NL Decision Matrix for Potable Water Treatment & Service Delivery Options

Project Objectives

- Summarizing the state of public drinking water in the province
- Reviewing available and in-use water treatment technologies utilized in other jurisdictions
- Reviewing water service delivery options utilized throughout Canada and other locations with similar remote challenges
- Develop a “Decision Matrix” – a guidance tool reviews water treatment technologies and water service delivery options

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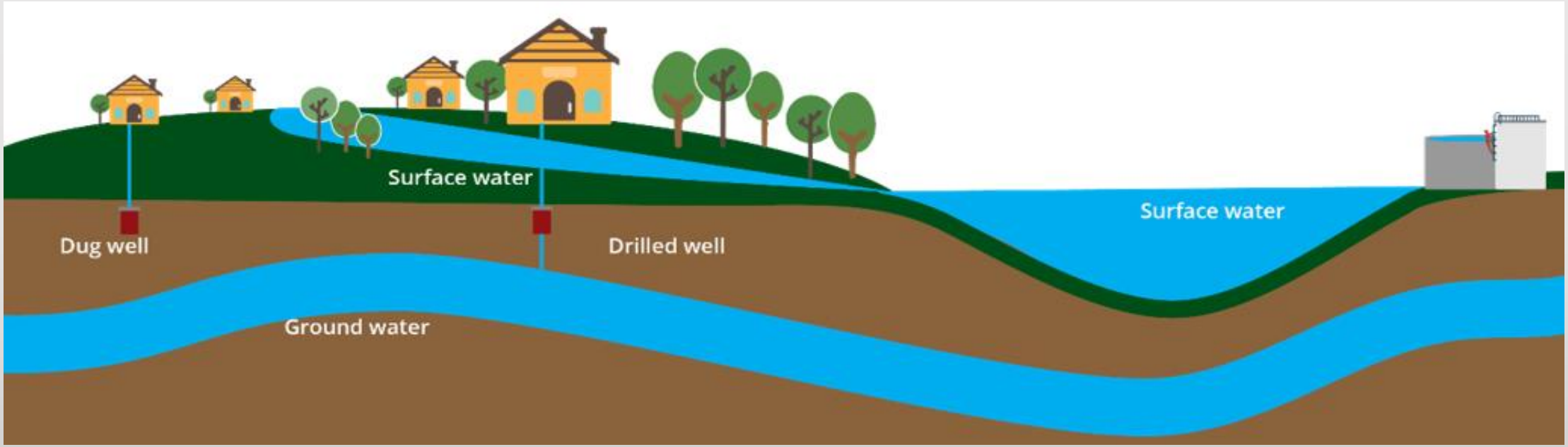
Project Overview



Project Overview

There are 512 drinking water systems across the province – approximately **68%** service less than 500 people.

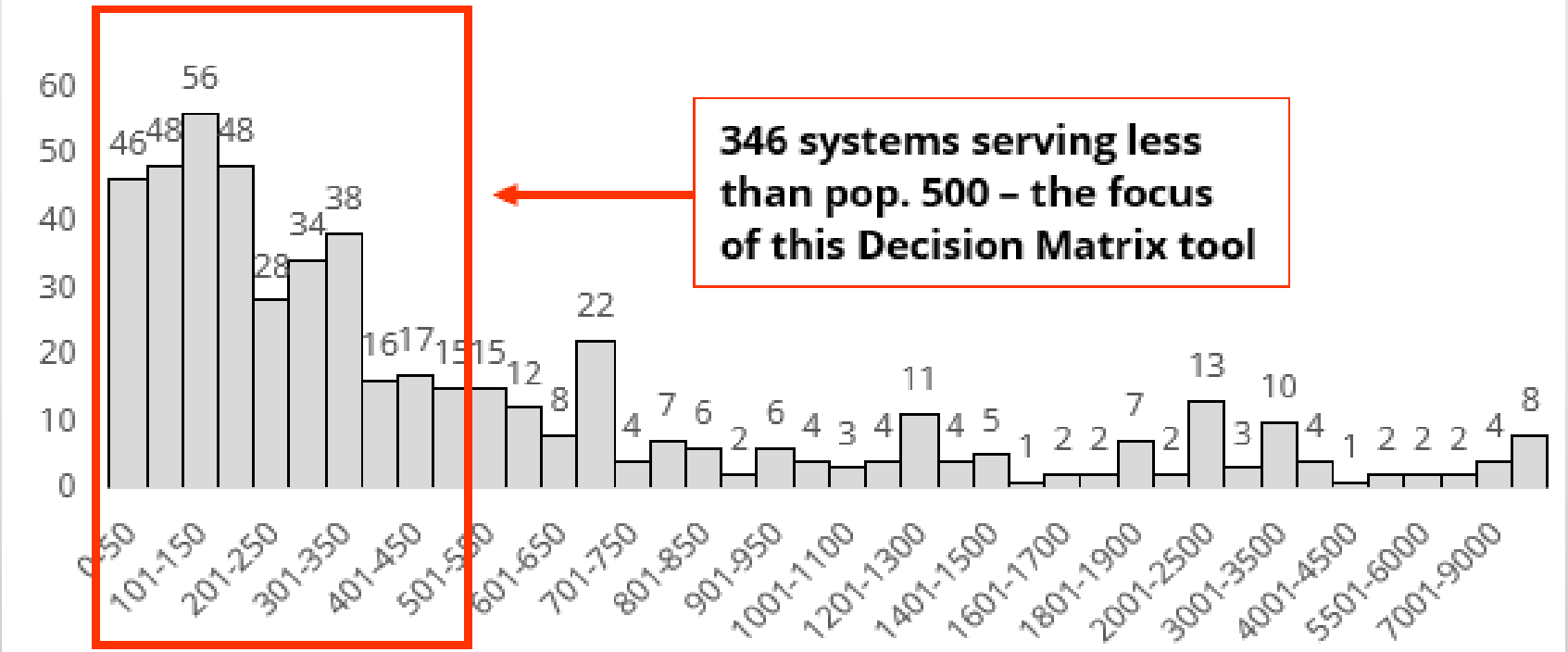


Figure 1-2: Number of drinking water systems by size of population served

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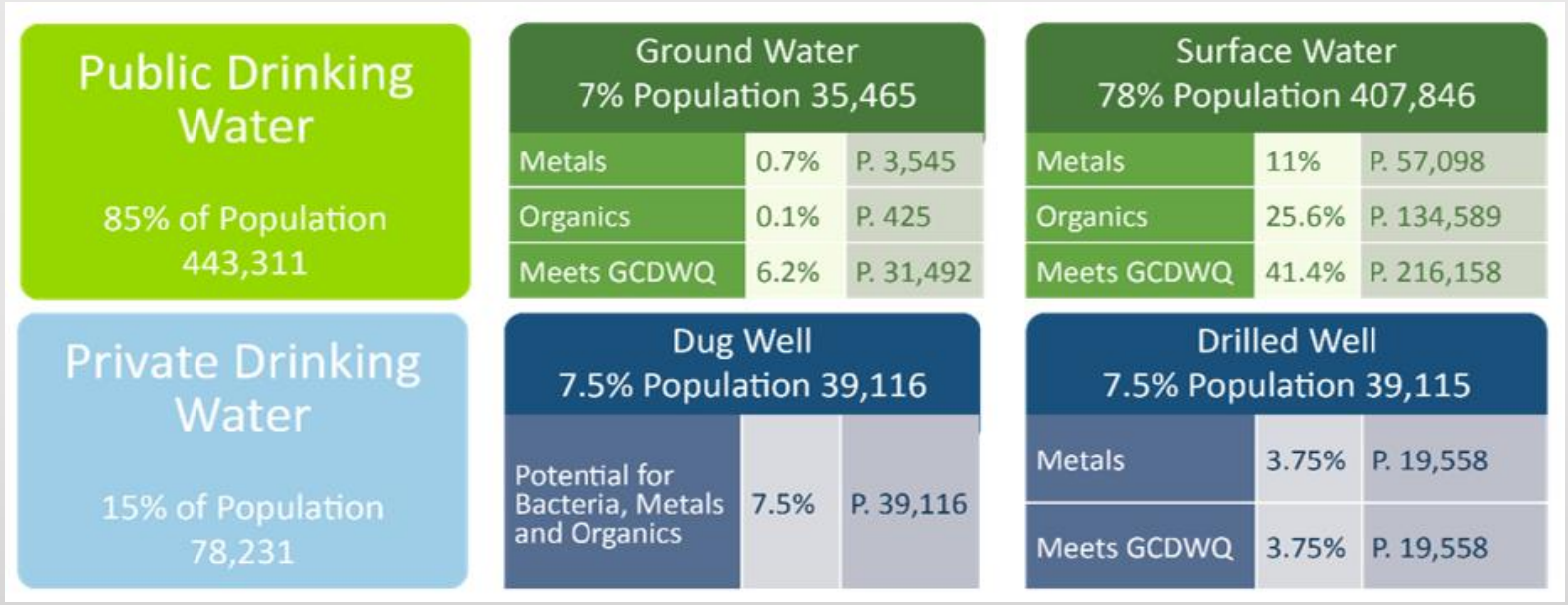
Project Overview

Approximately **51 %** of the population in NL meets the Canadian Drinking Water Quality Guidelines as issued by Health Canada!



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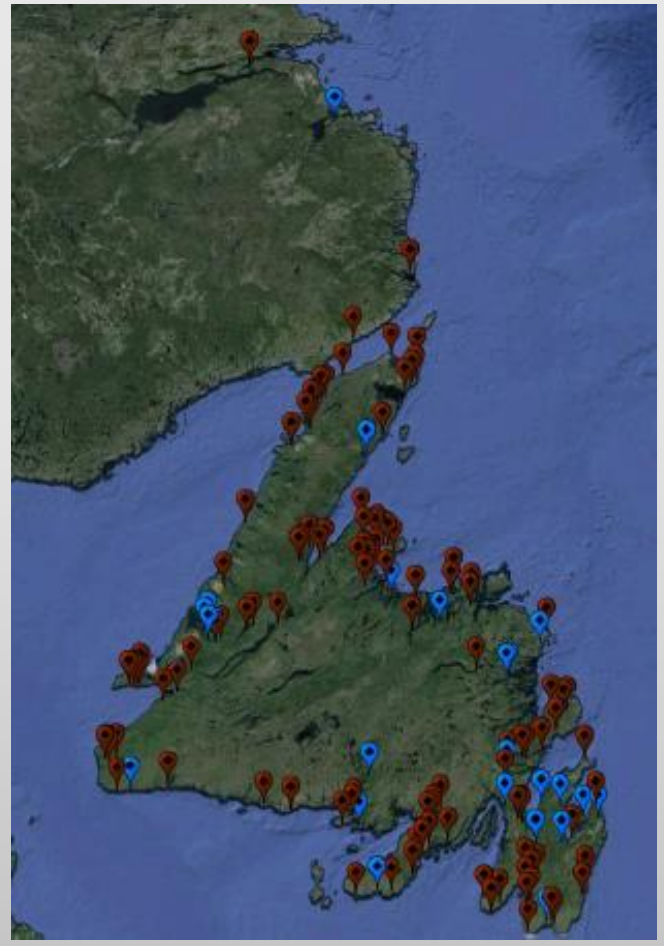
Water Quality Review – BWA's

As of April 22, 2024:

- 191 systems in 146 communities are under a Boil Water Advisory (BWA's)
- 119 of these communities have a population <500
- **82%** of the communities in NL, with at least one active BWA, have a census population less than 500 people !!



Water Quality Review - Groundwater

Parameter	Is there a MAC for Health Affects?	Health Considerations
Arsenic	✓	Cancer (lung, bladder, liver, skin) *Classified as human carcinogen
Manganese	✓	Neurological development and behavior; deficits in memory, attention, and motor skills
Iron	✗	N/A
Lead	✓	Reduced intelligence in children measured as decrease in IQ
Selenium	✓	Chronic selenosis
Uranium	✓	Kidney effects

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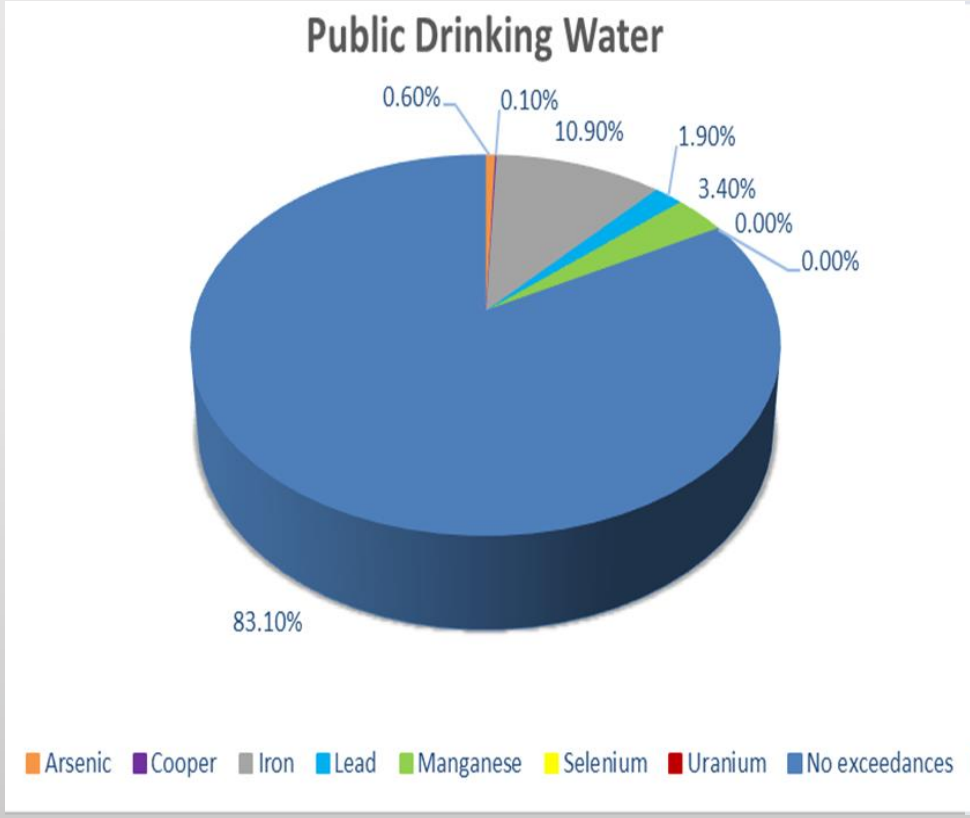
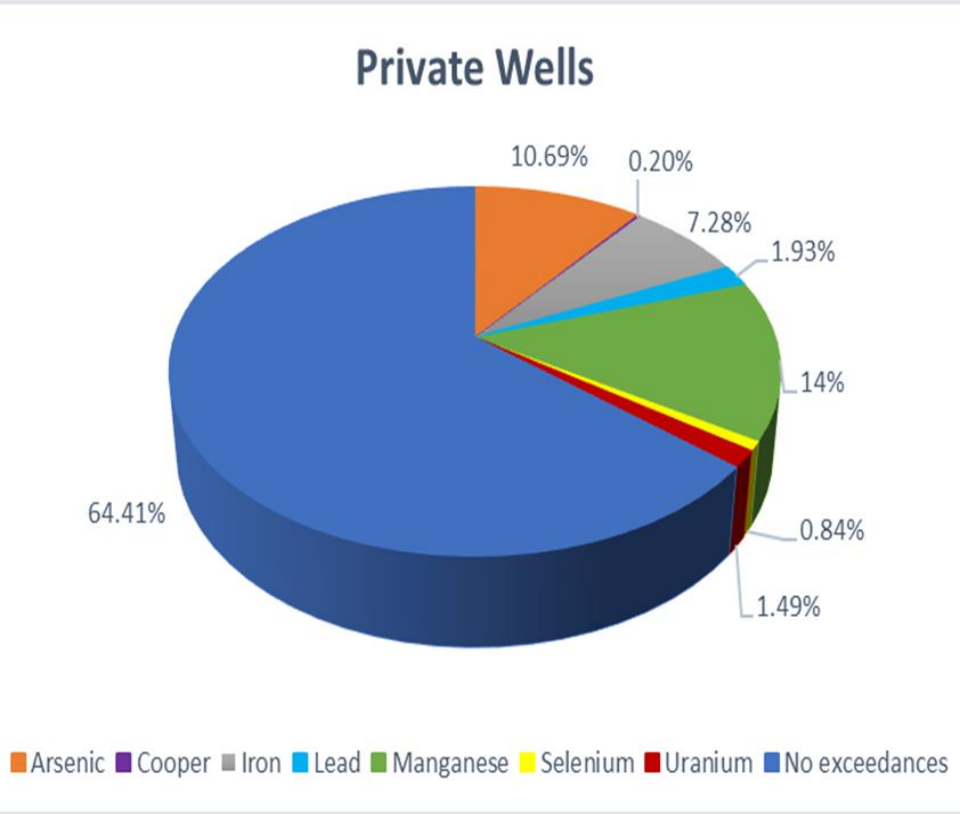
Water Quality Review - Groundwater

- Between **64 – 83%** of all ground water supplied systems in the province meet the GCDWQ
- Meaning that **17 – 36%** of systems do not meet the GCDWQ





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Water Quality Review – Surface Water

Low hardness

Low pH and alkalinity

High colour

High levels of natural organic matter

Water Quality Review – Surface Water

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Water Quality Review – Surface Water

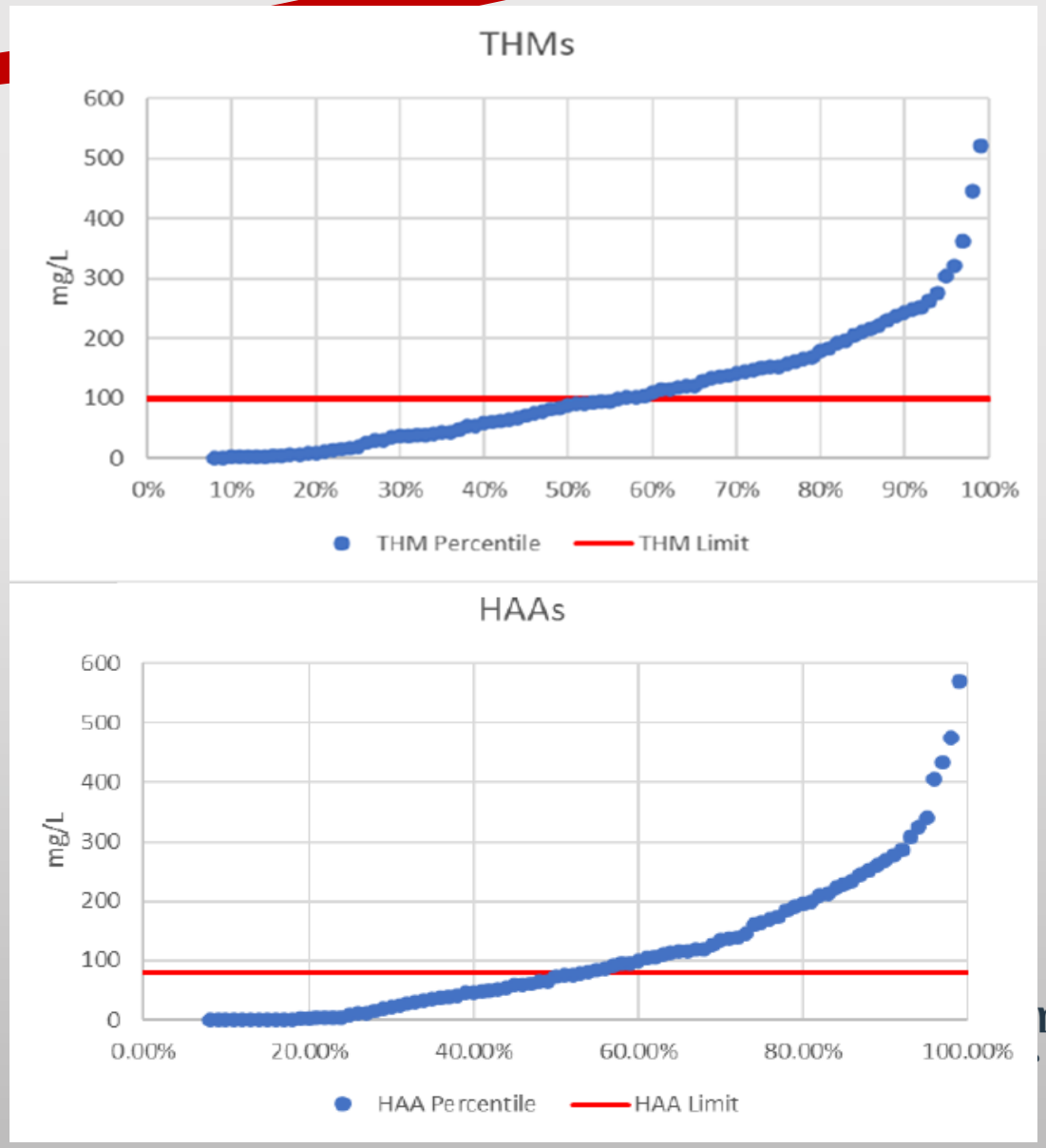
Parameter	Is there a MAC for Health Affects?	Health Considerations
Colour	✘	N/A
Dissolved Organic Carbon	✘	N/A
Natural Organic Mater	✘	N/A
Trihalomethanes (THMs)	✓	Certain related compounds are classified as probable carcinogenic; Long-term exposure to high levels may increase the risk of liver effects including fatty cysts, kidney and colorectal cancers.
Haloacetic Acids (HAAs)	✓	Certain related compounds are classified as probable carcinogenic; Long-term exposure to high levels may increase the risk of liver cancer, other organ cancers, liver and other organ effects (kidneys)

Water Quality Review – Surface Water

- **Maximum Acceptable Concentration (MAC)** as defined by Health Canada for **THM = 100 µg/L**

- **Maximum Acceptable Concentration (MAC)** as defined by Health Canada for **HAA = 80 µg/L**

- Sampling results over the last 10 years show that approximately **44%** of all public systems exceeded the Health Canada THM & HAA MAC's.



Water Quality as an Economic Problem

The chart highlights how economic capacity varies across different community sizes.

- Smaller communities (0-250) tend to have lower economic capacity, while;
- Larger communities (501-1500 and >1500) generally have higher economic capacity.
- This suggests that population size may be correlated with economic resources and capacity.

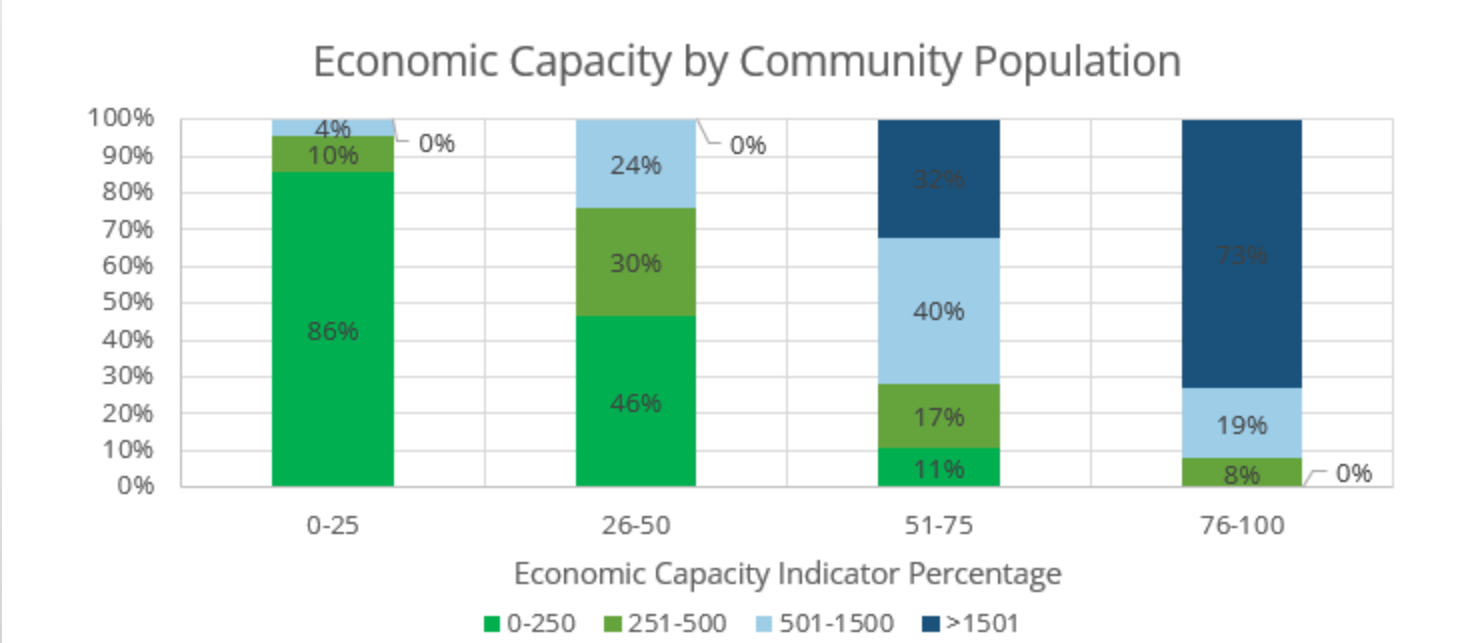


Figure 1-7: Percentages of communities in each bin by population

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Water Quality as an Economic Problem

- In the top bin of the Economic Capacity Indicator (76% - 100%), the majority **(63%)** of drinking water systems were rated as Excellent according to the Drinking Water Quality Index (DWQI)
- Looking at the next highest economic capacity indicator it is already down at **21%**

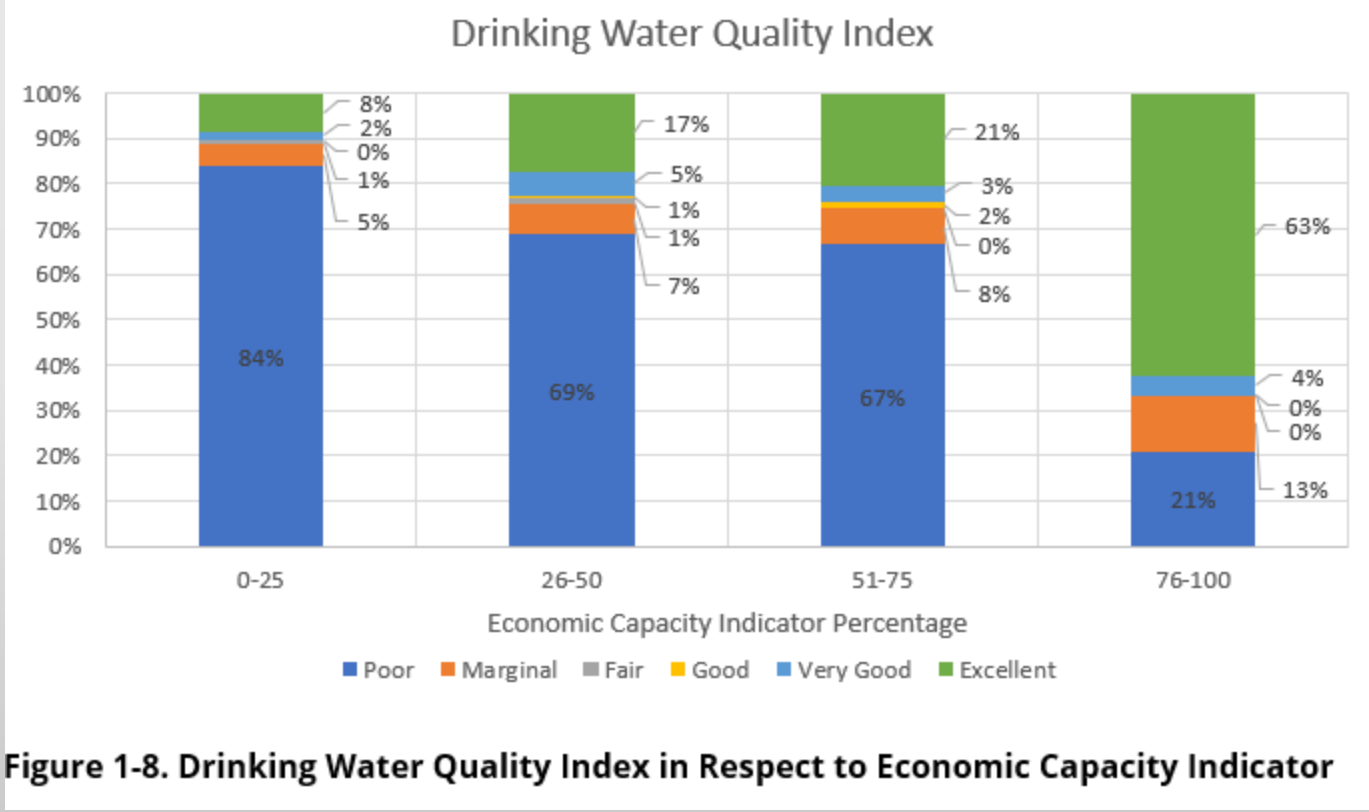

Figure 1-8. Drinking Water Quality Index in Respect to Economic Capacity Indicator

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Water Quality as an Economic Problem

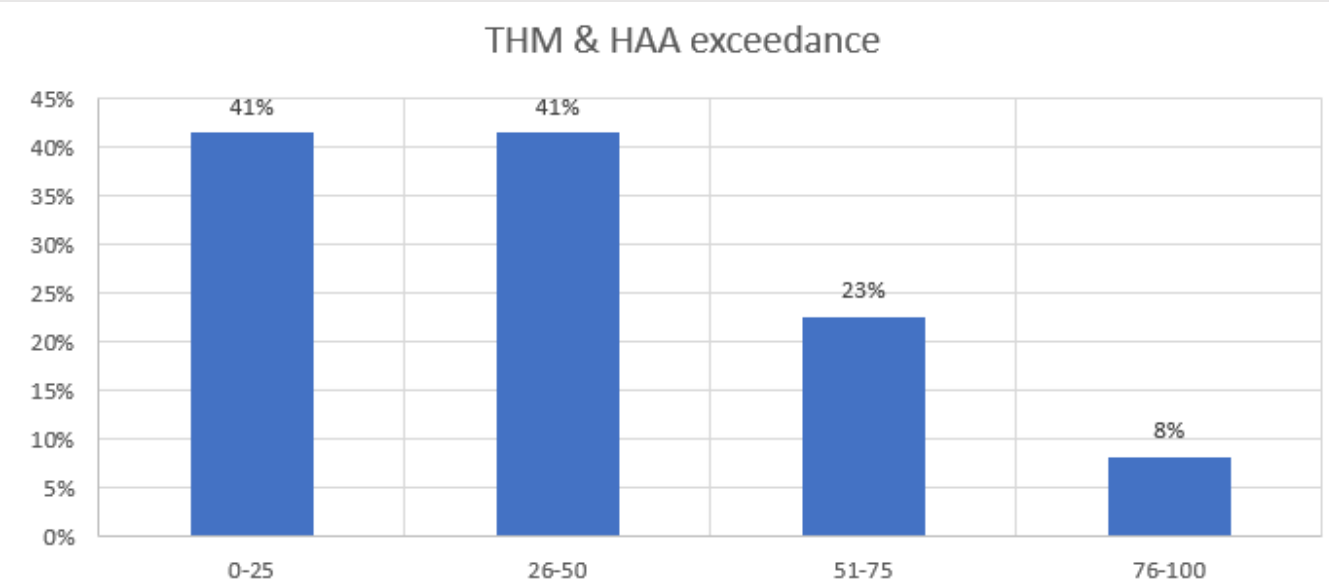

Figure 1-9. THM & HAA Exceedance in Respect to Economic Capacity Indicator

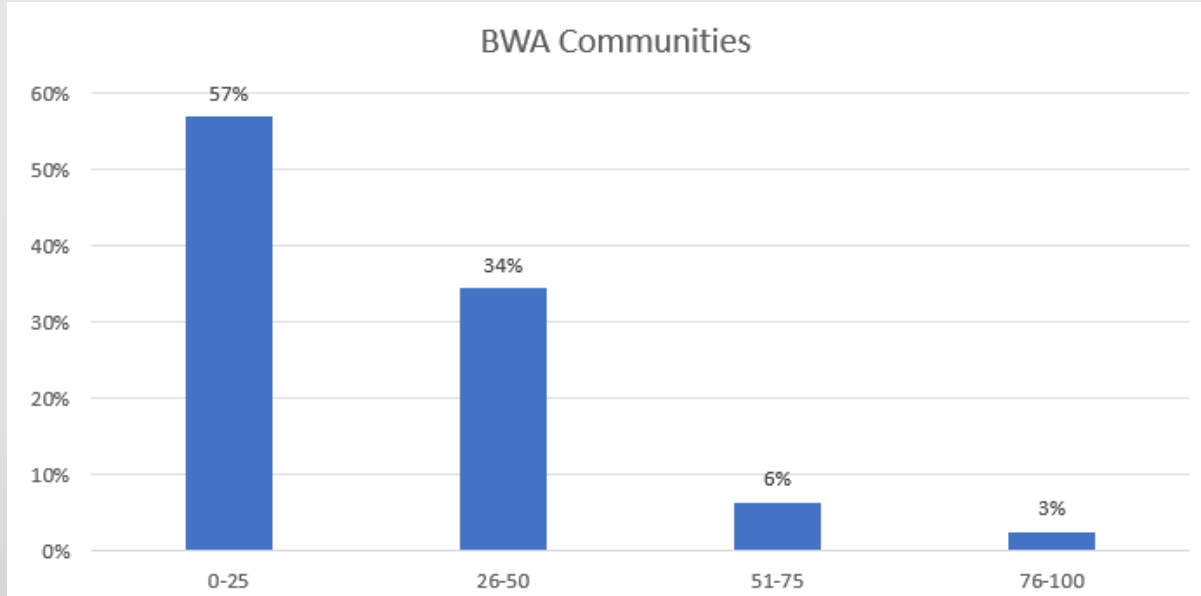

Figure 1-10. BWA Communities in Respect to Economic Capacity Indicator

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Where do we go from here?

1. Exploring non-traditional solutions
2. Policy and regulatory changes
3. Decentralized treatment options
4. Capacity building and training
5. Collaborative planning

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Centralized vs. Decentralized Treatment

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Residential-Scale Treatment: Point of Entry

Table F POE Summary

Technology	Target Parameters	Capital Cost ($)	Operating Cost ($/yr)
Cation Exchange	Iron, Manganese, Hardness	$1,500 - $2,000	$75 - $160
Anion Exchange	Arsenic, Uranium	$2,000 - $3,000	$100
Macro-porous Resin	Organics	$2,700 - $3,700	$370 - $520
Cartridge Filters	Turbidity, various	$200 - $1000	$50 - $130
Sand Media Filters	Manganese, Iron, hydrogen sulfide	$1,700 - $2,300	$200
Sacrificial Media Filters	Low pH	$1,300 - $2,000	$300
Reverse Osmosis	All contaminants	$12,000 - $25,000	$400
UV Disinfection	Microbiological	$500-$1500	$200/yr

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Residential-Scale Treatment: Point of Use

Table G: POU RO Cost

Technology	Target Parameters	Capital Cost ($)	Operating Cost ($/yr)
POU Reverse Osmosis	All contaminants	$700 - $1,200	$75 - 160

Table H: POU Activated Carbon Treatment Cost

Technology	Target Parameters	Capital Cost ($)	Operating Cost ($/yr)
POU Activated Carbon	All contaminants	$100 - $300	200$/yr

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Jurisdictional Scan of Service Delivery Options

Figure 3-1: Jurisdiction Comparison Summary Table

	International				USA					Canada											
	Ceara, Brazil	Mexico City, Mexico	New Zealand	Rural Nepal	Alaska	California	Delaware	Pennsylvania	Washington	Atlantic First Nation Water Authority	Alberta	British Columbia	Manitoba	Northwest Territories	Parks Canada	Quebec	Saskatchewan	Yukon	Nova Scotia	Ontario	Newfoundland and Labrador
Multiple service delivery options are available	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
POE/POU usage is allowed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	No
POE/POU Regulation is in place	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No	N/A	N/A	No	Yes	No
Dedicated Non-Potable water systems are present	No	No	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	N/A	Yes	Yes	Yes	N/A	No	No	No
Proactive Risk Management in place	Yes	N/A	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal Obligations for homeowner cooperation	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	No	N/A	Yes	No	No	No	No	No
Community involvement in water management	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	No	Yes	N/A	No	No	Yes	No	No	No
*Uses Cross-Subsidization model	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	No	No	No	Yes	No	No	Yes	No	No	No
**Legal liability protection for communities in place	Yes	N/A	Yes	Yes	Yes	Yes	Yes	N/A	No	Yes	No	Yes	Yes	No	No	Yes	No	No	No	No	No
External NGO involvement	Yes	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Seasonal classification of water systems	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
***Decentralized management models	Yes	Yes	Yes	No	Yes	Yes	No	No	No	Yes	No	No	No	Yes	Yes	No	Yes	No	No	No	No
Subsidizes Low-Income communities for system improvals	Yes	Yes	N/A	Yes	Yes	No	No	No	No	Yes	No	No	No	Yes	N/A	No	No	Yes	No	Yes	No
****Public-Private Partnerships approach is utilized	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No	No	No	No	No	Yes	No
Mandates universal potable water access	Yes	Yes	Yes	Yes	Yes	Yes	N/A	N/A	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Supports Indigenous water rights by legislation	Yes	N/A	Yes	Yes	Yes	Yes	N/A	N/A	N/A	Yes	N/A	Yes	N/A	Yes	N/A	Yes	N/A	Yes	Yes	Yes	Yes

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Decision Matrix – Excel Tool

Water Treatment and Service Delivery Assessment Tool Description:

Community:	Anchor Point
Supply Name:	Well Cove Brook
WS Number:	WS-S-0003
Water Source:	Surface Water
Population:	326
Population (Override):	

Raw Water Quality:	Average	Maximum	Unit
Turbidity	1.01	5.89	NTU
Colour	28.78	38.00	TCU
Alkalinity	93.2	120	mg/L
pH	7.97	8.48	
Hardness	97.45	130.00	mg/L
Iron	0.069	0.190	mg/L
Manganese	0.012	0.030	mg/L
Copper	0.011	0.15	mg/L
Sulphate	2.06	5.00	mg/L
DOC	5.66	8.2	mg/L
TDS	132.0	169.0	mg/L

Treated Water Quality:	Average	Maximum	Unit
Turbidity	0.75	**3.90**	NTU
Colour	**21.04**	**36.00**	TCU
Alkalinity	110.2	178.0	mg/L
pH	7.85	8.28	
Hardness	121.86	199.00	mg/L
Iron	0.095	**0.240**	mg/L
Manganese	0.018	**0.090**	mg/L
Copper	0.010	0.053	mg/L
Lead	0.000	0.000	mg/L
Arsenic	0.000	0.000	mg/L
Sulphate	1.66	5.00	mg/L
DOC	7.22	11.70	mg/L
TDS	160.7	281.0	mg/L
Trihalomethanes (THI	0.089	**0.222**	mg/L
Haloacetic Acid (HAA	**0.085**	**0.438**	mg/L

Proceed to the Next Sheet

Legend	
Bold Red	Exceedance of Maximum Acceptable Concentration (MAC)
Bold Blue	Exceedance of Aesthetic Objective (AO) Limit

Water Quality Sample (Override)

Parameter	Value	Unit
Turbidity		NTU
Colour		TCU
Alkalinity		mg/L
pH		
Hardness		mg/L
Iron		mg/L
Manganese		mg/L
Copper		mg/L
Lead		mg/L
Arsenic		mg/L
Sulphate		mg/L
DOC		mg/L
TDS		mg/L
THM's		mg/L
HAA's		mg/L

Target Water Quality Parameters

Organics (NOM, DOC)	Target
Manganese	Target
Lead	Non Target
Arsenic	Non Target
Iron	Target
Hardness	Target
pH	Non Target
Turbidity	Non Target
DBPs (THM & HAA)	Target

Resources

- Health Canada Organic Matter (2020)
- GCDWQ Manganese (2019)
- GCDWQ Lead (2019)
- GCDWQ Arsenic (2006)
- GCDWQ Iron (2024)
- GCDWQ Hardness (1979)
- GCDWQ pH (2015)
- GCDWQ Turbidity (2012)
- GCDWQ THMs (2006)
- GCDWQ HAAs (2008)

Centralized Corrective Measures (CM)

New Source(s)	Valid CM
Conventional Treatment	Valid CM
Membrane Treatment	Valid CM
Slow Sand Filtration	Invalid CM
Ion Exchange	Invalid CM
Adsorption	Invalid CM
Chemical Disinfection	Valid CM
Oxidative Media	Invalid CM
Bank Filtration	Valid CM
pH Adjustment	Invalid CM
Corrosion Inhibitor	Invalid CM
Pressure Filters	Invalid CM

De-Centralized Corrective Measures (CM)

PWDU	Valid CM
POE Water Softeners	Valid CM
POE Particulate Filters	Valid CM
POE Sacrificial Media Filter	Invalid CM
POE Reverse Osmosis	Valid CM
POE Oxidative Media	Valid CM
POU Under Sink RO	Valid CM
POU Activated Carbon Filters	Valid CM
POU UV System	Valid CM
POU Ultrafiltration	Valid CM
Trucked Water	Valid CM

Decision Matrix – Excel Tool

Valid CM?	Corrective Measure	Description	Estimated Capital Cost	Estiamted Operational Cost
Valid CM	Chemical Disinfection	Disinfection is the treatment process specifically designed for the reduction of harmful microorganisms. Disinfection is an essential aspect of the drinking water treatment process critical for protection against various waterborne pathogenic microorganisms (bacteria, viruses, protozoa). Harmful microorganisms are the most significant risk to public health from drinking water. The removal/inactivation of microbiological parameters is the highest priority for water treatment and is critical to providing safe drinking water. The most common type of disinfection is chemical disinfection, which is achieved through the addition of a variety of chemicals or physical agents. The most common disinfectant agent is chlorine, which is found in most water treatment plants throughout Canada. In the province of Newfoundland and Labrador, chemical disinfection is widely implemented in water treatment plants and water treatment facilities.	$94,000	$38,000
Valid CM	pH Adjustment	Corrosive water is caused by a variety of factors, including low pH (acidic). Corrosive water will react with metal piping and slowly degrade the material, releasing metal ions into the treated water supply. This can cause a variety of issues including leaks, discolouration and elevated concentr4ation of harmful ions (lead). Surface water in Newfoundland and Labrador is generally characterized as being low pH and corrosive. As such, in drinking water systems with a low pH source water, pH adjustment can be added to boost the pH of the treated water and decrease the overall corrosivity. The decreased corrosivity of the water will slow the rate of corrosion and can help to alleviate the related water quality problems.	$67,000	$52,000

Valid CM?	Corrective Measure	Description	Unit Cost	Unit Operational Cost	Total Capital Cost	Total Operational Cost
Valid CM	PWDU	Potable water dispensing units, abbreviated as PWDU's, are decentralized drinking water treatment systems that are designed to treat the consumptive fraction of a community's water demand. PWDU are intended to provide high quality drinking water that is only used for consumptive uses (drinking, cooking, baby formula, etc.). As such, water for nonconsumptive uses (showering, toilet, laundry) needs to be supplied from a different drinking water system (centralized distribution or private supply). The treated water from a PWDU is not connected to a centralized distribution system. PWDU's are typically constructed in a standalone building that contains the treatment system and an on site storage tank. The high-quality drinking water produced by a PWDU requires manual collection or a bottle delivery service for consumers to obtain the water. A PWDU can make advanced treatment technologies used in full scale water treatment plants, available to small communities with reduced financial capacity and technical expertise.	$1,112	$142	$735,000	$94,000

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Questions?