

RECLAMATION

Managing Water in the West

Produced Water Management for Oil and Gas Operations

November 1st, 2012

19th International Petroleum Environmental Conference

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U.S. Department of the Interior
Bureau of Reclamation

Bureau of Reclamation

Where do we fit into Produced Water?

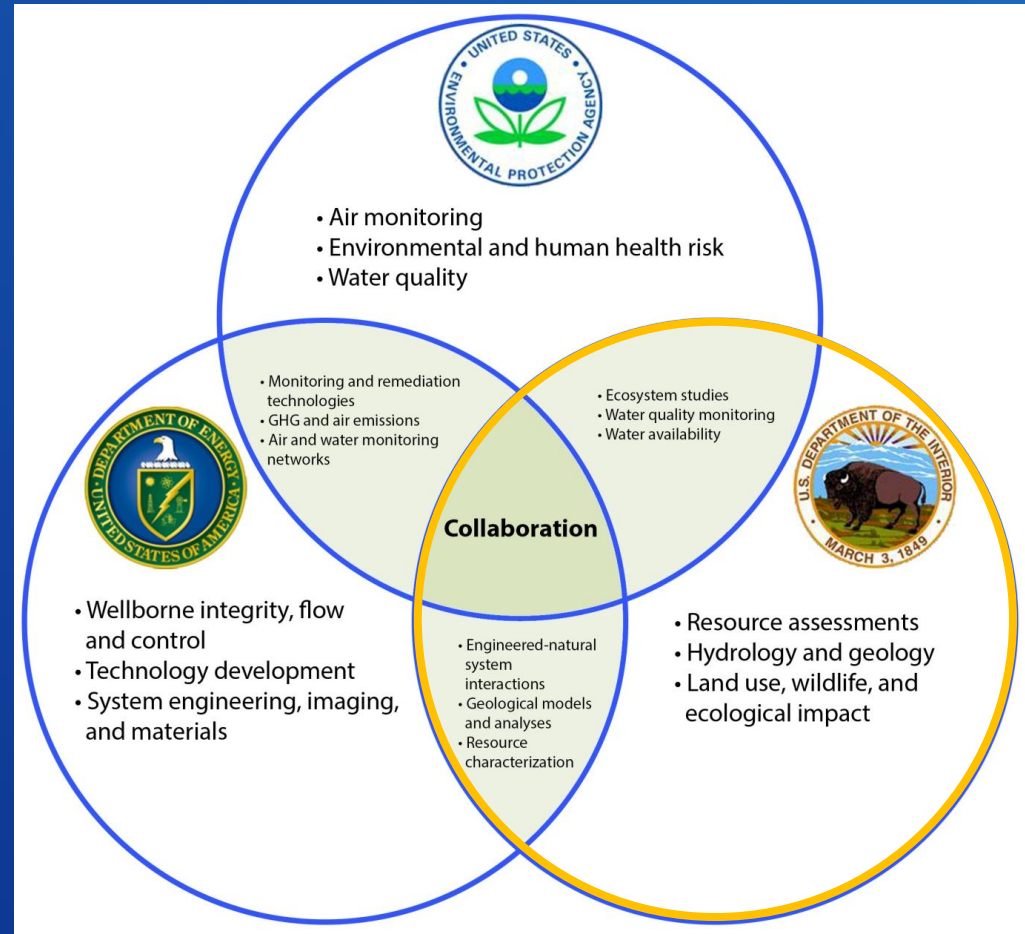
Develop new water supplies in the Western US

- Identify potential “new water” sources: brackish surface and groundwater, reclaimed wastewater, produced water, seawater
- Develop and validate water treatment technologies
- Identify location/quantity/quality/accessibility of water supply and demand to determine risk of water shortages and potential conflict

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Reclamation Research

- Alternative Water Supply Sources
- Produced Water Characterization
- Beneficial Use Opportunities
- Water Treatment and Management
- Rural Community Implications

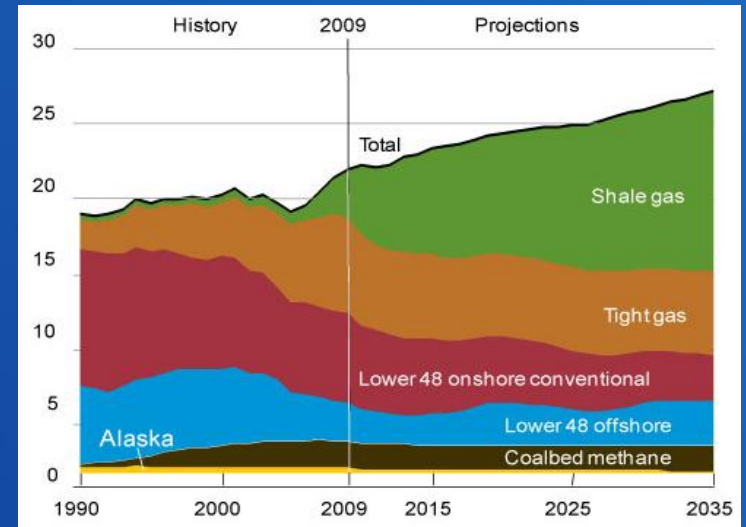


Multiagency Government Research Collaboration

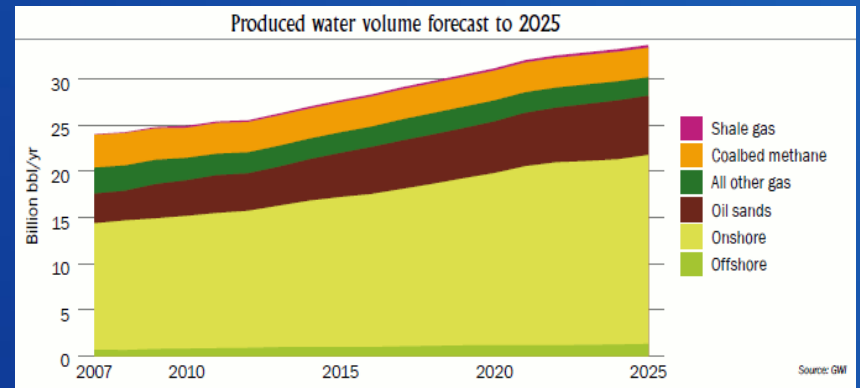
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Produced Water Generation

- Over 80% of oil and gas production occurs in the western US
- Water Generation: Approximately 1.5 billion gallons per day nationwide
- Water Demand: Hydraulic fracturing uses half a million gallons to over 10 million gallons of water/well fracturing event



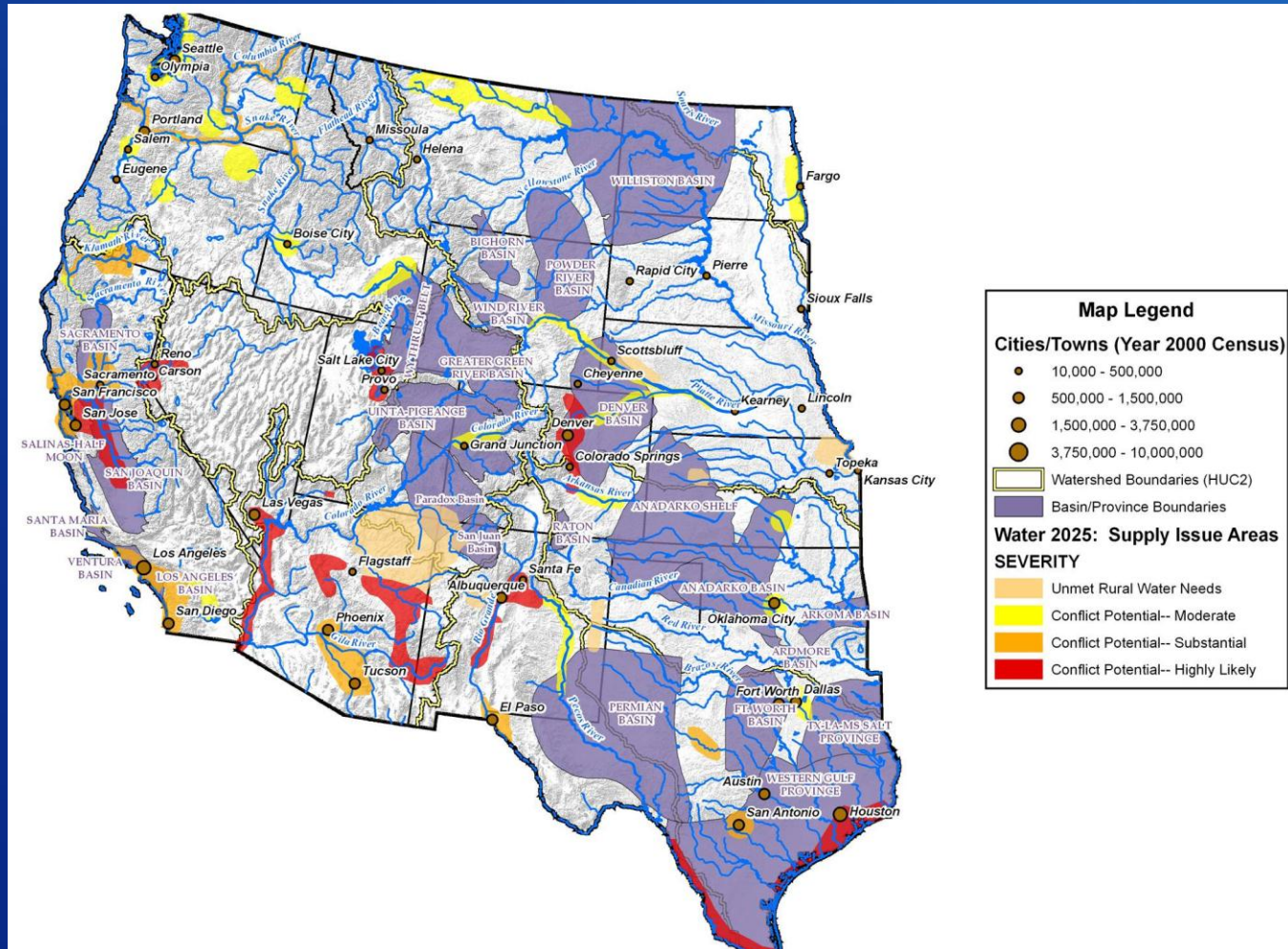
Natural gas production 1990-2035 (tcf),
EIA.gov, 4/26/11



Global Water Intelligence

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Geographical overlap between areas producing oil and gas and areas in need of additional water supplies.



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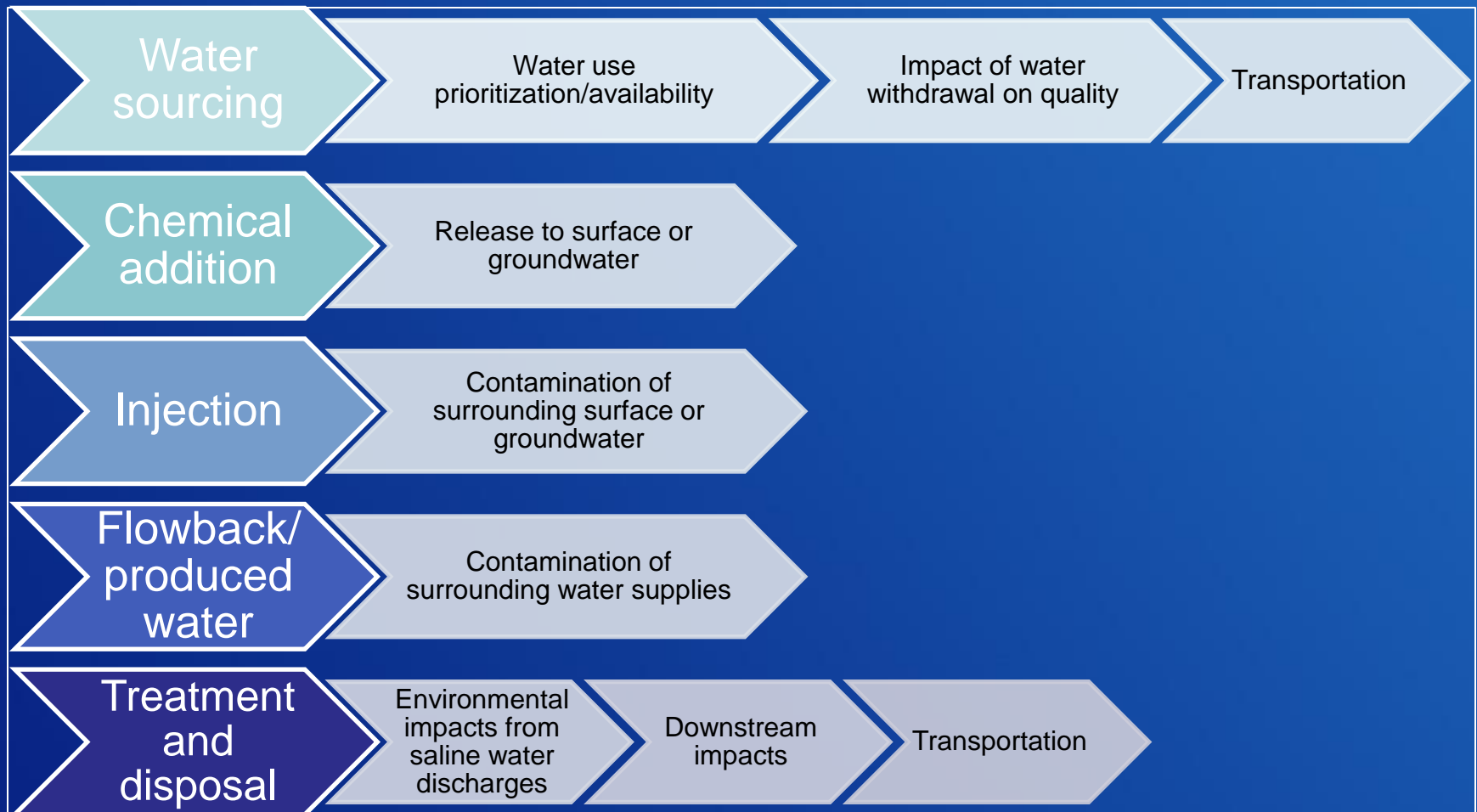
Produced Water as a Water Supply

- Drought-proof
- Non-tributary water not subject to water rights limitations
- Potential for variation in flow over time
- Oil and gas development for next 30 to 70 years
- Water resource can be mined up to 300 years



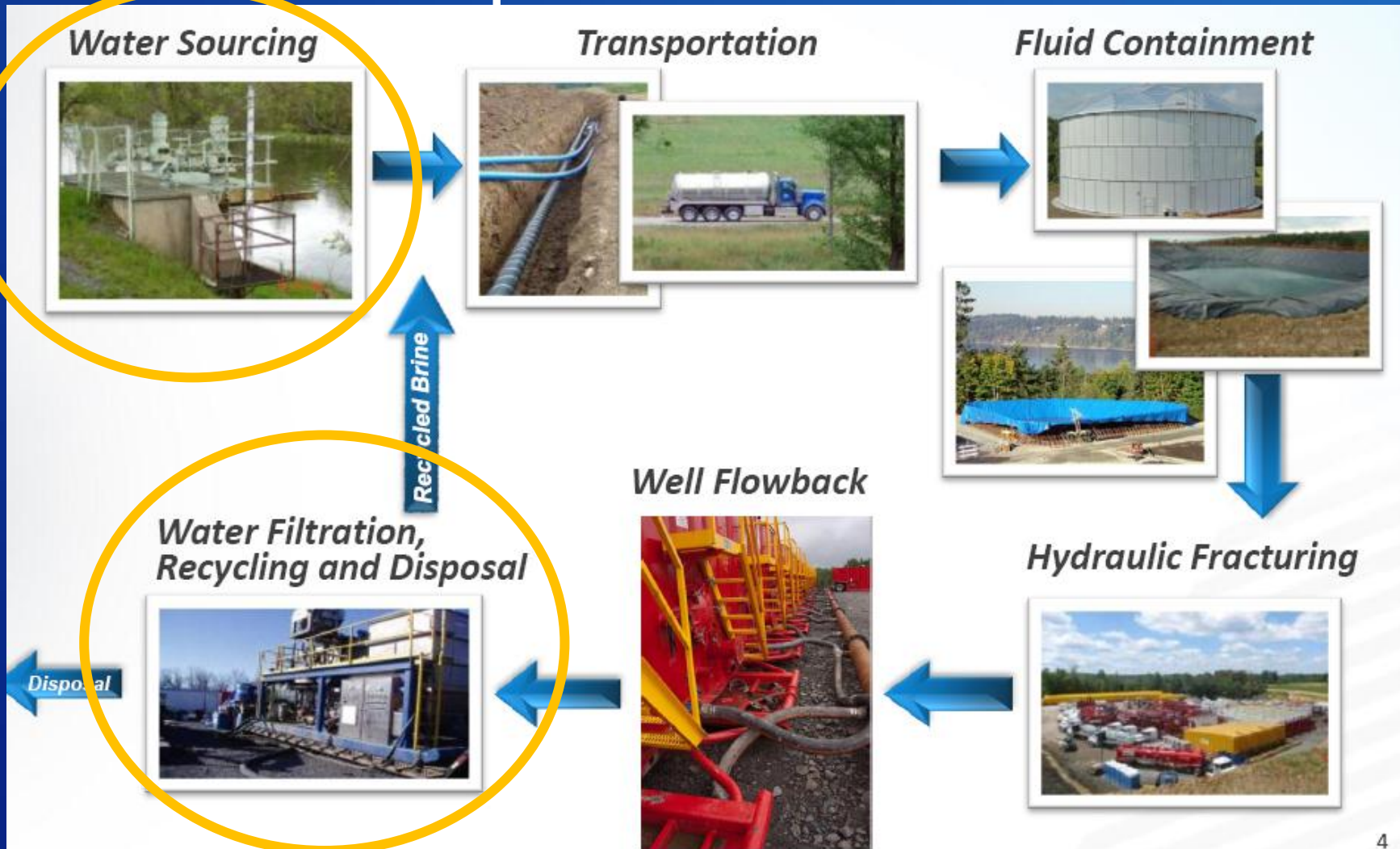
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Water availability and environmental concerns in petroleum production



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Water cycle in oil and gas production



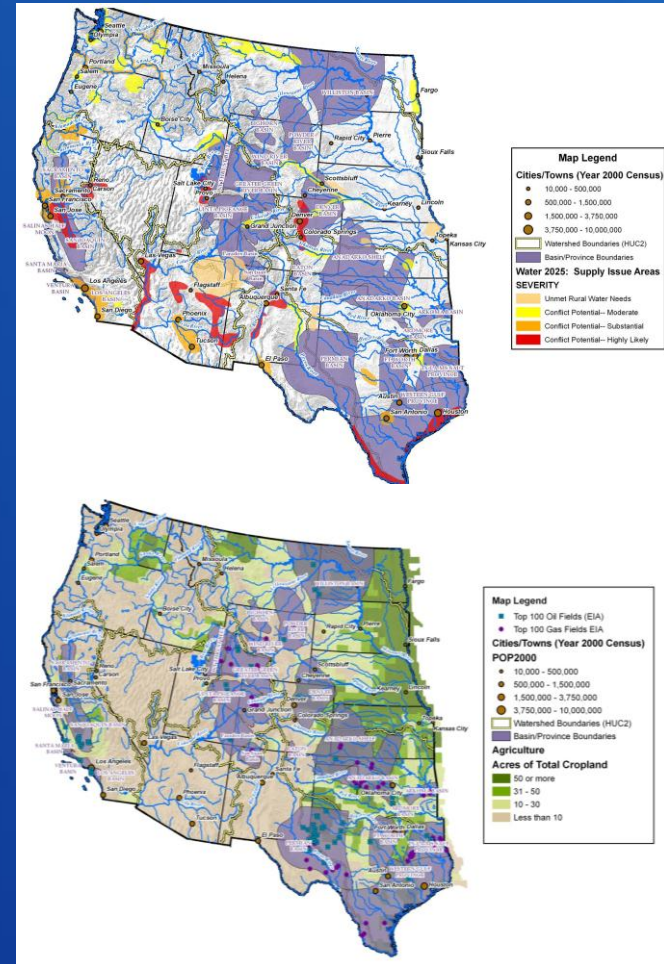
Source: Jim Raney, Director of Engineering,
Anadarko Petroleum, 2nd Annual Shale Gas Water
Management Conference, July, 26th 2012

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Water Management Primer for Oil and Gas Production

Primer Content:

- **Water Balance**
 - Water Needs
 - Potential Supply
- **Water Management**
 - Water sourcing
 - Beneficial Use
- **Water Treatment**
 - Categorical Processes
 - Constituent Based

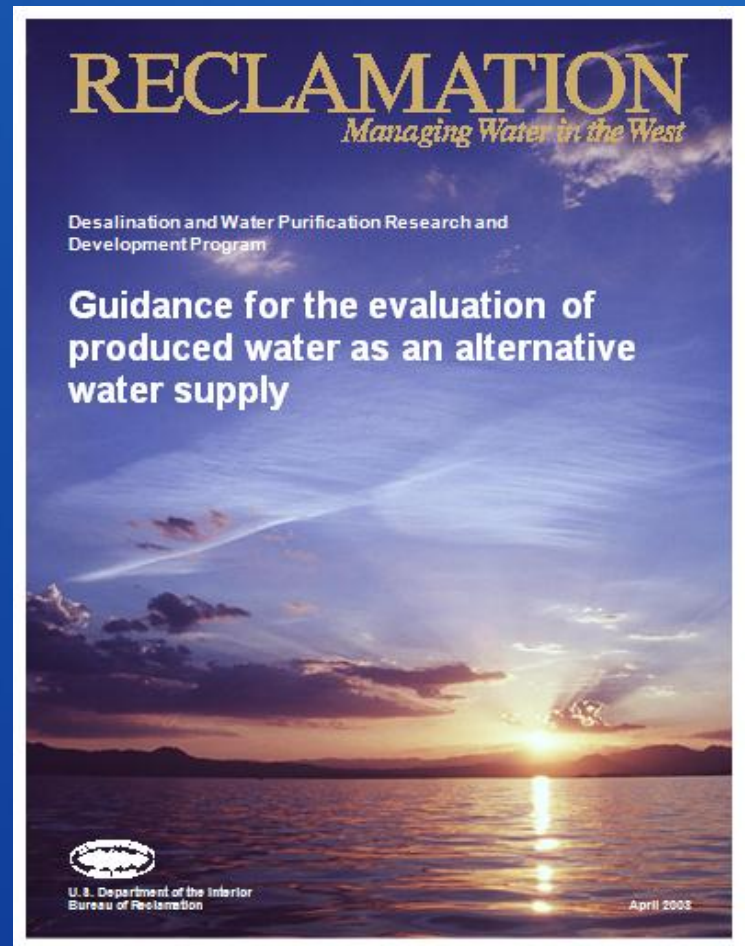


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Guidance Approach

Collecting Information:

- Published Studies
- Regulatory Guidelines
- Reclamation Experience
(Missouri River Bakken Shale
Fracturing Water Supply Agreements)
- Industry Collaboration
(Produced Water Treatment
Community of Practice)
- Commercial Treatment
(Technology Evaluation at Reclamation
Facilities, TechComm Technology
Showcase)

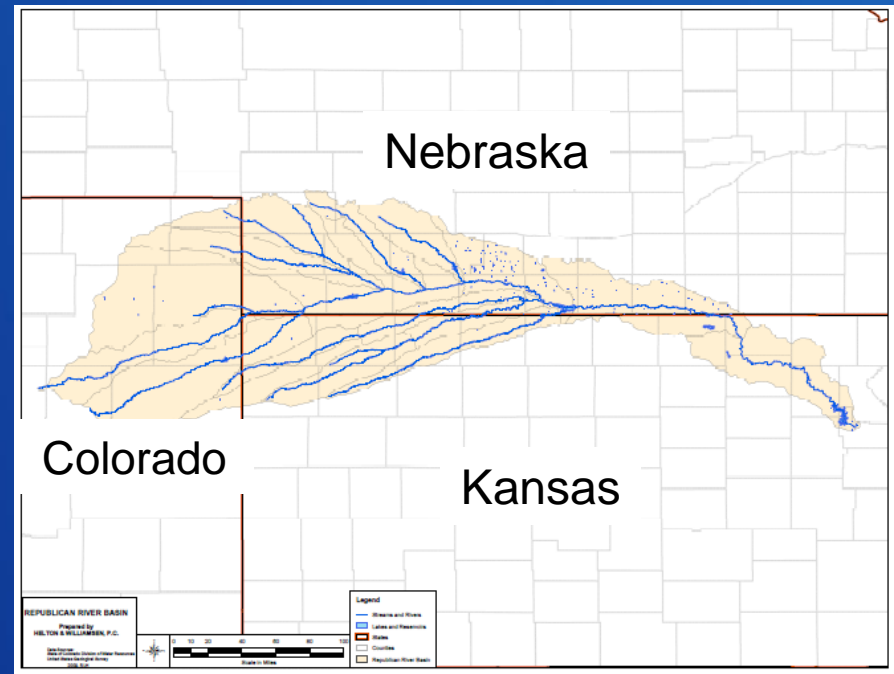
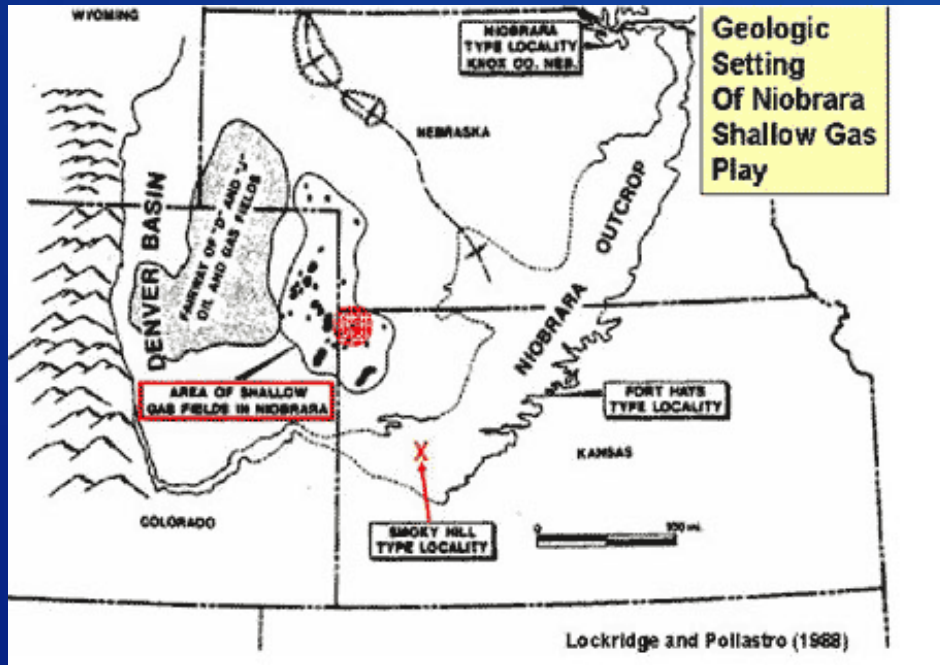


Estimated Completion Sept. 2013

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Water supply studies by basin

- Republican River Compact: “to provide for the most efficient use of the water of the Republican River Basin for multiple purposes...”
- Competing needs for a limited water supply



Alternative Water Supply

Primary Water Sources for Fracturing

- Municipal Water
- Surface Water - River/Creek
- Subsurface Water - Well Water
- Other Water - Industrial waters, flowback or produced water reuse

Source Water Restrictions

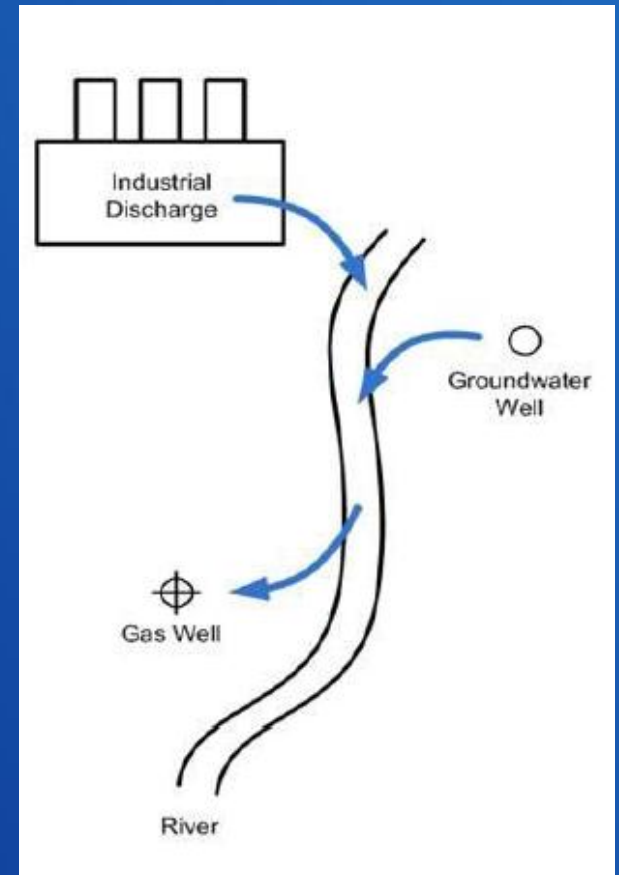
- Limited existing water infrastructure
- Drought risk
- Competition with urban growth
- Competition with agricultural water needs
- Seasonal variations and reliability of water supply

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Water Sourcing

Facilitating industrial water reuse:

- Direct reuse of hydraulic fracturing flowback and produced water
 - Compatible with the producing formation
 - Available on-site (reduces transport cost)
 - Reduces disposal wells
- Brackish groundwater as an alternative to fresh water for fracturing
- Industrial/commercial reuse sources
 - Increased volume in water ways
 - Free/natural conveyance system



Texas Bed and Banks Permit
Source: www.trinity.edu

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Beneficial Uses of Produced Water

- Irrigation
- Livestock watering
- Stream flow augmentation
- De-icing fluids
- Industrial uses



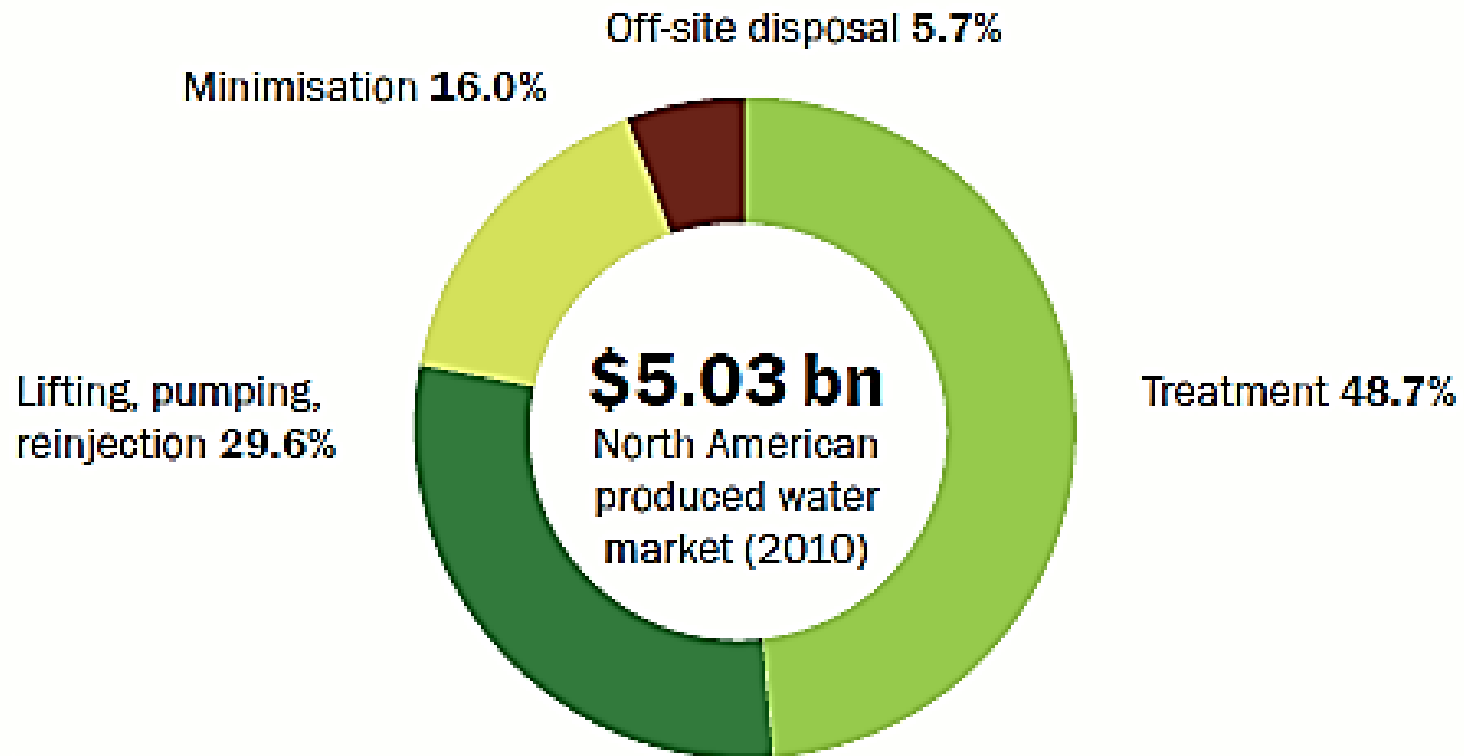
(Produced water management in Powder River Basin, NETL)

The majority of produced water is saline and requires some degree of treatment in order to be put to beneficial use

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Water Treatment Market

The North American produced water market by activity (2010)



NB: Includes opex and capex

Source: GWT

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Technology Clearinghouse

- Categorizing water treatment capabilities and performance
- Match technologies to applications
- Describe technologies based on classification of separation mechanism
- Generate a catalog of technologies
- Provide operational experience and performance data when available

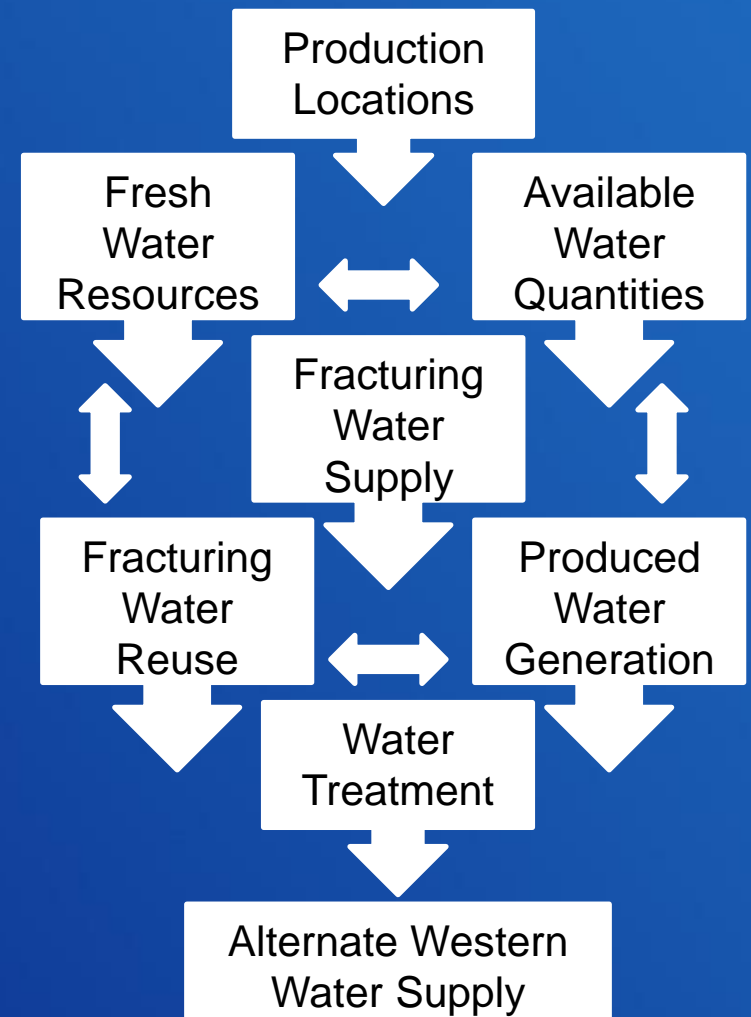


Reclamation's Denver Water
Treatment Research Laboratory

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Guidelines for Water Management

- Locations of opportunity
 - Regional GIS Mapping
 - Available Water Supply
 - Water Quantity Estimates
- Supply/demand balance
 - Alternative water resource
 - Facilitating industry reuse
- Water Treatment
 - Matching Appropriate Technology
 - Demo/Pilot Study Examples



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Opportunity for Collaboration

- Call for data, information, and technologies combinations
- Technologies for consideration
- Potential for collaboration



Reclamation's Brackish Groundwater
National Desalination Research Facility
(BGNDRF) in Alamogordo, NM



Dr. Ali at BGNDRF
(Courtesy of NMSU)

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Rocky Mountain Federal Marketplace 2013

Who: Federal laboratories, agencies, industry, academia, economic development organizations, entrepreneurs, and venture capital professionals.

When: May 22-23, 2013

Where: Hyatt Tech Center, Denver, CO

Why: Find opportunities for collaborative research, patent licensing, and other forms of interaction with the Federal labs, universities, and leading R&D companies.



For more information
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Communities of Practice

- Concept – Group who share a common goal and participate in efforts to identify solutions.
- Objective - Create solutions to pressing national problems.
- Expected Outcomes – Problem solving through collaboration and technology transfer & commercialization.



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