Study on Water Quality and Demand on Public Water Supplies with Variable Flow Regimes and Water Demand

Clean and Safe Drinking Water Workshop 2011

Gander, NL

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Presentation Overview

- Water demand
- Water age and water quality
- Summary of all participating communities
- Case studies
- Short-term strategies
- Long-term strategies
- Conclusion

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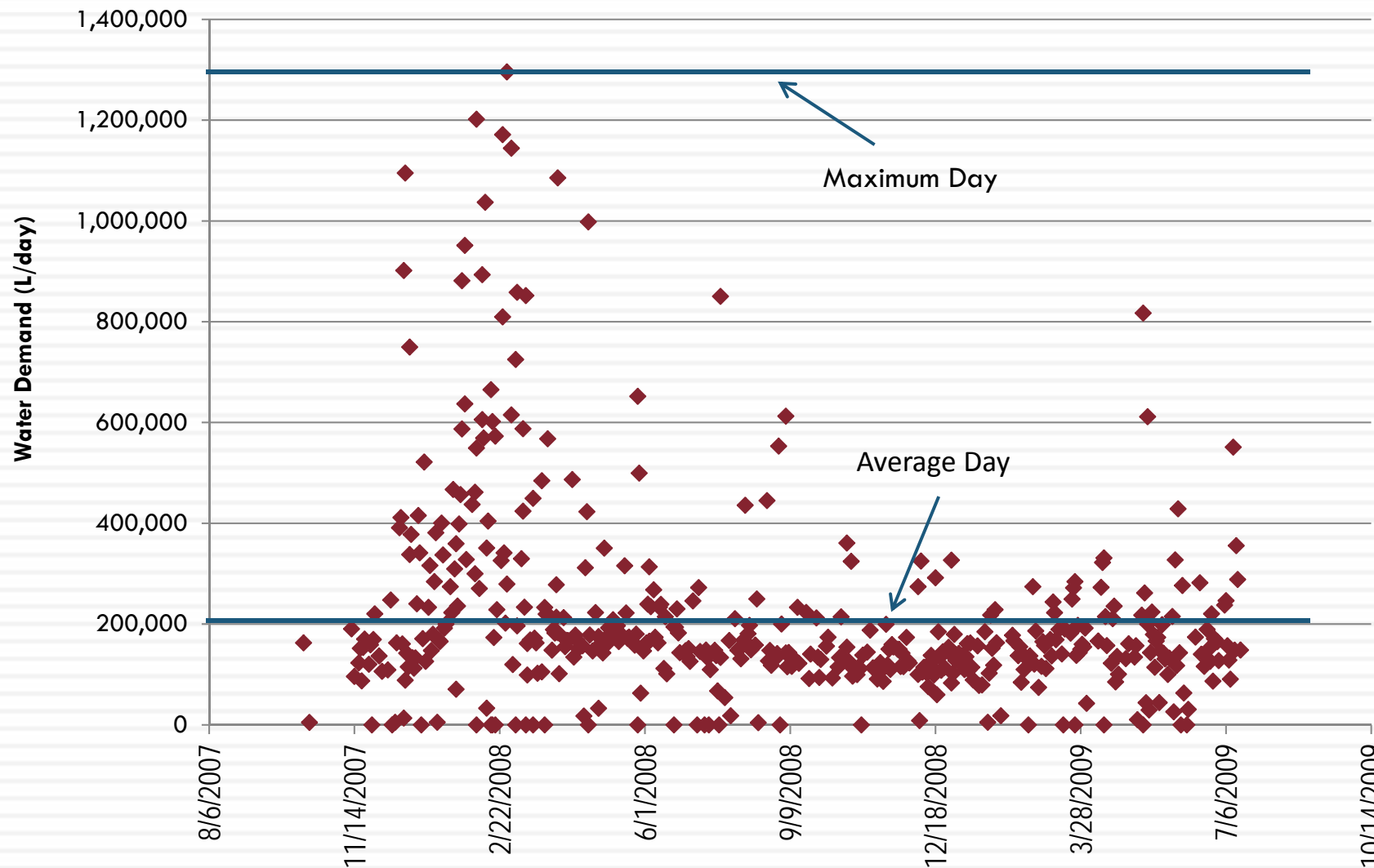
Water Demand

Monitoring Water Demand

DEPARTMENT OF MUNICIPAL AFFAIRS
UTILITIES MANAGEMENT DIVISION

FLOW PM	LBS. CL2		CL2 /PPM FREE	TOTALIZER US. GPM	OPERATOR REMARKS
	193		>2.2	322759000	
	197		>2.2	323500000	
	107		>2.2	324266000	
	207		>2.2	324923000	Changed Cl2 Cyl.
	173		>2.2	325533000	
	273		>2.2	326169000	Changed Cl2 Cyl.
	232		>2.2		

6	8:45 Am	119 #1	450		
7	8:30 Am	119 #1	282	462	
8.	8:35 Am	119 #1	475		
9.	8:20 Am	119 #1	481		
10.	8:30 Am	119	480		

Assessing Water Demand

Average Water Demand

504 L/person/day

Average per capita residential water use in Newfoundland and Labrador

813 L/person/day

Average per capita total water use in Newfoundland and Labrador

(Environment Canada, 2010)

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Water Demand

Type	Examples
Residential	Cooking, cleaning, gardening
Commercial	Restaurants, gas stations, retail
Institutional	Schools, hospitals
Industrial	Fish/seafood processing, manufacturing

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Industrial Demand

Fish Plant Operating
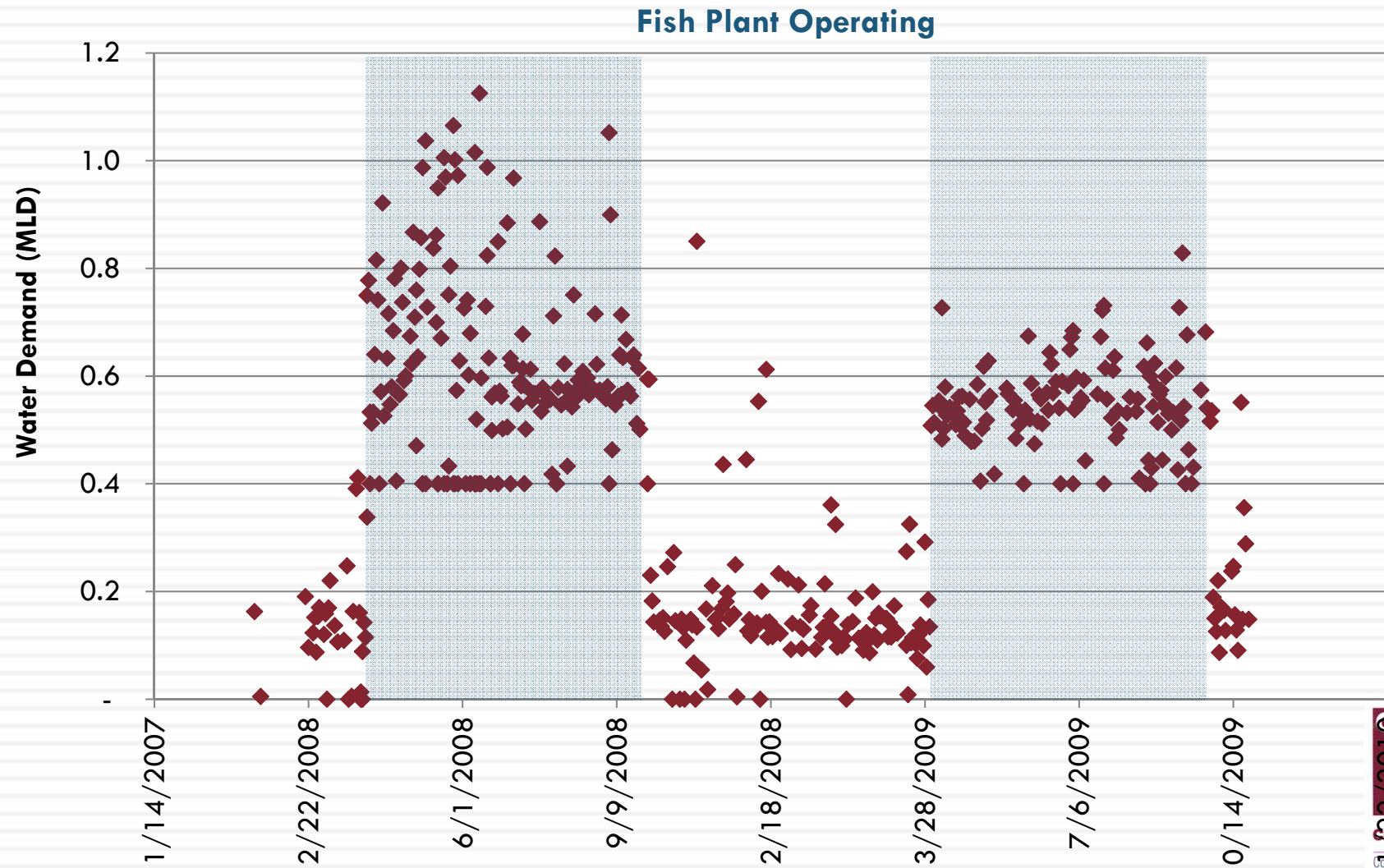
Impacts of Variable Demand

Periodic high demands can lead to:

- Increased 'wear and tear' on pipes and equipment
- Difficulties achieving provincial disinfection standards (20 minute contact time / CT = 6)
- Low or absent chlorine residual
- Oversized distribution system components
- Excessive water age

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Water Age

Water Age

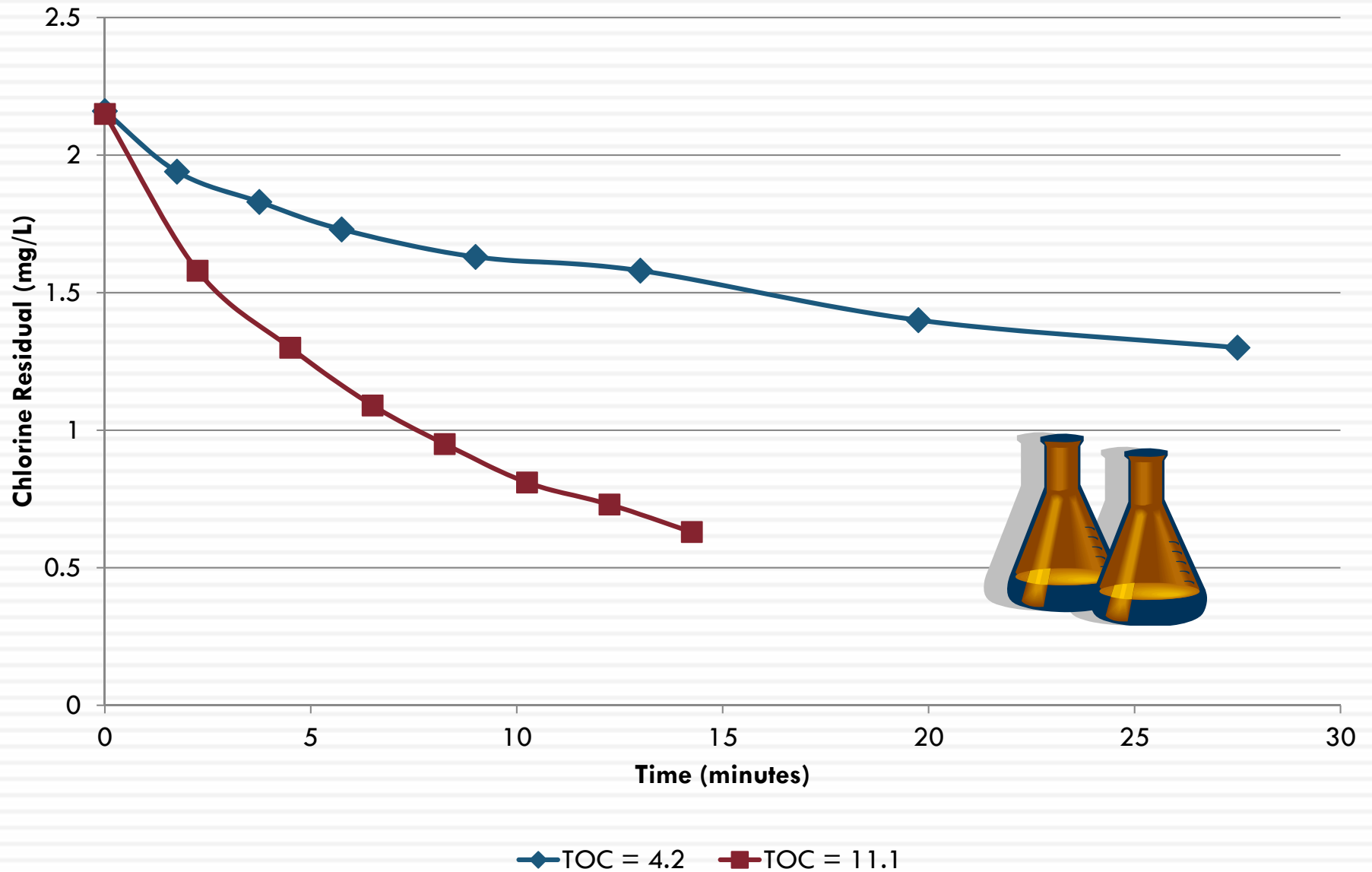Excessive water age (retention time) can result in numerous water quality problems:

- Chlorine decay
- Disinfection by-products
- Bacterial regrowth
- Corrosion

Chlorine Decay

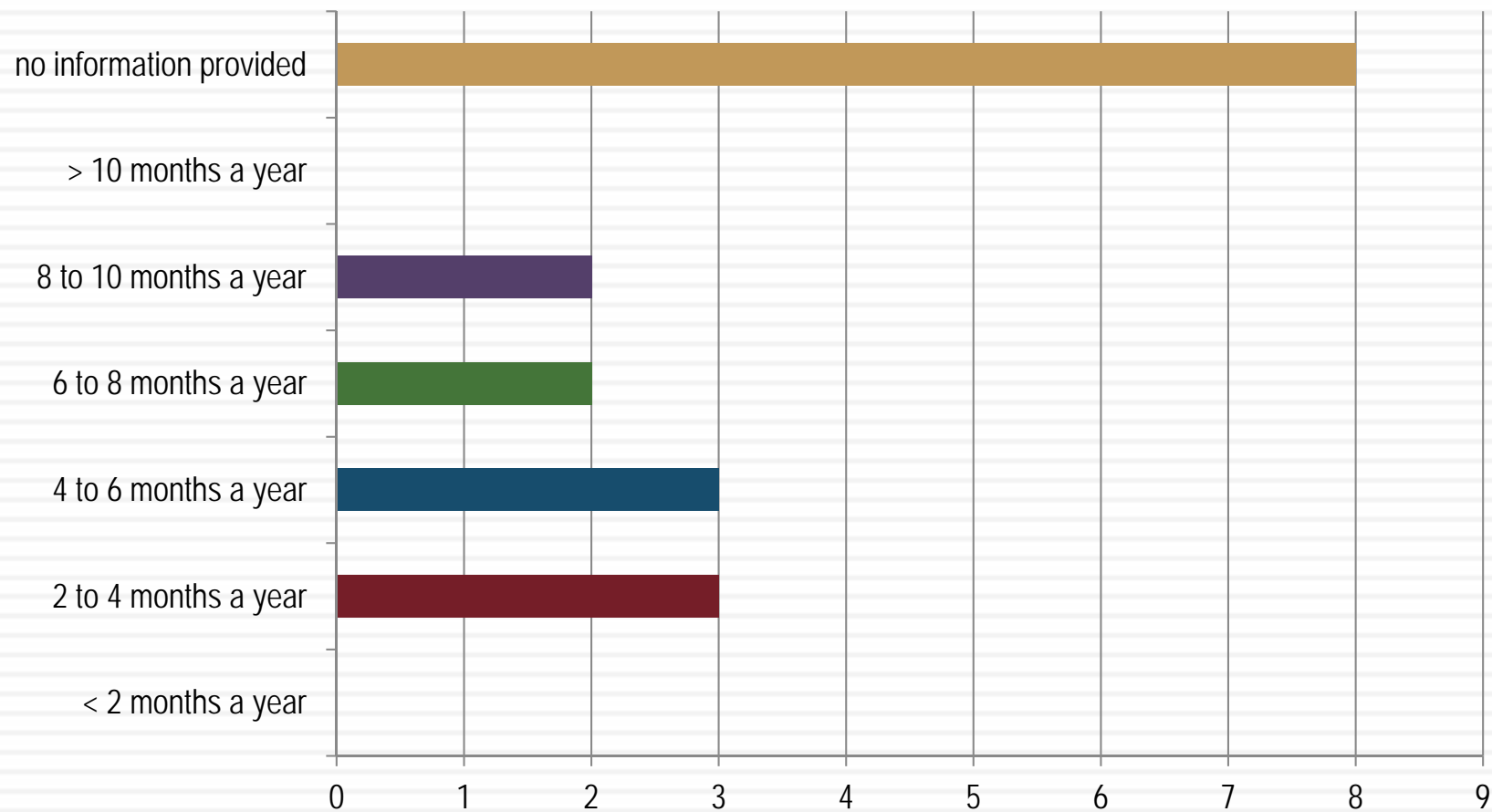The rate of chlorine decay depends on at least four factors:

- ◻ Initial chlorine dose;
- ◻ Water quality (colour, total organic carbon, etc.);
- ◻ Temperature; and
- ◻ Retention time.

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Same initial chlorine dose, different concentrations of total organic carbon (TOC):

Summary of Participating Communities

Fish Plant Operation
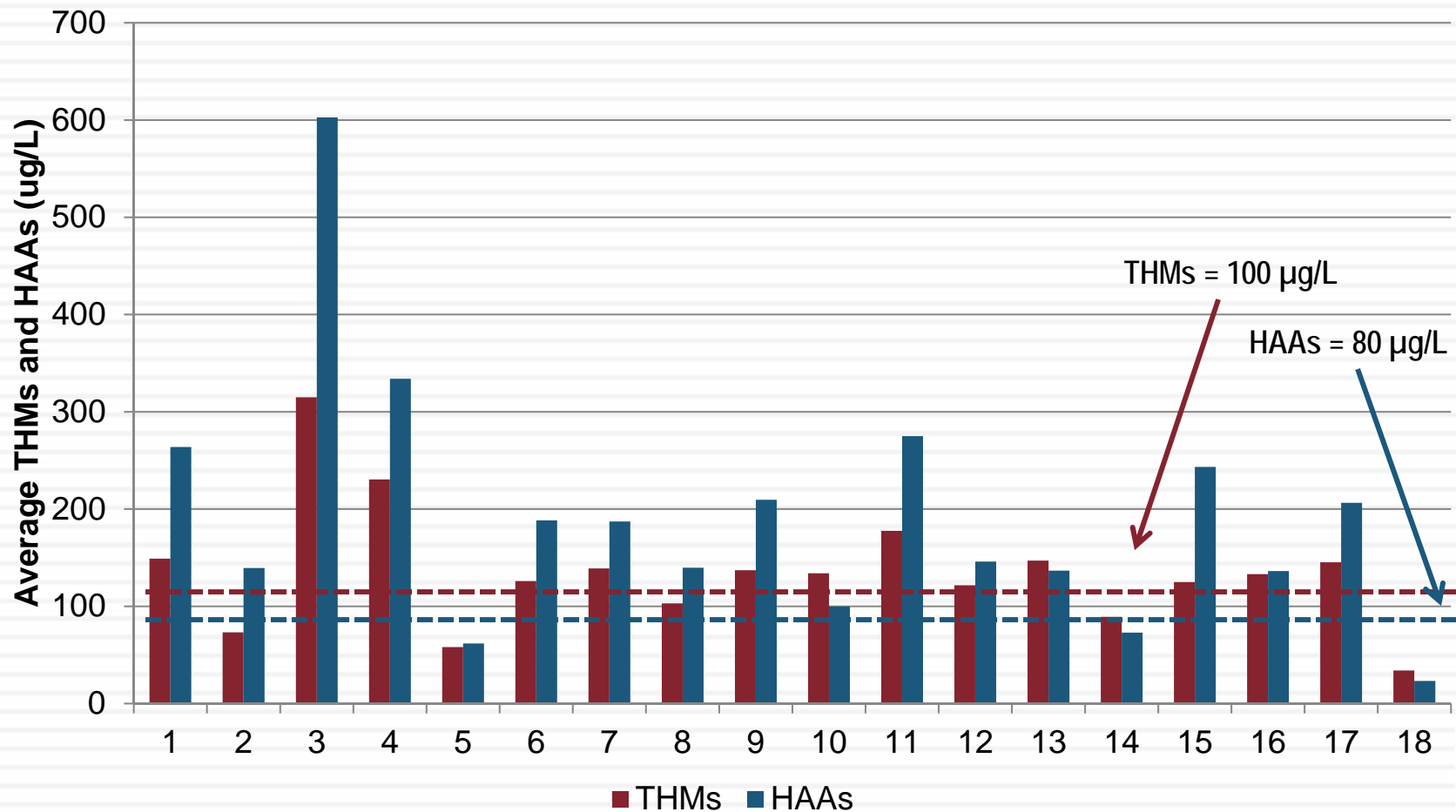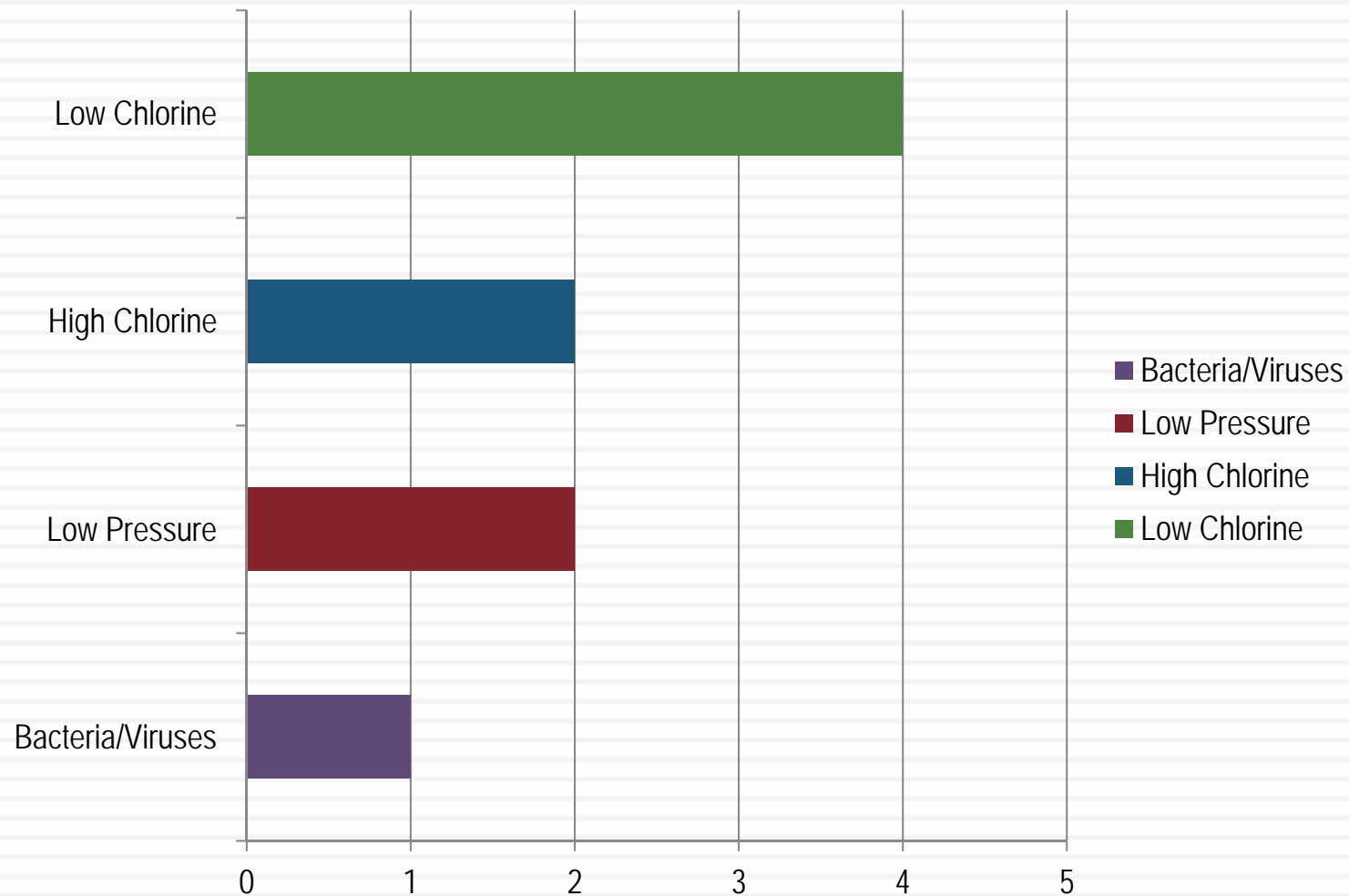
Flow Records

Category	Value
Transmission Main to Municipal System	5
Transmission Main to Industrial User	6
Outlet of Treatment System	8
Intake	5
No Information Provided	5

0 2 4 6 8 10

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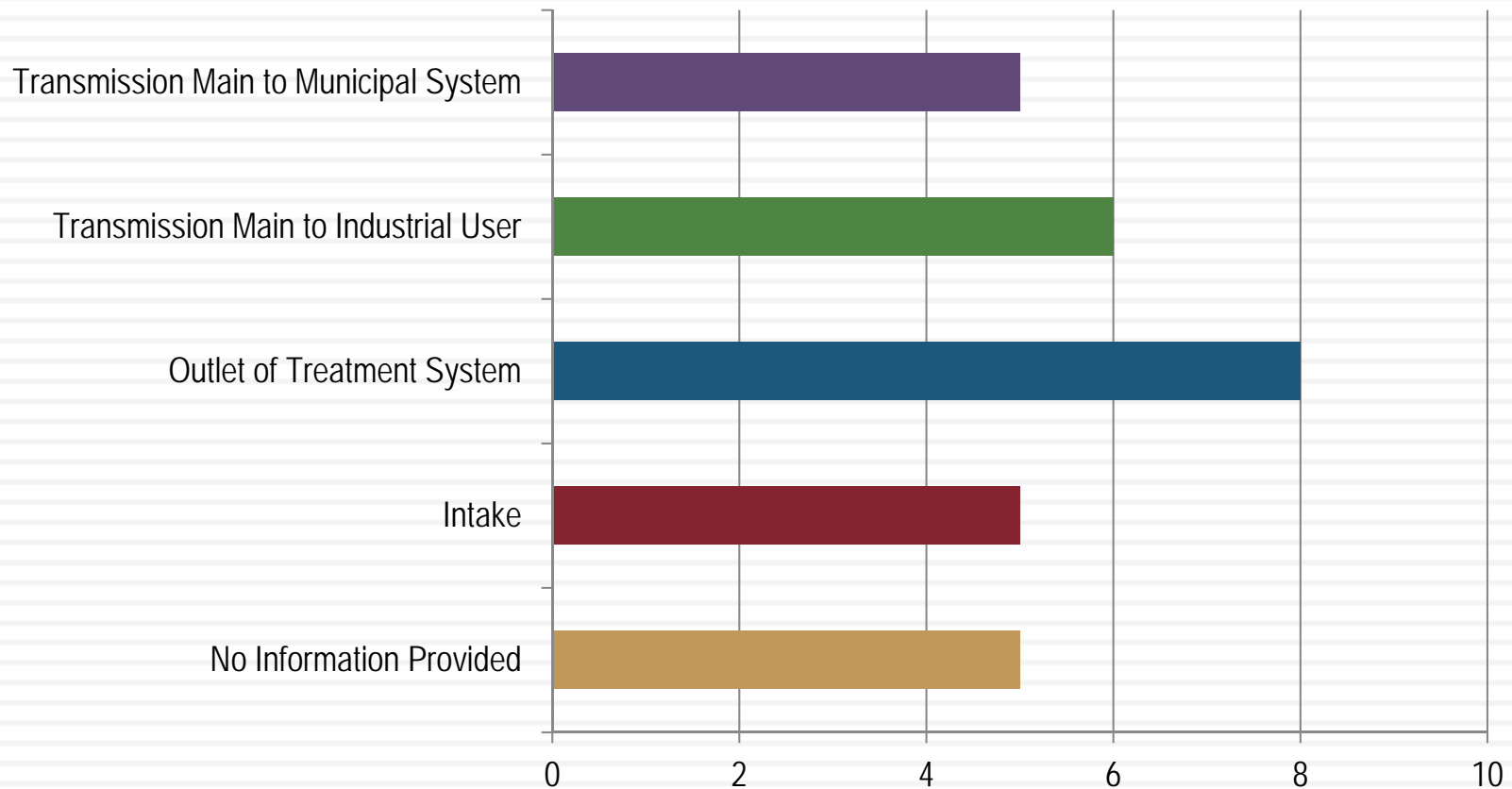
Water Quality Concerns: Industrial

Case Studies

Community A

Region: Central

Source: Pond

Disinfection strategy: Chlorine gas

Major concerns:

- Disinfection by-products

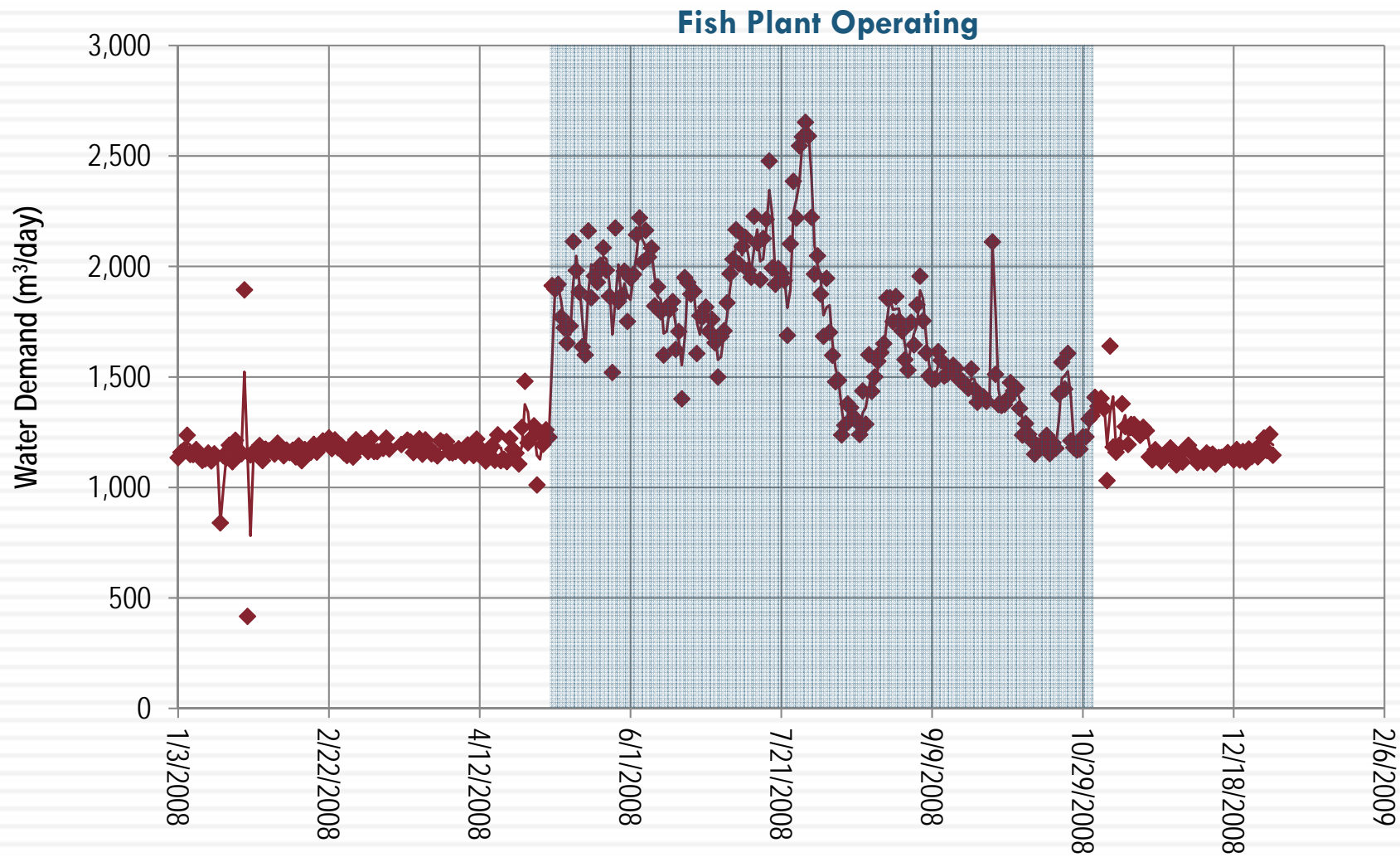CBCL LIMITED
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System Users

Population ~ 1,000

Users:

- Residential = 412
- Commercial = no information provided
- Industrial = 1
- Institutional = no information provided

+ 98% residential

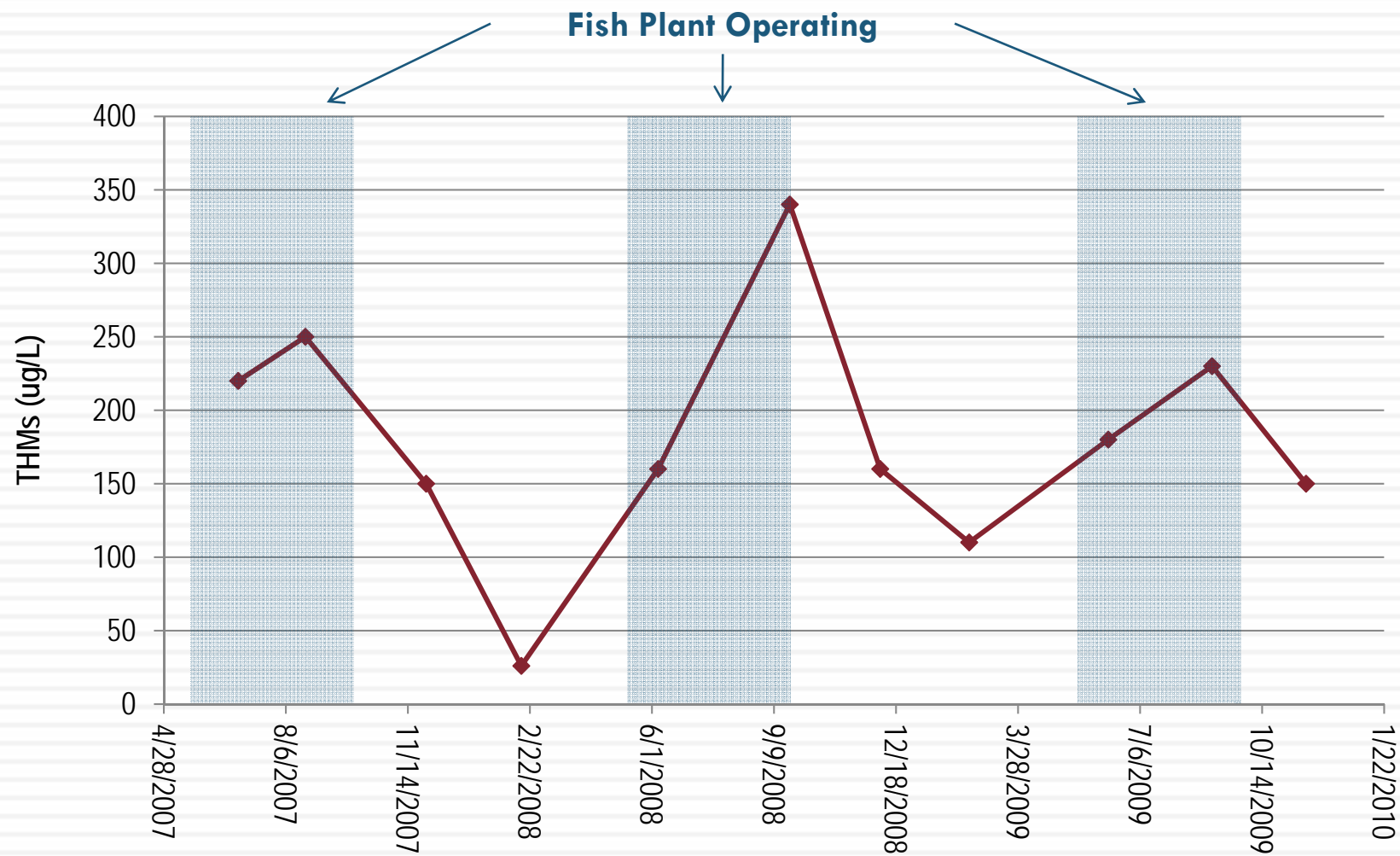Assumed per capita water demand = **504 Lpcd**

Water Demand

Water Demand

Demand	Expected *	Actual	Fish Plant On	Fish Plant Off
Average	0.5 MLD (0.1 MGD)	1.4 MLD (0.4 MGD)	1.7 MLD (0.5 MGD)	1.2 MLD (0.3 MGD)
Maximum	1.3 MLD (0.3 MGD)	2.8 MLD (0.7 MGD)	2.8 MLD (0.7 MGD)	1.9 MLD (0.5 MGD)

*(MOE, 2008; Environment Canada, 2010)

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Water Quality Concerns

Community B

Region: Eastern

Source: Lake

Disinfection strategy: Chlorine gas

Major concerns:

- Disinfection by-products
- Corrosion

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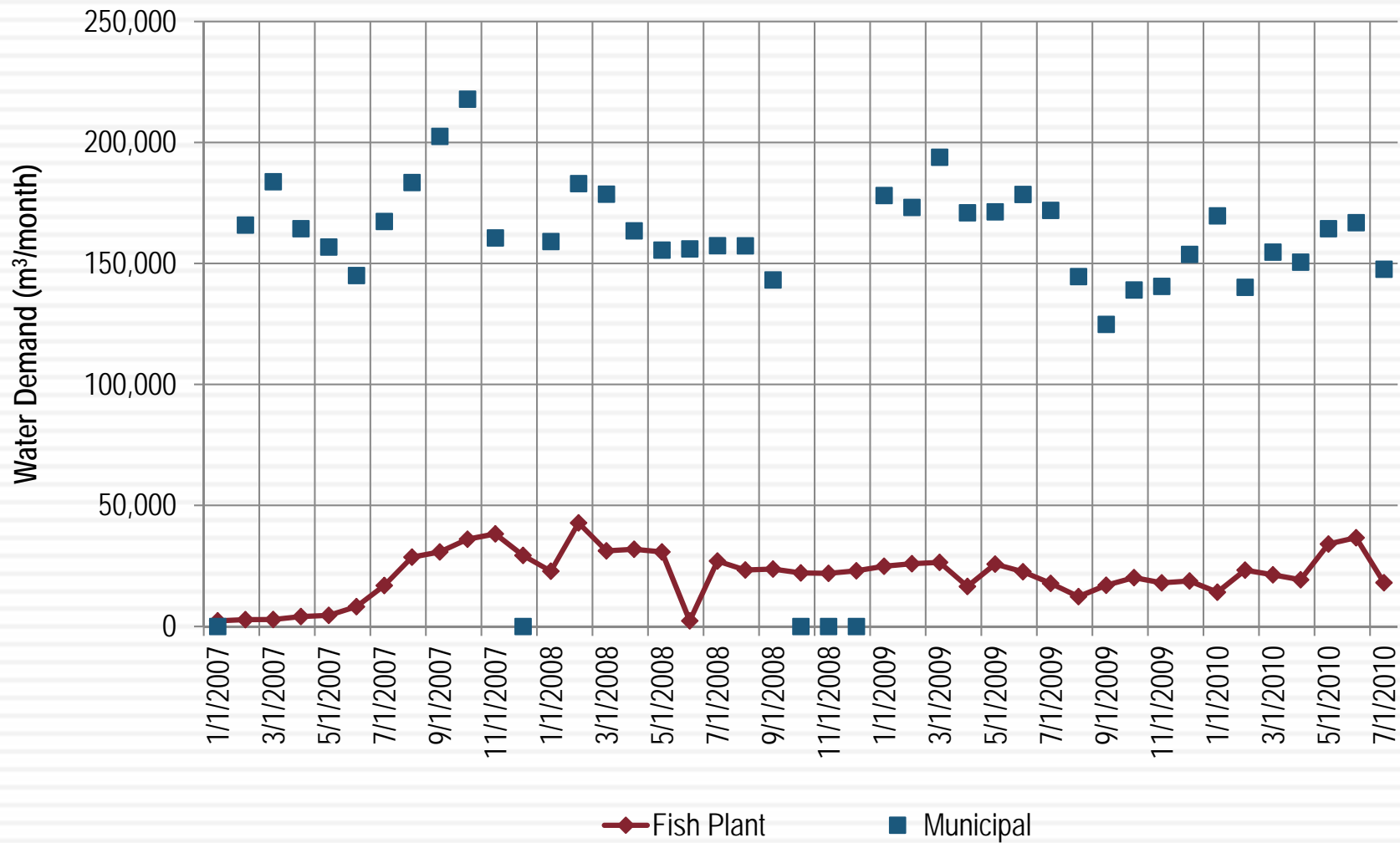Consulting Engineers

System Users

Population ~ 5,500

Users

- Residential = 2,403
- Industrial = 2
- Commercial = 403
- Institutional = 3

>20% non-residential

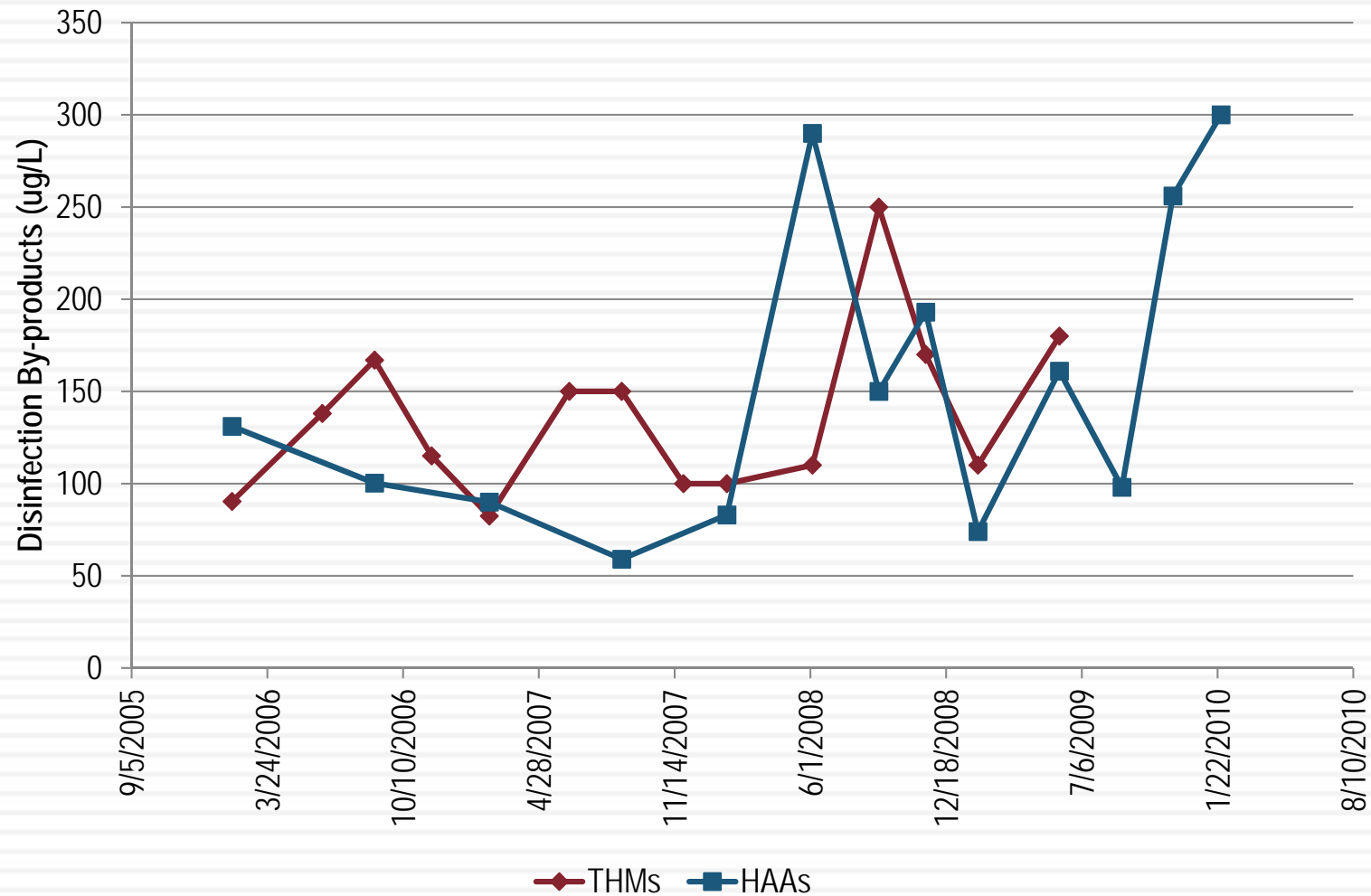Assumed per capita water demand = **813 Lpcd**

Water Demand

Water Demand

	Expected *	Actual
Average Demand	4.5 MLD (1.2 MGD)	5.5 MLD (1.5 MGD)
Maximum Demand	8.9 MLD (2.4 MGD)	8.2 MLD (2.2 MGD)

*(MOE, 2008; Environment Canada, 2010)

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Water Quality

Community C

Region: Labrador

Source: River

Disinfection strategy: Chlorine powder

Major concerns:

- Disinfection by-products
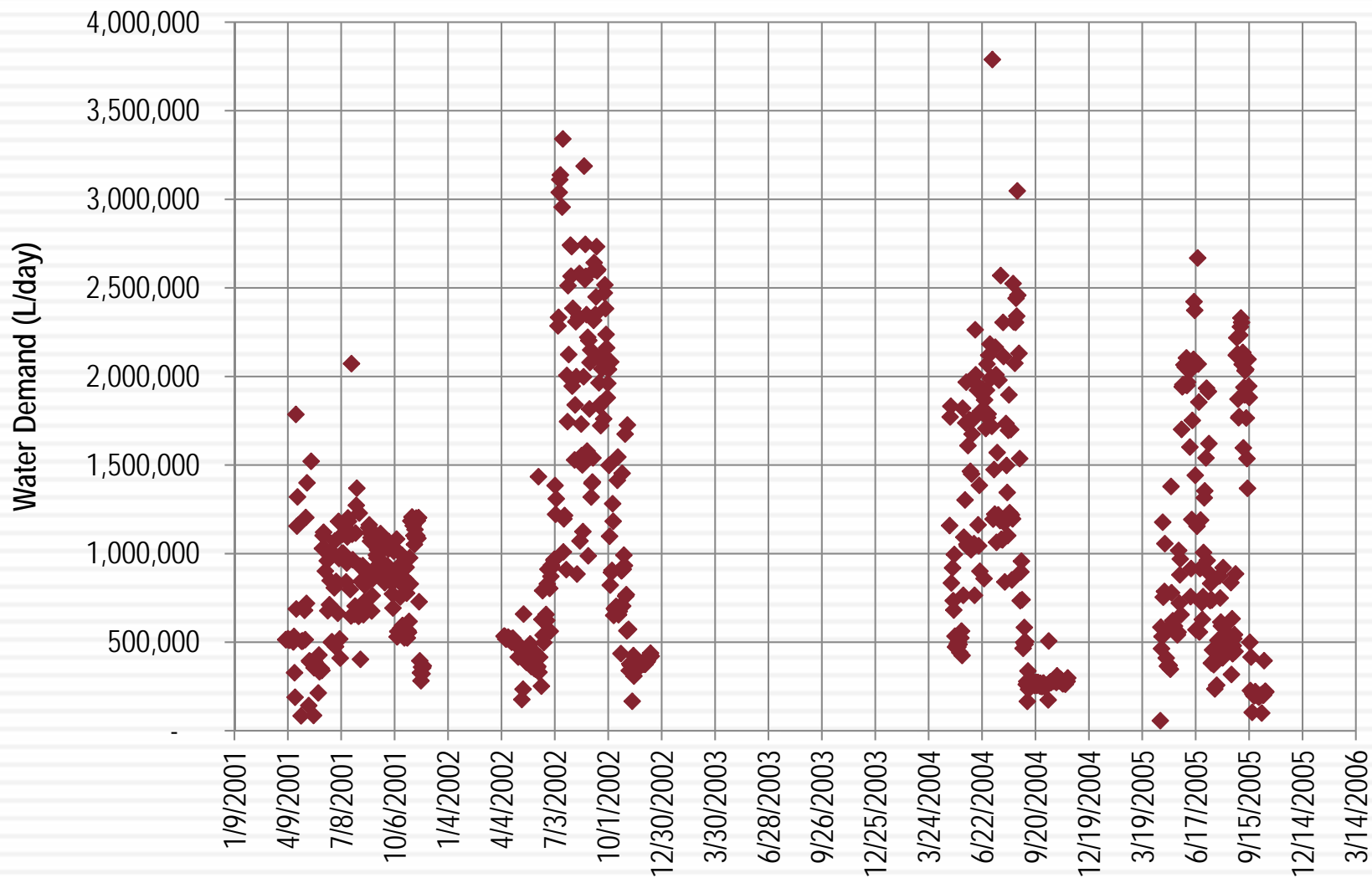- Boil water advisories

System Users

Population ~ 500

Users

- Residential = 154
- Industrial = 1
- Commercial = 13
- Institutional = 3

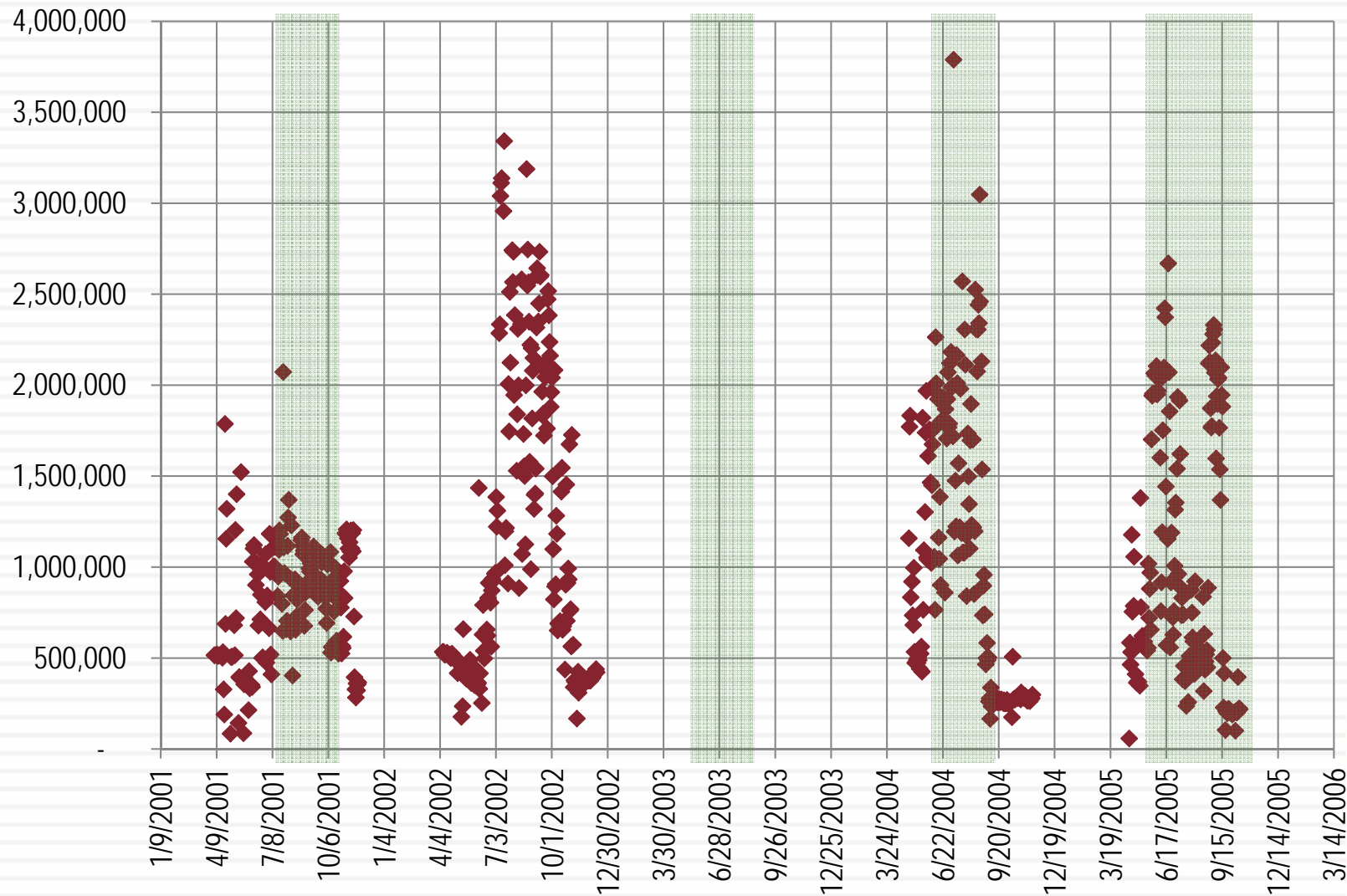+98% residential

Assumed per capita water demand = **504 Lpcd**

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Water Demand

Water Demand

	Expected *	Actual	Fish Plant On	Fish Plant Off
Average Demand	0.2 MLD (0.05 MGD)	unknown	1.3 MLD (0.3 MGD)	unknown
Maximum Demand	1.2 MLD (0.3 MGD)	3.8 MLD (1 MGD)	3.8 MLD (1 MGD)	unknown

Boil Water Advisories

Community D

Region: Western

Source: Pond

Disinfection strategy: Ozone and chlorine gas

Major concerns:

- Disinfection by-products
- Maintenance of chlorine residual
- Boil water advisories during fish plant operation

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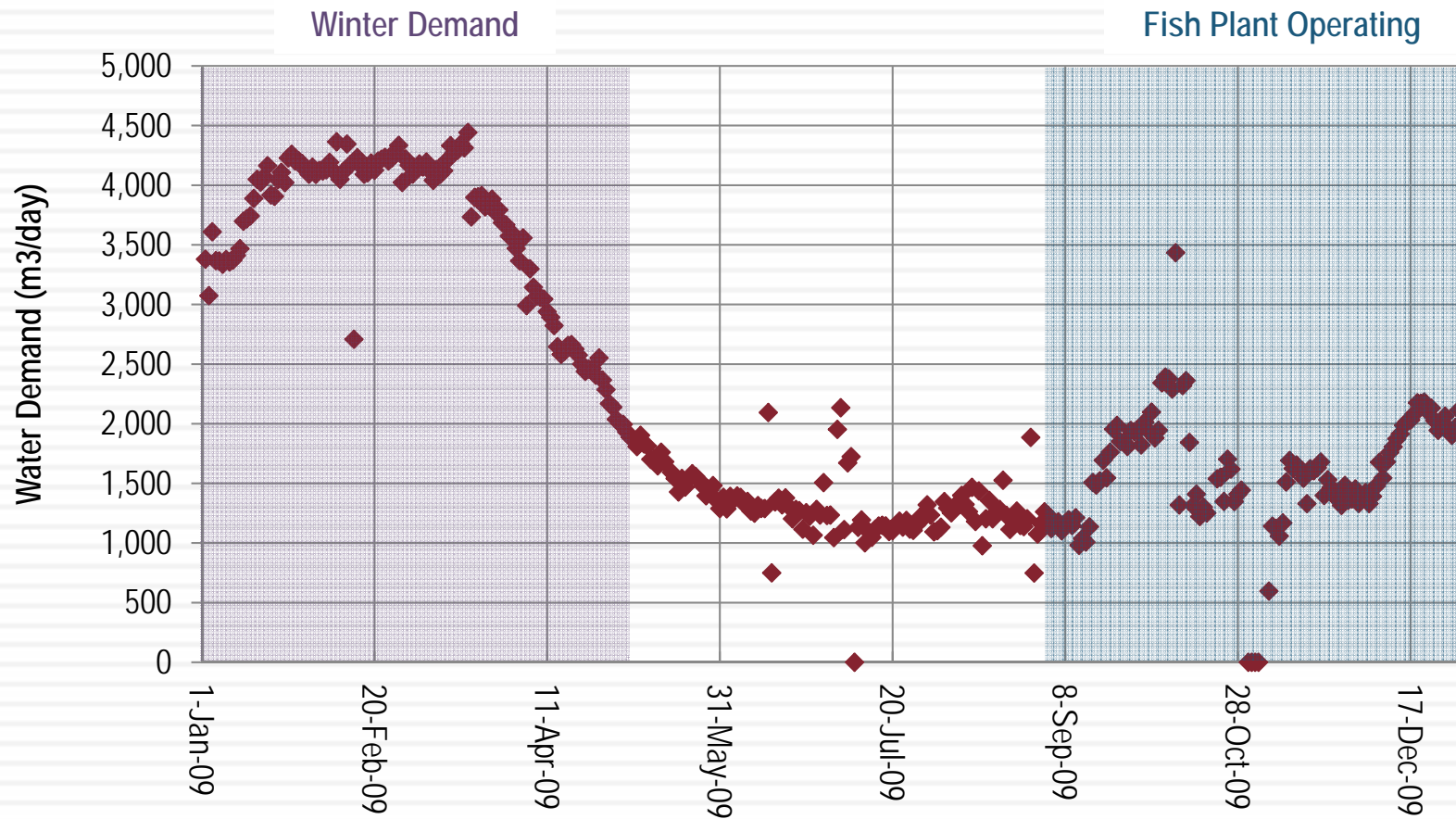Consulting Engineers

System Users

Population ~ 1,500

Users

- Residential = 729
- Industrial = 1
- Commercial = 9
- Institutional = 5

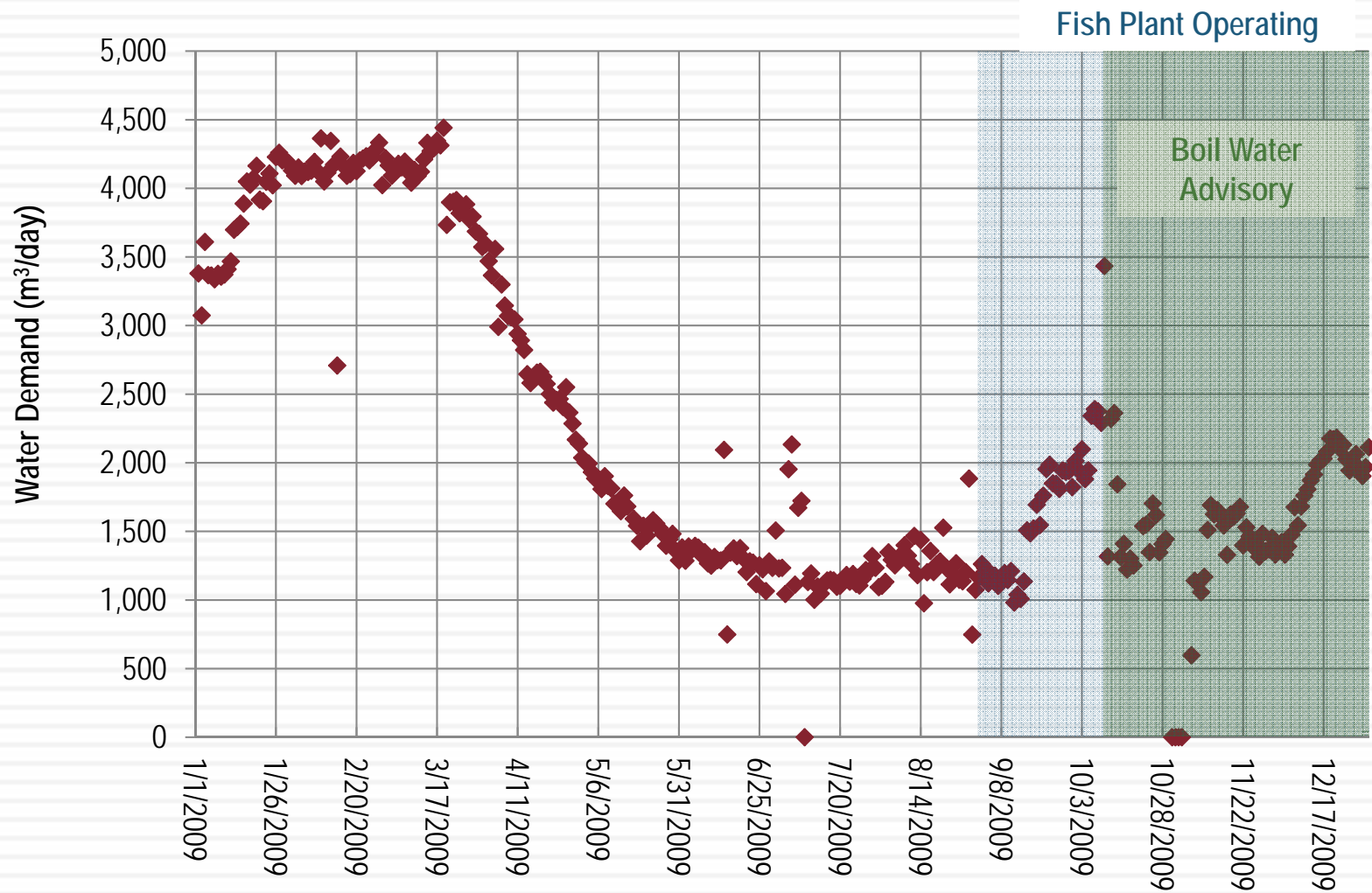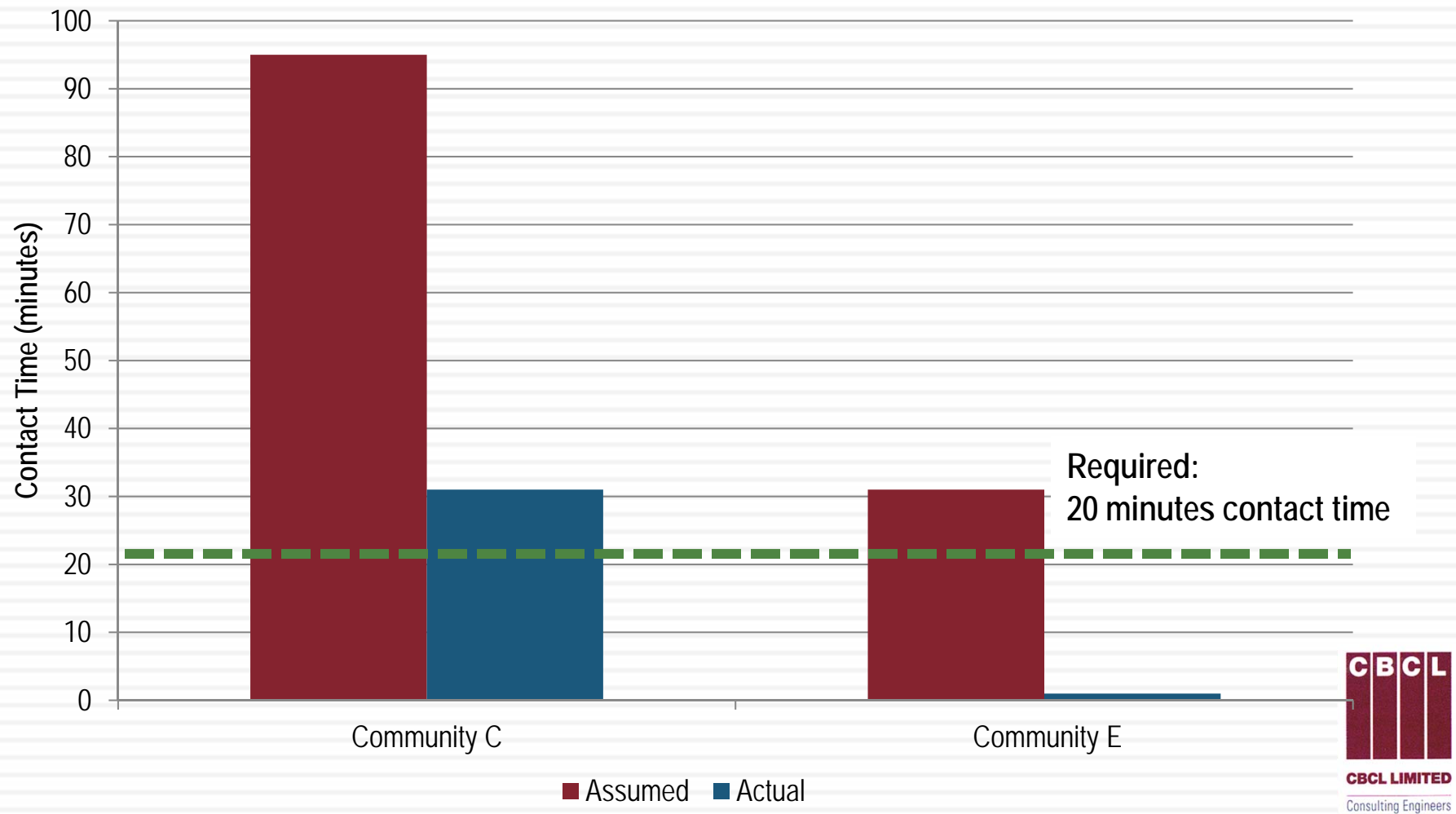> 95% residential

Assumed per capita water demand = **504 Lpcd**

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Water Demand

Water Demand

	Expected *	Actual	Fish Plant On	Fish Plant Off
Average Demand	0.8 MLD (0.2 MGD)	2.2 MLD (0.6 MGD)	1.6 MLD (0.4 MGD)	2.5 MLD (0.7 MGD)
Maximum Demand	2 MLD (0.5 MGD)	4.4 MLD (1.2 MGD)	3.4 MLD (0.9 MGD)	4.4 MLD (1.2 MGD)

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Boil Water Advisories

Short-term Mitigation Strategies

- Minimizing retention time and related issues:
    - Flushing to maintain chlorine residual as required

- Managing high flows:
    - Adjusting the operation of the chlorine dosing system during periods of high demand

- Overall:
    - Better record keeping

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Long-term Mitigation Strategies

- Minimizing retention time and related issues:
  - Removal of organics and pathogens before addition of chlorine

- Managing high flows:
  - Flow-based/automated chlorine dosing
  - Installation of chlorine booster stations where appropriate
  - Separate supply or dedicated storage for industrial user

- Overall:
  - Operator training
  - Improved communication between municipalities, regulators, and industrial users

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Acknowledgements

- Department of Environment and Conservation
  - Bob Picco
  - Annette Tobin

- CBCL Limited
  - Andrew McIntosh
  - Mark Bartlett
  - Ted Walsh
  - Chad Greenham
  - Greg Sheppard
  - Andrew Gates

- Water treatment and distribution operators in all of the participating communities

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Questions?