

# OIL FIELD PRODUCED WATER FOR CROP IRRIGATION

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# Presentation Overview

- Why are we here
- Project Charter
- Background on produced water
- Produced water analytical data
- Crop data
- Regulatory Issues

# Why Are We Here?

- To ensure protection of human health
- Heightened attention on oil production activities
- New projects to expand recycling for agriculture
- How do we address food safety concerns

# Crop Safety Goals

- Involve our sister agencies responsible for food safety
- Get input from experts
- Confirm use is appropriate
- Should there be conditions
- Not to become an extended research project

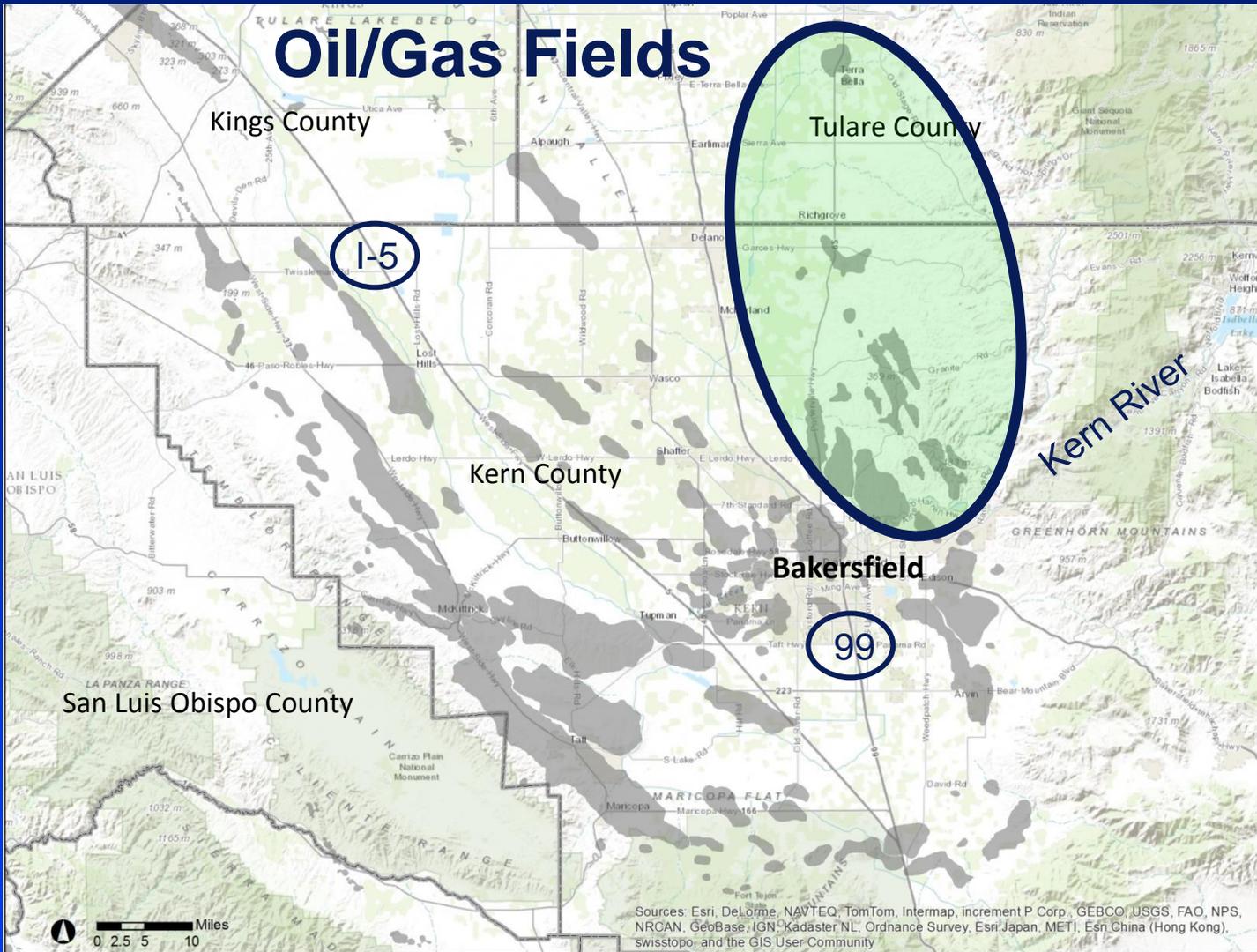
# Project Charter

- Open to discussion
- Provides some background
- Purpose
- White paper.

# Produced Water

- Water produced during oil extraction
- 1.9 billion barrels (240,000+ ac/ft) of produced water in 2013
- 878 million barrels for enhanced oil recovery in 2013
- Approximately 50,000 ac/ft currently used for irrigation
- Remainder is disposed in ponds and injection wells

# Oil/Gas Fields



Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

# Chemical Analyses

- General minerals
- Metals
- Volatile and semi-volatile organics
- Radionuclides

# Produced Water Quality Inorganic Compounds

	<b>TDS</b> mg/L	<b>Chloride</b> mg/L	<b>Boron</b> mg/L	<b>Sodium</b> mg/L	<b>Arsenic</b> ug/L
<b>VWM</b>	<b>570 - 600</b>	<b>80 - 82</b>	<b>1 – 1.1</b>	<b>180 - 210</b>	<b>34 - 41</b>
<b>Chevron</b>	<b>490 - 500</b>	<b>100 - 110</b>	<b>0.72 - 0.78</b>	<b>120 - 130</b>	<b>11 - 14</b>
<b>CRC</b>	<b>540 - 620</b>	<b>77 - 90</b>	<b>0.9 - 1.2</b>	<b>155 - 185</b>	<b>68 - 86</b>

# Produced Water Quality Organic Compounds

	Acetone ug/L	Benzene ug/L	Ethyl- benzene ug/L	Toluene ug/L	1,2,4- Trimethyl- benzene ug/L
VWM	ND – 79.4	ND	ND	ND – 7.5	ND
Chevron	31 - 150	ND - 0.67	0.25 - 1.2	0.39 - 1.3	0.40 – 1.9
CRC	ND-53.9	1.2	9.1	5.1	ND

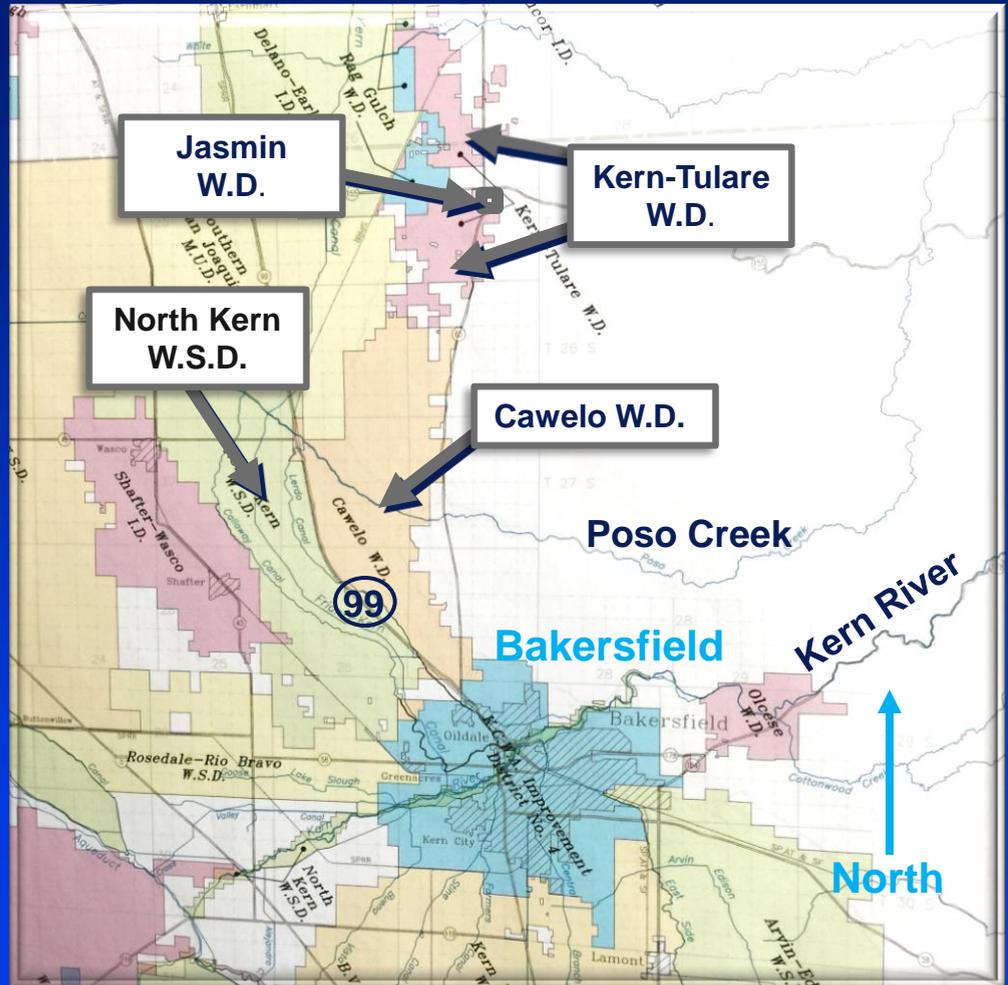
# Produced Water Quality Organic Compounds

	2-Butanone	m,p-Xylene	o-Xylene	Xylenes, Total
	ug/L	ug/L	ug/L	ug/L
VWM	ND	ND	ND	ND
Chevron	7.2 - 12	0.75 - 4.3	0.43 - 1.5	1.2 - 3.9
CRC	ND	14	7	21

# Produced Water Mixed with Other Irrigation Water



# Produced Water on Cropland



# Cropland Data

- 90,000+ Acres
- Crops Grown
  - Almonds (41,000 acres)
  - Grapes (15,000 acres)
  - Pistachios (12,000 acres)
  - Citrus (11,000 acres)
  - Other (apples, stone fruit, pomegranates, tomatoes, potatoes, beans, carrots)

# Produced Water Irrigation Issues

- Produced water being used
- Desire to increase use
- Media and stakeholder concern
- Hydraulic fracturing constituents on crops for human consumption

# Produced Water Irrigation Issues

- Increased the suite of analyses
- Demonstration of adequacy or prohibition
- Creating a food safety group

# Regulatory Issues

- Report of Waste Discharge
- Comply with laws, policies, and regulations
- Waste Discharge Requirements

# Questions ?

