Smart Distribution Systems:
Bringing Storage Tanks To The 21st Century

Outline / Agenda

1st - Intro – Who am I & Why am here? (5 min)

2nd – Cost Effective Technologies (20 min)

a) Mixing – Water quality + Case Studies

c) Chem-Feed – Alternative to manual boosting

b) Aeration – TTHM removal + Case Studies

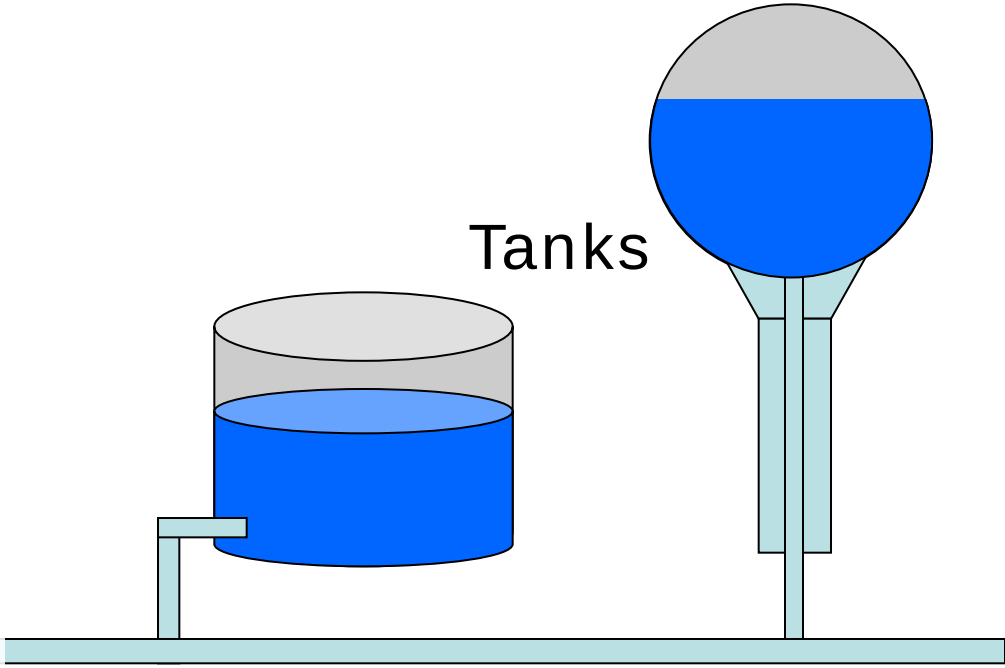
3rd – Q& A (5 min)

PAX WATER TECHNOLOGIES™

Goal:

Everyone learns something new.

Focus on Tanks



90% $$$
Of Proactive Spending Is In Treatment!

Only 10% $
Of Proactive Spending is In Distribution… However Water Spends +90% Of Its Time Here!

Why Mix Water Tanks?

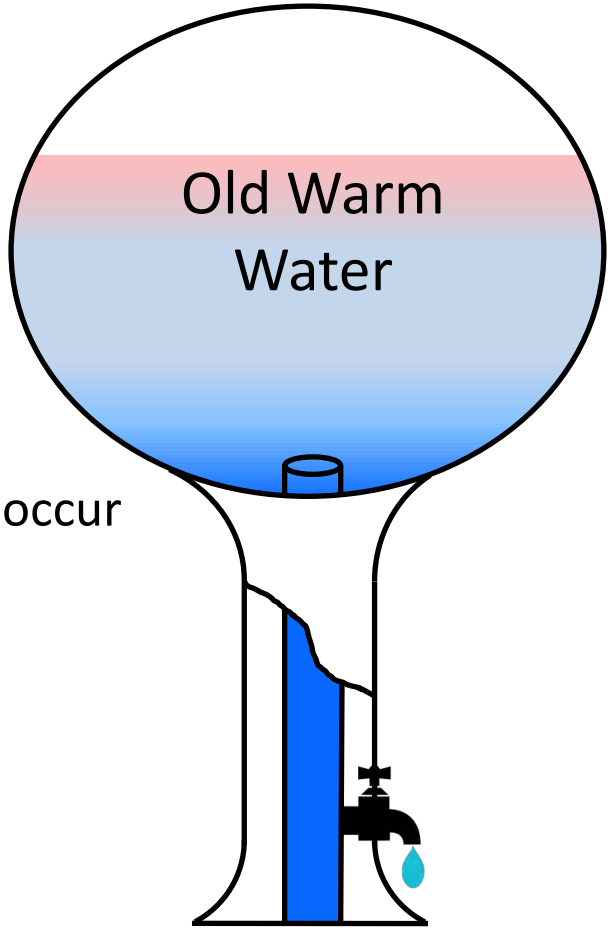
2 Main Reasons…

#1: Water Age / Water Quality

#2: RISK MANAGEMENT

#1: Water Age / Water Quality

Simple Reason

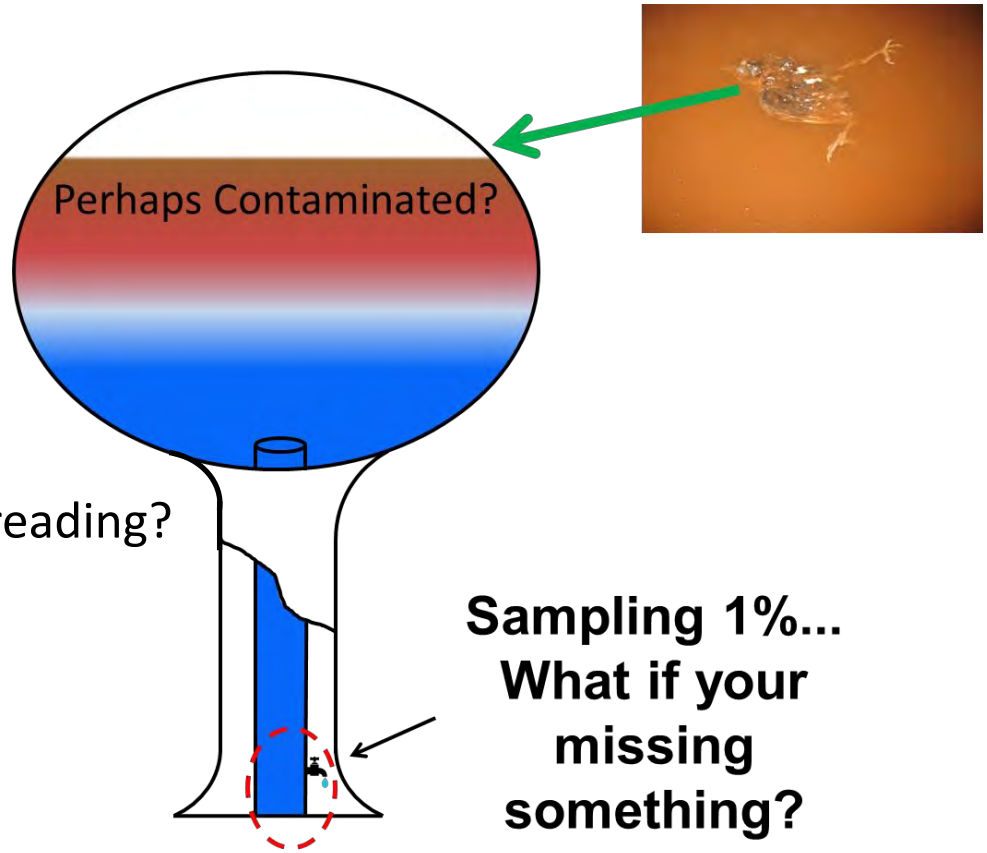


The longer it stays stratified…

- The worse it tastes
- The less accurate samples are
- The more residual abnormalities occur

#2: RISK MANAGEMENT

More Complex!



If your samples aren't accurate…

- What if you miss something?
- Is nitrification coming?
- Is there bio film eating residual?
- Is there coliform or other issues breading?

#2: RISK MANAGEMENT

Mixing Technologies

Nozzles
"Passive"

1995

Draft Tube
"Active"

2000

Active Mixer
"Active"

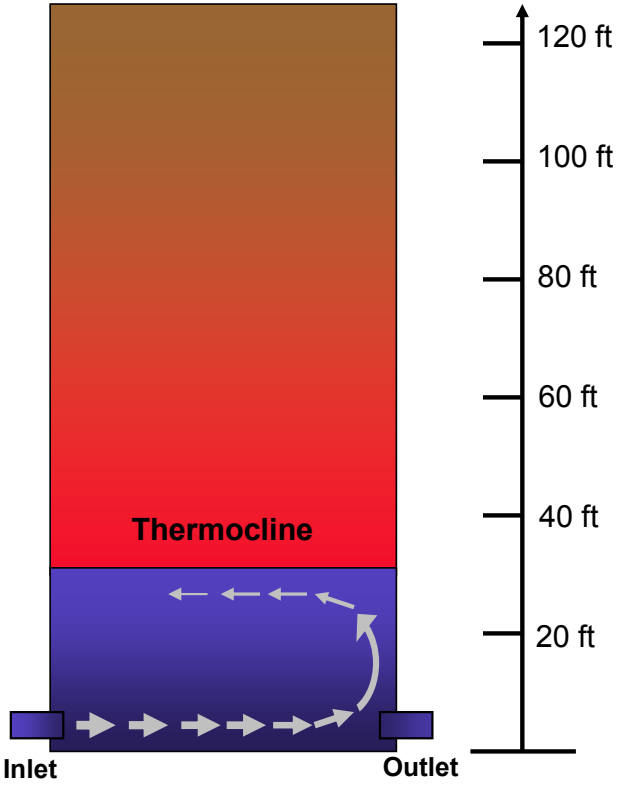
2005

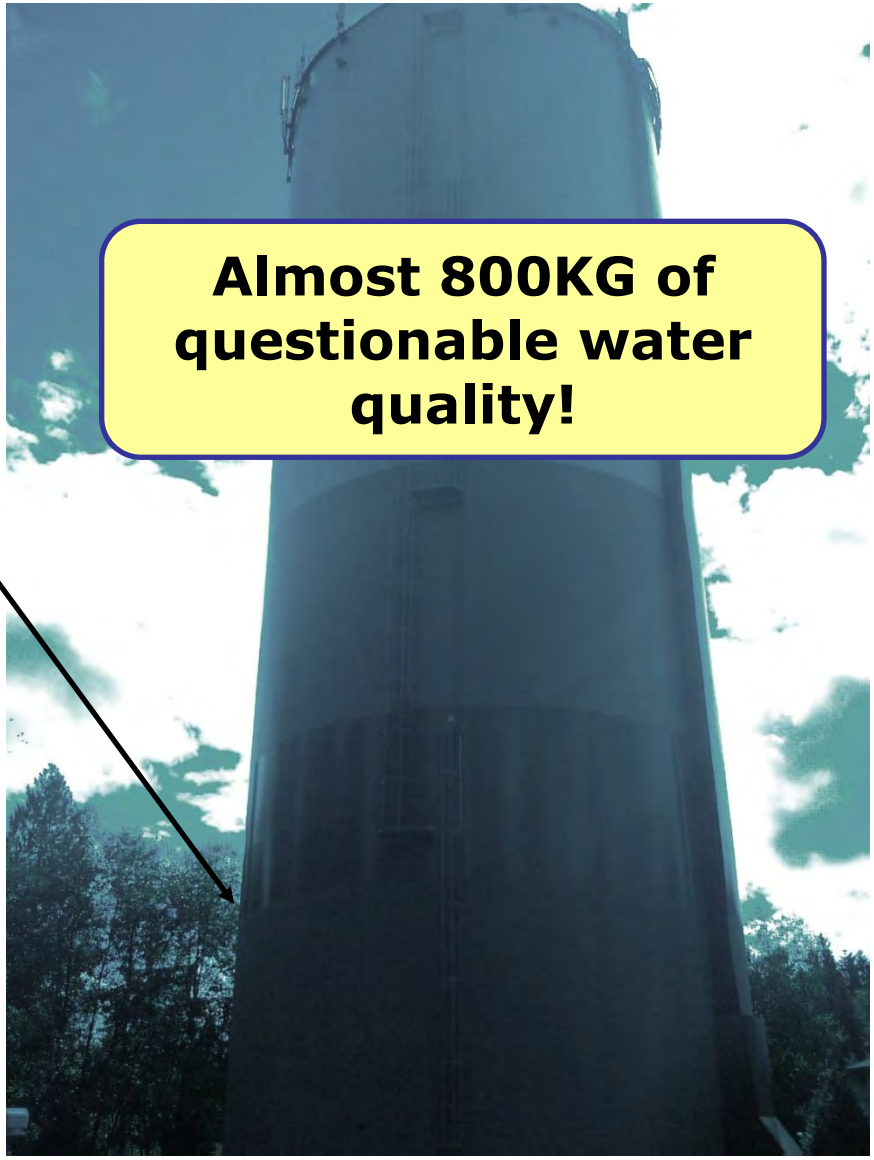
Timeline showing when solutions became available ….

Case Study: Spanaway WA
Motive: Water Quality

Spanaway, WA – 127 ft standpipe

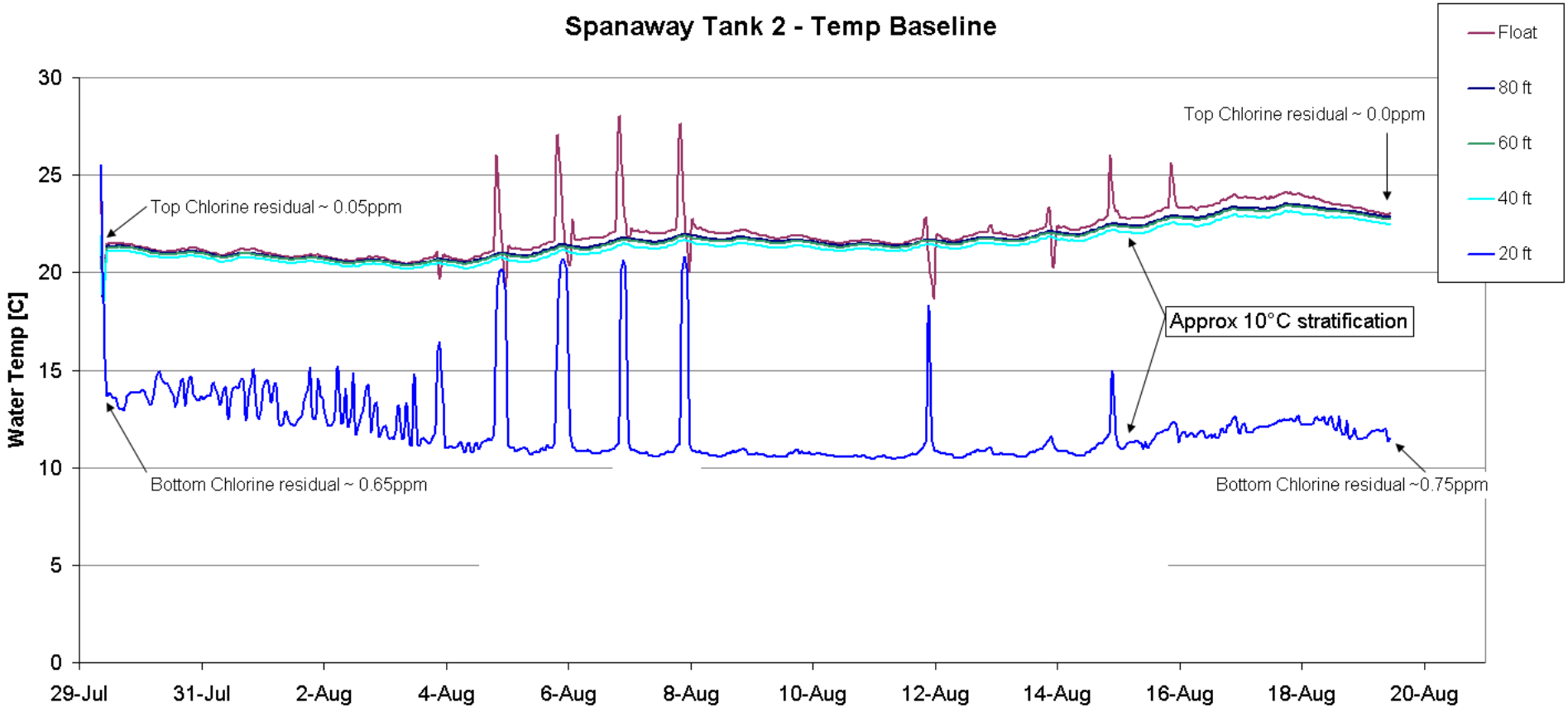
Condensation was visible up to approximately 24 feet above ground. But top of water was around 110 feet…



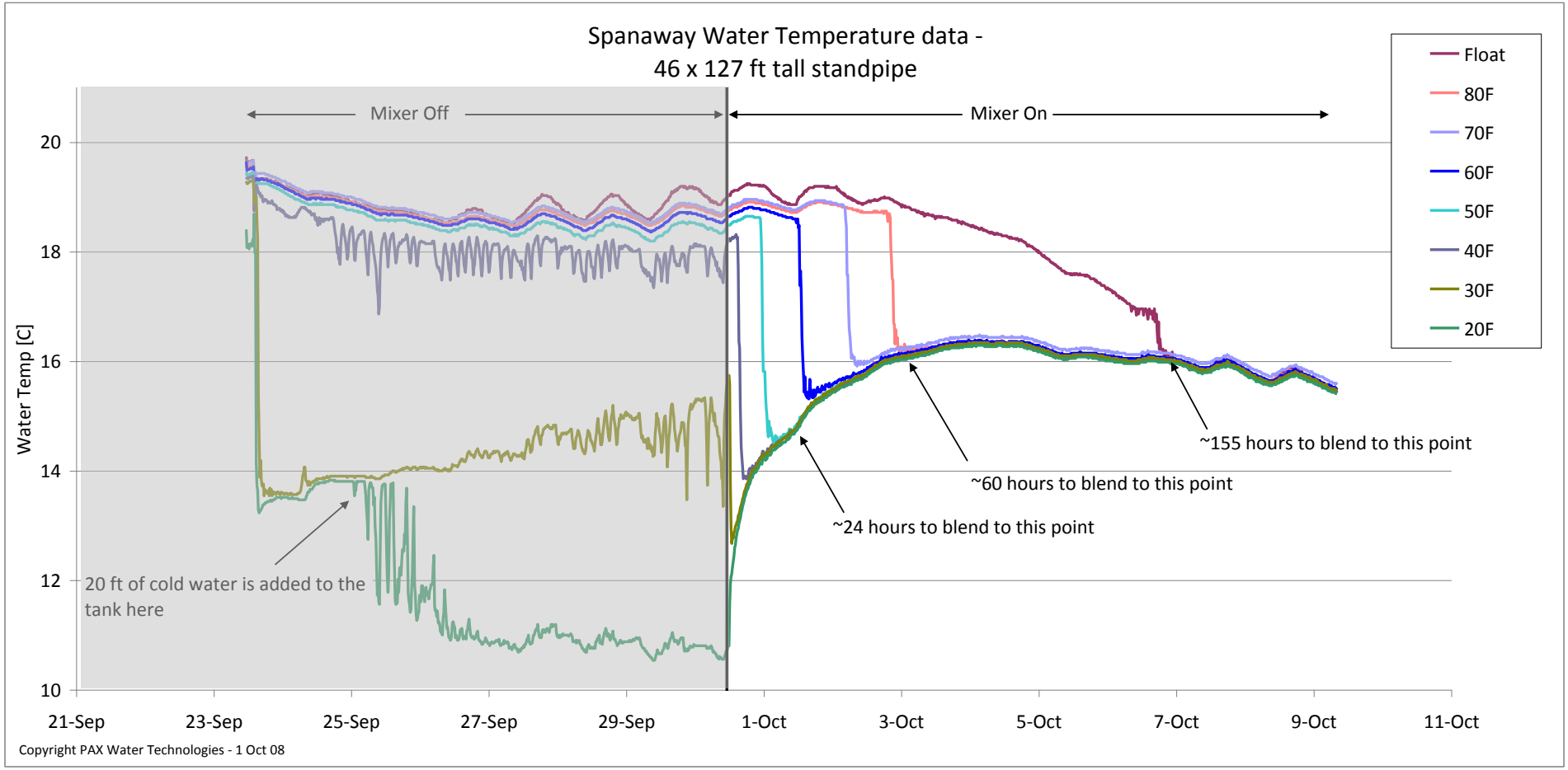


Almost 800KG of questionable water quality!

Temperature Results



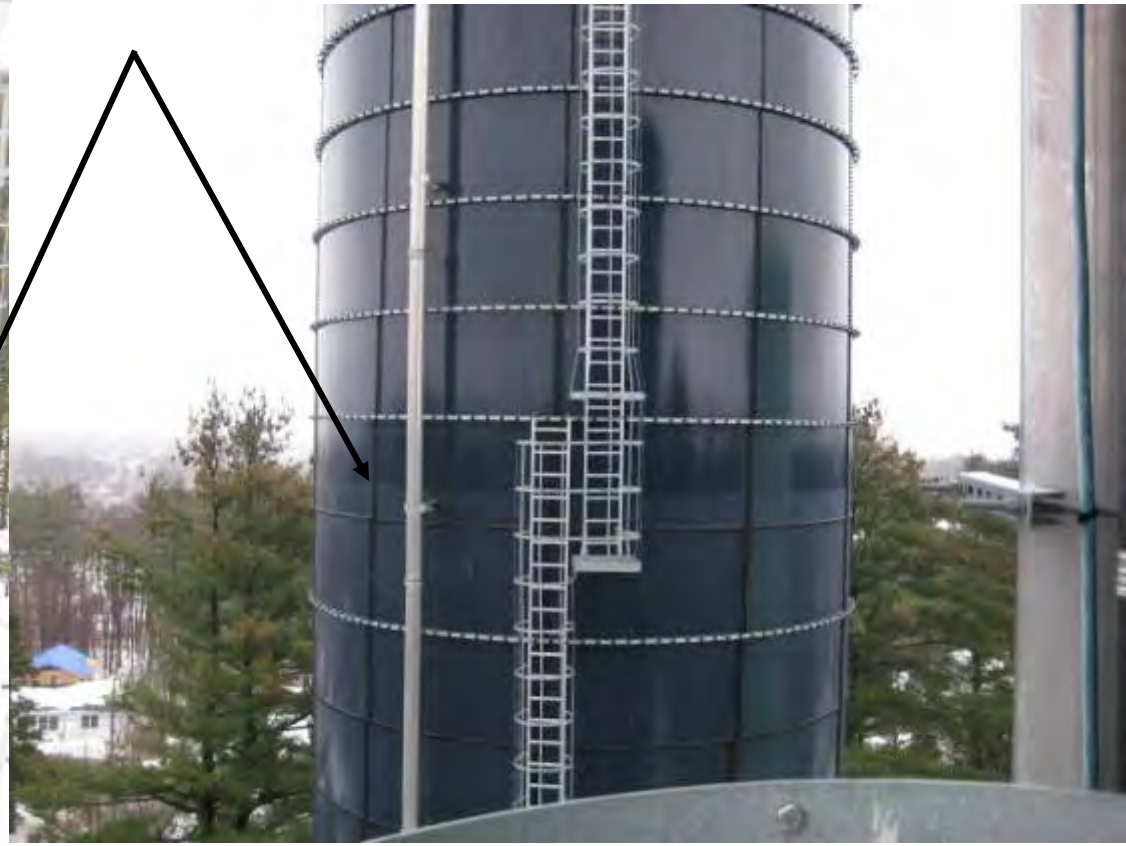
Spanaway WA – Standpipe 46’ x 127’ 1.5MG



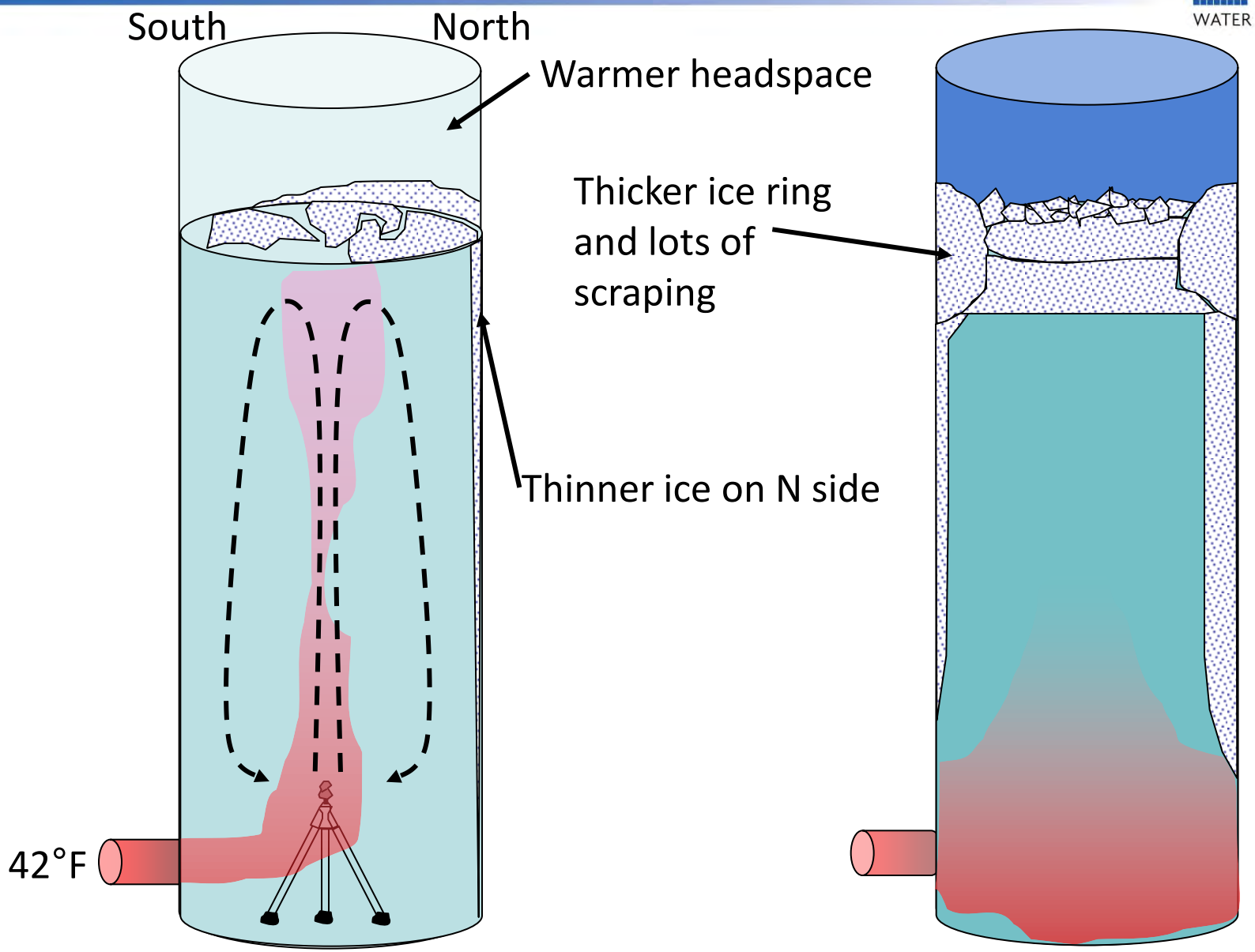
Case Study: Old Town Maine
Motives: Risk & Water Quality

Sweat line on both tanks

Tank 1 (PAX mixer)



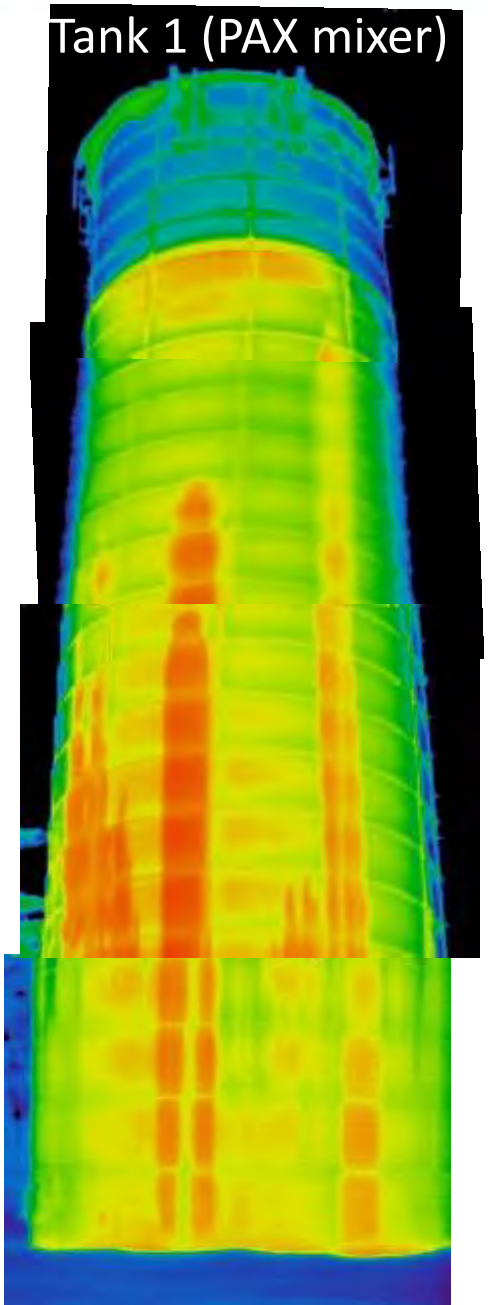
Tank 2 (no mixer)



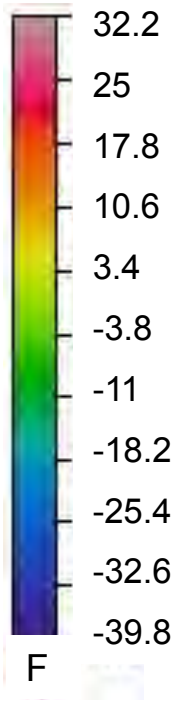
Tank 1 (PAX mixer)

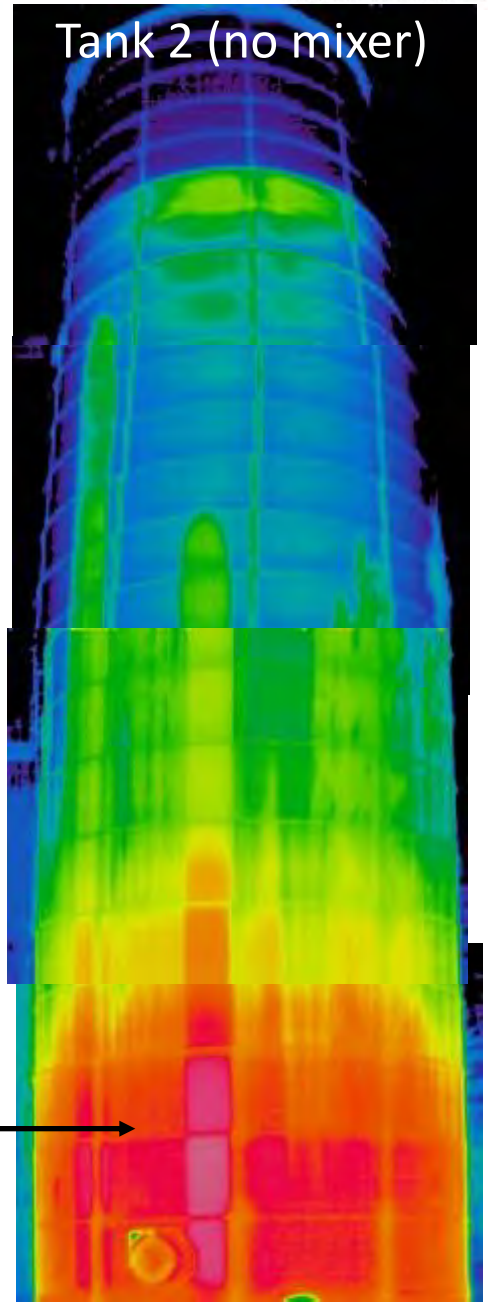
Tank 2 (no mixer)

PAX WATER TECHNOLOGIES™



Tank Skin Temperatures





Pocket of warm water at tank bottom (no mixer)

No damage to tank, structure or facility. Its all about velocity!

Spring Thaw – 3/25/09

How quickly can you eliminate destruction & potential failure? Again… Manage Risk!

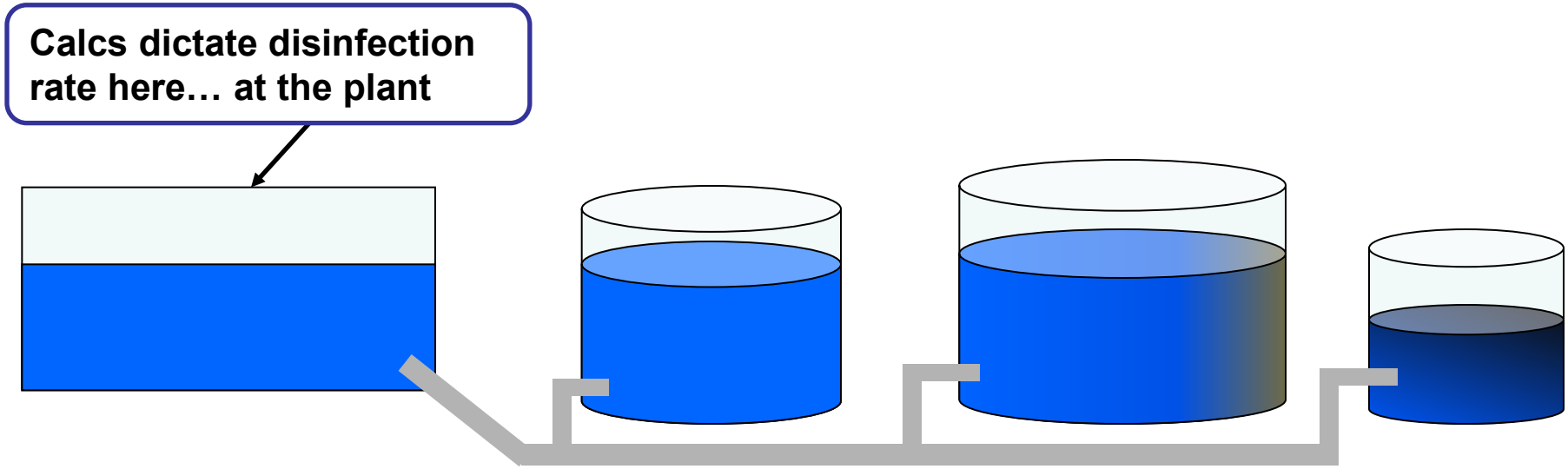
Tank #2 – not mixed

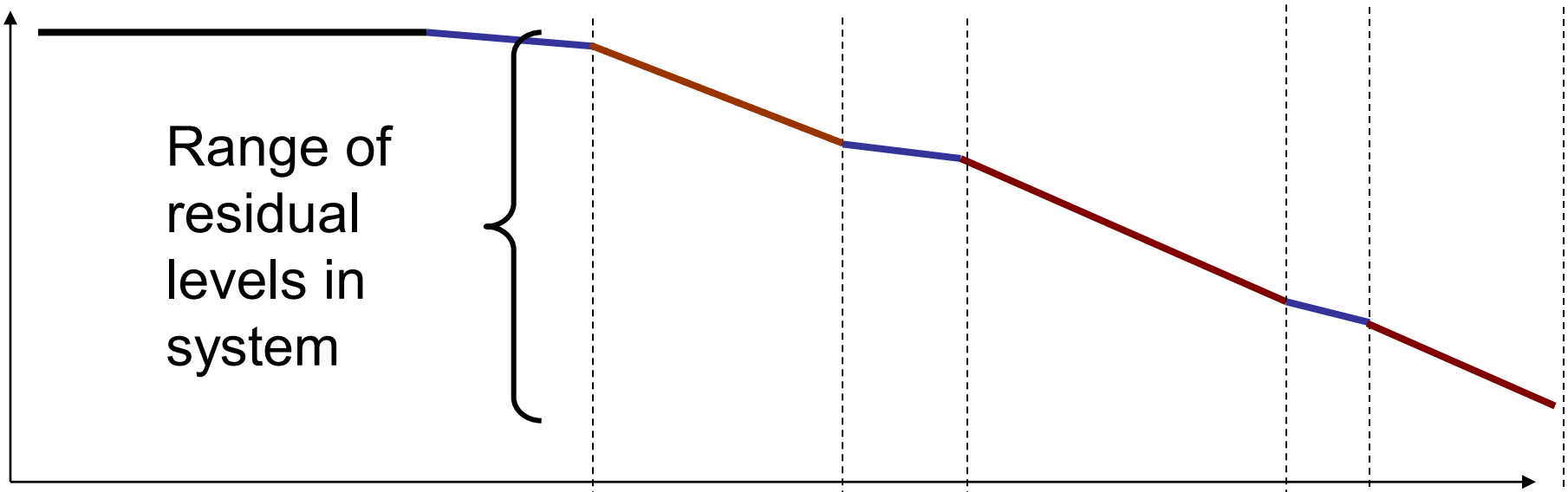
Tank #1 – Mixed

Its not all risk management… there are tools that make your crew more effective!

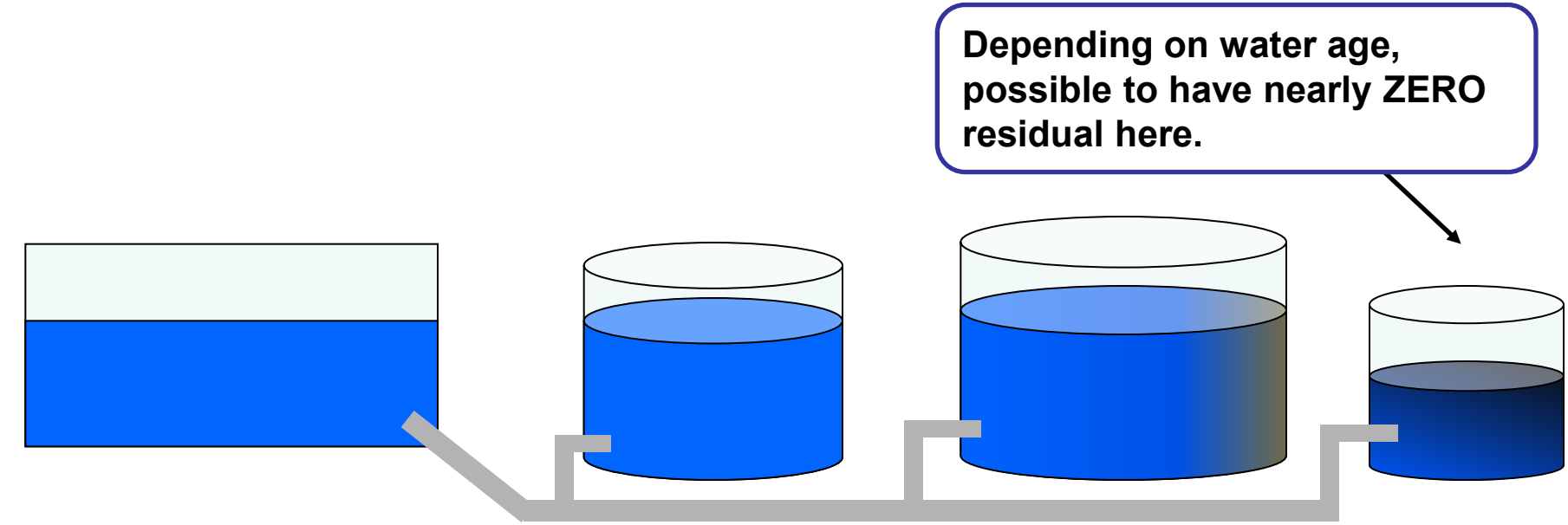
Reservoir Control Systems!

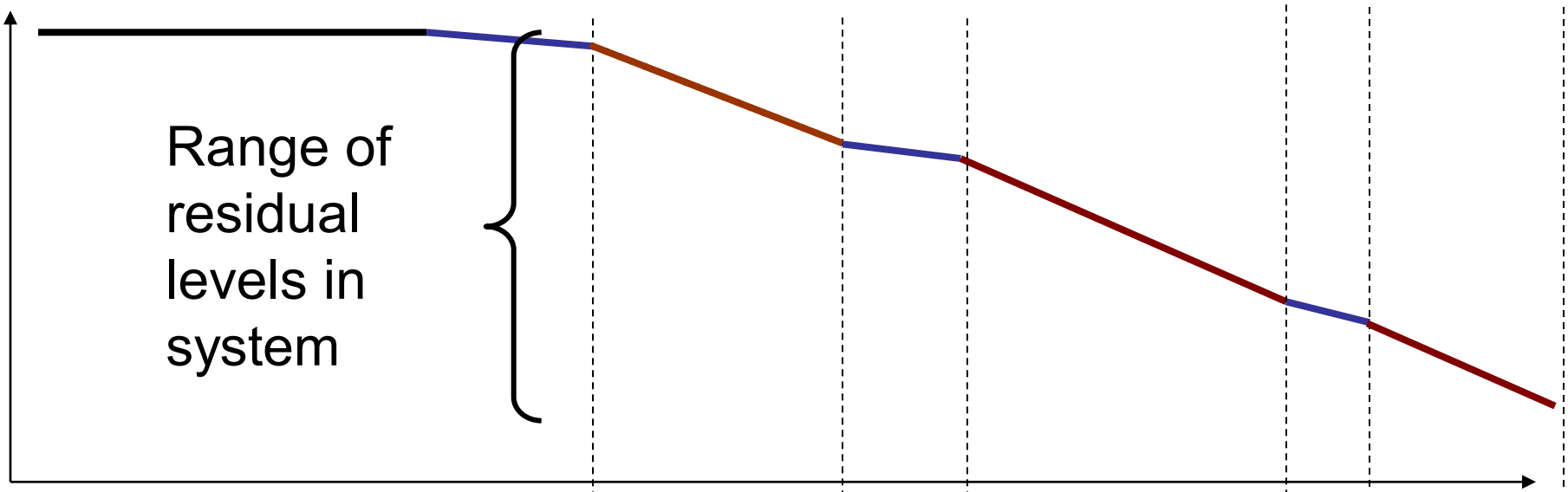
Residual Loss in Tanks



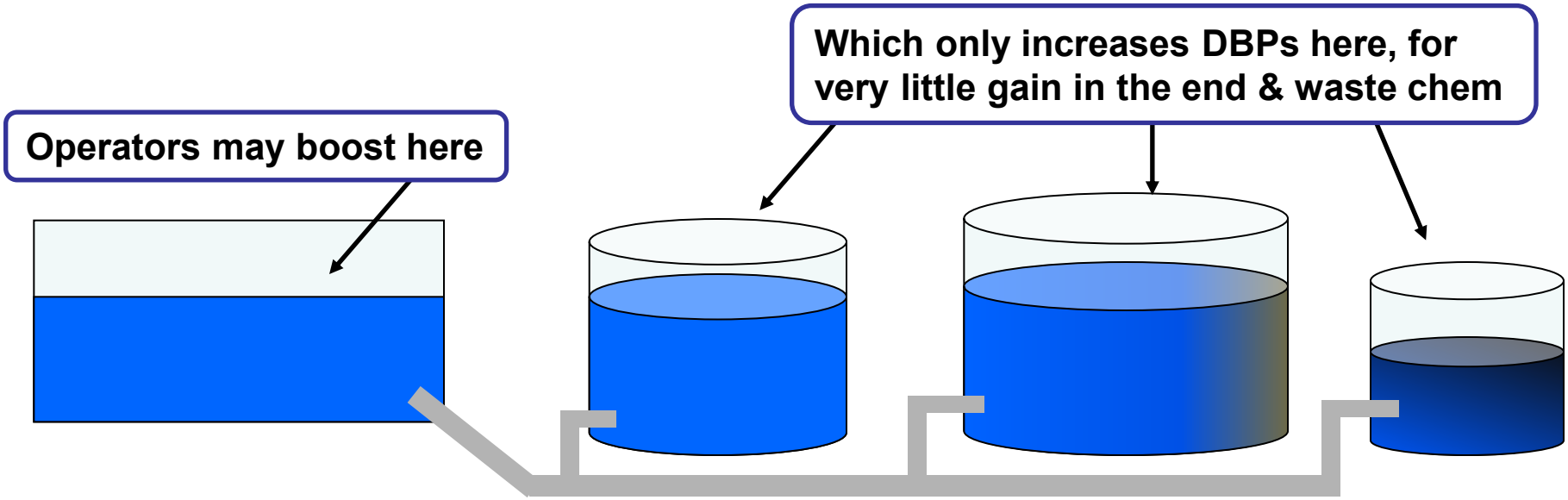


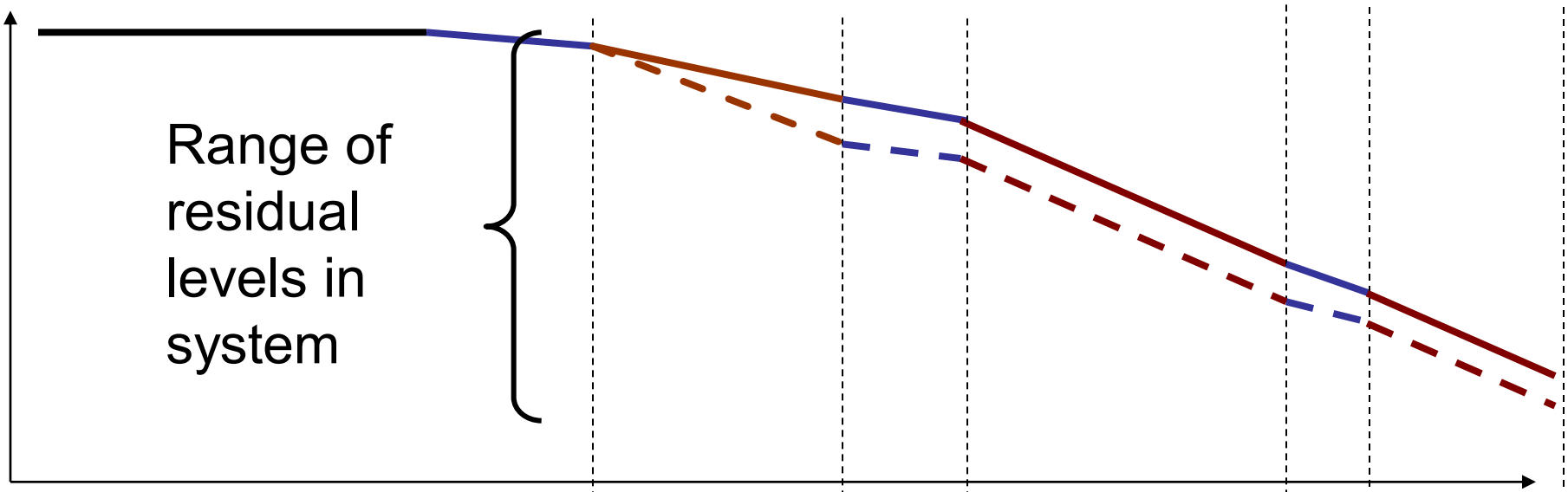
Residual Loss in Tanks



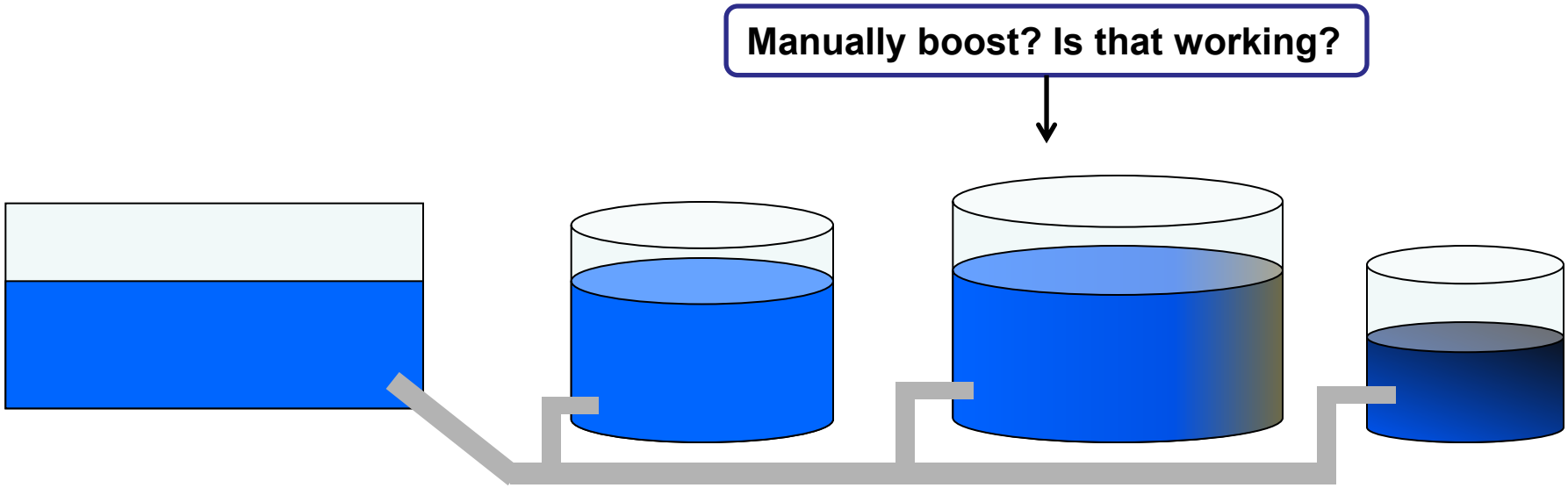


Residual Loss in Tanks

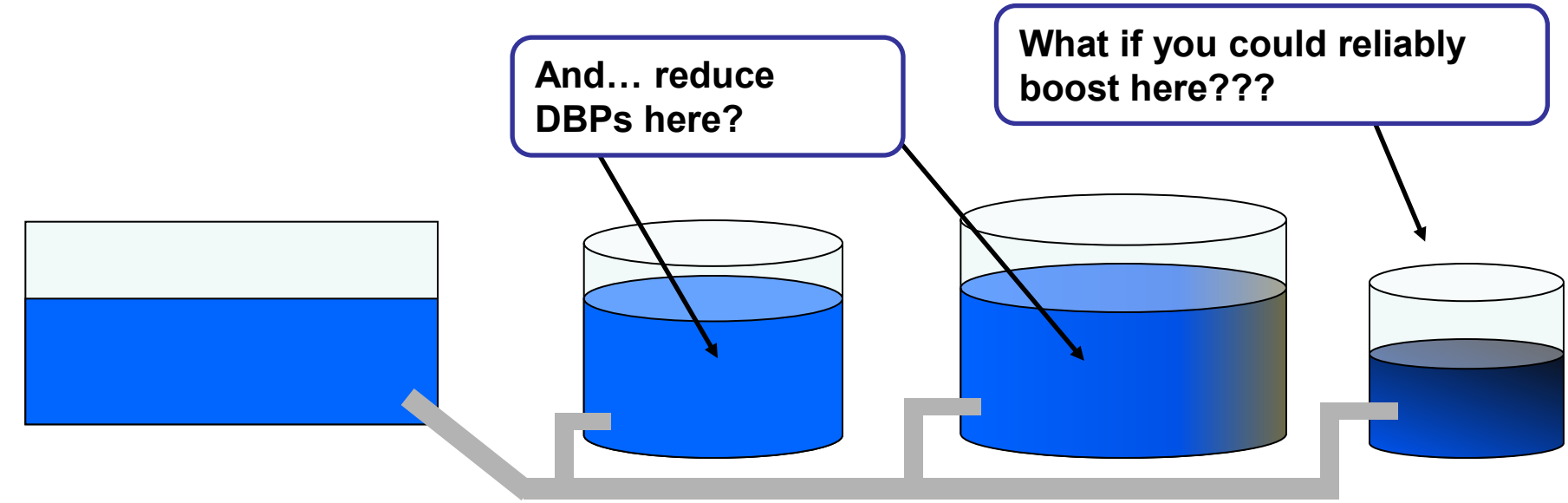


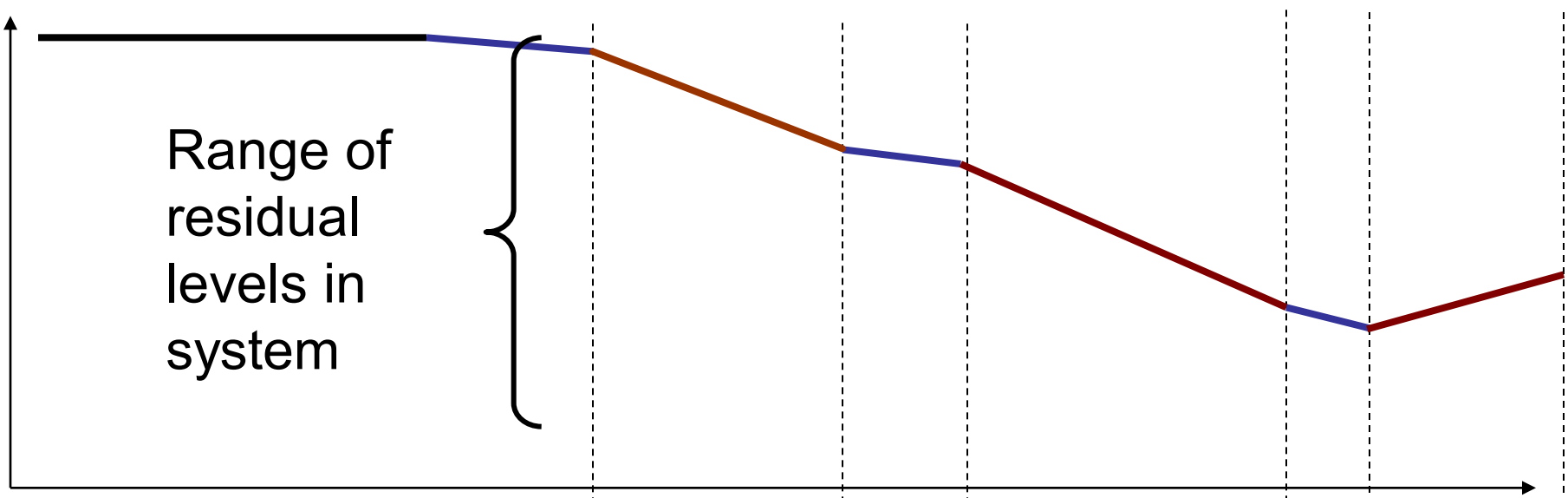


Residual Loss in Tanks

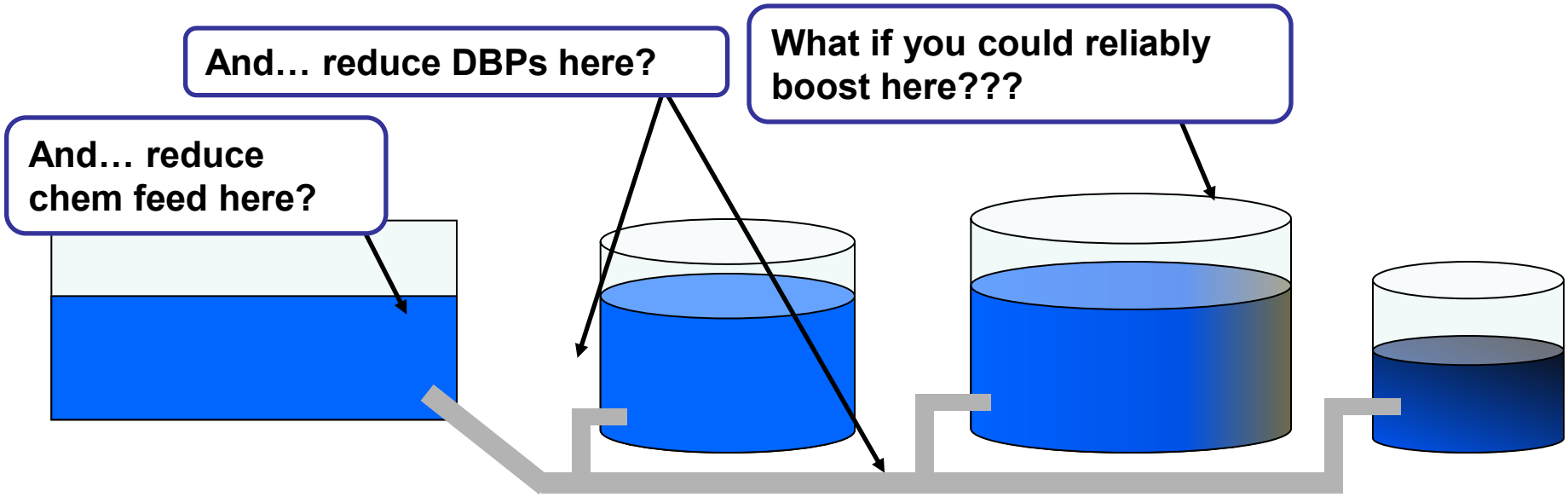


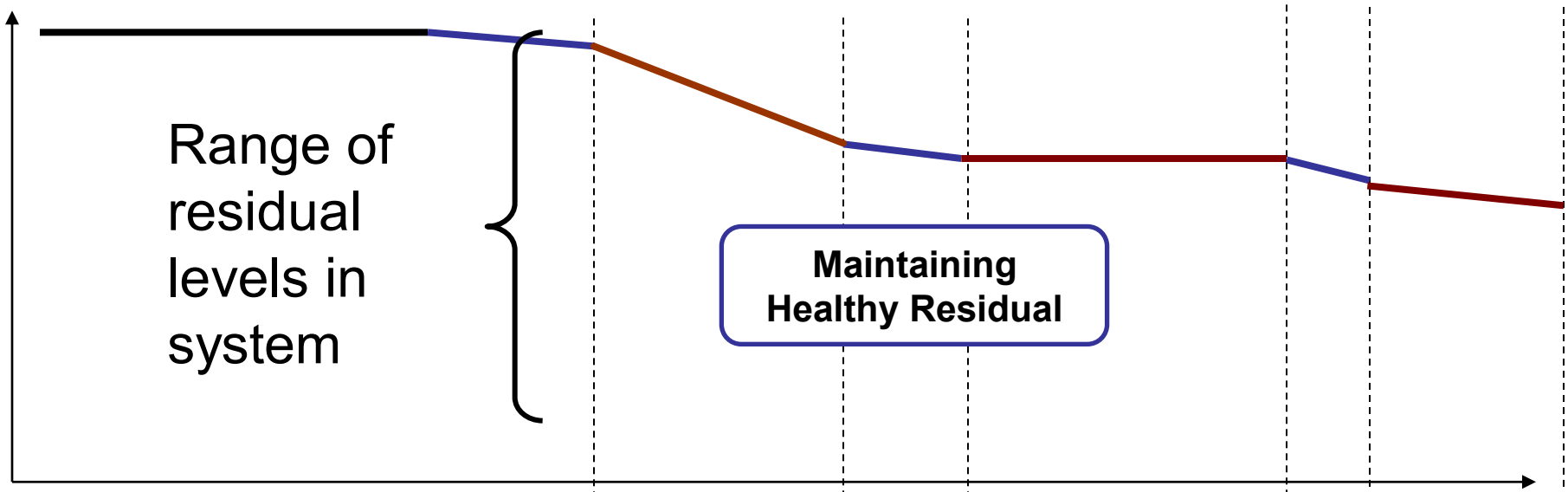
Residual Loss in Tanks



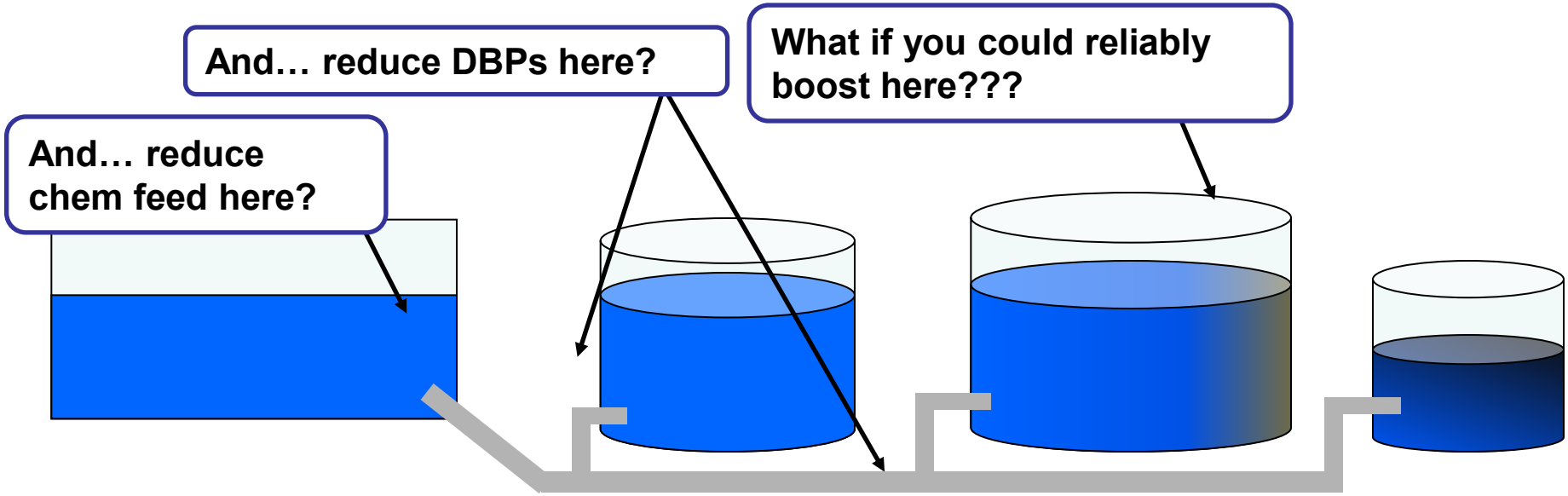


Residual Loss in Tanks





Residual Loss in Tanks

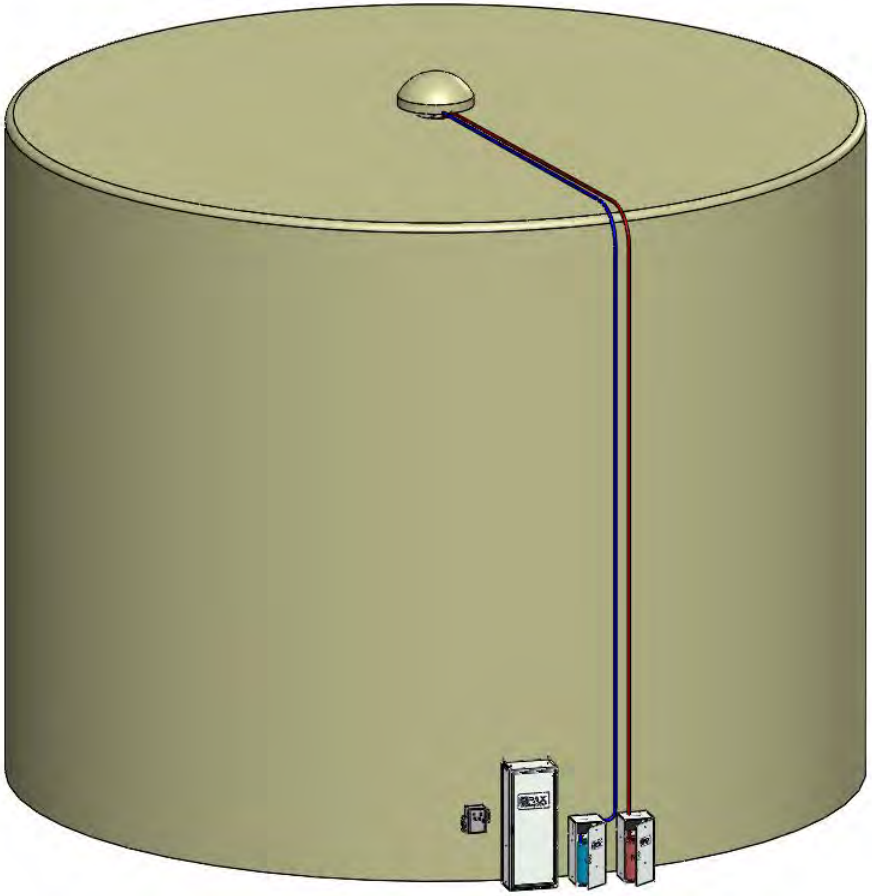


Smart Reservoir Control Systems

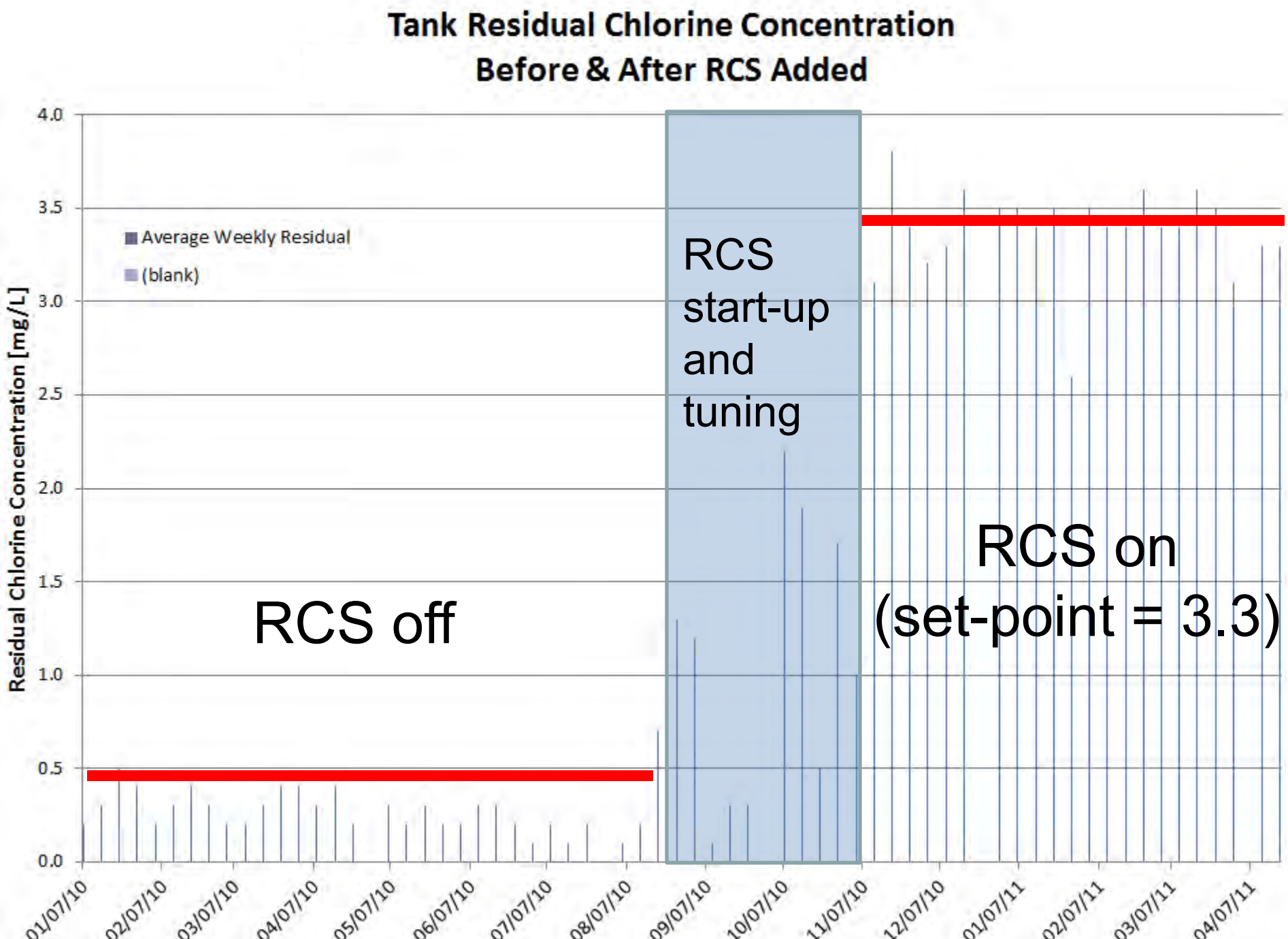
- Automated Water Quality samples / monitoring of tanks
- Automated dosing (chlorine or chloramine) based on samples
- Automated reports / control to operations

Work smarter, not harder!

RCS Installation layout



Secured Site Install: Chloraminated System, CA


Tank Residual Chlorine Concentration
Before & After RCS Added
Residual Chlorine Concentration [mg/L]
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Average Weekly Residual
(blank)
RCS off
RCS start-up and tuning
RCS on (set-point = 3.3)
01/07/10
02/07/10
03/07/10
04/07/10
05/07/10
06/07/10
07/07/10
08/07/10
09/07/10
10/07/10
11/07/10
12/07/10
01/07/11
02/07/11
03/07/11
04/07/11

Summary: Automated Residual Control and Stage 2 Compliance

- Active monitoring and boosting of disinfectant levels
- Reduces range of residual levels in system
  - Allows you to lower absolute levels = lower DBP production
- Rapid, targeted improvement in water quality
- Save on labor & chemicals
- Eliminate “disinfectant” slugs & corrosion!

In-Tank Aeration for THMs?

Aeration to remove THMs is not new…

Table 1. Simulated Aquarium Test

Aeration reduced THMs 85 percent in Solano Irrigation District's aquarium test.

Date	Time	Sample Location	THM Result	Difference
10/25/2006	10:10	Aquarium before aeration	151 µg/L	-85%
10/25/2006	12:55	Aquarium after aeration	23.2 µg/L	

Table 2. Full-Scale Storage Tank Test

Aeration at SSWA's Gregory Hill Storage Tank reduced THMs 70 percent.

Date	Time	Sample Location	THM Result	Difference
1/5/2007	11:00	Tank before aeration	120 µg/L	-70%
1/15/2007	10:20	Tank after aeration	36.4 µg/L	

NOVEL APPROACHES TO TRIHALOMETHANE MANAGEMENT

Paper Presented by :

Dr Rino Trolio

Authors:

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Richard Walker, *Manager Drinking Water Quality,*
Sharon McNeil, *Chemistry Graduate,*
Tran Huynh, *Water Quality Consultant,*
Norgurshiah Jusni, *Scientific Officer,*

Water Corporation (WA)

69th Annual Water Industry Engineers and Operators' Conference
Bendigo Exhibition Centre
5 to 7 September, 2006

Figure 2: *Aeration at Denmark Horsley Road Reservoir*

Installation of the continuous aeration system in Horsley Road Reservoir, resulted in a reduction in the average THM concentrations value from 218 µg/L to 73 µg/L.

Treatment

Storage Tank Aeration Eliminates

Trihalomethanes

In anticipation of the Stage 2 Disinfection Byproducts Rule's more stringent requirements, a California water association found a simple solution for eliminating treatment by-products.

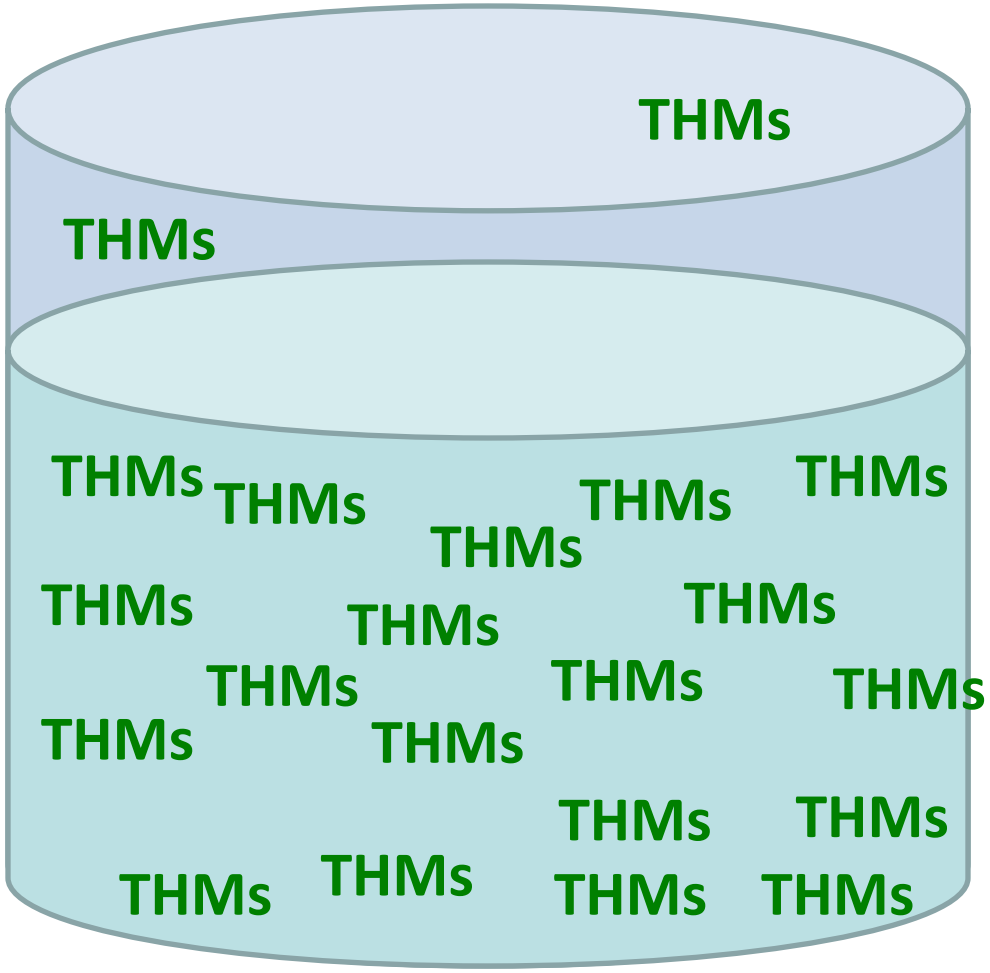
Treatment

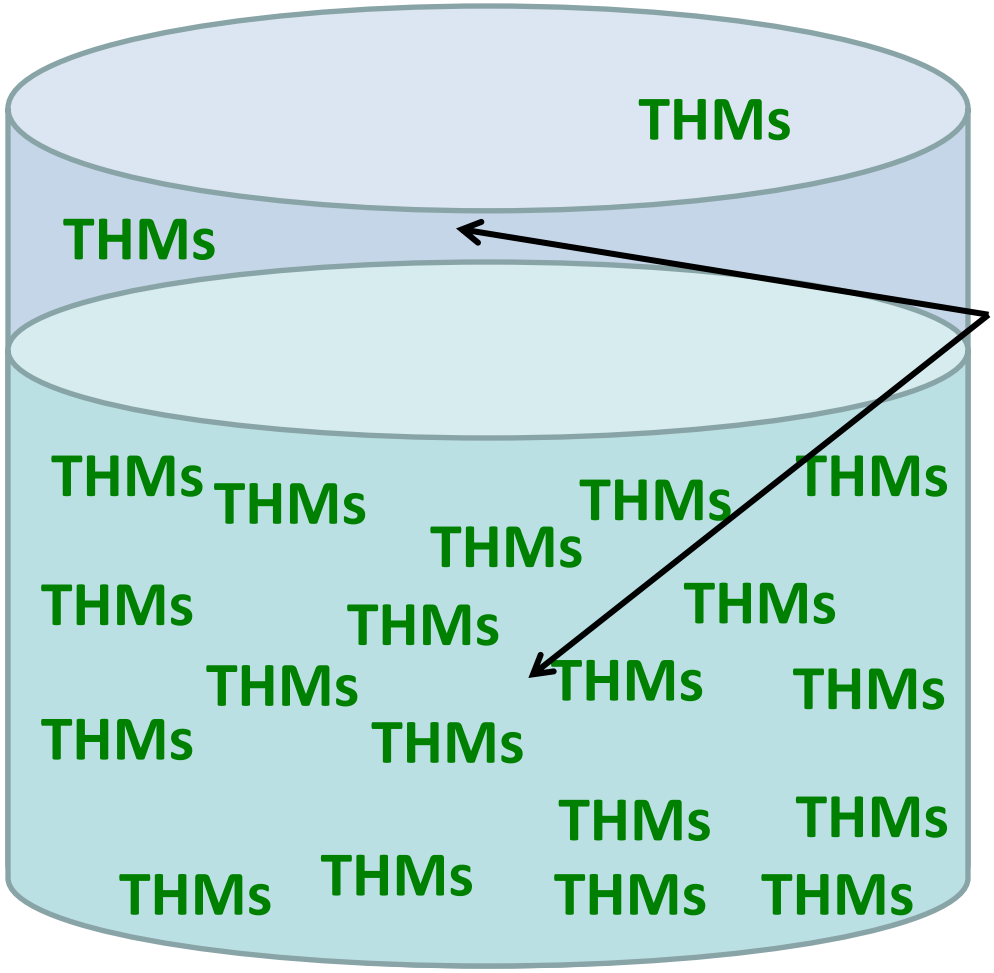
Aeration Decreases THMs

After considering several treatment options, a small system in Northern Ontario turned to aeration to reduce trihalomethanes in its municipal drinking water system.

Aeration has been PROVEN to work

Aeration - starts with evaporation

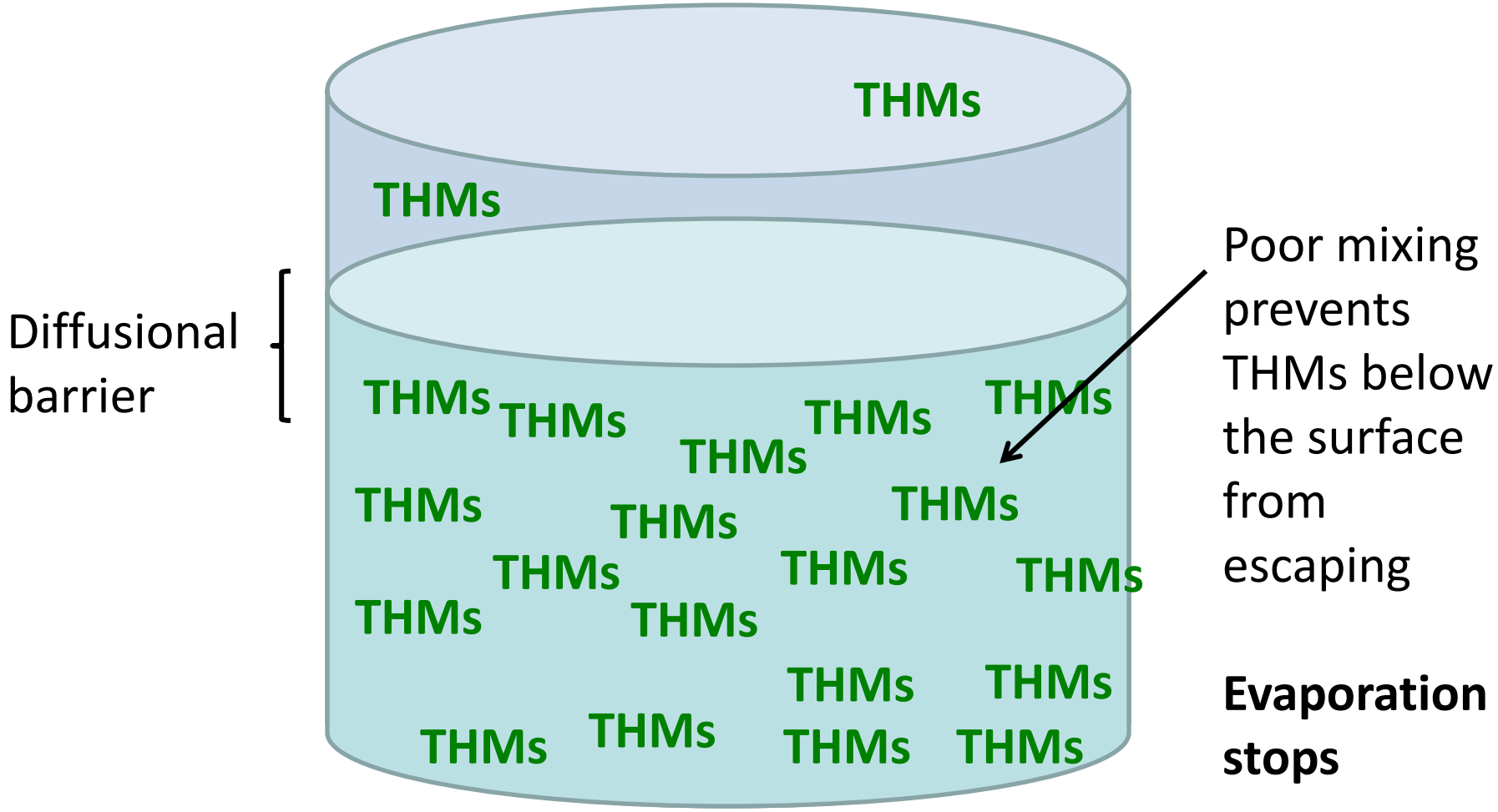




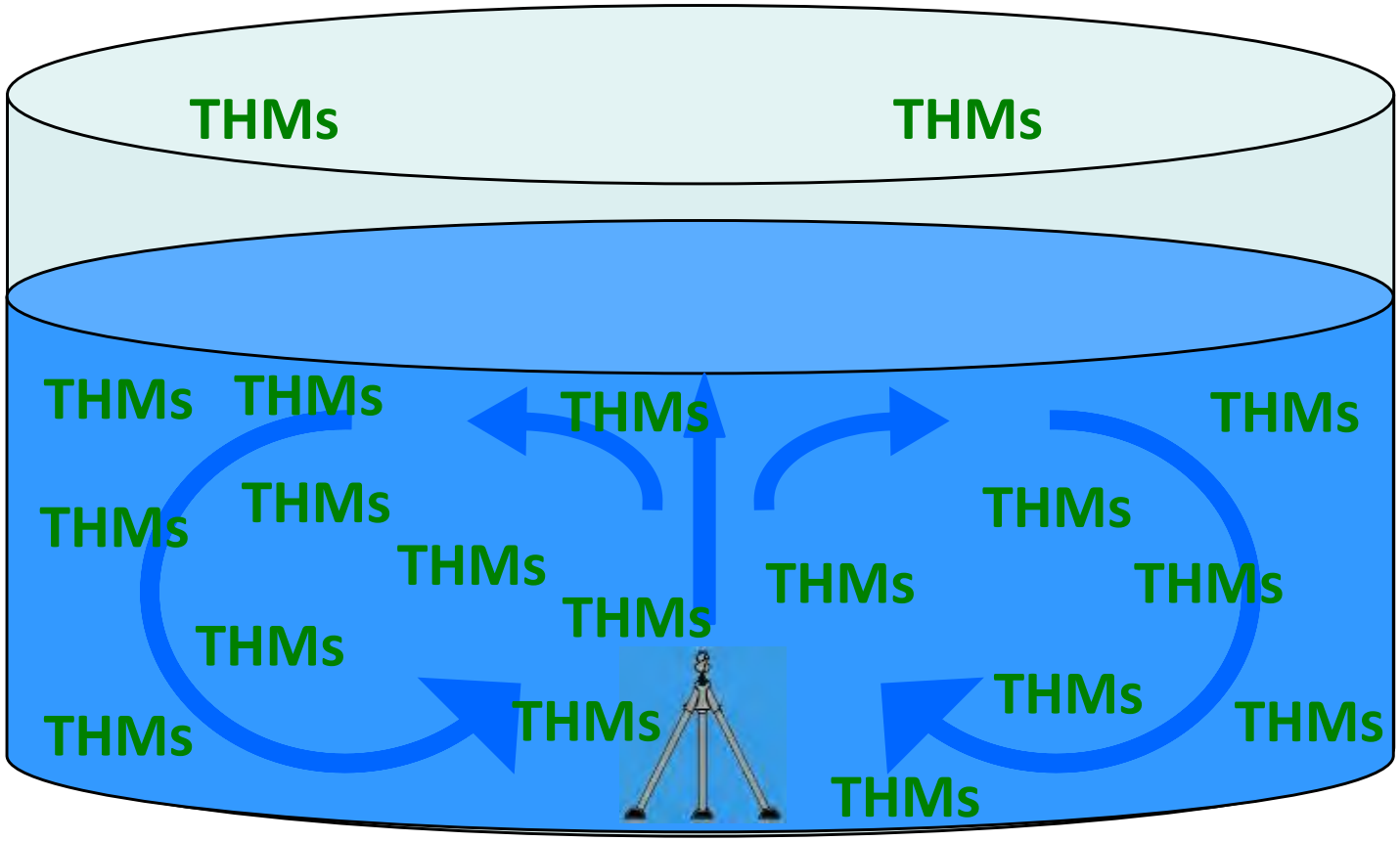
That ratio is the **Henry's Law constant**

At equilibrium, a ratio in THM concentration between the air and the water

Some aeration happens all by itself…

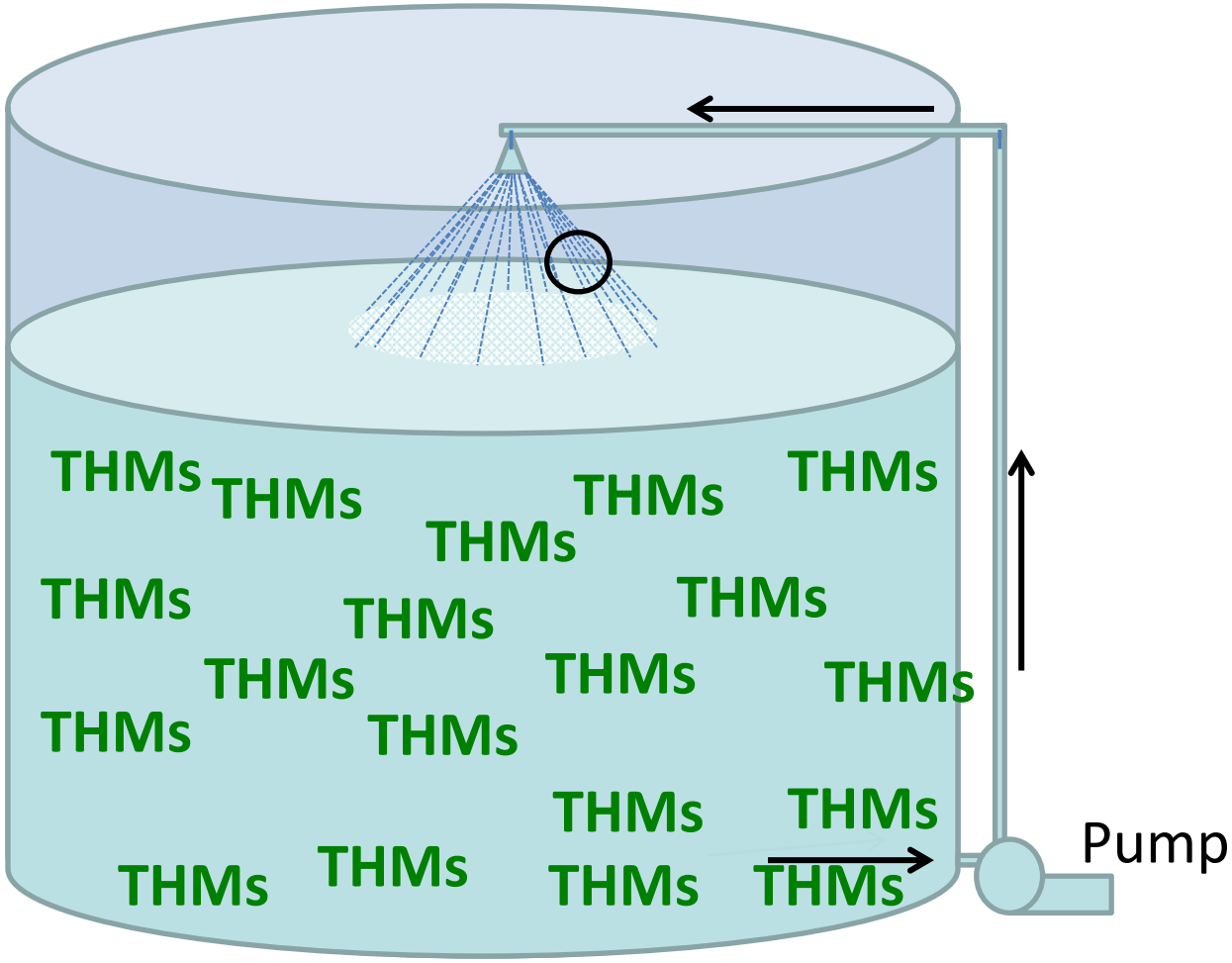


Mixing enhances aeration

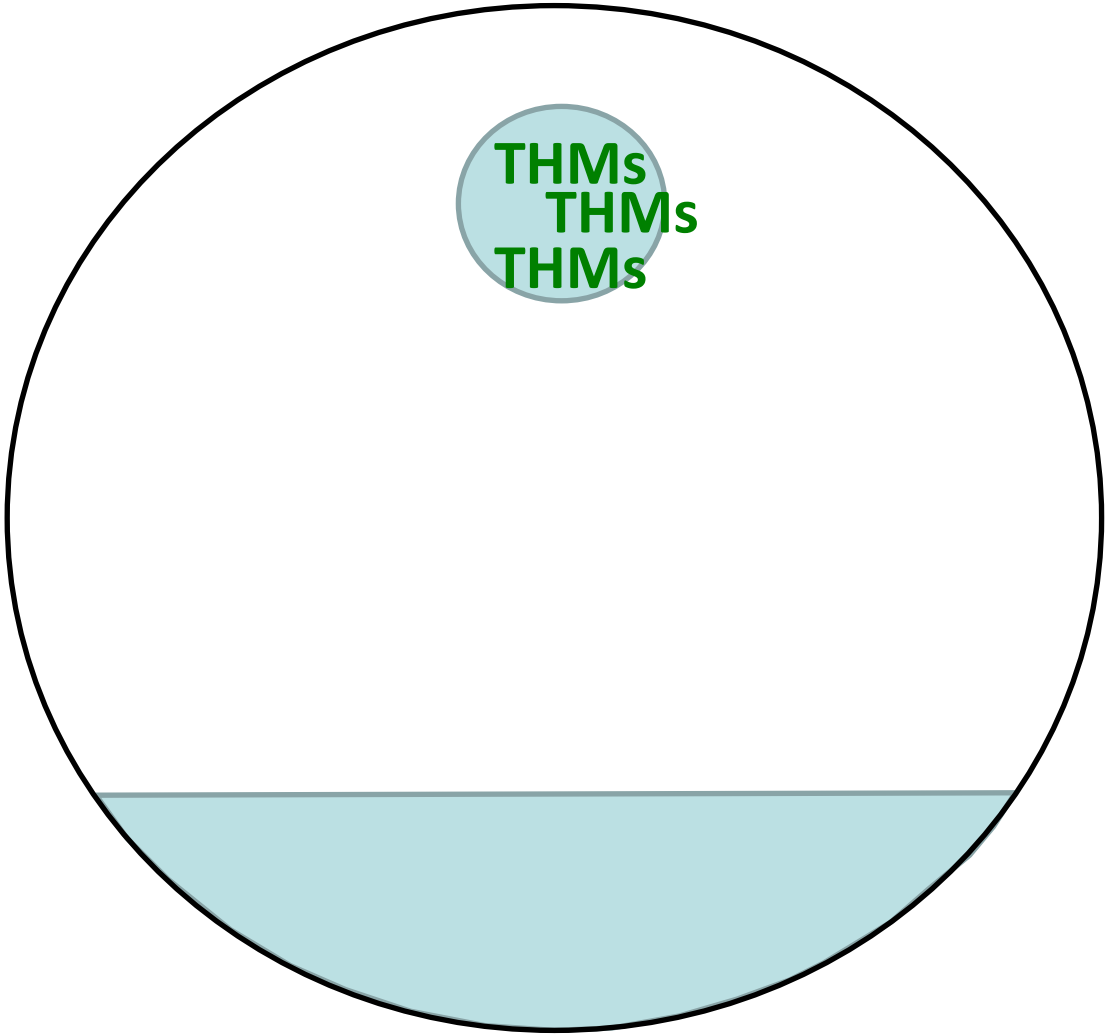


But you need <u>STRONG</u> mixing

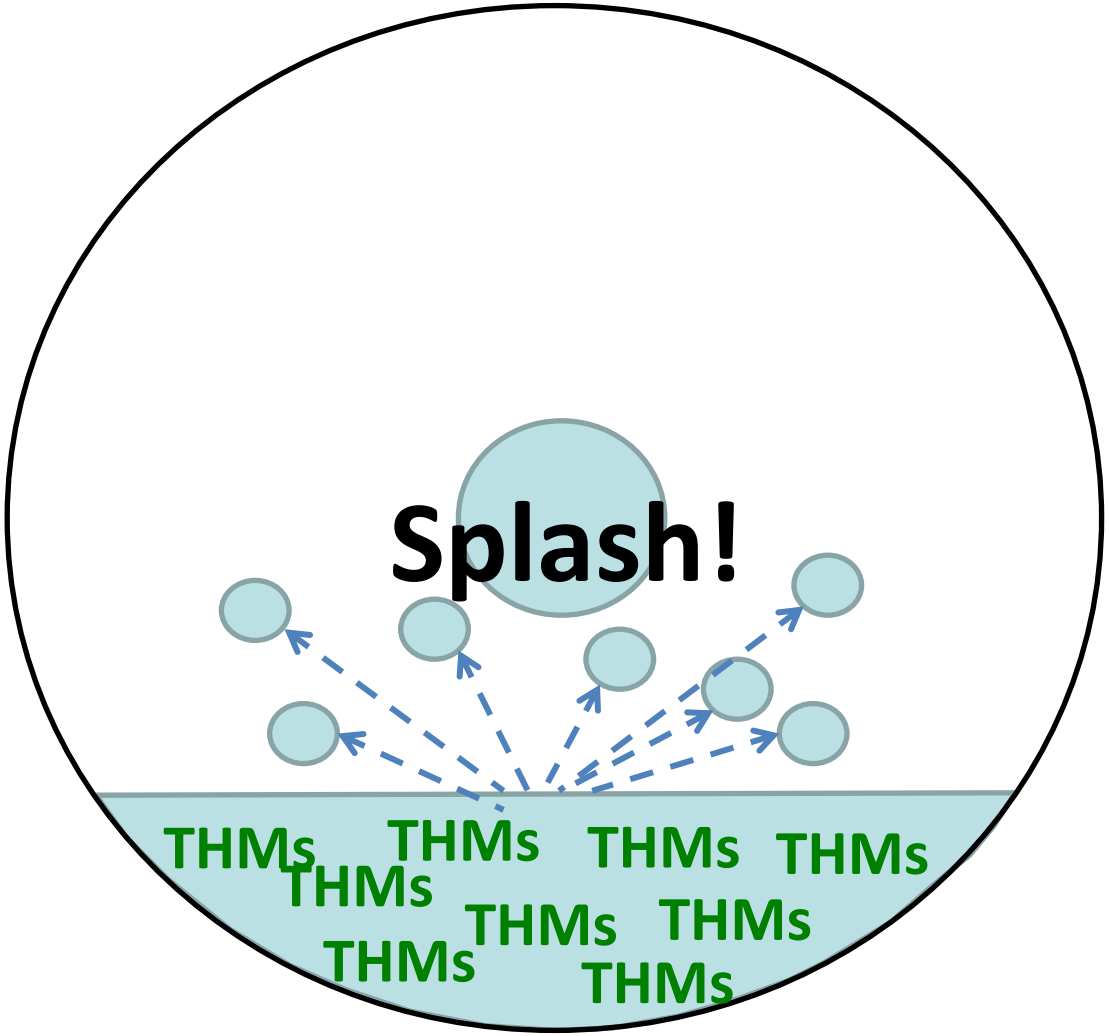
Spray aeration



Evaporation from droplets

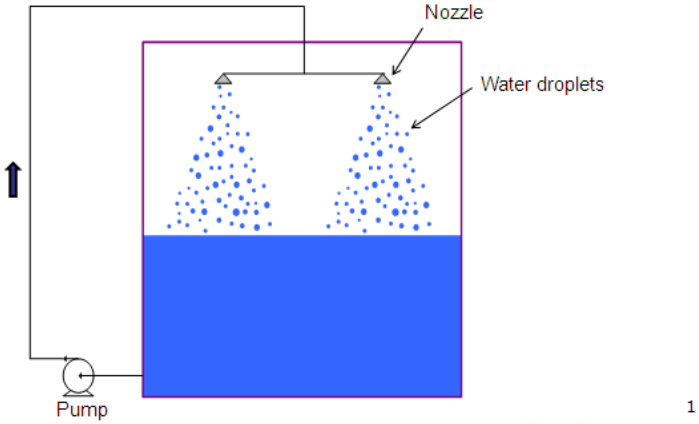


Aeration in splash zone

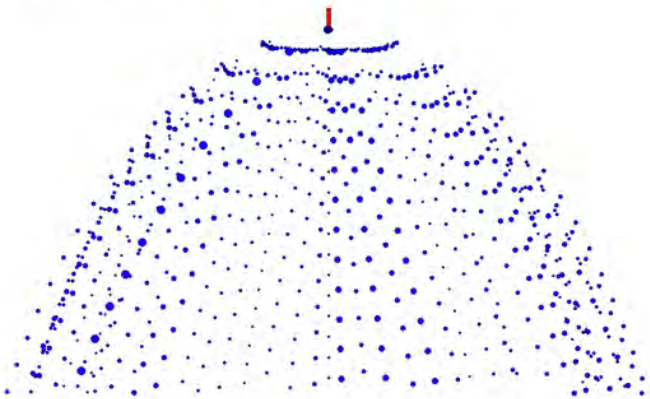


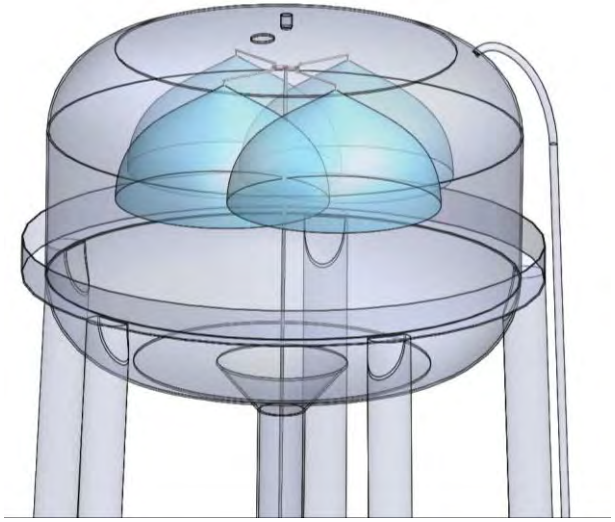
However Accurate THM modeling is!

Water sprayed at the top of the tank to strip DBPs into air

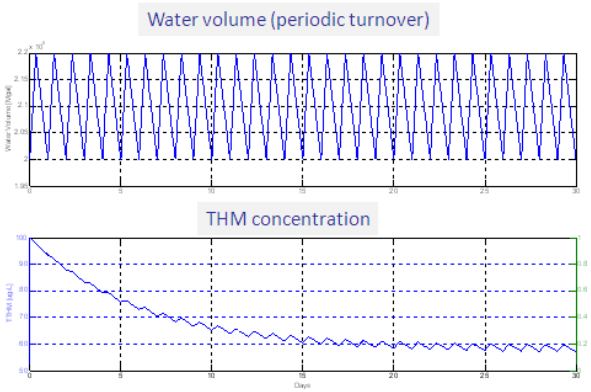


Spray efficiency model





Example of model output



Pilot study: Cal American, Monterey, CA

- Ryan Ranch Tank: 0.5MG, 72' dia., 16' h – end of line, low turnover
- THM levels average 140 μg/L in tank, max 50 μg/L rest of dist. system
- Three quarters of elevated levels, to avoid violation (RAA < 80 μg/L), sample needs to be just around 50 μg/L in Q3-2011
- **Estimate w/o intervention: 140 ug/l**
- Low Cl – periodic dosing onsite

- Cal American allows for only 2 violations across ALL their systems
- American Water corporate engineering had proposed a sprayer aeration system ($350K)
- Limited power at tank

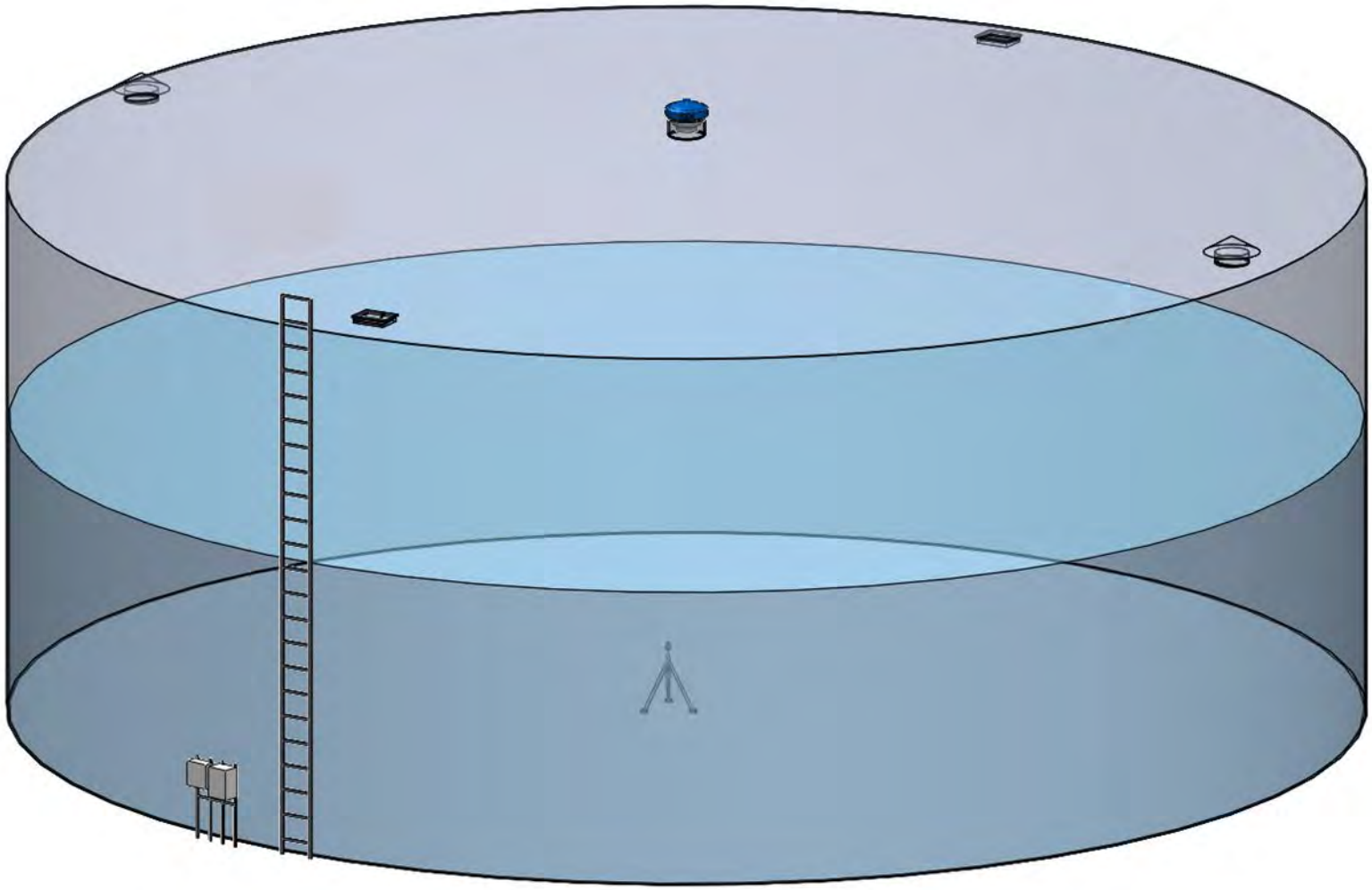
The TRS goals and design

Goals

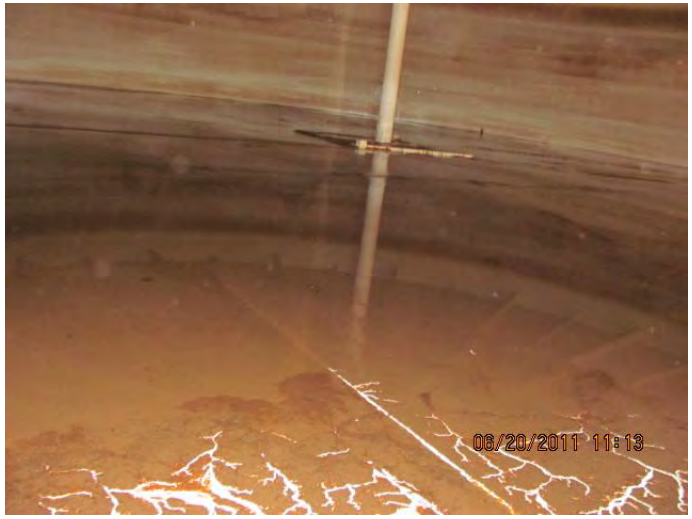
- Lower Cl demand
  - Eliminate stratification
  - Clean tank
- Remove THMs
  - Aeration
  - Goal: 60% reduction
- Use as little power as possible

Design

- Wash-out
- Chemical clean
- 1 PWM-400 mixer
- 1 PAX Powervent fan



TRS installation: Chemical cleaning



TRS Installation: Interior coatings repair

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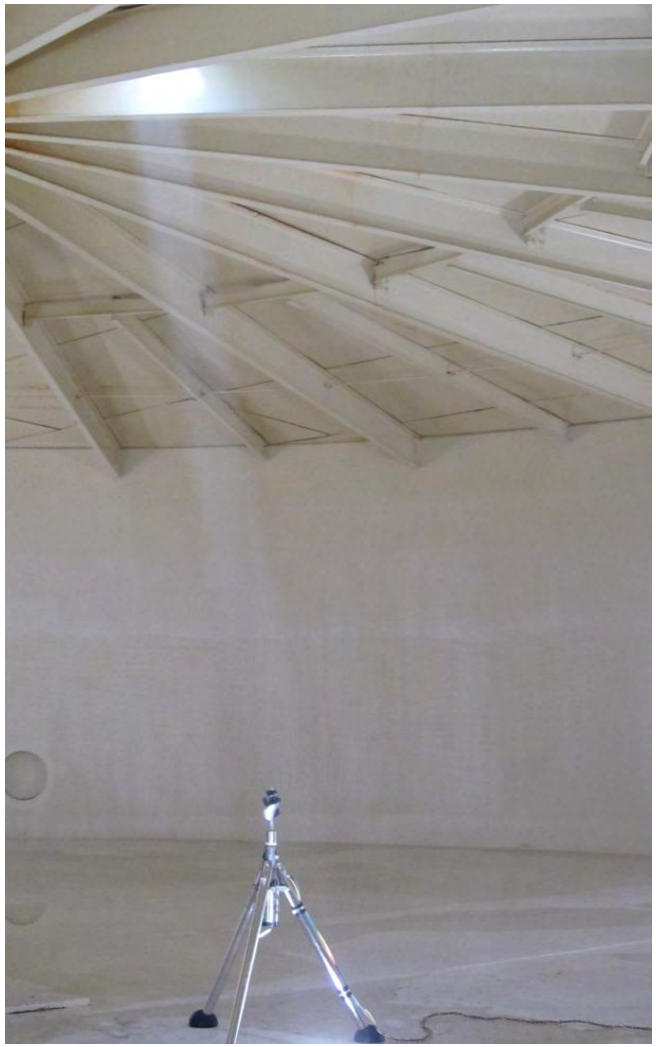
TRS Installation: PAX PowerVent Installation

TRS Installation: Mixer Installation

Initial results of Q3 compliance test

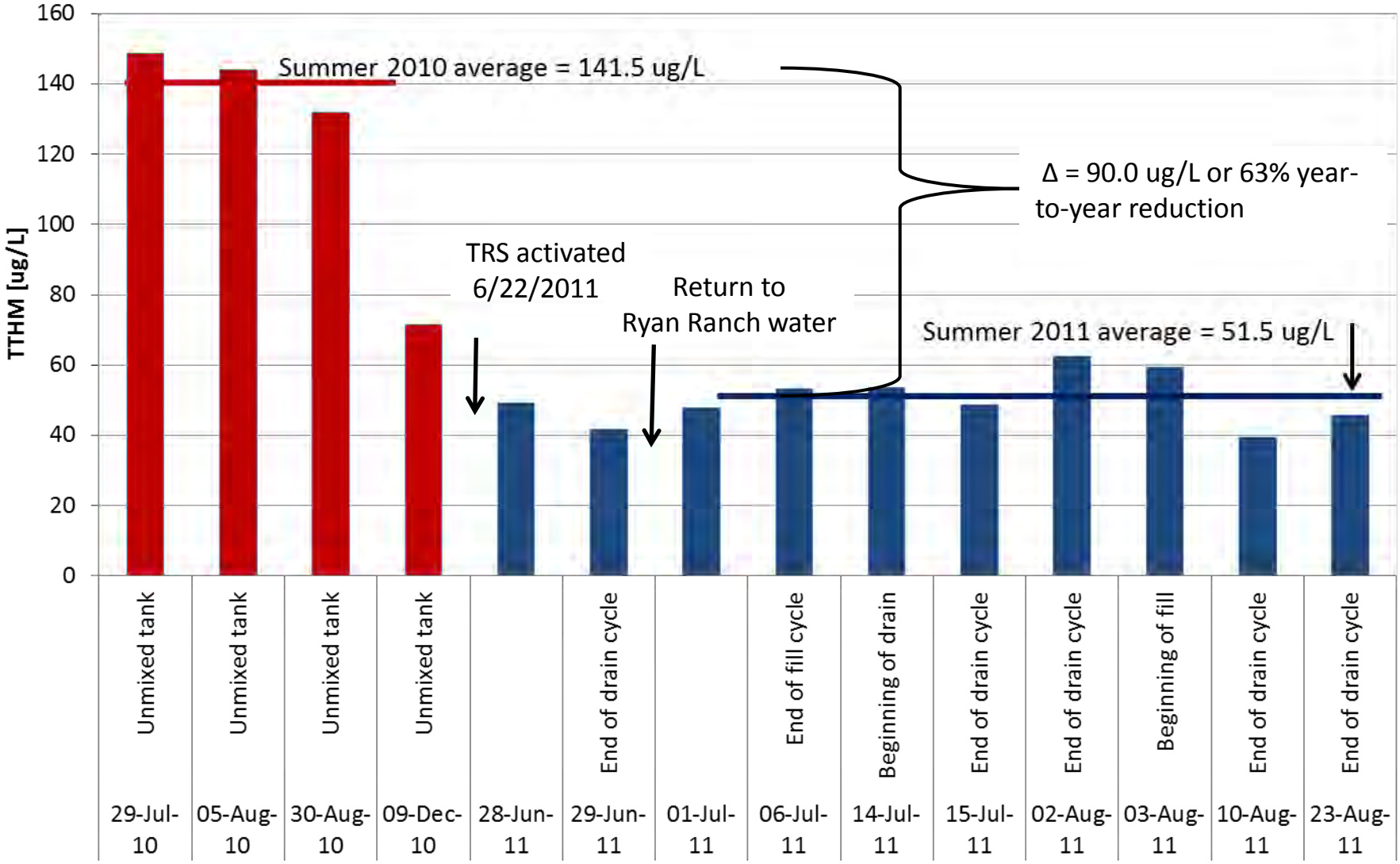


Post-TRS

Q3 Sample result = 49.2 µg/L

RAA = 79.3 µg/L (the MCL is 80…)

Have the low THM levels remained?



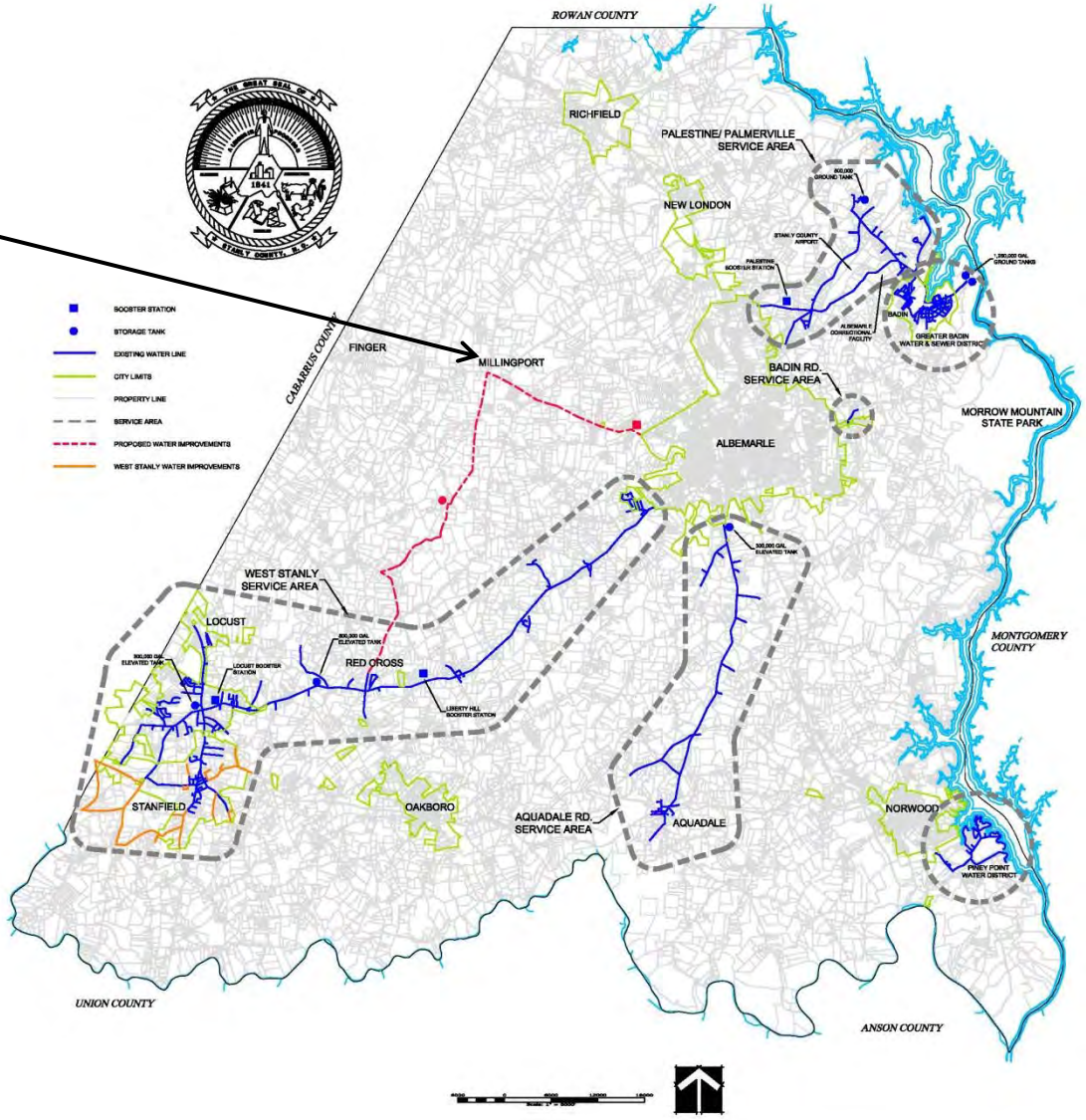
Case Study: Stanly County, NC
Motives: Aerate TTHMs

Stanly County, NC

- Millingport Tank: 200,000 G, Pedisphere – very low turnover
- Received 20 day old water from City of Albemarle
- THM levels average 78 μg/l – highs of 112 μg/l

  - Tried a type of active mixing in 2008 – no effect on water quality or THMs
  - Tank cleaned several times – no improvement

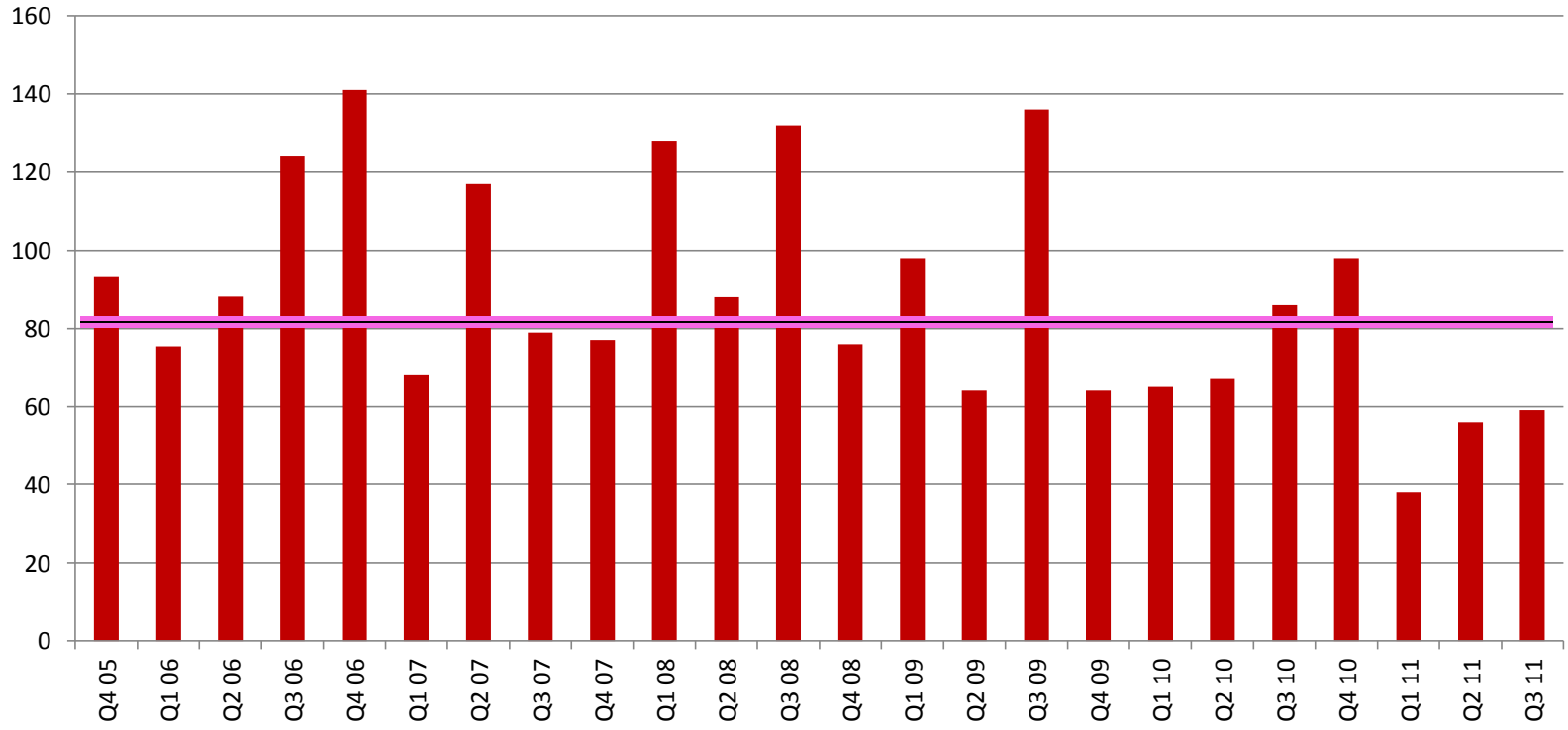
Stanly County, NC
Millingport



Customer Summary		
Service Area	Residential	Commercial
West Stanly	1575	162
Aquadale Rd.	378	24
Palestine/ Palmerville	344	26
Badin Rd.	19	1
Total Stanly County Utilities	2316	213
Piney Point Water District	217	2
Greater Badin Water & Sewer District	573	55

Chambers Engineering, PA
THE COUNTY OF STANLY
201 SOUTH SECOND STREET
ALBEMARLE, NC 28001
STANLY COUNTY PUBLIC UTILITIES
WATER SERVICE AREAS
EXISTING & PROPOSED

Millingport Stage 1 DBP history



The combination of small tank and low T/O makes for high TRS effectiveness

The TRS goals and design

Goals

- Remove THMs
  - Goal: 60% reduction

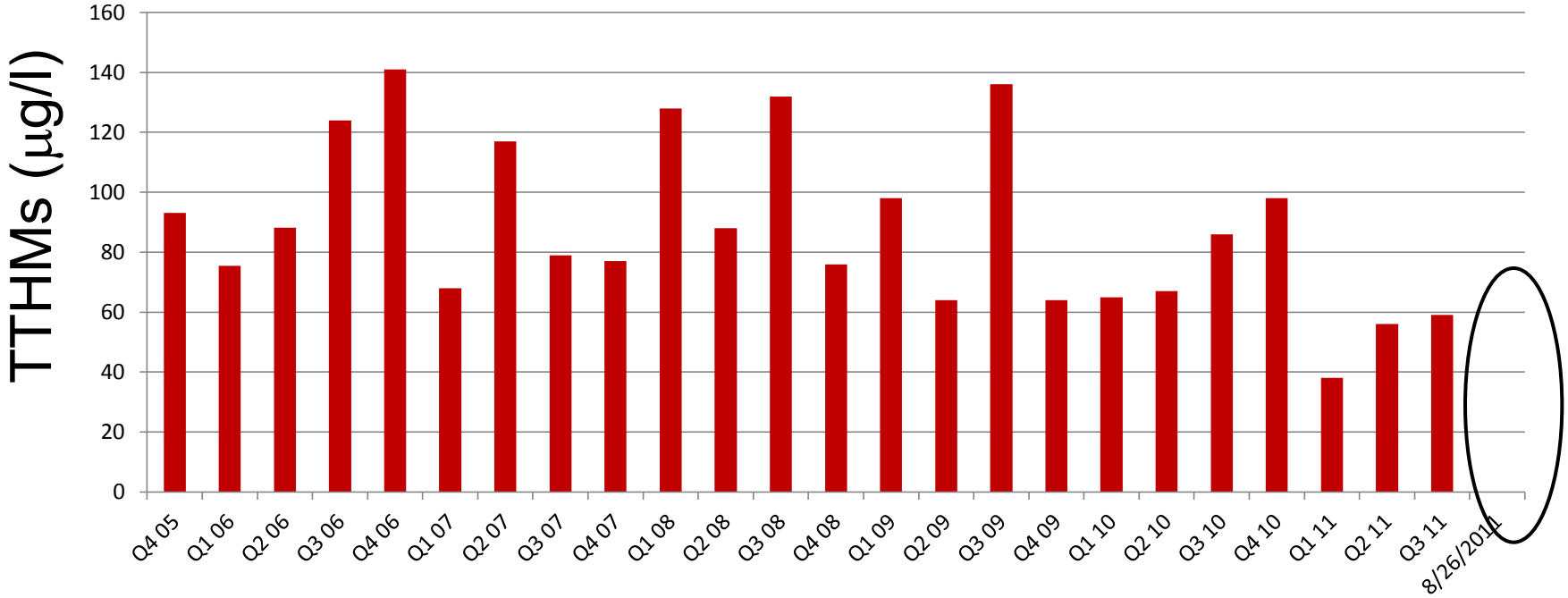
Design

- 4-nozzle sprayer system
- 1 PAX Powervent fan

No MIXER?
Accurate modeling allows the correct configuration & most efficient design. Why pay for something that isn't needed?

  - NEPTUNE models suggested >90% THM reduction…

After operation of the TRS



PAX WATER TECHNOLOGIES™

Location Code: TRC

Collection Date: 8/26/11

Collection Time: 13:16 PM

Collected By: DAVID FISHER, JR.

Mail Results to (water system representative): STANCO

Stanly County Utilities Dept
Attn: David Fisher,Jr
1000 N. First Street
Suite 12
Albemarle, NC 28001

Responsible Person's Info:

Phone: 1-704-986-3686

Fax #: 1-704-986-3711

Email: utservice@co.stanly.nc.us

Laboratory ID#: 37731

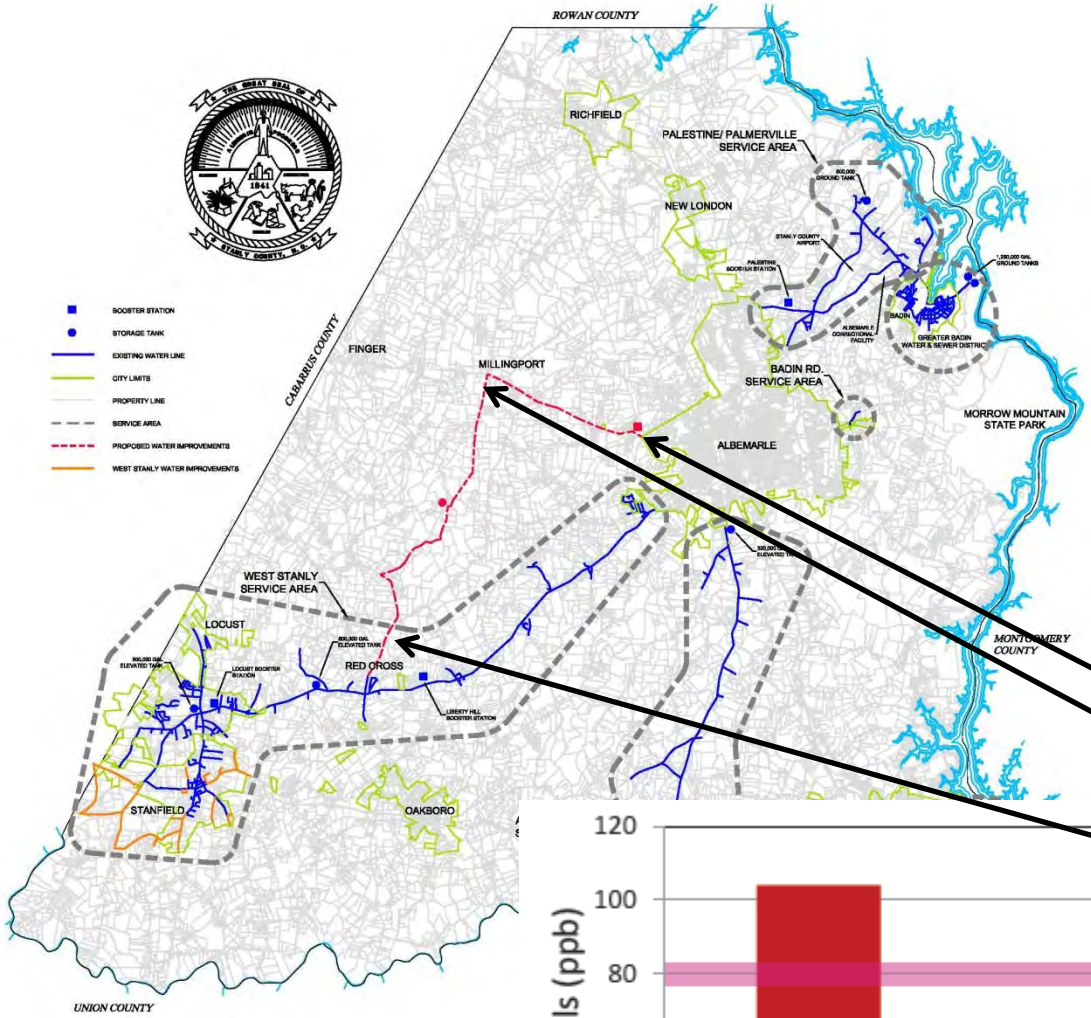
☐ SAMPLE UNSATISFACTORY ☐ RESAMPLE REQUIRED

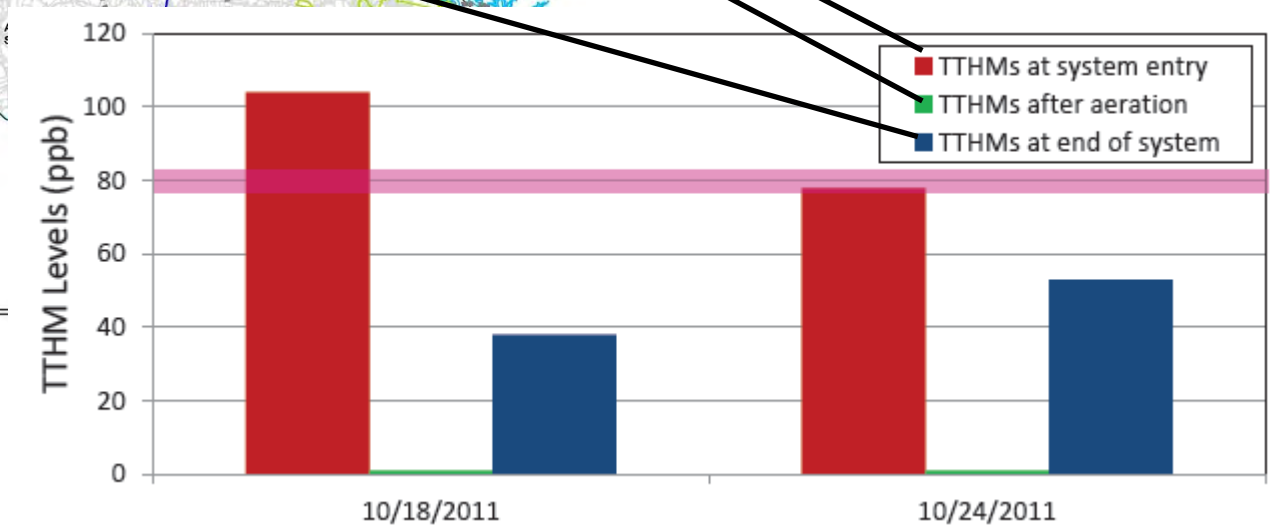
CONT. CODE	CONTAMINANT	METHOD CODE	REQUIRED REPORTING LIMIT (R.R.L)		QUANTIFIED RESULTS		ALLOWABLE LIMIT	
2941	Chloroform	502.2	0.001	mg/L	<0.001	mg/L	0.100	mg/L
2942	Bromoform	502.2	0.001	mg/L	<0.001	mg/L	0.080	mg/L
2943	Bromodichloromethane	502.2	0.001	mg/L	<0.001	mg/L	0.080	mg/L
2944	Chlorodibromomethane	502.2	0.001	mg/L	<0.001	mg/L	0.080	mg/L
2950	Total Trihalomethanes	502.2	0.0010	mg/L	<0.0010	mg/L	0.080	mg/L

100% THM removal

PAX WATER TECHNOLOGIES™

Further out in the distribution system…





Chambers Engineering, PA
THE COUNTY OF STANLY
201 SOUTH SECOND STREET
ALBEMARLE, NC 28001
STANLY COUNTY PUBLIC UTILITIES
WATER SERVICE AREAS
EXISTING & PROPOSED

To summarize todays talk

1. Mixing can: Improve water & minimize Risk
    a) mixer strength is crucial!
2. Automated Residual Feed
    a) Reduces labor
    b) Reduces chem costs
    c) Reduces Risk (nitrification, DBPs)
3. Aeration is not new
    a) can be accurately modeled (% removal upfront)
    b) reduced trial and error costs

Questions?

Nathan Miller
nmiller@paxwater.com