

# Chinook, Montana WTP Challenges with Treating the Milk River

Jeff Ashley, P.E.

PNWS-AWWA  
2017 Annual Conference



integrity

commitment

respect

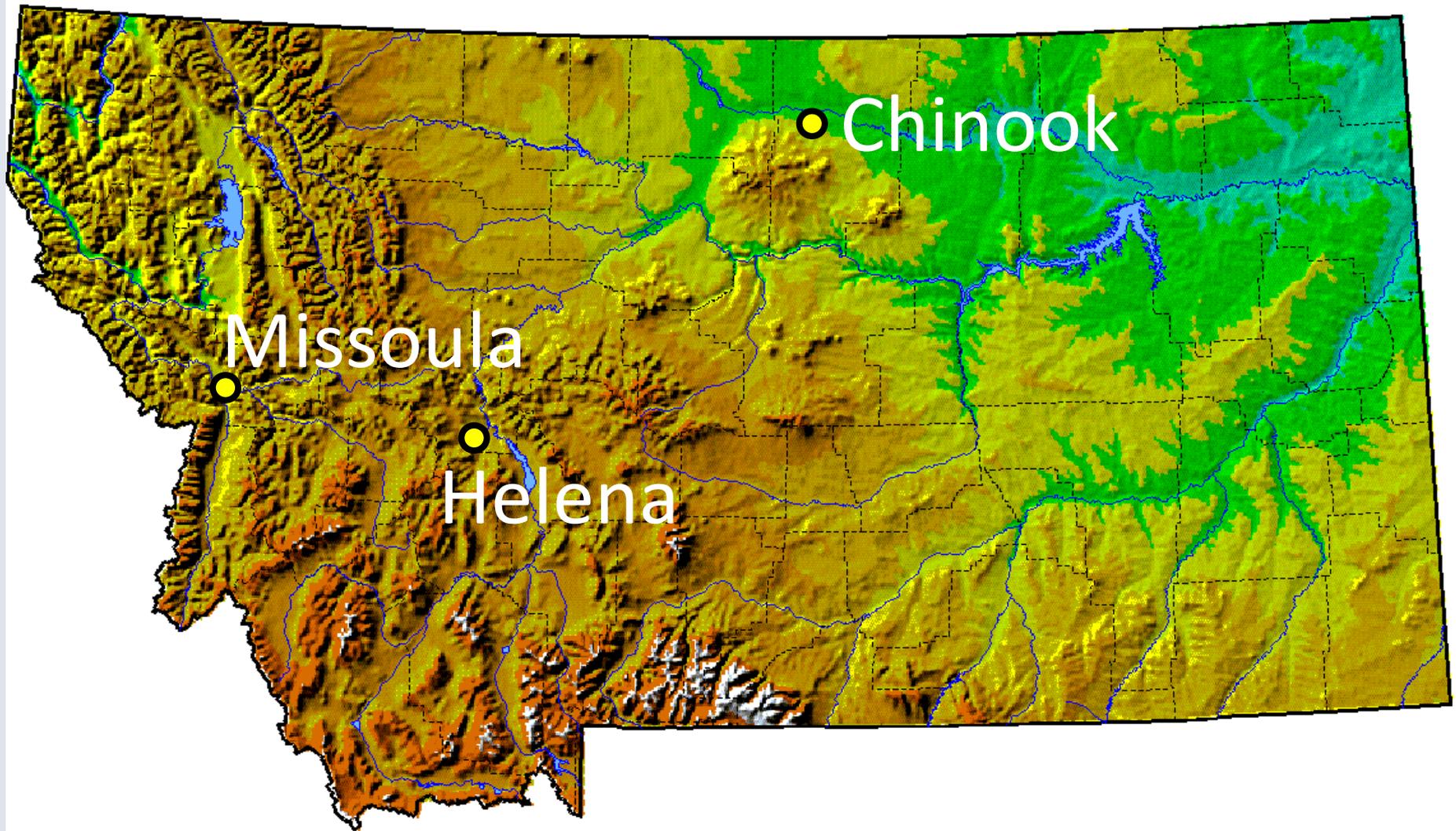
excellence

# Presentation Topics

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

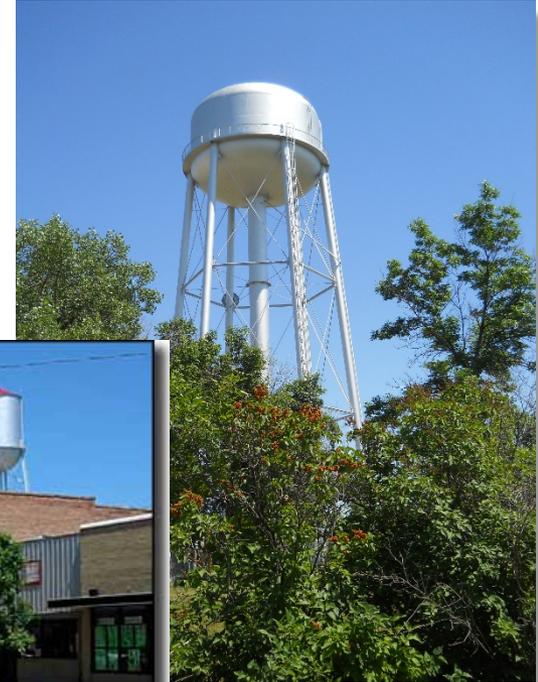
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# Chinook, Montana

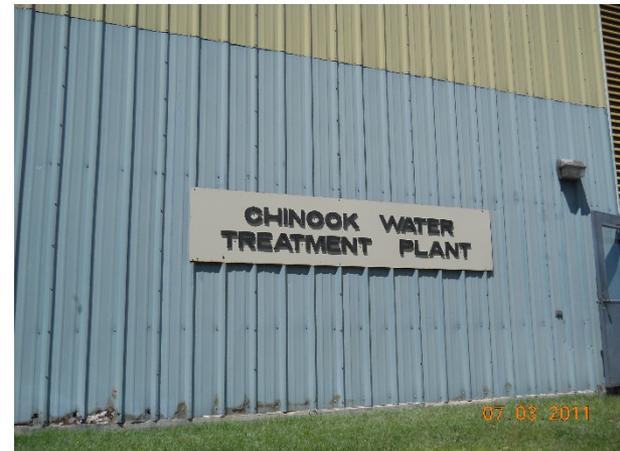
- Population = 1,200
- Agriculture economy
- “Hi-Line” community



# 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)

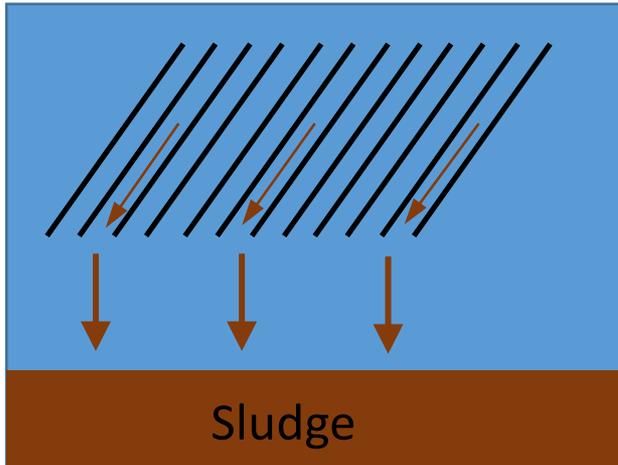




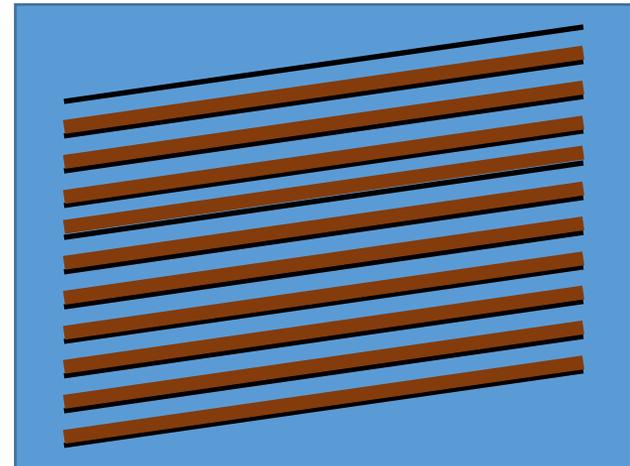
7.5-deg tubes

# Microfloc Aquarius

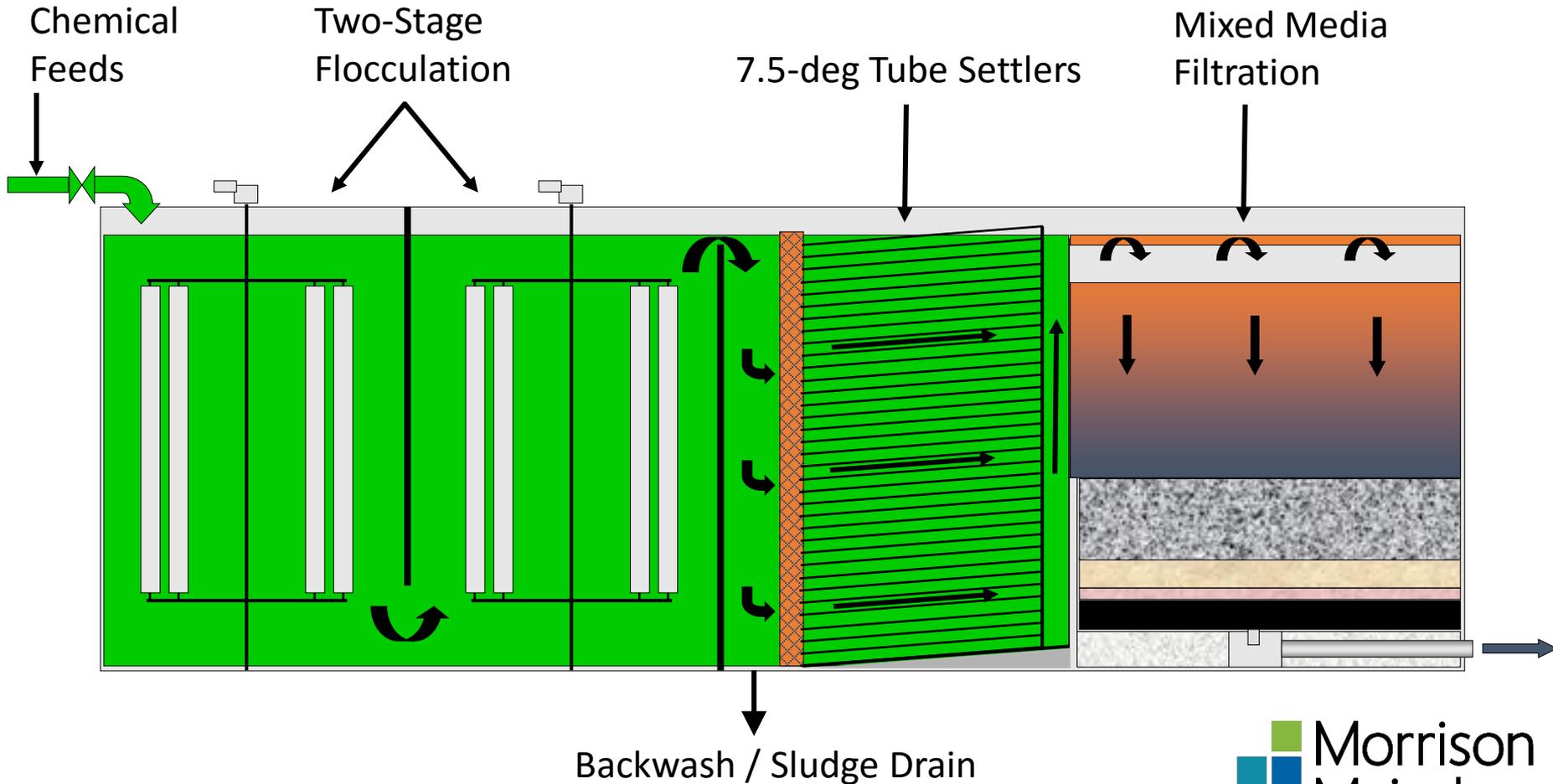
Traditional  
60-deg Tube or Plate Settlers



Microfloc  
7.5-deg Tube Settlers

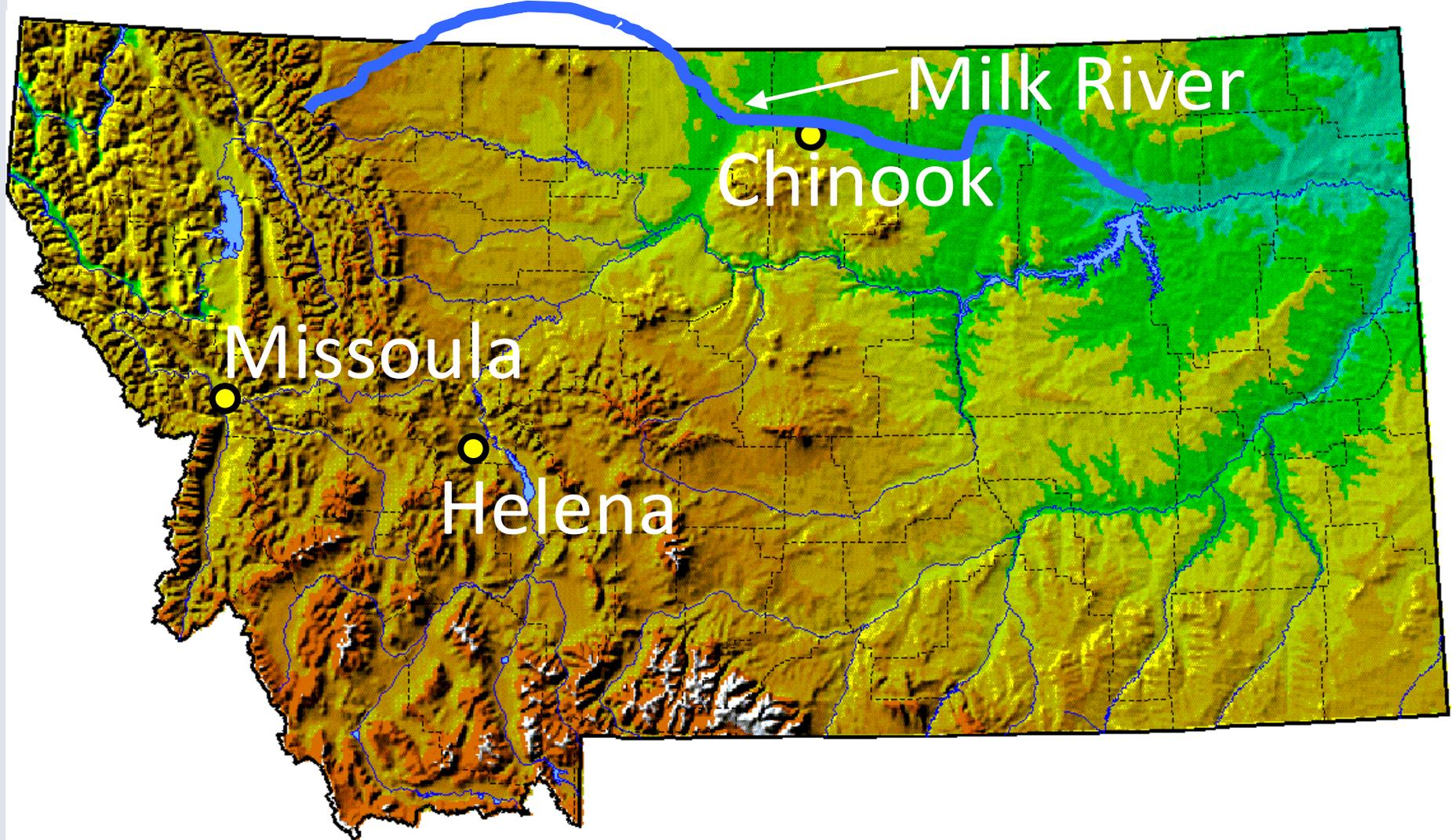


# Microfloc Aquarius



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Milk River

Chinook

Missoula

Helena

# 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

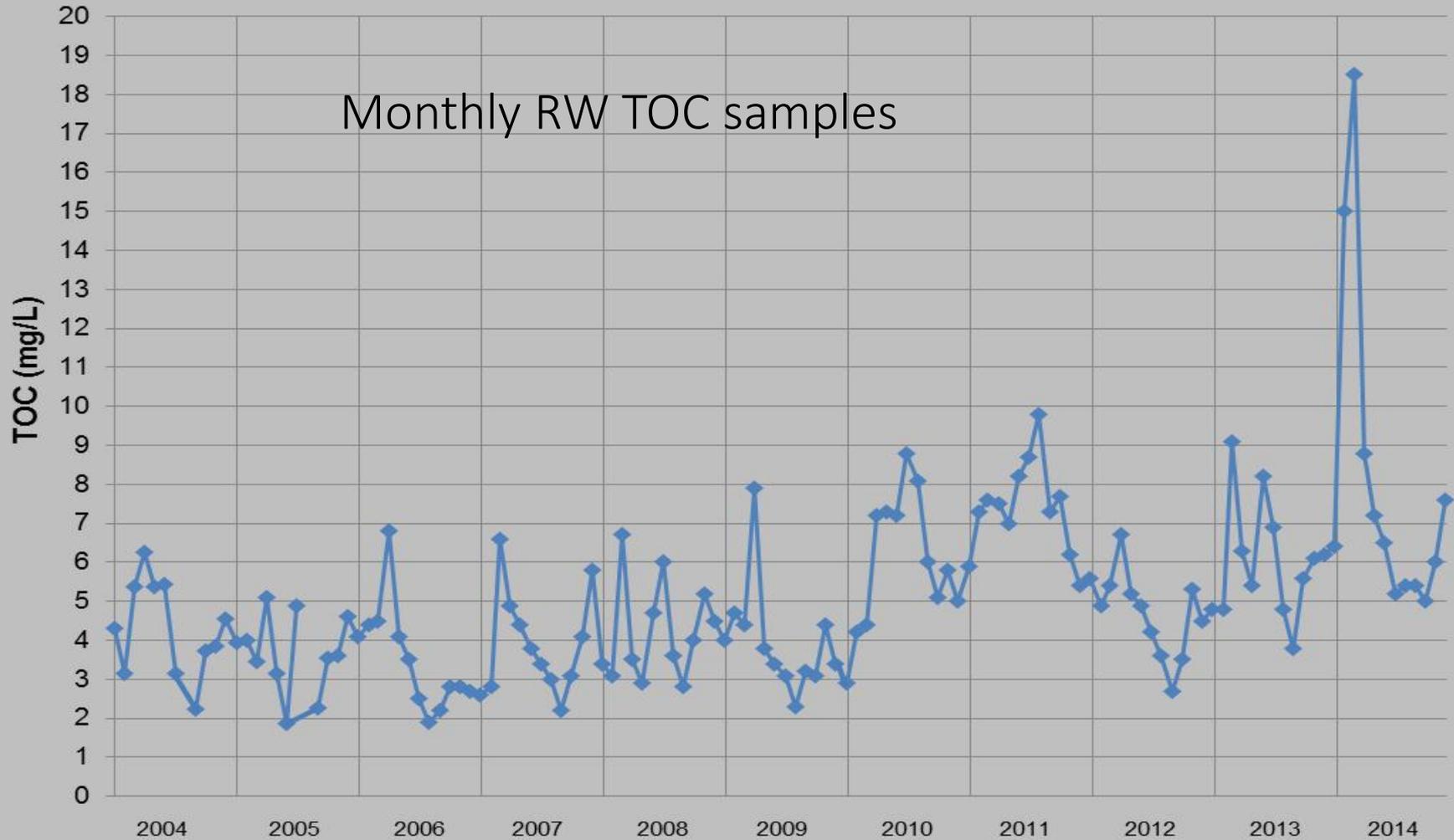
## Water quality parameters

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

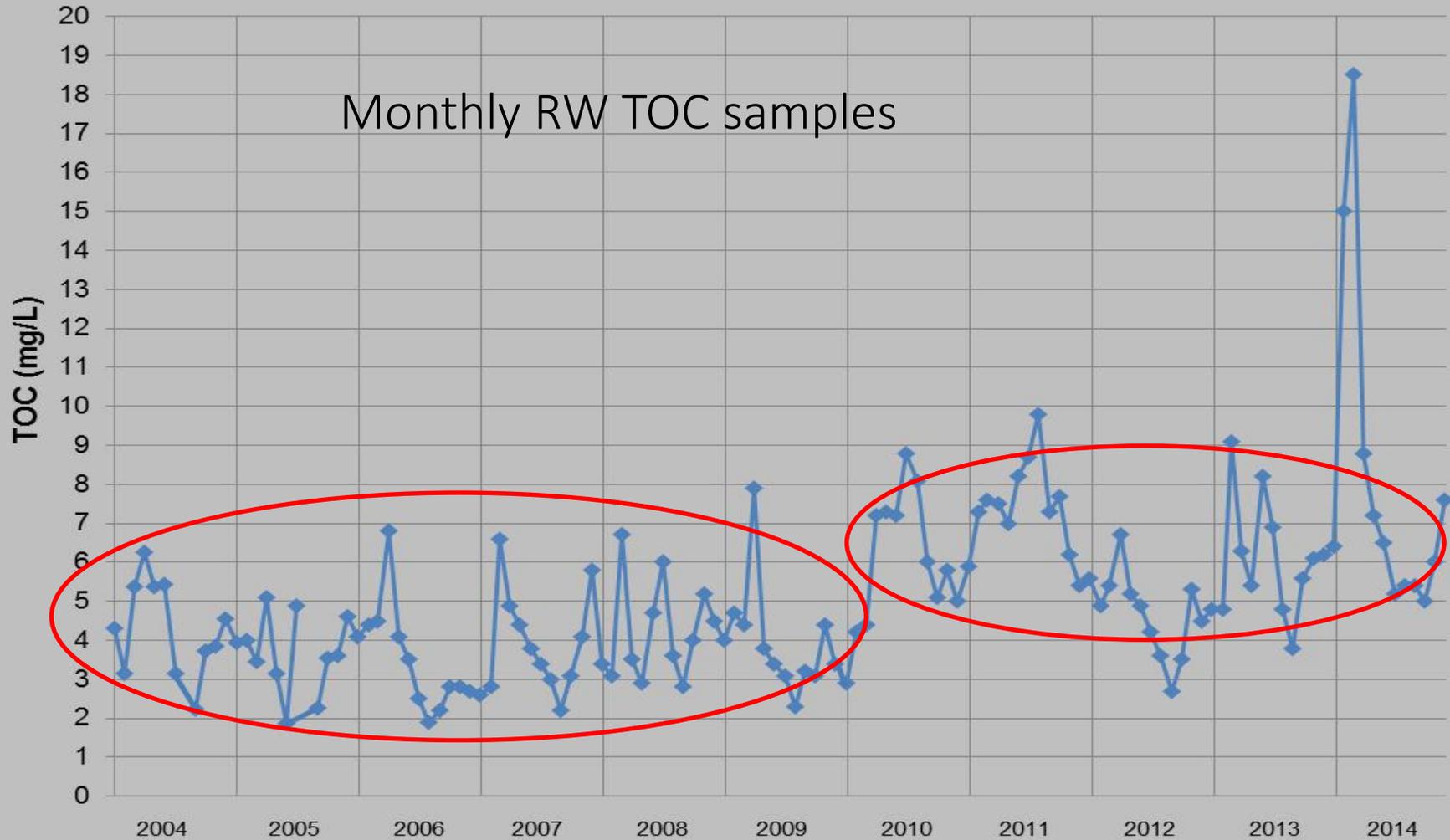
Measured as Total Organic Carbon (TOC)



# Raw Water TOC



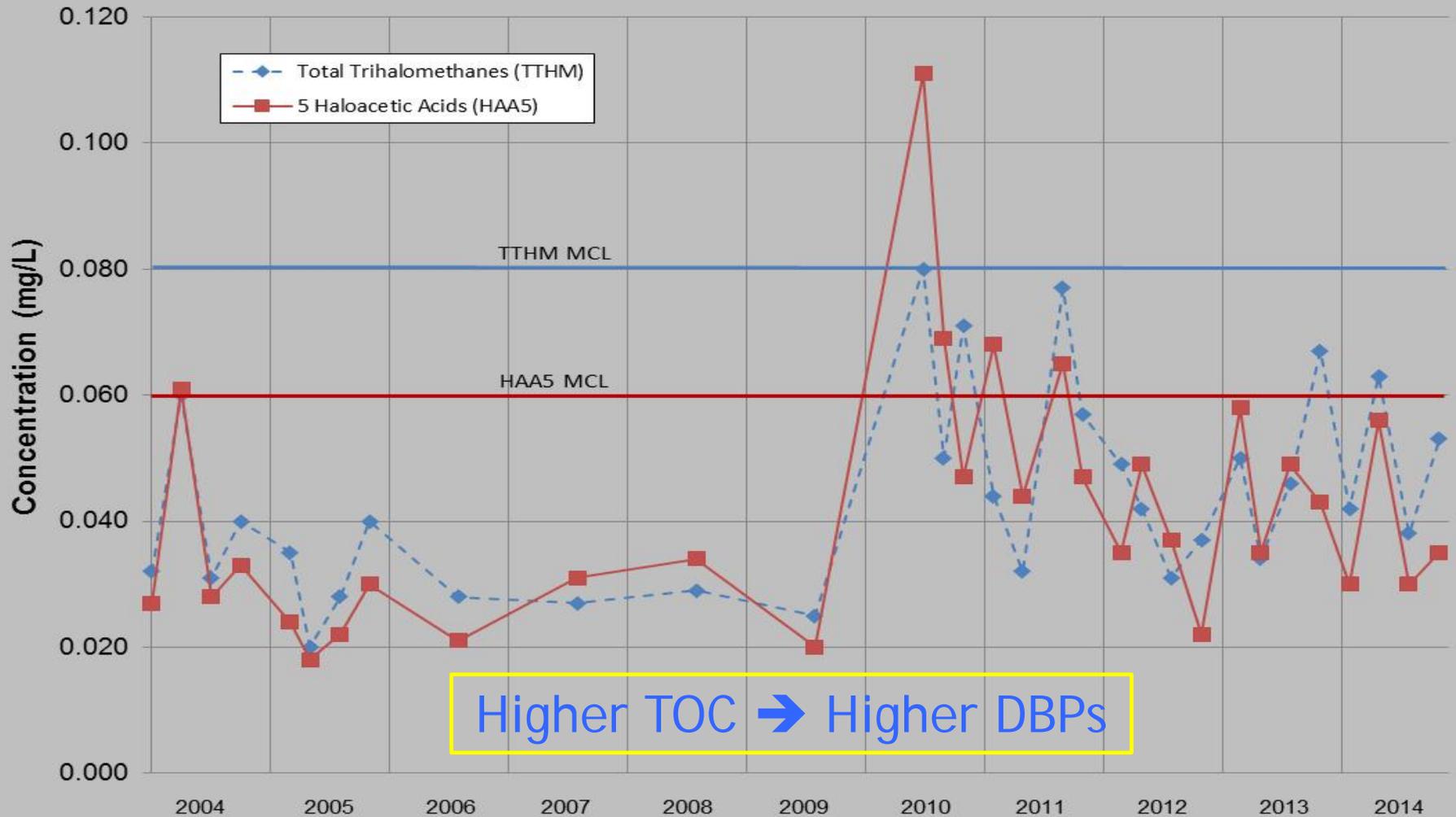
# Raw Water TOC







# Disinfection Byproducts



# Water Quality

## Challenges of Milk River

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



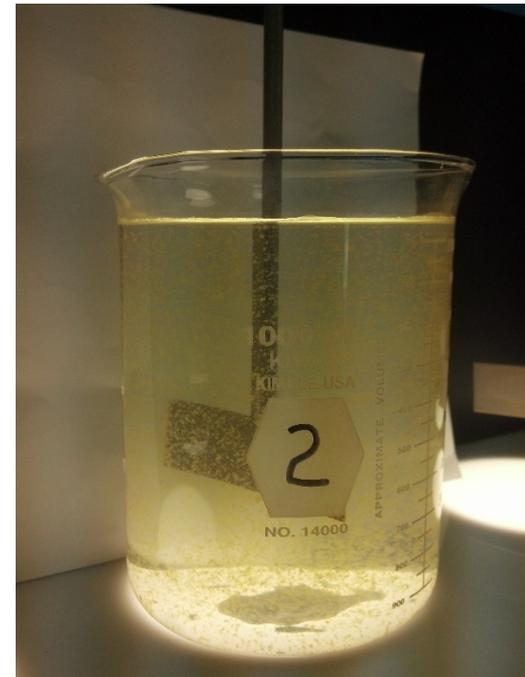
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# Jar Testing

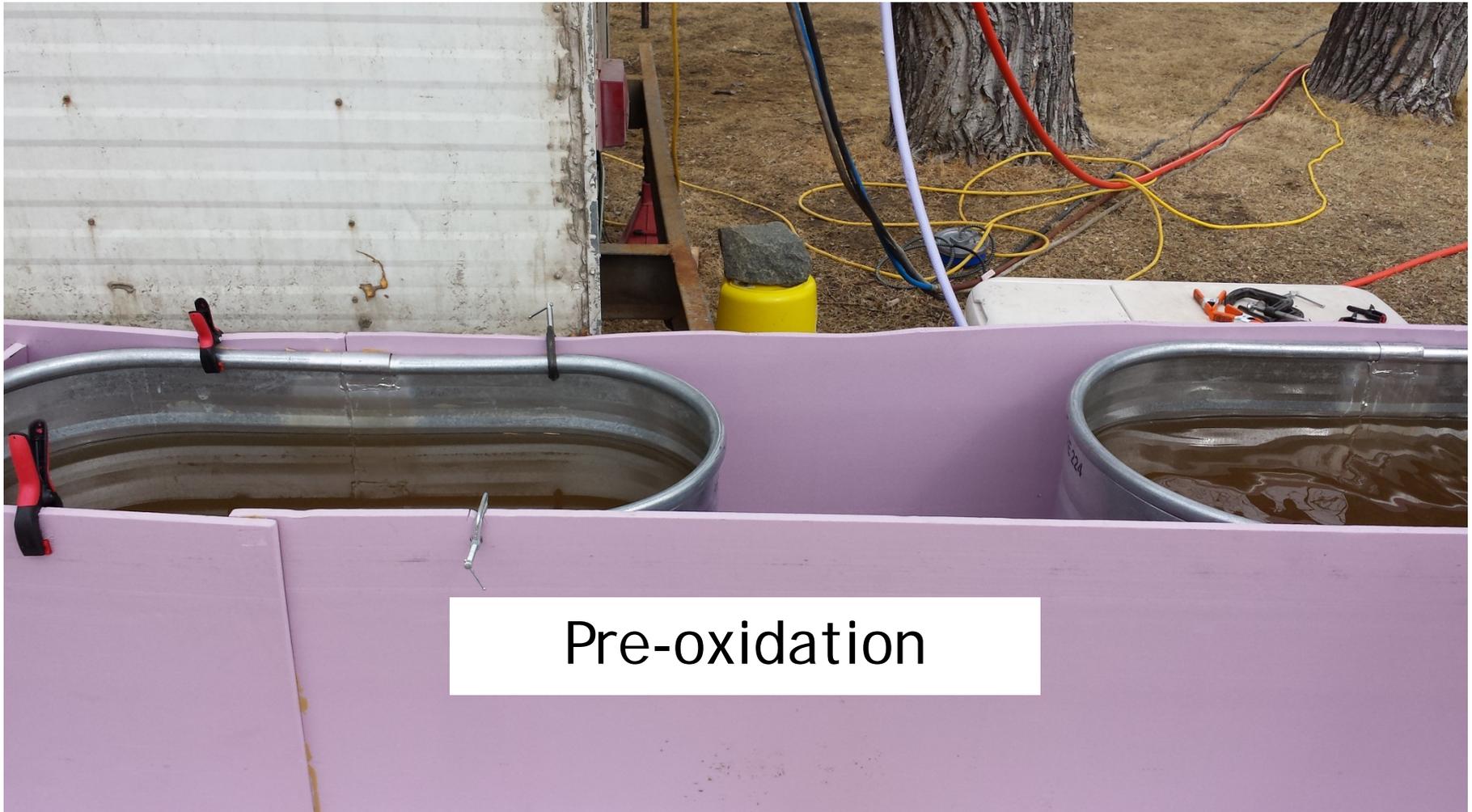
## Results

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



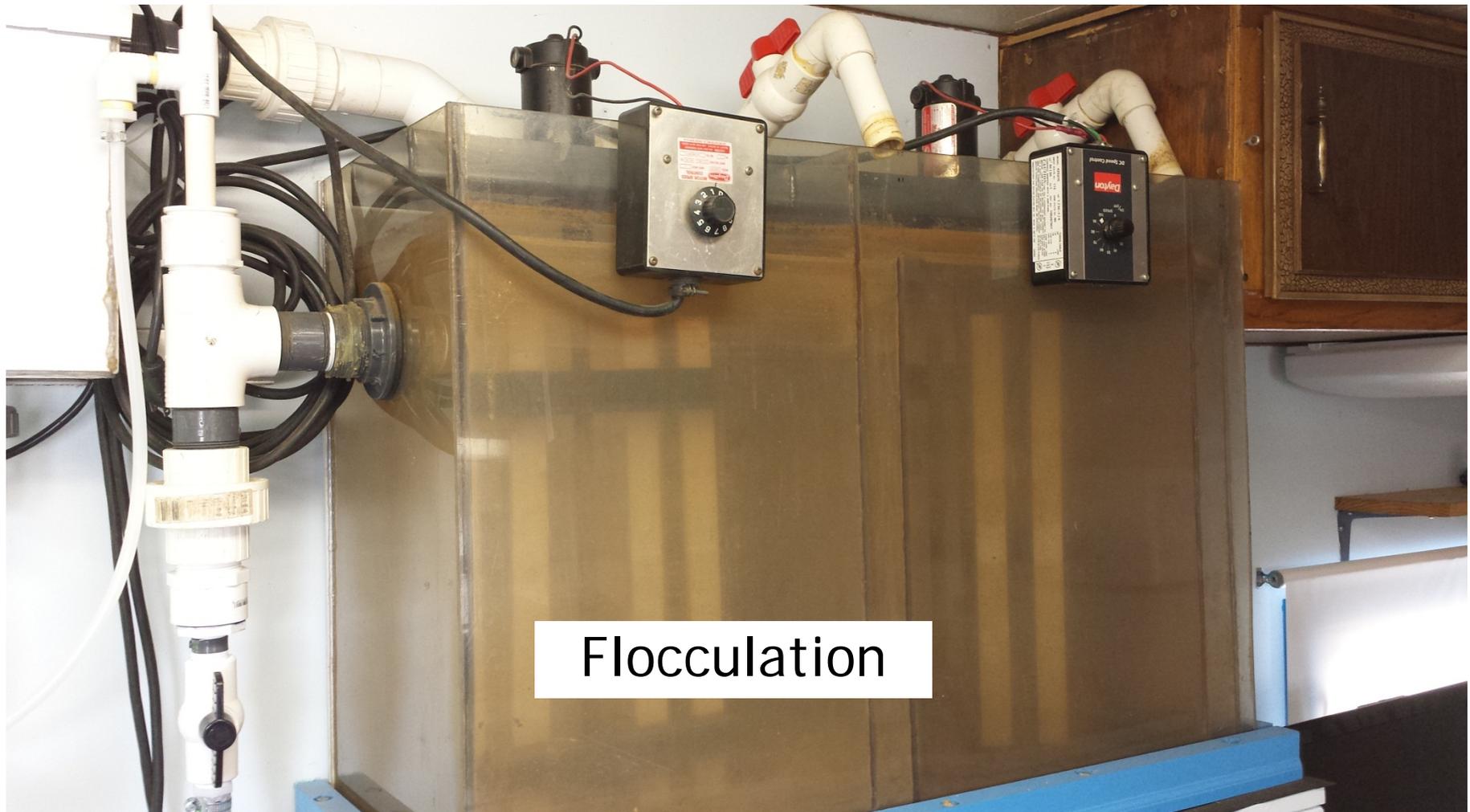
Conventional filtration

# Pilot Testing



Pre-oxidation

# Pilot Testing



# Pilot Testing



Tube Settlers

# Pilot Testing



## Filtration

- ✓ Mixed-media
  - Anthracite
  - Silica sand
  - Garnet sand
  
- ✓ 3.0 – 5.0 gpm/sf

# Pilot Testing

## Results

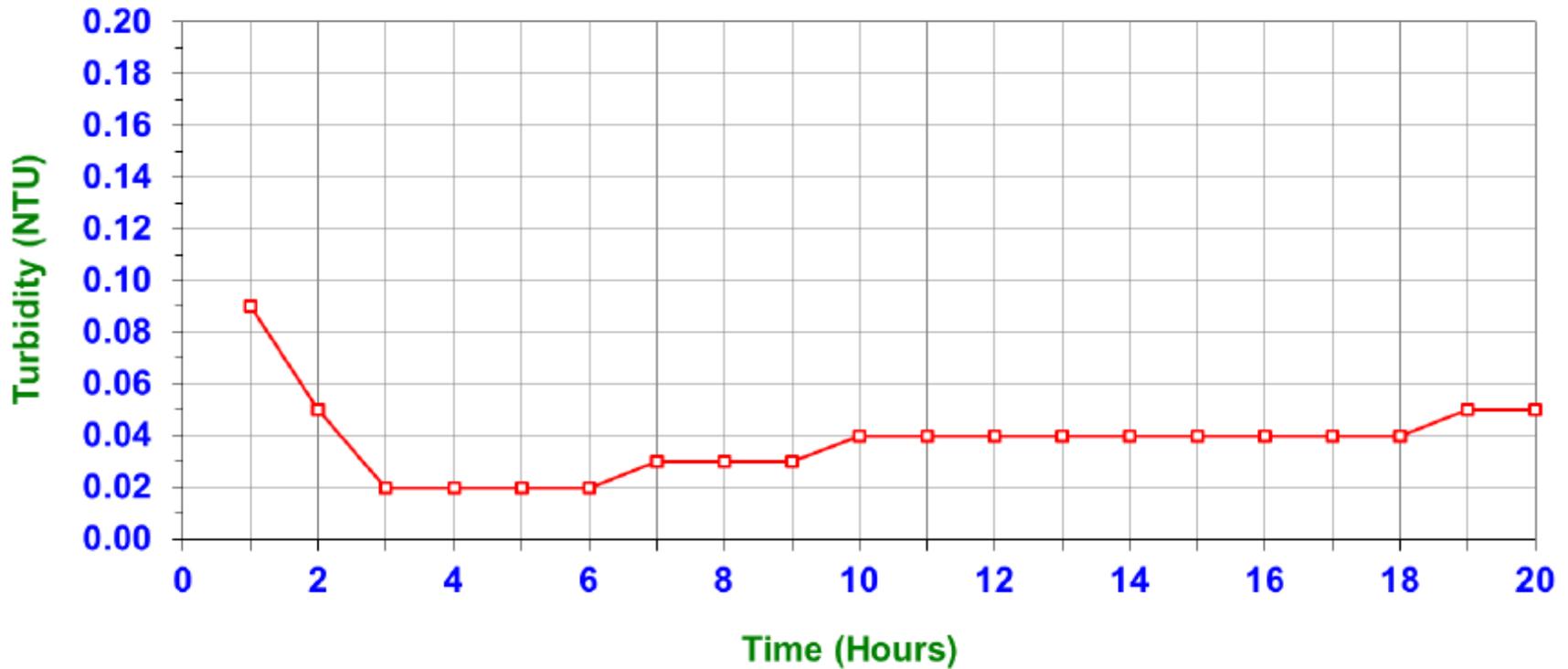
- ✓ Permanganate 1-3 mg/L
- ✓ Alum 90-120 mg/L
- ✓ Powdered Activated Carbon 5-30 mg/L
- ✓ TOC → 40-50% removal
- ✓ 20 hour filter runs



# 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





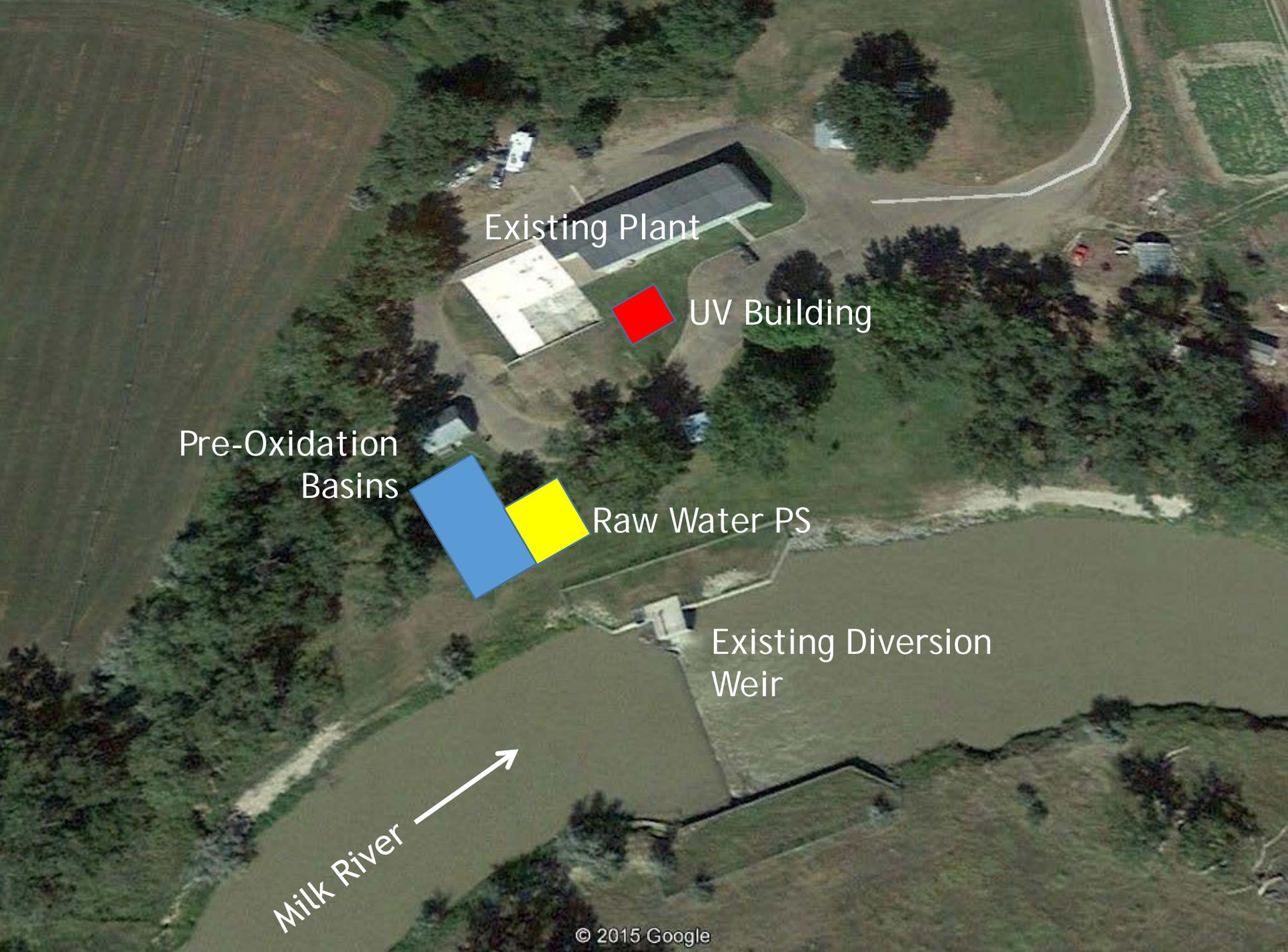
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# Challenges

- ✓ 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



# Presentation Topics

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- First Year Operation
  - ✓ Start-up April 2016

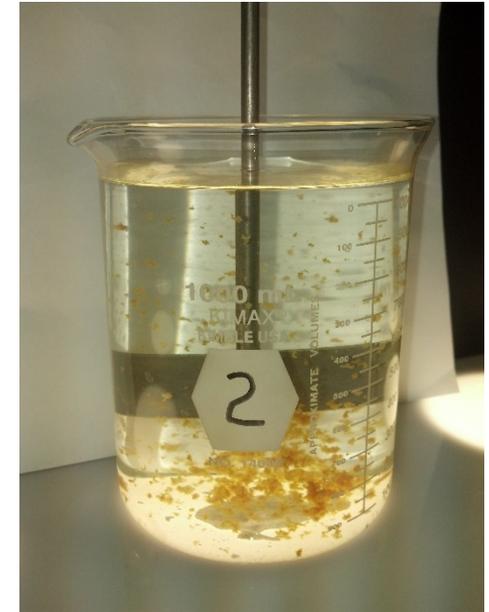
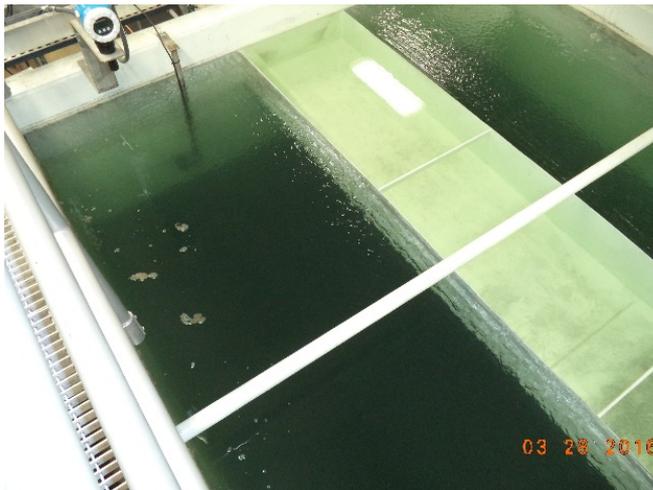
# Sodium Permanganate

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



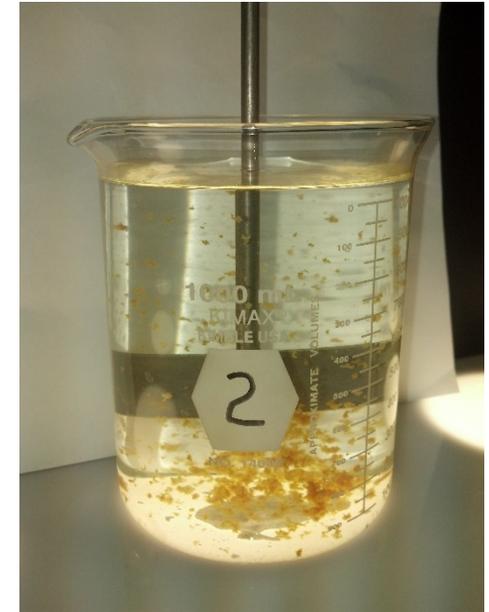
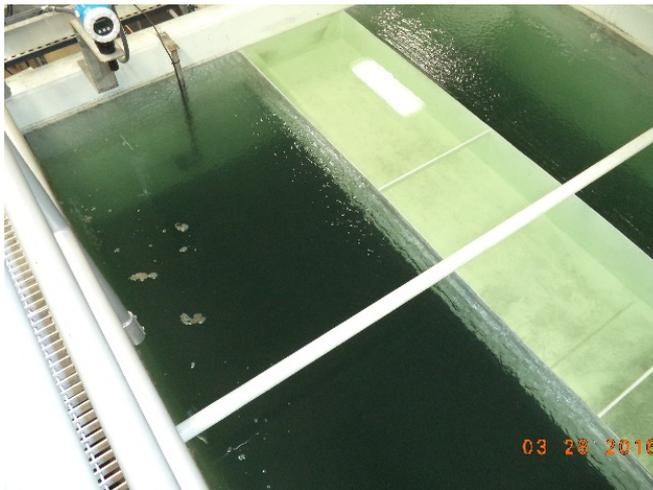
# Filter Breakthrough

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



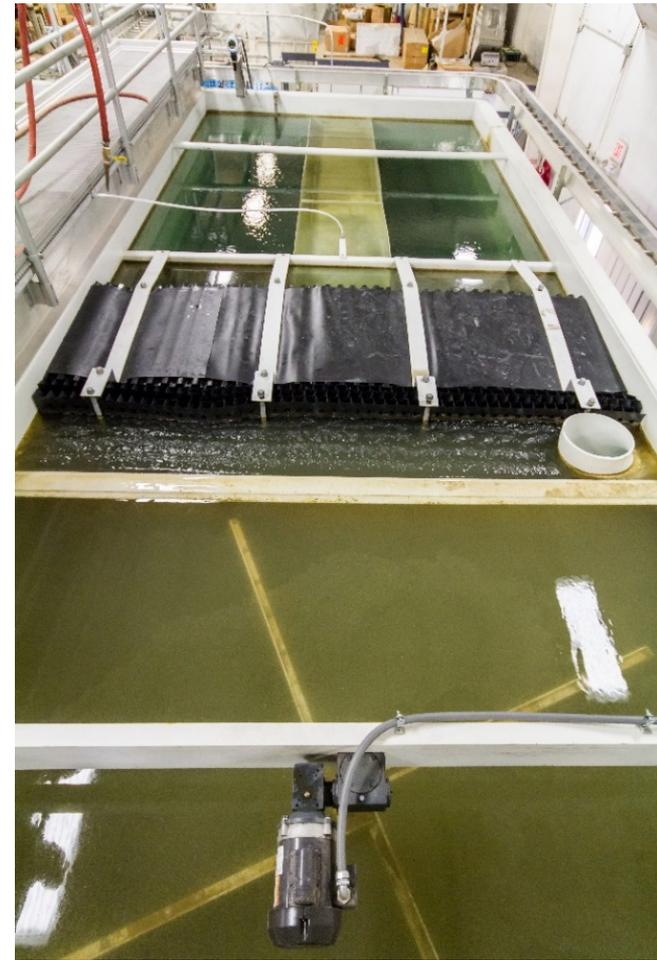
# Filter Breakthrough

- ✓ 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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Questions?



integrity

commitment

respect

excellence