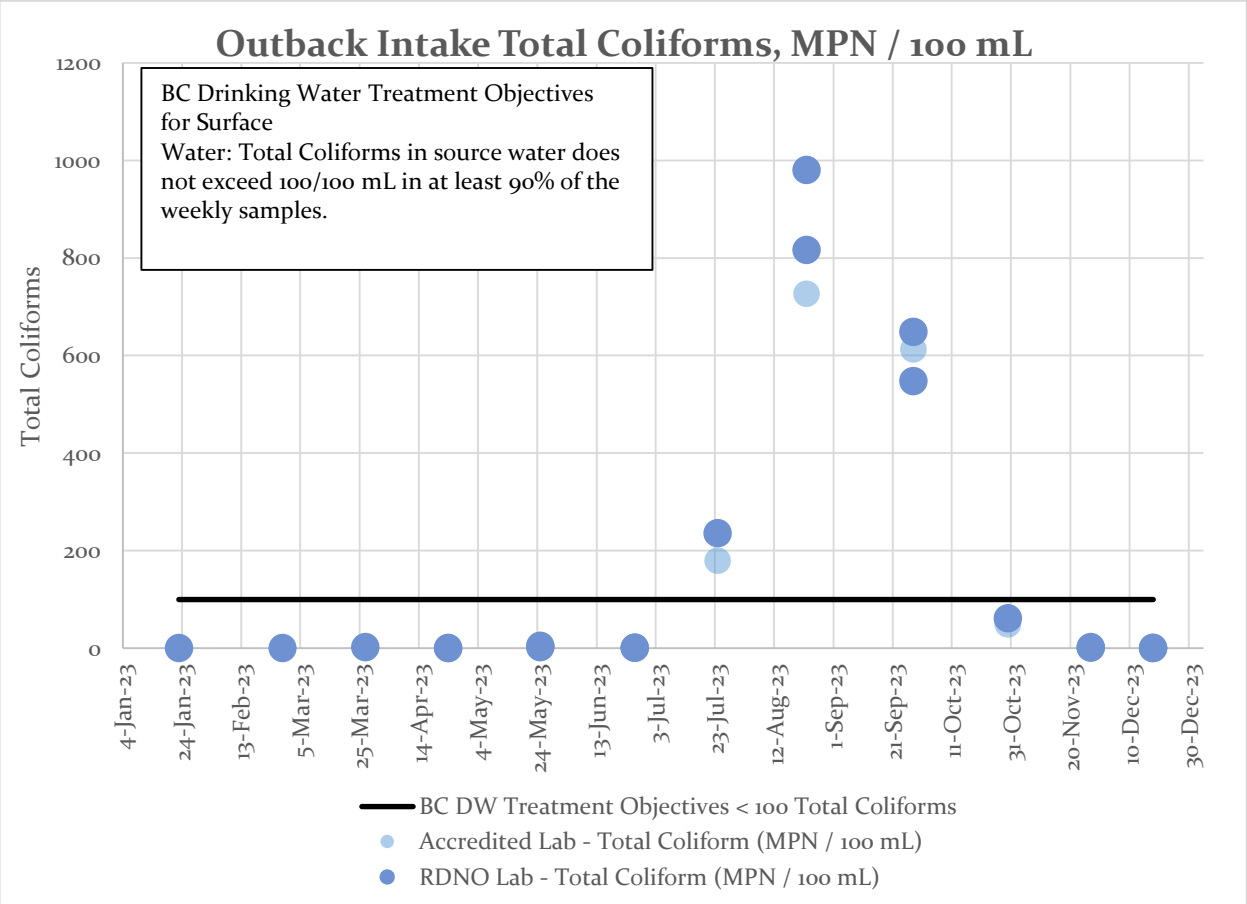


Figure 1 Source Water Total Coliform Results for Outback Intake (<1 Total Coliform are shown on the graph as 0 Total Coliform)

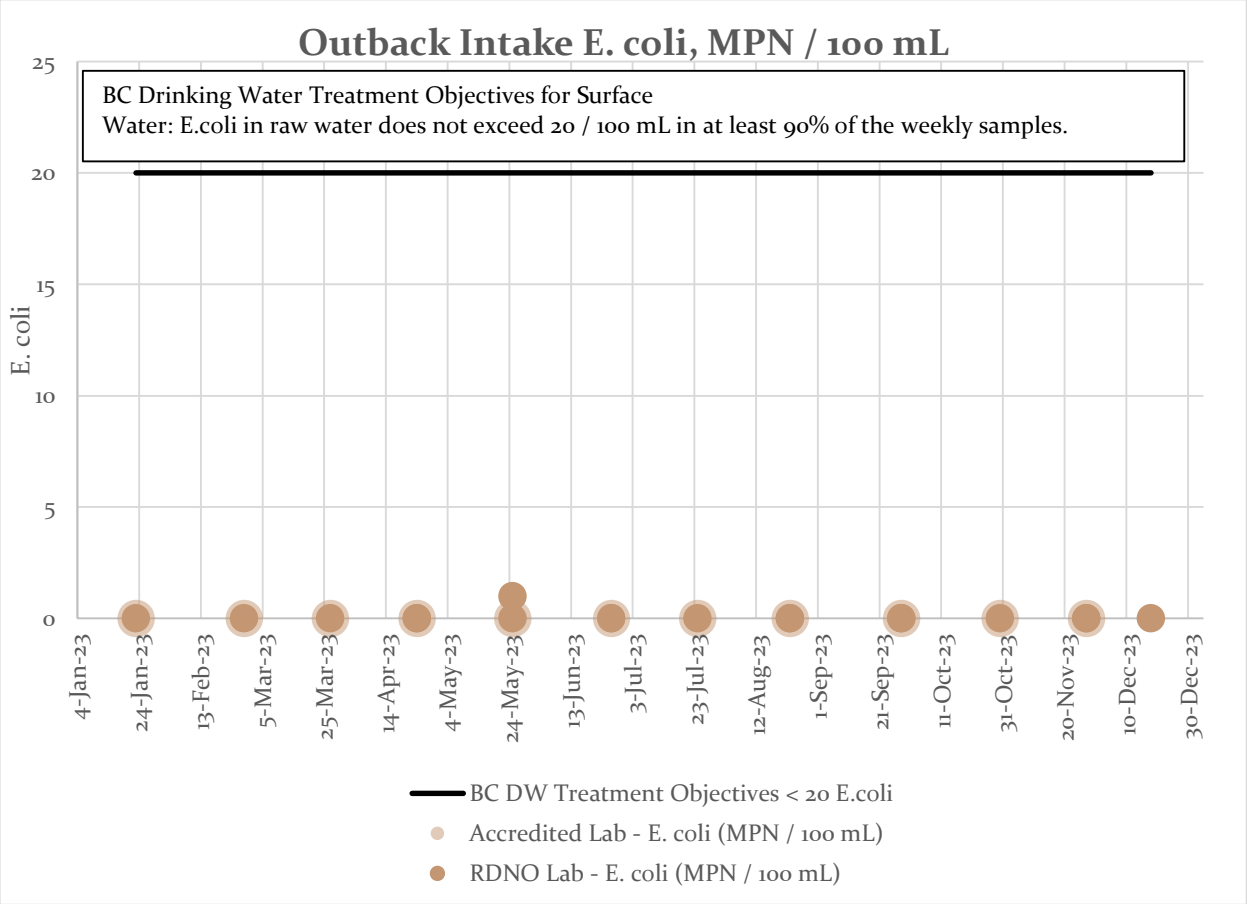


Figure 2 Source Water E.coli Results for Outback Intake (<1 E.coli are being shown on the graph as 0 E.coli)

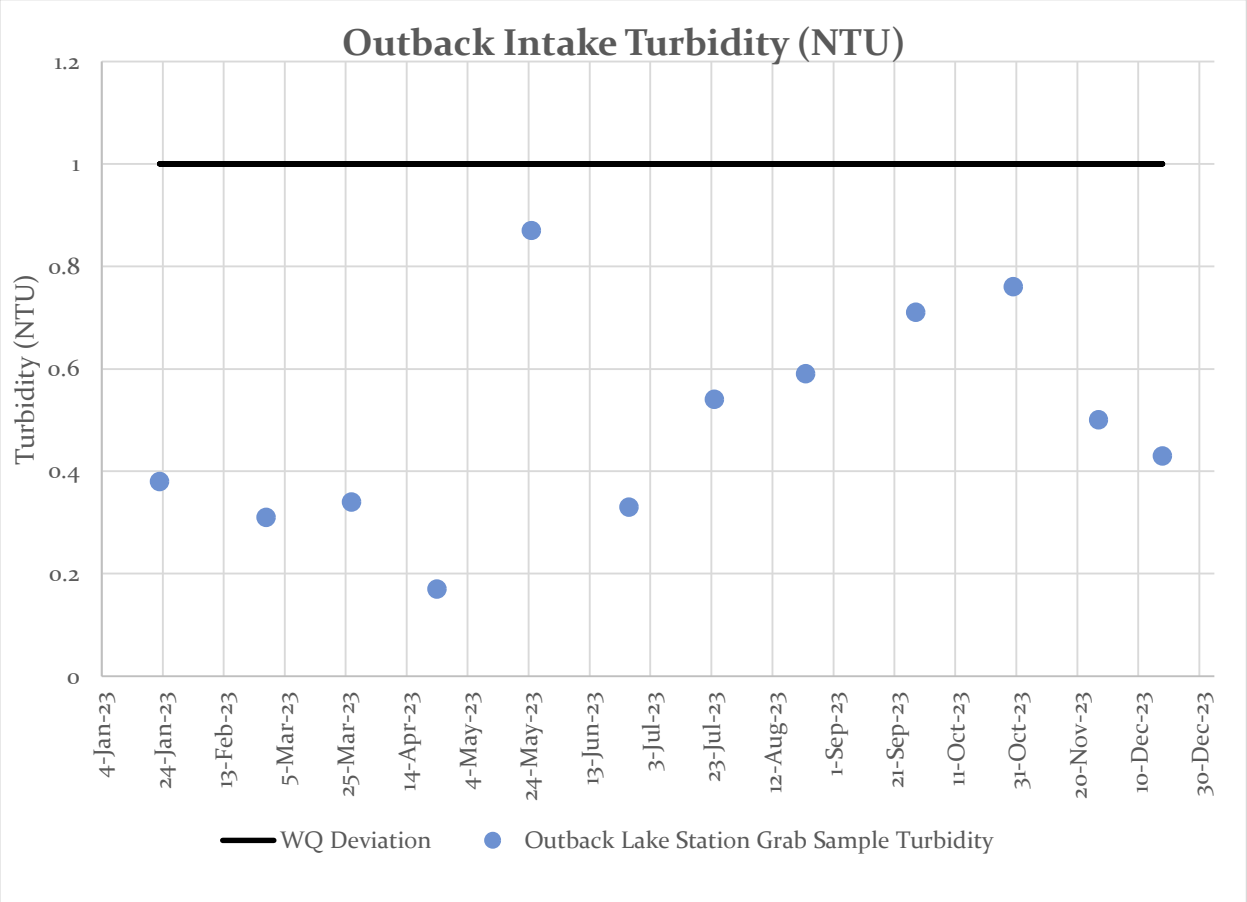


Figure 3 Outback Intake Grab Sample Turbidity

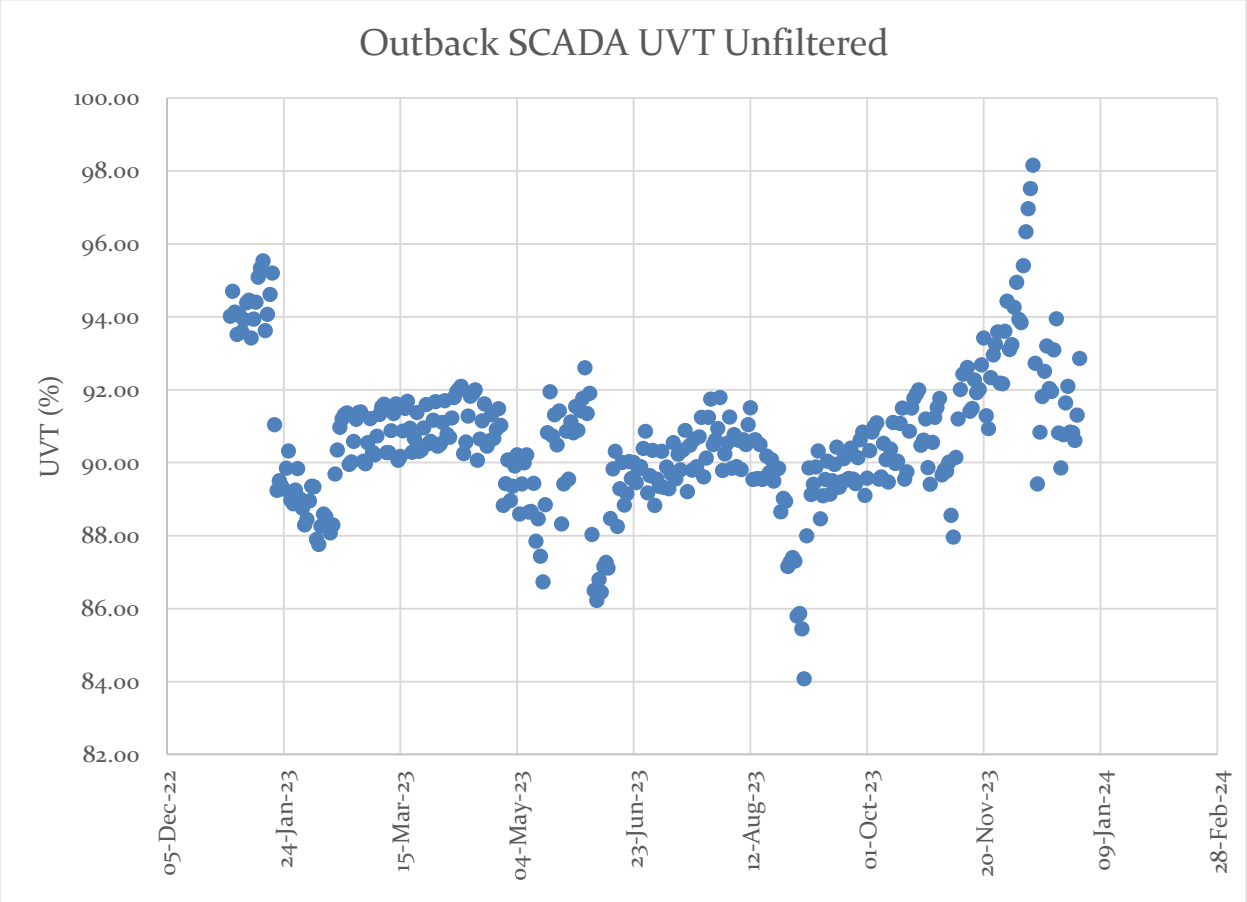


Figure 4 Outback SCADA UVT-unfiltered

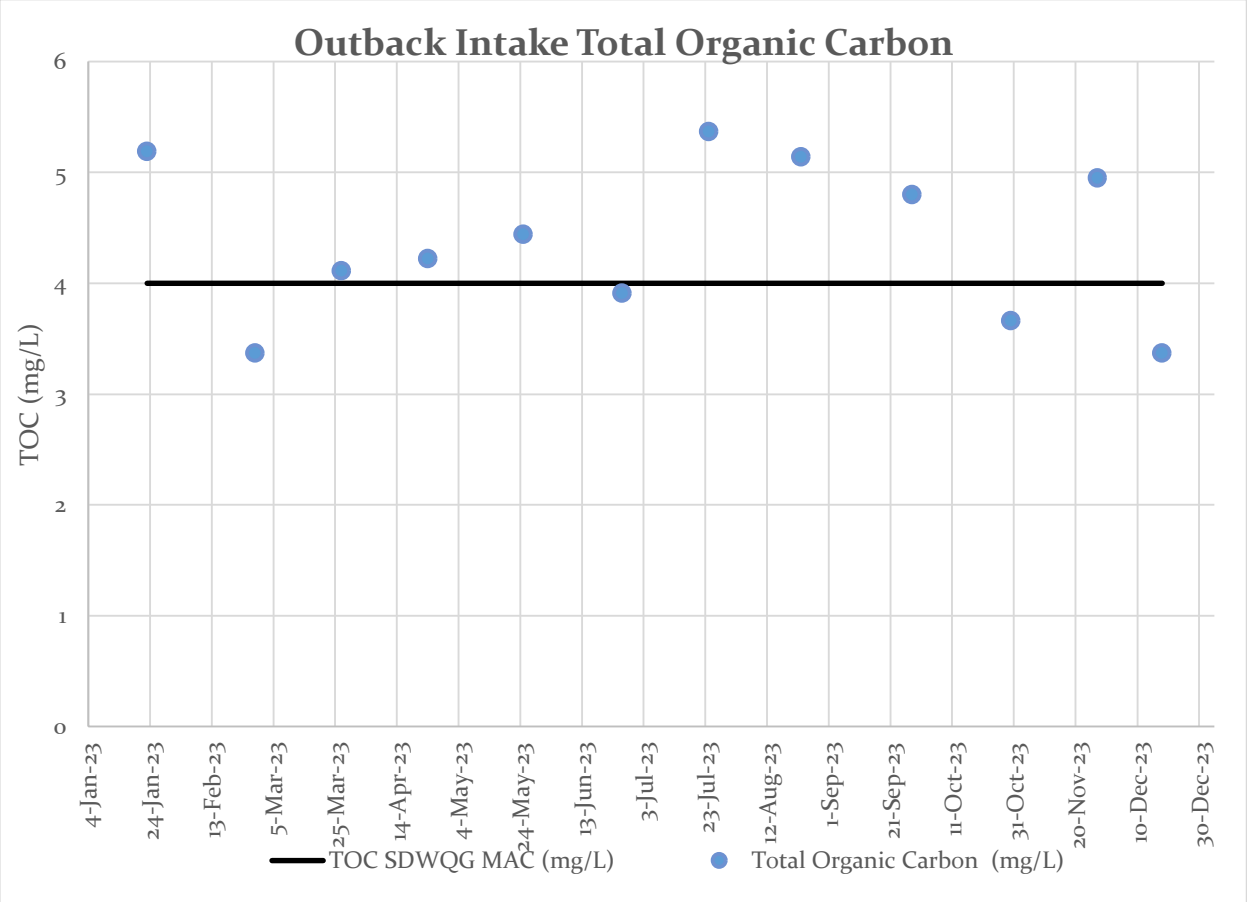


Figure 5 Outback Lake Station Total Organic Carbon

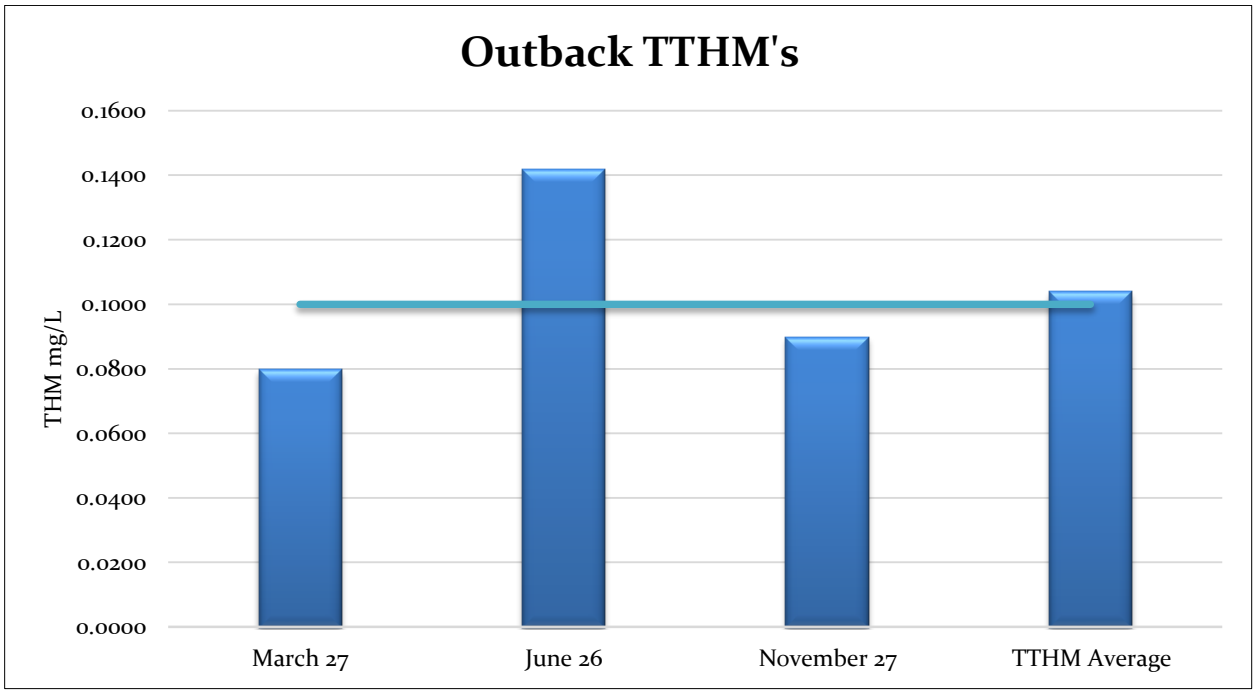


Figure 6 Outback Reservoir THM's

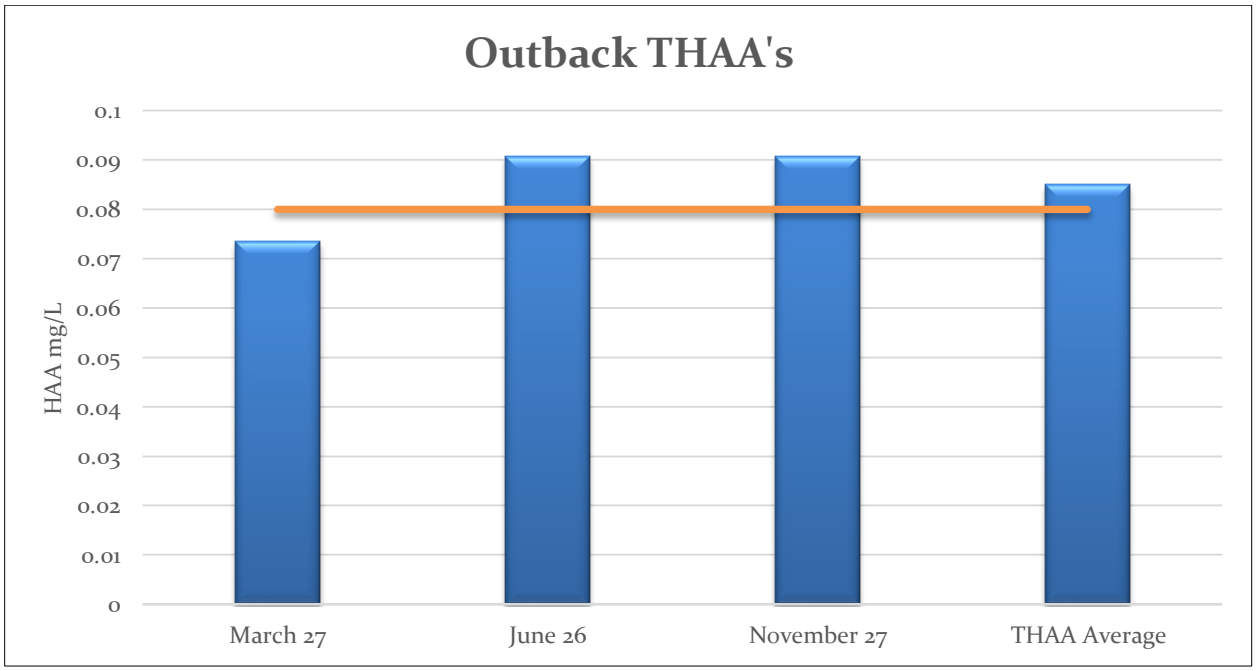


Figure 7 Outback Reservoir HAA's

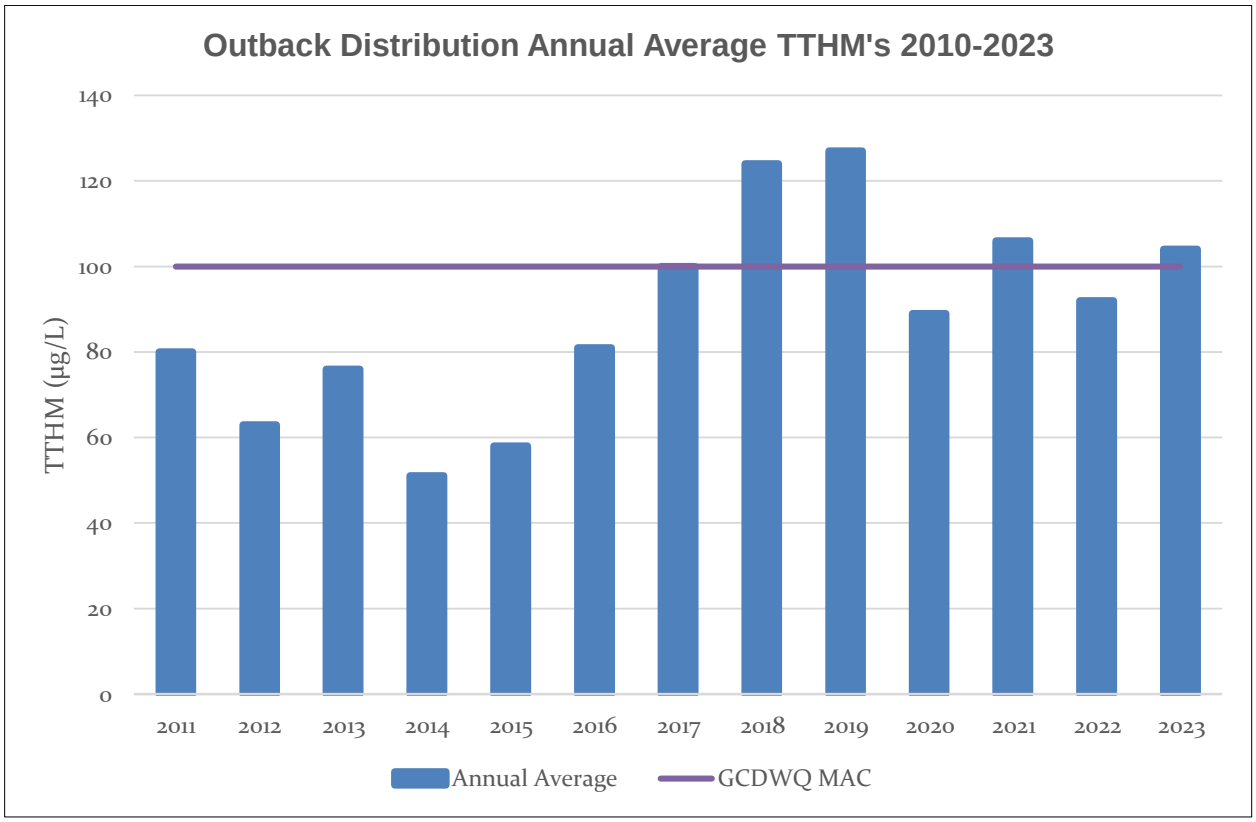


Figure 8 Outback Distribution THM Annual Average

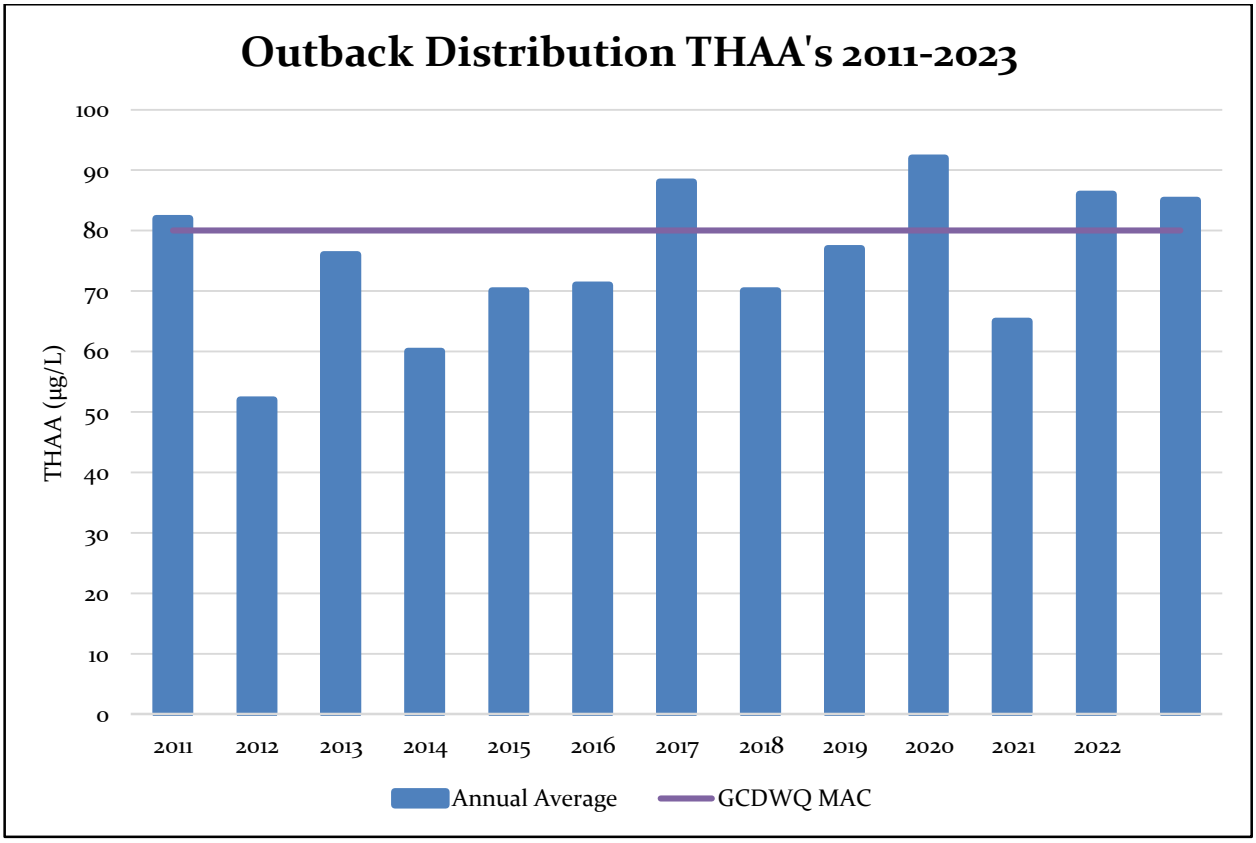


Figure 9 Outback Distribution HAA Annual Average

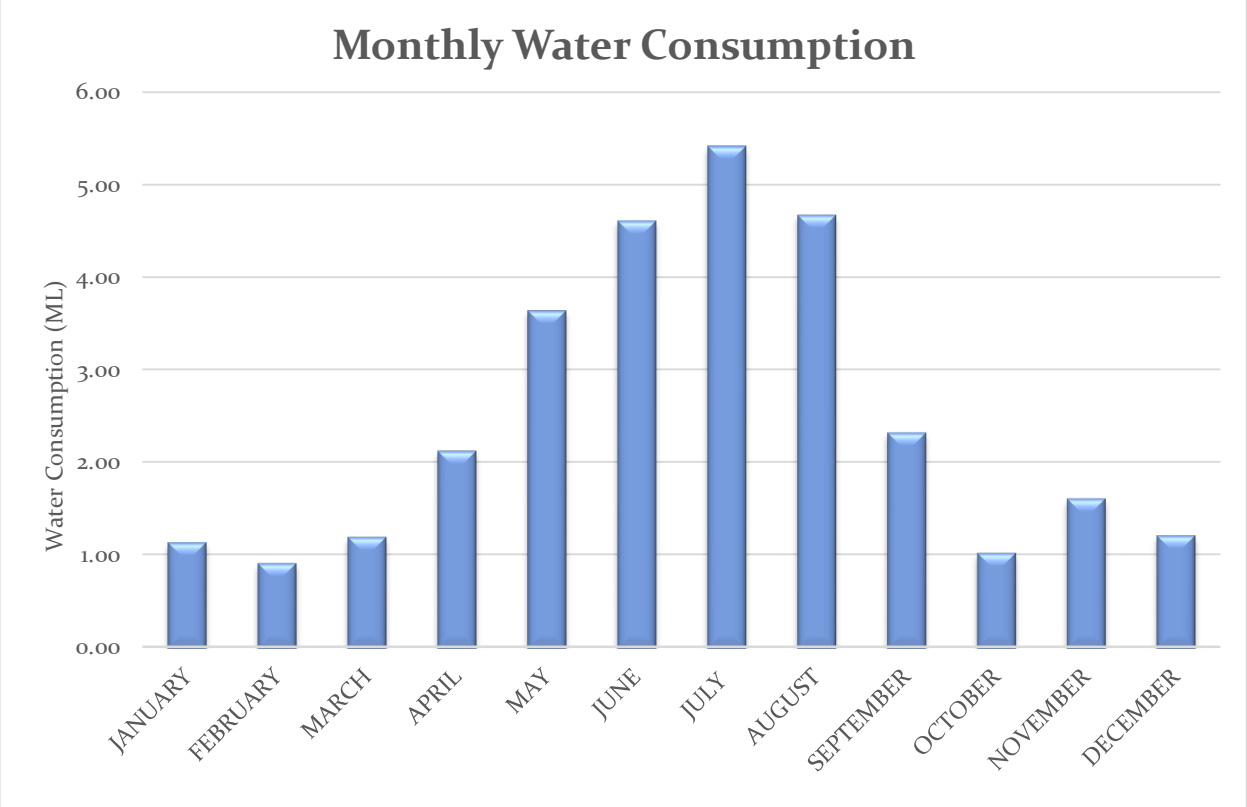
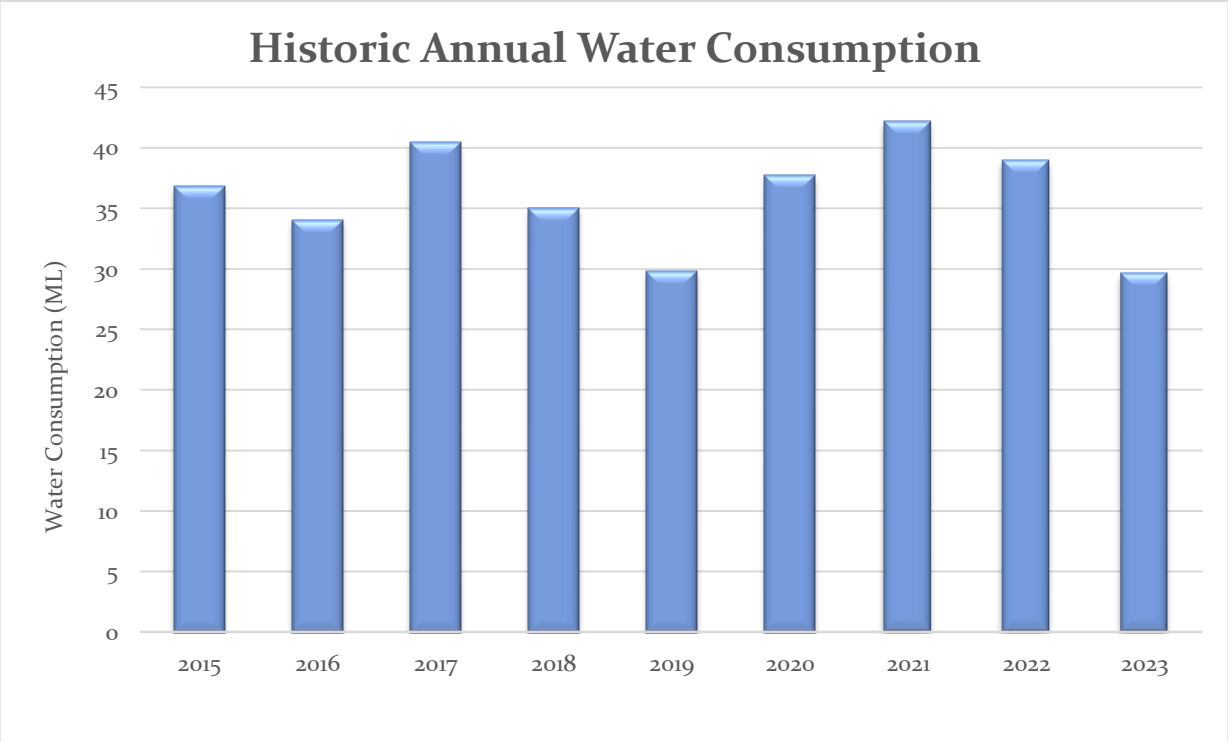


Figure 10 Monthly Water Consumption



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APPENDIX A

2023 OUTBACK WATER QUALITY MONITORING PLAN

2023 Outback and Delcliffe Schedule			
Week	**RDNO Water Quality Sampling (Monday)**	**RDNO Operator Sampling (Tuesday)**	**Instrument Maintenance**
Jan 2 - 6		Outback Reservoir SS, Delcliffe Road SS	
Jan 9 - 13		Outback Reservoir SS, Delcliffe Hill PS	
Jan 16 - 20		Outback Reservoir SS, Delcliffe Road SS	
Jan 23 - 27	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity
Jan 30 - Feb 3		Outback Reservoir SS, Delcliffe Road SS	
Feb 6 - 10		Outback Reservoir SS, Delcliffe Hill PS	
Feb 13 - 17		Outback Reservoir SS, Delcliffe Road SS	
Feb 20 - 24		Outback Reservoir SS, Delcliffe Hill PS	
Feb 27 - Mar 3	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity Turbidity
Mar 6 - 10		Outback Reservoir SS, Delcliffe Hill PS	
Mar 13 - 17		Outback Reservoir SS, Delcliffe Road SS	
Mar 20 - 24		Outback Reservoir SS, Delcliffe Hill PS	
Mar 27 - 31	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity Chlorine
Apr 3 - 7		Outback Reservoir SS, Delcliffe Hill PS	
Apr 10 - 14		Outback Reservoir SS, Delcliffe Road SS	
Apr 17 - 21		Outback Reservoir SS, Delcliffe Hill PS	
Apr 24 - 28	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity
May 1 - 5		Outback Reservoir SS, Delcliffe Hill PS	
May 8 - 12		Outback Reservoir SS, Delcliffe Road SS	
May 15 - 19		Outback Reservoir SS, Delcliffe Hill PS	
May 22 - 26		Outback Reservoir SS, Delcliffe Road SS	
May 29 - Jun 2	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity Turbidity
June 5 - 9		Outback Reservoir SS, Delcliffe Road SS	
Jun 12 - 16		Outback Reservoir SS, Delcliffe Hill PS	
Jun 19 - 23		Outback Reservoir SS, Delcliffe Road SS	
Jun 26 - 30	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity

2023 Outback and Delcliffe Schedule			
Week	**RDNO Water Quality Sampling (Monday)**	**RDNO Operator Sampling (Tuesday)**	**Instrument Maintenance**
Jul 3 - 7		Outback Reservoir SS, Delcliffe Road SS	
Jul 10 - 14		Outback Reservoir SS, Delcliffe Hill PS	
Jul 17 - 21		Outback Reservoir SS, Delcliffe Road SS	
Jul 24 - 28	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity
Jul 31 - Aug 4		Outback Reservoir SS, Delcliffe Road SS	
Aug 7 - 11		Outback Reservoir SS, Delcliffe Hill PS	
Aug 14 - 18		Outback Reservoir SS, Delcliffe Road SS	
Aug 21 - 25		Outback Reservoir SS, Delcliffe Hill PS	
Aug 28 - Sep 1	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity Turbidity
Sep 4 - 8		Outback Reservoir SS, Delcliffe Hill PS	
Sep 11 - 15		Outback Reservoir SS, Delcliffe Road SS	
Sep 18 - 22		Outback Reservoir SS, Delcliffe Hill PS	
Sep 25 - 29	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity
Oct 2 - 6		Outback Reservoir SS, Delcliffe Hill PS	
Oct 9 - 13		Outback Reservoir SS, Delcliffe Road SS	
Oct 16 - 20		Outback Reservoir SS, Delcliffe Hill PS	
Oct 23 - 27	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity
Oct 30 - Nov 3		Outback Reservoir SS, Delcliffe Hill PS	
Nov 6 - 10		Outback Reservoir SS, Delcliffe Road SS	
Nov 13 - 17		Outback Reservoir SS, Delcliffe Hill PS	
Nov 20 - 24		Outback Reservoir SS, Delcliffe Road SS	
Nov 27 - Dec 1	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Hill PS	pH Conductivity Turbidity
Dec 4 - 8		Outback Reservoir SS, Delcliffe Road SS	
Dec 11 - 15		Outback Reservoir SS, Delcliffe Hill PS	
Dec 18 - 22	Outback Intake, Delcliffe Intake	Outback Reservoir SS, Delcliffe Road SS	pH Conductivity
Dec 25 - 29		Outback Reservoir SS, Delcliffe Hill PS	

Outback - Weekly Sampling

Site & WaterTrax #	Bottles	Parameters
Outback Intake 1729C	1 - Caro Bacterial	Total Coliform, E.Coli

Outback - Monthly Sampling

Site & WaterTrax #	Bottles	Parameters
Outback Intake 1729C	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria), IRB (iron related bacteria)
	1 - PA	Bacterial (Most Probable Number)
	1 - TOC Caro	TOC
	1 - 1 L in house	Algae Density
	1 - 4 L Caro	Chlorophyll a (May to November)

Outback - Quarterly Sampling - March, June, September, December

Site & WaterTrax #	Bottles	Parameters
Outback Intake 1729C	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria), IRB (iron related bacteria)
	1 - PA	Bacterial (Most Probable Number)
	1 - TOC Caro	TOC
	1 - 125 mL Caro (yellow lid)	TP
	1 - 250 ml Caro	TN
	1 - 500 mL in house	Sulfate, Apparent Colour, Total Alkalinity, Total Hardness
	1 - 1 L in house	Algae Density
	1 - 4 L Caro	Chlorophyll a
Outback Reservoir SS 17FFF	2 - THM bottles	THM's
	2 - HAA bottles	HAA's

Outback - Annual Sampling (July)

Site and WaterTrax #	Bottles	Parameters
Outback Intake 1729C	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - PA	Bacterial (Most Probable Number)
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - 125 mL Caro (yellow lid)	TP
	1 - Cyanide	Cyanide
	1 - TOC	TOC
	1 - 1 L Caro	
	1 - 1 L in house	Algae Density
	1 - 4 L Caro	Chlorophyll a
Outback Reservoir SS 17FFF	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - PA	PA (MPN if Cl2 <0.20)

APPENDIX B

2023 SOURCE WATER COMPREHENSIVE ANALYSIS

Outback Water Quality 2023

Water System: Greater Vernon Water
Source: Okanagan Lake

Sampling Point: Outback Intake
Date of Sample: August 23, 2023

Parameter	Result	Guideline	Unit
ALKALINITY (BICARBONATE, AS CACO3)	123	N/A	mg/L
ALKALINITY (CARBONATE, AS CACO3)	<1.0	N/A	mg/L
ALKALINITY (HYDROXIDE, AS CACO3)	<1.0	N/A	mg/L
ALKALINITY (PHENOLPHTHALEIN, AS CACO3)	<1.0	N/A	mg/L
ALKALINITY (TOTAL, AS CACO3)	123	N/A	mg/L
ALUMINUM (TOTAL)	0.0063	OG < 0.1	mg/L
ANTIMONY (TOTAL)	<0.0002	MAC = 0.006	mg/L
ARSENIC (TOTAL)	0.00052	MAC = 0.01	mg/L
BARIUM (TOTAL)	0.0231	MAC = 2	mg/L
BERYLLIUM (TOTAL)	<0.0001	N/A	mg/L
BISMUTH (TOTAL)	<0.0001	N/A	mg/L
BORON (TOTAL)	<0.05	MAC = 5	mg/L
CADMIUM (TOTAL)	<0.00001	MAC = 0.007	mg/L
CALCIUM (TOTAL)	34.8	N/A	mg/L
CHLORIDE	5.87	N/A	mg/L
CHLOROPHYLL A	<1.0	N/A	mg/L
CHROMIUM (TOTAL)	<0.0005	MAC = 0.05	mg/L
COBALT (TOTAL)	<0.0001	N/A	mg/L
COLOUR (TRUE)	<5.0	AO ≤ 15	TCU
CONDUCTIVITY	284	N/A	µS/cm
COPPER (TOTAL)	0.00163	MAC = 2	mg/L
CYANIDE (TOTAL)	<0.002	MAC = 0.2	mg/L
DISSOLVED ORGANIC CARBON	4.92	N/A	mg/L
FLUORIDE	0.12	MAC=1.5	mg/L
HARDNESS (TOTAL, AS CACO3)	128	N/A	mg/L
IRON (TOTAL)	0.011	AO ≤ 0.3	mg/L
LEAD (TOTAL)	<0.0002	MAC = 0.005	mg/L
LITHIUM (TOTAL)	0.00322	N/A	mg/L
MAGNESIUM (TOTAL)	9.84	N/A	mg/L
MANGANESE (TOTAL)	0.00082	MAC = 0.12	mg/L
MERCURY (TOTAL)	<0.00001	MAC = 0.001	mg/L
MOLYBDENUM (TOTAL)	0.00342	N/A	mg/L
NICKEL (TOTAL)	0.00071	N/A	mg/L
NITRATE + NITRITE	<0.01	N/A	mg N/L
NITRATE	<0.01	N/A	mg N/L
NITRITE	<0.01	N/A	mg N/L
NITROGEN (TOTAL)	0.189	N/A	mg/L
PHOSPHORUS (TOTAL DISSOLVED)	<0.005	N/A	mg/L

PHOSPHORUS (TOTAL)	<0.05	N/A	mg/L
PH	7.96	7.0-10.5	pH units
POTASSIUM (TOTAL)	2.52	N/A	mg/L
SELENIUM (TOTAL)	<0.0005	MAC = 0.05	mg/L
SILICON (TOTAL, AS SI)	3.7	N/A	mg/L
SILVER (TOTAL)	<0.00005	N/A	mg/L
SODIUM (TOTAL)	12	AO ≤ 200	mg/L
STRONTIUM (TOTAL)	0.289	MAC = 7	mg/L
SULFUR (TOTAL)	10.9	N/A	mg/L
SULPHATE	31.4	N/A	mg/L
TELLURIUM (TOTAL)	<0.0005	N/A	°C
THALLIUM (TOTAL)	<0.00002	N/A	mg/L
THORIUM (TOTAL)	<0.0001	N/A	mg/L
TIN (TOTAL)	<0.0002	N/A	mg/L
TITANIUM (TOTAL)	<0.005	N/A	mg/L
TOTAL DISSOLVED SOLIDS	172	AO ≤ 500	mg/L
TOTAL KJELDAHL NITROGEN	0.189	N/A	mg/L
TOTAL ORGANIC CARBON	5.14	N/A	mg/L
TUNGSTEN (TOTAL)	<0.001	N/A	NTU
TURBIDITY	0.34	OG < 1	mg/L
URANIUM (TOTAL)	0.00251	MAC = 0.02	% T
UV TRANSMITTANCE (FILTERED)	85.7	N/A	% T
VANADIUM (TOTAL)	<0.005	N/A	mg/L
ZINC (TOTAL)	0.0064	AO ≤ 5	mg/L
ZIRCONIUM (TOTAL)	<0.0001	N/A	mg/L

"<" = Less than the detection limit shown

N/A = No current guideline

OG = Operational Guideline

MAC = Maximum Acceptable Concentration Guideline

AO = Aesthetic Objective Guideline