Monitoring the Natural Organic Matter Composition of Lake Winnipegosis Using Solid Phase Extraction

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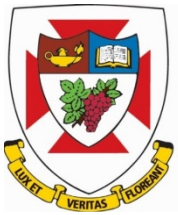

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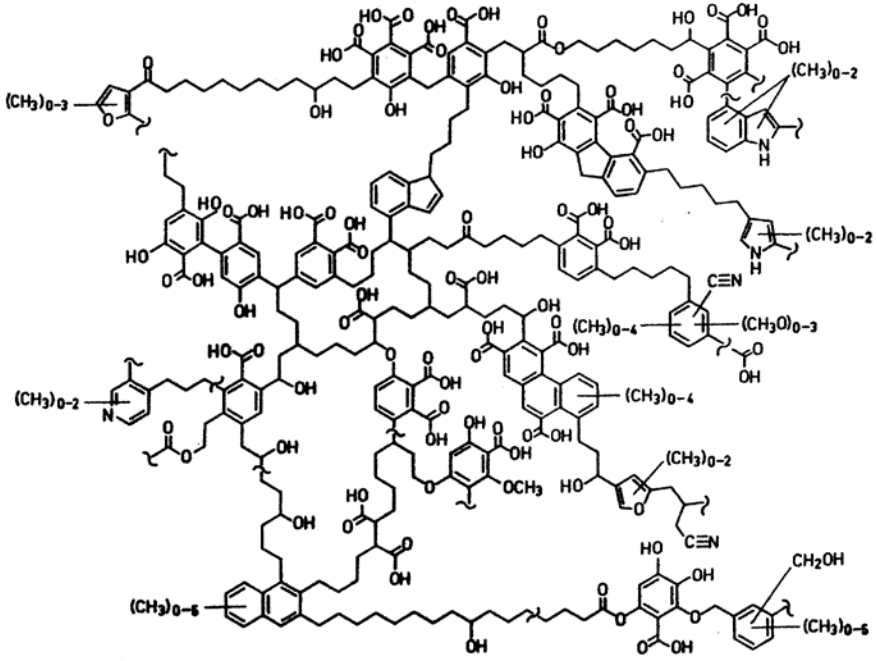
Objectives

1. Field study monitoring seasonal changes in Natural Organic Matter (NOM) composition in Lake Winnipegosis
   - Dissolved Organic Carbon (DOC)
   - Aquatic Humic Substances (AHS)

2. Monitor the removal of AHS and DOC in 3 water treatment plants located along Lake Winnipegosis: Waterhen, Duck Bay and Pine Creek First Nation.

Aquatic Humic Substances (AHS)

- Constitute a fraction of natural organic matter
  - Carbon-based compounds found in both surface and groundwater
- Can account for up to 50% of the organic carbon pool
- Humic and Fulvic acids

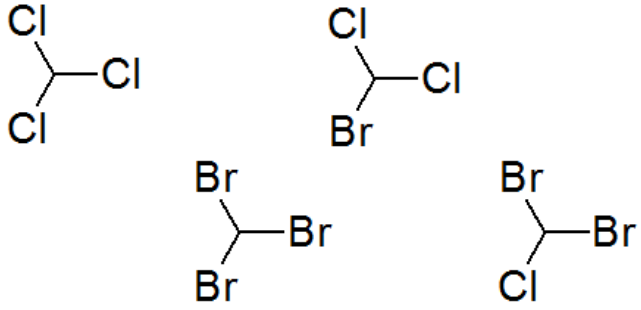


Why do we care about AHS?

1. Aesthetic Issues
   - Color
   - Odor
   - Taste
2. Increased operating cost
   - Chemical costs
   - Replacement of filter media or membrane
3. Disinfection byproduct precursor
   - Trihalomethanes (THMs)

Trihalomethanes (THMs)

- Group of halogenated methanes



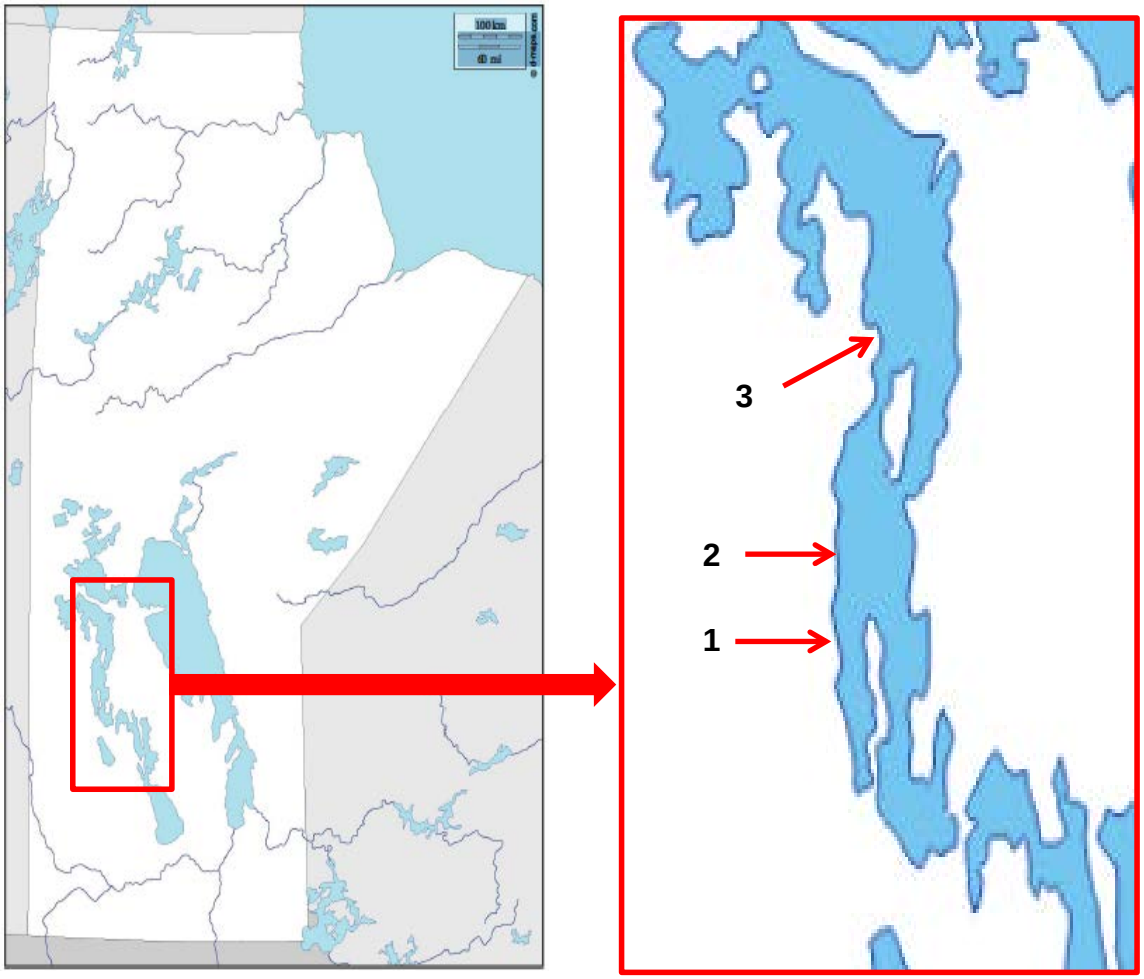
- Form during disinfection process by reaction with AHS
- Most prevalent disinfection byproduct
- Group 2 or 3 Carcinogens
- Regulated by Health Canada and Manitoba <0.100 mg/L
  - Currently 50-70% of Manitoba WTPs not in compliance (Manitoba Water Stewardship, 2011)

Solid Phase Extraction

- Can be used on-site by water treatment operators
  - Simple and requires very little training
  - Cheap and affordable
  - Direct measurement

Can be used to evaluate seasonal trends and plant operation

Sampling Sites – Lake Winnipegosis



Sample Locations

1. Camperville
2. Pine Creek FN
3. Duck Bay

Sampling Sites – Lake Winnipegosis

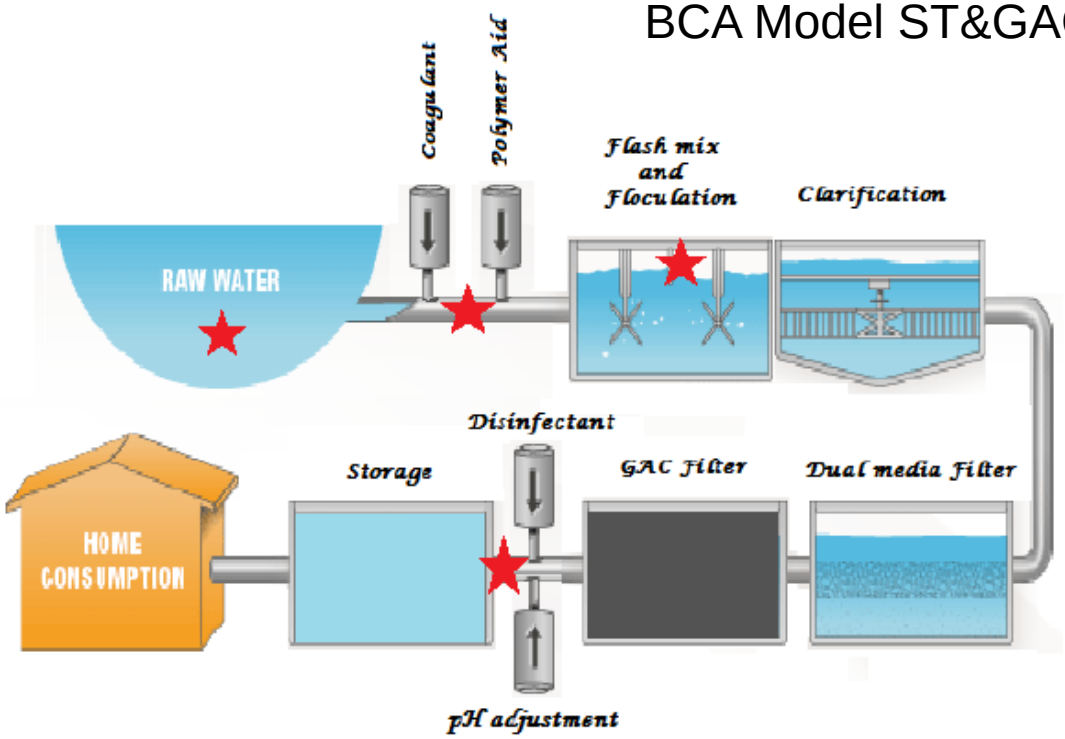
	Duck Bay	Camperville	GCDWQ Guidelines
Colour, True (TCU)	< 5.0	< 5.0	< 5.0
pH	8.43	8.29	6.5-8.5
Alkalinity (mg/L $CaCo_3$)	97.2	123	N/A
Total Organic Carbon (mg/L)	13.2	9.1	N/A
Total THMs (mg/L)	0.252	0.150	<0.100

ALS reports provided by the water treatment plants for August, 2011.

- No historical data available for Pine Creek (assumed to be similar)
- All three plants are not in compliance with guideline of 0.100 mg/L total THMs
- Sampled in August 2014, September 2014 and January 2015

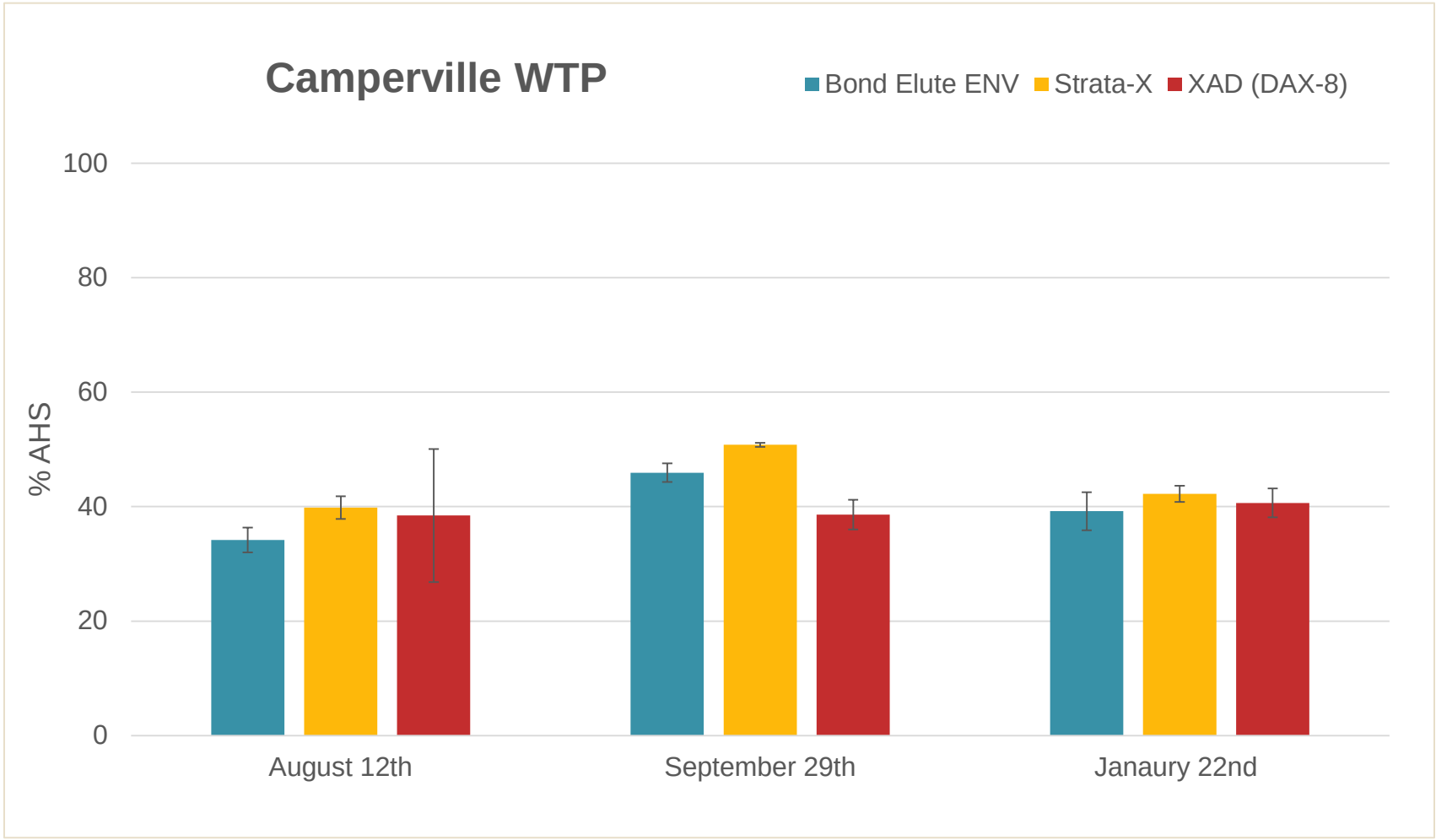
Sampling at Water Treatment Plants

BCA Model ST&GAC-50 system

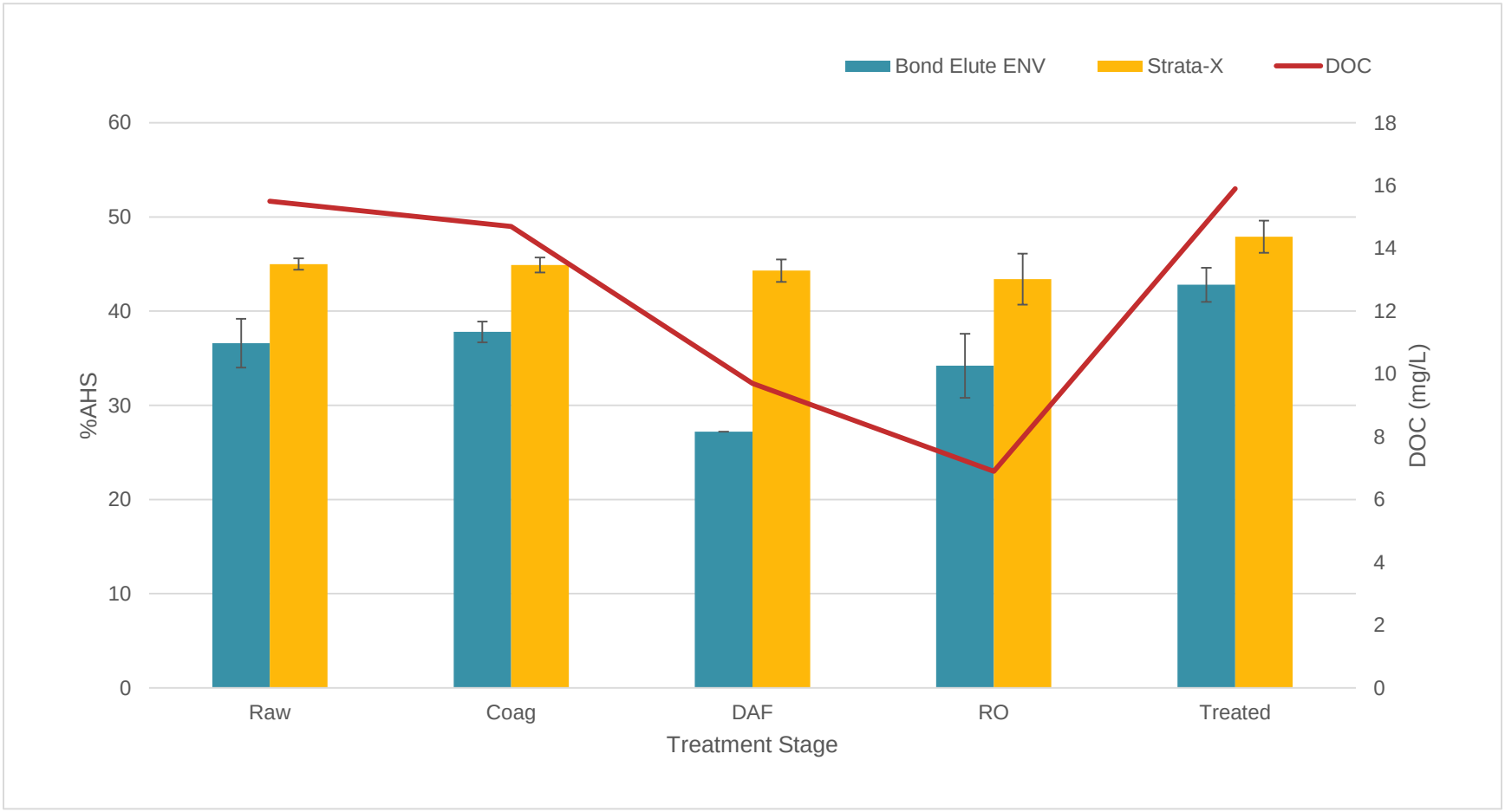


*Pine Creek is equipped with an RO system, and dissolved air flotation for clarification.

Results – Objective 1: Seasonal monitoring of AHS



Results – Objective 2: Pine Creek First Nation WTP



Little to no change in %AHS throughout the treatment train

Conclusions

1. The fraction attributed to AHS does not fluctuate to any appreciable degree seasonally
2. Little to no variation in %AHS throughout the treatment process, resulting in continued elevated levels of THMs
3. The Pine Creek First Nation WTP is operating poorly and needs better oversight

Future Work

- Sampling during the Spring 2015 for full year monitoring

Acknowledgements

- Dr. Beata Gorczyca and Mr. Charles Goss

Funding

- Natural Sciences and Engineering Research Council of Canada
- Manitoba Aboriginal and Northern Affairs
- Create H2O Program

Canada Research Chairs

NSERC CRSNG

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