Kneehill County

Hamlet of Wimborne

Fluoride Reduction Study

Report

CIMA+

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April 2024

Confidentiality and ownership

Revisions

05.03.2024	For Approval
23.04.2024	Final

2024-04-23

PERMIT TO PRACTICE
CIMA CANADA INC
RM SIGNATURE: _____
RM APEGA ID #: 85297
DATE: April 24 2024
PERMIT NUMBER: P8204
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Executive Summary

Hamlet of Wimborne has a small water treatment plant treating ground water. The hamlet population is approximately 60 with 24 active connections.

The Town practices chlorination as the only treatment technology. The water source has an elevated concentration of Fluoride. Additionally, an excess amount of Ammonia, Total Dissolved Solids (TDS) and Sodium is present in the water source.

The report evaluates the current system and recommends options of the reduction of Fluoride and other contaminants of concern.

Regulatory Requirements

Alberta Environment and Protected Areas (AEPA) requires that treated water supply meet the Canadian Drinking Water Quality Guidelines (CDWQG). In accordance with CDWQG, the maximum acceptable concentration (MAC) of Fluoride in drinking water shall not exceed 1.5 mg/L. The average Fluoride concentration in the Hamlet water is 2.5 mg/L.

AEPA requires the municipality to develop Fluoride reduction strategy.

Fluoride Reduction Strategies

CIMA+ has reviewed the following Fluoride reduction options:

- Centralized onsite treatment
- Point of Use treatment
- Water supply line extension from Torrington
- Potable water delivery to the Hamlet

Centralized Onsite Treatment

Centralized onsite treatment using a Reverse Osmosis system preceded by a biological granular activated carbon filter provides a cost effective, safe, and reliable solution.

The system can be designed for approximately 75% of the flow, with the remaining 25% bypassing the treatment and only undergoing chlorination. The proposed set up will be able to reduce Fluoride concentration in the drinking water below the MAC limit while maintaining a desirable mineral concentration in the drinking water and reducing the amount of chlorine required for disinfection.

Opinion of Probable Costs

Opinion of Probable Cost for the onsite RO/Biofiltration system is **$400,000 - $600,000.**

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List of Appendices

1. Introduction

Objectives

CIMA+ prepared this report with the main objective to summarize the following:

- Existing treatment system capacity, conditions, and treatment quality,
- Regulatory requirements,
- Options for treated water quality improvement,
- Construction and Operations Costs.

Preceding Documents

The following documents were utilized during the preparation of the current report:

- Wimborne Infrastructure Assessment, Opus Stewart Weir Ltd, April, 2016.
- Wimborne Lagoon Study, WSP, 2018.
- Sunnyslope Water Service Upgrades. Feasibility Study, WSP, June 2018.

2. Existing Capacity, Water Quality and Treatment

2.1 Raw Water Quality

Existing water well (according to Opus Engineering 2015 Wimborne Infrastructure assessment), is well #76-02-25-03, completed in 1976, having a depth of 87 m and classified as a high-quality ground water source. The maximum annual diversion is 6,820 m3/year with a maximum allowable pump rate of 0.76 L/s (65.4 m3/d).

The existing system operates based on the Code of Practice for Water Systems Using High Quality Groundwater. CIMA+ has reviewed the water analysis taken in December 2022 and December 2023 (Appendix A).

The water quality is typical for high quality ground water wells in the area. The following parameters exceed the CDWCG (Table 1).

Table 1 Wimborne Water Quality Parameters Exceeding CDWCG

Parameter	Concentration, mg/L	Limit , mg/L	Type of Guideline
Fluoride	2	1.5	MAC
Total Dissolved Solids	1,010	500	AO
Sodium	392	200	AO
Ammonia	0.8 - 1.2	n/a	n/a

MAC – Maximum Acceptable Concentration

AO – Aesthetic Objective

Only Fluoride levels exceed MAC concentration and require treatment. TDS and Sodium levels are high and could be giving salty or mineralized taste to the water. TDS and Sodium reduction is advisable but not mandatory.

Ammonia concentration is high. There is no limit or requirement for ammonia treatment. However, ammonia affects the efficiency of the chlorine disinfection process and the dosage of chlorine. According to the annual reports for 2021, 2022 (Appendix B), the average chlorine dose injected in order to achieve free chlorine residual fluctuates between 7 and 12 mg/L. Approximately 10 mg/L of free chlorine is required to remove 1 mg/L of ammonia and achieve traces of free chlorine in the treated water. The maximum dose of free chlorine addition during treatment should not exceed 9 mg/L, as per the NSF requirements. Doses higher than 9 mg/L could encourage the formation of disinfection byproducts. Therefore, ammonia concentration shall be reduced to ensure that the chlorine dose stays below 9 mg/L.

2.2 Potable Water Demand

CIMA+ has reviewed the flow data from 2021 and 2022 annual reports (Appendix B). The daily distribution flow fluctuates between 6 and 20 m3/day. The average daily flow is 8 m3/day.

According to the Kneehill County data, the Hamlet population is 60 persons with approximately 24 active connections. It is understood that the County does not expect any appreciable growth within the Hamlet and the population (and the water consumption) will remain approximately the same.

Therefore, any treatment system upgrade should be designed to provide maximum daily demand of **20 m3/day**.

2.3 Existing Potable Water Treatment

Wimborne existing treatment system consists of a single high quality ground water well, liquid chlorine injection, treated water reservoir (approximately 25 m^3), two distribution pumps operated by a pressure switch and a pressure tank.

The location of the water treatment facility within the Hamlet is shown in the Figure 1 below.

Figure 1 Water Treatment Building Location

Figure 2 Water Well Enclosure

The treatment system is located in a wooden clad building approximately 4 x 5 m size. The treatment facility site is fenced.

Figure 3 Water Treatment Building

Liquid sodium hypochlorite is injected before the water enters to the treated reservoir

Figure 4 Chlorine Injection

The distribution system operates at approximately 55 psi pressure.

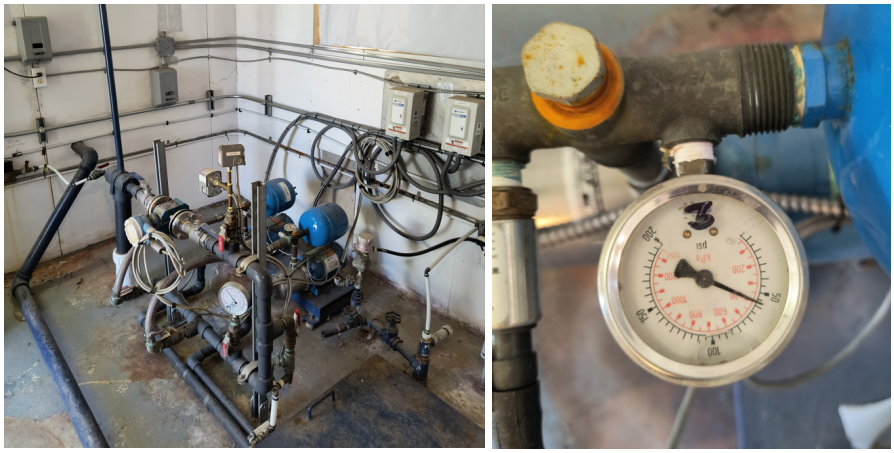

Figure 5 Distribution Pumps

Electrical system on site is powered by on overhead transformer. There is an electrical panel and a small generator onsite.

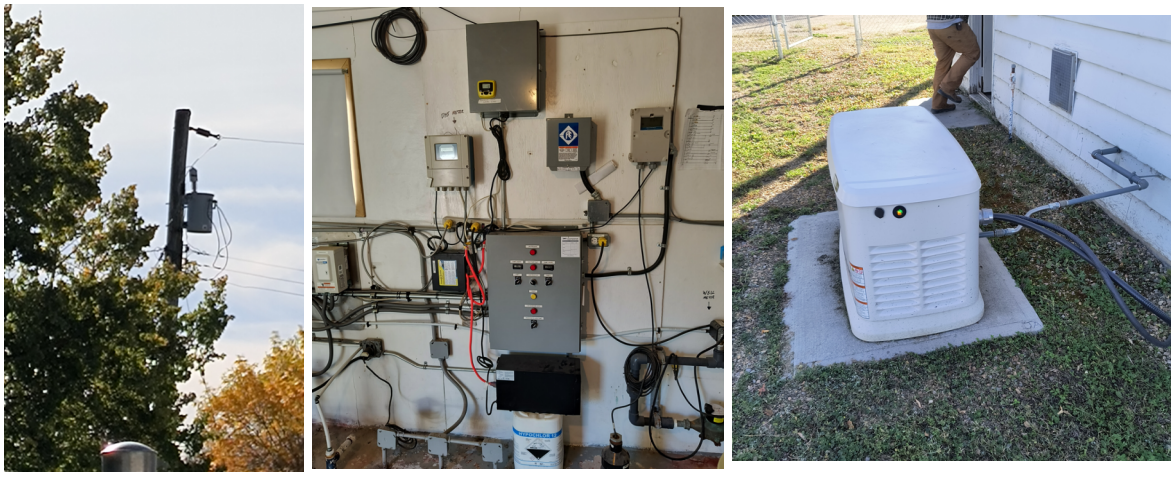

Figure 6 Electrical System

The raw water well pump operates based on the level in the treated water tank and is managed by the level transmitter controller. The potable water pumps operate off a pressure switch. A ProTalk alarm autodialer provides remote alarm notification to the operators.

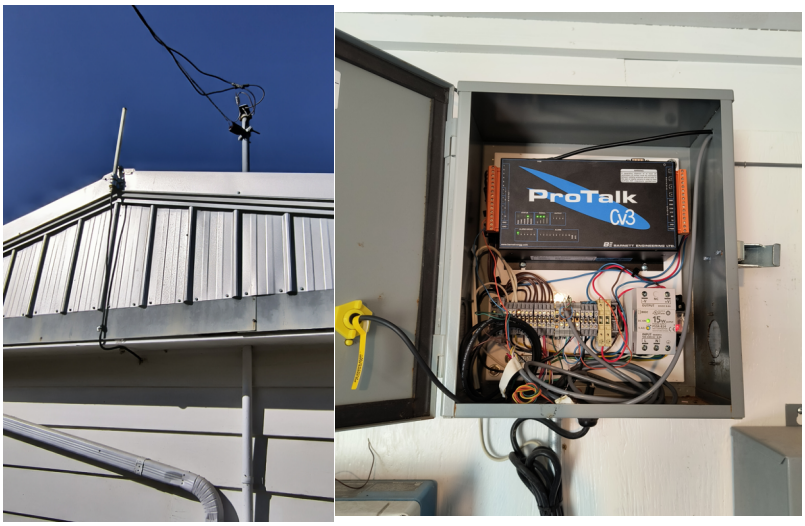

Figure 7 Alarm Autodialer

The amount of free chlorine residual in the reservoir water is monitored by a chlorine analyser.

Figure 8 Chlorine Analyzer

In case of fire in the community, an external fire pump can be connected from outside of the treatment facility to a 75 mm camlock connection to draw water directly from the reservoir.

The water distribution system is approximately 1 km long and consists of 75 mm piping.

2.4 Existing Wastewater Treatment

Treatment systems for Fluoride removal may create significant amounts of additional waste flow (e.g. Reverse Osmosis reject flow could reach 30% of production). Therefore, CIMA+ visited and observed the Hamlet's wastewater lagoon site.

The Hamlet has gravity operated sewer collection system on all major streets. The sewage is diverted by gravity to a wastewater treatment lagoon located approximately 1 km West of the Hamlet. The location of the lagoon is shown in Figure 9.

It is understood that a comprehensive lagoon study was completed in 2018. No capacity issues were noted in this study; however, some housekeeping upgrades were recommended (access road, berm widening, additional monitoring wells, etc).

Figure 9 Wastewater Lagoon Map

During the site visit and the discussion with the operators it was noted that the lagoon has a theoretical ability to release the excessive storage, however, over the last years it was operated as an evaporative lagoon due to the low amount of sewage generated by the Hamlet.

Figure 10 Wastewater Lagoon

Figure 10 Wastewater Lagoon Release Pipe

CIMA+ has not conducted a capacity assessment and has not evaluated if the existing lagoon is suitable to operate as an evaporative lagoon with the current or additional flows. However, based on site observations, the existing lagoon is underutilized, which allowed it to be used as an evaporative lagoon over the last years. If release is required in case of emergency, an overflow release pipe is available (Figure 10). In order to conduct the release, the operators will be required to extend the downstream hose by approximately 500m in order to bypass the private, fish bearing pond.

3. Fluoride Reduction Treatment

3.1 On-Site Treatment

Fluoride can be removed from drinking water through reverse osmosis, distillation, activated alumina filters, bone char carbon filters, etc.

Reverse osmosis (RO) treatment will provide an added benefit of removing Sodium and TDS. The other mentioned processes do not remove Sodium and TDS and are generally more complicated and more expensive. Therefore, only RO system treatment was considered.

RO is a water treatment process that uses a semi-permeable membrane to separate water molecules from other substances. RO applies pressure to overcome osmotic pressure that favors even distributions. RO can remove dissolved or suspended chemical species as well as biological substances (principally bacteria), and is used in industrial processes and the production of potable water. RO retains the solute on the pressurized side of the membrane and the purified solvent passes to the other side. It relies on the relative sizes of the various molecules to decide what passes through. "Selective" membranes reject large molecules, while accepting smaller molecules (such as solvent molecules, e.g., water).

The RO process effectively removes almost any minerals and elements. Therefore, the treated water will have minimal or non-detected Fluoride, TDS and Sodium. The water stripped from the minerals becomes corrosive and lacking micro elements beneficial for human consumption. In order to overcome the lack of micro elements, either remineralization should be done downstream of the RO or a portion of the flow can bypass the RO treatment and blend the non-treated and purified water.

CIMA+ finds that treating only a portion of the flow (approximately 50 - 75%) and subsequent blending of the flows will provide the most cost effective, reliable, and safe solution for Wimborne. The expected concentration of Fluoride, TDS and Sodium in treated water is shown in Table 2.

Table 2 Expected Treated Water Quality

Parameter	Raw Water Concentration, mg/L	Limit , mg/L	Treated Water, mg/L RO Treatment 50% Blending	Treated Water, mg/L RO Treatment 75% Blending
Fluoride	2.0	1.5	1.0	0.5
Total Dissolved Solids	1,010.0	500	500.0	250.0
Sodium	392.0	200	196.0	98

The information sheet for a preliminary selected RO system suitable for Wimborne is provided in Appendix C.

RO system installation is sensitive to the quality of the incoming water and works best when the inlet water is pre-treated and has minimal amount of suspended matter. Standard testing confirming the suitability of the raw water to be treated with the RO system is Silt Density Index (SDI) testing. The results of the SDI test are shown in Appendix D. The maximum value of SDI acceptable for the RO membrane manufacturers is 5.0. The test showed that the SDI was slightly above 5 in two instances and slightly below 5 in two others. Therefore, a raw water pre-treatment would be required.

Biologically activated pressure filters filled with sand and Granular Activated Carbon (GAC) can be used as a pre-filter. These filters will reduce ammonia as well as silt content.

Flow diagram of the proposed system is shown in Figure 11.

The proposed system will treat 20 m3/day. Full flow will be passing through the biofilters. The biofilters will be equipped with a small compressor and air injectors. The air will encourage the growth of nitrifying bacteria that will consume ammonia. The preliminary size of the biofilters is 10” diameter each.

Biofilter backwash will be completed using treated water from a hydropneumatics tank (minimum 150 L capacity).

Downstream of the biofilters, the flow will be split. Partial flow will go to the RO system. The RO will be equipped with a feed pump, 5 micron filter and the required instrumentation. The RO will also be equipped with a small metering pump for the anti-scalant system.

A fraction of the flow will bypass the RO system.

The mixture of the RO treated (purified) and bypassed water will then be chlorinated. Since the ammonia will be removed from the water the required amount of chlorine will be significantly less than now (likely 3 – 5 mg/L instead of the current 10 mg/L).

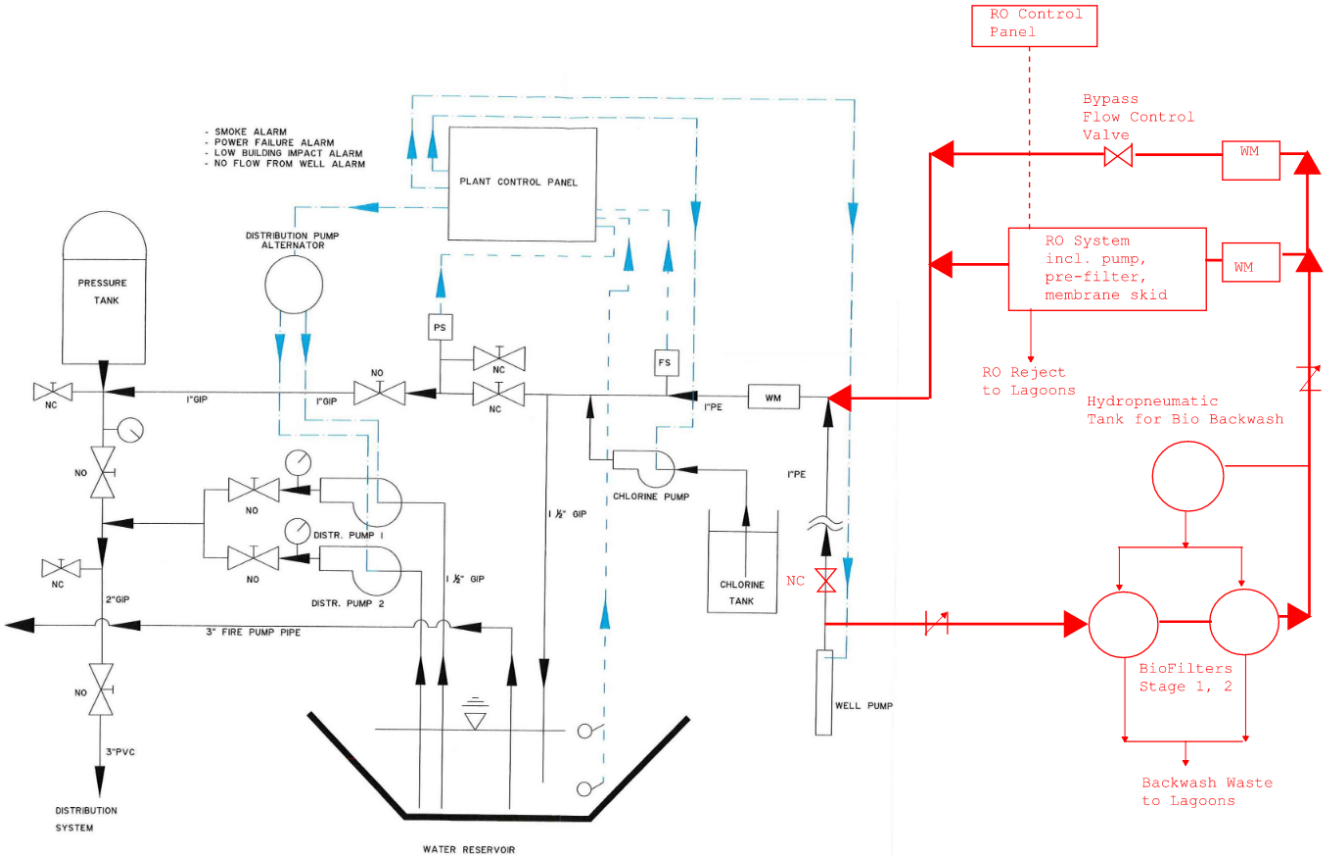

Figure 11 Treatment System Flow Diagram

It should be noted that the biofilters rely on a naturally occurring bacteria and it will take a few weeks to develop the bacterial culture. Before the bacteria are developed, the ammonia in the treated water will remain elevated and higher chlorine dosage will still be required.

Based on the site observations, there is a space within the existing treatment facility building approximately 3 x 2m that appears to be suitable for the Biofiltration/RO system placement. The available space is shown in Figure 12.

Both Biofiltration and RO system require drain connection to the sewer system. The existing treatment facility does not have sewer connection. However, the existing gravity collection pipe is approximately 50m from the treatment facility. Sewer pipe extension to the treatment facility will have to be added.

Figure 12 Spacing for RO System

The RO system will be supplied with its own controller. In order to make the biofiltration system backwash operate automatically, a new Programmable Logic Controller and automated valves will have to be added. Alternatively, backwash operation can be done manually by the operators.

The Opinion of Probable Costs (OPC) is provided in Appendix F. The OPC include two options.

- Fully Automated treatment system
- Manually operated treatment.

3.2 Point of Use Treatment

Point of Use (POU) RO treatment systems can be installed in each individual household. Specifications for a POU system are shown in Appendix E. The POU system, similar to the central RO system, will remove Fluoride, TDS and Sodium.

There are, however, several disadvantages associated with the POU systems.

The drinking water distributed by the municipality will have exceeded levels of contaminants (i.e. Fluoride). The responsibility for treatment will be passed to the customer. In addition to the initial installation (the costs of the installation will likely be absorbed by the County), the customer will be required to maintain the POU system (e.g. replace the filters). If one's system is not maintained properly the liability will still lay with the County (even if not legally but in the public opinion view).

Additionally, the POU system will likely be set up to treat the entire flow or at least the drinking water stream within each household. RO treated water requires remineralization in order to be suitable for day-to-day consumption. Remineralization cannot be easily achieved in a POU system.

Finally, the regulator (AEPA and Alberta Health) should be on-board with the implementation of the POU system. The regulators may be reluctant to approve it based on the above noted considerations.

Therefore, CIMA+ does not recommend the POU systems for this application.

4. External Water Supply

4.1 Water Supply from Torrington

Potable water to Wimborne can be supplied from Hamlet of Torrington located approximately 9 km away. The raw water well and chlorination (treatment) can be abandoned in Wimborne. Only the reservoir and the distribution pumps will remain.

There is no pipeline between Torrington and Wimborne. It is understood that an abandoned water line exists from the old Torrington water wells to Torrington. This line could potentially be used as a section of the Torrington – Wimborne transmission line. However, the conditions of the old line are unknown.

Therefore, for budgeting purposes CIMA+ suggests including the complete 9 km Torrington – Wimborne pipeline cost as part of the external water supply considerations. According to Opus 2018 Infrastructure Assessment report, the cost of 150 – 200mm diameter pipe was estimated at $1.8 mln. In 2024 dollars this cost will likely be **$2.5 mln**.

Torrington pump station receives its water from Aqua7 supply system (Drumheller) via Sunnyslope reservoir.

WSP has completed a feasibility study of the Sunnyslope reservoir upgrade (2018). According to this study, the supply to Torrington from Sunnyslope is limited to 1 L/s. Recent data from the past years, as reviewed in this study, indicates that the current consumption at the Torrington reservoir necessitates an increase in the supply flow. The study recommends the following actions:

- Upsizing the distribution pumps.
- Increasing the storage capacity at the Sunnyslope reservoir.
- Adding Pressure Reducing Valves (PRVs) to the connections between Sunnyslope and Torrington.
- Installing another booster pump in Linden.

CIMA+ assumes that the supply increase to Torrington is a pre-condition for considering the extension of the system to serve another municipality (Wimborne).

The upgrade estimate from the WSP 2018 study is $2.1 mln. In 2024 dollars this cost will likely be **$3.0 mln**.

It could be possible to only add a new distribution pump at Sunnyslope. This would increase the flow going to Torrington. However, this option would require reassessing the existing demands from Sunnyslope reservoir to ensure that the additional flow diverted to Torrington will not adversely affect the water availability for other Sunnyslope reservoir customers. After completing this reassessment, the Sunnyslope upgrade cost may be refined (potentially reduced). A simple addition of a new pump at Sunnyslope is estimated at $200,000.

Finally, there needs to be a fill line connection at Wimborne reservoir. This would include a flow control valve, flowmeter and chlorine residual analyzer.

The main disadvantage of the external pipeline feed for Wimborne is the piping costs and the need to upgrade some external infrastructure (Sunnyslope). Also, the long (9km) transmission line with a small demand will likely have a significant water retention. For example, a 150mm 9 km pipe would contain approximately 150 m3 of water. With the consumption of 8m3/day, it will take almost 19 days for the water to reach Wimborne. Water of this age will likely lose chlorine residual. It will likely be required to boost the chlorine before it leaves Torrington, and potentially boost it again before distribution in Wimborne.

4.2 Water Hauling to Site

Another option is to truck water. The closest truckfill is located in Torrington which is 9km from Wimborne.

CIMA+ obtained quotes from a couple of water haulers operating in the area.

The average price to deliver 8m^3 of potable water to Wimborne is $300. A single water truck per day would be normally required except for Summertime when 2 – 3 trucks per day will be needed.

Advantages: No capital costs at Wimborne. Will simplify the operation at Wimborne (i.e. the system will become “distribution only”).

Disadvantages: As noted in 4.1, the Torrington system appears to be at capacity. Therefore, the same capital upgrades for Sunnyslope as described in 4.1 will need to be considered. The operational costs will be significant (i.e. approximately $150,000 just for water hauling).

5. Cost Estimates

5.1 Operation Costs Considerations

The options reviewed in this report imply two main operation scenarios.

(1) Keeping the treatment system on site.

(2) Removing any onsite treatment and converting the existing facility to a “distribution only” system.

Depending on the selected scenario (treatment or distribution only), there will be different certified operator attendance requirements. The operators’ attendance requirements are defined in “Water and Wastewater Operators’ Certification Guidelines (2023)”. An additional parameter considered in these Guidelines is the availability of remote monitoring and process control.

It is understood that the existing treatment facility is equipped with an alarm autodialer with power back up. Based on the Wimborne Infrastructure Assessment (Opus 2015), Appendix G, the existing facility lists the following alarms:

- Smoke,
- Power failure,

- Low temperature,
- Well pump no flow,
- High reservoir level
- Low chlorine at distribution
- High chlorine at distribution

In order to consider the existing system to be “WITH remote monitoring” the following alarms should be added:

- Low pressure at distribution.

These additions are considered relatively simple, therefore, for the subsequent discussion the existing system is considered as a system “WITH remote monitoring”.

5.1.1 Operator attendance requirements

Scenario 1 (Proposed on site Fluoride treatment system):

The certified operator must visit the system at least once a week while the attending operator is physically present.

The attending operator must visit the system each day the system is producing treated water but a minimum of three times a week. Since the system can produce water every day, attendance is assumed five days a week.

Scenario 2 (Distribution Only system):

The certified operator must visit the system at least once a week while the attending operator is physically present.

The attending operator must visit the system a minimum of three times a week.

The main difference between the scenarios is the frequency of the operators’ attendance. If the onsite treatment is maintained, the operator shall visit the site five times per week. If the system only consists of the distribution system, the operator shall visit the site only three times per week.

5.1.2 Chemical Costs

Scenario 1 (Proposed fluoride reduction system on site) will require the injection of chlorine for disinfection and anti-scalant for the RO system.

Scenario 2 (Distribution only system) will not require any chemical addition. Chlorine injection infrastructure, however, should be maintained to provide Cl boost if necessary.

It should be noted that the amount of chlorine required in Scenario 1 will be significantly less than the current chlorine consumption because the ammonia will be removed through a biological process rather than through chlorination.

Note that CIMA+ has not obtained any formal quotes for chemicals, powers supply, etc. and has not reviewed the actual operators’ compensation. The operational cost numbers provided in the section below are approximations suitable for scenarios screening only.

5.2 Opinion of Probable Costs

Opinion of Probable Costs for the Stage One and Two construction are provided in Appendix B and C. The costs are Class 3 (accuracy of +/-15-20%) for Phase 1 construction and Class 5 (accuracy of +/-20-50%) for Phase 2.

It should be noted that the construction costs are provided based on the conditions of the construction market during Summer 2021. We observe significant volatility in the cost and availability of materials and labour. This may affect the actual prices of the project and ordering of equipment during tendering.

The summary of the costs is provided in Table 7.

Table 7 Construction Costs Summary

	Central RO Treatment(1)	**POU RO Treatment**	**Water Truck Delivery**	**Water Supply Extension from Torrington/ Sunnyslope**
Capital Costs				
Onsite Treatment	550,000			
POU Treatment		400,000		
Remote Communication Upgrade	50,000	50,000	50,000	50,000
Onsite Fill Line			100,000	100,000
Sunnyslope Pump Upgrade			200,000(2)	200,000(2)
Pipeline				2,500,000
Capital Total	**600,000**	**450,000**	**350,000**	**2,850,000**
Operation Costs				
Facility Operation Costs	104,000	104,000	63,000	63,000
Water Delivery			150,000	
Operation Total	**104,000**	**104,000**	**213,000**	**63,000**

(1) The costs assume a fully automated set up. A semi-automated (e.g. manual backwash) operated system is possible for relatively cheaper cost (c.$400,000).

(2) The noted costs only include an addition of one distribution pump at Sunnyslope reservoir ($200,000). An assessment of the current demand at Sunnyslope reservoir is required to confirm if other upgrades are required or not.

A

Appendix A
Water Analysis

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Report Transmission Cover Page

Bill To: Kneehill County
Box 400
1600, 2 Street NE
Three Hills, AB, Canada
T0M 2A0
Attn: Accounts Payable
Sampled By: Jeff Anderson
Company: Kneehill County

Project ID:
Project Name: Wimborne Annual 2022
Project Location:
LSD:
P.O.:
Proj. Acct. code:

Lot ID: **1613394**
Control Number:
Date Received: Dec 22, 2022
Date Reported: Dec 31, 2022
Report Number: 2830553

Contact	Company	Address
Accounts Payable	**Kneehill County**	Box 400, 1600, 2 Street NE Three Hills, AB T0M 2A0 Phone: (403) 443-5541 Fax: (403) 443-5115 Email: ap@kneehillcounty.com

Delivery	Format	Deliverables
Email - Single Deliverable	PDF	COC / Invoice

Contact	Company	Address
Al Kostrosky	**Kneehill County**	205 – 1st Ave West Three Hills, AB T0M 2A0 Phone: (403) 443-5541 Fax: (403) 443-5115 Email: Al.Kostrosky@kneehillcounty.com

Delivery	Format	Deliverables
Email - Merge Deliverables	PDF	COC / Test Report
Email - Single Deliverable	PDF	COC / COA
Email - Single Deliverable	PDF	COR
Email - Single Deliverable	PDF	Invoice

Notes To Clients:

- Dec 23, 2022 - Sample Information Sheet was erroneous: The sample is past hold time for chloramine analysis and cancelled THM analysis, no vials received. Confirmed with Al Kostrosky on December 23rd.

Element
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Analytical Report

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Lot ID: **1613394**
Control Number:
Date Received: Dec 22, 2022
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Report Number: 2830553

Reference Number	1613394-1
Sample Date	December 21, 2022
Sample Time	10:00
Sample Location	
Sample Description	Wimborne Pump House / Wimborne Annual 2022 / 14.3°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Inorganic Nonmetallic Parameters						
Ammonia - N		mg/L	<0.025	0.025		
Ammonium/Ammonia Preservation			Yes			
Sulfide	Total	mg/L	<0.002	0.002	0.05	Below AO
Organic Carbon	Total Nonpurgeable	mg/L	3.7	0.5		
Chlorine	Total	mg/L	0.8	0.1		
Chlorine	Free	mg/L	0.6	0.1		
Chloramine		mg/L	0.2	0.1		
Chlorate	Dissolved	mg/L	0.5	0.1	1.0	Below MAC
Chlorite	Dissolved	mg/L	<0.2	0.2	1.0	Below MAC
Cyanide	Dissolved	mg/L	<0.002	0.002	0.2	Below MAC
Bromate	Dissolved	mg/L	<0.003	0.003	0.01	Below MAC
Hydrogen Sulfide	Calculated	mg/L	<0.002			
Metals Dissolved						
Subsample			Lab Filtered			
Metals Total						
Aluminum	Total	mg/L	0.02	0.02	0.1 OG; 2.9 MAC	Below OG
Calcium	Total	mg/L	2.1	0.2		
Iron	Total	mg/L	0.15	0.05	0.3	Below AO
Magnesium	Total	mg/L	0.4	0.2		
Manganese	Total	mg/L	<0.005	0.005	0.02 AO; 0.12 MAC	Below AO
Potassium	Total	mg/L	1.1	0.4		
Silicon	Total	mg/L	2.97	0.05		
Sodium	Total	mg/L	394	0.4	200	Above AO
Sulfur	Total	mg/L	71.4	0.3		
Mercury	Total	mg/L	<0.000005	0.000005	0.001	Below MAC
Antimony	Total	mg/L	<0.0002	0.0002	0.006	Below MAC
Arsenic	Total	mg/L	<0.0002	0.0002	0.01	Below MAC
Barium	Total	mg/L	0.024	0.001	2.0	Below MAC
Beryllium	Total	mg/L	<0.0001	0.0001		
Bismuth	Total	mg/L	<0.0005	0.0005		
Boron	Total	mg/L	0.223	0.002	5.0	Below MAC
Cadmium	Total	mg/L	<0.00001	0.00001	0.007	Below MAC
Chromium	Total	mg/L	<0.0005	0.0005	0.05	Below MAC
Cobalt	Total	mg/L	<0.0001	0.0001		
Copper	Total	mg/L	0.008	0.001	1 AO; 2 MAC	Below AO
Lead	Total	mg/L	0.0004	0.0001	0.005	Below MAC

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Sample Time	10:00
Sample Location	
Sample Description	Wimborne Pump House / Wimborne Annual 2022 / 14.3°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Metals Total - Continued						
Lithium	Total	mg/L	0.045	0.001		
Molybdenum	Total	mg/L	0.002	0.001		
Nickel	Total	mg/L	<0.0005	0.0005		
Selenium	Total	mg/L	<0.0002	0.0002	0.05	Below MAC
Silver	Total	mg/L	<0.00001	0.00001		
Strontium	Total	mg/L	0.110	0.001	7.0	Below MAC
Thallium	Total	mg/L	<0.00005	0.00005		
Tin	Total	mg/L	<0.001	0.001		
Titanium	Total	mg/L	<0.0005	0.0005		
Uranium	Total	mg/L	<0.0005	0.0005	0.02	Below MAC
Vanadium	Total	mg/L	0.0002	0.0001		
Zinc	Total	mg/L	0.004	0.004	5.0	Below AO
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	<5	5	15	Below AO
Turbidity		NTU	0.5	0.1	0.1/0.3/1.0 OG	
Routine Water						
pH			8.71	1	7.0-10.5	Within OG Range
Temperature of observed pH		°C	19.6			
Electrical Conductivity	at 25 °C	µS/cm	1560	1		
Calcium	Dissolved	mg/L	2.0	0.2		
Magnesium	Dissolved	mg/L	0.4	0.2		
Sodium	Dissolved	mg/L	392	0.4	200	Above AO
Potassium	Dissolved	mg/L	1.1	0.4		
Iron	Dissolved	mg/L	0.04	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	<0.005	0.005	0.02 AO; 0.12 MAC	Below AO
Chloride	Dissolved	mg/L	11.9	0.4	250	Below AO
Fluoride		mg/L	2.00	0.05	1.5	Above MAC
Nitrate - N		mg/L	0.04	0.01	10	Below MAC
Nitrite - N		mg/L	<0.005	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	0.04	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	206	0.9	500	Below AO
Hydroxide		mg/L	<5			
Carbonate		mg/L	64			
Bicarbonate		mg/L	667			
P-Alkalinity	as CaCO3	mg/L	53	5		
T-Alkalinity	as CaCO3	mg/L	654	5		

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Analytical Report

Bill To: Kneehill County
Box 400
1600, 2 Street NE
Three Hills, AB, Canada
T0M 2A0
Attn: Accounts Payable
Sampled By: Jeff Anderson
Company: Kneehill County

Project ID:
Project Name: Wimborne Annual 2022
Project Location:
LSD:
P.O.:
Proj. Acct. code:

Lot ID: **1613394**
Control Number:
Date Received: Dec 22, 2022
Date Reported: Dec 31, 2022
Report Number: 2830553

Reference Number	1613394-1
Sample Date	December 21, 2022
Sample Time	10:00
Sample Location	
Sample Description	Wimborne Pump House / Wimborne Annual 2022 / 14.3°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water - Continued						
Total Dissolved Solids	Calculated	mg/L	1010	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	7			
Ionic Balance	Dissolved	%	97			
Mono-Aromatic Hydrocarbons - Water						
Benzene		mg/L	<0.001	0.001	0.005	Below MAC
Toluene		mg/L	<0.0004	0.0004	0.024 AO; 0.06 MAC	Below AO
Ethylbenzene		mg/L	<0.0010	0.0010	0.0016 AO; 0.14 MAC	Below AO
Total Xylenes (m,p,o)		mg/L	<0.001	0.001	0.02 AO; 0.09 MAC	Below AO

Approved by:

Mike Yohemas, BSc
General Manager

Data have been validated by Analytical Quality Control and Element's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

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Methodology and Notes

Bill To: Kneehill County
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Three Hills, AB, Canada
T0M 2A0
Attn: Accounts Payable
Sampled By: Jeff Anderson
Company: Kneehill County

Project ID:
Project Name: Wimborne Annual 2022
Project Location:
LSD:
P.O.:
Proj. Acct. code:

Lot ID: **1613394**
Control Number:
Date Received: Dec 22, 2022
Date Reported: Dec 31, 2022
Report Number: 2830553

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	*	Alkalinity - Titration Method, 2320 B	Dec 23, 2022	Element Edmonton - Roper Road
Alkalinity, pH, and EC in water	APHA	*	Conductivity, 2510 B	Dec 23, 2022	Element Edmonton - Roper Road
Alkalinity, pH, and EC in water	APHA	*	pH - Electrometric Method, 4500-H+ B	Dec 23, 2022	Element Edmonton - Roper Road
Ammonium-N in Water	APHA	*	Automated Phenate Method, 4500-NH3 G	Dec 28, 2022	Element Edmonton - Roper Road
Anions (Routine) by Ion Chromatography	APHA	*	Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	Dec 29, 2022	Element Edmonton - Roper Road
Approval-Edmonton	APHA		Checking Correctness of Analyses, 1030 E	Dec 29, 2022	Element Edmonton - Roper Road
Bromate in Water	APHA	*	Single-Column Ion Chromatography with Electronic Suppression, 4110 C	Dec 23, 2022	Element Edmonton - Roper Road
BTEX-CCME - Water	US EPA	*	Volatile Organic Compounds in Various Sample Matrices Using Equilibrium Headspace Analysis/Gas Chromatography Mass Spectrometry, 5021/8260	Dec 22, 2022	Element Calgary
Carbon Organic (Total) in water (TOC)	APHA		High-Temperature Combustion Method, 5310 B	Dec 23, 2022	Element Edmonton - Roper Road
Chlorate and Chlorite by Ion Chromatography	APHA	*	Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	Dec 28, 2022	Element Edmonton - Roper Road
Chloride in Water	APHA	*	Automated Ferricyanide Method, 4500-Cl- E	Dec 28, 2022	Element Edmonton - Roper Road
Chlorine (Free) in water	APHA	*	DPD Colorimetric Method, 4500-Cl G	Dec 23, 2022	Element Edmonton - Roper Road
Chlorine (Total) in water	APHA	*	DPD Colorimetric Method, 4500-Cl G	Dec 23, 2022	Element Edmonton - Roper Road
Colour (Apparent) in water	APHA	*	Visual Comparison Method, 2120 B	Dec 29, 2022	Element Edmonton - Roper Road
Cyanide (Dissolved) in water	Alta. Env. Method	*	Cyanide, Simple Extractable (Automated Pyridine-Barbituric Acid Colorimetric Method), 06608L	Dec 30, 2022	Element Edmonton - Roper Road
Mercury (Total) in water	EPA	*	Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry, 245.7	Dec 23, 2022	Element Edmonton - Roper Road
Metals ICP-MS (Total) in water	APHA/USEPA	*	Metals By Inductively Coupled Plasma/Mass Spectrometry, APHA 3125 B / USEPA 200.2, 200.8	Dec 23, 2022	Element Edmonton - Roper Road
Metals ICP-MS (Total) in water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	Dec 23, 2022	Element Edmonton - Roper Road
Metals Trace (Dissolved) in water	APHA		Hardness by Calculation, 2340 B	Dec 28, 2022	Element Edmonton - Roper Road
Metals Trace (Dissolved) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	Dec 28, 2022	Element Edmonton - Roper Road
Metals Trace (Total) in water	APHA	*	Inductively Coupled Plasma (ICP)	Dec 23, 2022	Element Edmonton - Roper

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Analytical Report

Bill To: Kneehill County
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1600, 2 Street NE
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T0M 2A0
Attn: Hayle Adkins
Sampled By: Jeff Anderson
Company: Kneehill County

Project ID: Kneehill County
Project Name: 2023 wimborne fluoride study
Project Location: Wimborne
LSD: 113 1st AVE wimborne
P.O.:
Proj. Acct. code:

Lot ID: **1700227**
Control Number:
Date Received: Dec 19, 2023
Date Reported: Dec 22, 2023
Report Number: 2957814

Reference Number	1700227-1
Sample Date	Dec 04, 2023
Sample Time	11:00
Sample Location	
Sample Description	Wimborne PH / 15.0°C
Matrix	Water

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Metals Total						
Aluminum	Total	mg/L	<0.2			0.02
Calcium	Total	mg/L	3			0.2
Iron	Total	mg/L	<0.5			0.05
Magnesium	Total	mg/L	<2			0.2
Manganese	Total	mg/L	<0.05			0.005
Potassium	Total	mg/L	<4			0.4
Silicon	Total	mg/L	3.1			0.05
Sodium	Total	mg/L	439			0.4
Sulfur	Total	mg/L	80			0.3
Antimony	Total	mg/L	<0.002			0.0002
Arsenic	Total	mg/L	<0.002			0.0002
Barium	Total	mg/L	0.02			0.001
Beryllium	Total	mg/L	<0.001			0.0001
Bismuth	Total	mg/L	<0.005			0.0005
Boron	Total	mg/L	0.31			0.002
Cadmium	Total	mg/L	<0.0001			0.00001
Chromium	Total	mg/L	<0.005			0.0005
Cobalt	Total	mg/L	<0.001			0.0001
Copper	Total	mg/L	0.02			0.001
Lead	Total	mg/L	0.001			0.0001
Lithium	Total	mg/L	0.05			0.001
Molybdenum	Total	mg/L	<0.01			0.001
Nickel	Total	mg/L	<0.005			0.0005
Selenium	Total	mg/L	<0.002			0.0002
Silver	Total	mg/L	<0.0001			0.00001
Strontium	Total	mg/L	0.12			0.001
Thallium	Total	mg/L	<0.0005			0.00005
Tin	Total	mg/L	<0.01			0.001
Titanium	Total	mg/L	<0.005			0.0005
Uranium	Total	mg/L	<0.005			0.0005
Vanadium	Total	mg/L	<0.001			0.0001
Zinc	Total	mg/L	<0.040			0.004
Zirconium	Total	mg/L	<0.01			0.001

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Analytical Report

Bill To: Kneehill County
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1600, 2 Street NE
Three Hills, AB, Canada
T0M 2A0
Attn: Hayle Adkins
Sampled By: Jeff Anderson
Company: Kneehill County

Project ID: Kneehill County
Project Name: 2023 wimborne fluoride study
Project Location: Wimborne
LSD: 113 1st AVE wimborne
P.O.:
Proj. Acct. code:

Lot ID: **1700227**
Control Number:
Date Received: Dec 19, 2023
Date Reported: Dec 22, 2023
Report Number: 2957814

Reference Number		1700227-1	1700227-3
Sample Date		Dec 04, 2023	Dec 18, 2023
Sample Time		11:00	10:30
Sample Location			
Sample Description		Wimborne PH / 15.0°C	Wimborne pump house / Resample (Diss. metals) / 13.1°C
Matrix		Water	Water

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Metals Dissolved						
Silicon	Dissolved	mg/L		2.85		0.05
Sulfur	Dissolved	mg/L		34.1		0.3
Aluminum	Dissolved	mg/L		0.006		0.002
Antimony	Dissolved	mg/L		<0.0002		0.0002
Arsenic	Dissolved	mg/L		0.0002		0.0002
Barium	Dissolved	mg/L		0.068		0.001
Beryllium	Dissolved	mg/L		<0.0001		0.0001
Bismuth	Dissolved	mg/L		<0.0005		0.0005
Boron	Dissolved	mg/L		0.217		0.002
Cadmium	Dissolved	mg/L		0.00004		0.00001
Chromium	Dissolved	mg/L		<0.0005		0.0005
Cobalt	Dissolved	mg/L		<0.0001		0.0001
Copper	Dissolved	mg/L		0.0021		0.0002
Lead	Dissolved	mg/L		0.0001		0.0001
Lithium	Dissolved	mg/L		0.045		0.001
Molybdenum	Dissolved	mg/L		0.006		0.001
Nickel	Dissolved	mg/L		<0.0005		0.0005
Selenium	Dissolved	mg/L		<0.0002		0.0002
Silver	Dissolved	mg/L		<0.00001		0.00001
Strontium	Dissolved	mg/L		0.104		0.001
Thallium	Dissolved	mg/L		<0.00005		0.00005
Tin	Dissolved	mg/L		<0.001		0.001
Titanium	Dissolved	mg/L		<0.0005		0.0005
Uranium	Dissolved	mg/L		<0.0005		0.0005
Vanadium	Dissolved	mg/L		<0.0001		0.0001
Zinc	Dissolved	mg/L		0.003		0.001
Zirconium	Dissolved	µg/L		<1		1
Subsample			Lab Filtered	Field Filtered		

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Analytical Report

Bill To: Kneehill County
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1600, 2 Street NE
Three Hills, AB, Canada
T0M 2A0
Attn: Hayle Adkins
Sampled By: Jeff Anderson
Company: Kneehill County

Project ID: Kneehill County
Project Name: 2023 wimborne fluoride study
Project Location: Wimborne
LSD: 113 1st AVE wimborne
P.O.:
Proj. Acct. code:

Lot ID: **1700227**
Control Number:
Date Received: Dec 19, 2023
Date Reported: Dec 22, 2023
Report Number: 2957814

Reference Number	1700227-3
Sample Date	Dec 18, 2023
Sample Time	10:30
Sample Location	
Sample Description	Wimborne pump house / Resample (Diss. metals) / 13.1°C
Matrix	Water

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Routine Water						
Calcium	Dissolved	mg/L	2.1			0.2
Magnesium	Dissolved	mg/L	0.4			0.2
Sodium	Dissolved	mg/L	363			0.4
Potassium	Dissolved	mg/L	1.2			0.4
Iron	Dissolved	mg/L	0.19			0.01
Manganese	Dissolved	mg/L	0.007			0.005
Hardness	Dissolved as CaCO3	mg/L	7			

Approved by:

Randy Neumann, B.Sc
Director

Data have been validated by Analytical Quality Control and Element's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

B

Appendix B
Annual Report

2021 Annual Water Report

Alberta Environmental Protection and Enhancement Act

Code of Practice

System Name: Wimborne Waterworks System

Approval #: 139784

Operation ID #: 134758

Prepared For: Alberta Environment

Prepared By: Kneehill County

A. Performance Data Summary:

		Jan.	Feb.	Mar.	Apr.	May	Jun	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Avg.
Inlet Flows (m^3)	Tot.	199.2	200.5	215.6	206.2	232.1	254.1	295.4	300.4	200.4	213	216.2	193.2	2,726.3	227.2
Inlet Flows (m^3)	Avg.	6.9	7.71	6.9	6.9	7.5	8.5	9.8	9.7	6.9	7.3	7.2	6.4		7.6
Inlet Flows (m^3)	Min.	4	4.1	3.6	4.3	3.8	4.1	6.8	3.7	3.5	4.4	3.5	4		4.2
Inlet Flows (m^3)	Max.	15	12.5	8	8.2	8.5	11.3	15.2	16.5	10.1	12.3	9.7	7.8		11.3
Distribution Flows (m^3)	Tot.	186.3	192.2	204.7	196.4	223.6	246.2	288.2	293	193.5	203.1	207.7	183.7	2,618.6	218.2
Distribution Flows (m^3)	Avg.	6.4	7.39	6.6	6.5	7.2	8.2	9.6	9.5	6.7	7	6.9	6.1		7.34
Distribution Flows (m^3)	Min.	4.6	5.1	4	5.4	4.1	4.9	6.1	5.2	4	4.9	2.4	4		4.56
Distribution Flows (m^3)	Max.	12.8	11.7	7.4	8.4	9	11.9	19.9	14.9	9.4	10.6	8.2	7.7		
Total Cl_2 Residual - Distribution (mg/L)	Avg.	1.01	0.84	0.73	0.95	0.81	0.79	0.68	0.80	0.78	1.01	0.84	0.83		0.84
Total Cl_2 Residual - Distribution (mg/L)	Min.	0.77	0.61	0.51	0.75	0.54	0.41	0.45	0.58	0.34	0.66	0.61	0.68		0.58
Total Cl_2 Residual - Distribution (mg/L)	Max.	1.40	1.02	1.01	1.20	1.23	1.20	0.86	1.03	1.20	1.64	1.20	1.07		1.17
Free Cl_2 Residual - Pumphouse (mg/L)	Avg.	0.98	0.84	0.74	0.94	0.76	0.79	0.76	0.88	0.85	1.05	0.84	0.84		0.86
Free Cl_2 Residual - Pumphouse (mg/L)	Min.	0.69	0.59	0.5	0.65	0.39	0.56	0.48	0.6	0.54	0.77	0.6	0.61		0.58
Free Cl_2 Residual - Pumphouse (mg/L)	Max.	1.36	1	1.1	1.24	1.1	1.19	1.12	1.07	1.21	1.29	1.25	1.09		1.17
Bac-T Samples	Tot.	4	4	5	4	5	4	4	5	4	4	5	4	52	4.3

B. Summary of Chemical Usage: 12% Sodium Hypochlorite (Cleartech)

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Avg.
Cl_2 Amount Used (ltrs) @ 12%	Tot.	13.30	13.90	16.60	16.90	19.10	20.30	25.10	25.70	17.30	20.20	15.10	14.80	218.30	18.19
Cl_2 Amount Used (ltrs) @ 12%	Avg.	0.46	0.53	0.54	0.56	0.62	0.68	0.84	0.83	0.60	0.70	0.50	0.49		0.61
Cl_2 Amount Used (ltrs) @ 12%	Min.	0.10	0.20	0.20	0.40	0.20	0.20	0.30	0.30	0.20	0.20	0.10	0.20		0.22
Cl_2 Amount Used (ltrs) @ 12%	Max.	0.90	1.30	0.90	0.90	0.80	1.30	1.80	1.70	1.00	1.10	0.90	0.80		1.12
Cl_2 Dosage (mg/L)	Avg.	8.05	7.98	9.31	9.70	9.74	9.58	10.04	10.11	10.20	8.96	8.25	8.71		9.22
Cl_2 Dosage (mg/L)	Min.	7.69	6.78	8.42	9.13	9.14	9.00	9.35	9.55	9.00	7.57	7.22	8.33		8.43
Cl_2 Dosage (mg/L)	Max.	8.65	9.15	10.45	10.20	10.60	10.39	10.92	10.57	11.70	10.20	9.03	9.15		10.08
C.T. Value	Avg.	23.5	18.07	18.4	21	16.9	15.3	12	16.6	20.2	22.4	20.9	21		18.9
C.T. Value	Min.	11	10	10	14	6	8	7	8	11	15	14	14		10.7
C.T. Value	Max.	34	27	33	32	28	25	18	26	32	35	43	39		31.0

C. Chemical Analysis: Copy Included

D. Comments / Summary of Notifications and Corrective Actions Taken:

E. Operators: Don Adolf #2818, Al Kostrosky #3317, Don Collins #4062, Jeff Anderson #5451, John McKiernan #3314

2022 Annual Water Report

Alberta Environmental Protection and Enhancement Act

Code of Practice

System Name: Wimborne Waterworks System

Approval #: 139784

Operation ID #: 134758

Prepared For: Alberta Environment

Prepared By: Kneehill County

A. Performance Data Summary:

		Jan.	Feb.	Mar.	Apr.	May	Jun	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Avg.
Inlet Flows (m^3)	Tot.	204.6	185	202.1	200.3	239.1	205.9	231.2	318.4	219.8	239	199.2	199.2	2,643.8	220.3
Inlet Flows (m^3)	Avg.	6.6	6.6	6.5	6.9	7.7	6.9	7.9	10.3	7.6	7.7	6.64	6.9		7.4
Inlet Flows (m^3)	Min.	3.6	3.8	3.7	3.8	4.2	3.4	3.5	3.7	6.2	2.6	3.3	3.6		3.8
Inlet Flows (m^3)	Max.	9	7.7	8.2	9.6	8.8	8.1	12.5	16.2	8.3	9	8.5	11.4		9.8
Distribution Flows (m^3)	Tot.	192.5	175.1	196.5	192.5	228.7	193.6	224.2	309.4	209	230.1	189	185.2	2,525.8	210.5
Distribution Flows (m^3)	Avg.	6.2	6.3	6.3	6.6	7.4	6.5	7.7	10	7.2	7.4	6.3	6.4		7.03
Distribution Flows (m^3)	Min.	3.6	4.4	3.3	4.2	4.6	4	4.1	3	5.2	4.5	4.5	4.8		4.18
Distribution Flows (m^3)	Max.	7.6	7.3	8.2	8.7	8.6	7.7	12.6	16	8	9.5	7.3	8.8		
Total Cl_2 Residual - Distribution (mg/L)	Avg.	0.89	0.83	0.86	0.82	0.85	0.88	0.89	0.83	0.78	0.63	0.81	0.93		0.83
Total Cl_2 Residual - Distribution (mg/L)	Min.	0.69	0.60	0.57	0.54	0.29	0.60	0.63	0.52	0.58	0.27	0.59	0.70		0.55
Total Cl_2 Residual - Distribution (mg/L)	Max.	1.19	1.08	1.12	1.11	1.49	1.20	1.19	1.15	1.09	1.00	1.00	1.40		1.17
Free Cl_2 Residual - Pumphouse (mg/L)	Avg.	0.87	0.82	0.85	0.93	0.86	0.87	0.86	0.86	0.83	0.74	0.89	0.94		0.86
Free Cl_2 Residual - Pumphouse (mg/L)	Min.	0.47	0.55	0.45	0.63	0.29	0.61	0.65	0.63	0.6	0.4	0.72	0.67		0.56
Free Cl_2 Residual - Pumphouse (mg/L)	Max.	1.14	1.09	1.27	1.3	1.45	1.21	1.17	1.07	1.12	1.3	1.07	1.5		1.22
Bac-T Samples	Tot.	5	4	4	4	5	4	4	5	4	5	4	4	52	4.3

B. Summary of Chemical Usage: 12% Sodium Hypochlorite (Cleartech)

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Avg.
Cl_2 Amount Used (ltrs) @ 12%	Tot.	21.80	15.20	14.90	14.10	20.20	15.40	17.00	22.60	17.80	15.70	17.30	16.61	208.61	17.38
Cl_2 Amount Used (ltrs) @ 12%	Avg.	0.70	0.54	0.48	0.48	0.65	0.50	0.59	0.73	0.61	0.51	0.58	0.57		0.58
Cl_2 Amount Used (ltrs) @ 12%	Min.	0.20	0.30	0.00	0.10	0.20	0.10	0.20	0.30	0.40	0.00	0.20	0.10		0.18
Cl_2 Amount Used (ltrs) @ 12%	Max.	0.90	0.60	0.70	0.70	0.80	0.80	0.90	1.00	0.80	1.10	1.00	1.10		0.87
Cl_2 Dosage (mg/L)	Avg.	8.65	8.71	8.64	8.79	10.16	9.02	9.07	8.45	9.27	8.00	10.25	10.04		9.09
Cl_2 Dosage (mg/L)	Min.	8.03	8.03	8.08	8.38	9.44	8.17	8.69	7.99	8.31	4.50	8.91	9.29		8.15
Cl_2 Dosage (mg/L)	Max.	9.75	9.73	9.85	9.51	10.81	9.69	9.29	9.12	10.06	10.00	11.70	10.70		10.02
C.T. Value	Avg.	22.9	20.5	21.6	19.3	18.8	21.9	19.2	15.3	17.8	16.4	22.3	22		19.8
C.T. Value	Min.	11	11	10	9	7	12	12	6	9	4	15	15		10.1
C.T. Value	Max.	35	29	35	37	33	36	36	24	24	29	32	43		32.8

C. Chemical Analysis: Copy Included

D. Comments / Summary of Notifications and Corrective Actions Taken:

E. Operators: Don Adolf #2818, Al Kostrosky #3317, Don Collins #4062, Jeff Anderson #5451, John McKiernan #3314

C

Appendix C
RO/Bio System

R1–SERIES REVERSE OSMOSIS SYSTEMS

AXEON® R1–Series Reverse Osmosis Systems are designed for overall superior performance, high recovery rates, minimal energy consumption and offer great savings with low maintenance and low operation costs.

R1–Series Reverse Osmosis Systems feature a new, innovative design. These systems feature only the highest quality components, including a programmable computer controller with many built-in standard features, a stainless steel booster pump for high performance and corrosion resistance, ultra low energy membranes and fiberglass membrane housings for enhanced performance and durability.

R1–Series Reverse Osmosis Systems have been engineered for capacities ranging from 1,800-21,600 gallons per day.

R1–12140
Reverse Osmosis System

BENEFITS

- Fully Equipped and Customizable
- Skid Mounted
- Decreased Size of Dimensional Footprint from Standard Reverse Osmosis Systems
- Components Easily Accessible
- Pre-Plumbed, Wired and Assembled
- Individually Tested and Preserved
- Low Operation and Maintenance Costs
- Easy Maintenance and Servicing
- 20% Less Energy Use than Standard Reverse Osmosis Systems
- 1-Year Limited Warranty

AXEON Naming Matrix

R1	6	1	40

R–Series Model

R1	Tap Water Model

Housing Quantity Designation

1	1 Vessel
2	2 Vessels
3	3 Vessels
4	4 Vessels
5	5 Vessels
6	6 Vessels
8	8 Vessels
10	10 Vessels
12	12 Vessels

Membrane Quantity Per Housing

1	1 Membrane

4.0 Inch Membrane Diameter

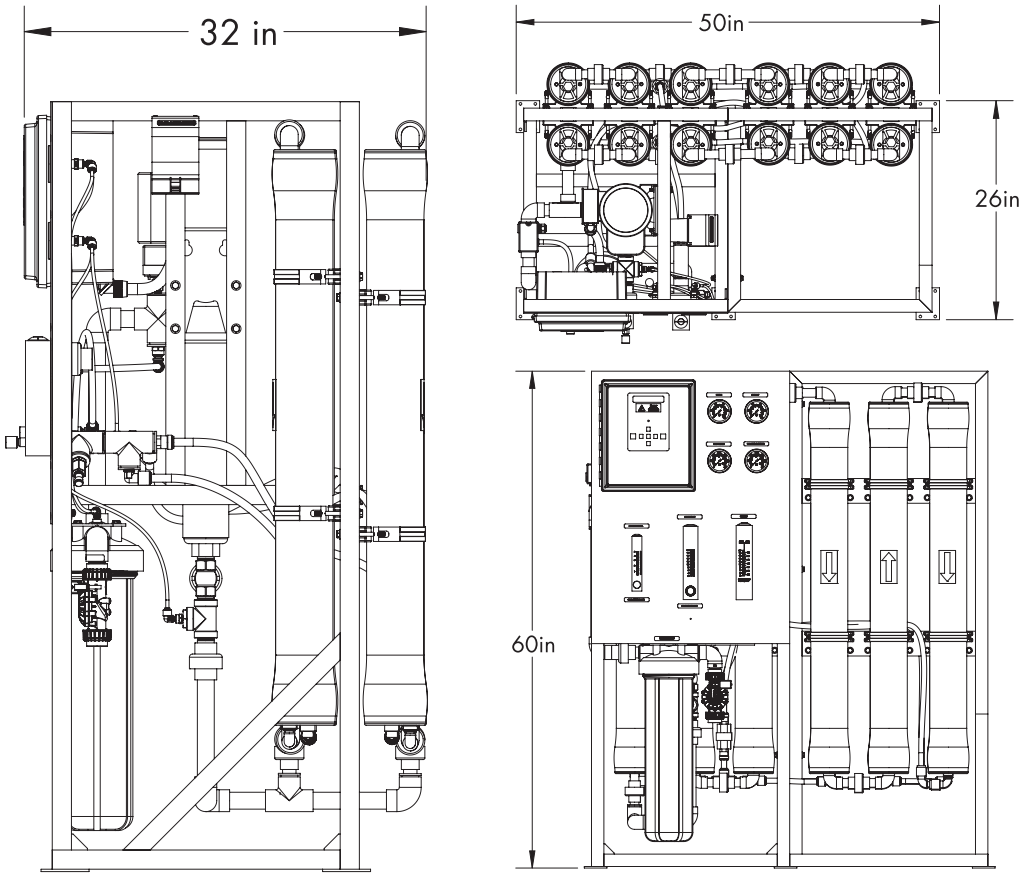
FEATURES

- S–150 Computer Controller
  - LCD Backlit Display
  - Pre-Treatment Lockout
  - Tank Level Input
  - Low Pressure Monitoring and Alarm
  - Hour Meter
  - TDS Monitoring
  - Feed Flush
- AXEON Permeate and Concentrate Flow Meters
- AXEON Concentrate Recycle Flow Meter
- AXEON Pre-Filter 0-100 psi Panel Mounted Glycerin Filled Gauges
- AXEON Pump Discharge and Concentrate 0-300 psi Panel Mounted Glycerin Filled Gauges
- AXEON 5-Micron Sediment Pre-Filter
- AXEON HF5–Series Ultra Low Energy Membrane Elements
- AXEON FRP–Series Membrane Housings (300 psi)
- AXEON by Pentair® 20" Big Grey Cartridge Housings
- Goulds® Multi-Stage Stainless Steel Booster Pump
- ASCO™ Composite Feed Solenoid Valve
- Feed Low Pressure Switch
- White Powder Coated Aluminum Frame
- Dual Chemical Pump Outlets

OPTIONS AND UPGRADES

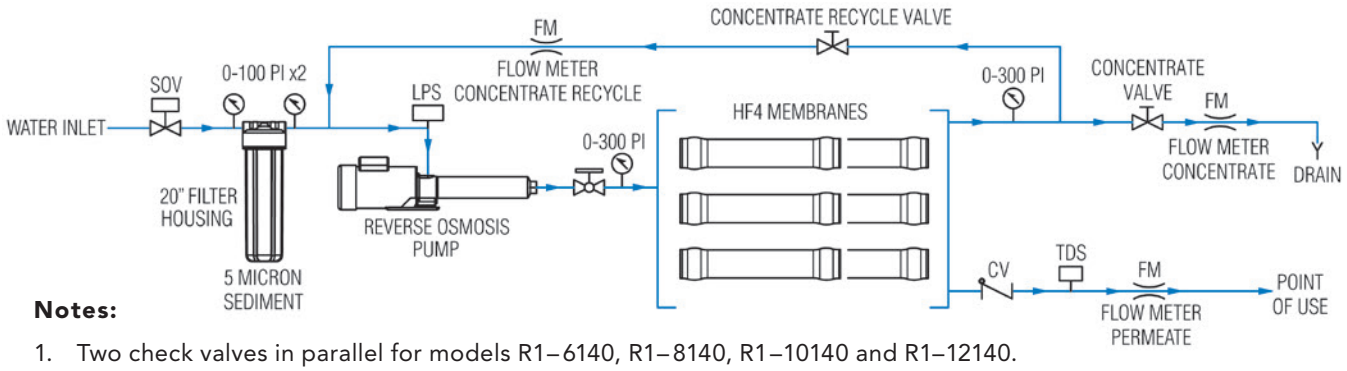
- S–150 Expander Board
- S–150 Dual TDS Board and Sensor
- Filmtec® LCLE Membrane Elements
- AXEON SS–Series Membrane Elements
- AXEON NF3–Series Membrane Elements
- AXEON NF4–Series Membrane Elements
- AXEON HR3–Series Membrane Elements
- Hanna® BL 981411 pH Controller
- Permeate Flush
- Permeate Divert
- Permeate Sample Valves
- Pump Pressure Relief Valve
- Blending Valve
- High Pressure Tank Switch
- Wooden Crate

R1–12140
Reverse Osmosis System



Notes:

1. All dimensions are given in inches.
2. R1–12140 AXEON model shown.

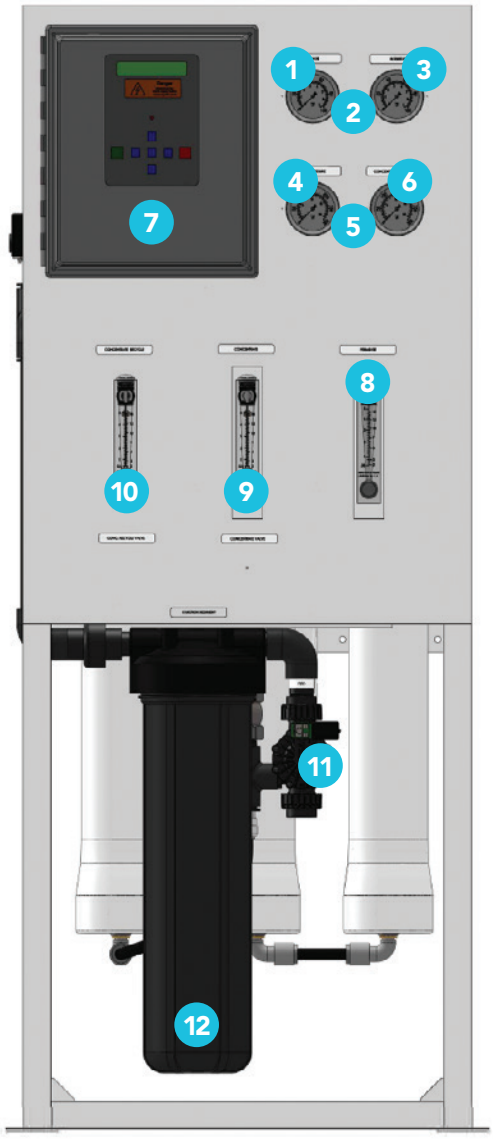


Notes:

1. Two check valves in parallel for models R1–6140, R1–8140, R1–10140 and R1–12140.

ARRAY SPECIFICATIONS

Model	Vessel Array	Vessel Size	Vessel Quantity	Membrane Size	Membrane Quantity
R1–1140	1	4040	1	4040	1
R1–2140	1:1	4040	2	4040	2
R1–3140	1:1:1	4040	3	4040	3
R1–4140	1:1:1:1	4040	4	4040	4
R1–5140	1:1:1:1:1	4040	5	4040	5
R1–6140	2:2:2	4040	6	4040	6
R1–8140	2:2:2:2	4040	8	4040	8
R1–10140	2:2:2:2:2	4040	10	4040	10
R1–12140	2:2:2:2:2:2	4040	12	4040	12



1 **Filter In**
Measures feed pressure which needs a minimum > 45 psi. Lower pressure can create low pressure faults.

2 Differential pressure is measured based on the Filter In and Filter Out and if it exceeds 15 psi then the filter must be replaced.

3 **Filter Out**
Measures pressure after the filter. This pressure must be above > 40 psi. Low pressure switch will shut off unit when it goes below < 15 psi.

4 **Pump Pressure**
Displays pressure after the RO Pump and before the first membrane. Max pressure is 200 psi.

5 If differential pressure on these two gauges shows above 15 psi per each membrane housing (ex. 3 membranes in series would add up to 45+ psi) then membrane likely is fouled. Clean or replace membranes.

6 **Concentrate Pressure**
Displays pressure after the last membrane.

7 **S150 Controller**
Monitors functions from TDS, temperature, rejection (with dual TDS Option) RO pump, pressures and solenoid valve. Voltage standard is 220 1 pH and optional 3 pH, voltage 380, 460, 575 VAC. This controller is UL/CUL certified.

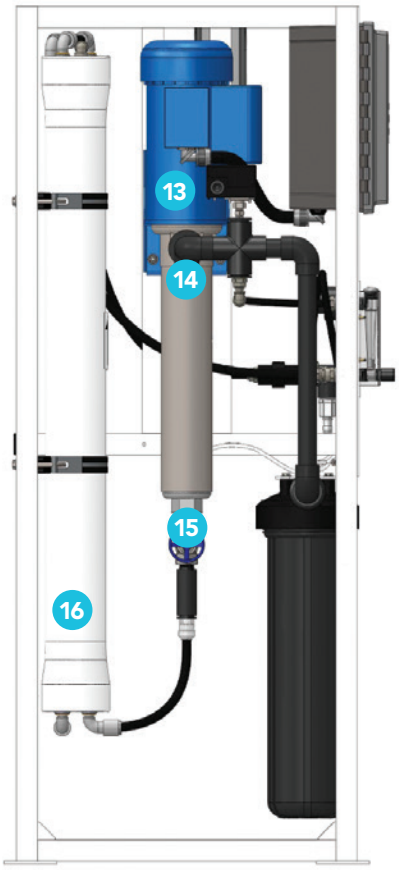
8 **Permeate**
Shows the amount of water being produced in GPM (Gallons Per Minute), also known as Product Water.

9 **Concentrate/Concentrate Valve**
Measures flows of waste water using an integrated needle valve to adjust pressure and flows.

10 **Concentrate Recycle/Concentrate Recycle Valve**
Measures flows of recycled water from the waste water side for higher recovery using an integrated needle valve to adjust flows. This is used in conjunction with concentrate water.

11 **Solenoid Valve**
The ASCO brand solenoid is a composite valve that lets water in or stops based on RO demand. The size is 1" FNPT (female pipe thread). ALWAYS have the same size or larger pipe.

12 **Sediment Filter**
This uses a 4.5" x 20" filter that traps particulates as low as 5 microns using a 5 MIC filter.

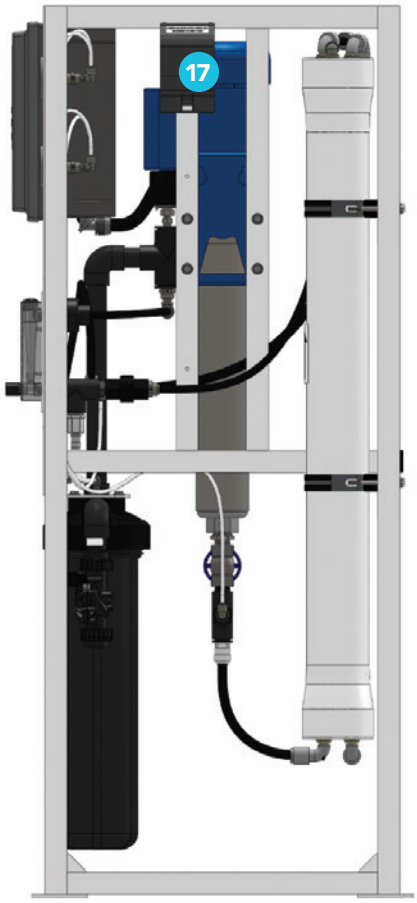


13 RO Pump
This produces the required pressure for the RO system. The R1 has two sizes: 1.5 hp for the R1–1140 to R1–4140 and 3 hp for the R1–5140 to R1–12140.

14 Injection Port
This is for the injector used in a chemical injection system. This injects a chemical to help prevent fouling of the membrane. S200 is the chemical used to sequester hardness so it won't plug the membranes. Up to 300 GPG.

15 Pump Throttle Valve
This controls the flow and pressure from the pump. NEVER fully close this or damage will occur from heat and dead heading.

16 Fiberglass Pressure Valve
Stores membranes (HF5–4040) that produce clean water.



17 Injection Power
Power source only for the chemical injection pump. It is not to be used for anything else or overloading can occur.

RWS–Series
Packaged Water Systems

AXEON Reverse Osmosis Packaged Water Systems include configurations that produce 2,000 to 21,000 gallons of pure water per day. These systems arrive fully assembled, tested and ready for plug-in-play installation.

SPECIFICATIONS

MODELS	R1–1140	R1–2140	R1–3140	R1–4140	R1–5140	R1–6140	R1–8140	R1–10140	R1–12140
Design									
Configuration	Single Pass	Single Pass	Single Pass	Single Pass	Single Pass	Single Pass	Single Pass	Single Pass	Single Pass
Feedwater TDS max (ppm)[A]	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Standard Recovery %	29	45	56	63	68	56	63	68	71
Rejection and Flow Rates[B]									
Permeate Flow Rate (gpd / lpd)	1,800 / 6,813	3,600 / 13,627	5,400 / 20,441	7,200 / 27,254	9,000 / 34,068	10,800 / 40,882	14,400 / 54,509	18,000 / 68,137	21,600 / 81,764
Permeate Flow (gpm / lpm)	1.25 / 4.73	2.50 / 9.46	3.75 / 14.19	5.00 / 18.93	6.25 / 23.66	7.50 / 28.39	10.00 / 37.85	12.50 / 47.32	15.00 / 56.78
Minimum Concentrate Flow (gpm / lpm)	3 / 11.35	3 / 11.35	3 / 11.35	3 / 11.35	3 / 11.35	6 / 22.71	6 / 22.71	6 / 22.71	6 / 22.71
Concentrate Recycle Flow Rate (gpm / lpm)	Up to 5 / 18.93	Up to 5 / 18.93	Up to 5 / 18.93	Up to 5 / 18.93	Up to 5 / 18.93	Up to 5 / 18.93	Up to 5 / 18.93	Up to 5 / 18.93	Up to 5 / 18.93
Connections									
Feed Connection (in)	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT
Permeate Connection (in)	3/4 FNPT	3/4 FNPT	3/4 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT
Concentrate Connection (in)	3/4 FNPT	3/4 FNPT	3/4 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT	1 FNPT
Membranes									
Membranes Per Vessel	1	1	1	1	1	1	1	1	1
Membrane Quantity	1	2	3	4	5	6	8	10	12
Membrane Size	4040	4040	4040	4040	4040	4040	4040	4040	4040
Nominal TDS Rejection %	98.5	98.5	98.5	98.5	98.5	98.5	98.5	98.5	98.5
Vessels									
Vessel Array	1	1:1	1:1:1	1:1:1:1	1:1:1:1:1	2:2:2	2:2:2:2	2:2:2:2:2	2:2:2:2:2:2
Vessel Quantity	1	2	3	4	5	6	8	10	12
Pumps									
Pump Type	Multi-Stage	Multi-Stage	Multi-Stage	Multi-Stage	Multi-Stage	Multi-Stage	Multi-Stage	Multi-Stage	Multi-Stage
Motor HP	1.5	1.5	1.5	1.5	3	3	3	3	3
RPM @ 60Hz	3450	3450	3450	3450	3450	3450	3450	3450	3450
System Electrical									
Standard Voltage + Amp Draw	220V, 60Hz, 1PH, 8.8A[C]	220V, 60Hz, 1PH, 8.8A[C]	220V, 60Hz, 1PH, 8.8A[C]	220V, 60Hz, 1PH, 8.8A[C]	220V, 60Hz, 1PH, 16A[C]	220V, 60Hz, 1PH, 16A[C]	220V, 60Hz, 1PH, 16A[C]	220V, 60Hz, 1PH, 16A[C]	220V, 60Hz, 1PH, 16A[C]
System Dimensions									
Approximate Dimensions[D] L x W x H (in / cm)	26 x 26 x 60 / 73.66 x 66.04 x 154.94	26 x 26 x 60 / 73.66 x 66.04 x 154.94	26 x 26 x 60 / 73.66 x 66.04 x 154.94	32 x 26 x 60 / 78.74 x 66.04 x 154.94	32 x 26 x 60 / 78.74 x 66.04 x 154.94	32 x 26 x 60 / 78.74 x 66.04 x 154.94	32 x 50 x 60 / 83.82 x 127 x 154.94	32 x 50 x 60 / 83.82 x 127 x 154.94	32 x 50 x 60 / 83.82 x 127 x 154.94
Approximate Weight (lbs / kg)	250 / 113.40	290 / 131.54	330 / 149.68	370 / 167.83	430 / 195.05	470 / 213.19	510 / 231.33	550 / 249.48	590 / 267.62

Test Parameters: 550 TDS Filtered (5–Micron), Dechlorinated, Municipal Feedwater, 65 psi / 4.50 bar Feed Pressure, 80 psi / 5.5 bar Operating Pressure, 77°F / 25°C, Recovery as stated, 7.0 pH. Data taken after 60 minutes of operation.

A. Low temperatures and feedwater quality, such as high TDS levels will significantly affect the systems production capabilities and performance. Computer projections must be run for individual applications which do not meet or exceed minimum and maximum operating limits for such conditions.
B. Product flow and maximum recovery rates are based on feedwater conditions as stated above. Do not exceed recommended permeate flow.
C. Varies with motor manufacturer.
D. Does not include operating space requirements.

OPERATING LIMITS[E]

Maximum Feed Temperature (°F / °C)	85 / 29	Maximum Free Chlorine (ppm)	0
Minimum Feed Temperature (°F / °C)	40 / 4	Maximum TDS (ppm)	2,000
Maximum Ambient Temperature (°F / °C)	120 / 49	Maximum Hardness (gpg)	0
Minimum Ambient Temperature (°F / °C)	40 / 4	Maximum pH (continuous)	11
Maximum Feed Pressure (psi / bar)	85 / 6	Minimum pH (continuous)	2
Minimum Feed Pressure (psi / bar)	45 / 3	Maximum pH (cleaning 30 minutes)	13
Maximum Pressure (psi / bar)	200 / 14	Minimum pH (cleaning 30 minutes)	1
Maximum Feed Silt Density Index (SDI)	< 3	Maximum Turbidity NTU	1

E. System pressure is variable due to water conditions. Permeate flow will increase at a higher temperature and will decrease at a lower temperature.

D

Appendix D
SDI Test Results

PROCESCO INC.

BENCH TEST
SILT DENSITY INDEX & WATER QUALITY TESTING

WIMBORNE WTP
KNEEHILL COUNTY
ALBERTA

Prepared for:

CIMA+
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Prepared by:

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December 11th, 2023
J23436

INTRODUCTION

Procesco Inc. was retained to perform a bench test for the SILT DENSITY INDEX from the potable water treatment plant located at Wimborne in Kneehill County, AB.

The treated water source should comply with the Health Canada Guidelines for Canadian Drinking Water Quality (further CDWQG). The treatment objective of the bench testing was to confirm that the proposed treatment by Reverse Osmosis is suitable to treat the water source for Fluoride reduction.

Procesco Inc. used the following tests:

- Silt Density Index (SDI) test is performed by flowing water through a 0.45 micron, cellulose acetate Millipore filter for a total of 15 minutes at 30psi.
- Site tests were performed using the Hach DR890 colorimeter and water testing strips.

Procesco Inc. bench testing equipment was utilized on site on November 30, 2023.

This report, which outlines the testing procedure, the results conclusions, was prepared by Procesco Inc. and IQWater Inc. using the field data obtained by the Procesco Inc. personnel during the bench testing.

SUMMARY OF TEST RESULTS

SDI testing was conducted on raw well water as well as chlorinated water from the treated water reservoir.

Raw Water test 1: Test was not completed due to filter paper plugging at 10 minute sampling time. SDI >> 5

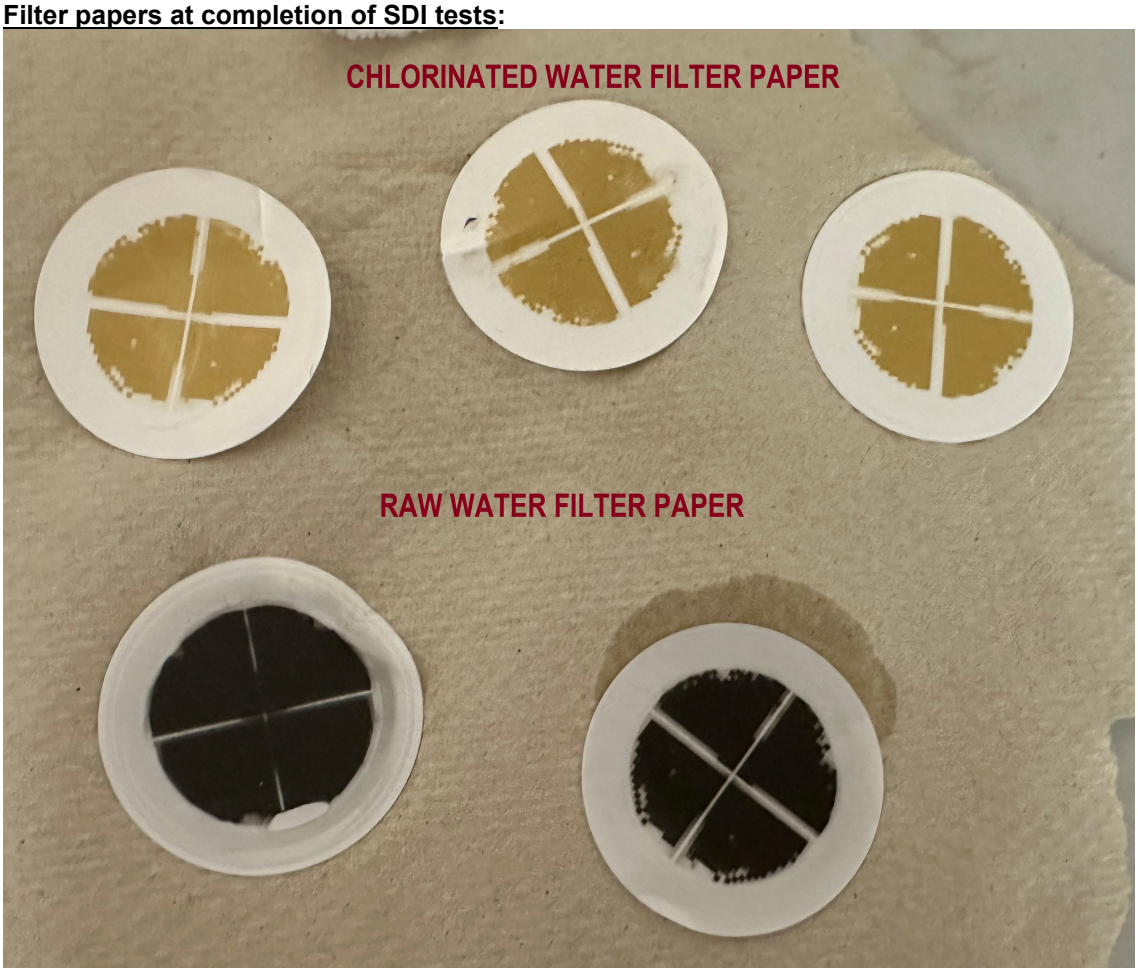
Raw Water test 2: SDI = 6.0

Treated Water test 1: SDI = 5.4

Treated Water test 2: SDI = 4.1

Treated Water test 3: SDI = 4.6

Filter papers at completion of SDI tests:



Water Information – Site Tests

- *Raw*
  - Iron (ppm) 0.08
  - Manganese (ppm) 0.001
  - NH3 (ppm) 0.09
  - pH 7.7
  - Alkalinity 180
  - CH (ppm) 0

- *Treated*
  - Iron (ppm) 0.04
  - Manganese (ppm) 0.002
  - NH3 (ppm) 0
  - pH
  - Free Cl (ppm) 0.5
  - Alkalinity 180
  - CH (ppm) 0

CONCLUSIONS:

Test results for the raw water resulted in an SDI value greater than 5, which is the recommended maximum for most membrane manufacturers. One of the raw water SDI tests was not possible to complete due to the filter paper becoming completely blocked resulting in no water flow.
Two of the three treated water SDI results were in the range of 4, with one result over 5.
This variability in results may be due to inconsistent raw water quality with surges of silt plugging the filter paper.

A Pre-Filtration system is required for the use of a Reverse Osmosis system.
A biological pre-filter, two filters in series, would be suitable for ammonia removal as well as iron, manganese and silt reduction for the treatment of the raw water.

PROCESCO INC.

E

Appendix E
RO System (POU)

F

Appendix F
Opinion of Probable Costs

March. 2024

HAMLET OF WIMBORNE
CLASS 4 OPINION OF PROBABLE COSTS
Fluoride Removal

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST
	Treatment Package	1	LS	$ 80,000.00	$ 80,000.00
	Well Pump Replacement	1	LS	$ 40,000.00	$ 40,000.00
	Sewer Extension from WTP to MH	1	LS	$ 40,000.00	$ 40,000.00
	Electrical Upgrade	1	LS	$ 75,000.00	$ 75,000.00
	PLC **(Optional)**	1	LS	$ 75,000.00	$ 70,000.00
	Process Instrumentation **(Optional)**	1	LS	$ 75,000.00	$ 75,000.00
	SUBTOTAL				**$ 380,000.00**
CONTINGENCY (25%)					$ 100,000.00
ENGINEERING (15%)					$ 70,000.00
	TOTAL (Rounded)				**$ 550,000.00**
Note: actual distribution of budget between different sub-items may vary					

4-Mar-24

Fluoride Removal Operation and Maintenance Costs

Operation and Maintenance Costs

		Motor Power		Monthly Cost	Unit Cost	Annual Cost	Operating# Months	Notes/Remarks
Power	Quanity	bhp	kW					
Well Pump	1	5	3.7285	$ 214.76		$ 2,416.07	12	operates quarter time
Distribution Pump	1	5	3.7285	$ 214.76		$ 8,053.56	12	
RO Pump	1	1	0.7457	$ 42.95		$ 483.21	12	operates quarter time
Biofilter Compressor	1	1	0.7457	$ 42.95		$ 1,610.71	12	
					Electrical Rate		0.25	
Duty Run Time For Motors							$/kw-h	
Duty operating capacity Distribution	100%							
Duty operating capacity Treatment	30%							
Chemical								
Sodium Hypochloride, 12%, l/d	0.5			$ 22.50	$ 1.50	$ 270.00	12	
Anti-Scalant, l/d	0.1			$ 9.00	$ 3.00	$ 108.00	12	
Building Maintenance								
Heating						$ 3,000.00	12	Estimated based on the size of the bldge
Miscellaneous System Maintenance						$ 10,000.00	12	
SubTotal Operation and Materials						**$ 25,941.55**		
Operator Labour Level II	Rate/Hr	Hrs on Site	Days/Week	Weekly Cost				One operator 5 d/week 3 hrs per day
	100	3	5	1500		$ 78,000.00		
Total (Rounded)						**$ 104,000.00**		

4-Mar-24

Distribution Only Operation and Maintenance Costs

Operation and Maintenance Costs

		Motor Power		Monthly Cost	Unit Cost	Annual Cost	Operating# Months	Notes/Remarks
Power	Quanity	bhp	kW					
Distribution Pump	1	5	3.7285	$ 214.76		$ 8,053.56	12	
					Electrical Rate		0.25	
Duty Run Time For Motors							$/kw-h	
Duty operating capacity Distribution	100%							
Chemical								
n/a								
Building Maintenance								
Heating						$ 3,000.00	12	Estimated based on the size of the bldge
Miscellaneous System Maintenance						$ 5,000.00	12	
SubTotal Operation and Materials						**$ 16,053.56**		
Operator Labour Level I	Rate/Hr	Hrs on Site	Days/Week	Weekly Cost				One operator 3 d/week 3 hrs per day
	100	3	3	900		$ 46,800.00		
Total (Rounded)						**$ 63,000.00**		

G

Appendix G
Wimborne Infra Assessment. Opus, April 2016

H

Appendix H
Sunnyslope Feasibility Study. WSP, June 2018