Irrigation Protection in CBM Areas

ASMR Annual Conference
Laramie, WY June 5, 2013

Wyoming Ag Protection Standard

Chapter 1, Section 20; Wyoming Water Quality Rules and Regulations:

"All Wyoming surface waters which have the natural water quality potential for use as an agricultural water supply shall be maintained at a quality which allows continued use of such waters for agricultural purposes.

Degradation of such waters shall not be of such an extent to cause a measurable decrease in crop or livestock production.

Unless otherwise demonstrated, all Wyoming surface waters have the natural water quality potential for use as an agricultural water supply."

What We're **NOT** talking about….

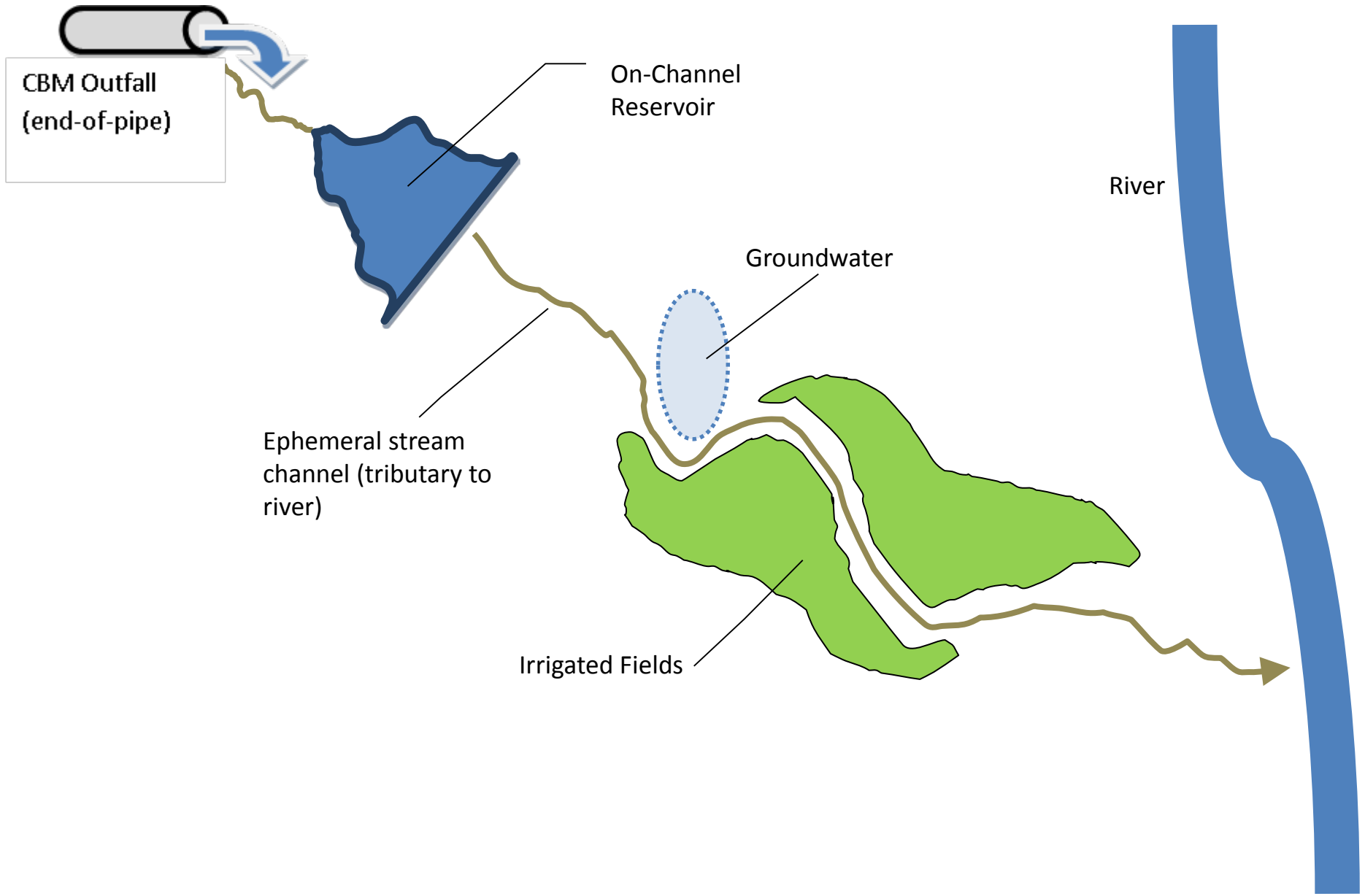
What We **ARE** talking about….


Not Protected as
Irrigation

What Gets Monitored

- CBM Outfalls (Produced Water)
- CBM Reservoirs
- Surface Water (Downstream)
- Groundwater
- Soils
- Crops / Forage

Typical CBM Layout



Reservoirs

Threshold: Reservoir water EC concentrating salts at 150% or greater.

Action: Cease discharge of CBM water into affected reservoirs.

Groundwater

Threshold 1: Groundwater within 6 feet of surface.

Action 1: Increase sampling frequency. Add sampling for dissolved inorganic carbon.

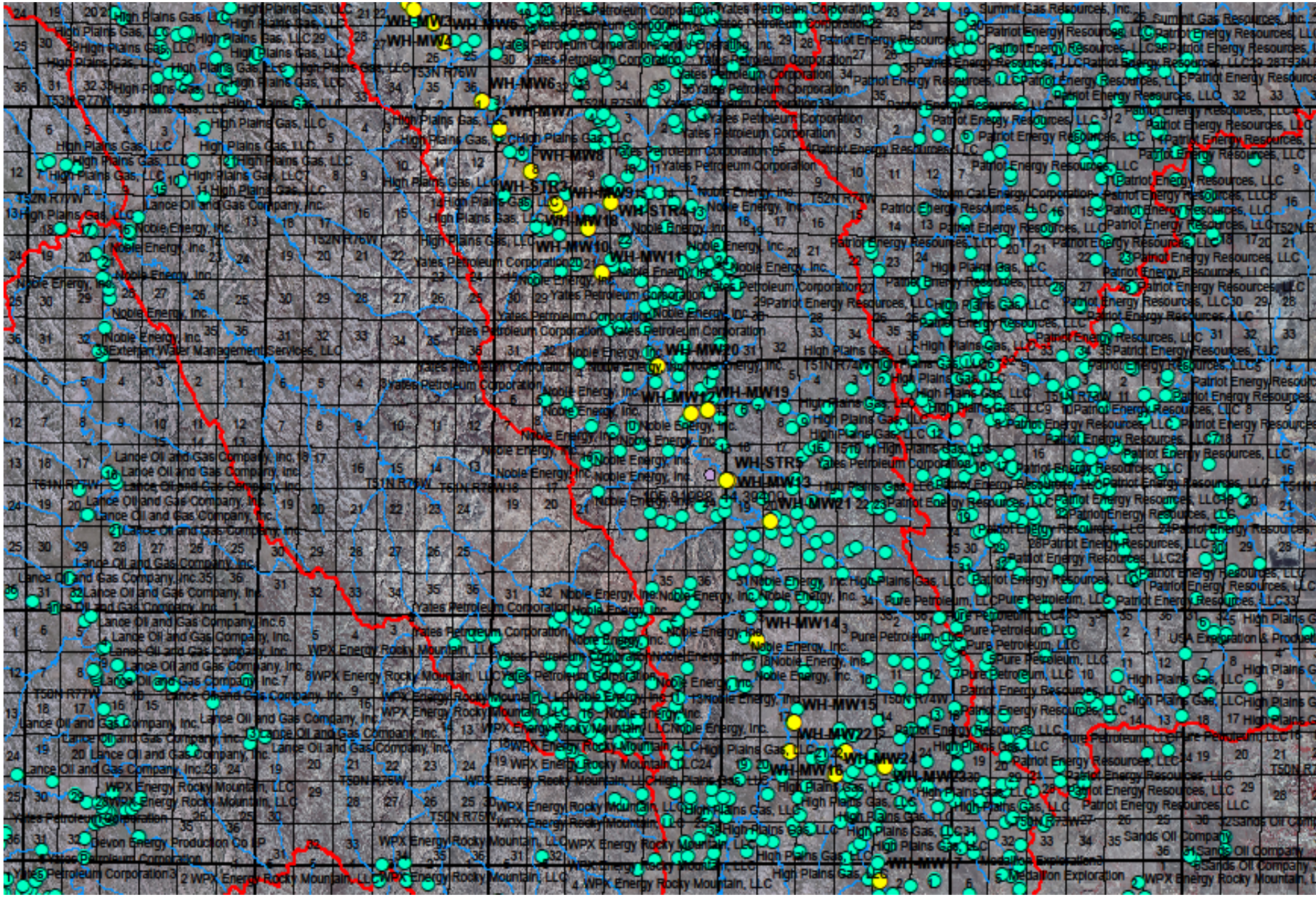
Threshold 2: Groundwater within 3 feet of surface AND contains CBM water.

Action 2: Cease CBM flows from contributing areas.

Soils

- **Threshold:** 40% increase in EC or SAR in one year; or 15% increase over 2 years or more; or, regardless of trend, any finding of ESP > 10% or EC > 4,000 micromhos/cm at 0-12” depth.

- **Action:** Increase soil sampling to twice per year. Investigate source of problem. If CBM water a contributing factor, mitigate by reducing CBM discharges, improving drainage and/or amending soils.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Yates Petroleum Corporation
Noble Energy, Inc.
Patriot Energy Resources, LLC
Lance Oil and Gas Company, Inc.
WPX Energy Rocky Mountain, LLC
Pure Petroleum, LLC
Summit Gas Resources, Inc.
Storm Cat Energy Corporation
Devon Energy Production Co LP
Sands Oil Company
Medallion Exploration
Exterran Water Management Services, LLC
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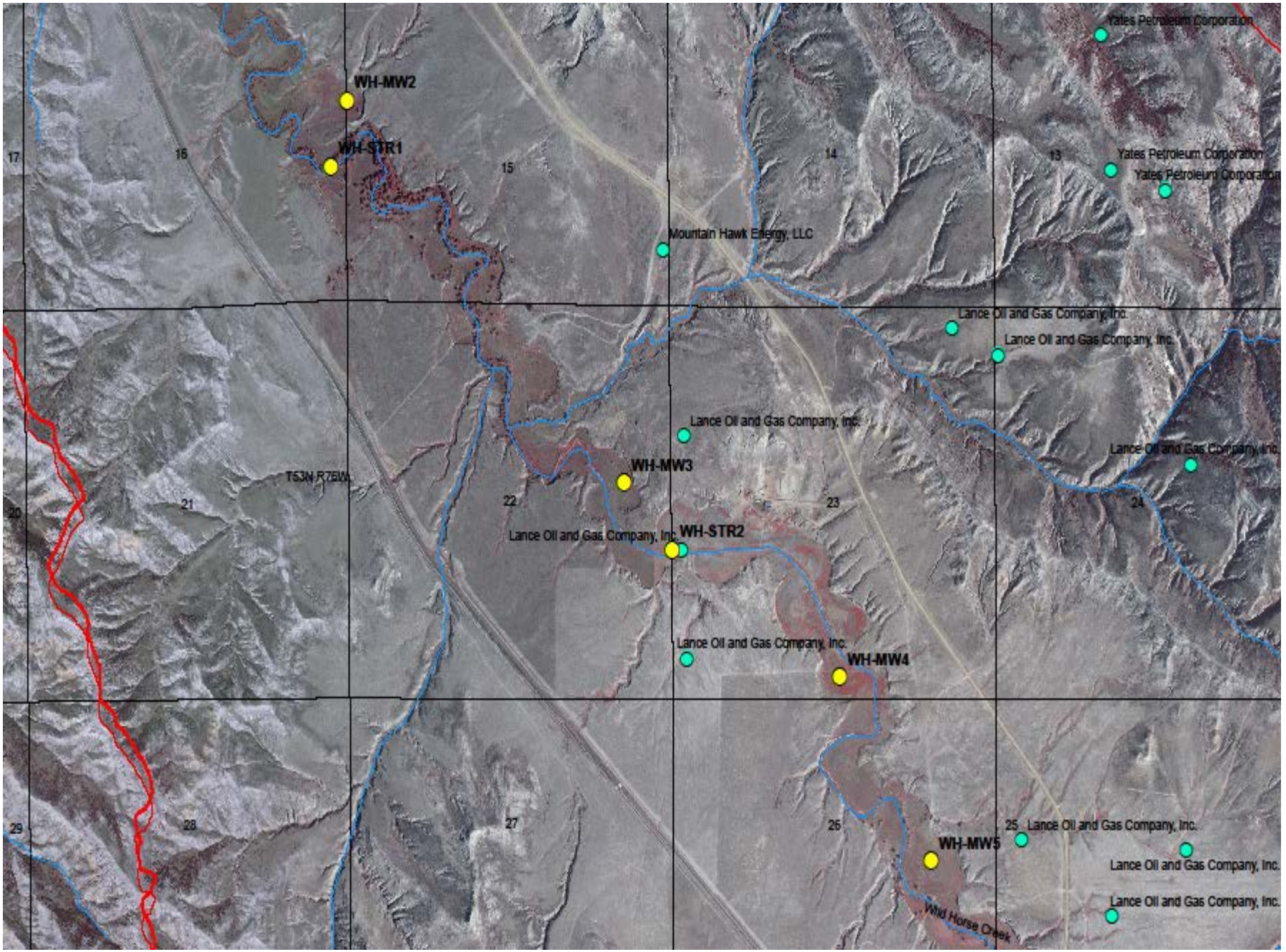
WH-MW2
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Yates Petroleum Corporation
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Mountain Hawk Energy, LLC
Lance Oil and Gas Company, Inc.
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Wild Horse Creek

2012 Dead Horse Creek:

Depth to groundwater: 3.5 – 12.5 ft

Groundwater EC: 3,000 – 12,000 µmhos/cm

Groundwater Carbon C^{13}/C^{12} : -4.5 to -12.5

Soil EC: 4,000 – 17,000 µmhos/cm

Soil ESP: 1 - 20

Soil Smectite: 18 – 32 %

Reservoir EC: 550 – 5,300 µmhos/cm

2012 Beaver Creek:

Depth to groundwater: 6 – 12.5 ft

Groundwater EC: 7,200 – 8,300 µmhos/cm

Groundwater Carbon C^{13}/C^{12} : -4.5 to -14.5

Soil EC: 1,300 – 32,000 µmhos/cm

Soil ESP: 1 - 20

Soil Smectite: 18 – 41 %

Reservoir EC: 800 – 3,600 µmhos/cm