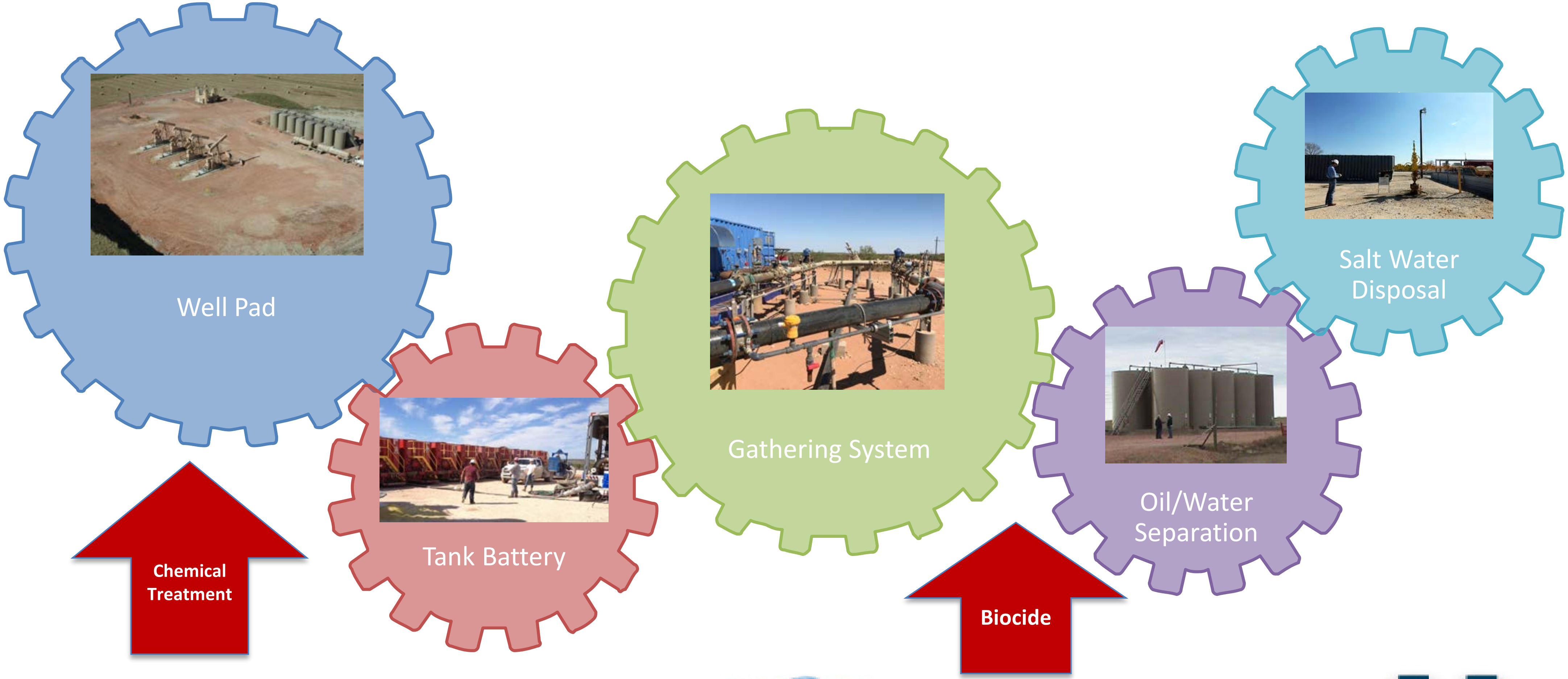
HYDROZONIX

Treatment for Blended Produced and Fresh/Brackish Water

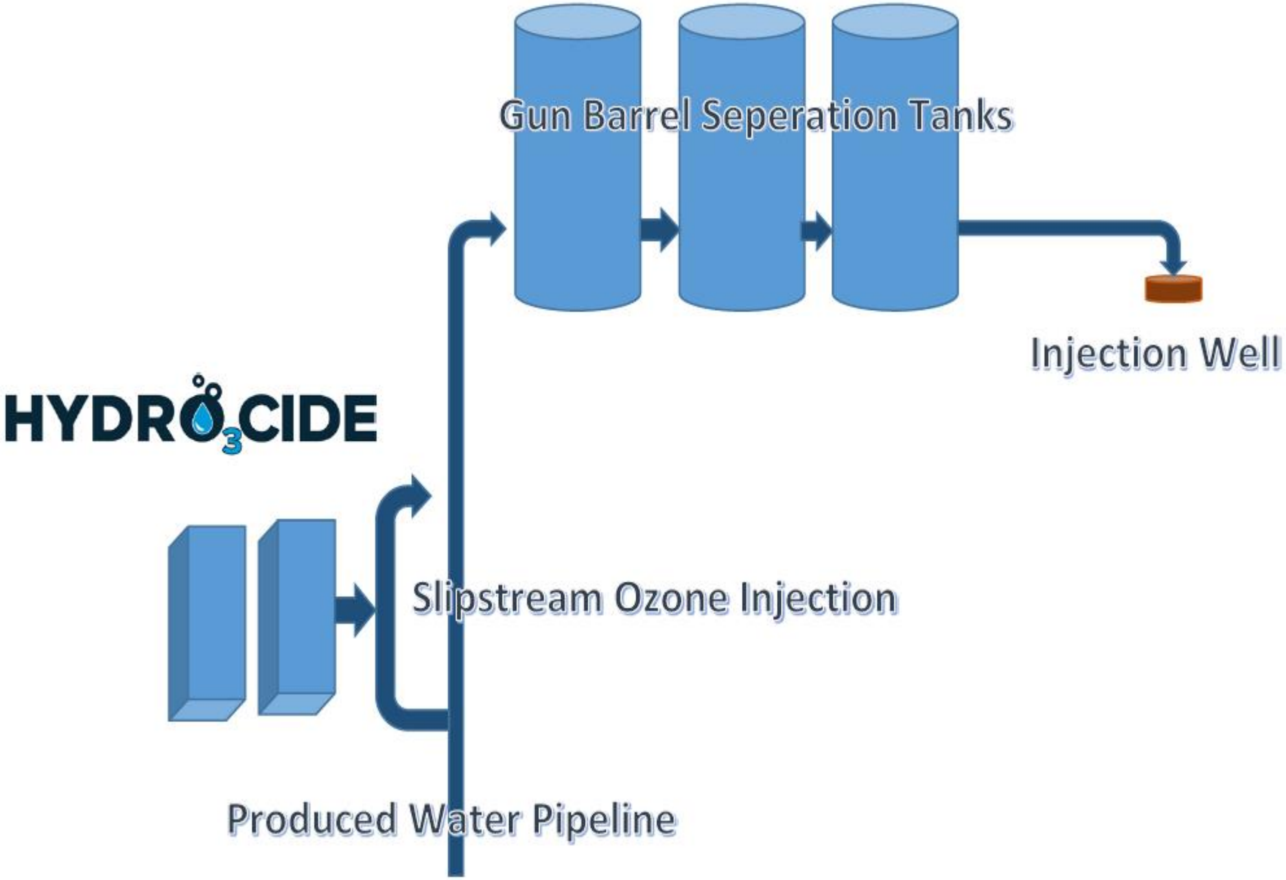
Produced Water Cycle

Wellhead to Injection Well



HYDRO3CIDE

Typically placed prior to gun barrels to prevent bacteria and provide iron control



H2O

Produced Water Cycle

Wellhead to Reuse

Produced Water Options

Where are you getting your Produced Water

Tank Battery

Gun Barrel OWS

Produced Water from tank batteries can have higher oil, iron and solids. Must consider this if recycling from this point

HYDRO3CIDE

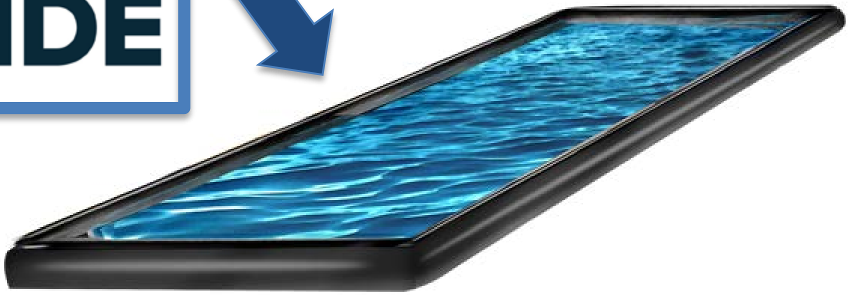
Produced Water from Gun Barrels is generally better quality. Low oil, low solids and if oxidation is being used for bacteria control, low iron

Produced Water Options

Typical Reuse Model

Tank Battery

Gun Barrel OWS



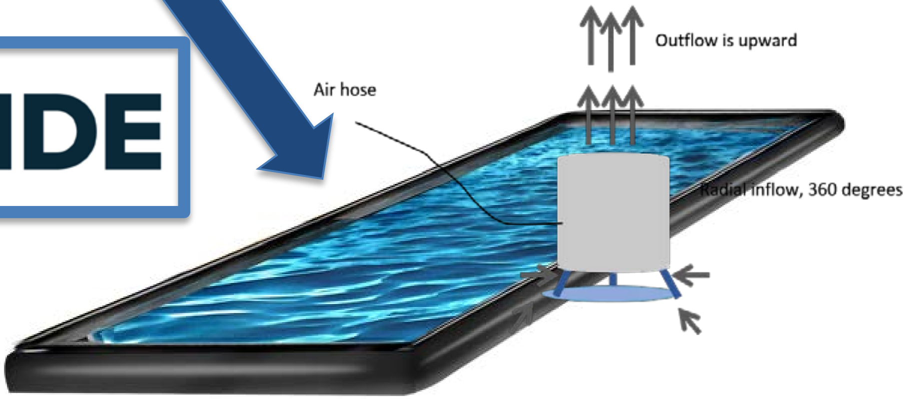
Produced Water Options

Typical Reuse Model w/Aeration

Tank Battery

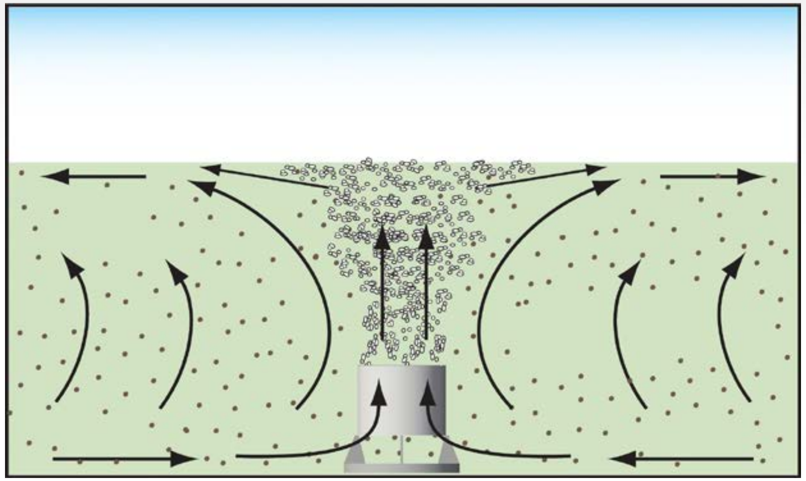
Gun Barrel OWS

HYDRO3CIDE

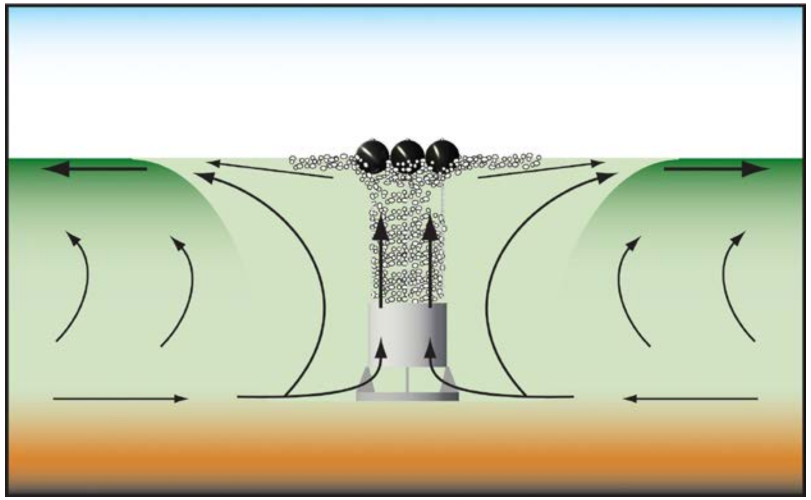


Aeration Background

- Air Driven
- Submersible or Floating
- Submersible better for oxidation and solids control
- Submersible include bubble tubing and diffuser type systems
- Floating only aerates the top few feet, leaving the remaining water to foul and bacteria to grow
- **Systems must be sized based on water quality and oxygen demand**



Submersible

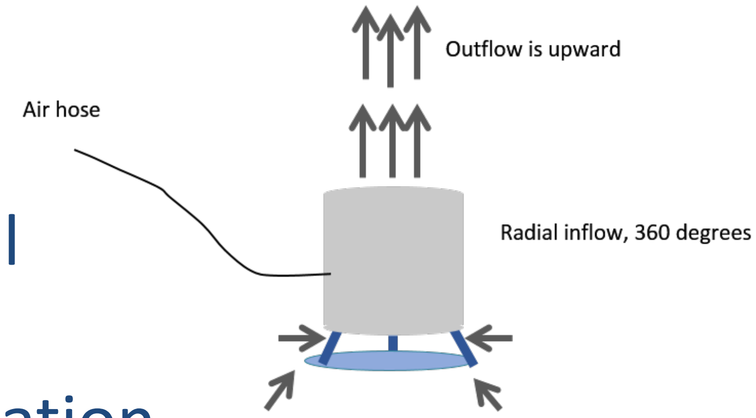


Floating

Aeration: Produced Water

Aeration Benefits

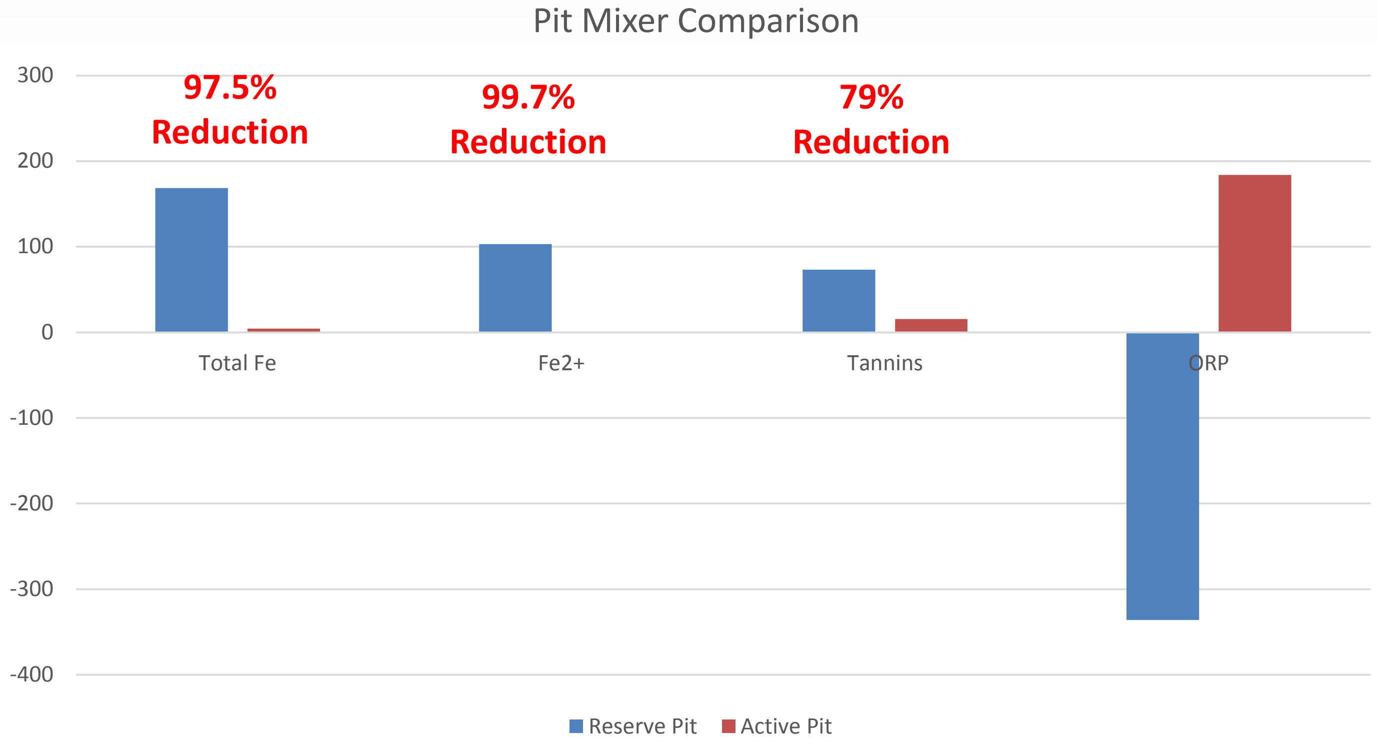
- Bacterial Control/Growth Inhibition
- Algae Control/Growth Inhibition
- Iron Control
- Sulfide Control
- Stratification Control
- Icing Inhibition
- Mixing / Homogenization
- Low Cost



Aeration: Produced Water

Produced Water Pit Mixing w/Aeration

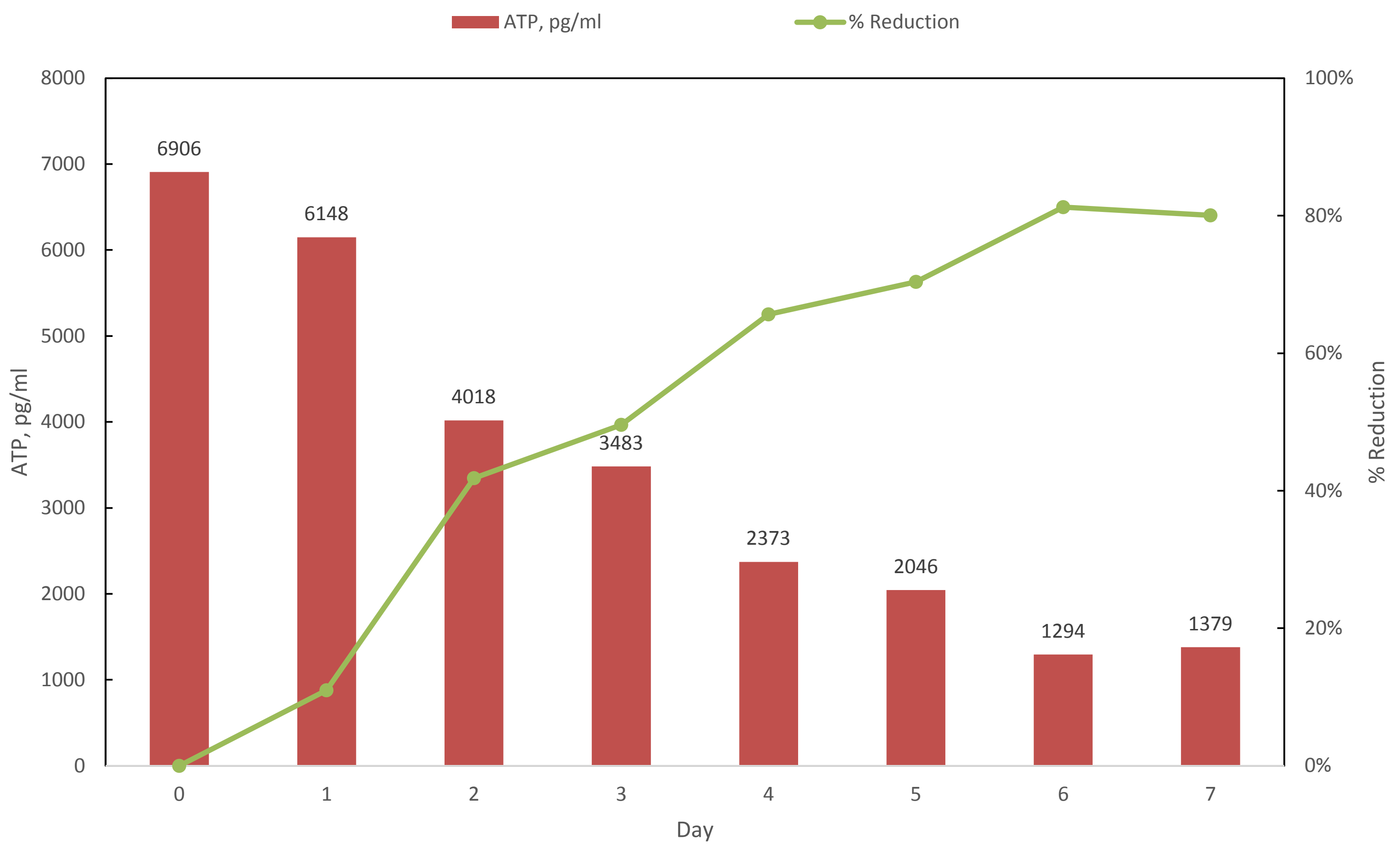
Improved Water Quality – 24 hour



Parameters	Active Pit with Mixing / Aeration	Reserve Pit without Mixing / Aeration
Pit Volume, bbl	100,000	15,000
ORP, mv	184	-336
Total Fe, mg/L	4.3	168.7
Fe^{2+}, mg/L	0.3	103.0
Tannins, mg/L	15.5	73.0

<u>Case Study :</u> What Aeration Does

ATP over time



Produced Water Reuse Requirements

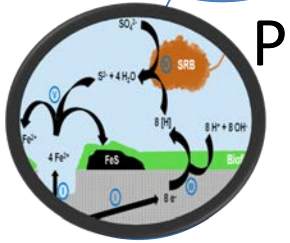
What Are Your Goals

Constituent	Slickwater	Guar (Linear)	Guar (XL)	Hybrids (XL)
Chlorides (ppm)	140K (anionic) No Limit (cationic)	60K	60K	60K
Total Hardness (ppm)	50K	20K	20K	20K
Iron (ppm)	25	10	10	10
Oil (ppm)	100	50	50	50
TSS (ppm)	100	100	100	100
Boron (ppm)	No Limit	10	10	No Limit
Bacteria (cfu/ml)	100	100	100	100

Water Treatment Requirements

Slickwater Fracs

Bacteria Control



Primary

Bacteria causes corrosion, plugging/fouling and generation of hydrogen sulfide

Primary

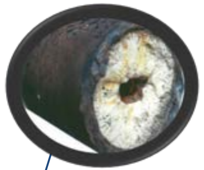
Iron & Sulfide Control

Iron can cause formation damage and Sulfides form dangerous gases

Solids Control

Secondary

Solids can cause formation damage and contribute to plugging/fouling



Tertiary

Scale Inhibition

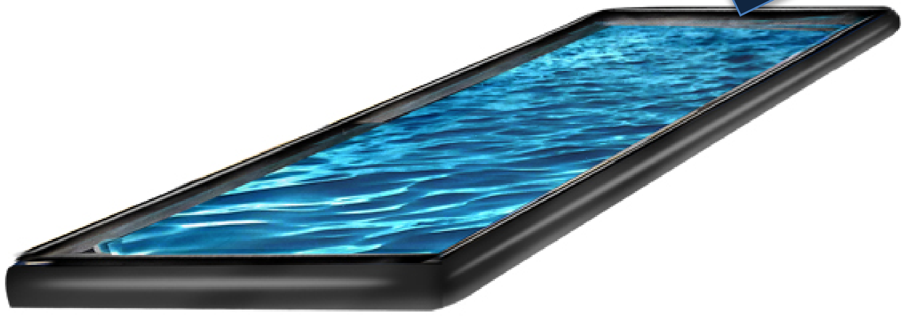
Scale can cause plugging/fouling, and contribute to underlayment corrosion

Water Treatment Requirements

Conventional Treatment Program

Blend

Disinfection



Fresh/Brackish Water

Produced Water

Treatm

Pr

ova

(S ning)

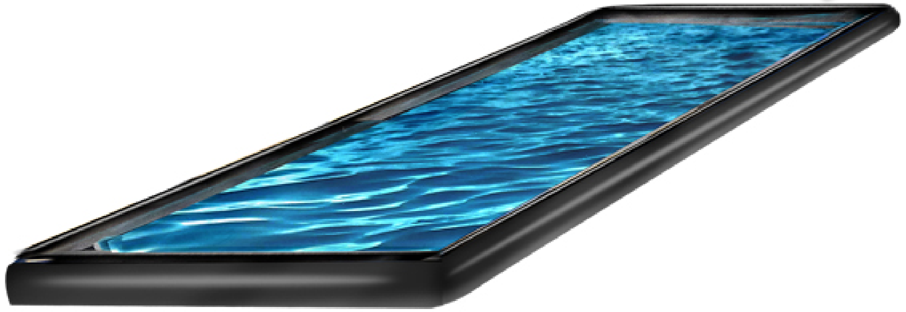
- Floc and drop
- EC

Water Treatment Requirements

Conventional Treatment Program

Blend for Scale Inhibition/Add Scale Inhibitor

Disinfection



Fresh/Brackish Water

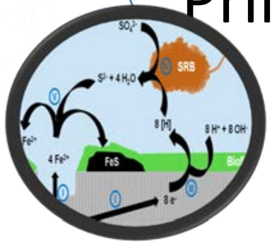
Produced Water

Water Treatment Requirements

Slickwater Fracs

Bacteria Control

Primary



Bacteria causes corrosion, plugging/fouling and generation of hydrogen sulfide

Iron & Sulfide Control

Primary

Iron can cause formation damage and Sulfides form dangerous gases

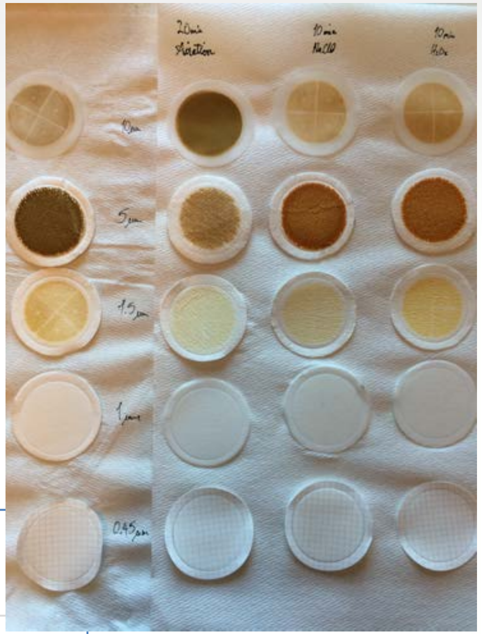
Solids Control

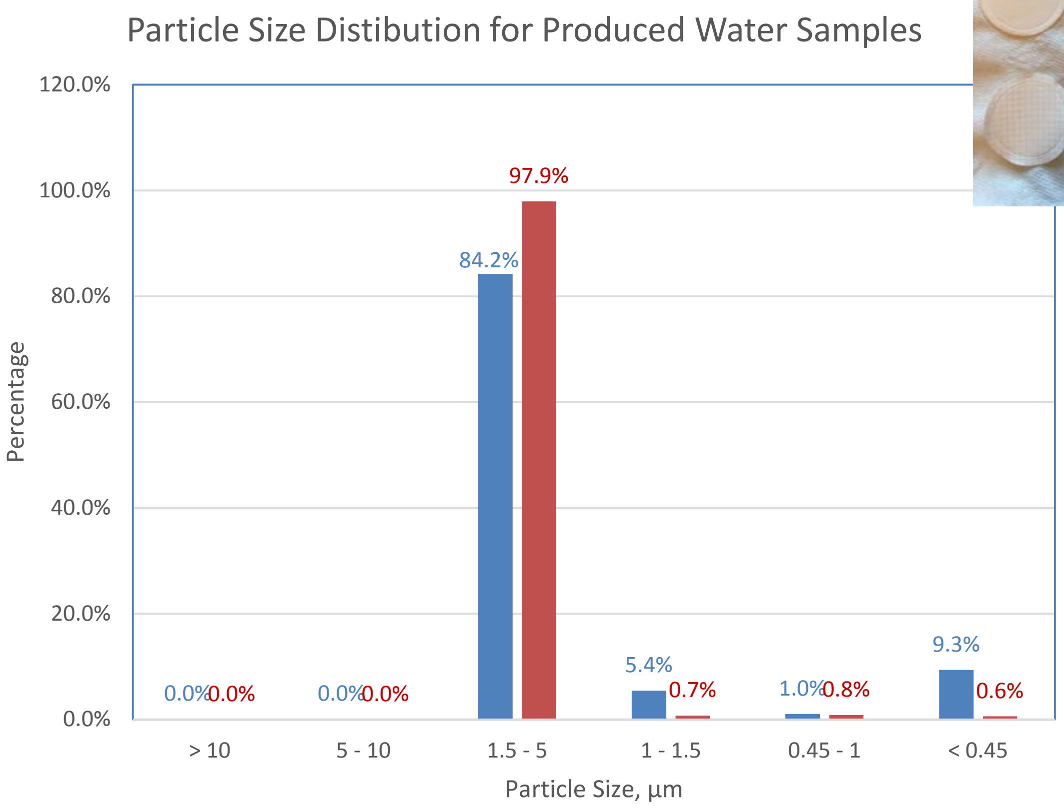
Secondary

Solids can cause formation damage and contribute to plugging/fouling

The Hydrozonix Difference

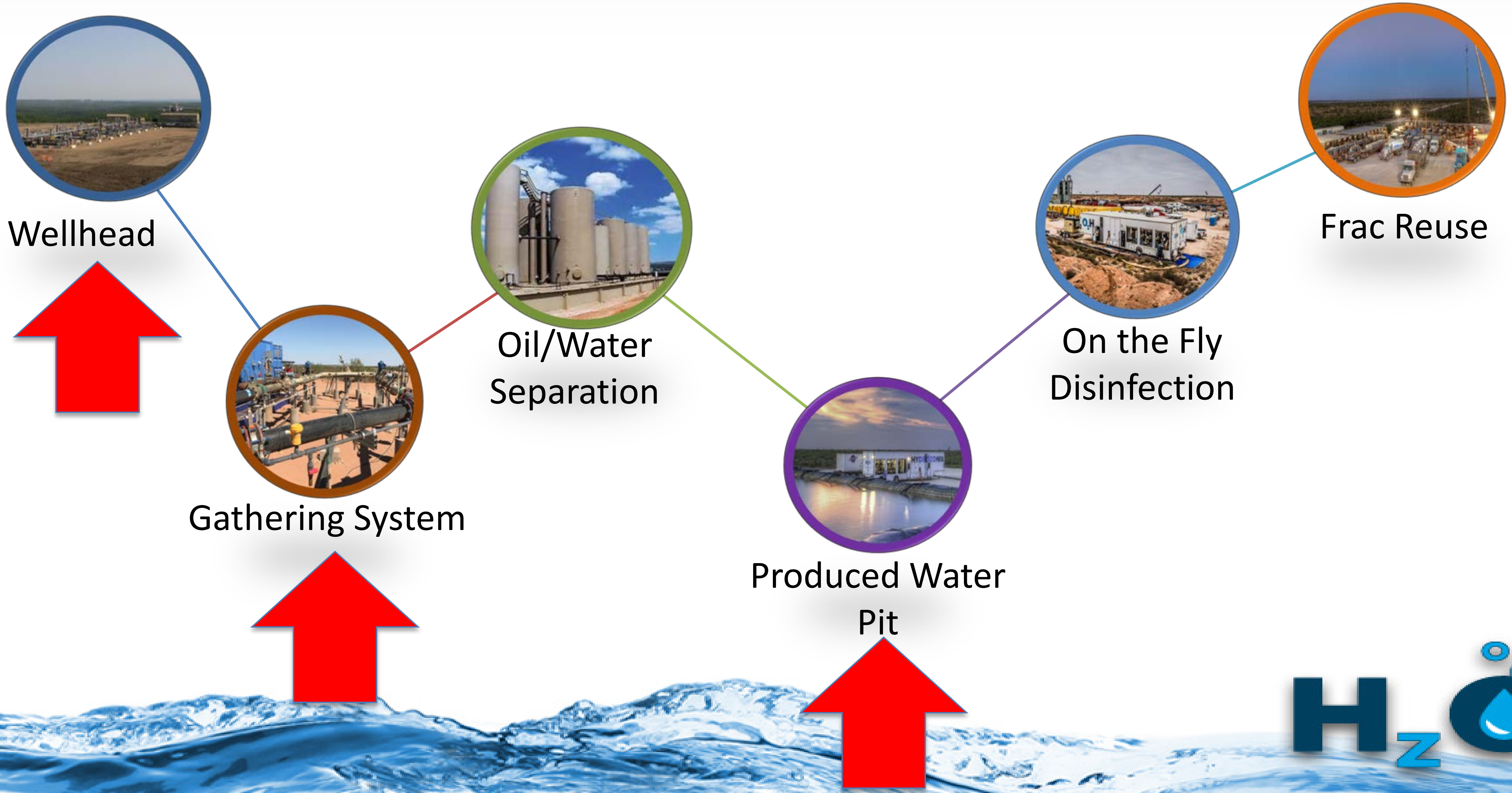
- Identify right micron size to satisfy your goal
- Field evaluations and size distribution are performed to identify micron size performance
- Nominal vs. Absolute





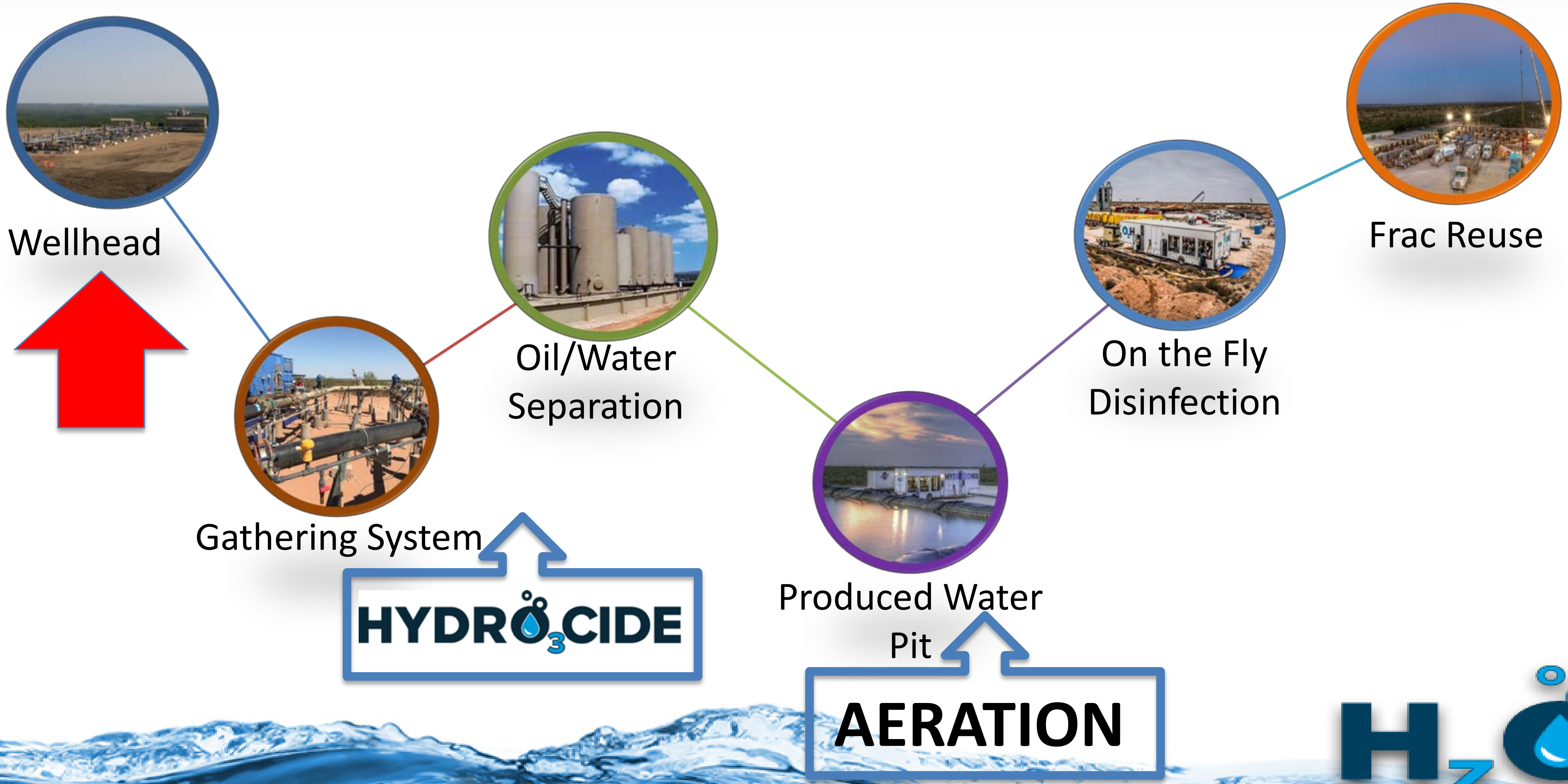
Prodcued Water Reuse Cycle

Slickwater Fracs



Prodcued Water Reuse Cycle

Slickwater Fracs



Produced Water Management for Reuse

HYDRO$_3$CIDE

Bacteria, Iron & Sulfide Control

Bacteria: 90%

Iron: 90%

Sulfides: 90%

Aerating Mixer

Bacteria, Iron, Sulfide & Solids Control

Bacteria: 70%

Iron: 90%

Sulfides: 80%

On-the-Fly

Bacteria, Iron & Sulfide Control

Bacteria: 90%

Iron: 90%

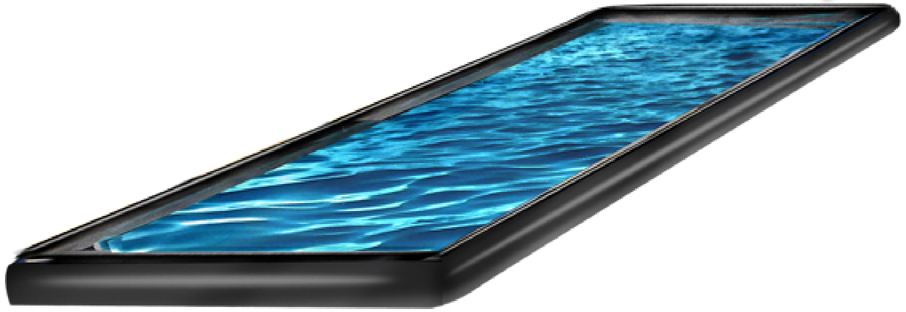
Sulfides: 90%

Water Treatment Requirements

Conventional Treatment Program

Blend for Scale Inhibition/Add Scale Inhibitor

Disinfection

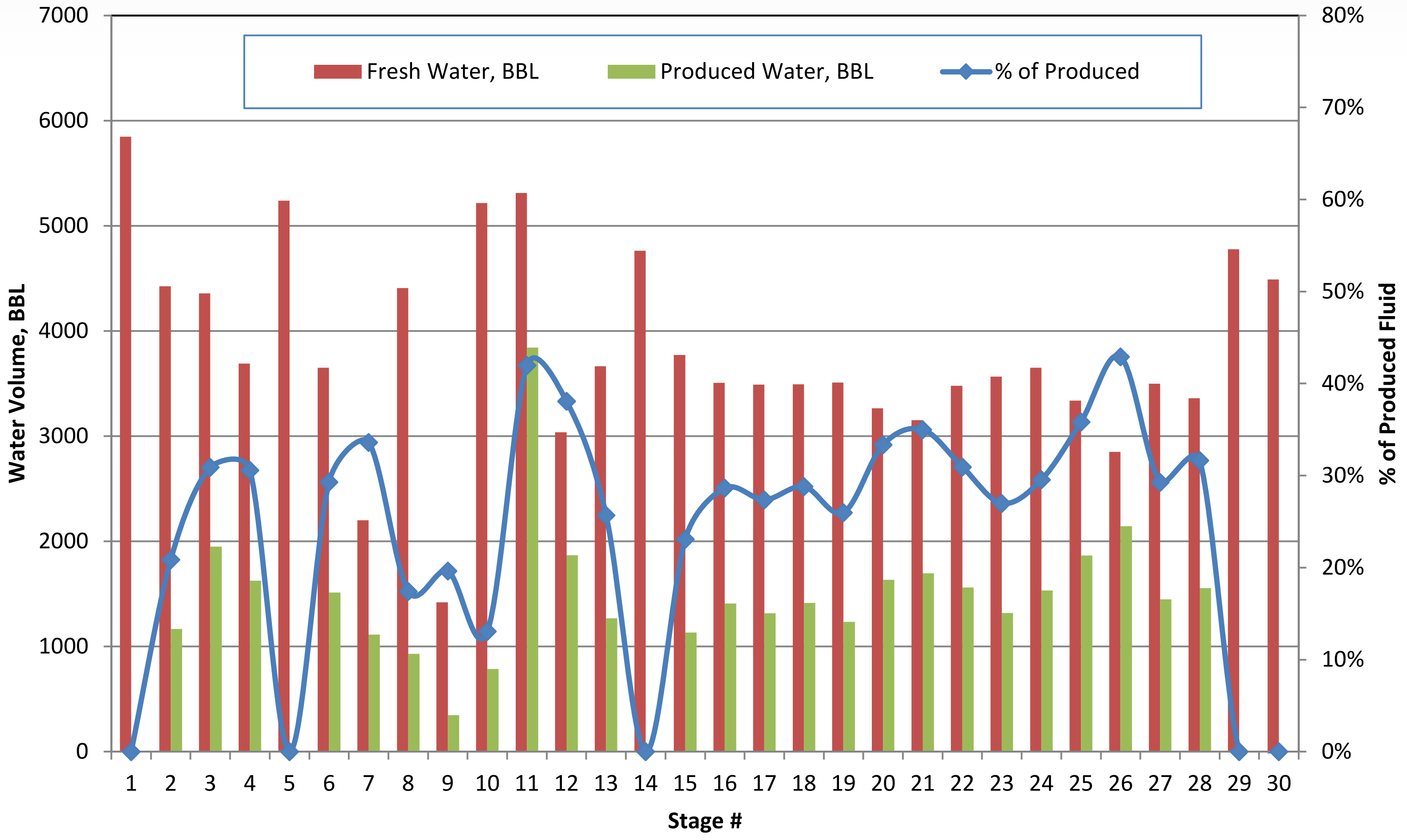


Fresh/Brackish Water

Produced Water

Blend Control

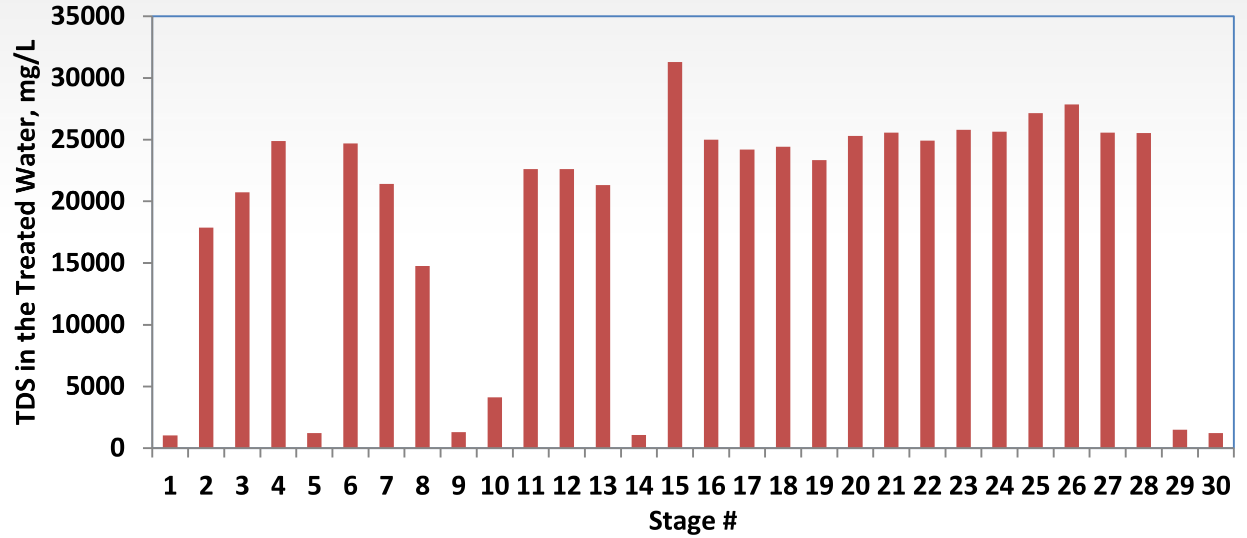
No Control

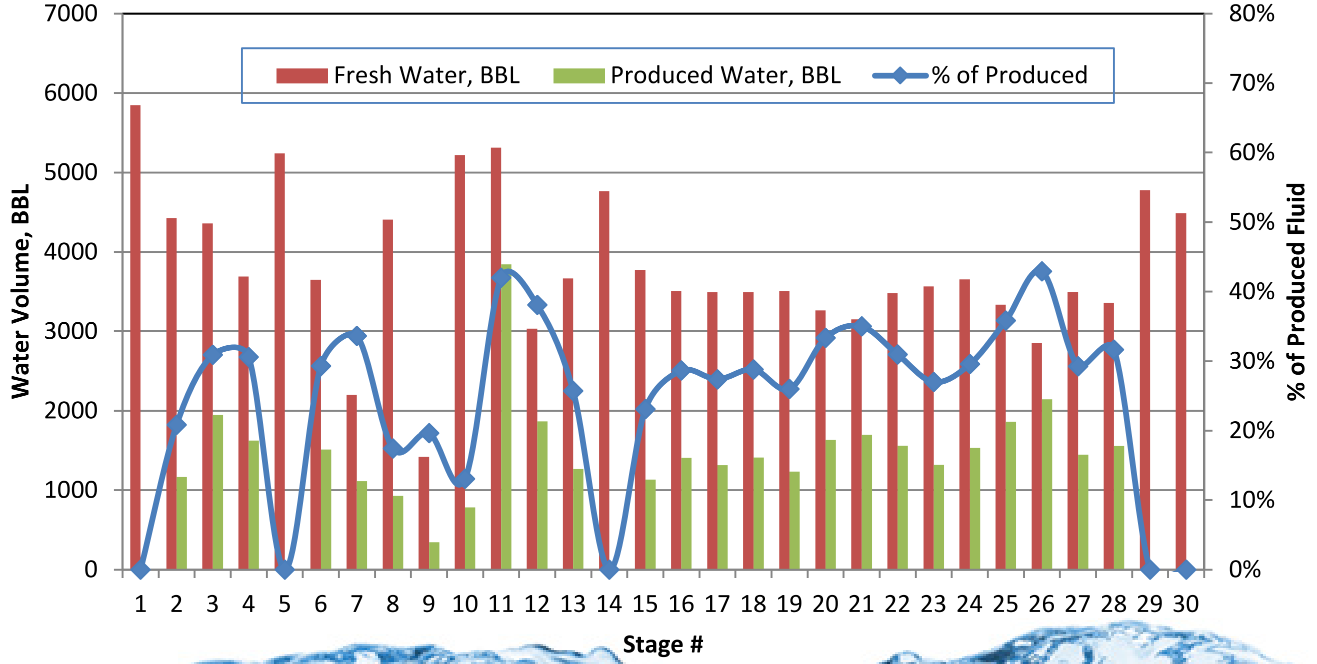


Volume of Fresh Water and Produced Fluid Treated at Different Stages

Blend Control

TDS & Blend Ratio

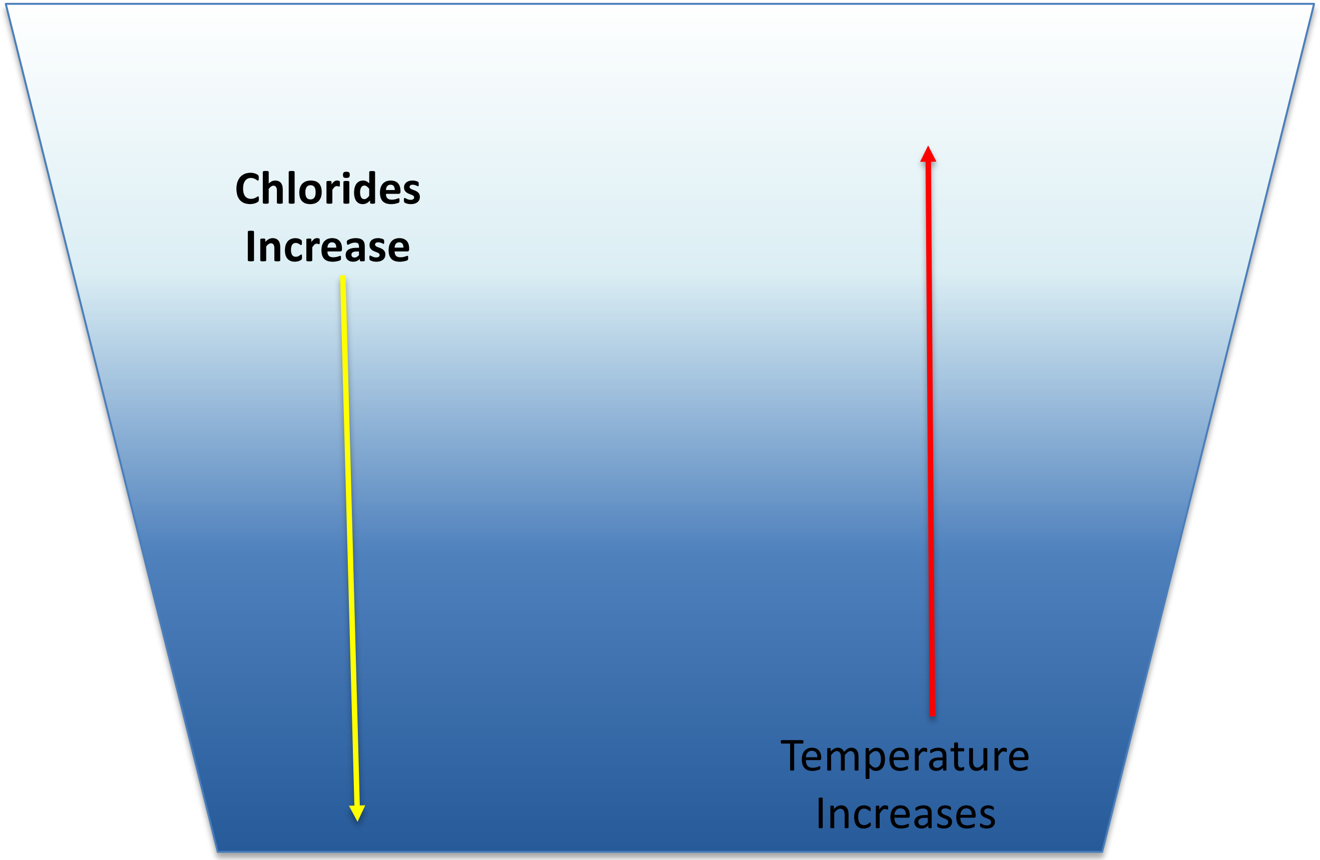




Produced Water Stratification

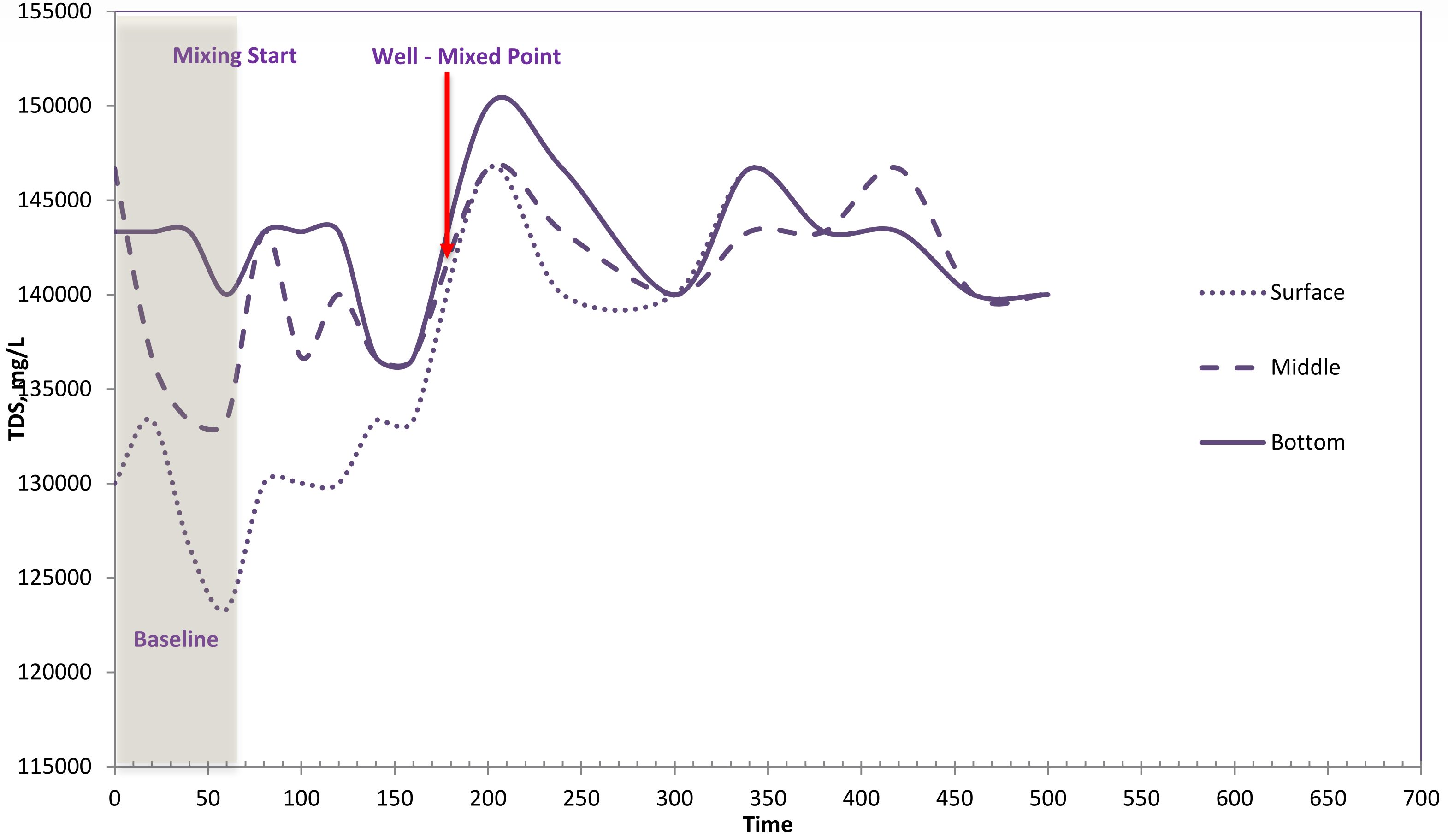
Pit Stratification

- A static, unmixed pit will stratify
- Chlorides will increase with depth
- Temperature will decrease with depth
- Zones are created at different depths with changing water quality



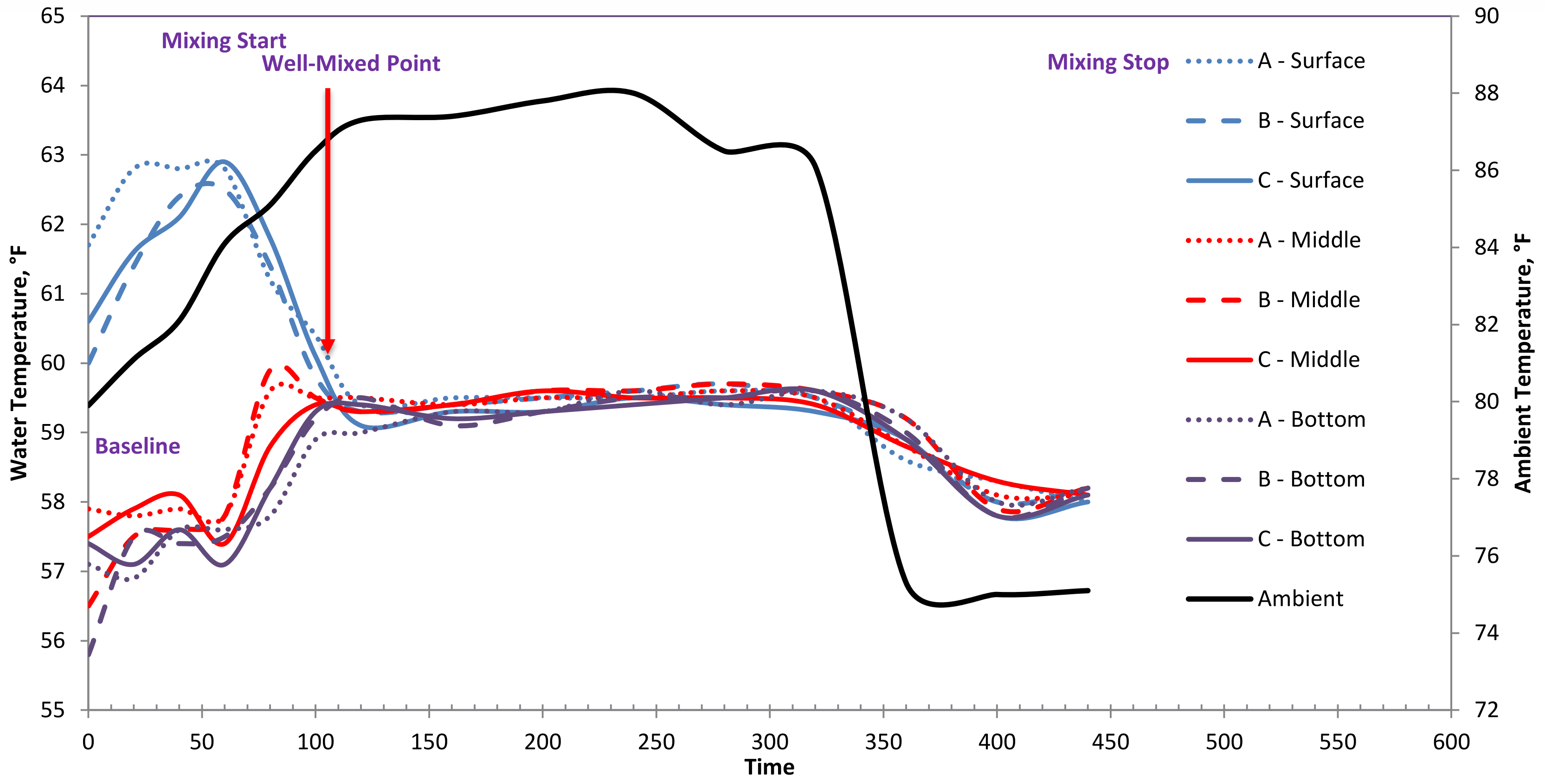
Produced Water Pit Mixing

Continuous TDS Monitoring: Baseline shows stratification



Produced Water Pit Mixing w/Aeration

Continuous Temperature Measurement: 3 zones monitored

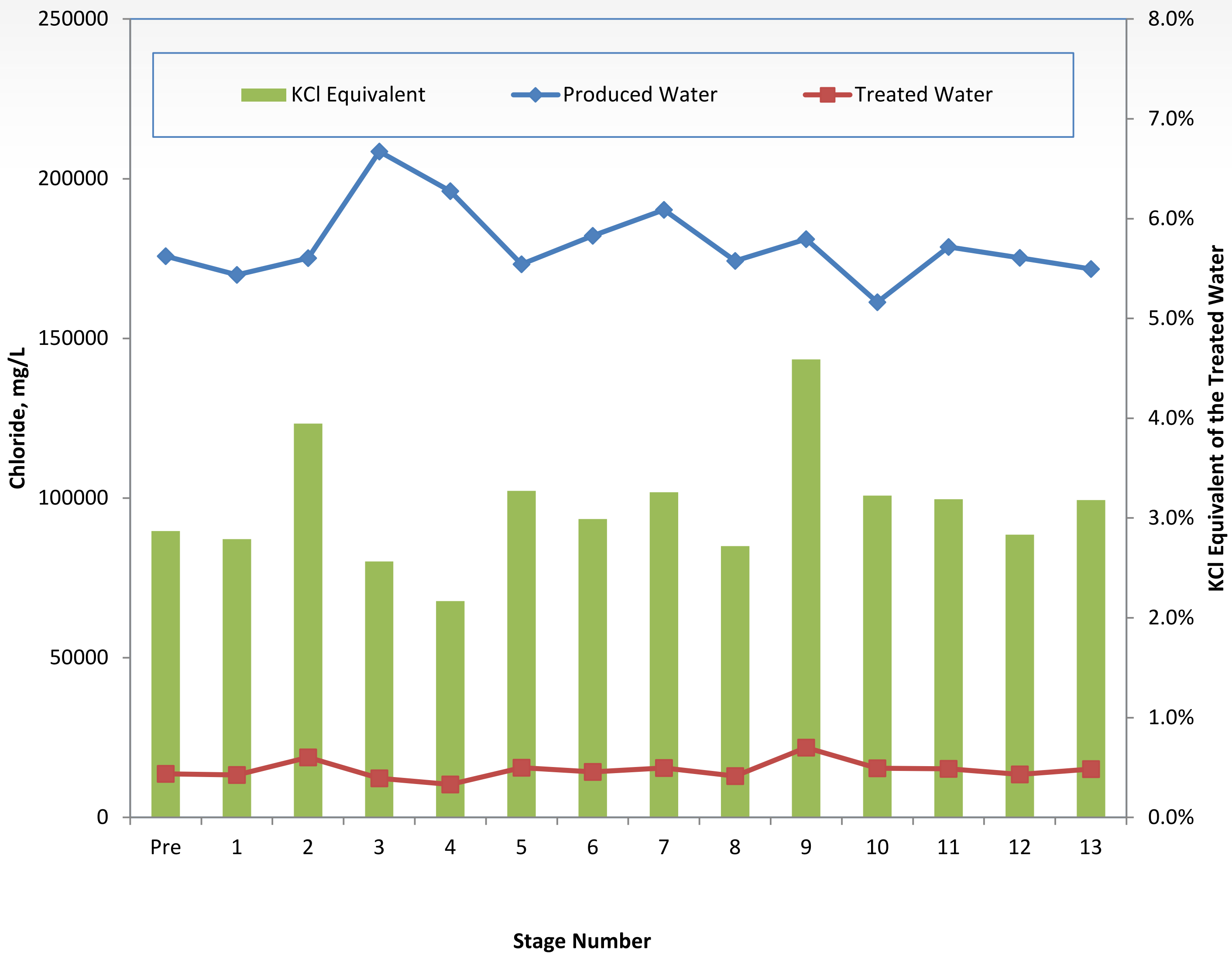


Blend Control

Keep Blend Ratio Consistent with TDS/Chloride Real Time Monitoring

Monitor Chlorides and TDS

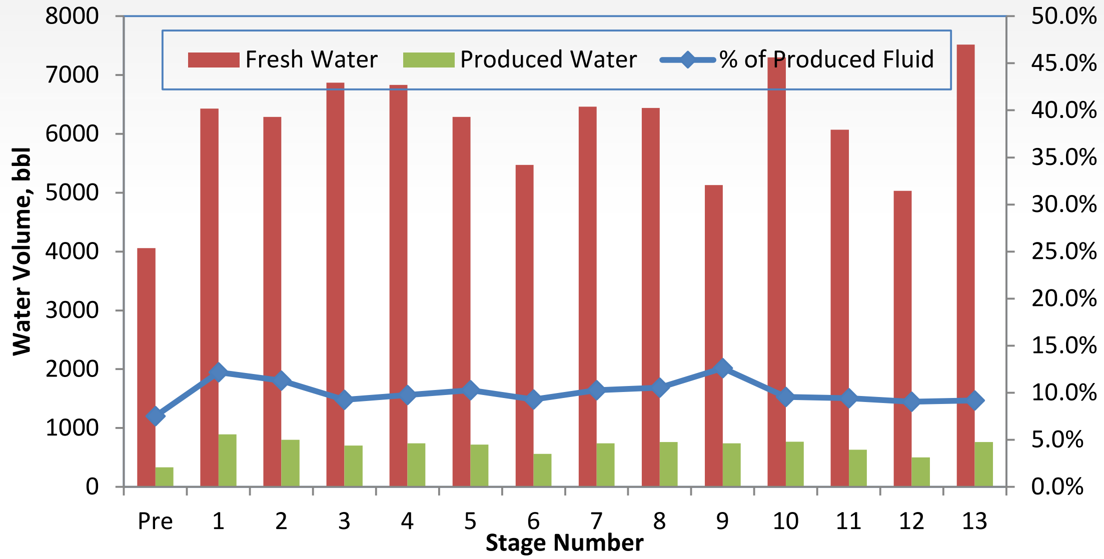
- To Monitor Blend
- For KCl equivalency

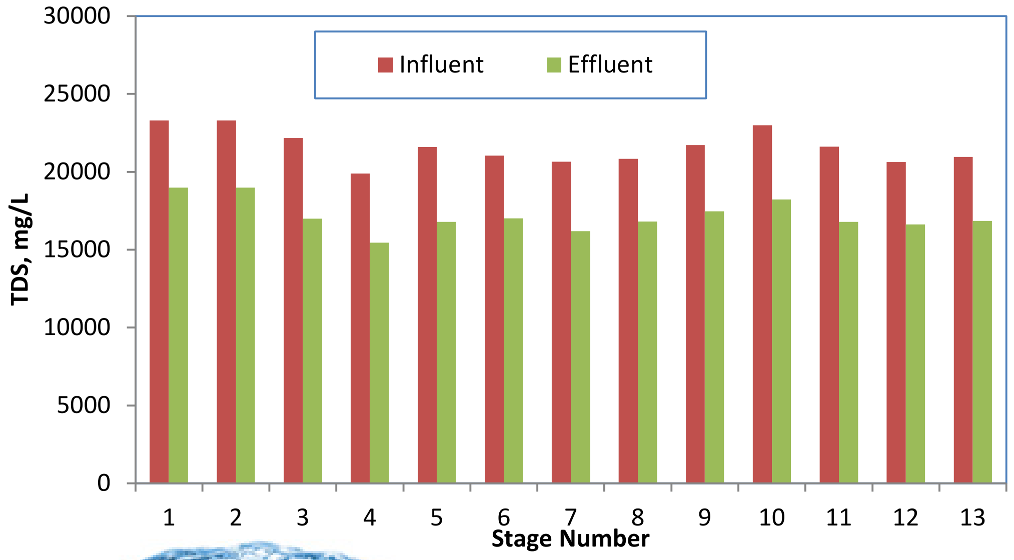


Solution

Keep Blend Ratio Consistent

- Calibrate Pumps
- Monitor TDS Real Time
- Adjust Blend Ratio
- Prevent Friction Reducer Compatibility Issues





Basics of Produced Water Reuse

Five Principal Requirements

Pretreatment
HYDRO$_3$CIDE
Bacteria, Iron & Sulfide Control

Solids Control
Filtration
No what micron size you need.

Pit Treatment
Aeration
Bacteria, Iron & Sulfide Control

On-the-Fly
Bacteria Control
Bacteria, Iron & Sulfide Control w/ Ozone

Water Quality Assurance
Real Time
Critical to a successful program & Blend Control

HYDRO$_3$CIDE

Aerating Mixers

EF80 – Ozone based treatment

Summary

Optimize your chemical program in your gathering system. Use aeration to preserve your water quality. Simplify your On-the-Fly disinfection program. Monitor compatability and disinfection real time.

Questions ?

www.hydrozonix.com