

The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance. The main title is centered in the upper half of the slide.

# PRODUCED WATER RECYCLING

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VP ENGINEERING – FREESTONE MIDSTREAM

BUT FIRST, A QUICK UPDATE . . .



**CONCORD<sup>®</sup>**

BUT FIRST, A QUICK UPDATE . . .



**FREESTONE**

**MIDSTREAM, LLC**

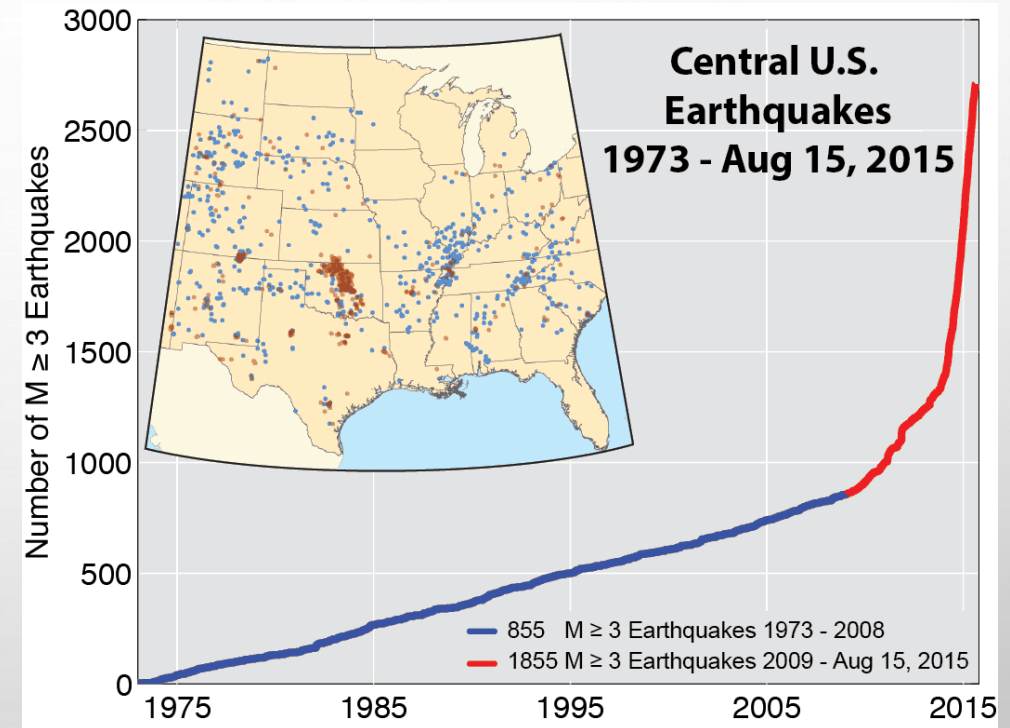
# WHY RECYCLE?

## RISK ABATEMENT

- INCREASING COMPETITION FOR FRESH WATER
- INCREASING COMPETITION FOR DISPOSAL CAPACITY
- OPERATIONAL RISK OF WATER DISPOSAL IS INCREASING
  - INCREASE IN NUMBER OF SEISMIC EVENTS
  - STATE AGENCIES RESTRICTING INJECTION
- GREATER PUBLIC OPPOSITION – LEGISLATIVE AND CITIZEN INITIATIVES
- DECREASE TRUCKS ON THE ROAD

## COMPETITIVE ADVANTAGE

- INNOVATIVE SOLUTIONS TO WATER MANAGEMENT PROBLEMS
- ASSURANCE OF SUPPLY
- CONSISTENCY IN OPERATIONS
- ENHANCED PUBLIC PERCEPTION



# WHAT IS IN THE WATER?



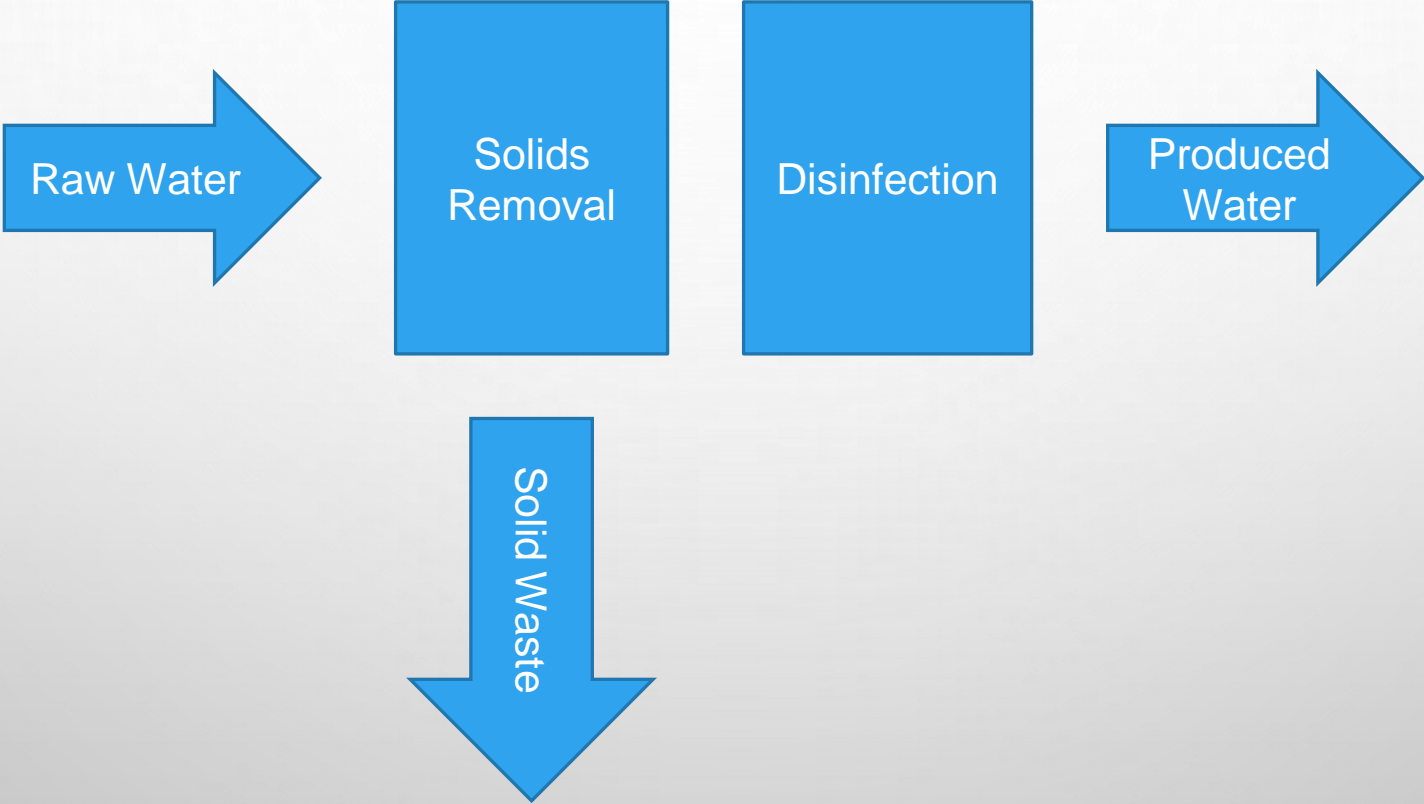
# DIFFERING TREATMENT APPROACHES

- FRAC ON THE FLY - \$0.10-\$0.25/BBL
  - ONLY REMOVE SOLIDS AND SOME BACTERIA
  - GOOD FOR SLICKWATER FRACS BUT STORAGE IS DIFFICULT
- CLEAN BRINE - \$0.20-\$0.50/BBL
  - REMOVES OIL, SOLIDS, AND BACTERIA
  - ALLOWS LONG TERM STORAGE BUT ONLY GOOD FOR SLICKWATER FRACS OR HIGH FRESH WATER BLENDS ON GEL FRACS
  - IDEAL FOR SURFACE STORAGE WHEN BEING REUSED FOR FRAC
- SOFTENED CLEAN BRINE - \$0.50-\$1.00/BBL
  - REMOVES OIL, SOLIDS, BACTERIA, AND SOME METALS AND HARDNESS
  - REDUCES SCALING POTENTIAL AND IMPROVES USABILITY
- FRESH WATER - \$1.50-\$3.00/BBL
  - REMOVES ALL CONTAMINANTS DOWN TO AGRICULTURAL OR SURFACE WATER STANDARDS INCLUDING TDS (SALT)
  - USABLE IN ALL OILFIELD APPLICATION
  - USABLE WITH PROPER DISCHARGE PERMITS IN OTHER INDUSTRIES

# TREATMENT TECHNOLOGIES

- OIL/WATER SEPARATION
  - CPI
  - DAF/IGF
  - GRAVITY SETTLING
  - WALNUT SHELL FILTER
  - ELECTROCOAGULATION
- SOLIDS REMOVAL
  - GRAVITY SETTLING
  - FILTRATION
  - ELECTROCOAGULATION
- DISINFECTION
  - BIOCIDES
  - BLEACH
  - CHLORINE DIOXIDE
  - ELECTROCOAGULATION
- SCALING POTENTIAL REDUCTION
  - CHEMICAL PRECIPITATION
  - SOFTENING
  - ION EXCHANGE
- SALT REDUCTION
  - REVERSE OSMOSIS
  - DISTILLATION/EVAPORATION
  - CRYSTALLIZATION
- BTEX REMOVAL
  - GAC
  - OTHER ADSORPTION
  - AIR STRIPPING

# FRAC ON THE FLY





# FRAC ON THE FLY TECHNOLOGIES

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- SOLIDS REMOVAL

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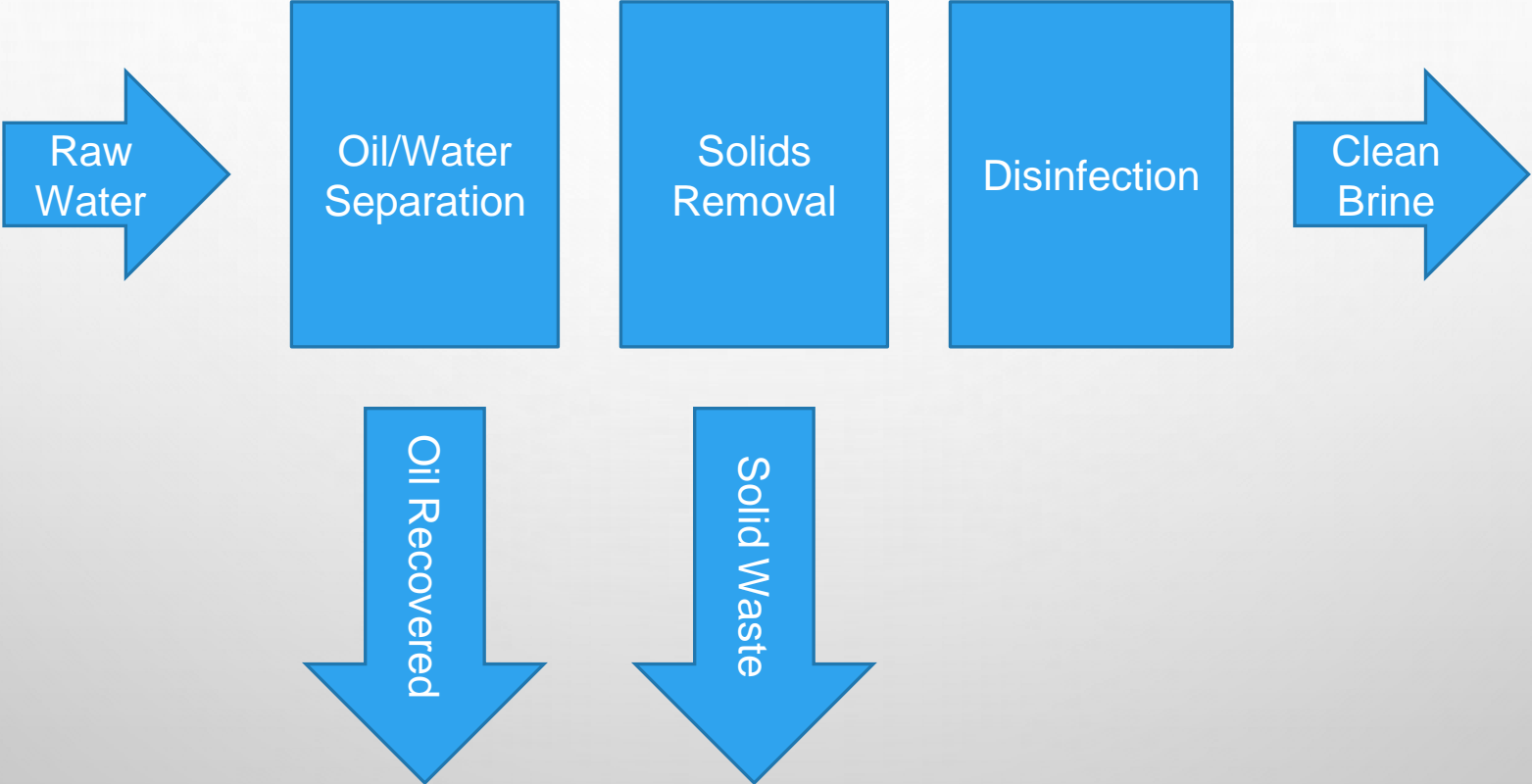
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# CLEAN BRINE

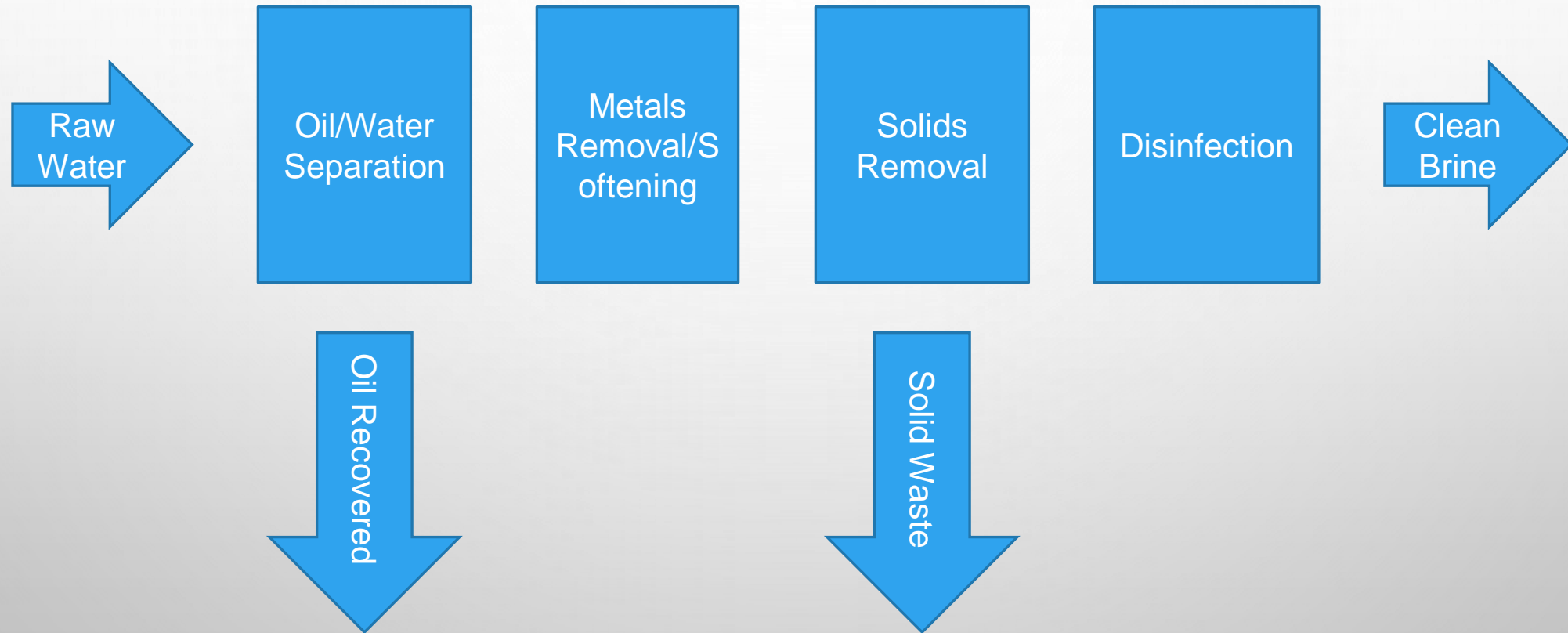


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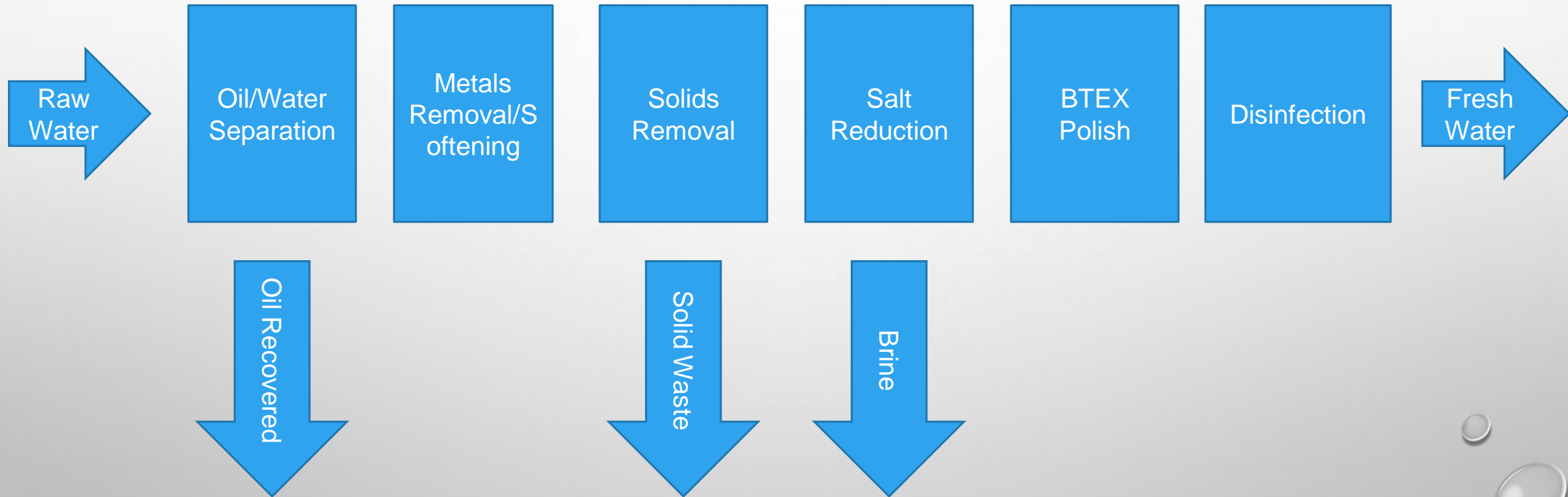
# SOFTENED CLEAN BRINE



# SOFTENED CLEAN BRINE TECHNOLOGIES

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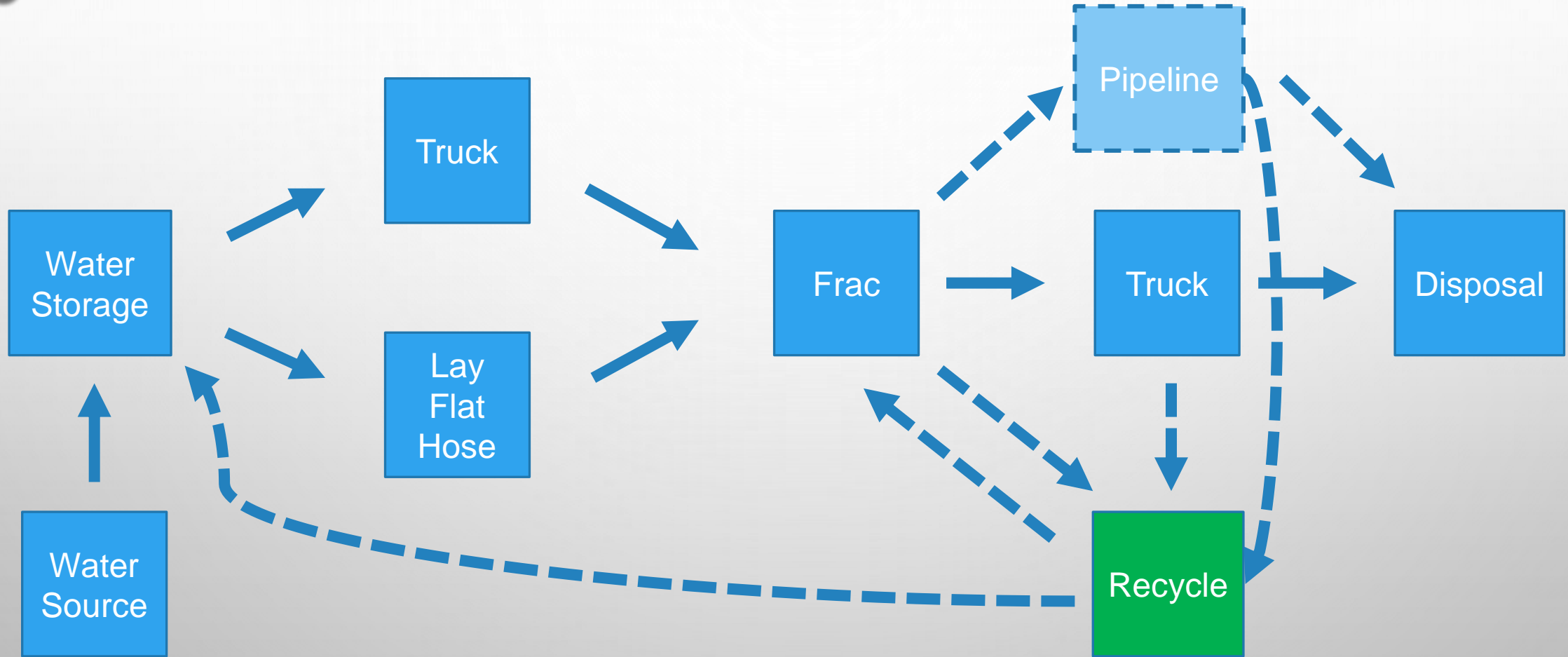
# FRESH WATER (AGRICULTURE, DISCHARGE, LIVESTOCK)



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# WATER RECYCLING LOGISTICS ITS COMPLICATED . . .





# LOGISTICS DETERMINE MANY ASPECTS OF RECYCLING PROGRAM

Basic Treatment

Low Cost

Low Maintenance

Smaller Volumes

Unreliable Replacement for Disposal

Advanced Treatment

Higher Cost

Higher Maintenance

Larger Volumes

Reliable Replacement for Disposal



High Speed  
to Frac



Low Speed to  
Frac





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**QUESTIONS?**