



# Making the Best of What You've Got

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## Optimizing Military Water Treatment Plant Processes for *Cryptosporidium* Removal & Regulatory Compliance

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## Report Documentation Page

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# BRIEFING OUTLINE

**PURPOSE:** Explain how optimizing an Army water system can meet multiple regulatory and treatment objectives.

1. Background
2. Case study
3. Conclusions
4. Recommendations



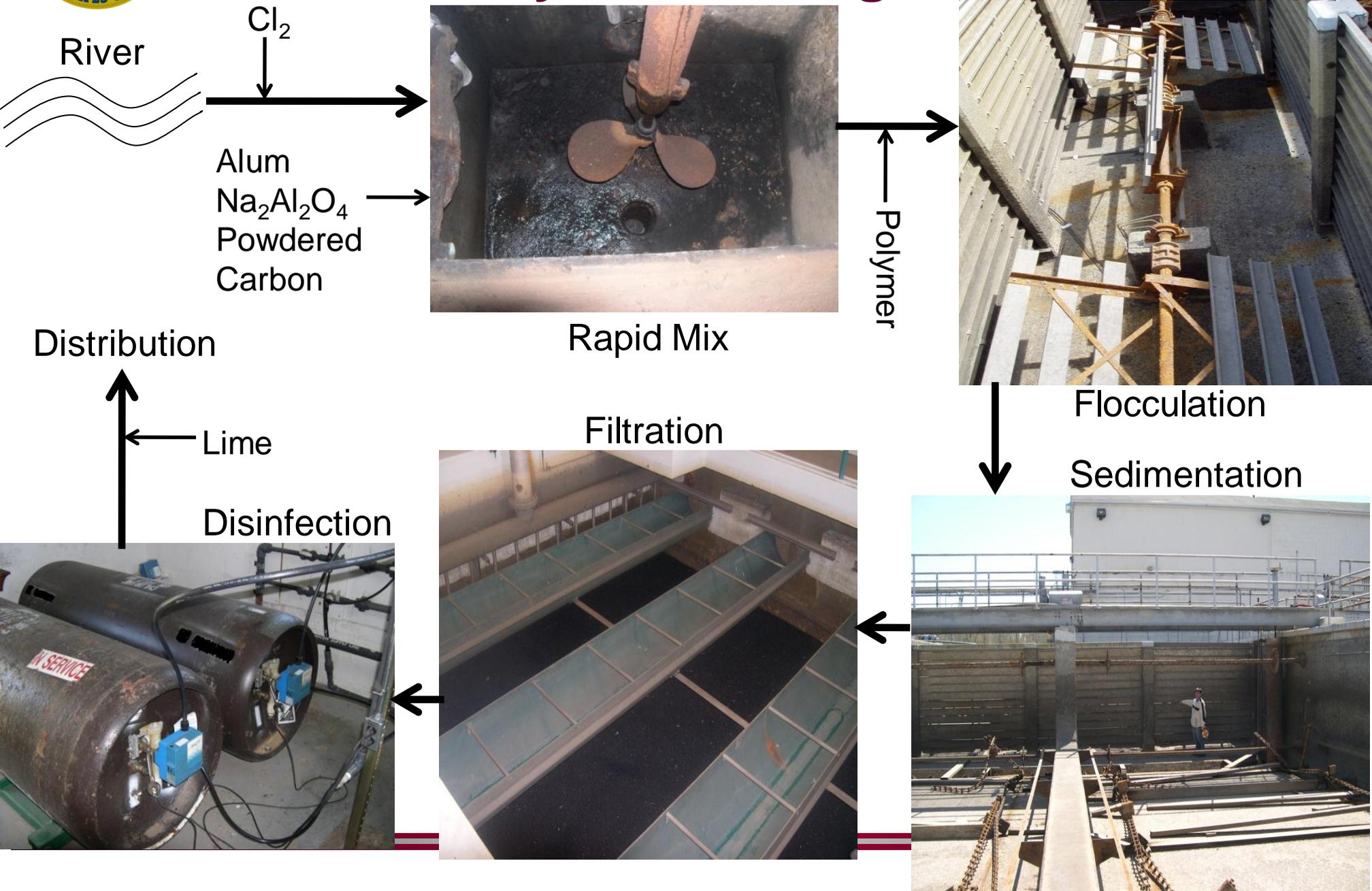
# Regulatory Background

- Long Term 2 Enhanced Surface Water Treatment Rule
  - LT2ESWTR
  - Affects relatively small number of military water systems
    - Army ~ 20 water systems\*
  - But, affects large population
    - Army ~ 0.3 million persons served
  - Purpose: Reduce acute health risks associated with microbial pathogens
    - Specifically *Cryptosporidium*

\* Includes privatized water systems



# Water System Background

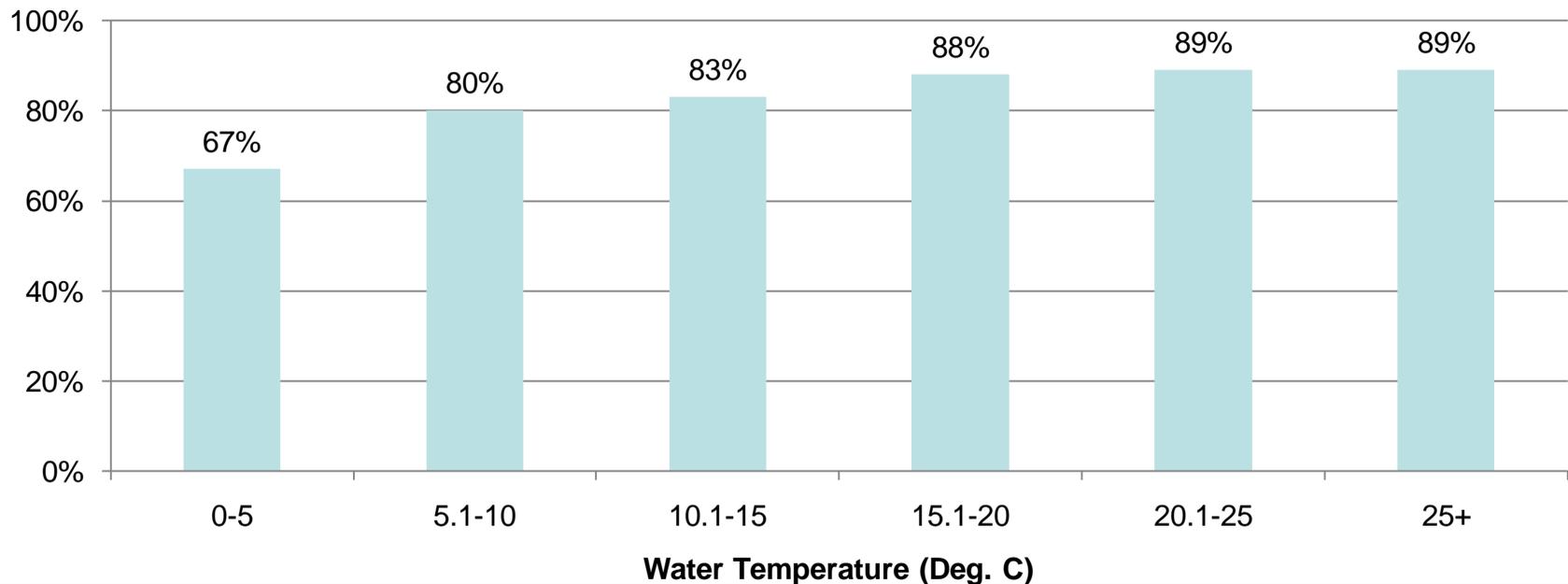




# Case Study-Challenges

- Additional treatment required for LT2ESWTR
  - Provide additional 1-log *Cryptosporidium* treatment
- Cold water treatment challenges
  - Resulting scrutiny from state regulatory agency

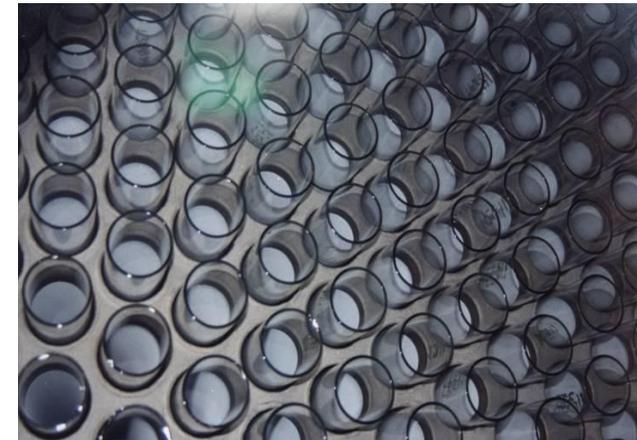
**Average Percent Turbidity Removal Through Sedimentation  
Jan 06 - Jan 10**





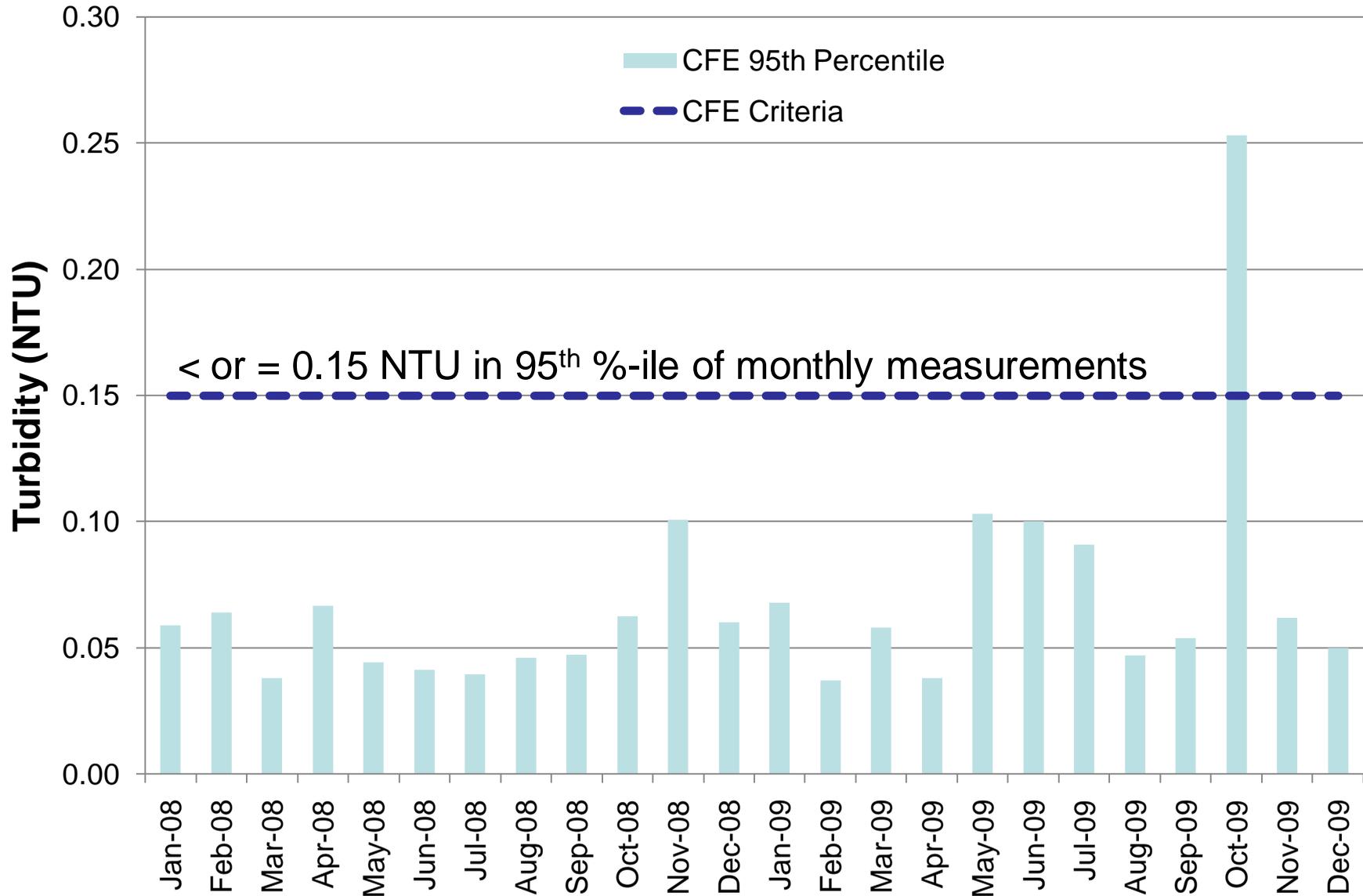
# Case Study-Goals

- Identify options to meet both challenges
  - Single
    - Advanced filtration (\$\$\$-\$\$\$\$)
    - Advanced disinfection (\$\$-\$\$\$\$)
    - Optimized filtration performance (\$-\$)
  - Multiple
    - Presedimentation + 1 more (\$\$\$-\$\$\$\$)
    - Watershed protection + 1 more (\$-\$\$\$)
- Ensure simultaneous compliance
  - Lead and Copper Rule
  - Stage 2 Disinfectants and Disinfection Byproducts Rule



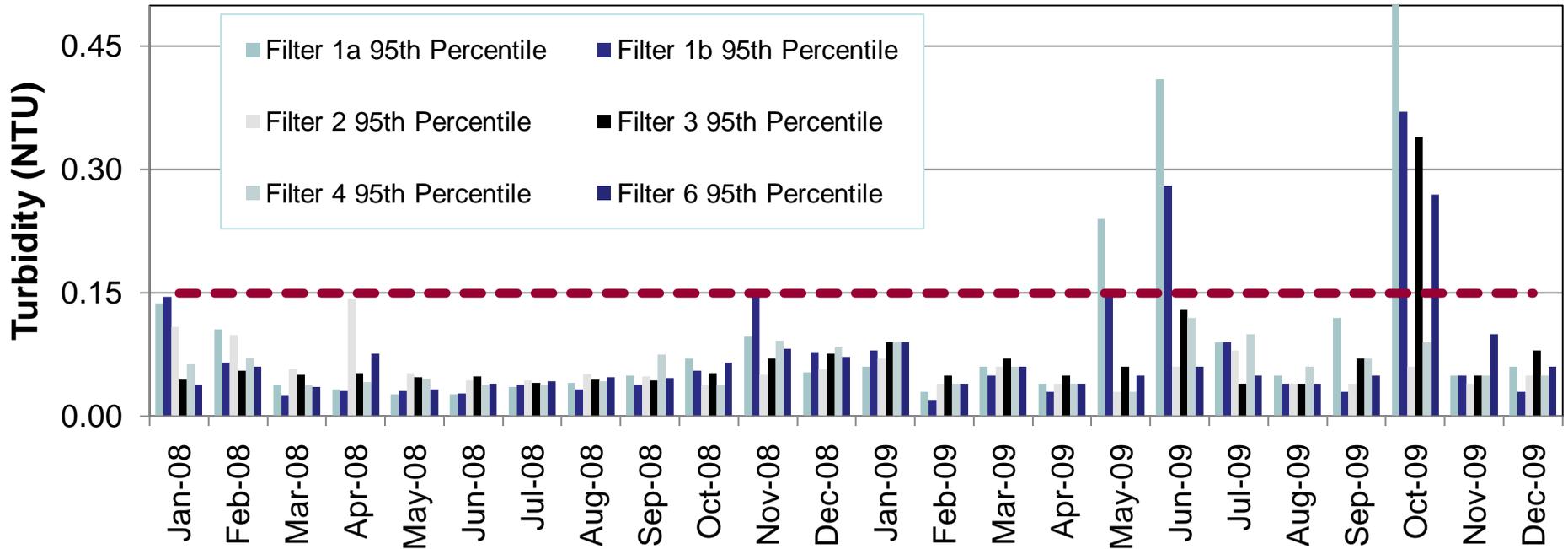


# Optimized Filtration – CFE Criteria





# Optimized Filtration – IFE Criteria

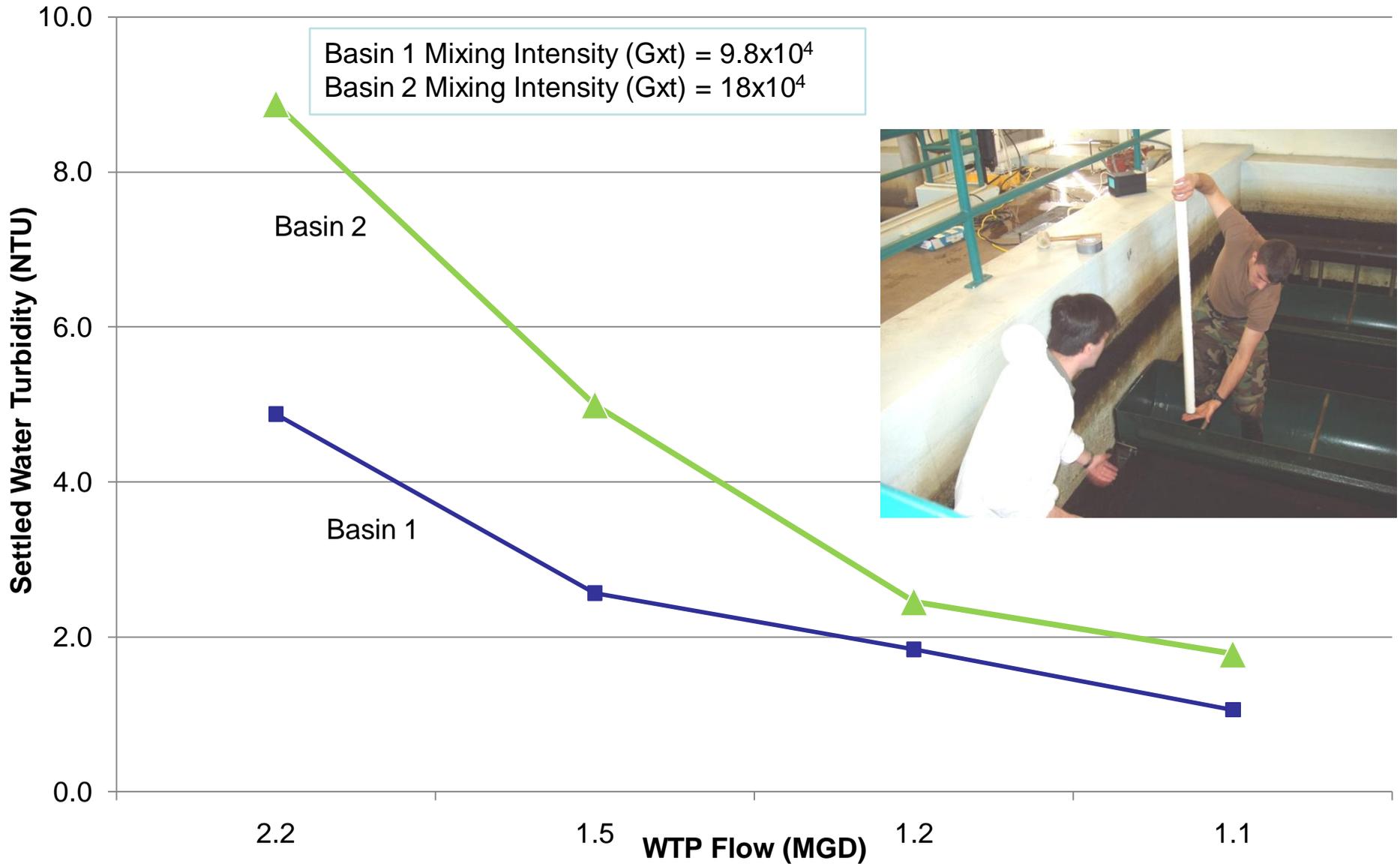


## Monthly samples > 0.3 NTU in two consecutive measurements

Jan 08	Jul 08	Jan 09	Jul 09
Feb 08	Aug 08	Feb 09	Aug 09
Mar 08	Sep 08	Mar 09	Sep 09
Apr 08	Oct 08	Apr 09	Oct 09
May 08	Nov 08	May 09	Nov 09
Jun 08	Dec 08	Jun 09	Dec 09



# Optimized Performance - Flocculation





# Optimized Performance - Coagulation

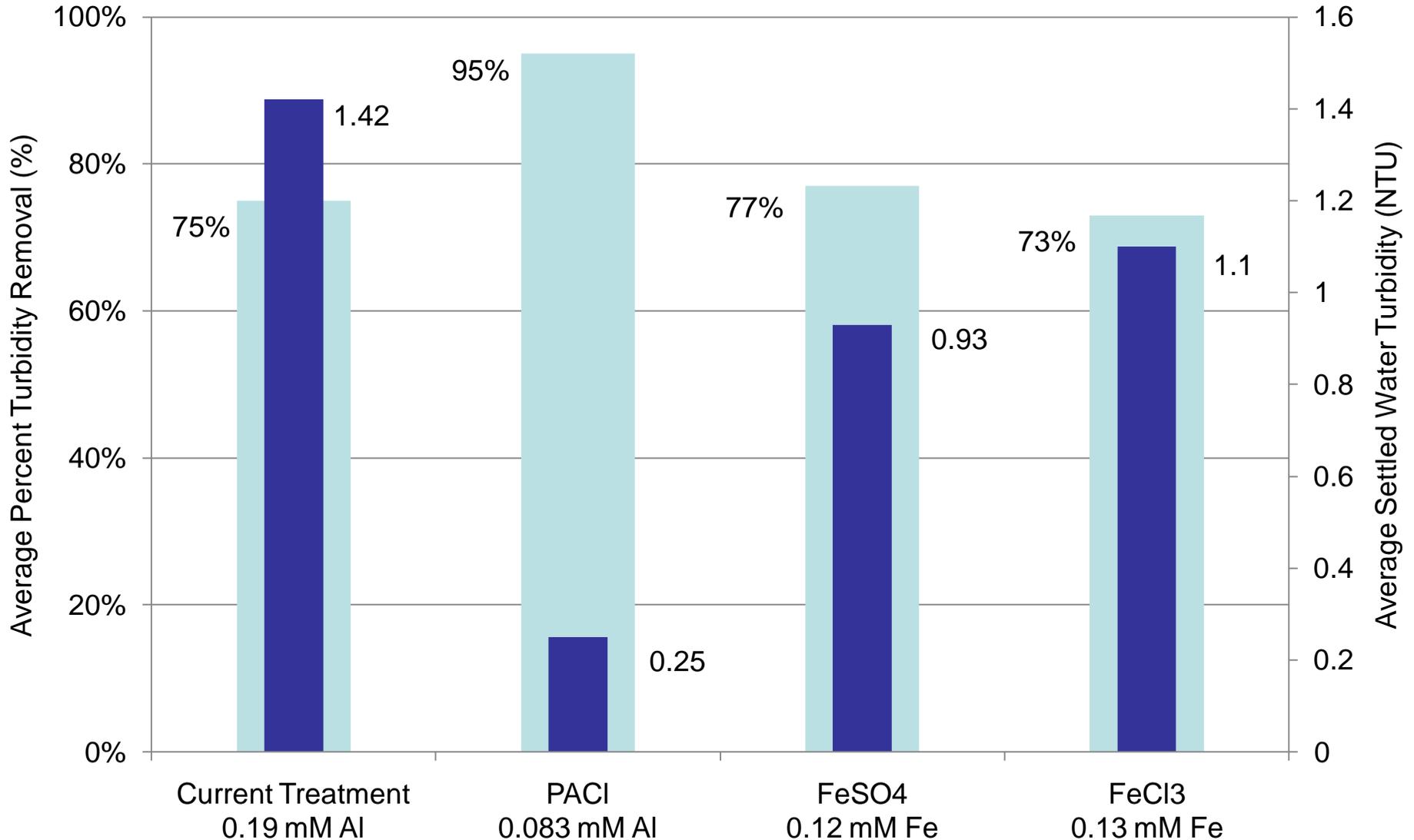
- Evaluate alternative coagulants
  - Polyaluminum Chloride (PACl)
  - Ferric Sulfate ( $\text{FeSO}_4$ )
  - Ferric Chloride ( $\text{FeCl}_3$ )
- Benefits
  - Cold water effective
  - Regional experience
  - Reduced chemical usage





# Alternative Coagulant Performance

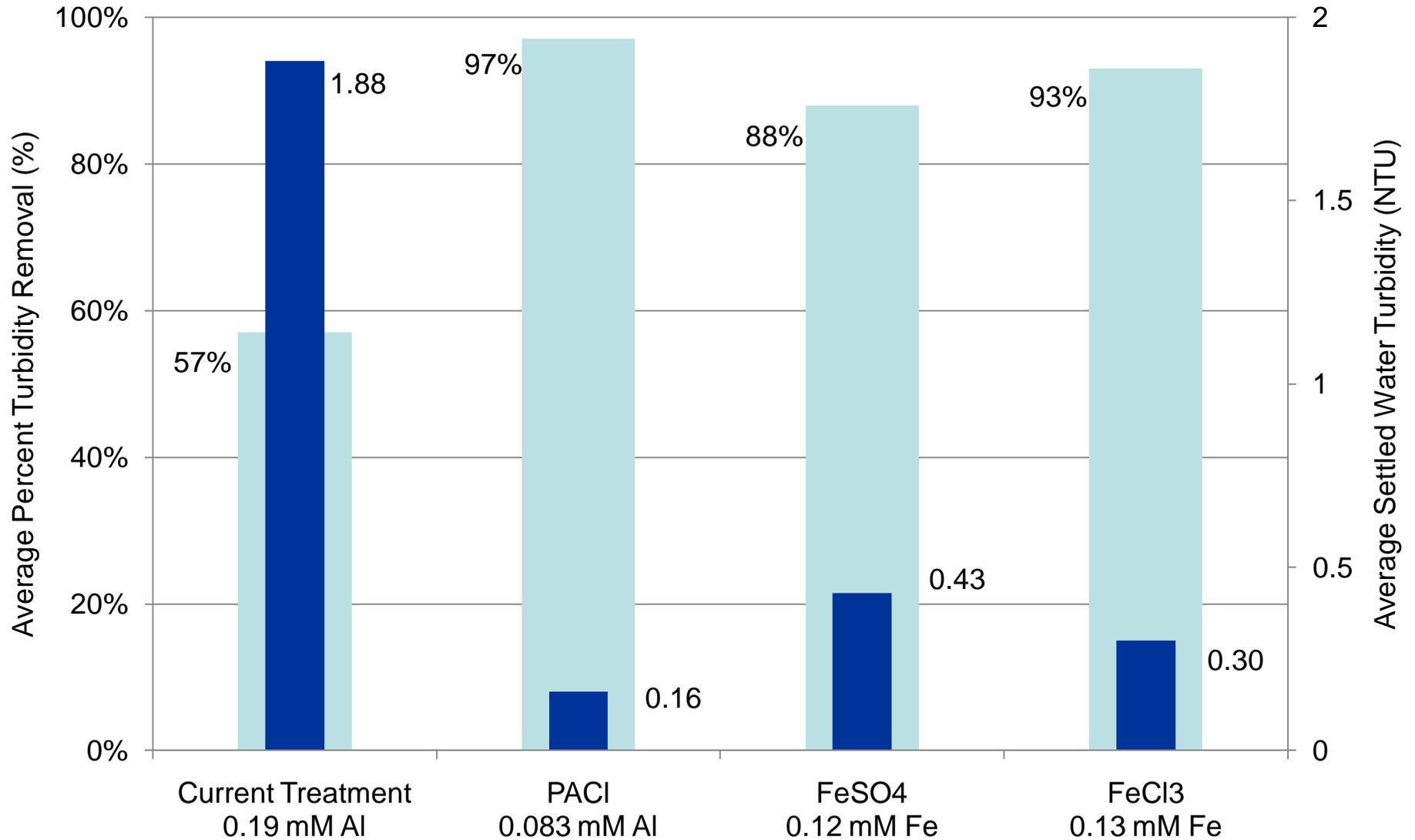
## Cold Water Turbidity Removal Performance (1-13 °C)





# Alternative Coagulant Performance

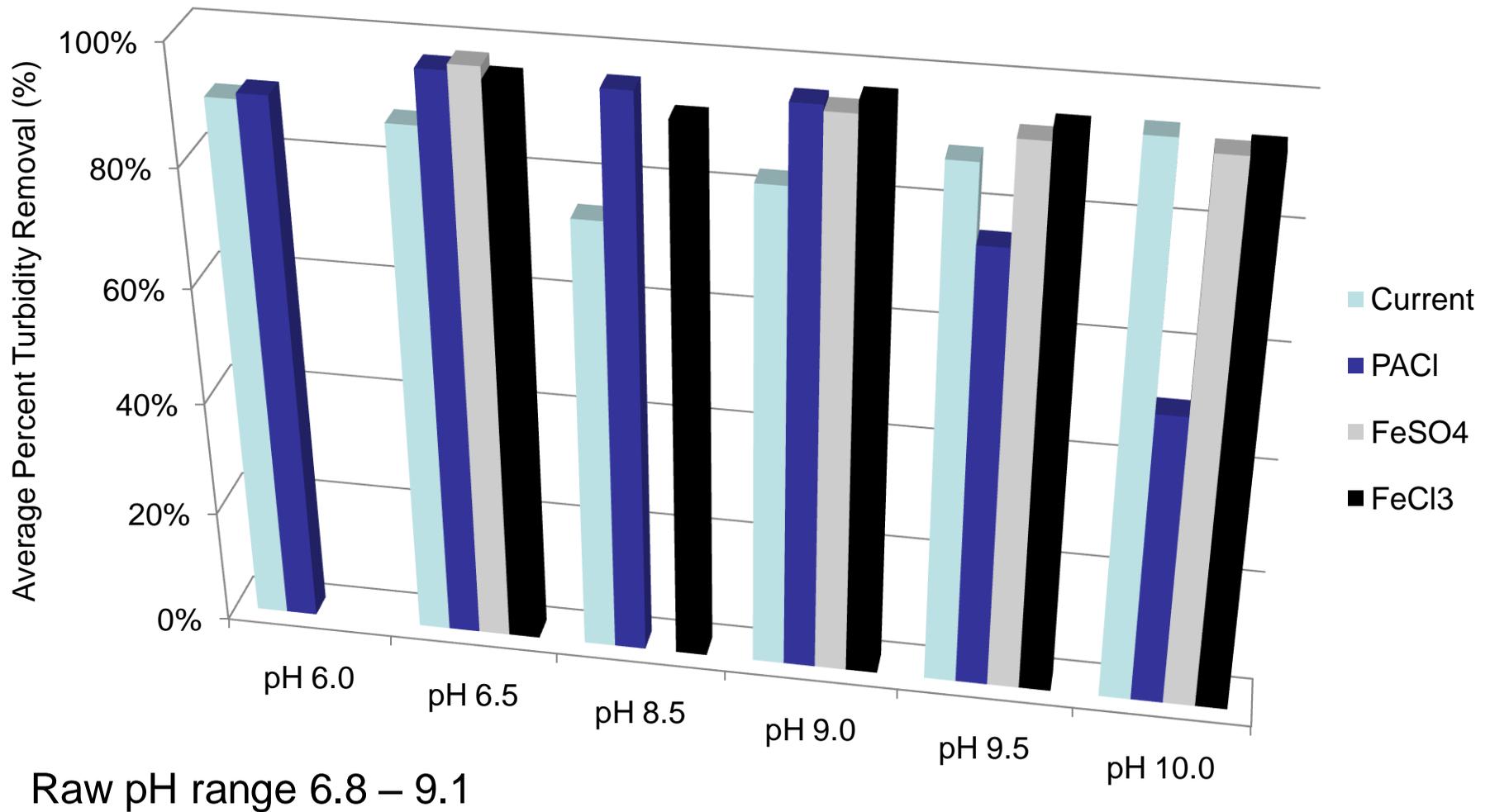
## Seasonal Turbidity Removal Performance





# Alternative Coagulant Performance

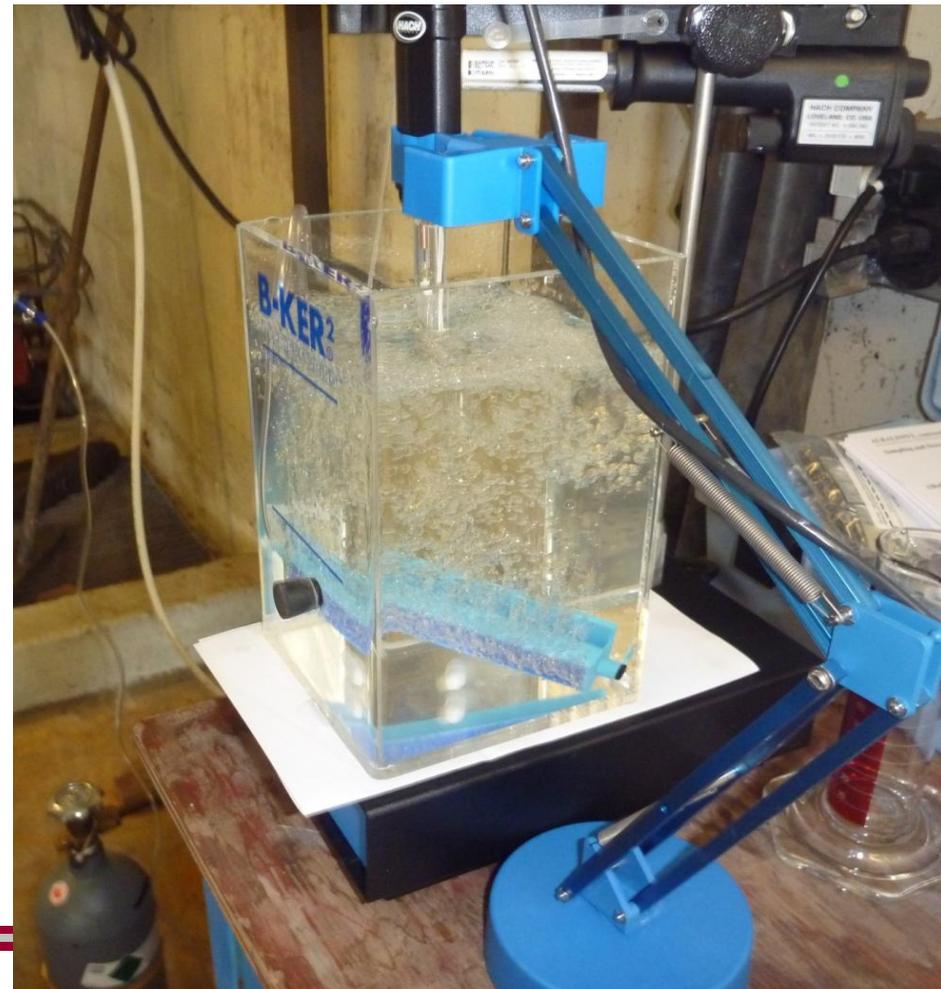
## Low and High pH Range Turbidity Removal Performance





# Simultaneous Compliance

- Stage 2 Disinfectants & Disinfection Byproducts Rule
  - PACl could increase disinfection byproduct formation
    - Removes less organic matter
  - May require acid addition
    - Carbon dioxide
- Lead and Copper Rule
  - May increase corrosion
    - Orthophosphate addition





# Costs-Annual Chemical Usage

	Current Treatment	PACI	FeCl <sub>3</sub>	FeSO <sub>4</sub>
Coagulant (\$/yr)	\$70,000	\$50,000	\$40,000	\$70,000
Post-Lime feed (\$/yr)	\$13,000	\$6,000	\$12,000	\$9,000
CO <sub>2</sub> addition (\$/yr)	-	\$9,000	-	-
PO <sub>4</sub> addition (\$/yr)	-	\$6,000	\$6,000	\$6,000
<b>TOTAL</b>	<b>\$83,000</b>	<b>\$71,000</b>	<b>\$58,000</b>	<b>\$85,000</b>
Sludge production (Tons/yr)	26	17	34	42



# Conclusions

- LT2ESWTR compliance and cold water treatment?
  - Optimizing flocculation not enough
  - Switching to PACl will work
    - CO<sub>2</sub> addition necessary at pH > 9.0
  - Iron coagulants not much better in cold water
- Simultaneous compliance
  - PACl: CO<sub>2</sub> addition to improve organics removal
  - Alternative coagulants: orthophosphate addition for corrosion control



# Recommendations

- Conduct full-scale trial of PACI
- Improve overall treatment
  - Flocculation
    - Install variable frequency drives
    - Increase size of baffle wall openings
  - Adjust filter operations
  - Install online raw water monitoring equipment



# Questions?

