

Chinook, Montana WTP

Challenges with Treating the Milk River

Jeff Ashley, P.E.

PNWS-AWWA
2017 Annual Conference



integrity

commitment

respect

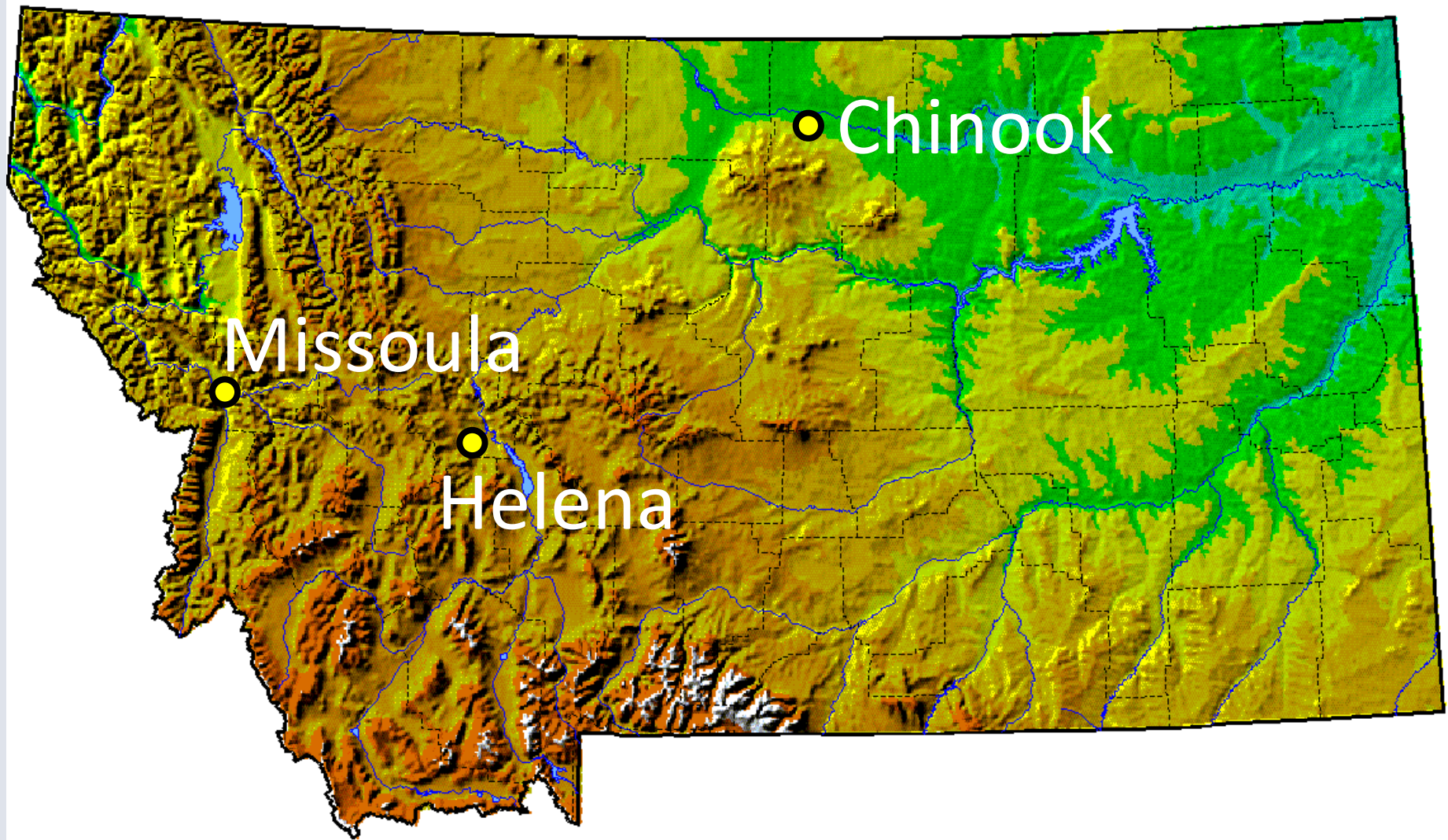
excellence

Presentation Topics

- Existing Treatment Plant
- Water Quality
- Jar Testing and Pilot Testing
- Upgrades
- Construction
- First Year Operation

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Chinook, Montana

- Population = 1,200
- Agriculture economy
- “Hi-Line” community



Treatment Plant

Conventional Filtration (1976) 0.75 mgd

1. Raw Water Pumping
2. Coagulation / Flocculation / Settling
 - ✓ Suspended solids
 - ✓ Total Organic Carbon (TOC)
3. Mixed Media Filtration
4. Disinfection
 - ✓ Chlorine gas
5. High Service Pumping



Aging equipment, antiquated electrical & controls

Package Plant (Microfloc Aquarius)



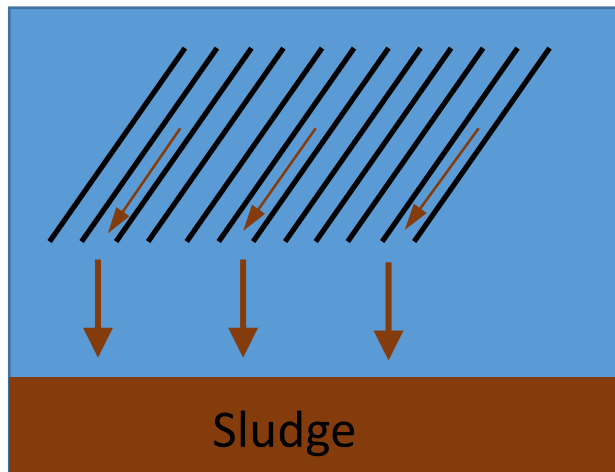


7.5-deg tubes

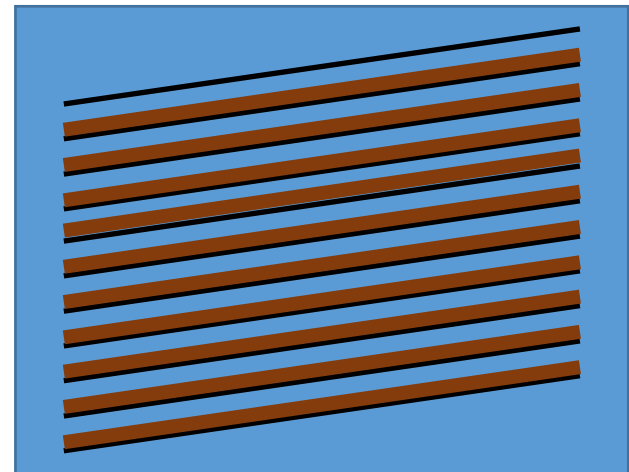
The image shows a laboratory experiment setup. A wooden frame contains a black corrugated tube. A channel within the frame is filled with a yellow liquid, likely oil, which is used to observe the flow characteristics of the 7.5-degree tubes. The setup is designed to study fluid dynamics in a controlled environment.

Microfloc Aquarius

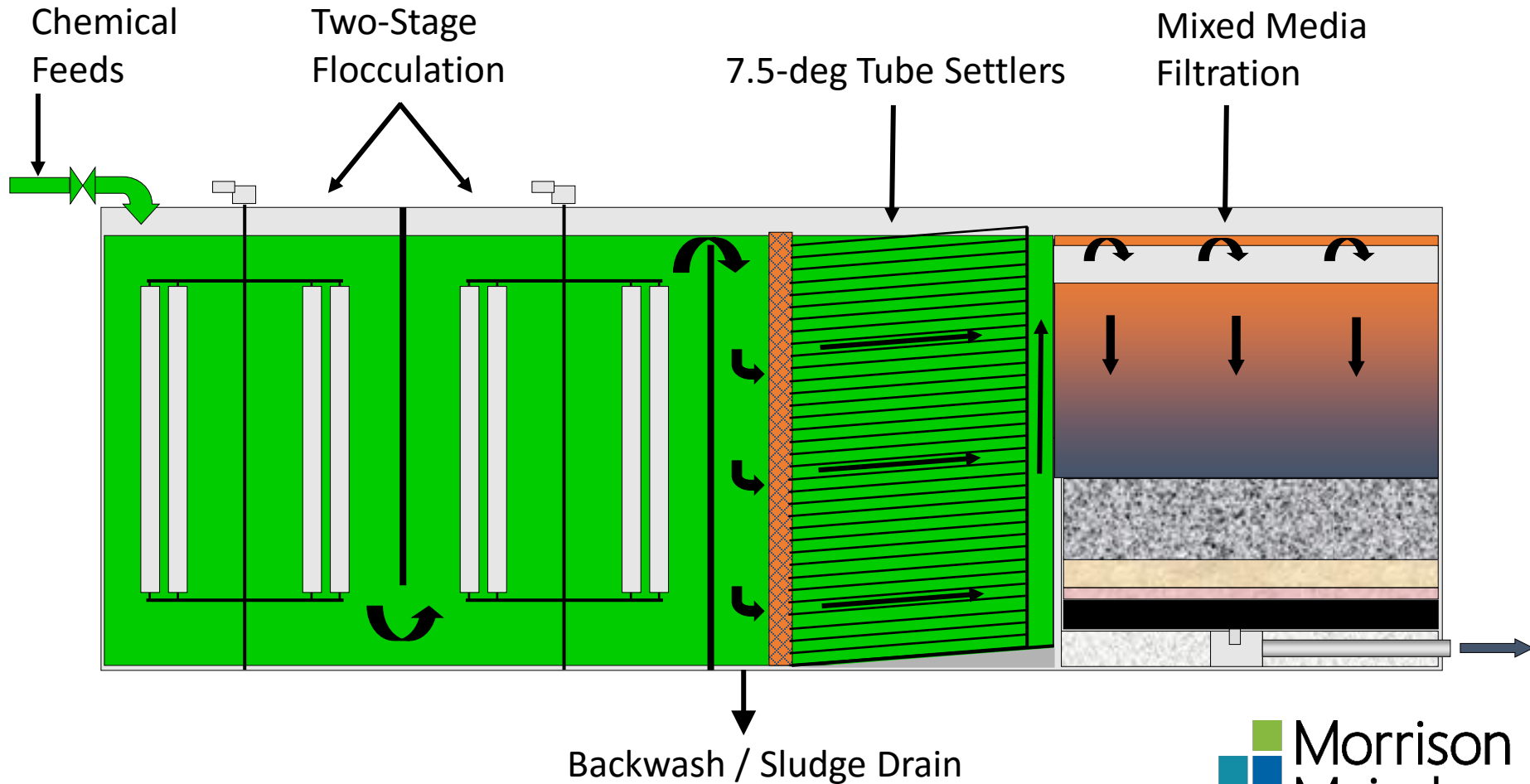
Traditional
60-deg Tube or Plate Settlers



Microfloc
7.5-deg Tube Settlers

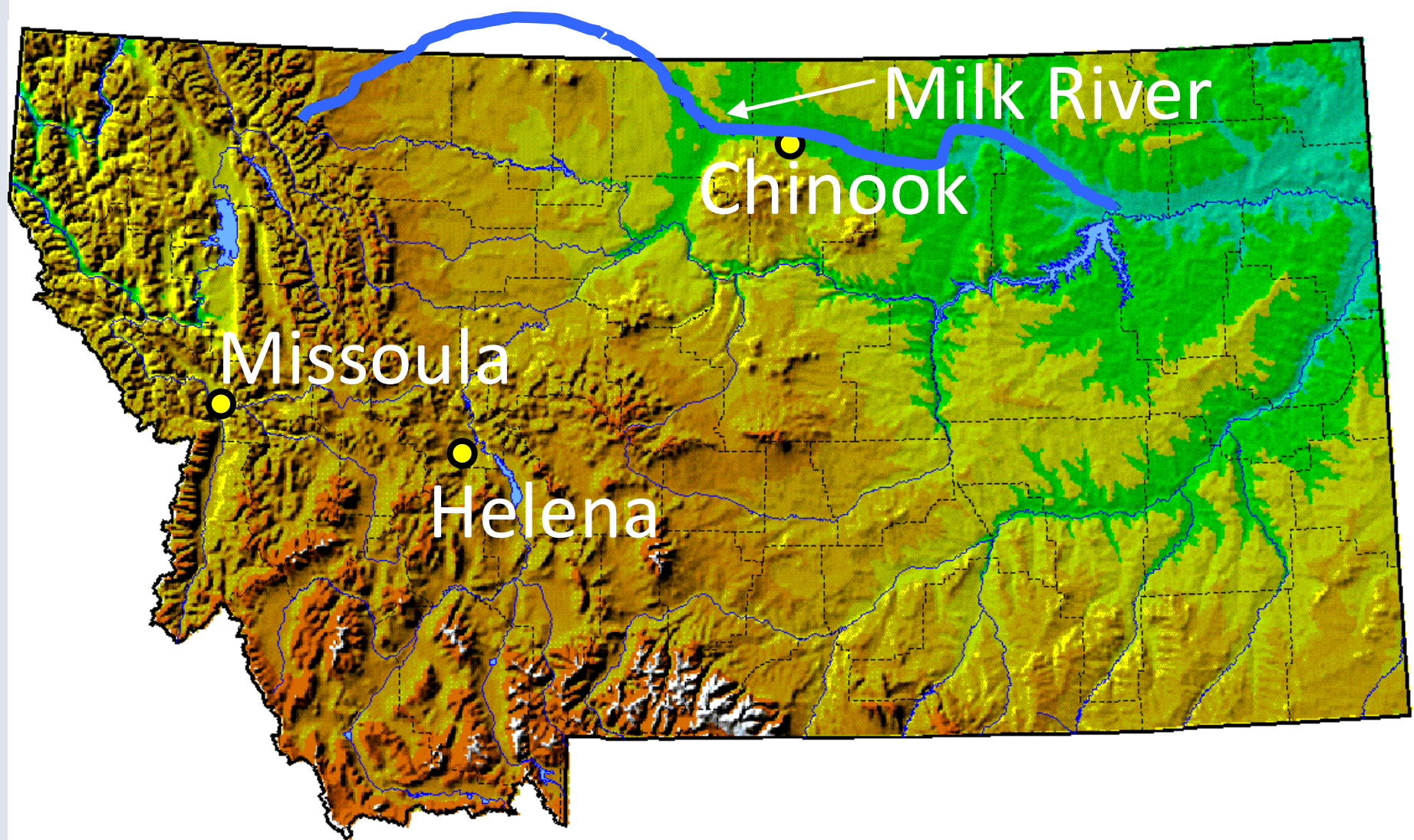


Microfloc Aquarius



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Milk River

- *"the water of this river possesses a peculiar whiteness, being about the colour of a cup of tea with the admixture of a tablespoonfull of milk. from the colour of its water we called it Milk river."* – Meriwether Lewis
- Clays & silts in southern Alberta
- 729 miles long







07.03.2011



Milk River

Missouri River

Water Quality

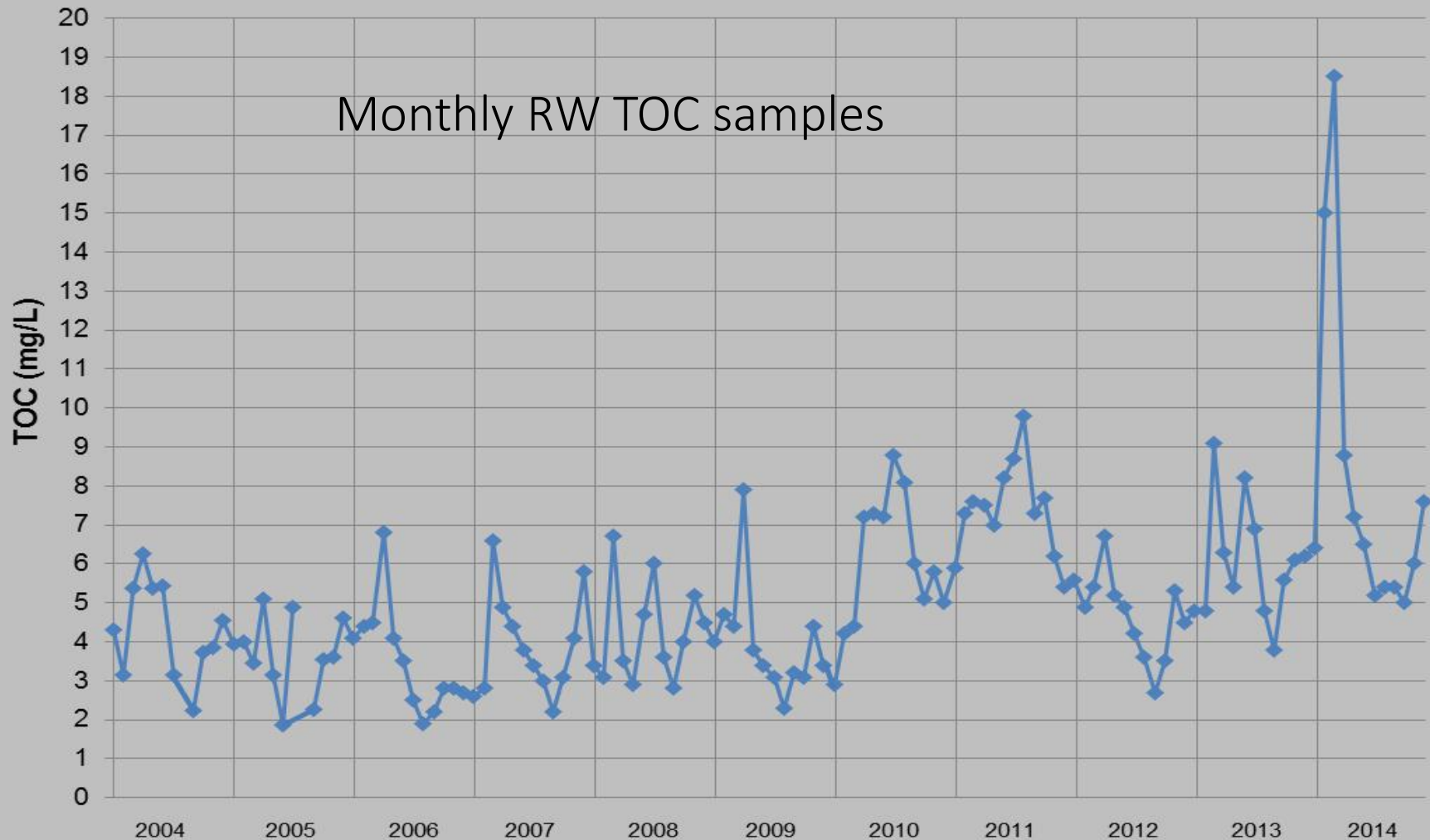
Water quality parameters

- ✓ Suspended solids
- ✓ Turbidity (~ 2,500 NTU)
- ✓ Sand, grit, etc.
- ✓ Organic material

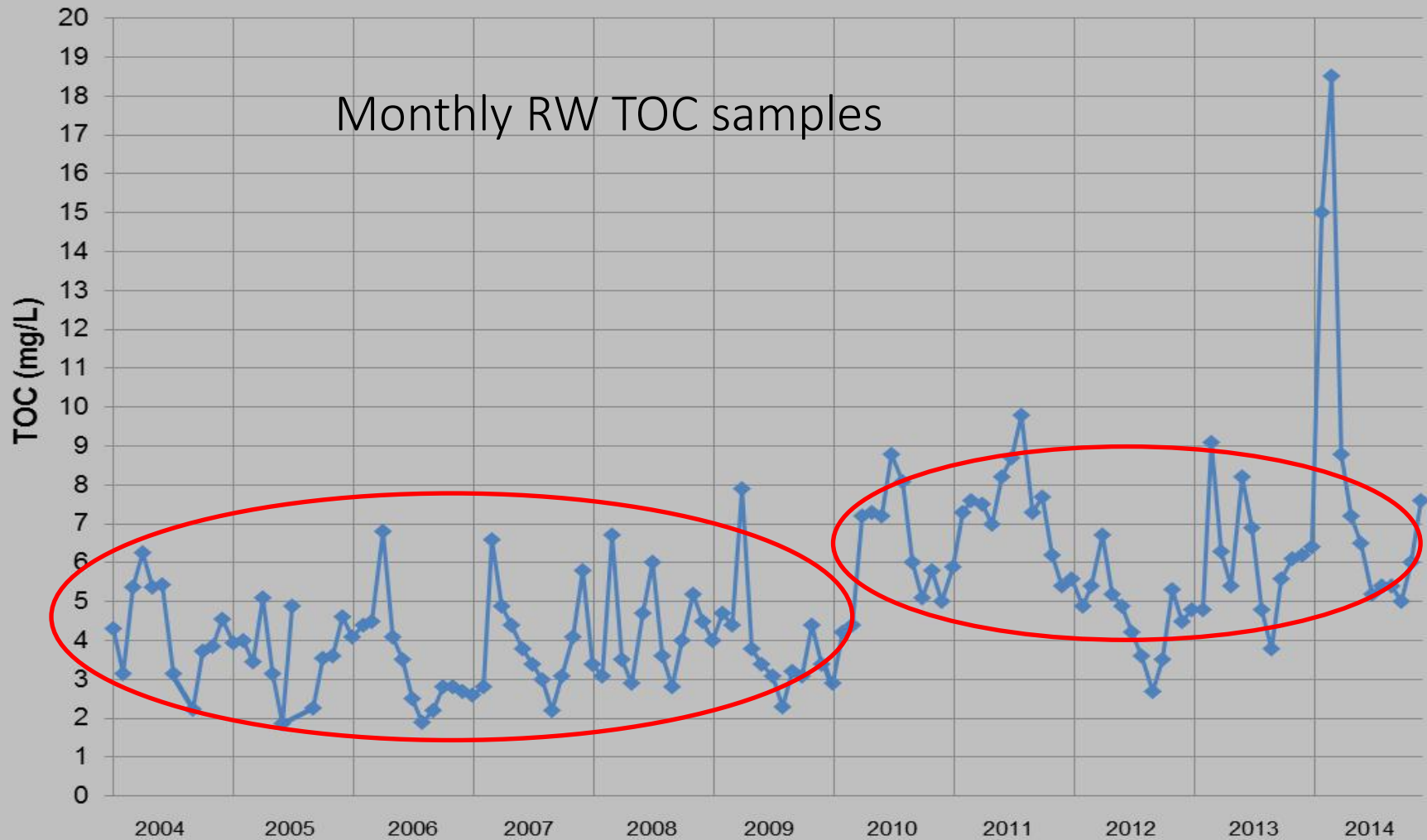
Measured as Total Organic Carbon (TOC)



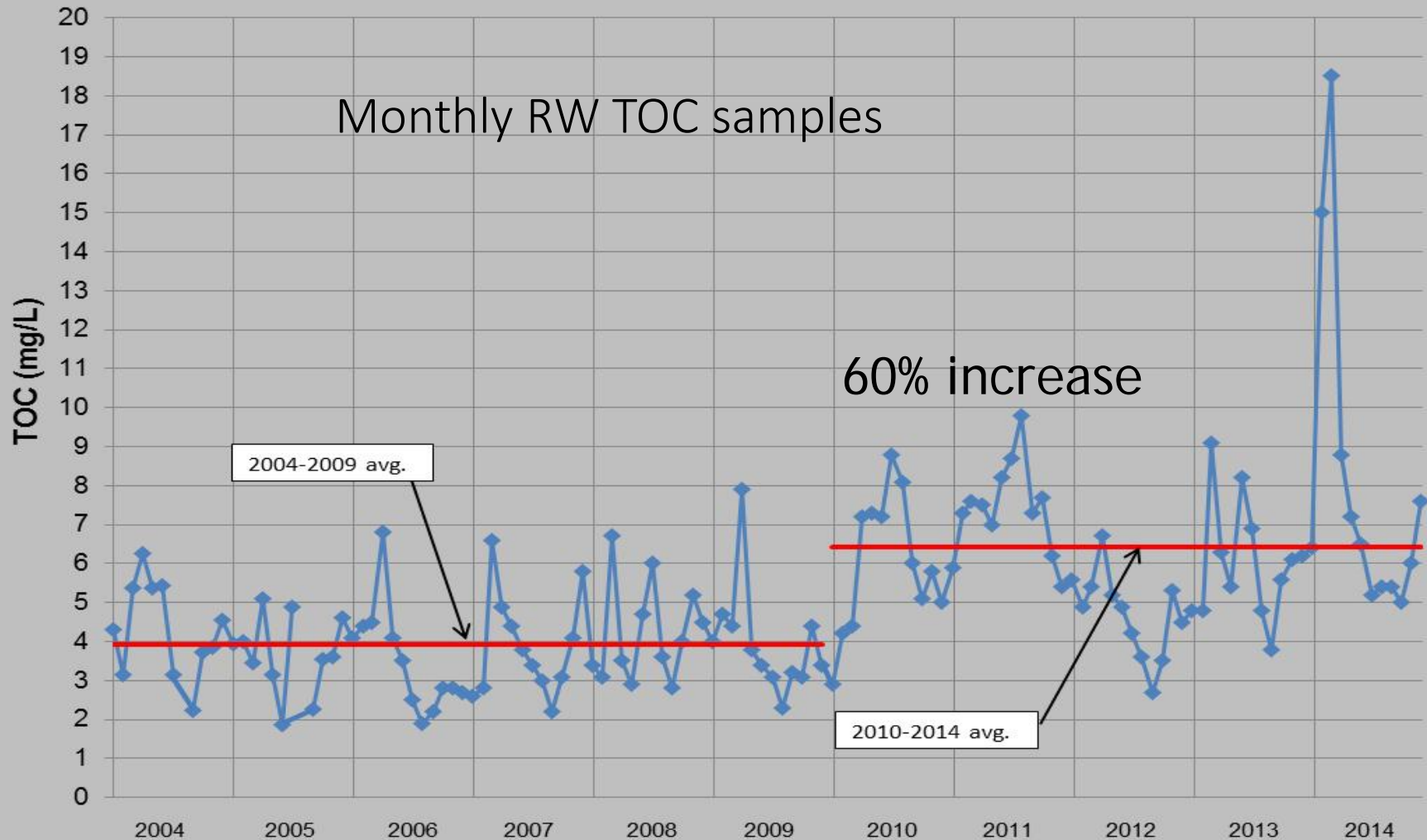
Raw Water TOC



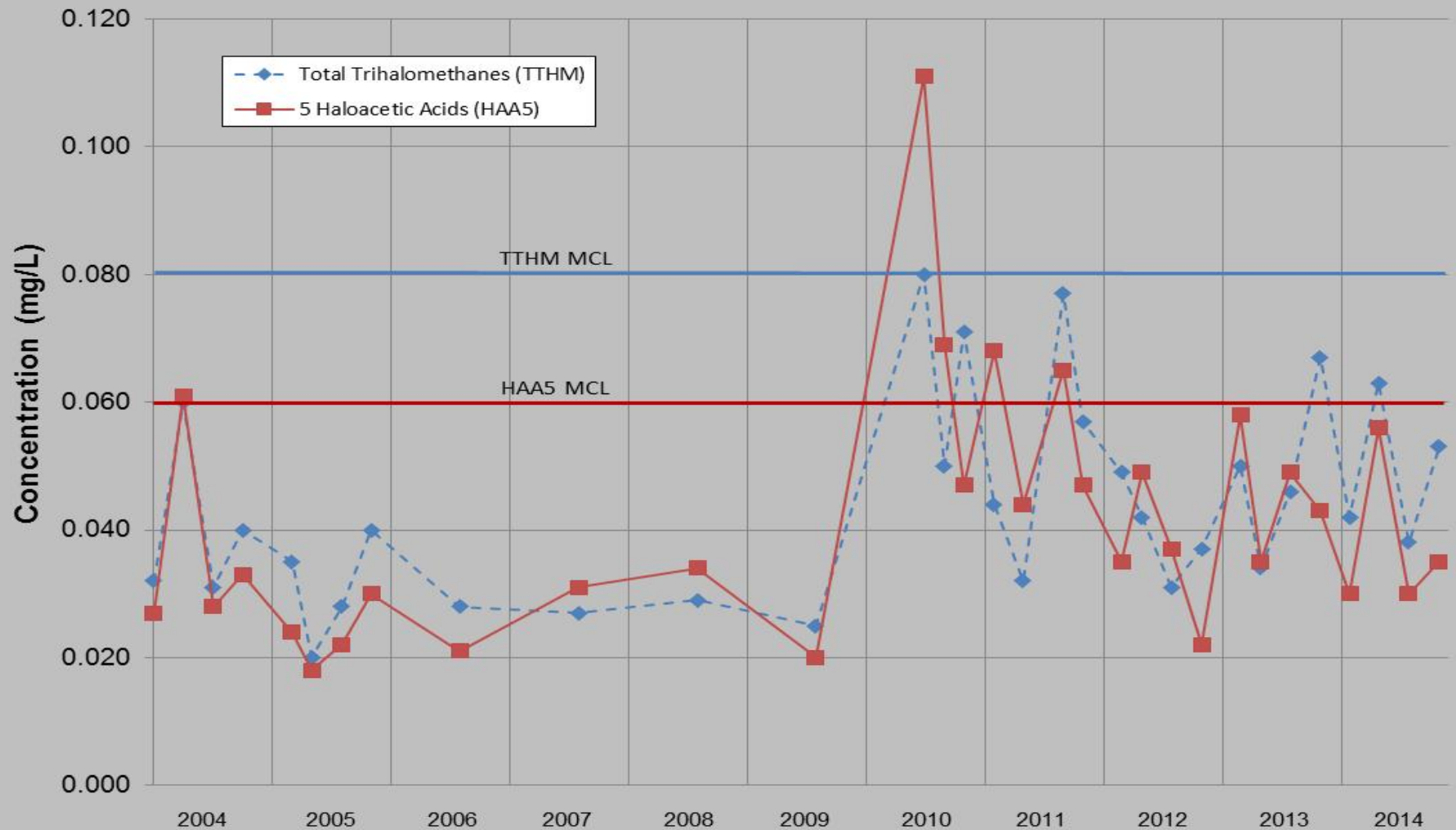
Raw Water TOC



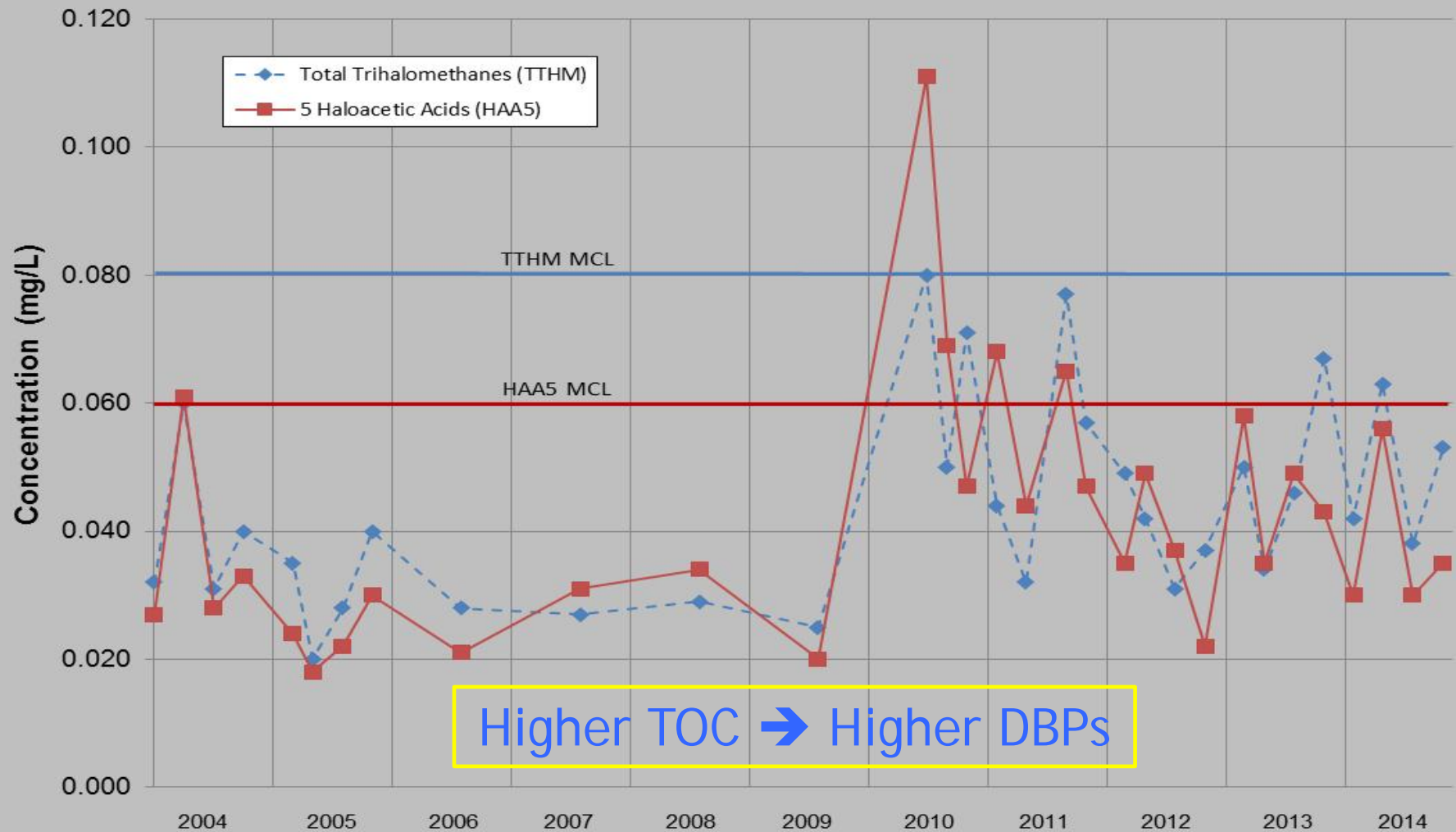
Raw Water TOC



Disinfection Byproducts



Disinfection Byproducts



Water Quality

Challenges of Milk River

- ✓ Variable turbidity
- ✓ Increased TOC
- ✓ DBP violations in 2011



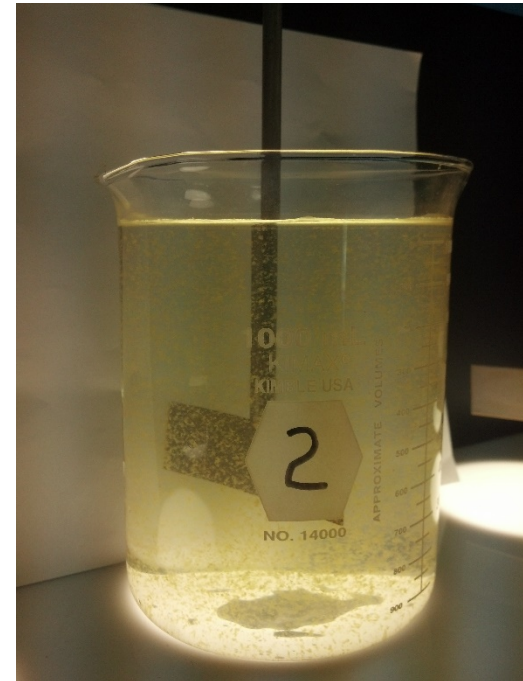
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Jar Testing

Results

- ✓ “Oxidant demand”
 - 1.0 mg/L permanganate dose
 - Improved filterability
- ✓ Alum ~ 60 mg/L
- ✓ Optimized polymers



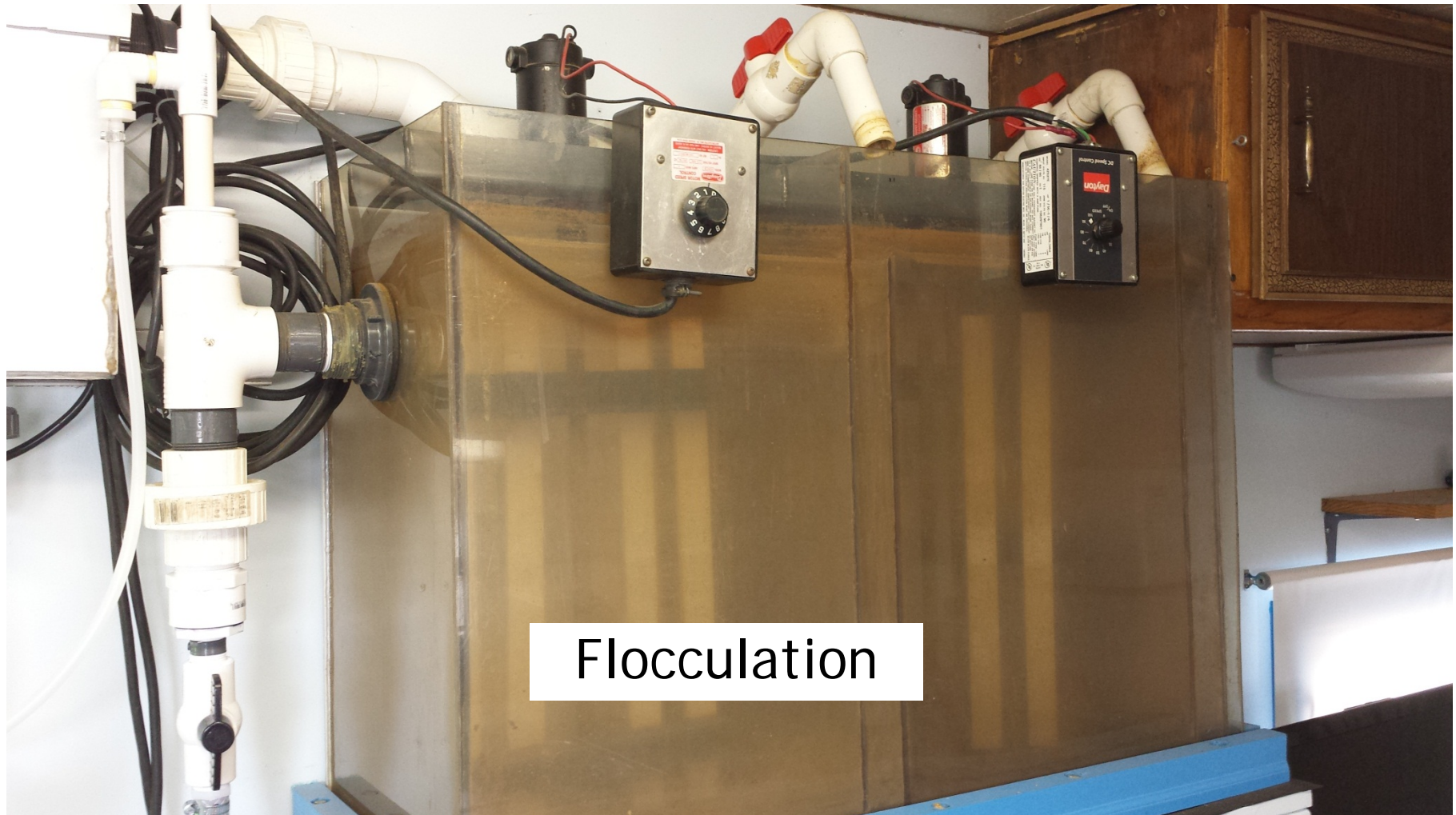
Conventional filtration

Pilot Testing



Pre-oxidation

Pilot Testing



Flocculation

Pilot Testing



Pilot Testing



Filtration

- ✓ Mixed-media
 - Anthracite
 - Silica sand
 - Garnet sand

- ✓ 3.0 – 5.0 gpm/sf

Pilot Testing

Results

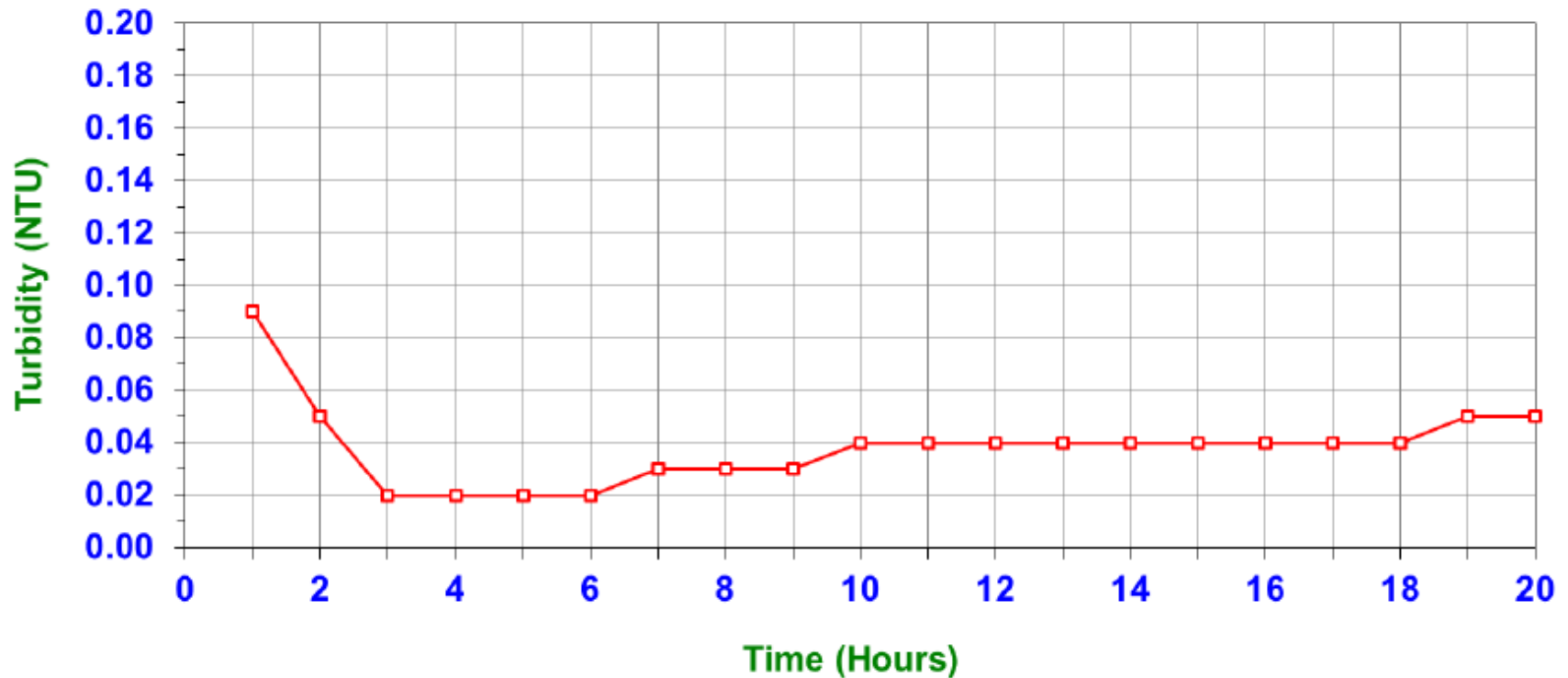
- ✓ Permanganate 1-3 mg/L
- ✓ Alum 90-120 mg/L
- ✓ Powdered Activated Carbon 5-30 mg/L
- ✓ TOC → 40-50% removal
- ✓ 20 hour filter runs



Pilot Testing

Run 6 - Chinook, MT

—□— Finish Water Turbidity



Pilot Testing

Design Considerations

- ✓ Conventional Filtration (Package Plant)
- ✓ Pre-oxidation basins = 3 hours detention time
- ✓ Permanganate
- ✓ PAC



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Proposed Upgrades

Design Elements

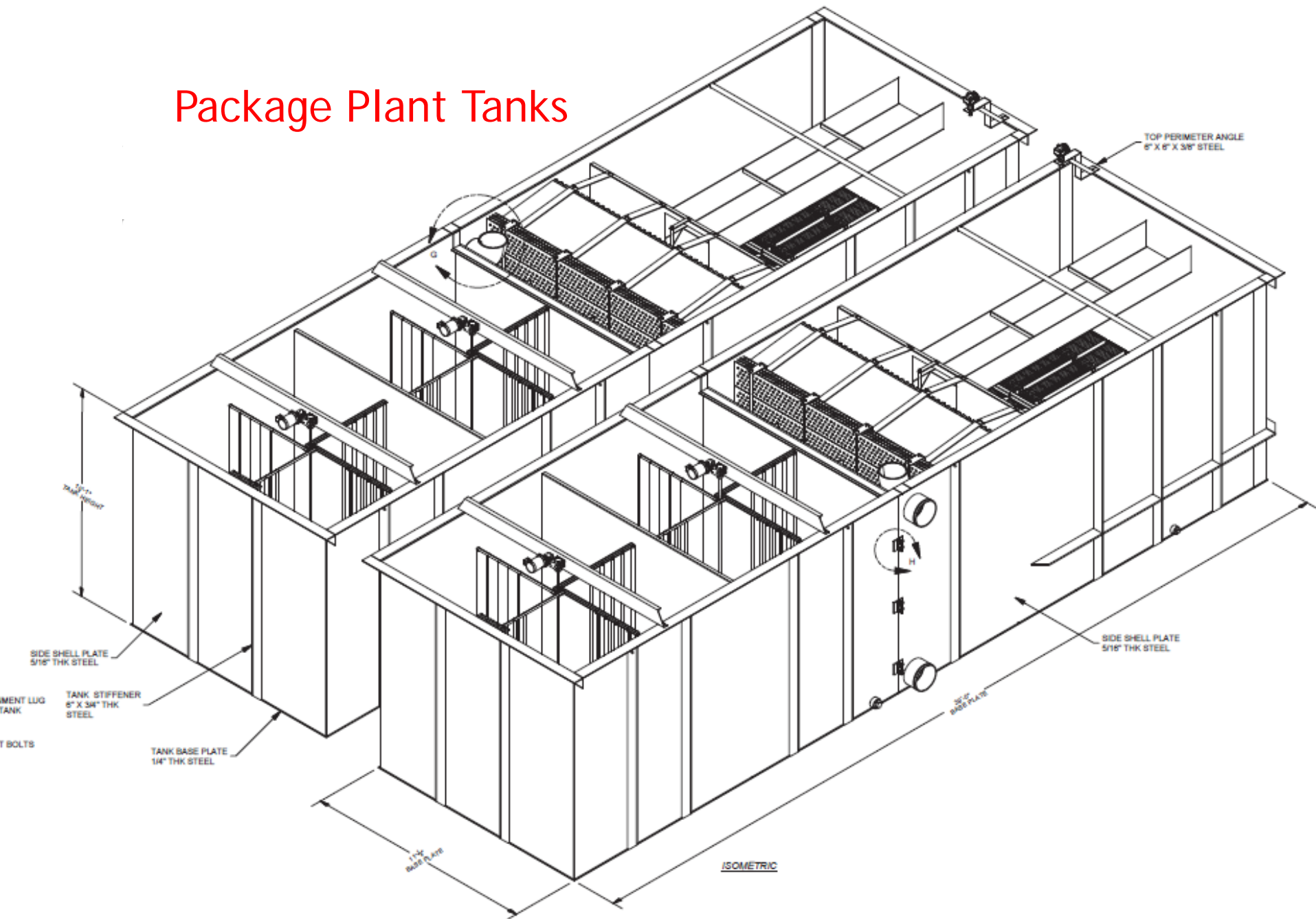
- ✓ Raw water pump station
- ✓ Pre-Oxidation basins
- ✓ New package plant trains
- ✓ Backwash pumps
- ✓ UV disinfection
- ✓ Electrical & control upgrade
- ✓ Permanganate & PAC feed
- ✓ Chemical feed upgrade



Water Treatment Plant Improvements Project
Chinook, MT
Basis of Design Report



Package Plant Tanks



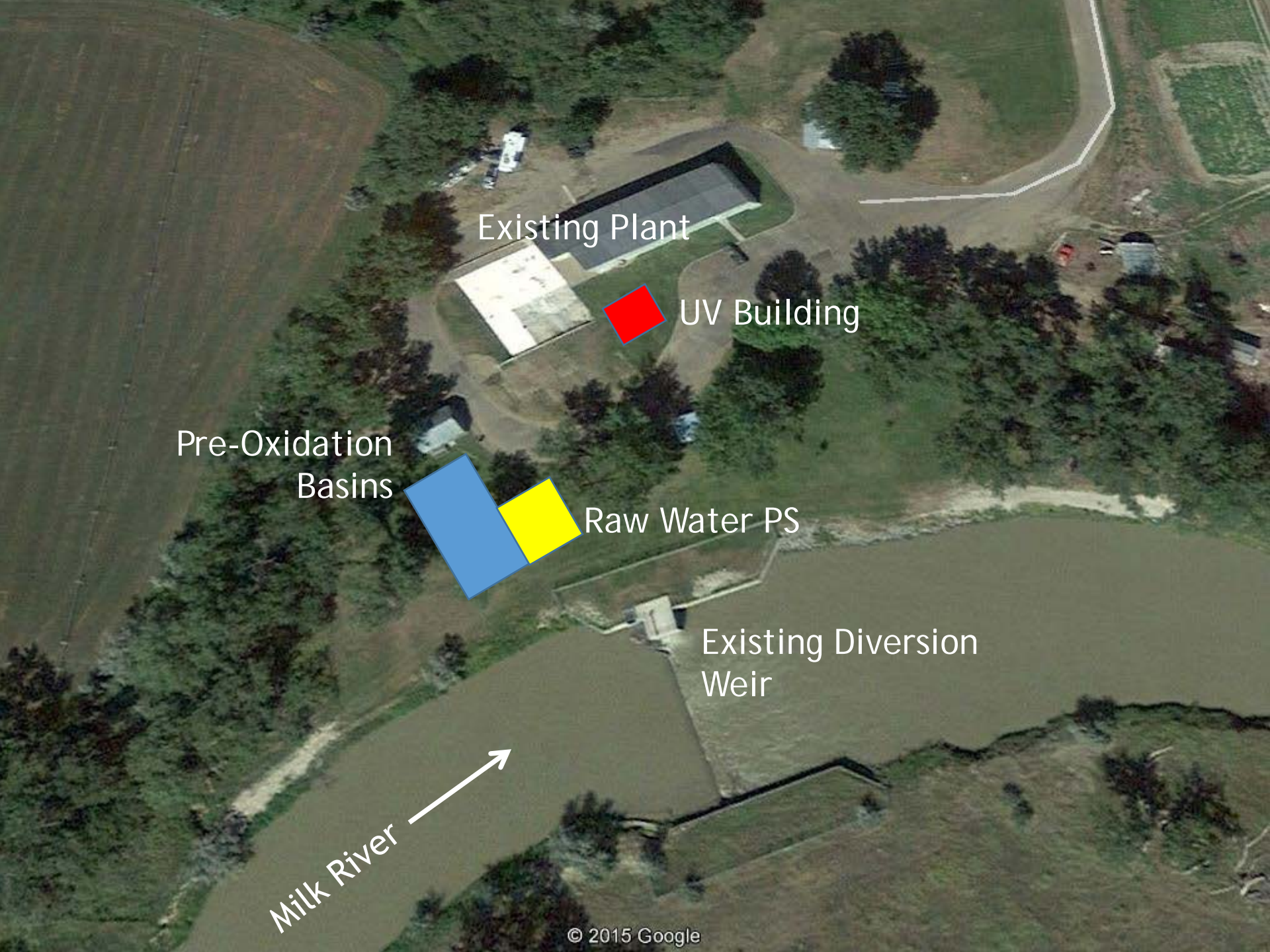
Presentation Topics

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- **Construction**
- First Year Operation

Challenges

- ✓ Raw water pumping “switch”
- ✓ New vs. old electrical / control
- ✓ Package plant tank demo ➔ 1 at a time
- ✓ New tank start-up





Existing Plant

UV Building

Pre-Oxidation
Basins

Raw Water PS

Existing Diversion
Weir

Milk River





12 29 2015



01 12 2016



03 08 2016



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 - ✓ Start-up April 2016

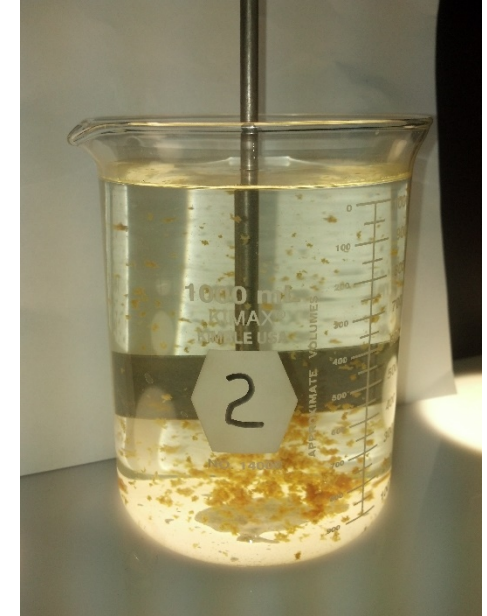
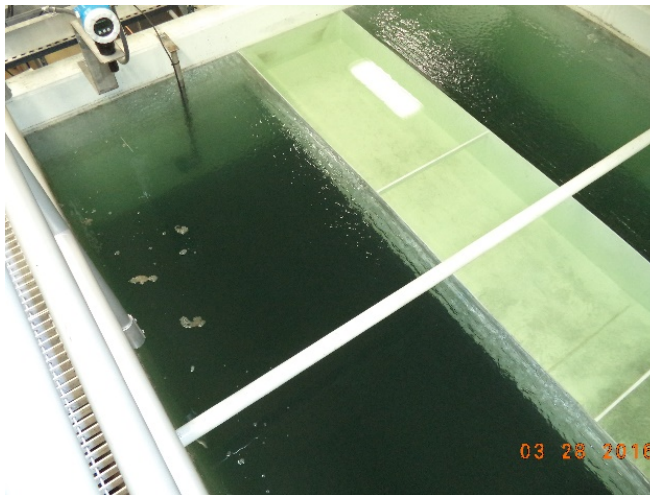
Sodium Permanganate

- ✓ 20% solution
- ✓ CPVC components
- ✓ Small leaks
- ✓ Compatibility ???
 - ❑ Conflicting info
- ✓ Replaced with Polypropylene



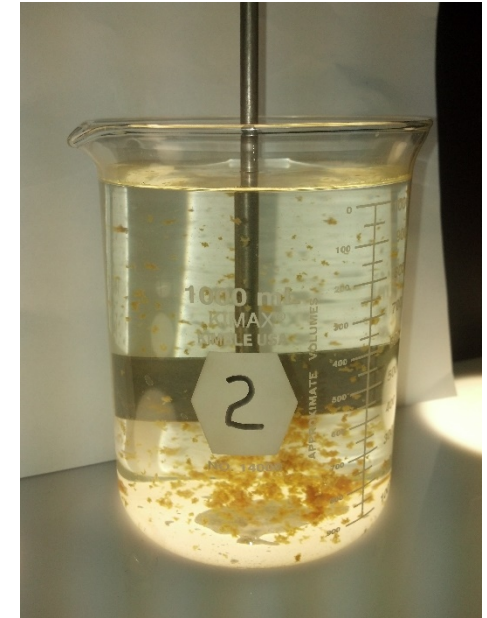
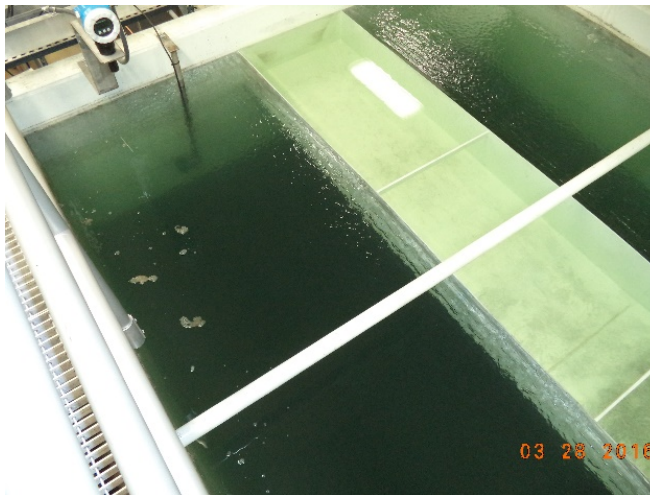
Filter Breakthrough

- ✓ Summer operation went well
- ✓ **Poor floc this Winter**
- ✓ Short filter runs
- ✓ Does Filter Aid help?
- ✓ Polymer dosing



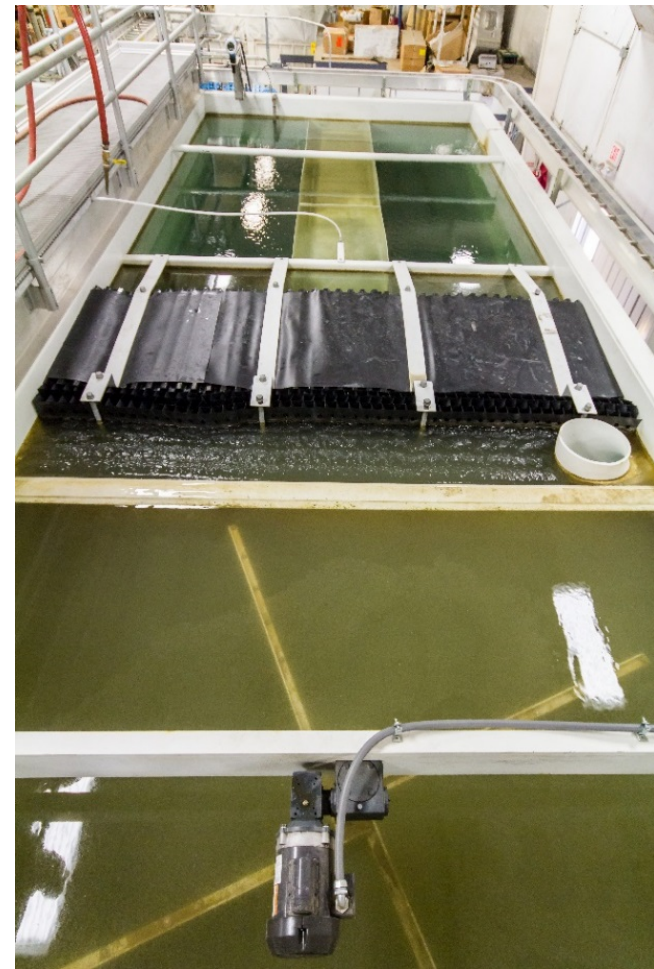
Filter Breakthrough

- ✓ Conclusions from Winter Optimization
 - ❑ Overcharging with polyamine cationic polymer
 - ❑ Pre-oxidation very effective
 - ❑ Filter aid → has some effect
 - ❑ Acrylamide cationic polymer to floc tanks



Overall

- ✓ Pre-Oxidation
 - Settling in tank (grit, sand, etc.)
 - Improvement in treatment
- ✓ Optimized polymers
 - Summer vs. Winter
- ✓ TOC removal 33-50%
 - Alkalinity > 200 mg/L
 - DBPs in compliance
- ✓ Filter performance excellent
 - Turbidity < 0.08 NTU





07.03.2011



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Challenges with Treating the Milk River

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Questions?



integrity

commitment

respect

excellence