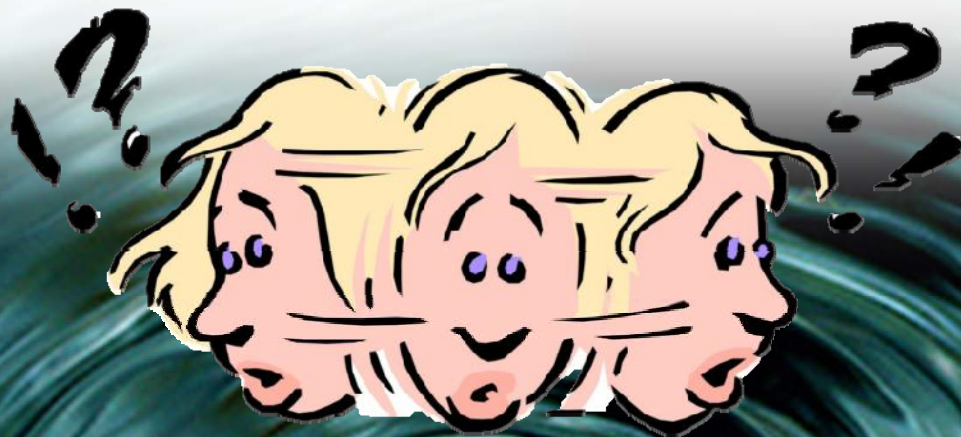
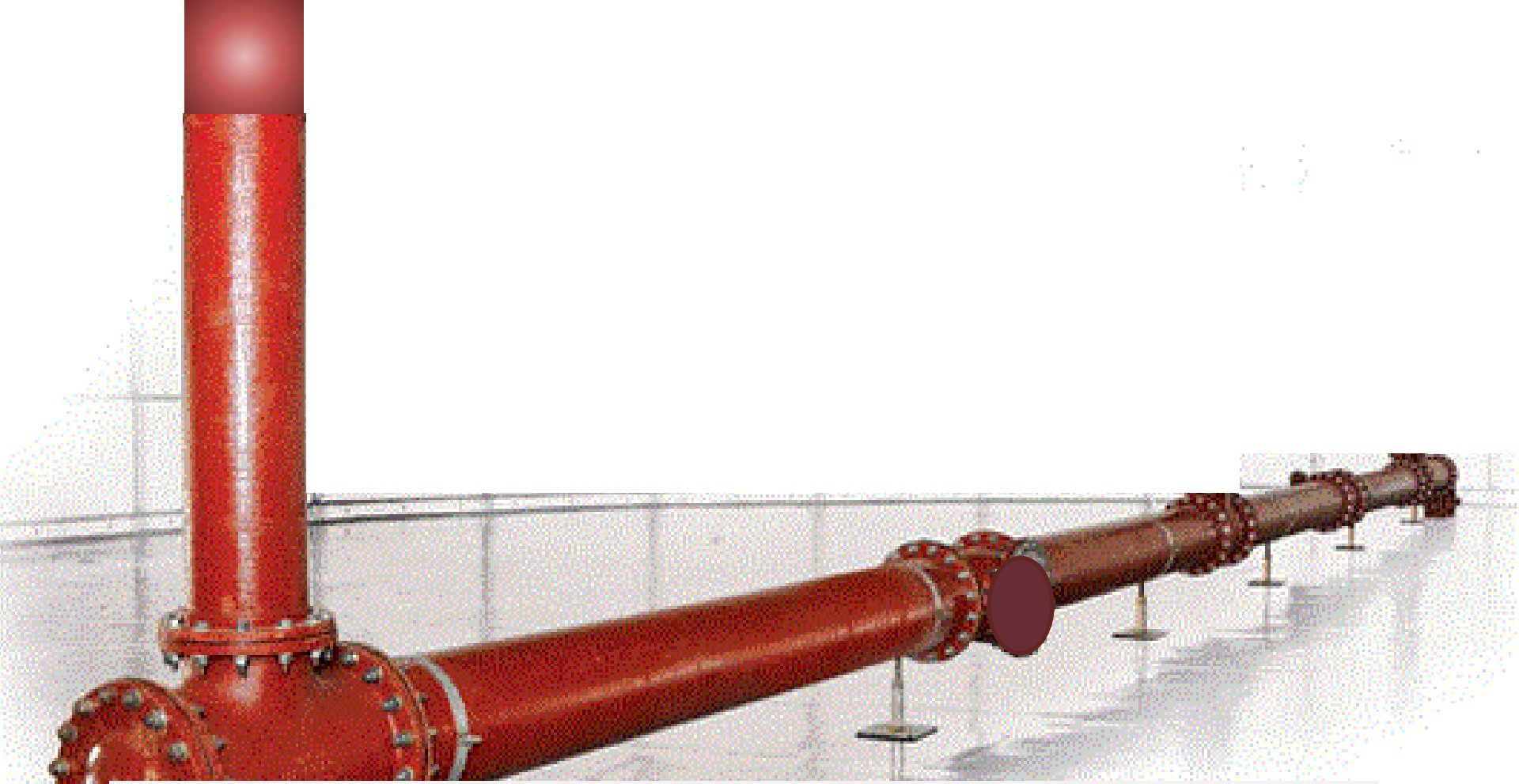


All Mixed Up?

Picking and Choosing Your Tank Mixing System





Tank Mixing

- Still in its infancy.
- Majority of tanks do not have mixers.

Overview

- What's the Problem?
- Tank Design & Mixing
- Mixers
 - Types
 - Top FAQs
- Case Studies
- How to Pick?



What's the Problem?

- Zones of older water
- Thermal stratification
- Chemical stratification

Will Mixing Help?

Yes!



What's the Problem?

- Ice in tank
- Coating abrasion
- Structural damage
 - Leaks – bolted tanks
 - Ladders & overflows
- Complete freezing, loss of storage

Will Mixing Help?

Yes!



What's the Problem?

Got data?

Accurate data?

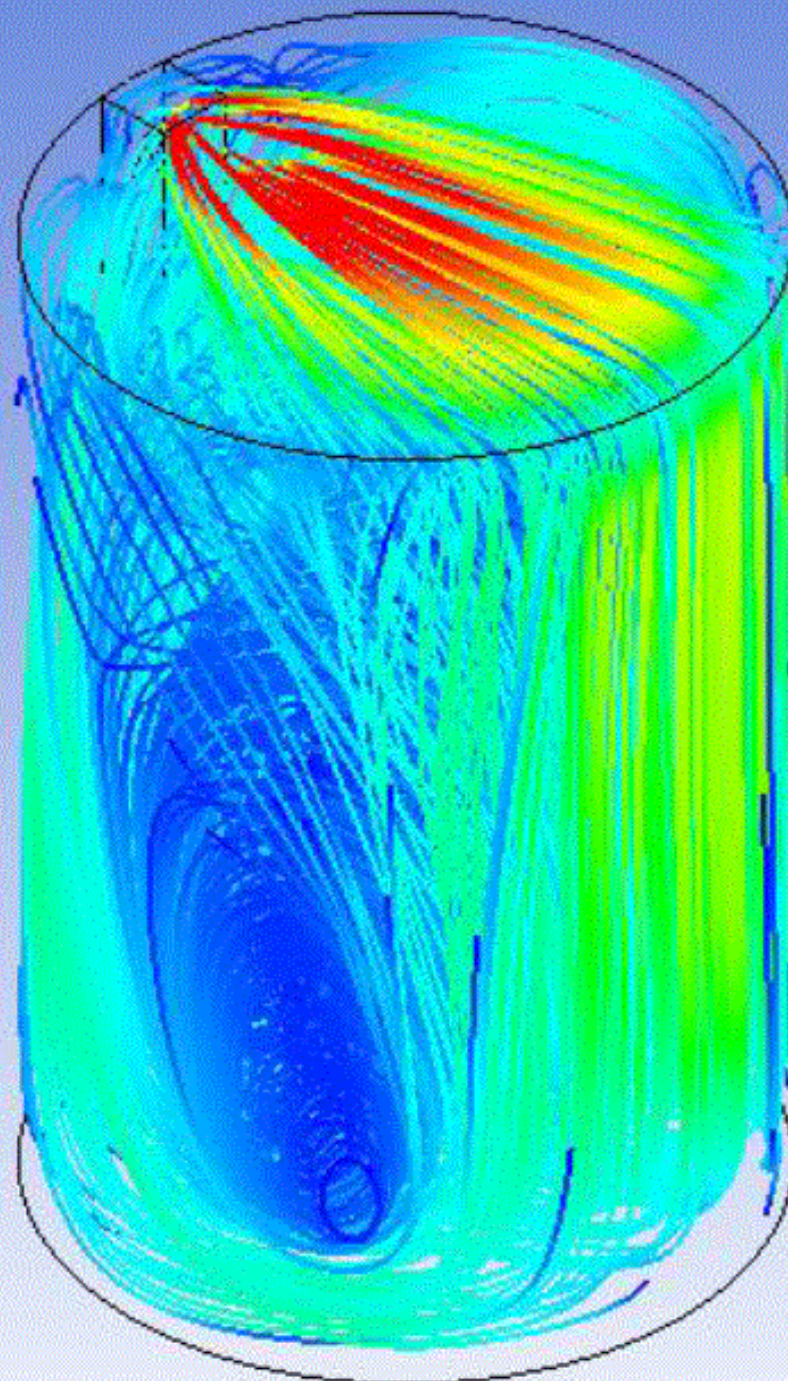
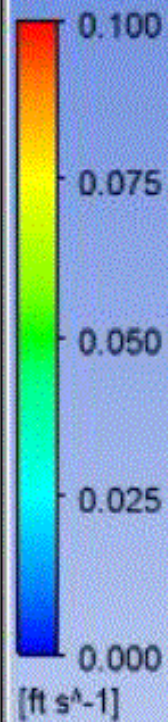
Monitoring Studies

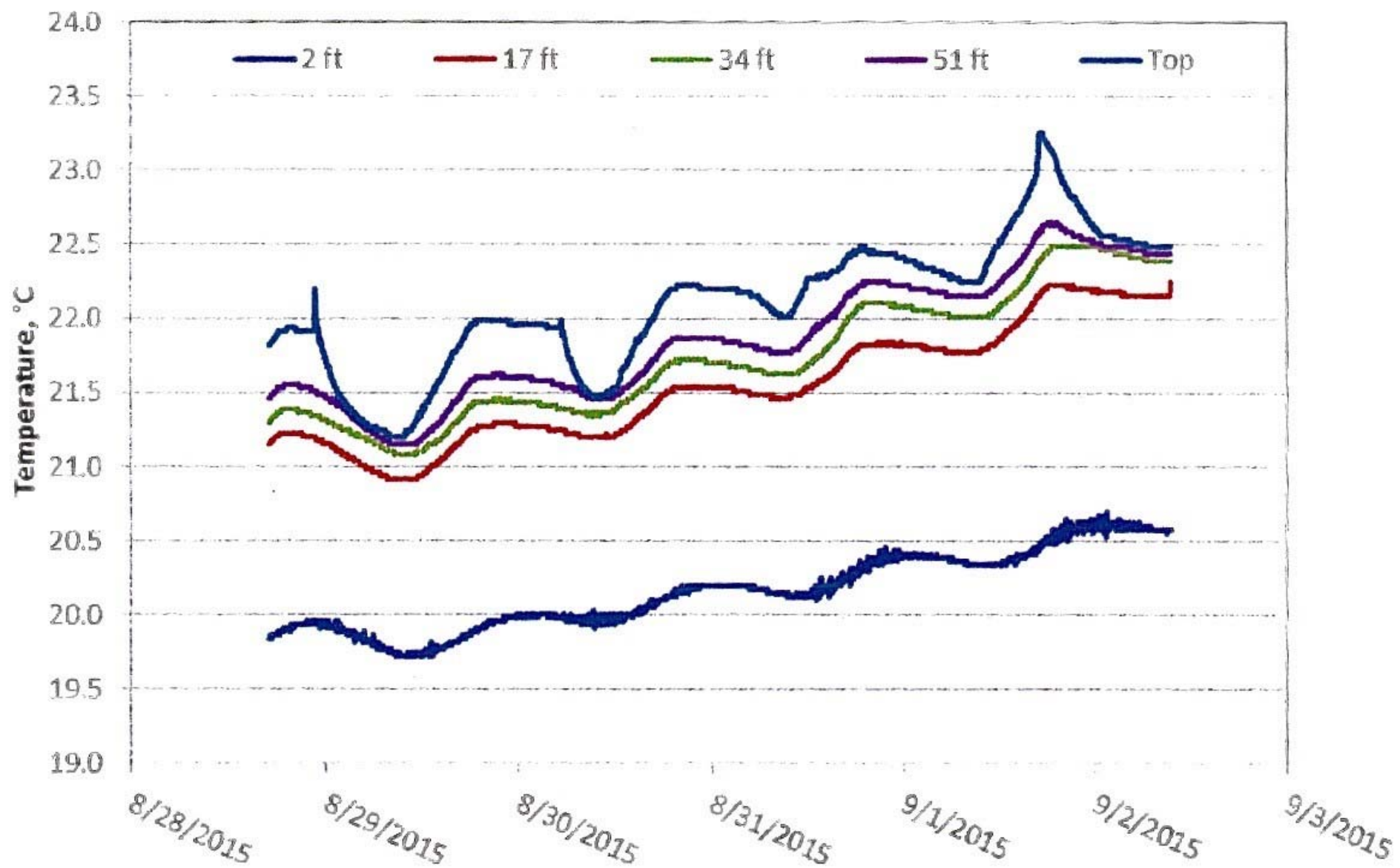
- Instantaneous vs. Extended Period
- Actual vs. Theoretical

Monitoring Studies

- **Water Quality** – Chlorine residual readings at various levels inside tank or system.
- Tracer Studies or Computational Fluid Dynamic **(CFD) Modeling** – Info on mixing behavior.

Velocity
Streamline 3





Tank Design In the past...

Designed for:

- Hydraulic requirements
- Equalize pressure
- Balance water use during the day
- Emergency storage, fire protection
- Bigger is better
- Future growth

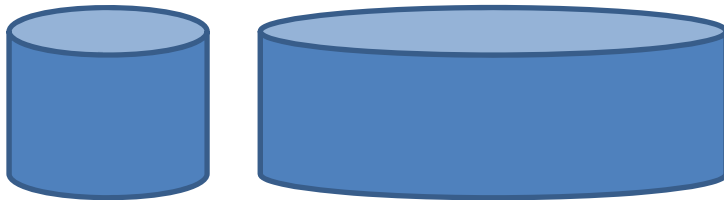


Tank Design Geometry

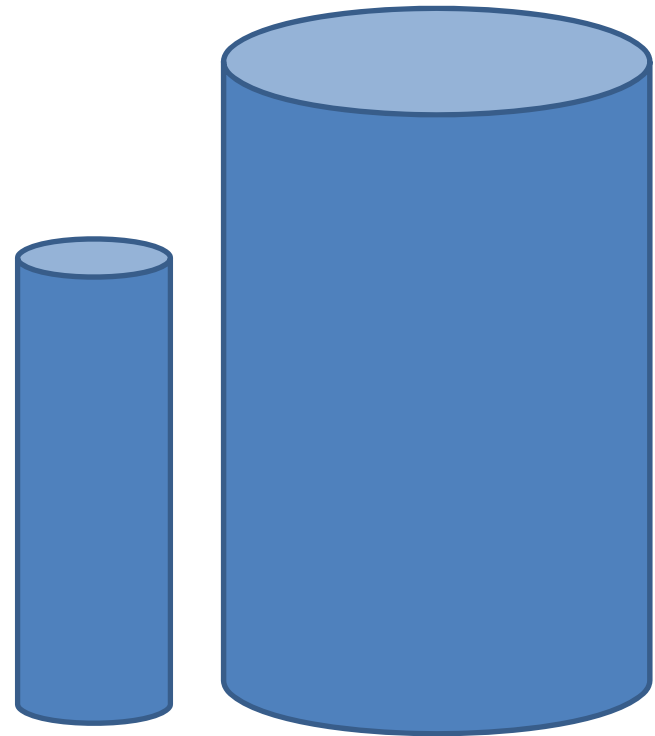
EASY



HARD

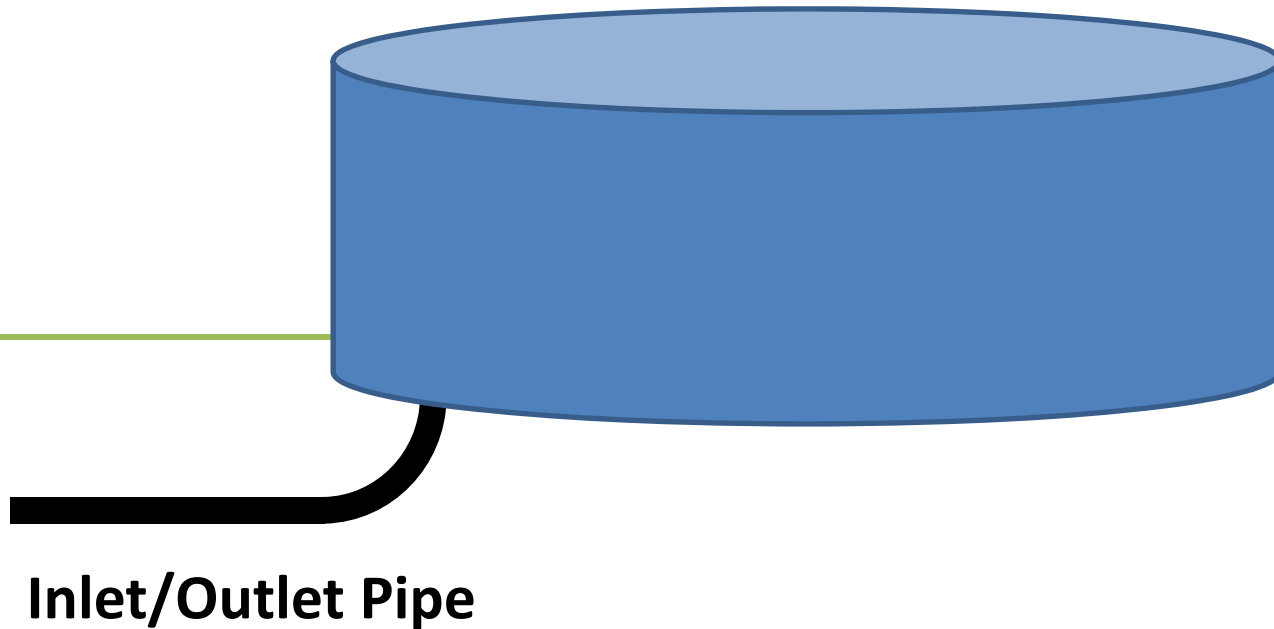


Reservoirs

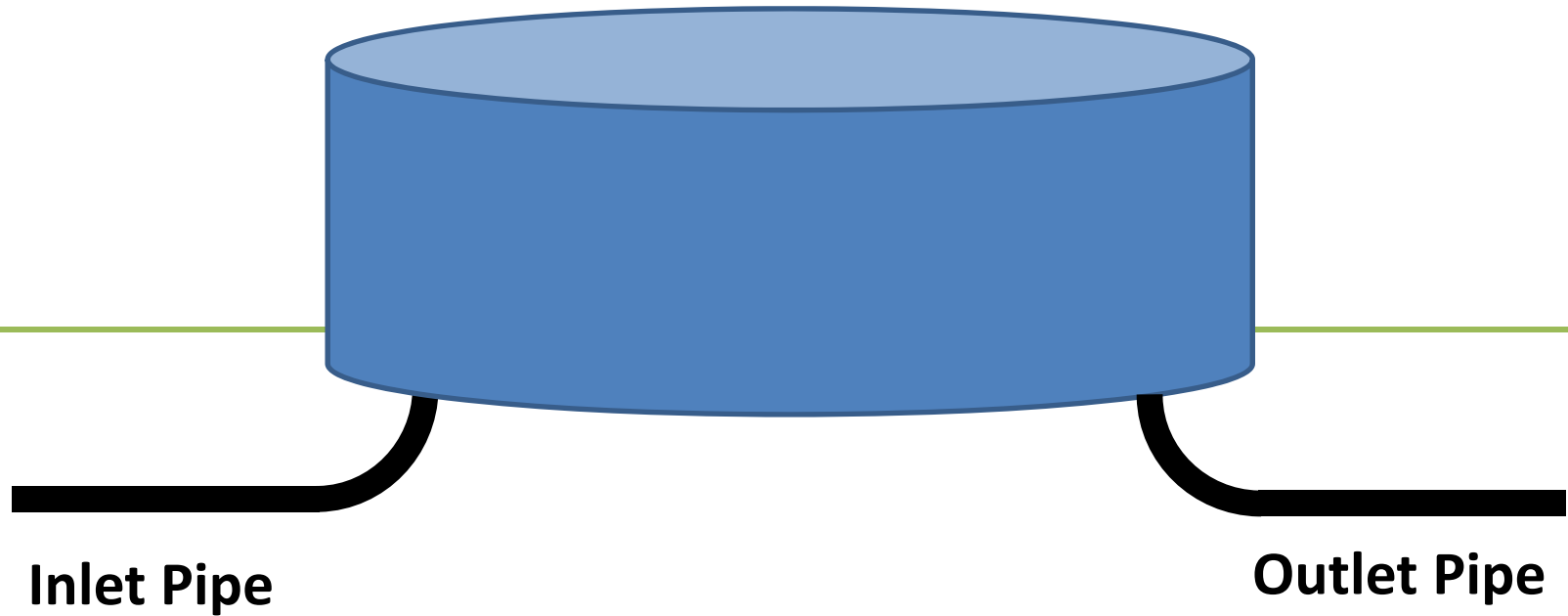


Standpipes

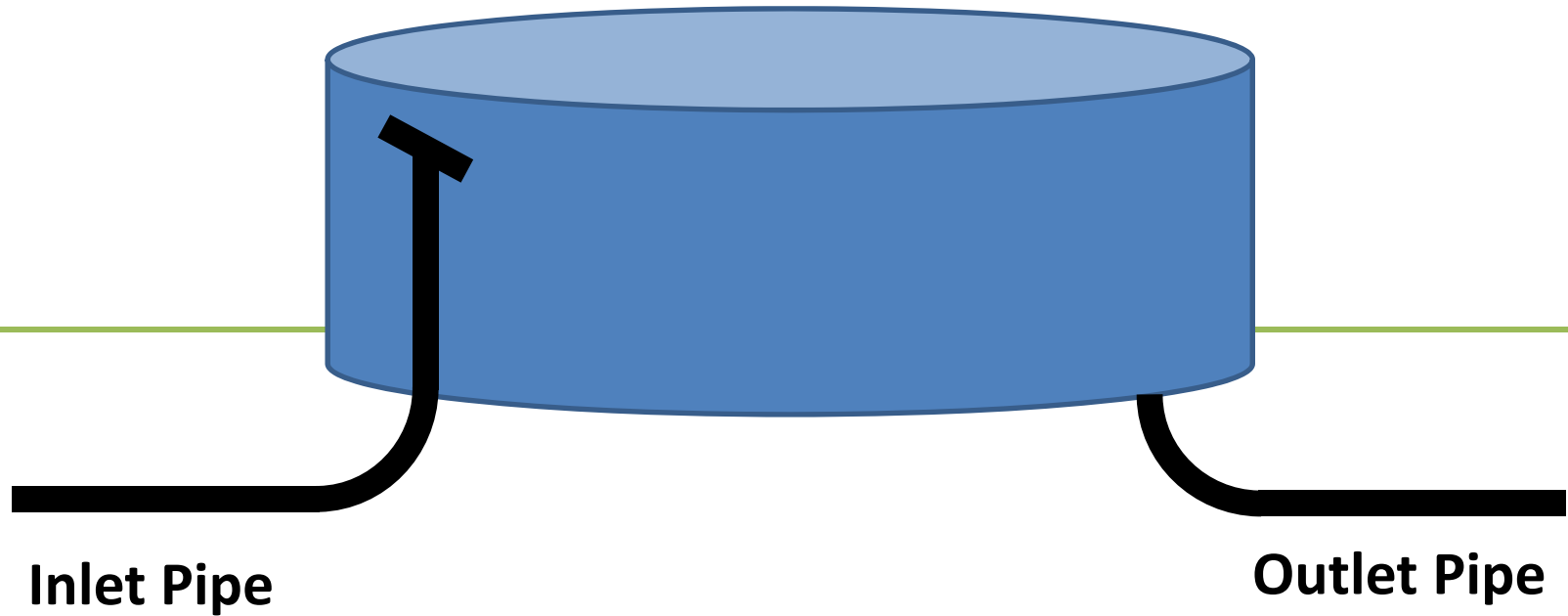
Tanks Piping



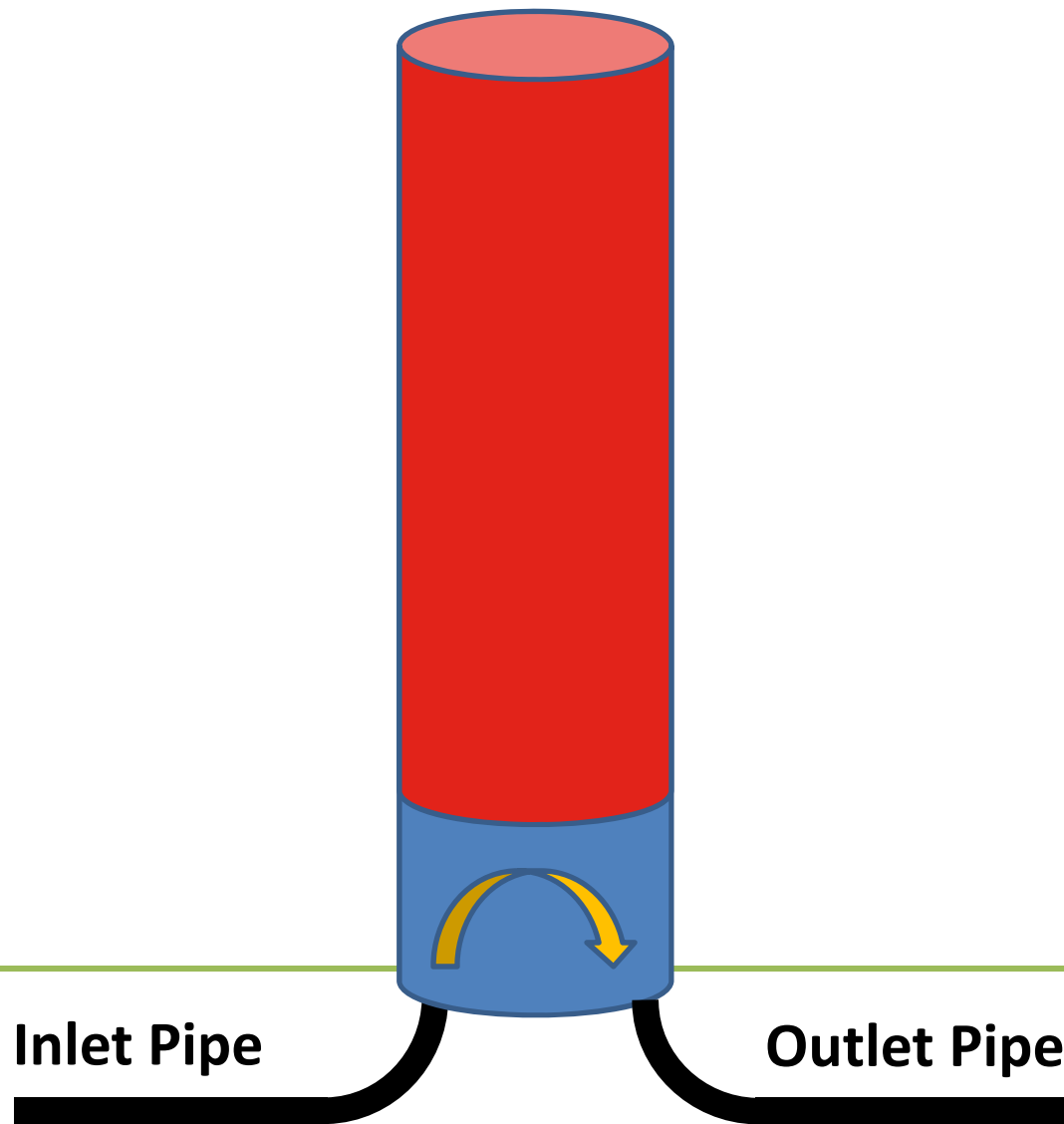
Tank Design: *Back In The Day*



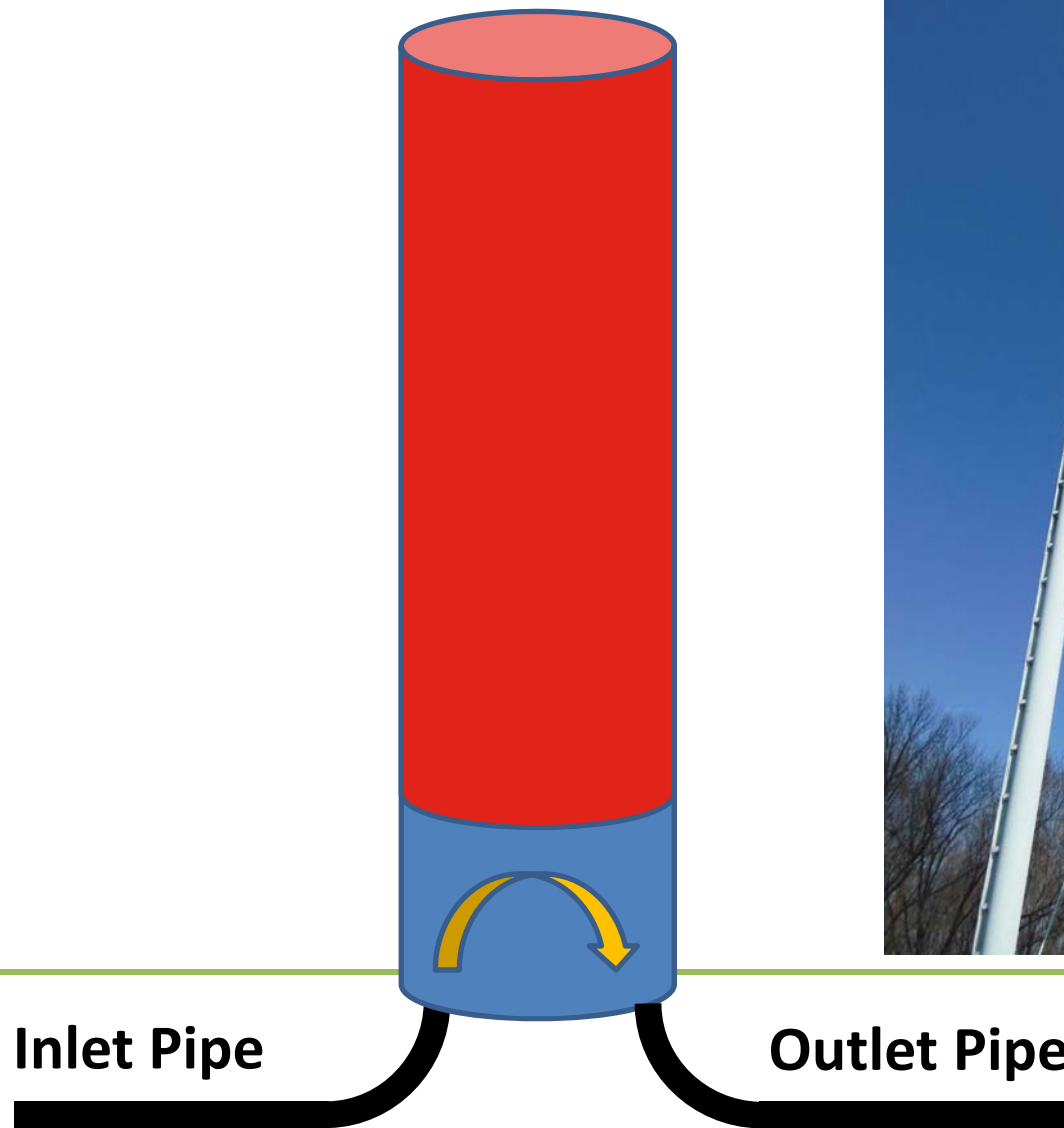
Tank Design: *Options*



Tank Design: *Options*



Tank Design: *Standpipe*



Tank Design: *Elevateds more appealing*

Mixers What can they do?

- ☒ Move water in the tank
- ☒ Inject chemicals
- ☒ Prevent or minimize freezing
- ☒ Reduce water age

Mixers What can they do?

- ☒ Move water in the tank
- ☒ Inject chemicals
- ☒ Prevent or minimize freezing
- ☒ Reduce water age

To reduce water age:

1. Use more water – hydrant flushing, tank overflowing.
2. Reduce the amount of storage.

Mixers Types

Passive

Increase water velocity upon entering tank to mix.



Active

Provide energy to move water in the tank.



Mixers Differences

Passive

- No** Moving parts
- No** Power
- No** Maintenance
- Yes** Drain tank to install
- No** Always mixing
- Yes** Accurate data critical
- No** Move to other tanks
- Yes** Small pressure loss
- Yes** Chemical injection
- No** TTHM removal

Active

- Yes** Moving parts
- Yes** Power
- Yes** Maintenance
- No** Drain tank to install
- Yes** Always mixing
- No** Accurate data critical
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Mixers Passive



Photo courtesy of Tideflex Technology

Passive Homemade



Passive: Tideflex



Passive CB&I - FreshMix

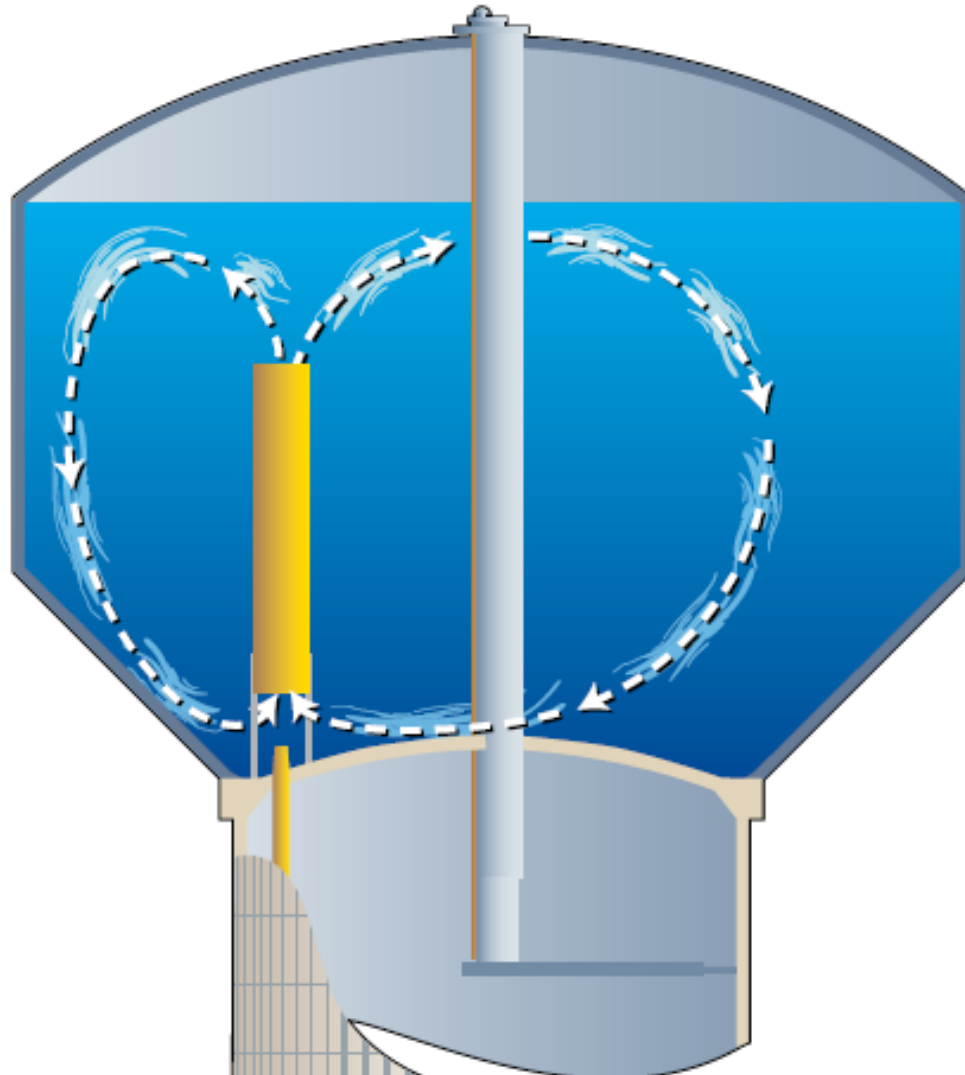


Photo courtesy of CB&I

Passive Landmark Tanks

Hydrodynamic Mixing System (HMS)

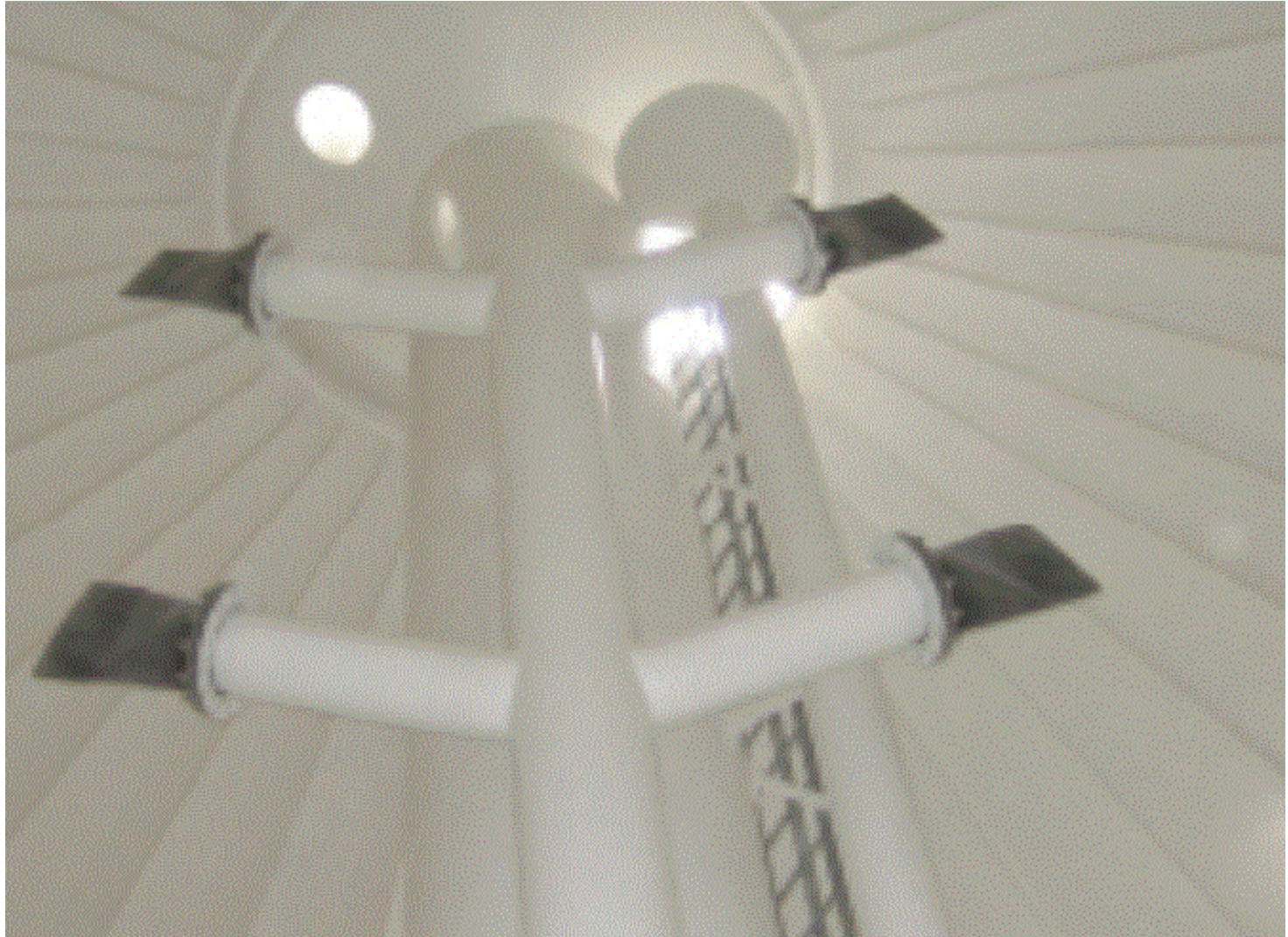


Photo courtesy of Landmark Corporation

Passive “Tank Mixer” from York Water



Passive “Tank Mixer” from York Water



Passive “Tank Mixer” from York Water



Mixers Active



Photo courtesy of PAX Water Technology

Active PAX



Photo courtesy of PAX Water Technologies

Active PAX Monopod



Active SolarBee

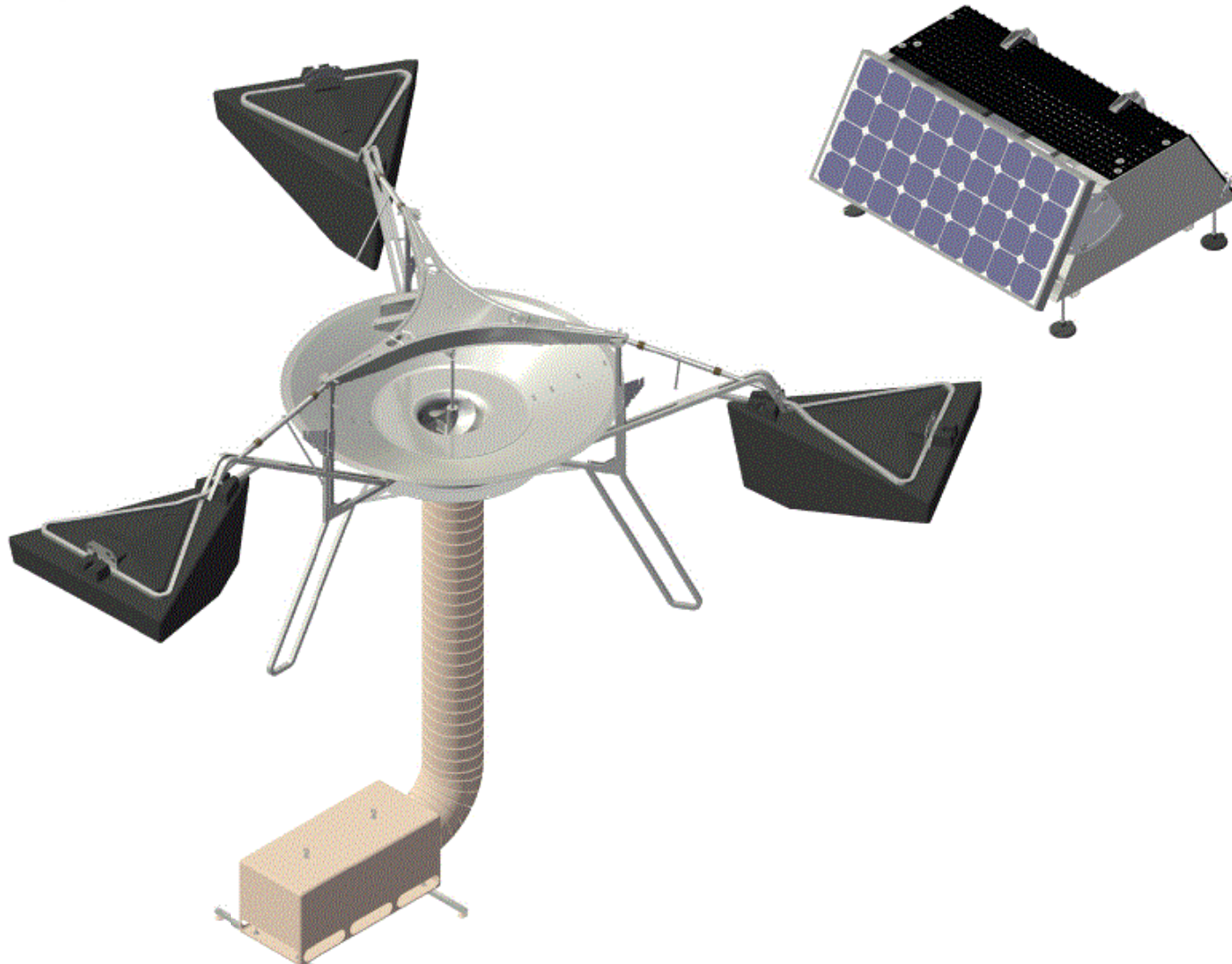


Photo courtesy of Medora Corporation

Active SolarBee

Portable Water Quality Monitoring

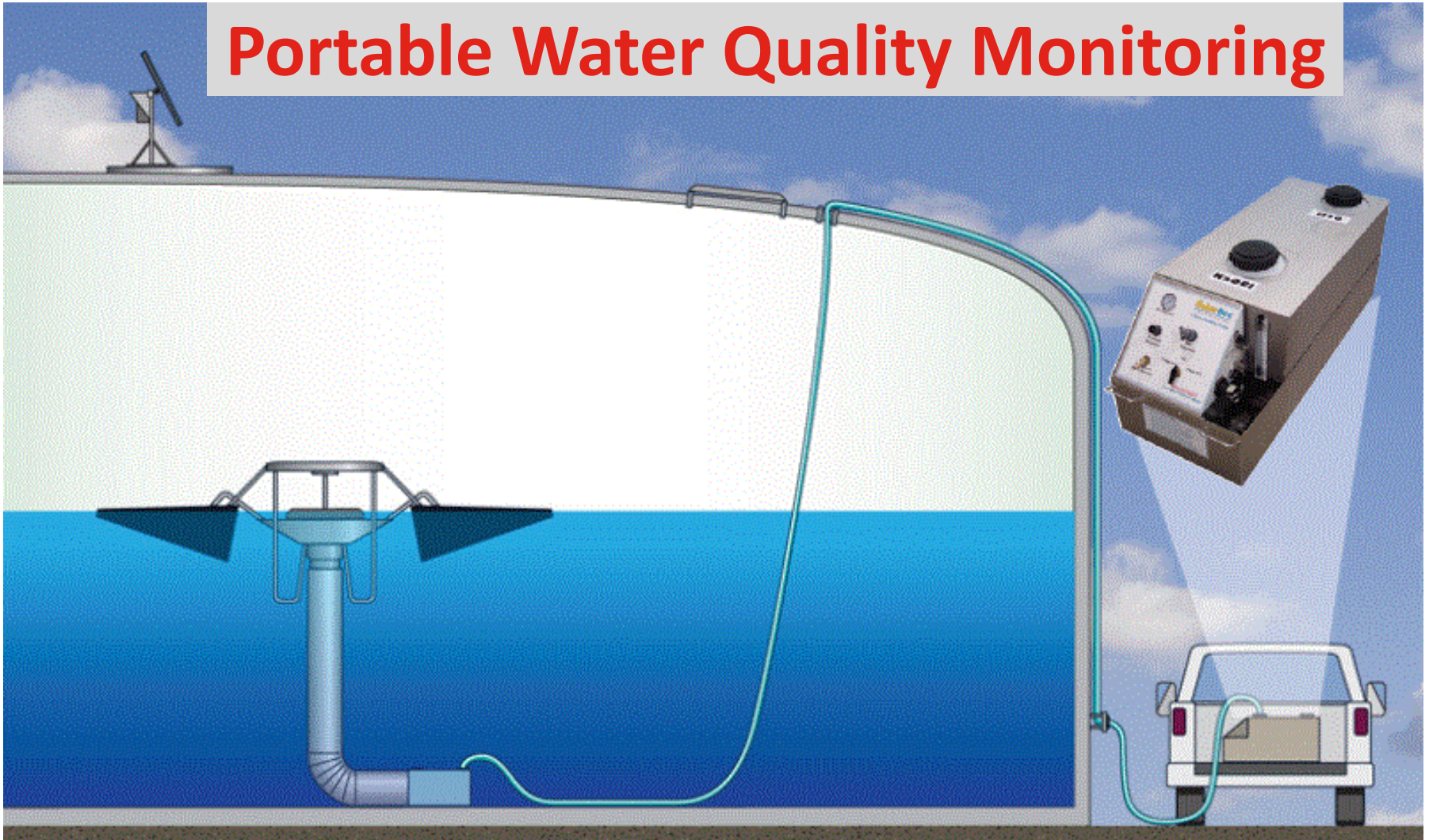


Photo courtesy of Medora Corporation

Active GridBee



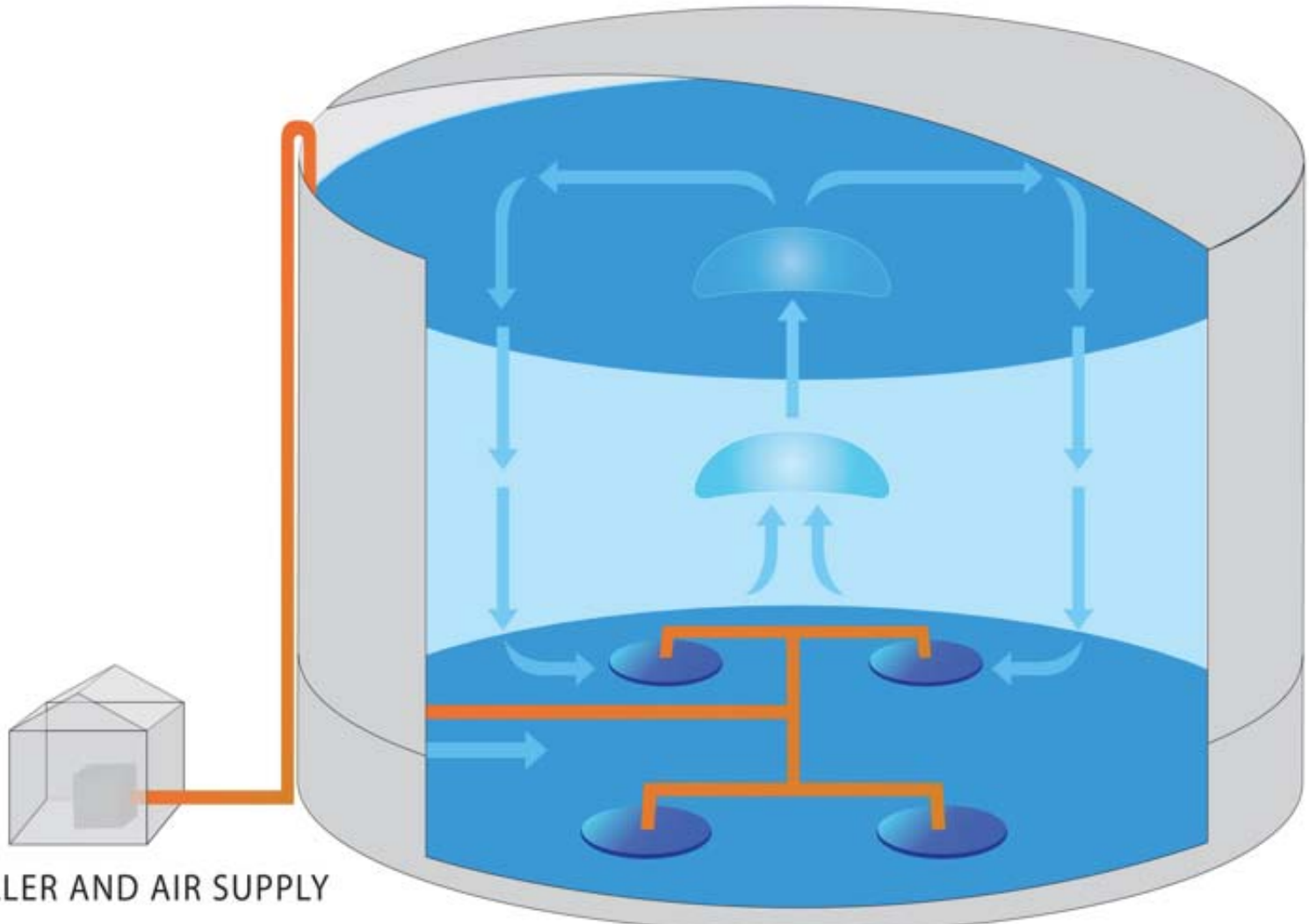
Photo courtesy of Medora Corporation

Active Tank Shark



Photo courtesy of UGSI Solutions, Inc.

Active PHi, Pulsair



CONTROLLER AND AIR SUPPLY

Photo courtesy of Pulsed Hydraulics, Inc.

Mixers Top 5 FAQs

5. Do I need to drain and clean out my tank first?
No, but it's recommended.
4. Does the PA DEP require mixing in all tanks?
No, but it should be considered.
3. Is a PA DEP permit required for a new mixer?
Yes, a minor permit amendment is required.
2. Who installs mixers?
Owners, Tank Painters & Builders, Suppliers.
1. Which type should I buy?
?????

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1. Which type should I buy?
Work with an experienced Engineer to decide.

Mixers 5 Case Studies



Photo courtesy of Medora Corporation



Photo courtesy of Medora Corporation



2.0 MG Reservoir



**250,000 Gallon
Spheroid**



POTABLE WATER QUESTIONNAIRE

Please enter as much information as possible in the boxes below, then email this form to INFO@MEDORACO.COM, or fax to 701-225-0002.

A. TANK LOCATION AND OWNER INFORMATION

CONTACT NAME

Accurate Data

ARE YOU WORKING WITH A MEDORA CORP. REGIONAL MANAGER OR LOCAL REPRESENTATIVE ?

B. CITY WATER SYSTEM OVERVIEW

TYPE OF DISINFECTANT BEING USED IN THIS WATER? (CHLORINE, OR CHLORAMINE, OR OTHER)

IS THE SOURCE WATER FROM SURFACE (RIVER AND IMPOUNDMENTS,) OR WELLS

EXISTING TANK, OR NEW TANK BEING CONSTRUCTED

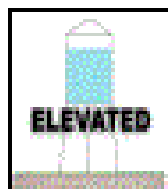
THIS TANK'S MAIN FUNCTION, SUCH AS GENERAL STORAGE, CT TANK, CLEARWELL, OTHER

EXISTING AND/OR EXPECTED WATER QUALITY PROBLEMS IN THIS TANK

PROJECT OBJECTIVES: GENERAL MIXING, THM REMOVAL, CHLORINE BOOSTING, ICE PROTECTION

MOST STATES REQUIRE A PERMIT FOR MIXING OR THM REMOVAL IN A TANK, DOES YOURS

C. TANK DESCRIPTION AND DIMENSIONS (PLEASE FILL OUT THE PERTINENT SECTION BELOW)



PUT "X" IN ONE:

Spheroid
Hydropillar
Cylindrical
Other

RATED VOLUME, GALLONS

TANK DIAMETER, FEET

TANK HEIGHT, FEET

DISTANCE, TANK BOTTOM TO GROUND

HATCH: UNOBSTRUCTED L X W, INCHES

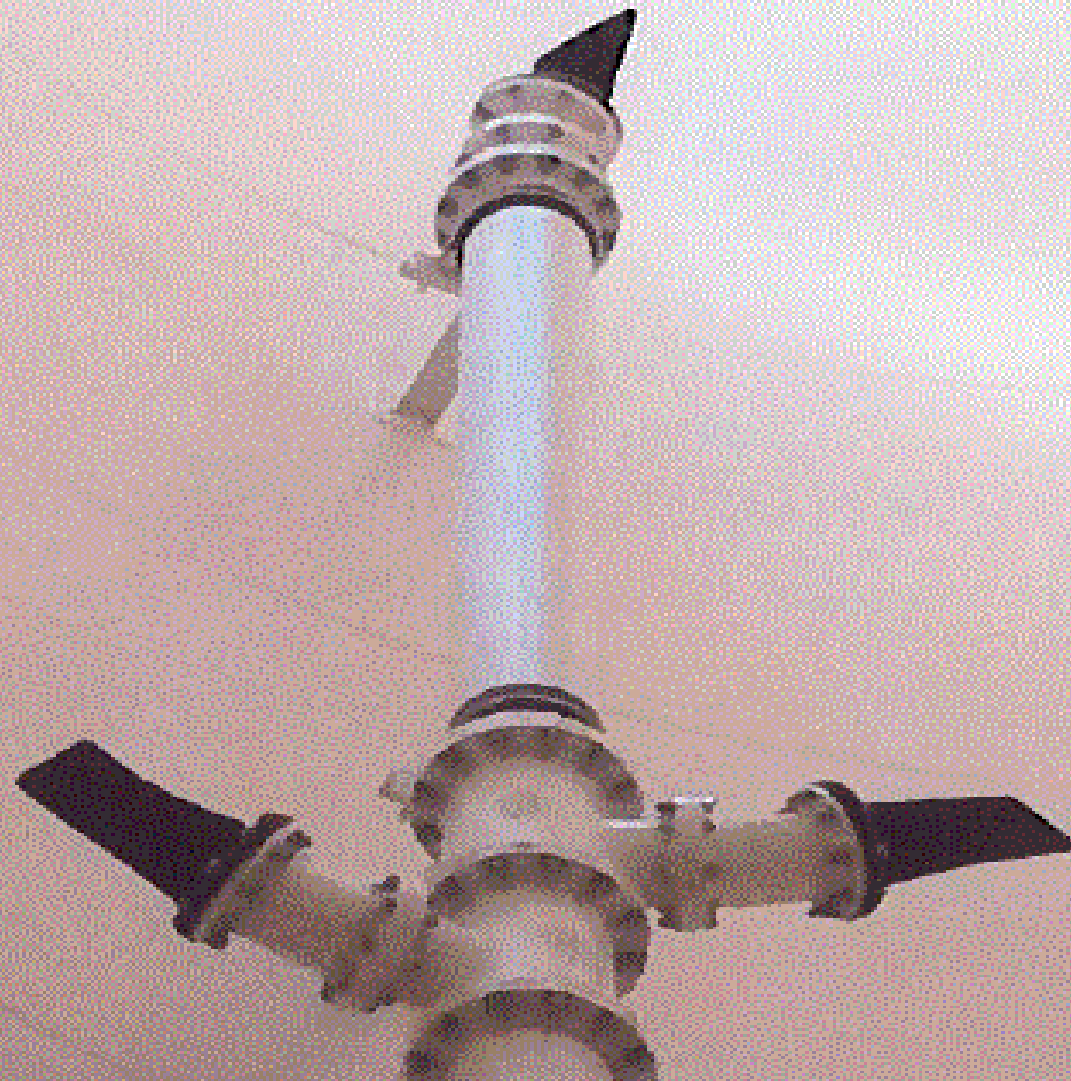
RISER DIAMETER, INCHES

WET RISER OR DRY RISER

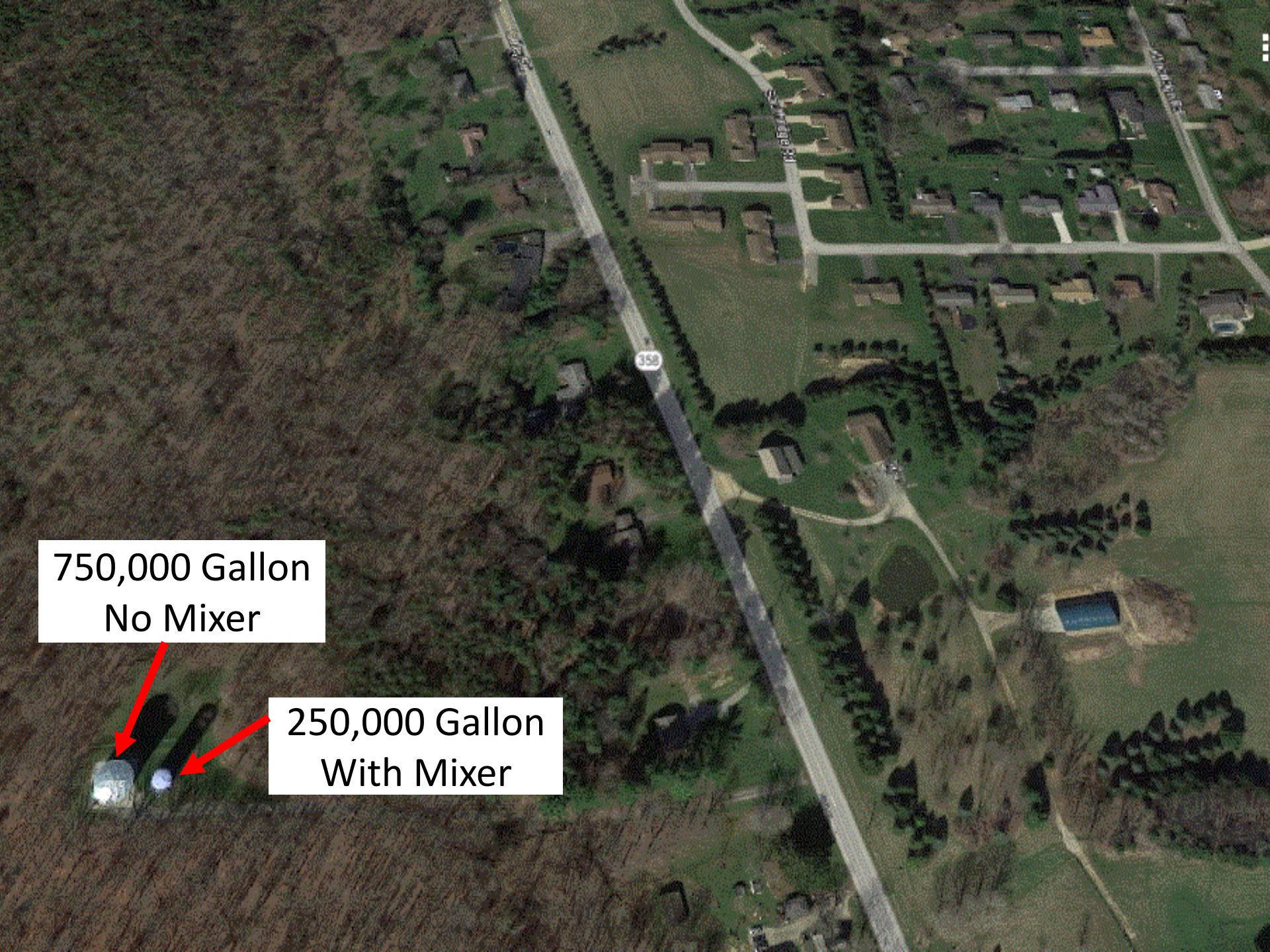
RISER HEIGHT, FEET

LOCATION

OR



Entech Engineering was NOT the mixer designer.

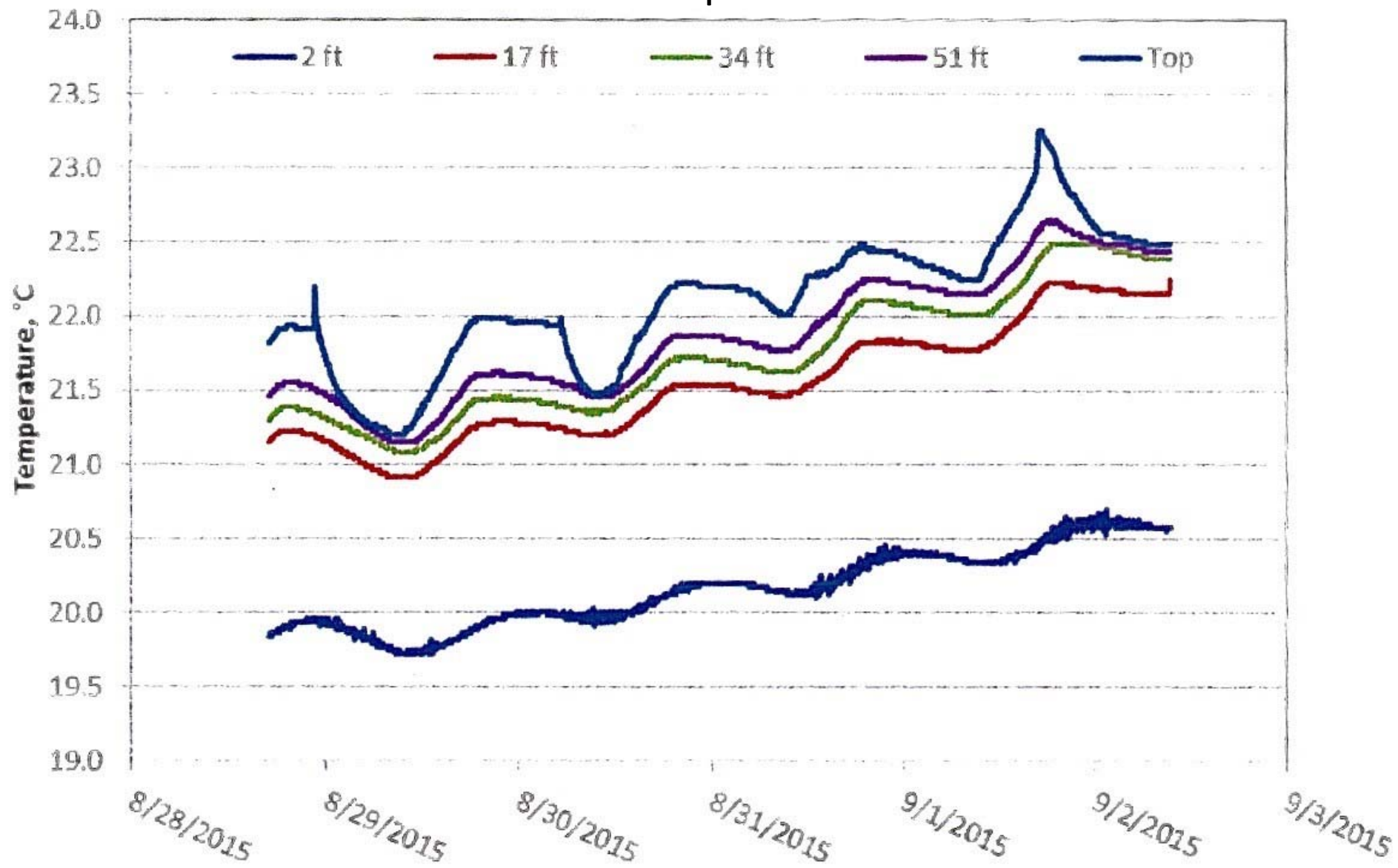


750,000 Gallon
No Mixer

This is an aerial photograph showing a rural landscape. A major road, marked with a '359' shield, runs diagonally from the top left towards the bottom right. To the left of the road is a large, dark, wooded area. To the right is a residential neighborhood with many houses and green lawns. In the bottom left corner, there are two small, light-colored structures. A red arrow points from the '750,000 Gallon No Mixer' text box to the larger of these two structures. Another red arrow points from the '250,000 Gallon With Mixer' text box to the smaller structure. Further to the right, there is a larger, rectangular structure with a blue roof, possibly a pool or a large storage tank.

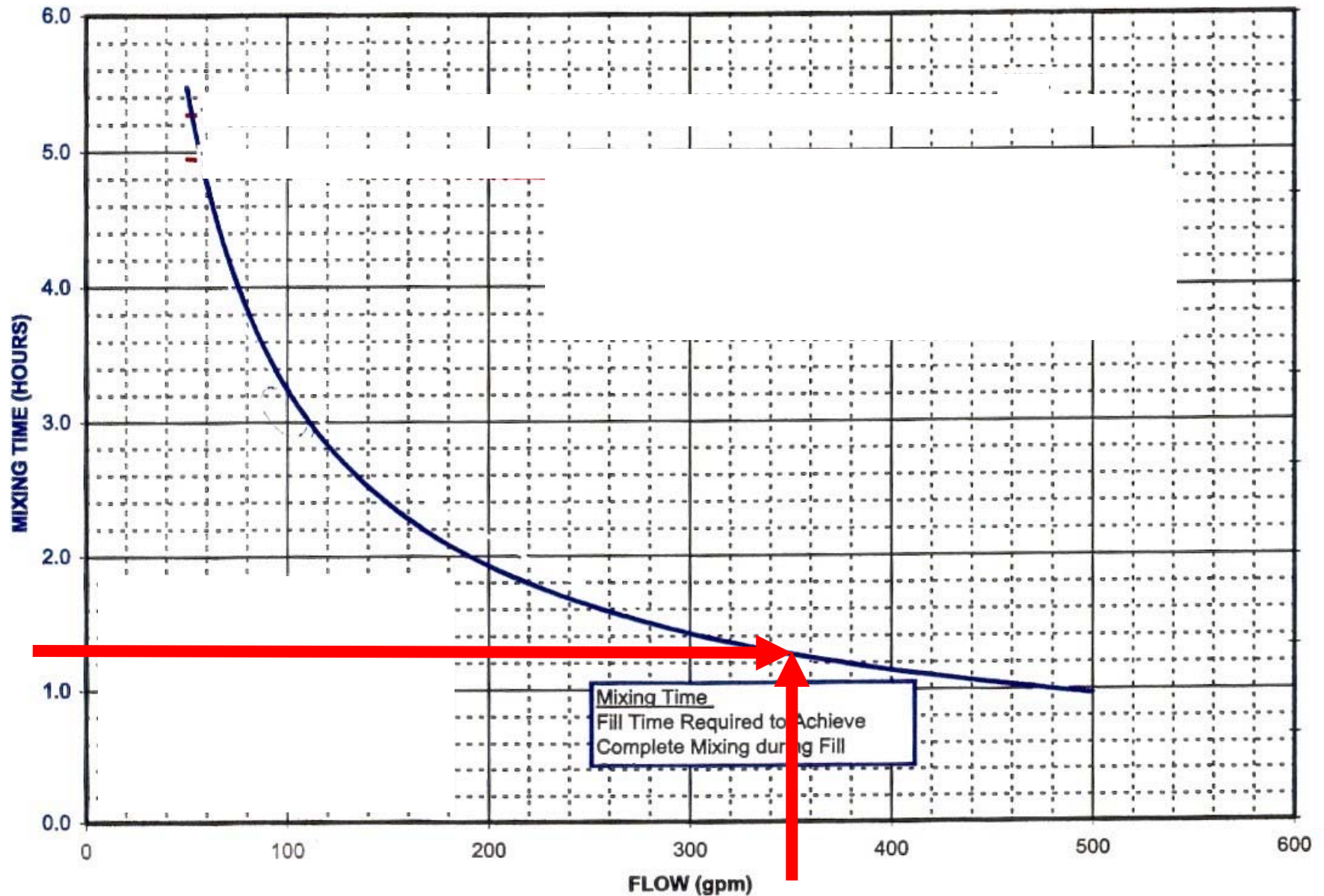
250,000 Gallon
With Mixer

.25 MG Tank Temperature Trends



Mixing Time and Minimum Required Drawdown

0.25MG Standpipe





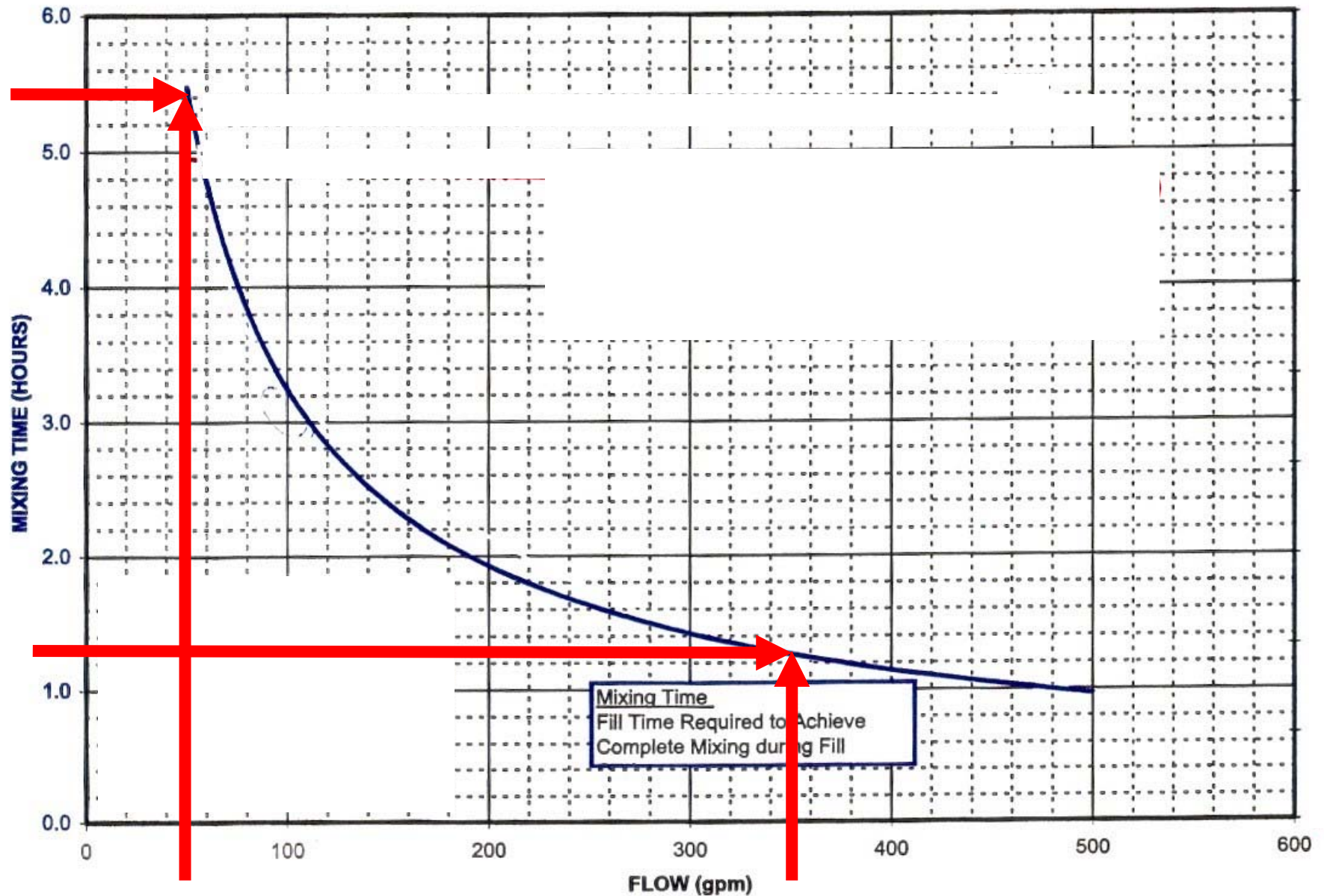
Pump: 350 gpm

750,000 Gal.

250,000 Gal.

Mixing Time and Minimum Required Drawdown

0.25MG Standpipe



4

**1.0
MG**

**1.0
MG**

**10.0
MG**

**1.5
MG**



- PSI provides equipment.
- Owner provides installation and electrical.







Ammonia →

Hypochlorite →

Water →

Plus freeze
protection





Tornado Troubles





Tank demolition improves water quality



Mixers How to Pick?

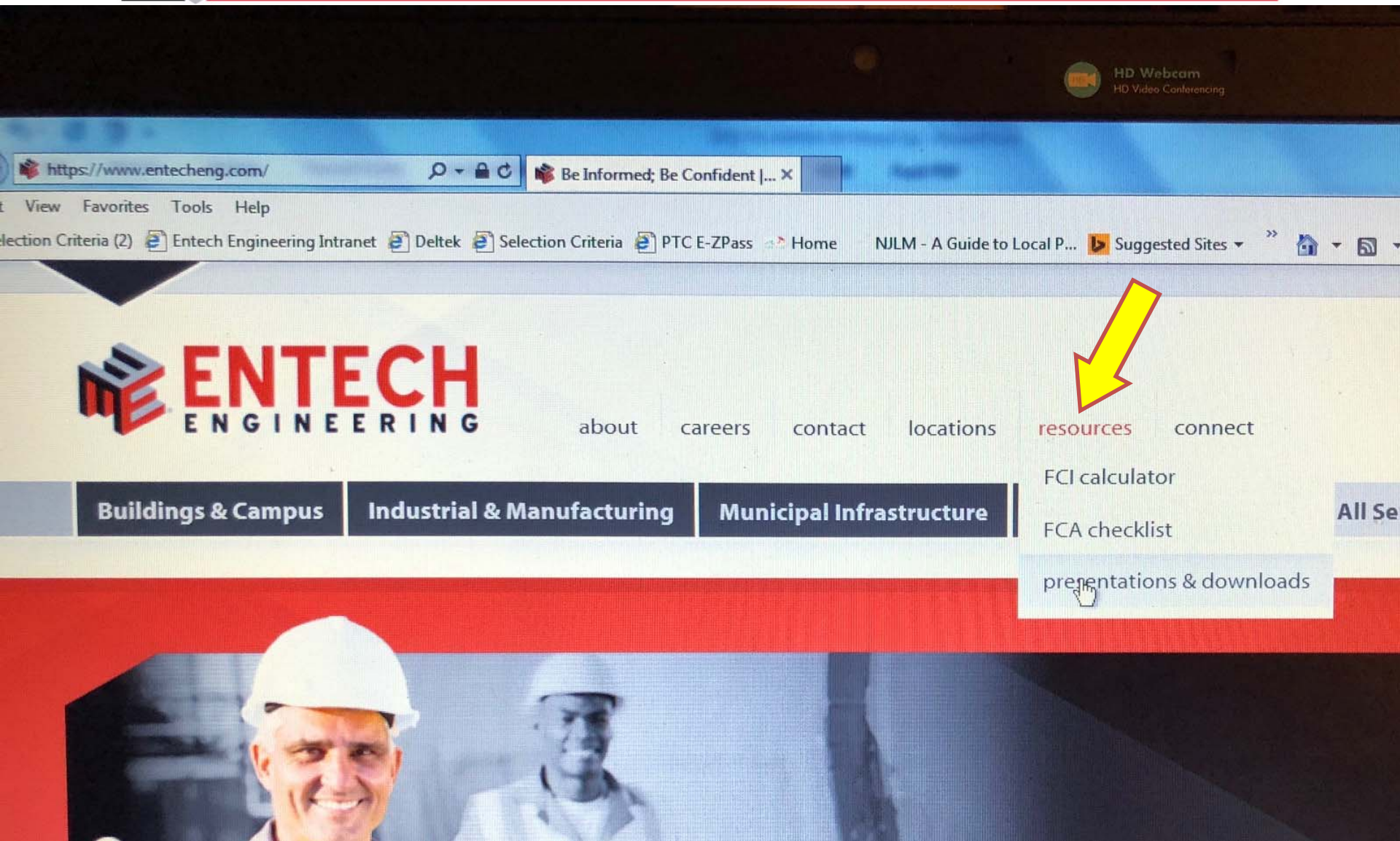
- What's the problem?
- Are your Operators hands-on?
- Is your personnel trained to climb tanks?
- Is initial cost the biggest factor?
- Or cost plus O&M over time?
- Ease of use?
- Reliability?
- Familiarity?

Mixers How to Pick?

- Is tank maintenance or a cleanout planned?
- Can the tank be drained?
- Design for now, or plan for the future?
- How hard to add in the future?

Work with an experienced Engineer to make an informed decision.

Tank Mixing Matrix www.entecheng.com



Tank Mixing Matrix www.entecheng.com

All Mixed Up? Water Tank Mixing Made Easy last updated: 3.15.17

The growing focus on water quality in potable water tanks has many tank owners considering mixing. This chart helps identify the broad categories of mixers, active and passive, as well as specific types. But every tank and distribution system is different, and numerous factors go into selecting the mixing system that is best for you. We hope you find the information helpful, and if you'd like to discuss your specific situation and how it impacts the options below, contact us - we love to talk tanks!



Type	Manufacturer	Estimated Cost ⁽¹⁾	Life Expectancy (years)	Estimated Annual O&M Costs	Electrical Requirements	Chemical Injection Option?	Drain Tank to Install? ⁽²⁾	Description	Comments	Installations
ACTIVE MIXING SYSTEMS	<u>GridRec Submersible Mixer</u>	\$30k	10 - 20	\$200 - 500	120 VAC, 20 amp service	Yes	No	316 stainless steel unit, approximately 3 feet long and 10 inches round, setting a few inches above the tank bottom on feet, or suspended from the tank roof. Circulates water by inducing from along the tank floor through the ends, then sending it upward and out across the water surface in layers causing direct and induced mixing effects. Power cord is run from grade, up shell, through roof hatch to unit. Unit is connected to chain to access it.	Drop in through roof hatch (~75 pounds) powered, then turned on. Fits through 12" diameter roof hatch. Can be retrieved via hatch for future maintenance or removal. Does not need to be welded to floor. Tank painters can install mixer during repainting, and also providing conduit and wiring to ground to be powered by Owner's electrician.	Thousands throughout the US.
	<u>PAX Water Mixer</u>	\$40k	10 - 20	\$200 - 500	120/240 VAC, 50/60 Hz, 15 amp circuit, nominal power draw 0.345 kVA (345 watts)	Yes	Maybe	A stainless steel submersible motorized impeller device sets on the tank bottom in a flat bottom tank, or is secured to the riser in an elevated tank, and circulates water throughout the entire tank from bottom to the top. Power cord is run from grade, up shell, through roof hatch to unit. Unit is connected to chain to access it.	Mixer mounted on tripod stand, does not need to be anchored to floor but is recommended, and mounting is required in elevated tanks with a sloped bottom, so tank must be drained first. Typically fits through 24" roof hatch. Has SCADA outputs. Option for solar power. Tank painters can install mixer during repainting, and also provide conduit and wiring to ground to be powered by Owner's electrician.	Thousands throughout the US & Canada, various climates, including ambient temps of -40F.
	<u>PHI Hydro-Pulse Mixing System</u>	\$20 - 25k	10 - 20	\$200 - 500	20 amp, 115 volt single phase, 60 Hz service, plus power for air compressor	No	Yes	This mixing system utilizes the injection of compressed air through a piping system from an air compressor at the base of the tank, to up above the high water level, then down to specifically spaced bubble forming plates anchored to the tank bottom. The mixing aspect of this system comes from the bubbles rising from the bottom to the top of the tank.	Claims to have 50% energy savings compared to other mixing technology. Used for many years in a variety of other applications, like wastewater. Need to support air tubing/piping to tank walls inside and out, may require welding and coating touch-up afterwards.	Dozens of installs throughout PA.
	<u>SolarRec Submersible Mixer</u>	\$30k	10 - 20	\$500 - 1,000	solar powered	Yes	No	System is basically a flexible tube, weighted on one end to the tank bottom, and floated to the top on the other with a solar powered motor spinning an impeller near the top of the water, drawing water up from the tank bottom, pushing it out the top end at the surface. Solar panel is fixed in place on tank roof near hatch, and cables run through hatch to supply power.	Brushless motor, solar modules, and digital control system outside of the tank. Solar mounts are hurricane rated for wind loads, typically welded to tank roof. Larger and elevated tanks raise concerns with limited water turnover, and lessen the guarantee of ice prevention. Can function, even in low light conditions, as power is stored in a battery. Add second solar panel for back-up in case of snow covering panels. Larger units need a bigger roof hatch (2'x3') for installation, along with crane or manlift to hoist it up and in. Larger units also recommend Owner has inflatable boat to use inside tank to perform check-ups and field adjustments of unit. Also need to keep solar panels clean.	Installations across the US, with large concentration in CA. Numerous PA installs in tank sizes ranging from 0.3MG to 10MG.
	<u>Tank Shark</u>	\$40 - 50k (mixer only)	10 - 20	\$500 - 1,000	power for booster pump - varies depending on size and tank height	Yes	No	Stainless steel unit sets on tank bottom with one or more eductor nozzles located 3-5 feet above the base of the tank, causing an upward flow of water equal to approximately five times the nozzle flow. Flow through the nozzles is generated by booster pump outside the tank, pumping water through tubing up shell, through roof, and down to unit. No moving parts or electrical equipment within the tank.	In cold climates, need insulation and heat tracing on source water piping from booster pump to tank roof entry point. Most attractive if additional dosing and mixing of chemicals is desired, typically in million gallon+ tanks or ones in problem areas of a water system. Can set up real-time water sampling, then adjust chemical doses automatically. Added features can be costly, but worth it if no other mixing solutions work.	3 in Coatesville, PA; 1 upcoming in Abingdon, PA. Numerous installs in CA and TX.
	<u>TAP-APP (Air Pulse Protection) by Calbrecht Tanks</u>	\$20 - 25k	10 - 20	\$500 - 1,000	(4) 110 VAC, 15 amp GFI outlets; (1) 230 VAC, single phase, 20.6-22.7 amp supply to air source	Yes	Yes	Uses pulses of air to move water inside tank. Air compressor at base of tank pumps air through tubing up above high water level, then down to tank bottom and out to bubble forming plates. Tubing passes through and under plates, then air forms large bubbles under the plate that rise to the top surface of the water, causing mixing. No moving parts or electrical equipment within the tank.	Mixing cycles can be scheduled according to specific mixing needs and around daily peak energy periods. Similar technology to PHI Pulse Hydraulics system detailed above.	More than 100 installs.

In-tank aeration systems can be coupled with active mixers to remove Trihalomethanes (THMs)

IN-TANK AERATION	<u>DIY - Spray System</u>	\$20 - 25k	10 - 20	\$1,000	Power required for booster pump - single phase, 115/208-230 VAC	No	No	For Trihalomethane (THM) removal. Consists of a tap off the inlet pipe, a pump at the base of the tank, and small diameter piping running up the shell to several couplings in the roof, that discharge water into the tank through spray nozzles. Acts as a stripping tower.	Typically found in systems with operations staff who are mechanically inclined and safety trained to work at heights for installation & maintenance. Accelerated corrosion may occur on interior roof and upper shell, due to air and water mist. More effective with blower through roof for air changes, and additional roof vents as required. Nozzles can clog and need replacement. Freeze protection may be needed in colder climates in winter, or decommission system.	Known systems in Upper Mohawk Valley, NY; Monroe County Water Authority, NY; Rockville, MD.
	<u>PAX Trihalomethane Removal System (TTRSM)</u>	\$50 - 70k	10 - 20	\$1,000	Varies depending on size & components of system	No	No	For THM removal, 3 options for various tank sizes and styles. Water is pumped into a piping system that extends up above the high water level in the tank, then sprayed through nozzles as a mist, releasing THMs into the air. Acts as a stripping tower. Can combine with a PAX mixer.	More commonly found in states with strict mixing requirements (NM, AZ, etc.). Accelerated corrosion may occur on interior roof and upper shell due to air and water mist. More effective with blower through roof for air changes, and additional roof vents as required.	Rockville, MD; Stanley County, NC; numerous in CA.
	<u>GridRec THM & VOC Removal System</u>	\$50 - 70k	10 - 20	\$1,000	240VAC/1PH, 240VAC/3PH or 480VAC/3PH, 60Hz power	No	No	For THM removal, various options for various tank sizes and styles. Water is drawn through hose from tank bottom up to top of tank and sprayed out through nozzle as a mist, releasing THMs into the air. Acts as a stripping tower.	Accelerated corrosion may occur on interior roof and upper shell due to air and water mist. More effective with blower through roof for air changes, and additional roof vents as required. Recommend that Owner has inflatable boat to use inside tank to perform check-ups and field adjustments of unit.	Several in southeastern PA.

Questions?

