

Evaluating Manganese Treatment to Reduce Customer Complaints

**PNWS-AWWA
Annual Conference
May 6, 2016**

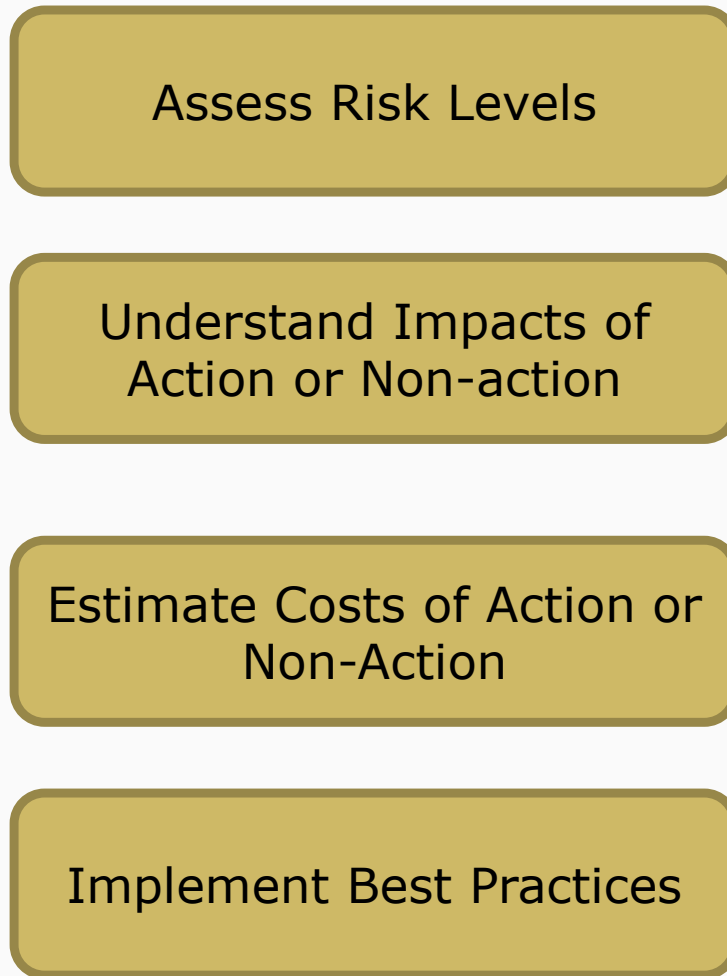


**Stephen Booth, Ph.D.
Melinda Friedman, PE**

**Confluence Engineering Group, LLC
206.527.6832
www.confluence-engineering.com**



Legacy Mn Utility Self-Assessment



Legacy Mn Risk Assessment Factors

Evidence Mn is/has entered distribution system

Evidence Mn is/has accumulated in distribution system

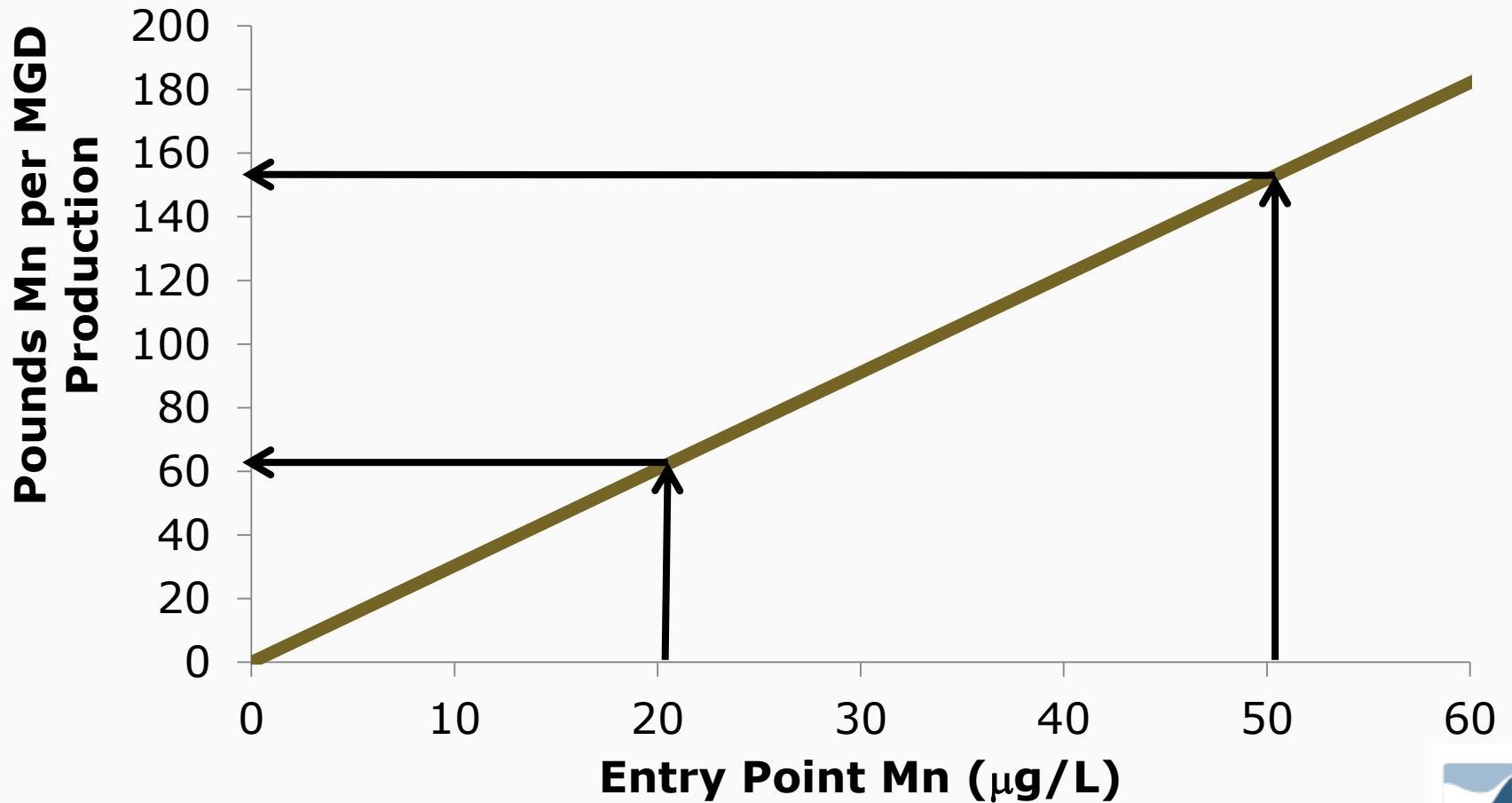
Legacy Mn Risk

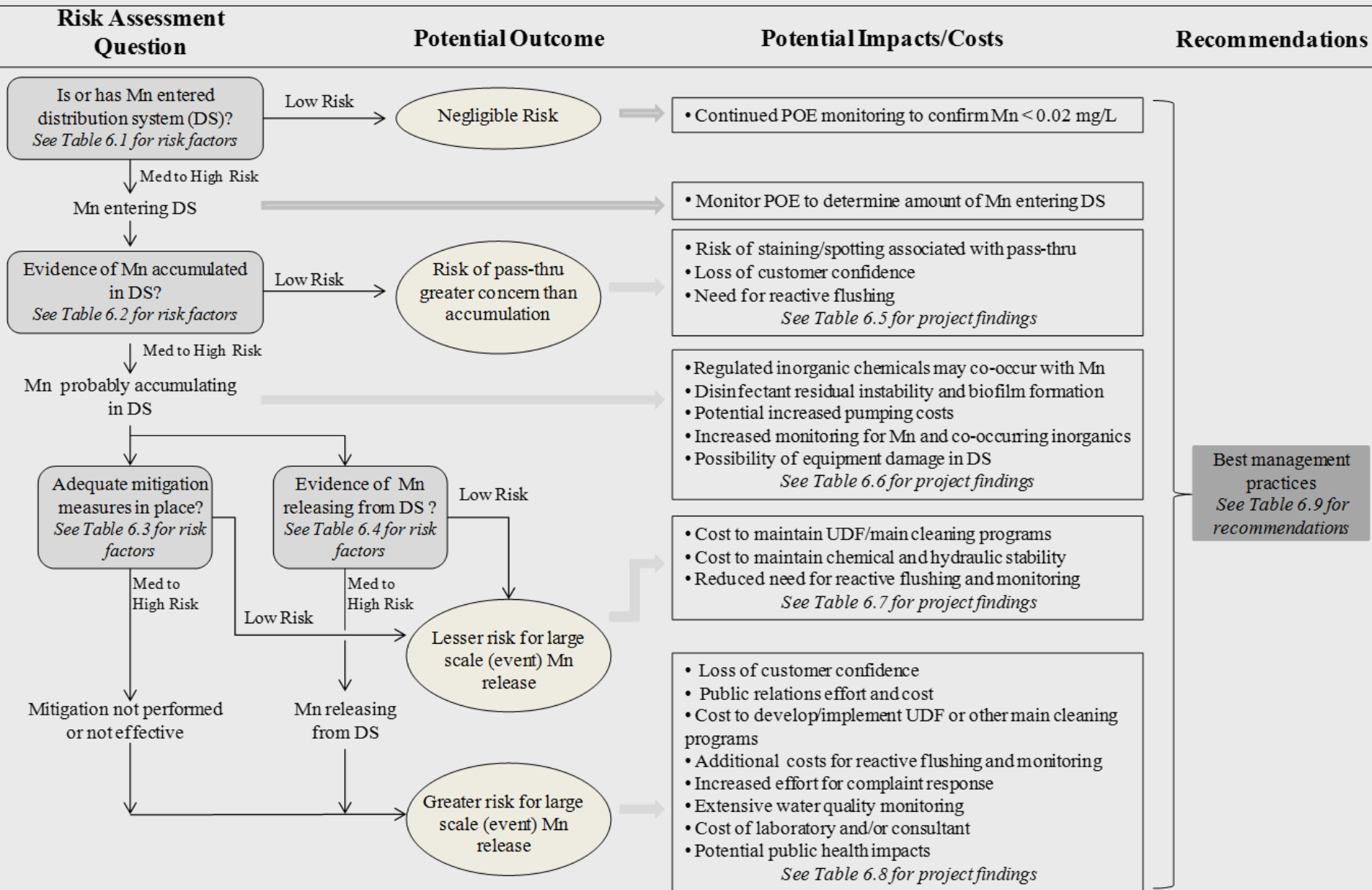
Adequacy of mitigation measures, current and past

Evidence Mn is/has released from distribution system



Conceptual Manganese Loading

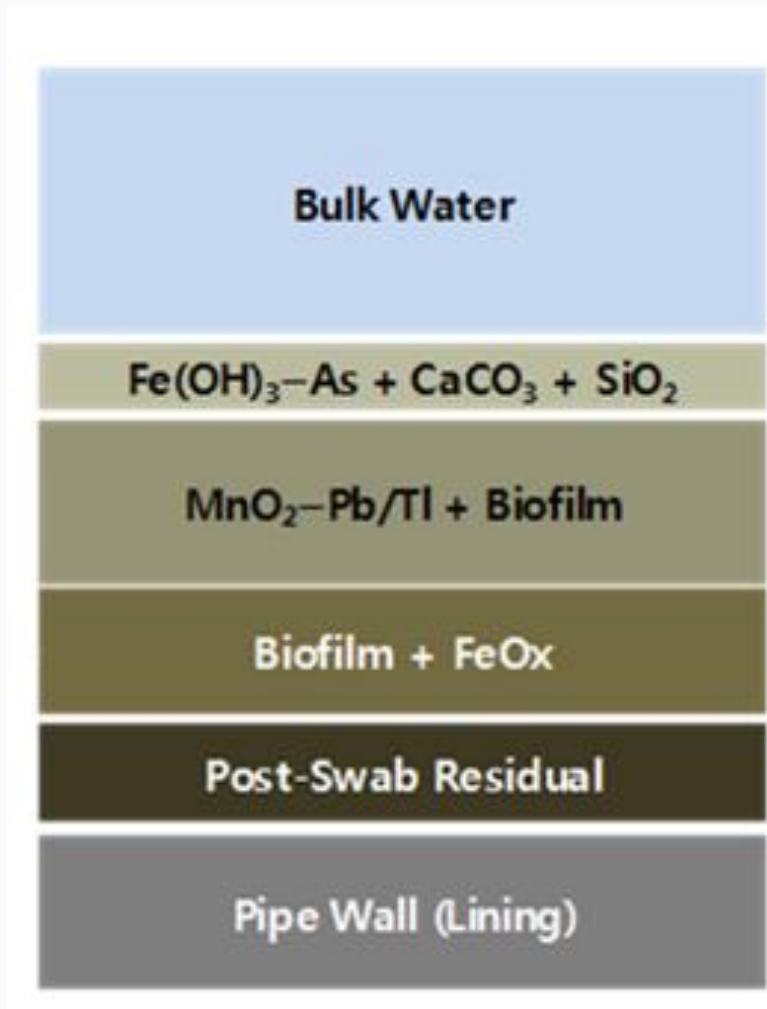




Risk Assessment Example – Mn Entering DS

Consideration	Risk Level		
	High	Medium	Low
Point-of-entry Mn concentration	<ul style="list-style-type: none"> Typically >0.05 	<ul style="list-style-type: none"> Typically 0.02 to 0.05 	<ul style="list-style-type: none"> Typically < 0.02
Source water Mn variability	<ul style="list-style-type: none"> Highly variable > 0.05 	<ul style="list-style-type: none"> Somewhat variable 	<ul style="list-style-type: none"> Consistently ≤0.01
Mn treatment practice	<ul style="list-style-type: none"> Source water Mn >0.05 and sequestration used High water age No Mn removal 	<ul style="list-style-type: none"> Source water Mn level ≤0.05 and sequestration successful 	<ul style="list-style-type: none"> No specific Mn treatment process used due to low Mn
Mn treatment performance	<ul style="list-style-type: none"> Treatment process difficult to optimize Inadequate process monitoring 	<ul style="list-style-type: none"> Treatment process is moderately stable 	<ul style="list-style-type: none"> Treatment readily achieves Mn target of <0.01

Conceptual Deposit Profile



Loose surficial particles

→ UDF

Deeper cohesive films

→ Ice Pigging or Swabbing



Address Legacy Deposits and Contaminants

- **Be proactive and “preventative”**
- **Physical Release Control: Remove “loose” deposits**
- **Chemical Release Control: Stabilize adherent deposits**
- **Remove adherent deposits if metals risk is high**



Mitigation of Stubborn Legacy Deposits

- Pipes include cement-lined, AC, and plastic
- Thin, slimy films with cohesive “sludge”
 - Legacy Fe/Mn precipitates
 - Co-precipitated trace metals
 - Biofilm



Source: Park City Municipal Corporation



Unidirectional Flushing



Grab samples for AST
Peak TSS = 10 mg/L

Foam Swabbing/Cubing



**Grab samples for AST
Peak TSS = 1,000 mg/L**

Source: Friedman, Hill, McNeill et al., WaterRF 4509, in publication (2015)

Ice Pigging

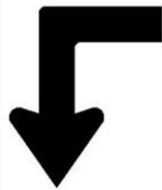


Grab samples for AST
Peak TSS = 900 mg/L

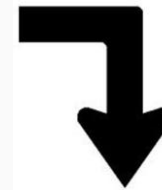
Source: Friedman, Hill, McNeill et al., WaterRF 4509, in publication (2015)

Pre- and Post-Cleaning Pipe Conditions

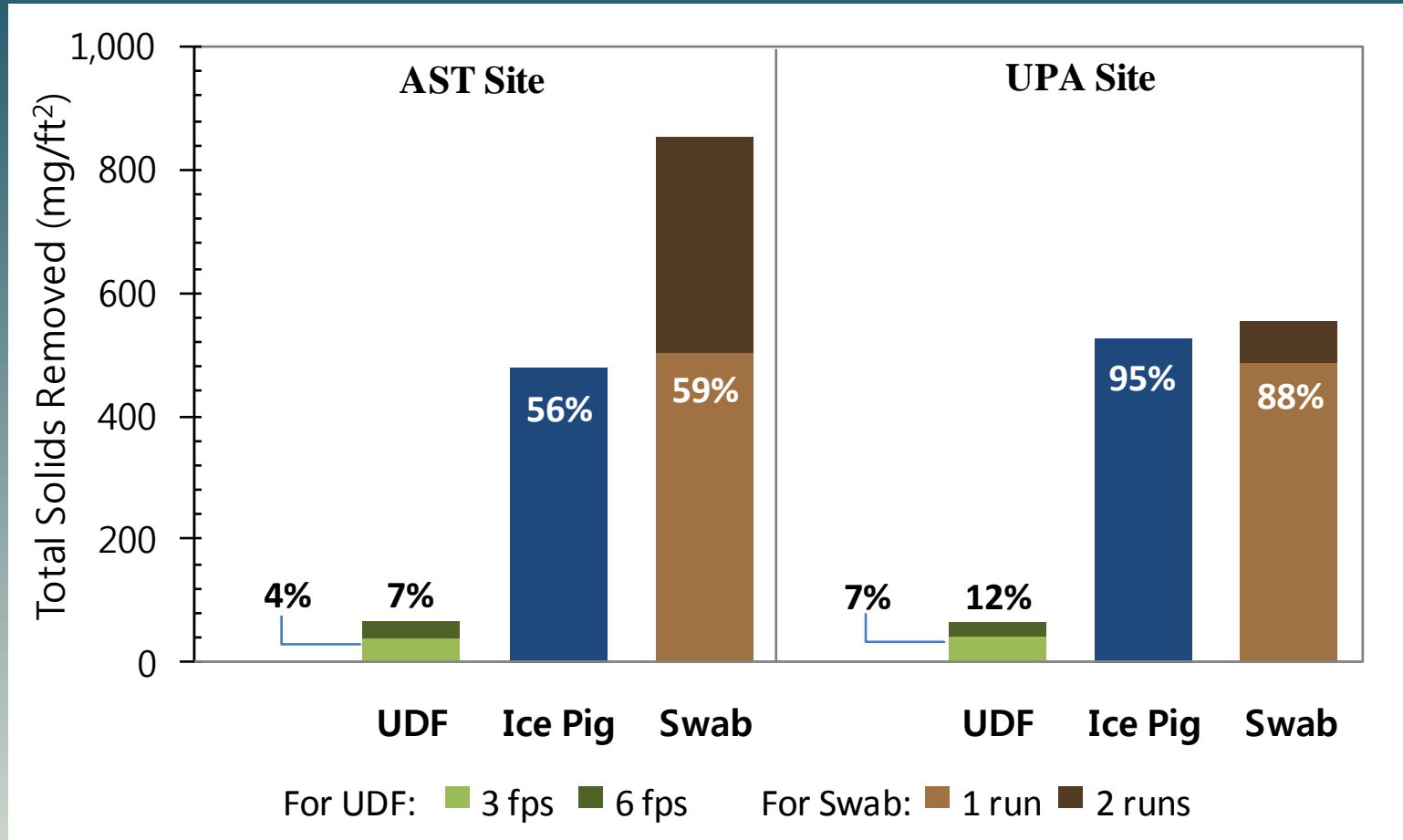
After UDF
at 6 fps



After Ice
Pigging



Comparison of Cleaning Performance

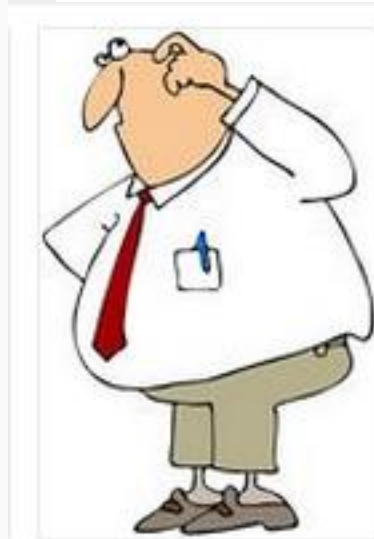


% = Relative Cleaning Effectiveness

So What Does This Mean for Utilities?

Is it even worthwhile to flush?

Should I be swabbing or ice pigging instead?



...and how frequently?



Routine UDF Still Plays a Key Role

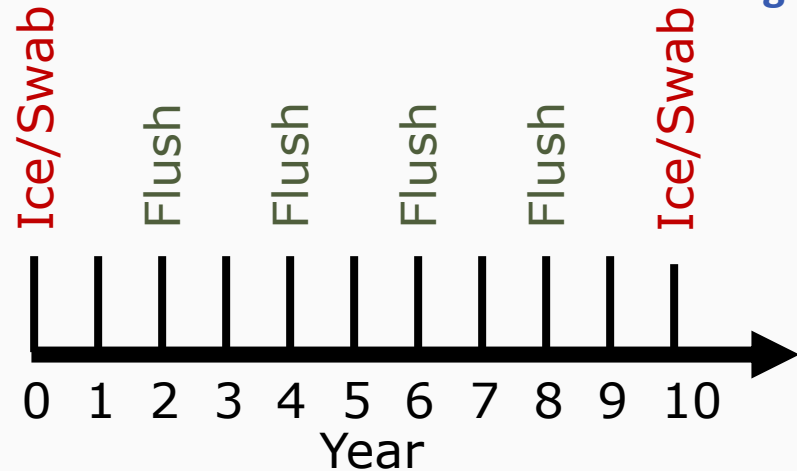
- **Removal of hydraulically-mobile trace inorganic chemicals**
- **Reduces overall accumulation rate**
- **Helps address other water quality issues**
- **Relatively low application cost**
 - UDF: \$1,000/mile
 - Ice/Swab: ~\$6,000/mile



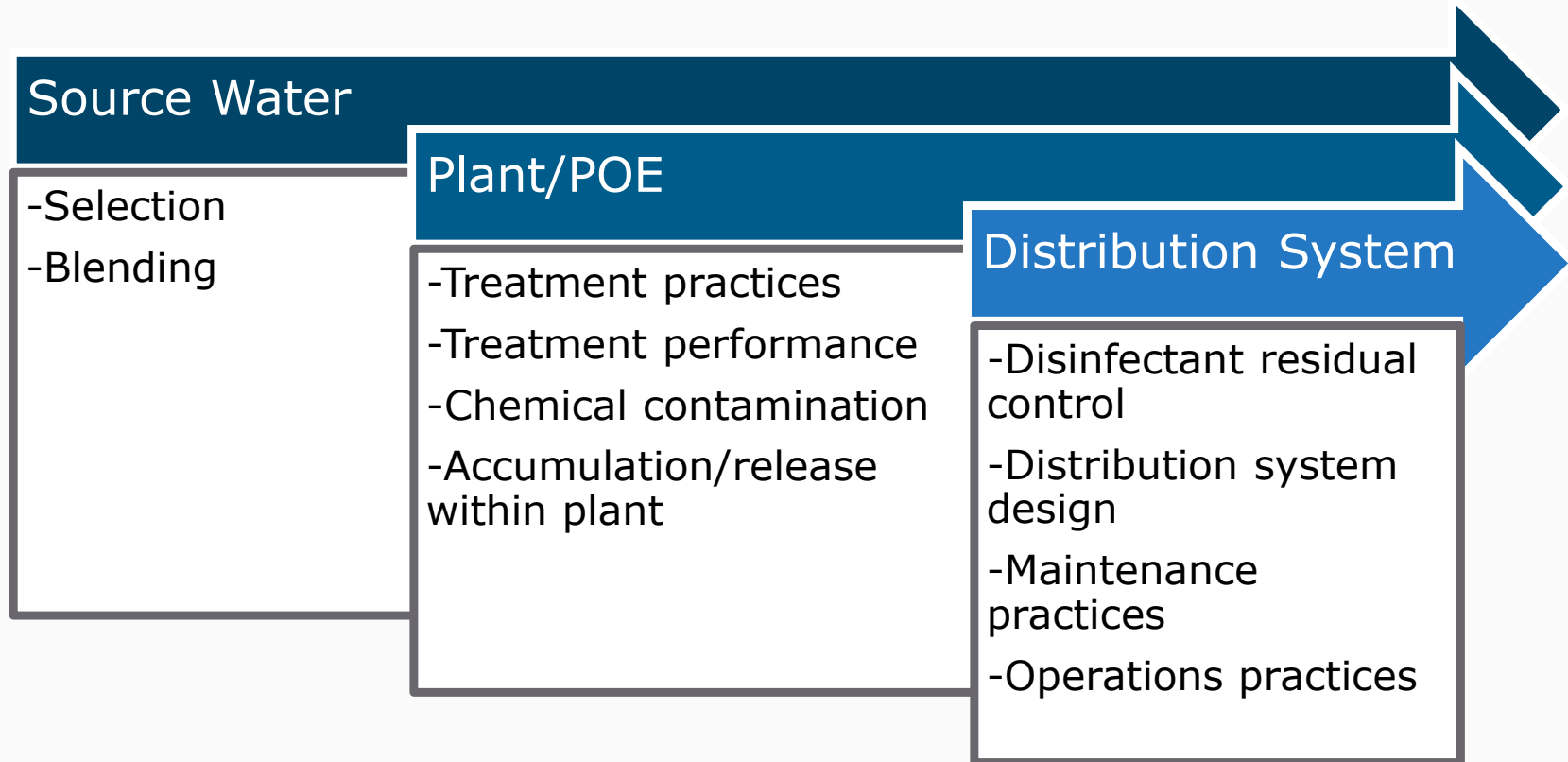
But UDF cannot get at 100% of legacy deposits – site-specific issues!

- If risk factors warrant, use an integrated strategy instead of an “either/or”
- Supports objective of meeting level-of-service goal (reduce risk) with the lowest life-cycle cost
- Target frequencies depend on local conditions
 - On-going loading
 - Hydraulics
 - Pipe type

Possible Schedule for Low-Level Loading



Three Broad Categories for Risk Mitigation



Conclusions

- **Manganese can accumulate even if low levels at the POE**
- **New tools exist to self-assess risks and determine best mitigation strategies**
- **UDF remains an important tool but limited effectiveness for cohesive deposits**
- **Ice pigging and swabbing are effective for cohesive deposits**



Questions?

Presented By:

Stephen Booth, P. Eng.

Melinda Friedman, P.E.

Confluence Engineering Group, LLC

melinda@confluence-engineering.com

206.527.6832

www.confluence-engineering.com

