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Department of Environment & Conservation

Standard Operating Procedures for the Reduction of Boil Water Advisories in Newfoundland & Labrador

MNL 2016 Municipal Symposium

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Boil Water Advisories

- Boil water advisories are public announcements, issued by the province advising the public that they should boil their drinking water prior to consumption
- Only issued on public drinking water systems
- There are currently 20 "Standard Reasons" for issuing a BWA
- Can be issued by community

- Issued as a result of:
  - Confirmed microbiological contamination
  - Possible risk of microbiological contamination



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History of BWAs in NL

Province started issuing BWA in the 1980s

300-500 BWAs issued per year

May 2000
Walkerton, ON

BWAs not centrally recorded

BWAs recorded in MIMS database

Less than 50 BWAs issued each year

Last confirmed waterborne disease outbreak in May 2002 (Botwood-*giardia*)

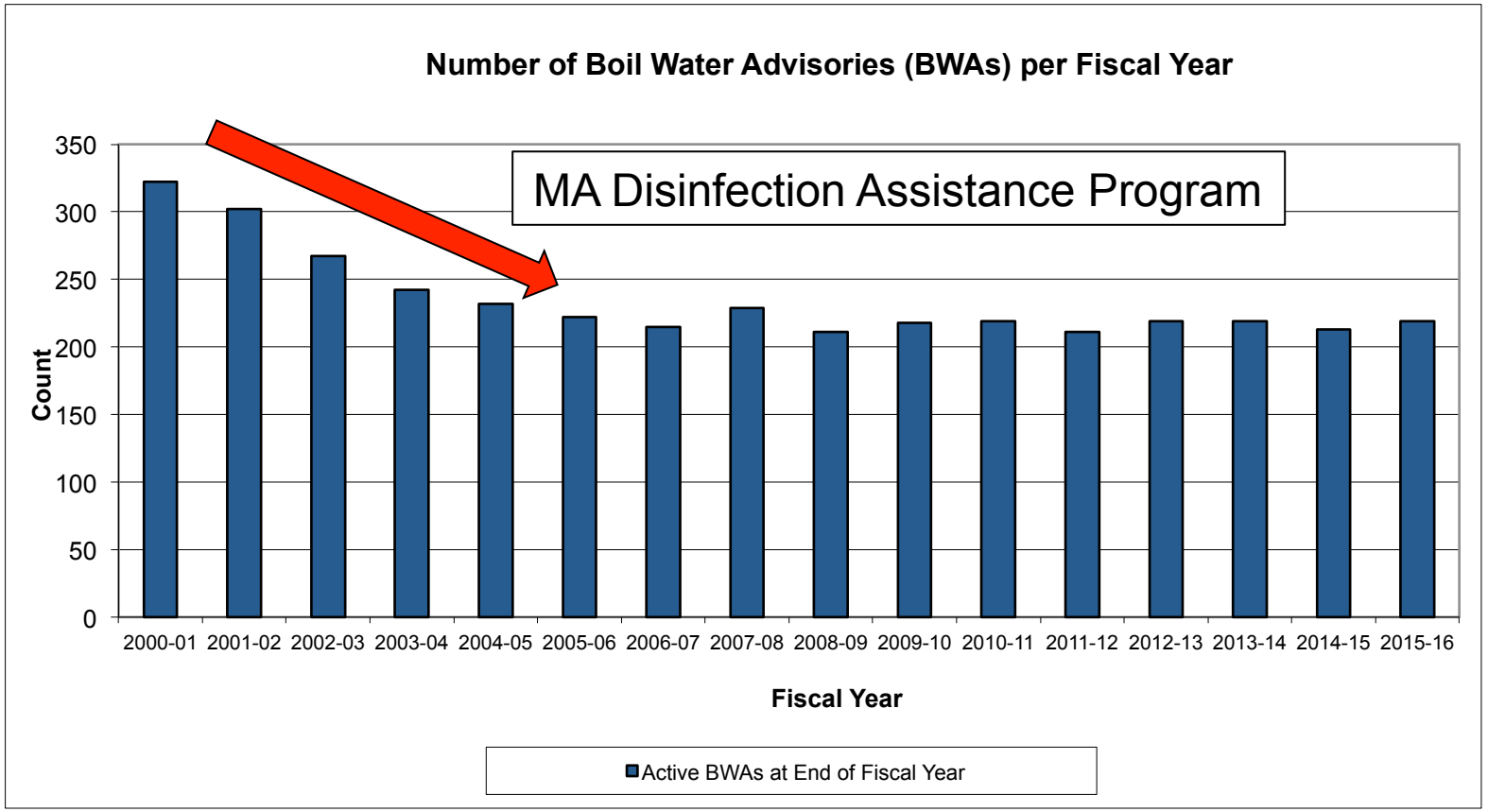
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Snapshot of Active BWA Since 2001



•As of Mar 31, 2016 there were 219 BWA affecting 157 communities and a serviced population of 44,818 in NL

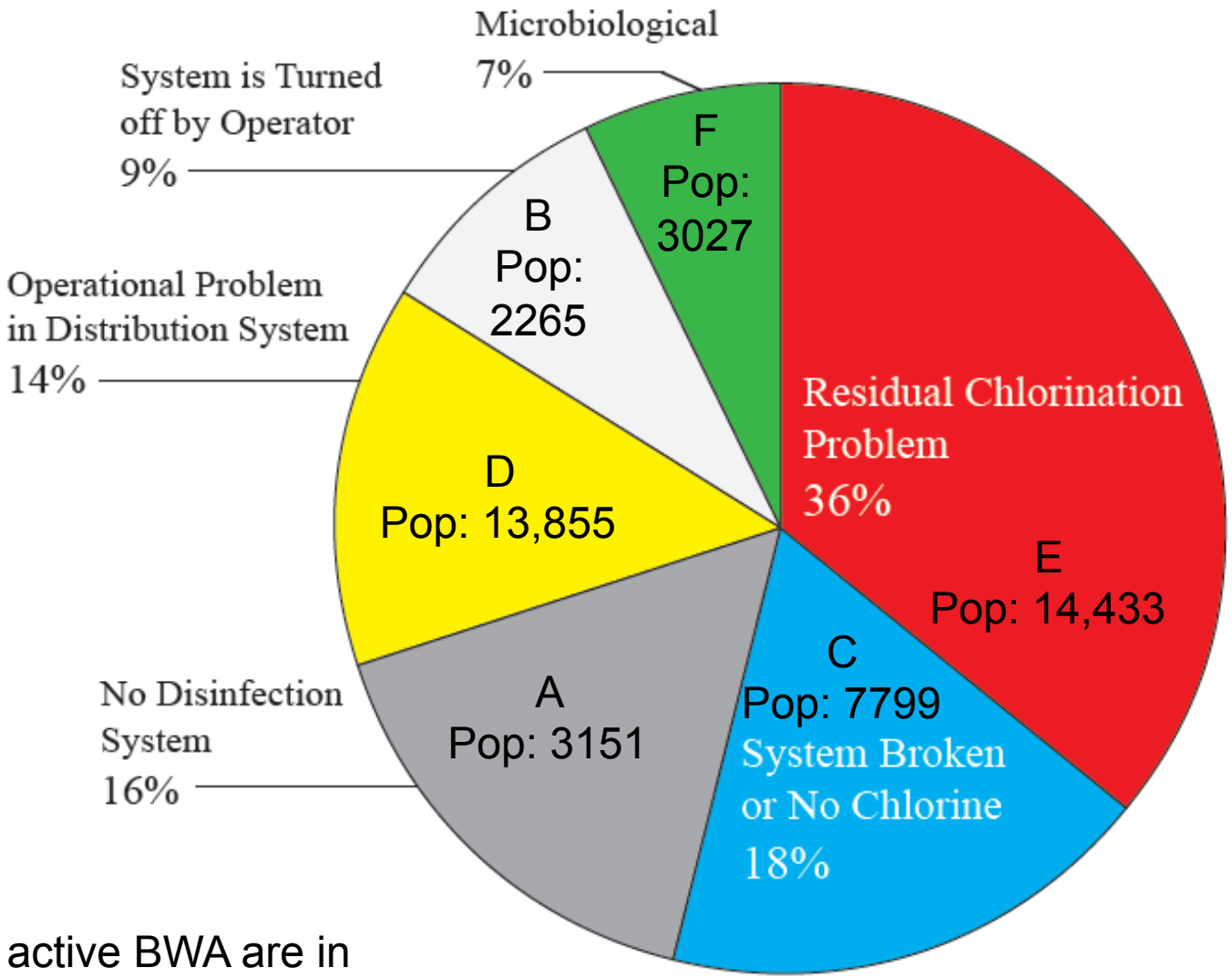
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Reasons for BWAs



- 174 active BWA are in towns with a population of 500 or less

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Days on BWA

Reason Code	Reason	Days on BWA (average)
A	No Disinfection	6622 (18.1 yrs)
B	Chlorination turned off	4352 (11.9 yrs)
C	Disinfection system mechanical/operational issues	3260 (8.9 yrs)
D	Distribution system mechanical/operational issues	633 (1.7 yrs)
E	Residual issues	3814 (10.4 yrs)
F	Positive pathogenic tests	492 (1.3 yrs)

- Based on active BWAs as of March 31, 2016
- 57% (126) of BWAs are long-term BWAs in place for more than 5 years
- Average BWA lasts 3478 days (9.5 yrs)
- Public compliance with BWA ranges from 47-74%

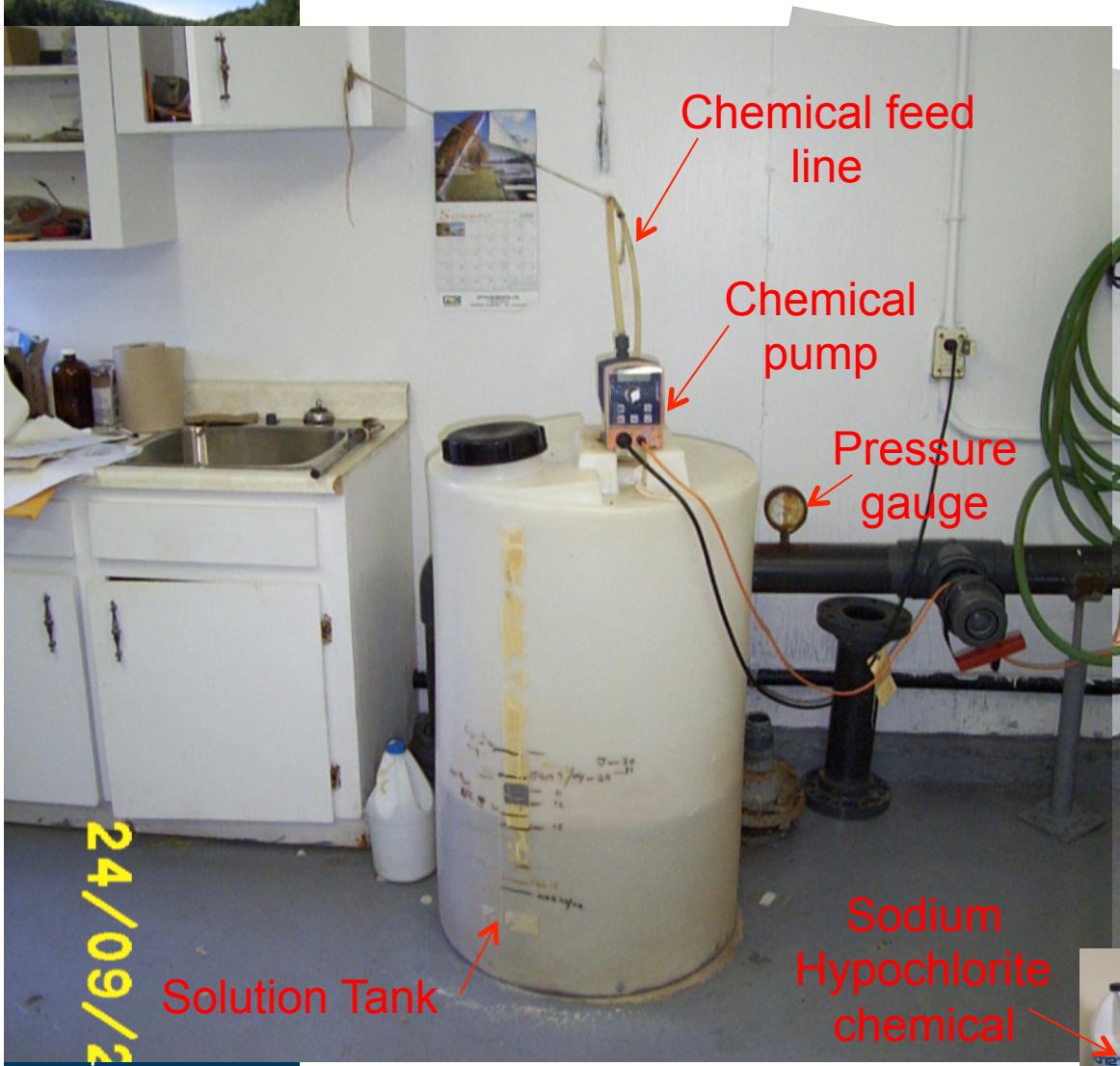


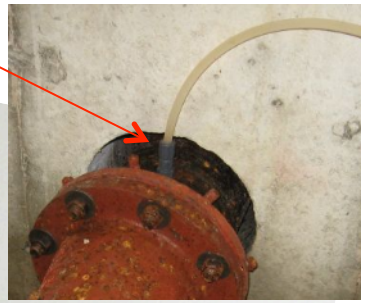
Roles and Responsibilities

Health and Community Services	Service NL	Environment and Conservation	Municipal Affairs	Community
▪Bacteriological analysis (6 public health/ hospital labs)	▪Collect bacteriological samples ▪Issue BWA ▪Update MIMS •BWA database •Bacteriological database (Total Coliform and *E. Coli* results)	▪Source water protection ▪Environmental permits and inspections of drinking water systems ▪Operator training ▪Identification of corrective measures ▪Water quality and BWA reporting	▪Infrastructure funding ▪Maintain MIMS	▪Meet requirements of the Permit to Operate ▪Set water rates ▪Submit capital works funding applications ▪Operation and maintenance of the drinking water system

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Hypochlorination System





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Gas Chlorination System

Automatic switch

Gas control system

Viewing window

Vacuum regulators

Vent

Gas line

Eye wash

150 lbs gas cylinders

Weigh scales

Gas sensor

14:28

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MNL Resolutions 2015

- 9-2015
  - Develop and implement a strategy to remove BWAs in a Timelier Manner (Dover)
- 10-2015
  - Create a strategy to address long-term BWAs (Trinity Bay North)

- 8 long-term BWAs lifted in 2015-16!
- Each BWA is unique and requires a solution tailored to the community and issues involved

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Community Sustainability Partnership

- Capacity supports for communities announced in April 2015
- Drinking Water Initiatives:
  - Regional Operators Initiative
  - BWA Reduction Initiative
    - Reduce the number of BWAs in the province
      - Develop Standard Operating Procedures (SOPs) for the Reduction of BWAs (Phase 1)
      - Implement SOPs for the Reduction of BWAs (Phase 2)
      - Development of secondary SOP implementation tools (Phase 2)

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SOPs to Remove BWAs

- Hired consultant Big East Engineering Ltd. in July 2015 to undertake work
- SOPs outline the various steps communities must take to have a BWA lifted
  1. Identify BWA Cause
  2. Steps to address BWA
  3. BWA preventative measures
- BWA System Assessment Form developed
- Set of 18 SOP flowcharts have been developed for each BWA reason code used in the province
- Set of 13 checklist and log forms developed for preventative maintenance
- BWA SOPs will be available from WRMD website:
  - http://www.env.gov.nl.ca/env/waterres/quality/drinkingwater/advisories.html

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BWA System Assessment

- Form examines all aspects of drinking water system for probable causes of BWA
- Critical and serious issues that may be causing the BWA are highlighted as part of assessment

Code	System Aspects	*CR - Critical Issue* *SR - Serious Issue* Response Yes/No/NA	Result CR / SR /OK
Drinking Water System Facility Events			
F-1	Has there been recent operations or maintenance that could introduce bacteria into the system?	**Yes**	**CR**
	Notes: Many leaks in two sections of old mains and when completing repairs shut down whole system which results in pressure loss in system.		
F-2	Has system pressures dropped below 20psi recently?	**Yes**	**CR**
	Notes: Yes pressure drops when system shut down for repairs, which reportedly is required monthly.		
F-3	Has there been a recent fire fighting, hydrant flushing or other high-flow event?	**Yes**	**OK**
	Notes: No hydrants however they have a flushing device on end of main and have started to use it this summer.		

BWA SOP: Reason Code A

STANDARD OPERATING PROCEDURE							
SOP #	1	REASON CODE:	A — *Water supply has no disinfection system*	REV:	0	DATE:	Dec. 2015

BWA CAUSE IDENTIFICATION

Complete Assessment Tool

Identify Potential Cause(s)

Cause #1
No disinfection system.

Cause #2
Lack of financial/staffing resources or knowledge of importance of disinfection.

RECOMMENDED STEPS TO ADDRESS BOIL WATER ADVISORY

Implement Short Term Corrective Measures

- ☐ Owner to contact government agencies (ENVC, HCS, and Service NL) to request assistance in educating stakeholders on the importance of disinfection processes in providing safe drinking water.
- ☐ Owner to educate residents and water users on the importance of disinfecting the water prior to drinking. Distribute educational pamphlets.
- ☐ Owner to have the existing water system evaluated for recommended upgrades.
- ☐ Owner to apply for funding through MIGA's various funding programs for disinfection system and associated appurtenances. Online applications can be made at: https://msis.gov.nl.ca/MSIS/Security/External/externaldefault.aspx?ReturnUrl=%2fMSIS%2f
- ☐ Install and operate disinfection system.

Confirm Operation and Lift BWA

- ☐ Owner to test disinfectant residuals to confirm compliance with the Drinking Water Treatment Standards.
- ☐ Owner to contact Service NL office to request an Environmental Health Officer to re-sample the drinking water system for compliance with provincial drinking water bacteriological and disinfection standards.

Implement Long Term Corrective Measures

- ☐ Owner should provide opportunities for training to increase operators knowledge associated with cause and corrective measures.
- ☐ Owner should ensure operators have appropriate level of training/education to allow operators to be eligible for certification in accordance with provincial standards. Operator training may be obtained via ACWWA, On-line courses and ENVC Operator Education, Training and Certification.

IMPLEMENT PREVENTATIVE MAINTENANCE

DAILY

- ☐ Measure and record flow rates.
- ☐ Complete daily disinfection and treatment logs.
- ☐ Visual inspection of chemical feed pumps and feed lines.
- ☐ Measure and record chemical usage.
- ☐ Measure and record free and total chlorine residual throughout the distribution system (first user, end of main and branch lines).

WEEKLY

- ☐ Visual inspection of chlorine injector for leaks and ensure operating normal.

MONTHLY

- ☐ Inspect and clean intake structure (including screens).
- ☐ Inventory all consumables and order supplies as necessary.

3 MONTHS

- ☐ Clean chemical feed lines and solution tanks.

6 MONTHS

- ☐ Inspect watershed for potential sources of contamination (including development activity, storage of chemicals/fuels and animal activity).

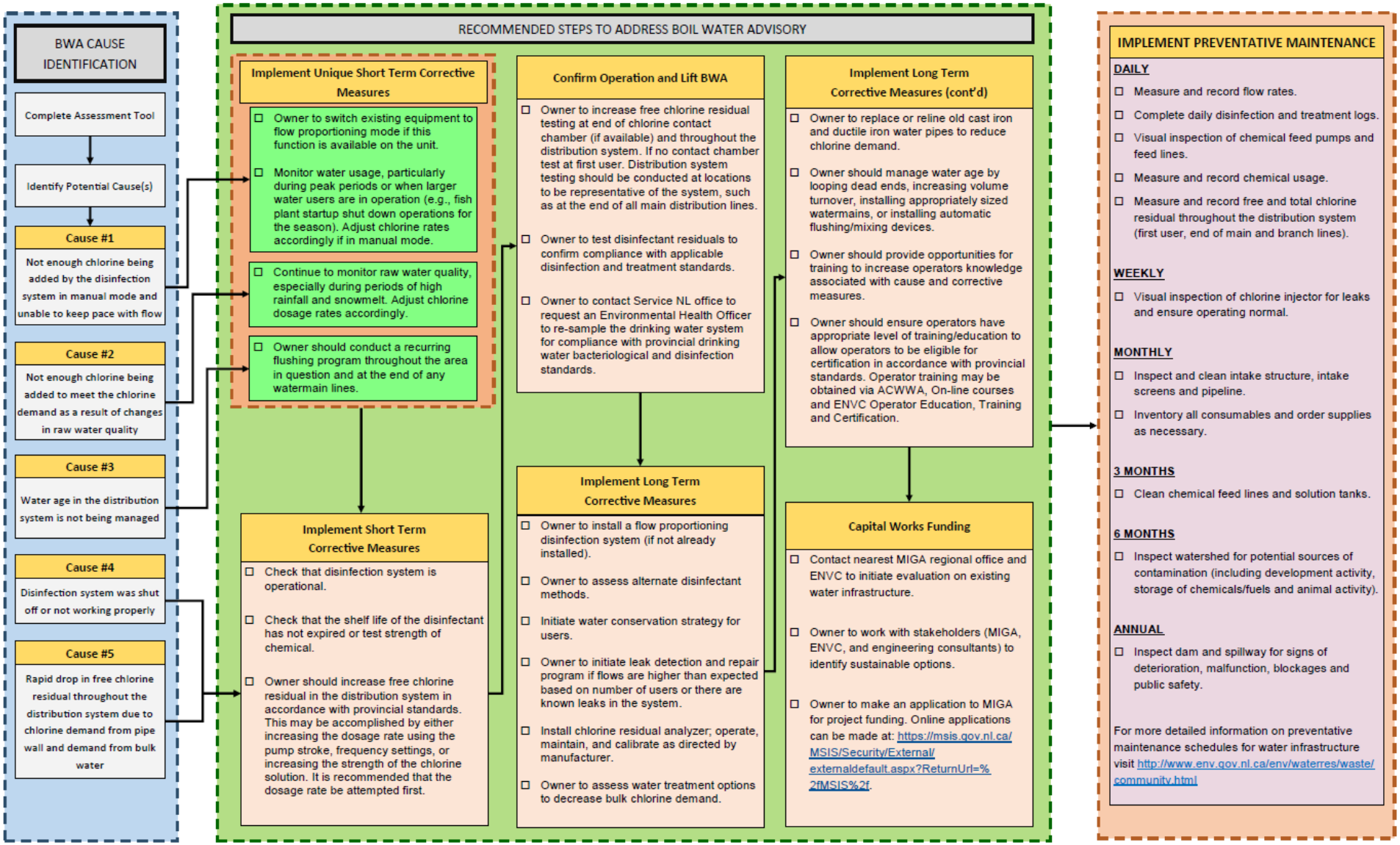
ANNUAL

- ☐ Inspect dam and spillway for signs of deterioration, malfunction, blockages and public safety.

For more detailed information on preventative maintenance schedules for water infrastructure visit http://www.env.gov.nl.ca/env/waterres/waste/community.html

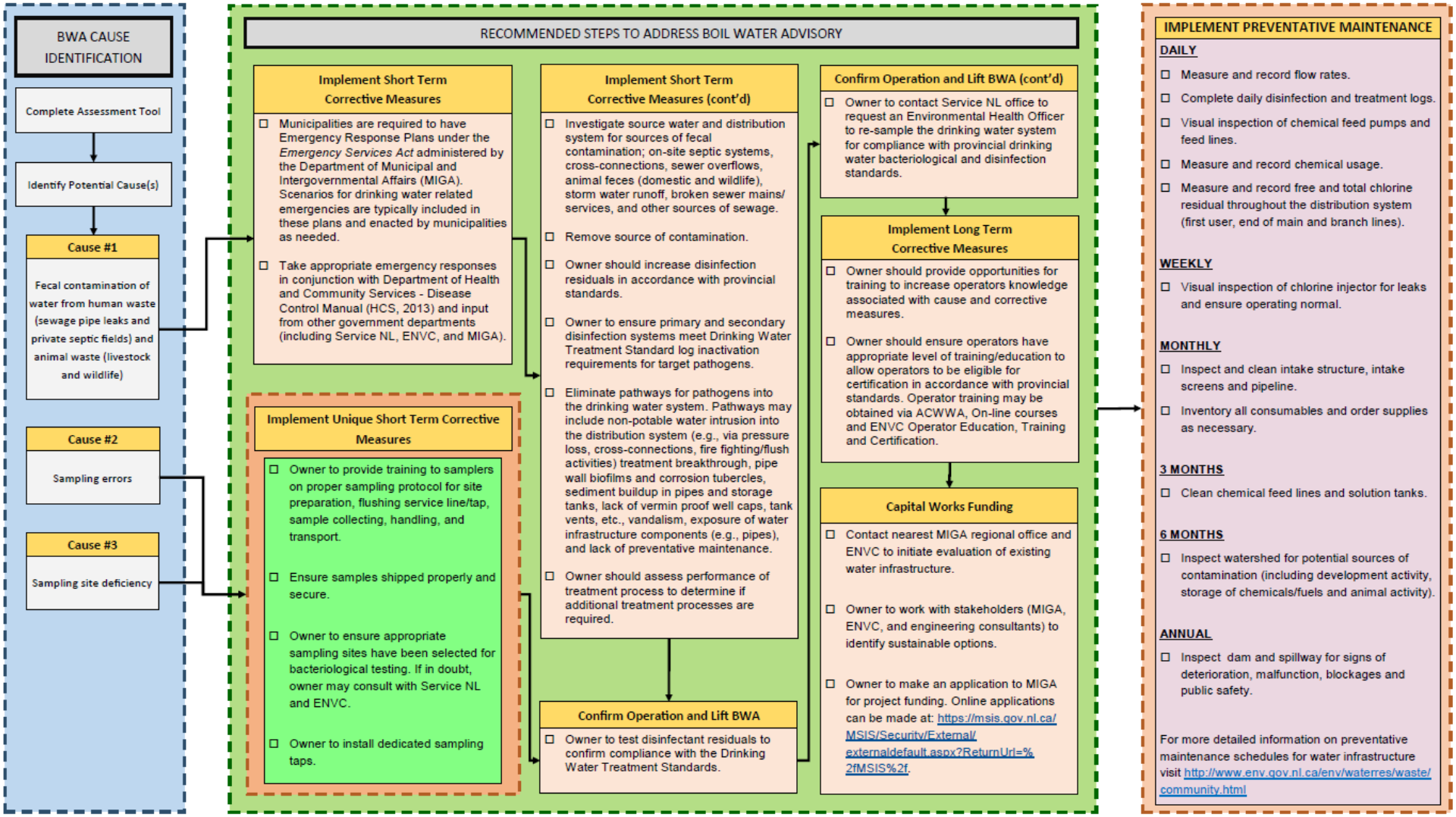
BWA SOP: Reason Code E2

STANDARD OPERATING PROCEDURE							
SOP #	11	REASON CODE:	E2—No free chlorine residual detected in the water distribution system.	REV:	0	DATE:	Dec. 2015



BWA SOP: Reason Code F

STANDARD OPERATING PROCEDURE							
SOP #	14	REASON CODE:	F2E—Escherichia coli (E. coli) detected AND repeat samples can not be taken as required F4—Escherichia coli (E.coli) detected in an initial sample(s) is considered extensive and the water system has other known problems. F5—Escherichia coli (E.coli) detected and confirmed in repeat sample.	REV:	0	DATE:	Dec. 2015



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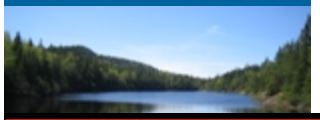


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Portugal Cove South

- BWA issued: Jan 1984
  - Oldest BWA on record
- Motivation to get off of BW:
  - Potential designation of nearby Mistaken Point as an UNESCO World Heritage Site
- BWA lifted: Apr 15, 2016



Portugal Cove South (PCS)

Service NL	Environment and Conservation	Municipal Affairs	Community
▪Mar-Apr 2016- collect bacteriological samples (4 trips) ▪Mar-Apr 2016- recommendations on operational improvements ▪Apr 15, 2016- lifted BWA	▪Aug 2014- permit to construct issued to town for water systems upgrades ▪Sept 2015- hands on disinfection training for operator ▪2015-16- technical support ▪Oct 2015- consultant piloted the BWA System Assessment Form and SOPs	▪2014- capital works funding granted	▪2014- applied for capital works funding ▪July 2015- new disinfection system installed ▪July 2015-present- operation of disinfection system

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Root Causes of Current/Future BWA and Corrective Actions In PCS

1. Inability to maintain free chlorine residuals throughout distribution system during periods of poor water quality
   - Increase chlorine dosage or chlorine solution strength during poor water quality events
2. Leaks may be contributing to problems maintaining chlorine residual
   - Identify leaks and complete repairs
3. Inability to clean chlorine tank without shutting down system water supply to town or turning off disinfection system
   - Install backup chlorine tank

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BWA Reduction Initiative- Phase 2

- Implementation of SOPs for the Reduction of BWAs
  - Priority to remove long-term BWAs
- Development of secondary SOP implementation tools
  - Drinking Water System Operational SOPs
  - Presentations for public or council meetings
  - Public awareness raising materials
  - Full cost accounting assessment tool
  - Sanitation survey for potential sources of pathogens (*E.coli*, *Giardia*, *Cryptosporidium*) and corrective action

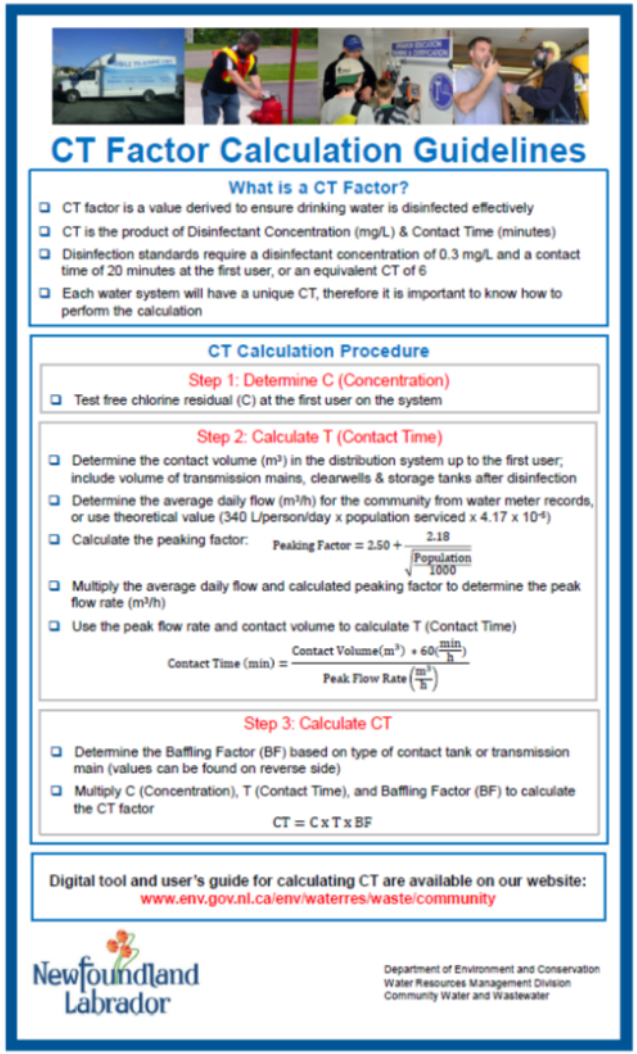
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Drinking Water System Operational SOPs



CT Factor Calculation Guidelines

What is a CT Factor?

- CT factor is a value derived to ensure drinking water is disinfected effectively
- CT is the product of Disinfectant Concentration (mg/L) & Contact Time (minutes)
- Disinfection standards require a disinfectant concentration of 0.3 mg/L and a contact time of 20 minutes at the first user, or an equivalent CT of 6
- Each water system will have a unique CT, therefore it is important to know how to perform the calculation

CT Calculation Procedure

Step 1: Determine C (Concentration)

- Test free chlorine residual (C) at the first user on the system

Step 2: Calculate T (Contact Time)

- Determine the contact volume (m^3) in the distribution system up to the first user; include volume of transmission mains, clearwells & storage tanks after disinfection
- Determine the average daily flow (m^3/h) for the community from water meter records, or use theoretical value (340 L/person/day x population serviced x 4.17×10^{-4})
- Calculate the peaking factor: $\text{Peaking Factor} = 2.50 + \frac{2.18}{\sqrt{\frac{\text{Population}}{1000}}}$
- Multiply the average daily flow and calculated peaking factor to determine the peak flow rate (m^3/h)
- Use the peak flow rate and contact volume to calculate T (Contact Time)

$$\text{Contact Time (min)} = \frac{\text{Contact Volume}(m^3) \times 60(\frac{\text{min}}{h})}{\text{Peak Flow Rate}\left(\frac{m^3}{h}\right)}$$

Step 3: Calculate CT

- Determine the Baffling Factor (BF) based on type of contact tank or transmission main (values can be found on reverse side)
- Multiply C (Concentration), T (Contact Time), and Baffling Factor (BF) to calculate the CT factor

$$CT = C \times T \times BF$$

Digital tool and user's guide for calculating CT are available on our website:
www.env.gov.nl.ca/env/waterres/waste/community

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Community Water and Wastewater

- Addresses BWA Reason Code E1
  - Primary disinfection requirements met

- http://www.env.gov.nl.ca/env/waterres/training/operator_onsite_training

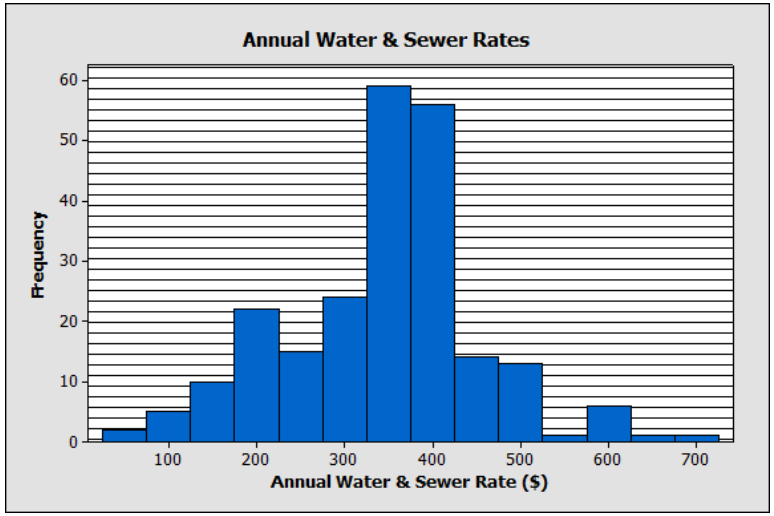
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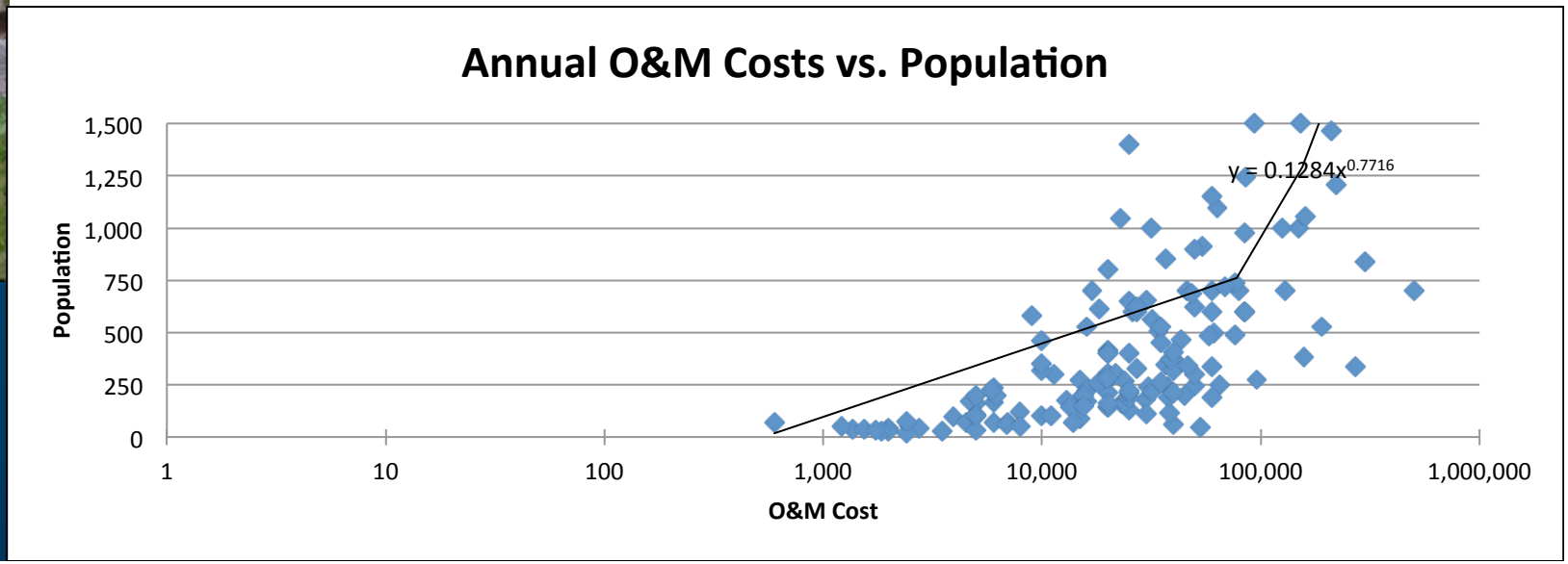
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Full Cost Accounting: Water Rates vs. O&M Costs



- Addresses BWA Reason Code B3
- Mean 2015 water & sewer rate: $345



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Path Forward



- Continued reduction in the number of active BWAs in the province
- Implementation of BWA SOPs
- Selection of communities to participate in Phase 2
- Development of secondary SOP implementation tools

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Questions?



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Discussion

- Handout:
  - 5 Different BWA Scenarios
  - SOPs for the BWA Reason Code
- Report on:
  - What are 3 barriers to removing this BWA?
  - What are 3 key steps to get this community off of a BWA?

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Town A

Town A has a population of 375 (150 households) and a liquid hypochlorination system. Town A has been on a BWA since 2010 for reason code D1: water distribution system is undergoing maintenance or repairs. The BWA was initially issued when a leak on a watermain was fixed. Town A never came off the BWA. The chlorine chemical pump has been malfunctioning. The drinking water system also does not have a flow meter to measure the amount of water used, which makes controlling free chlorine residuals in the distribution system difficult. The water system operator is not a certified operator and does not have much training. Water rates for the town are $400 per household.

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Town B

Town B has a population of 100 people and is supplied by two groundwater wells. Approximately 50 people are on each well. Town B has been on a BWA since 1995 for reason code A: water supply has no disinfection system. In 1995, the town wrote a letter the Department of Environment stating that they refused to chlorinate their drinking water system because it would ruin the taste of their water. In the past 5 years, Town B has suffered from higher rates of gastrointestinal illness than neighboring towns with disinfection systems on their drinking water system. Water rates for the town are $50 per household. There is a Regional Operator with the Regional Service Board working with towns in the area.

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Town C

Town C has a population of 200 people with drinking water coming from a surface water source with a liquid hypochlorination system. The drinking water distribution system is a long, linear system with cast iron pipes. Town C's water distribution system was sized to provide water to a fish plant that is no longer in use. Without the fish plant, the age of water in the distribution system has increased from 12 hours to over 50 hours. Town C has been on a BWA since 2006 for BWA reason code E2: no free chlorine residual detected in the water distribution system. The chlorination system has not been operated consistently for a number of years. Residents often complain that they can smell and taste the chlorine in the water, so the chlorinator is often turned down. The town currently has no water system operator.

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Town D

Town D has a population of 600 people on a surface water source with a gas chlorination system. Average flow on the water distribution system is around 20 USGPM. In April 2016, flow on the distribution system suddenly increased to 100 USGPM due to a leak on the system. Water pressure in the distribution system also dropped at the same time. A leak has been identified on an old watermain in an area of town where there are on-site septic systems. The old watermain runs through an area suspected to be contaminated from these septic fields. There have been several leaks on this section of old watermain before that resulted in BWAs. Town D has been on a BWA since April 2016 for reason code F4: *E.coli* detected in an initial sample(s) is considered extensive and the water system has other known problems.

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Town E

Town E has a population of 300 people (120 households) and is a remote community only accessible by air or water. Town E has a surface water source with a liquid hypochlorination system. Town E has been on a BWA since 2011 for reason code C2: disinfection system is off due to lack of chlorine or other disinfectant. Every winter, the same problem occurs so the town has never come off the BWA. Water rates for the town are $700 per household. It is not clear who is responsible for budgeting and ordering the sodium hypochlorite for the disinfection system, the water system operator or the town administrator. There is never enough chemical ordered to last through the winter. Water use increases significantly in the winter as residents run their taps to prevent their pipes from freezing.