

# Williams Fork, Piceance Basin: Flowback Water Reuse – Quality and Quantity

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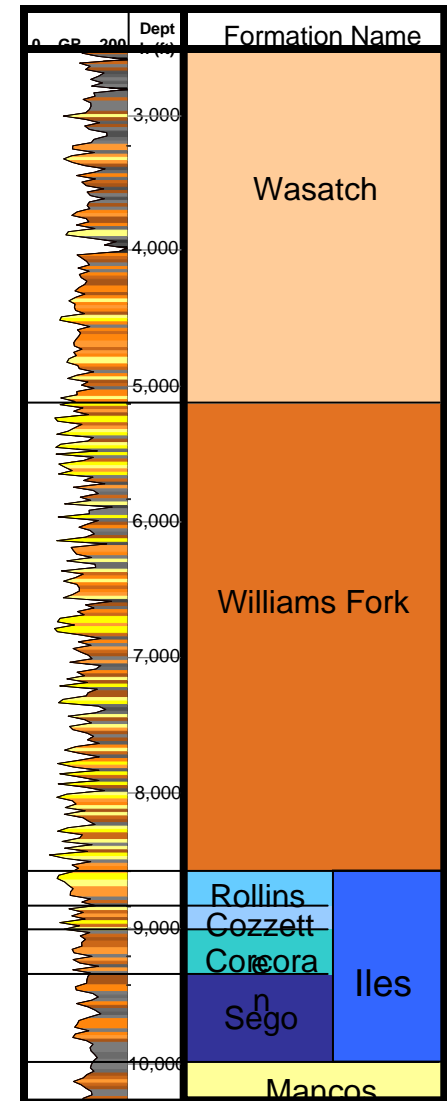
# Williams Fork, Piceance Basin Water Strategy Presentation Outline

## Piceance Overview

- Geology and Fracturing Necessities
- Current Water Quality and Infrastructure
- Source Inflow Volumes of Water
- Outflows of Water

# Piceance Basin – Williams Fork

- Geology
  - Overpressure Reservoir
  - 3000' Vertical Section
  - Shale, Sandstone, Coal Deposition
  - Avg Porosity 6%
  - Avg Permeability 7 $\mu$ D
  - Avg Water Saturation 65%
  - Frac Gradient 0.5-0.75 psi/ft
- Frac Characteristics
  - Highly Naturally Fractured
  - High-Perm Formation Created When Hydraulically Fractured



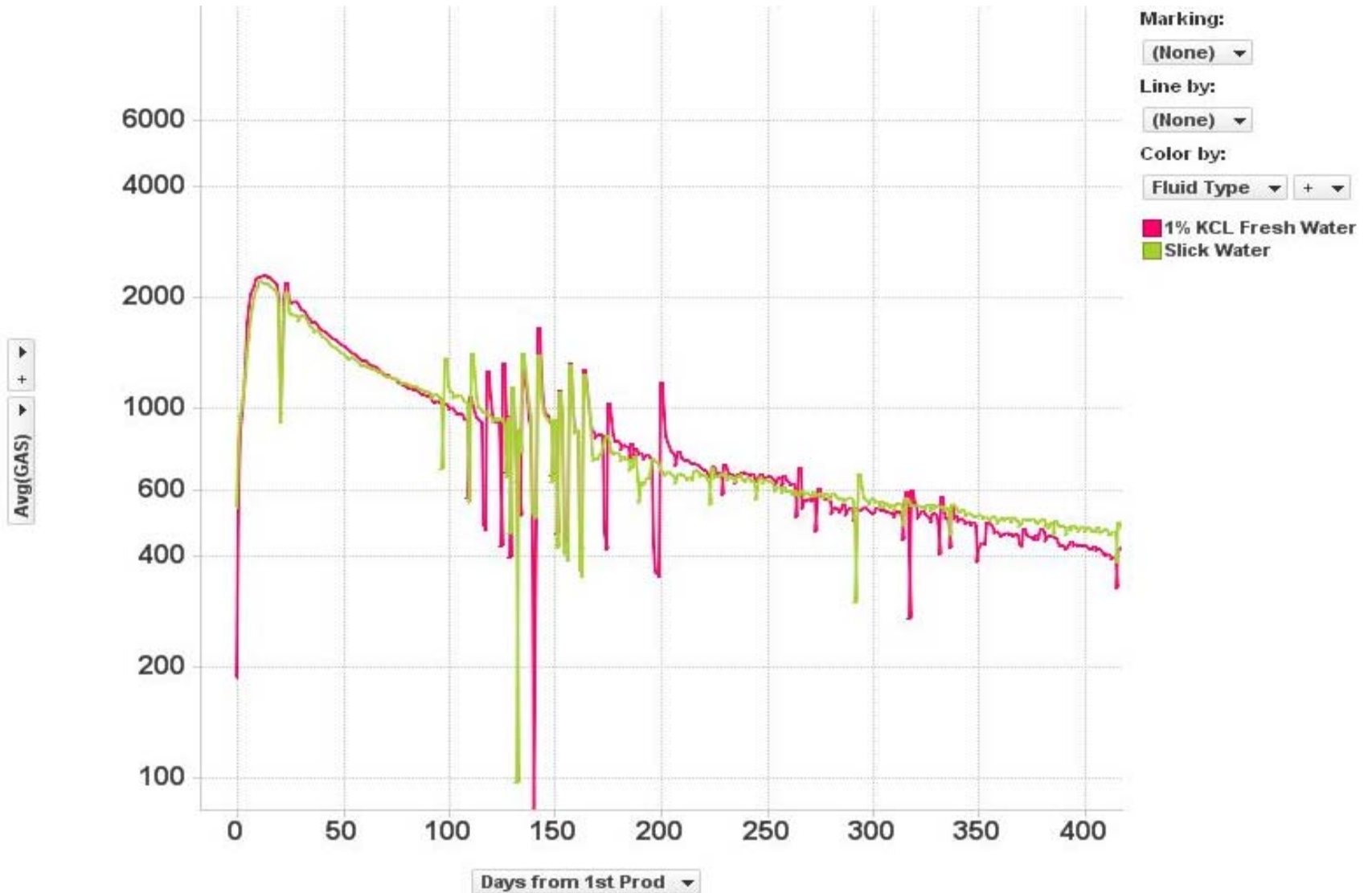
# Why Produced Water

- Formation Needs
  - Proppant
    - High Perm Fractured Environment
    - Low/No Proppant
  - Gels
    - Cause Damage to Formation
    - Not Needed For Proppant Transport
    - Not Needed For Fracture Height Growth
  - Water
    - Clay Swelling Not an Issue
    - Very Little Fines Migration
    - Compatibility

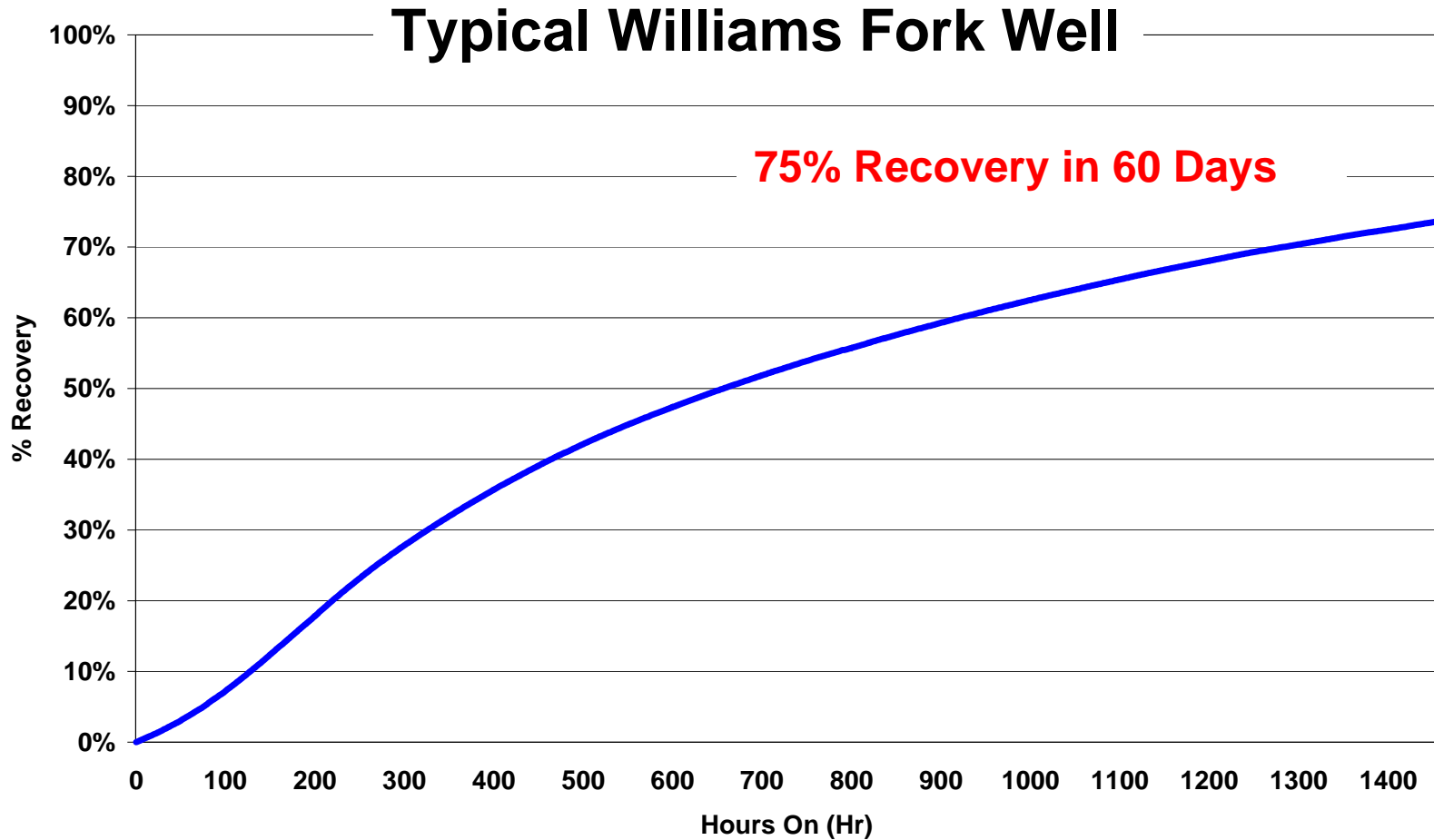
## Example: Fracturing Fluid Composition

- “Slickwater” fracturing fluid
  - Water: 98.9% to 99.2% (average 100,000 bbl/well)
  - Sand (proppant): 0.7% to 1%
  - Other additives (combined): <0.09%
- Fluid and water flowed back is either recycled and used as frac fluid (reducing fresh water usage) or disposed of in permitted injection wells

# Fresh vs Produced Water Study



# Flowback Water Recovery



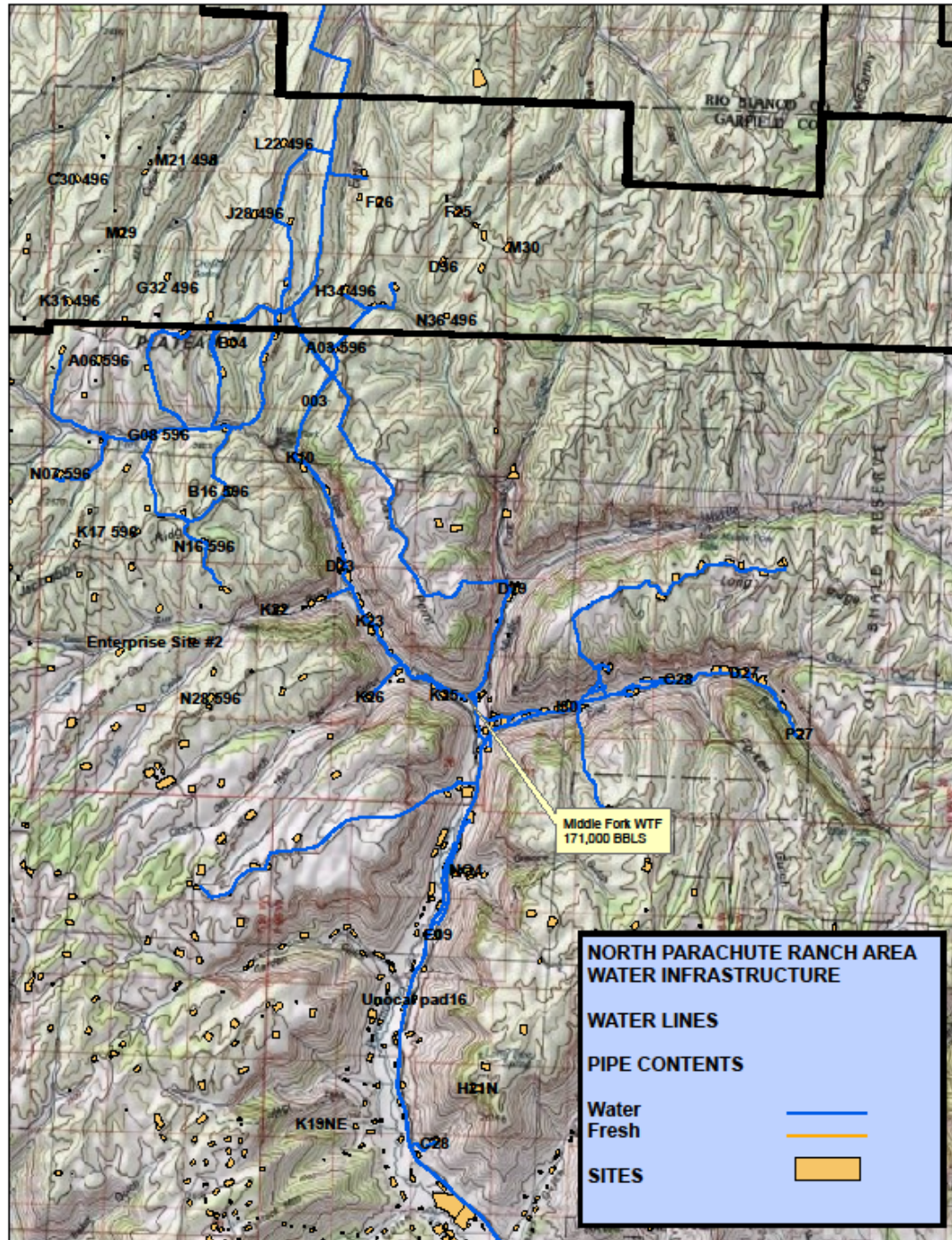
- 100% Recovery over Life of Well

# Piceance Basin Water Strategy

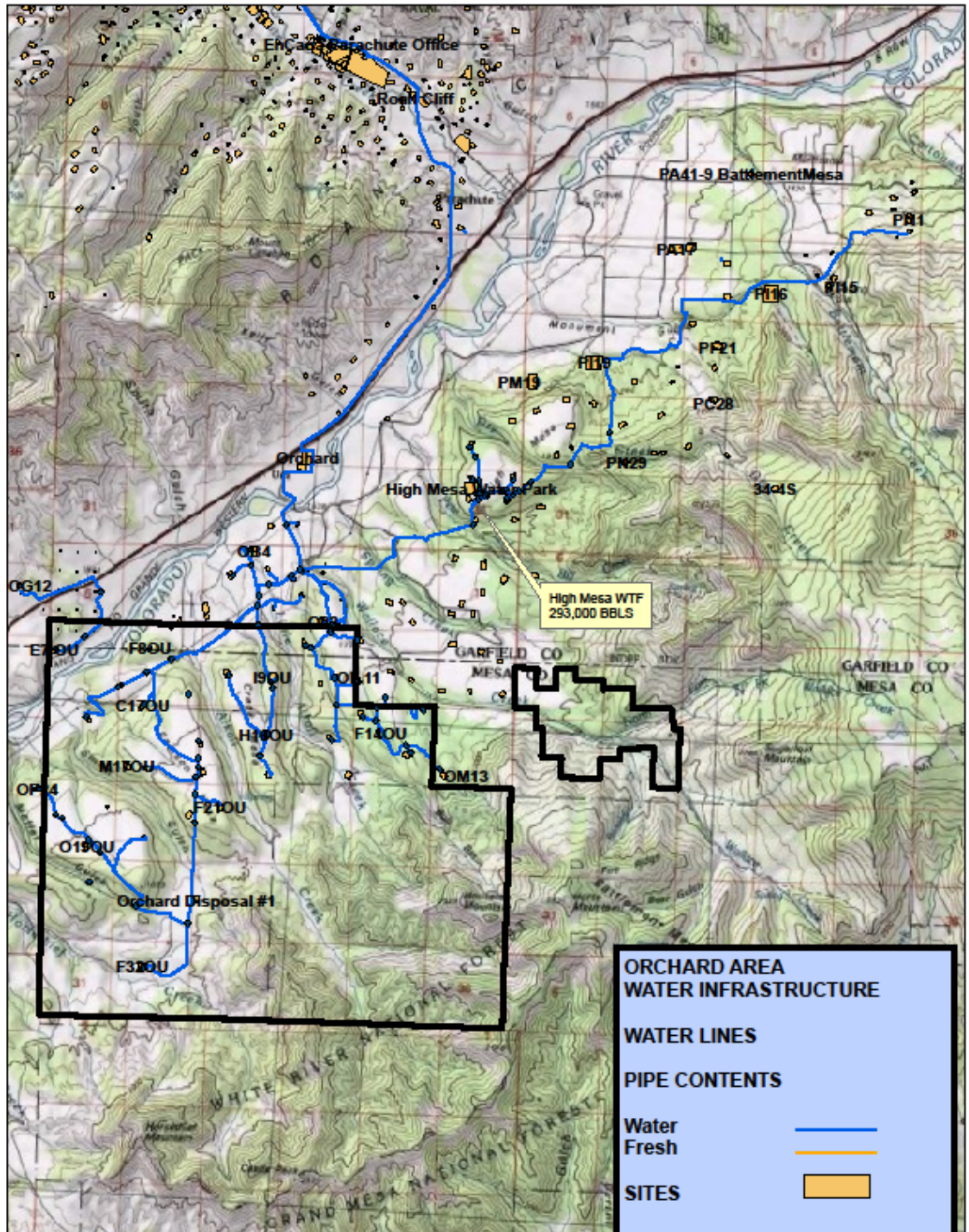
## Water Recycling Composition

- North and South Piceance operations are interconnected
- Produced and flowback water taken to central water facility by pipeline (where available) or water truck
- Water is treated for reuse
  - Solids, iron and hydrocarbon levels decreased
  - Stored in tanks or large facility ponds
  - Water is chemically treated for scaling and to break emulsions
- Water reused in completions operations
  - Transport by pipeline or truck, within geologic basin
  - Disposal minimized where possible
- On average 90% - 95%, of the water used in Piceance operations is recycled; the balance is fresh water used in drilling









High Mesa WTF  
293,000 BBLs



**ORCHARD AREA  
WATER INFRASTRUCTURE**

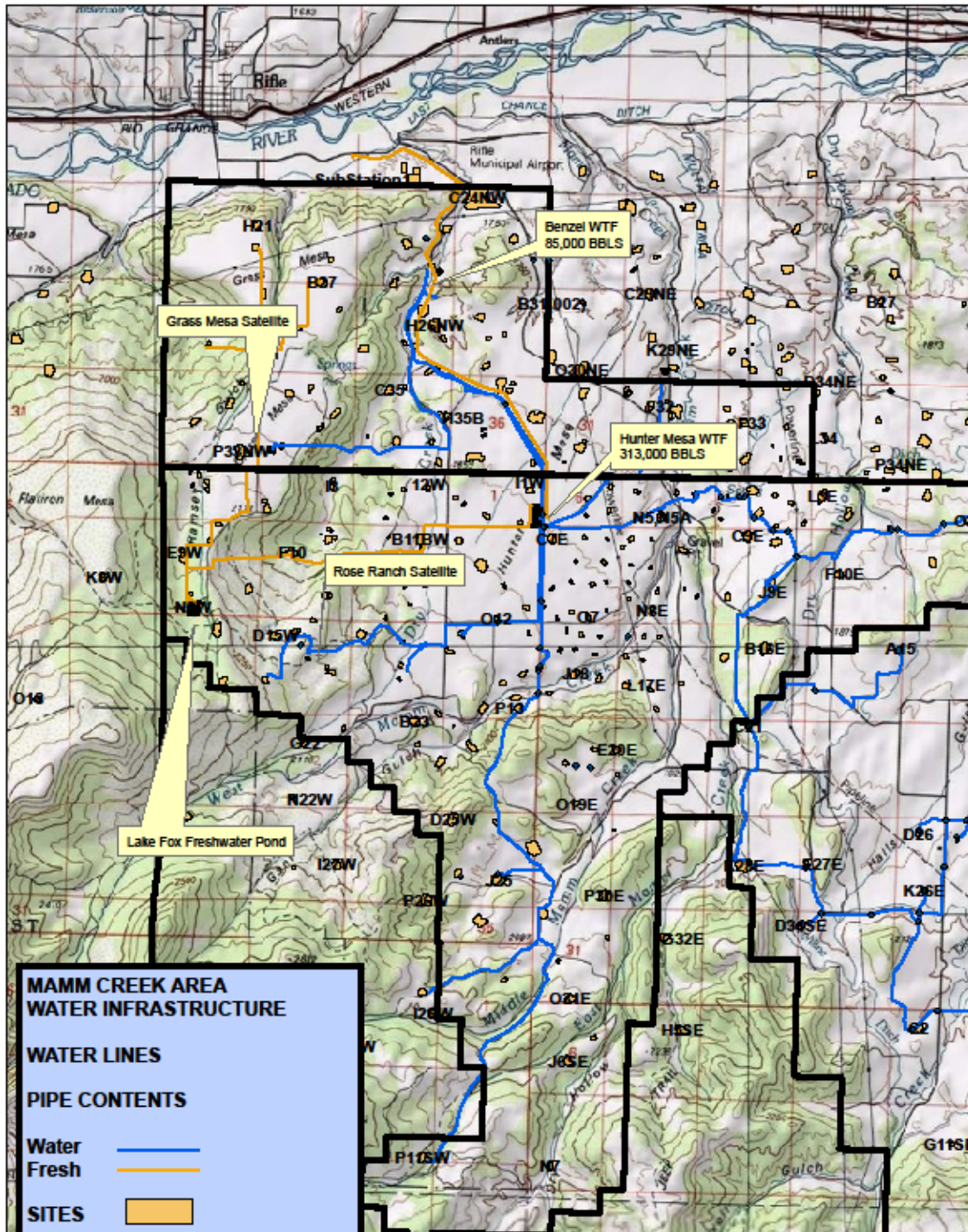
**WATER LINES**

**PIPE CONTENTS**

- Water
- Fresh
- SITES







Grass Mesa Satellite

Benzel WTF  
85,000 BBLs

Hunter Mesa WTF  
313,000 BBLs

Rose Ranch Satellite

Lake Fox Freshwater Pond

# Piceance Basin Water Strategy

## Current Infrastructure (estimates)

### Hunter Mesa Water Treatment Facility

- 40 miles of connected pipeline
- 2 high pressure pumps
- 310,000 bbl storage pond (13 million gallons ~ 40 acre-ft)

### Benzel Water Treatment Facility

- 4 Miles of connected pipeline
- 85,000 bbl storage pond (3.6 million gallons ~ 11 acre-ft)

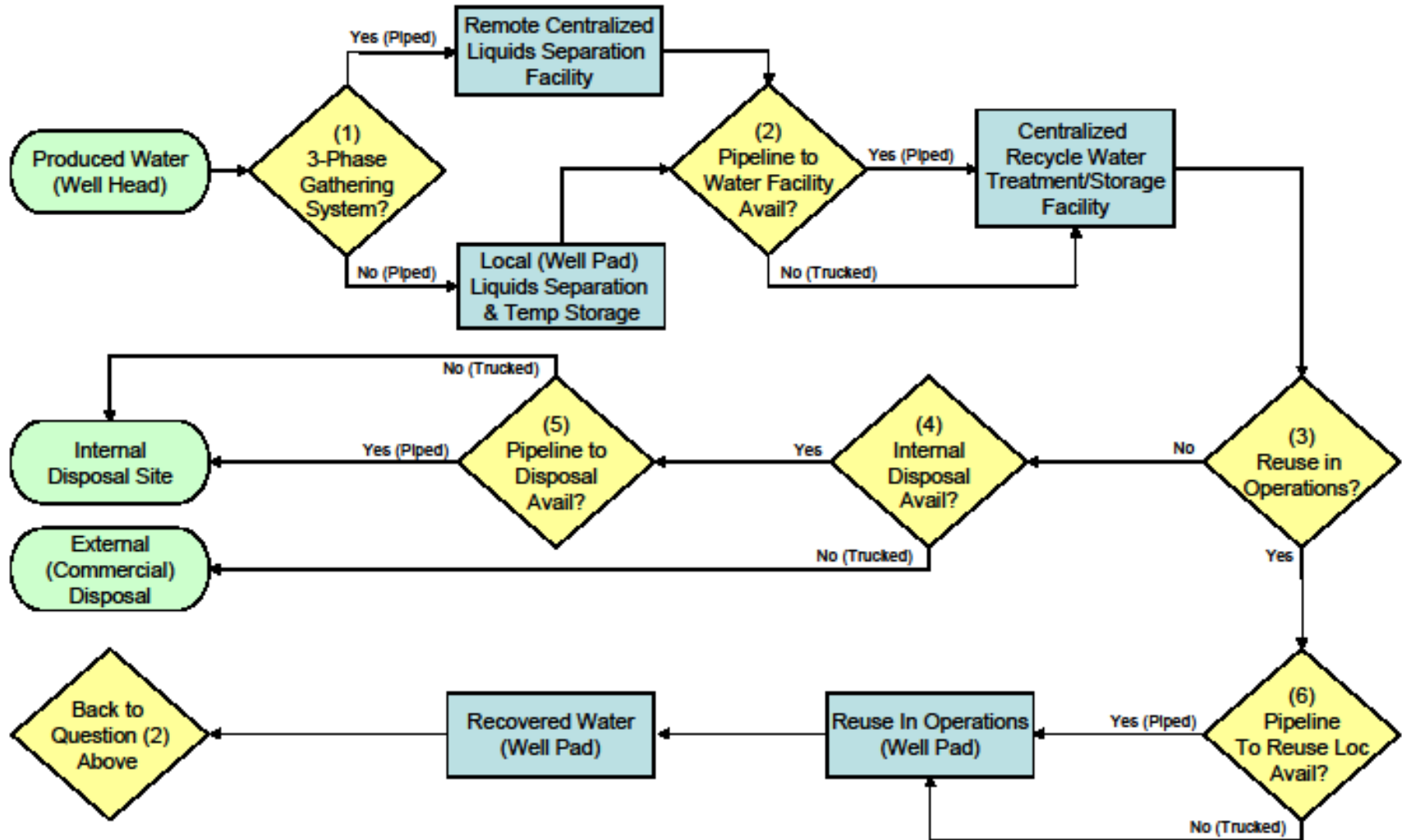
### High Mesa Water Treatment Facility

- 40 miles of connected pipeline
- 1 high pressure pumps
- 208,000 bbl storage pond (8.7 million gallons ~ 27 acre-ft)

### Middle Fork Water Facility

- 17 miles connected pipeline
- 4 high pressure pumps
- 217,000 bbl storage pond (9.1 million gallons ~ 28 acre-ft)

# Piceance Produced Water Process Flowchart



# Water Quality & Treatment

## Typical Water Treatment Facility in the Industry





# Piceance Water Basin Strategy

## Secondary Water/Condensate/Solids Separation

- Dissolved Air Flotation - Solids and hydrocarbon removal step
- Oil/Water Separator – Hydrocarbon removal step



# Piceance Basin Challenges & Opportunities

## Dissolved Air Flotation Results



90% Solids Reduction  
50% BOD Reduction



75% Iron  
Reduction



80% Hydrocarbon  
Reduction



# Questions?

