Web Conference Summary of June 4, 2013 Technical Workshop on Water Acquisition Modeling

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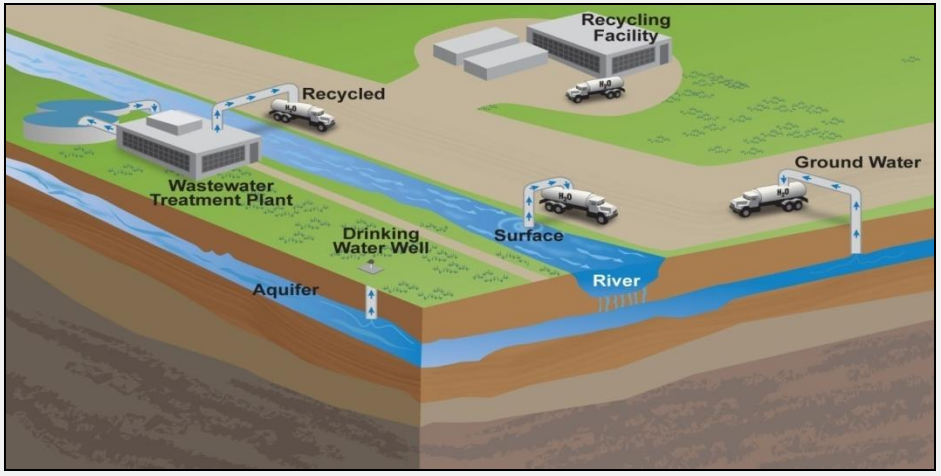
July 16, 2013



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EPA Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

Assess whether hydraulic fracturing may impact drinking water resources

Identify driving factors that may affect the severity and frequency of any impacts

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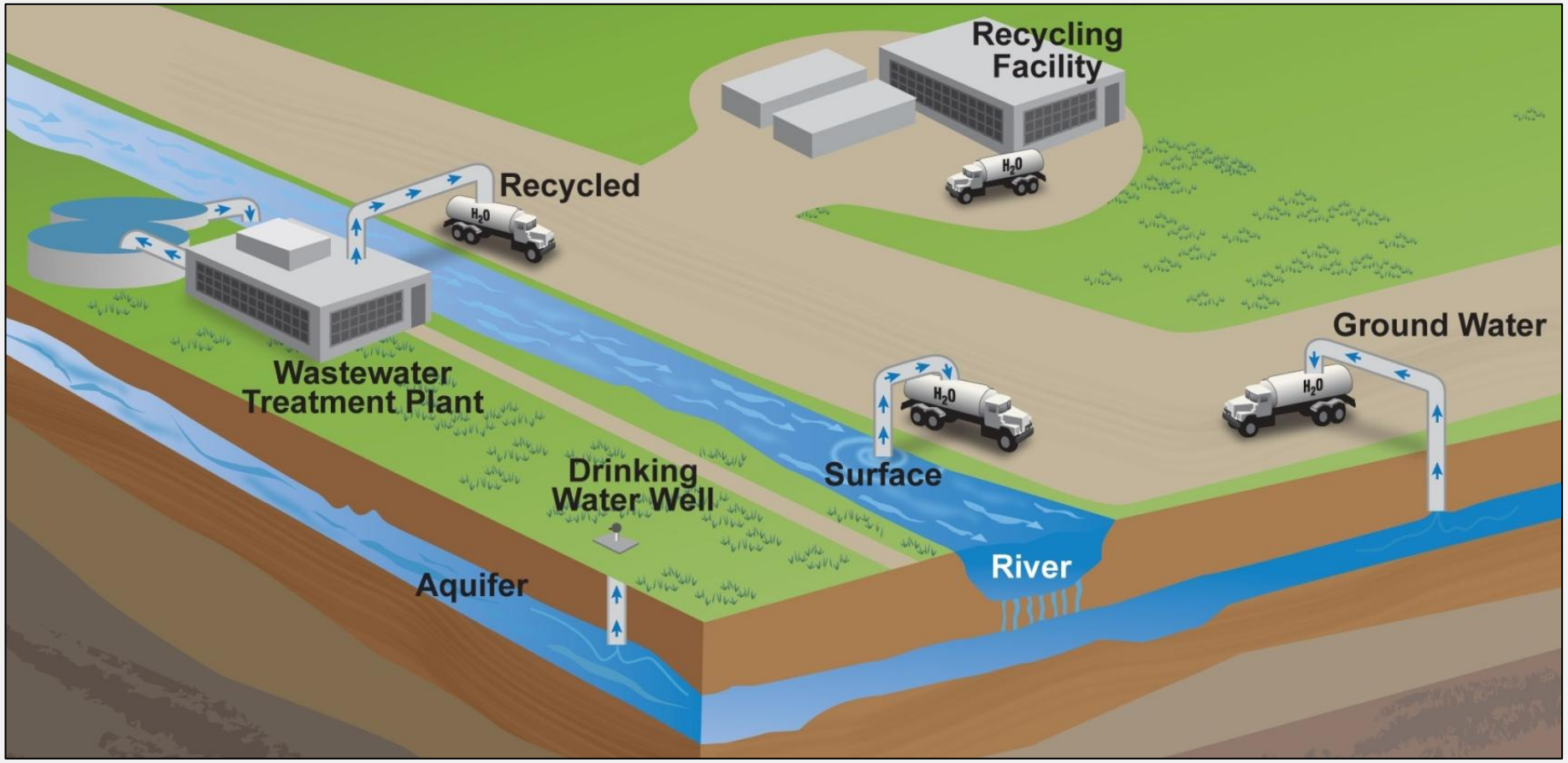
Water Acquisition



What are the possible impacts of large volume water withdrawals from ground and surface water on drinking water resources?

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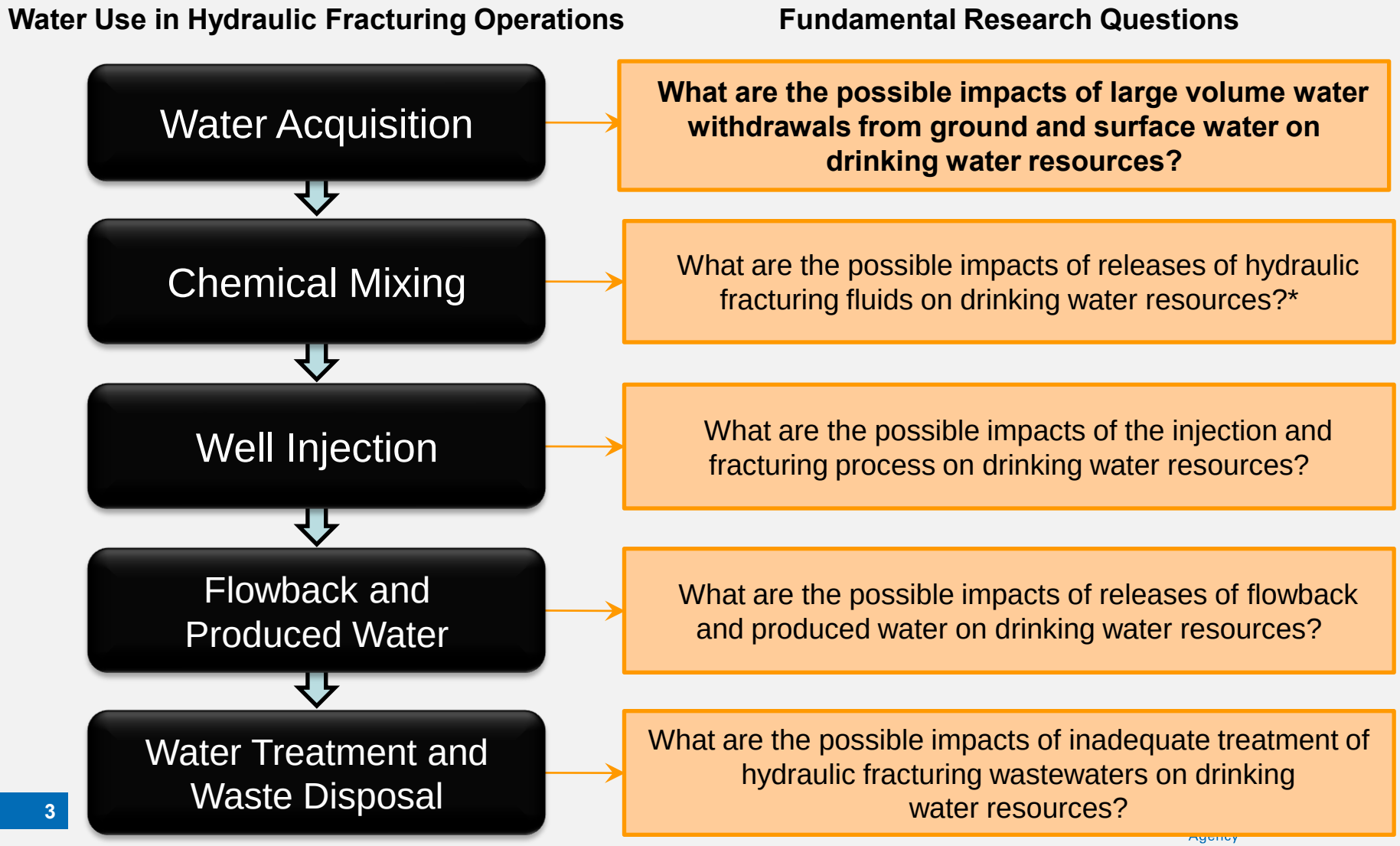
Hydraulic Fracturing Water Cycle



EPA Hydraulic Fracturing Study – research questions

Water Acquisition →

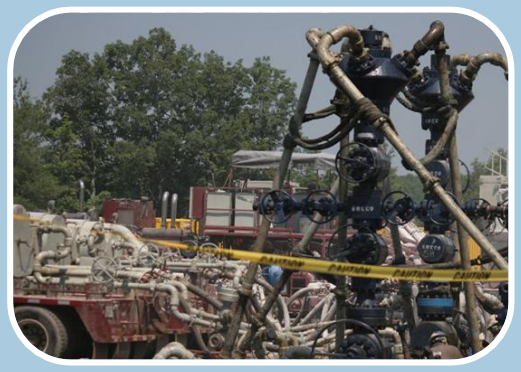
What are the possible impacts of large volume water withdrawals from ground and surface water on drinking water resources?

How much water is used in hydraulic fracturing operations, and what are the sources of this water?

How might water withdrawals affect short- and long-term water availability in an area with hydraulic fracturing activity?

What are the possible impacts of water withdrawals for hydraulic fracturing operations on local water quality?

Consideration of Scale: National Estimates



1.5×10^{14} gallons

USGS estimated national water use in 2005

1.5×10^{12} gallons

USGS estimated national water use for Mining and Oil and Gas in 2005

~1% of total

$7\text{-}14 \times 10^{9}$ gallons

EPA estimate of water used for hydraulic fracturing in 2009-2010

<0.1% of total in 2005

Impacts of water withdrawals for hydraulic fracturing may not be visible at the national level

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Consideration of Scale: State Estimates

- Volume of water withdrawals may vary by state
- Potential impacts may depend on
  - Scale and distribution of hydraulic fracturing operations
  - Local geology
  - Local hydrology and water needs

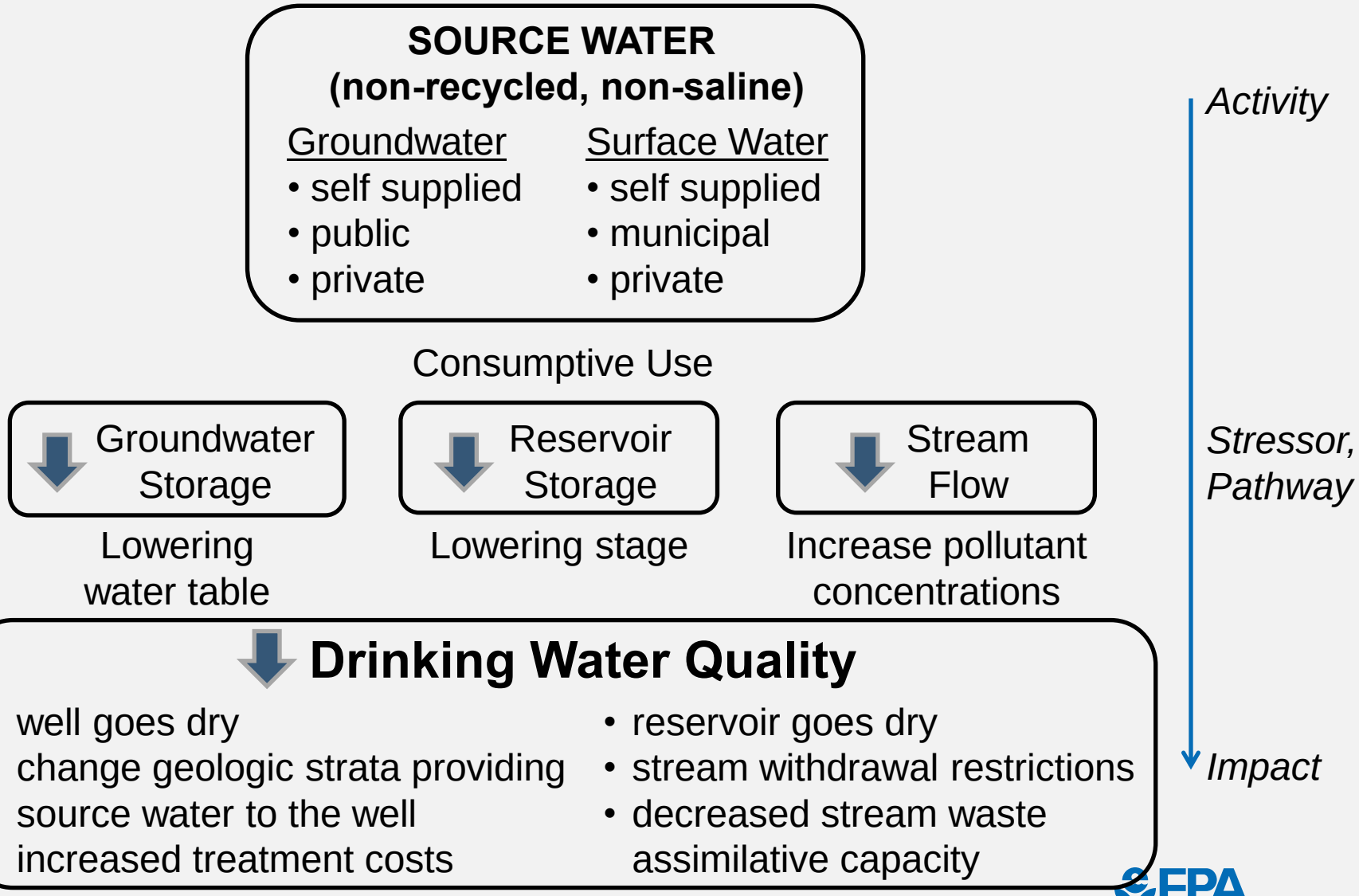
	COLORADO	PENNSYLVANIA
Total number of wells drilled in 2010	2,753	1,386
Estimated water use per well in 2010 (million gallons)	1.7	5
Estimated total water use for hydraulic fracturing in 2010 (million gallons)	4,700	6,900
Percentage of total state water use in 2005	0.09%	0.2%

Impacts of water withdrawals for hydraulic fracturing may not be visible at the state level

Water Recycling/Reuse

- Anecdotal evidence of increasing recycling/reuse of produced and flowback water
- Comments from April Wastewater Workshop:
  - Dependent on local conditions: geologic and economic
  - Potential for cost savings
  - Possible reduced freshwater utilization

Activity – Stressor/Pathway – Impact



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Water Availability Modeling

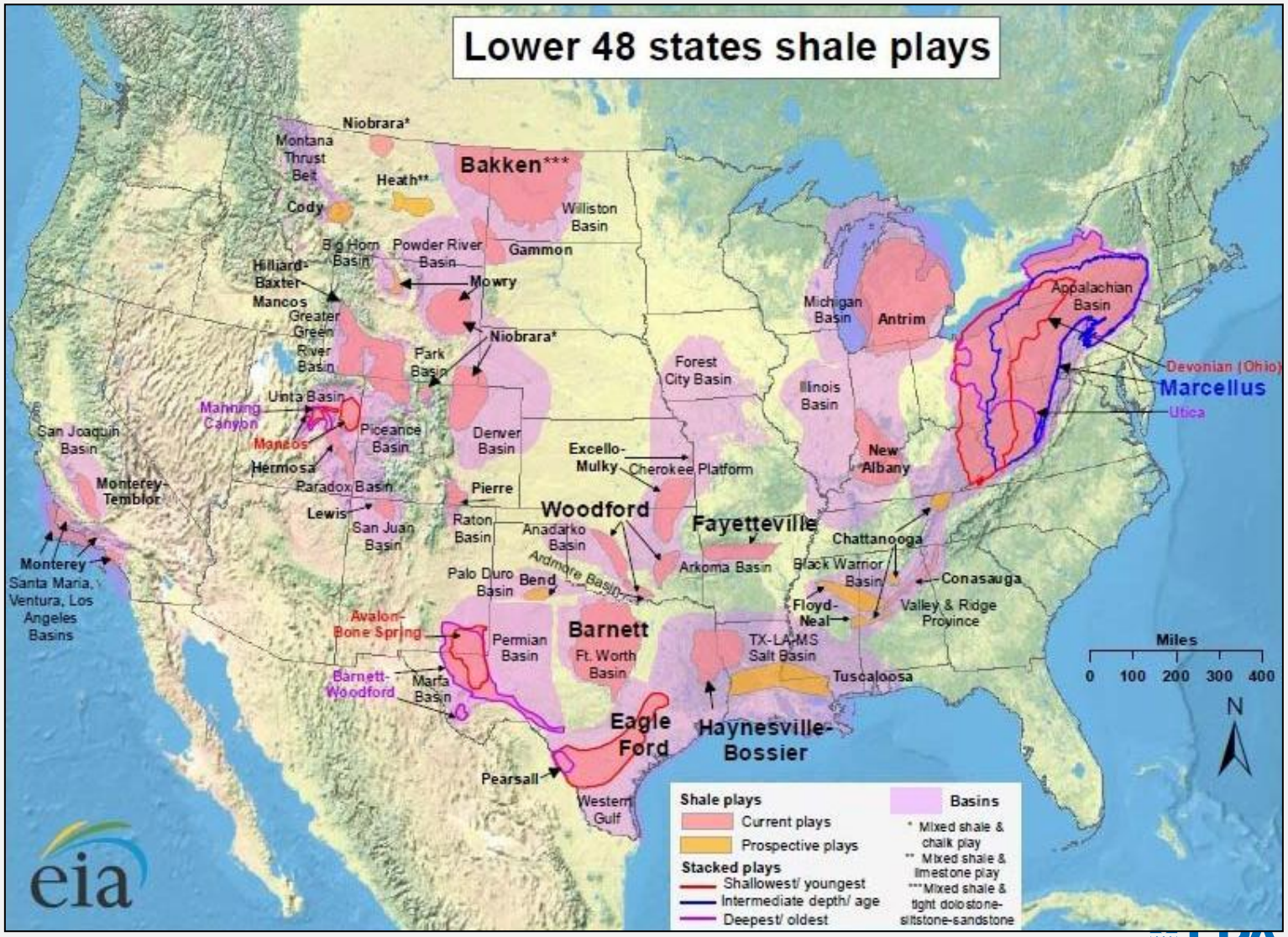
OBJECTIVE:

Evaluate possible impacts of large-volume consumptive water withdrawals supporting hydraulic fracturing under hypothetical yet possible future scenarios.

APPROACH:

1. Select representative watersheds
2. Establish baseline hydrological conditions
3. Modify baselines to include recent water withdrawals including hydraulic fracturing
4. Design future scenarios
5. Run the simulations
6. Investigate impact

Watershed Selection …



Source: US Energy Information Administration based on data from various published studies
Updated: May 9, 2011

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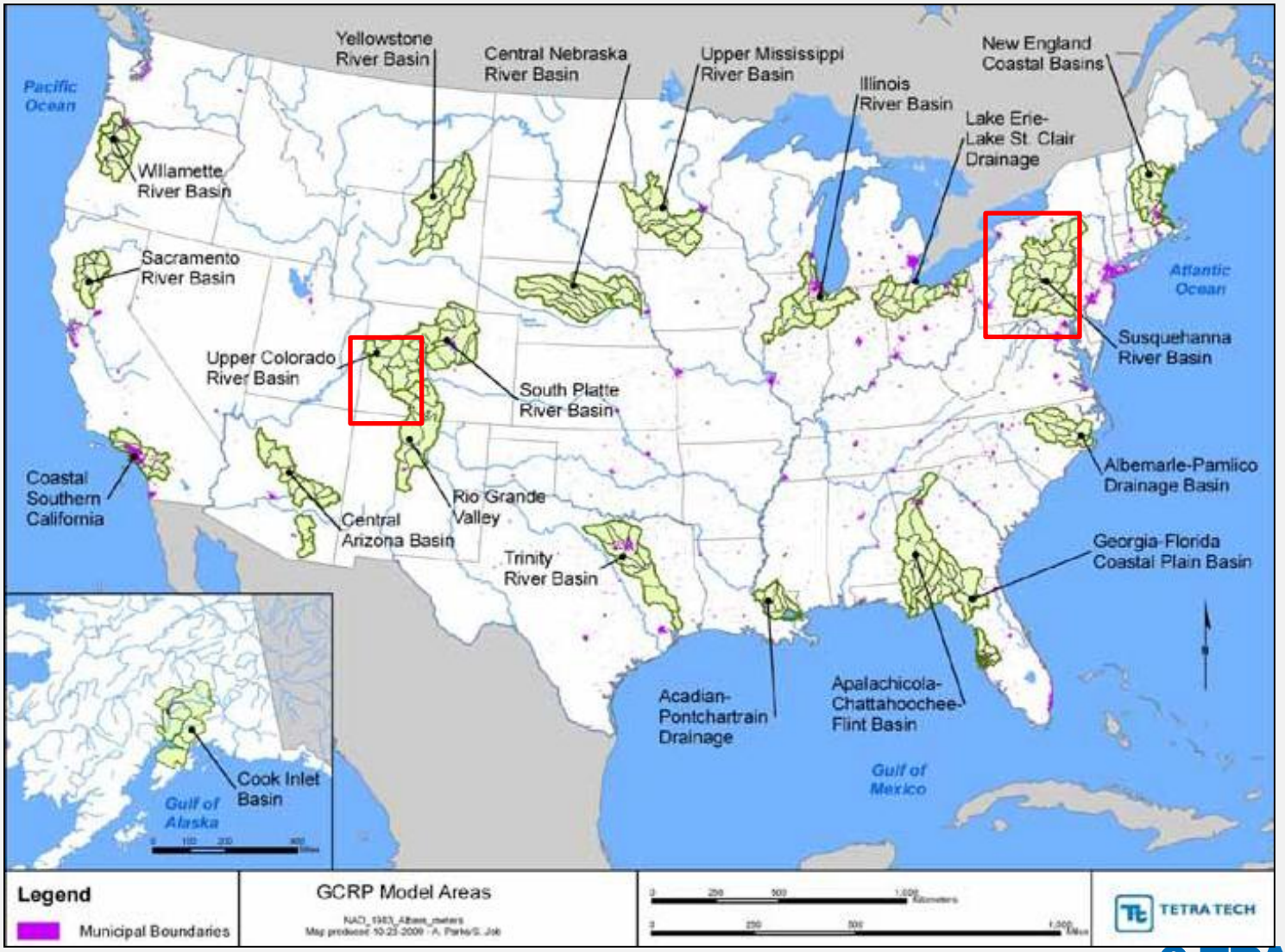
… Watershed Selection



EPA 20 Watershed Study also shown in Johnson et al. 2012. *J Water Resources Planning and Management.* Doi:10:1061/(ASCE)WR.1943-5454.0000175.

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Workshop Structure

Two Sessions

- Data on water acquisition and water recycling/reuse
- Hydraulic fracturing water acquisition and water availability modeling approaches

50 participants from an array of stakeholders including states, industry, academia, non-governmental organizations, and federal agencies

Session 1: Analysis of Existing Data
Discussion Questions

- What existing data could be used to better understand the effects of water acquisition on water availability?
- What is a scientifically robust approach to measuring and monitoring hydraulic fracturing water use and disposition?
- What is the current industry practice with respect to recycling/reusing water for hydraulic fracturing operations?
- What are the long-term, lifecycle implications and regional trends of recycling/reusing water in hydraulic fracturing operations?

Session 1 Presentations

- **Water Acquisition: Analysis of Existing Data** Andrew Gillespie, *US EPA*
- **Sources of Data to Understand Hydraulic Fracturing Water Use in Texas**

  J-P Nicot, *University of Texas at Austin*
- **Water Acquisition for Unconventional Natural Gas Development Within the Susquehanna River Basin**

  James Richenderfer, *Susquehanna River Basin Commission*
- **Recycling and Reuse of Produced Water to Reduce Freshwater Use in Hydraulic Fracturing Operations**

  Matthew Mantell, *Chesapeake Energy Corporation*

Session 1: Analysis of Existing Data
Participant Comments

Existing sources of data

- Some published data exist (e.g. JP Nicot)
- Be careful to account properly for municipal water use
- Consider state and local regulations, court decrees, interstate agreements which affect where water may be taken
- Projections of future drilling activity will be indicator of future water use

Session 1: Analysis of Existing Data
Participant Comments

Key attributes of scientifically robust approach

- Analyses should function across scales, understand local community impact, including other water uses
- Account for different levels of industry activity in different places
- Focus priority on understanding water dynamics in heavily populated areas with competition for water
- Consider water impacts of hydraulic fracturing relative to impacts from energy alternatives (e.g. coal) – water-energy nexus

Session 1: Analysis of Existing Data
Participant Comments

Current Industry Practices

- Analyses needs to account for dynamic industry, constantly adapting approaches to meet demand
- Reuse technologies, brine use are increasingly relevant where conflicts exist over surface water rights
- Quantifying refracturing of existing wells not as important as quantifying new wells
- Over time, water production via natural gas combustion offsets water loss via injection/wastewater disposal

Session 1: Analysis of Existing Data
Participant Comments

Lifecycle Implications and Regional Trends

- Lifecycle of play is relevant, water use efficiency expected to increase as play matures and usage projections are refined
- Industry purchase of water from municipalities can provide funds for infrastructure improvement, increased efficiency
- Future trends in water use dependent on many macroeconomic issues which drive water use, technology innovation and adaptation

Session 2: Modeling Water Availability
Discussion Questions

- What would a more generalized, conceptual model look like for assessing hydraulic fracturing impacts in different areas of the US and at different scales?

- What factors should be included in a generalized model?

Session 2 Presentations

- **EPA Scenario Modeling Water Availability** *Steve Kraemer, US EPA*
- **Mapping Water Availability and Cost in the Western United States**
  Vincent Tidwell, Sandia National Laboratory
- **Integrated, Collaborative Water Research in Western Canada**
  Ben Kerr, Foundry Spatial Ltd
- **Water Need and Availability for Hydraulic Fracturing in the Bakken Formation, Eastern Montana** *Mitch Plummer, Idaho National Laboratory*

Session 2: Modeling Water Availability
Participant Comments

Modeling approaches

- Modeling should consider cost data, economic considerations, adaptive industry practices, and relative efficiencies compared to other energy sources
- EPA should coordinate with USGS, which has extensive experience in water resource studies as well as databases from stream gauges
- Modeling should consider surface water – ground water linkages, e.g. with models such as MODFLOW, GSFLOW, SEAWAT and MT3D to quantify brine migration

Session 2: Modeling Water Availability
Participant Comments

Modeling approaches (continued)

- Models should account for regulatory regime, future energy scenarios, and competition for water from other industries
- Modeling should consider water quality as well as water quantity, e.g. using available data such as TMDLs
- The study should consider whether aquifer drawdown can lead to movement of preexisting subsurface contaminants
- Modeling should extend in time beyond cessation of operations to quantify cumulative effects

Session 2: Modeling Water Availability
Participant Comments

Comments on the selected basins

- Some agreement that the basin scale was appropriate for modeling, and recognition that additional basins should be studied including ground water dominated basins
- Modeling should be commensurate with the precision of data available, and should include uncertainty and sensitivity analysis
- For the Colorado River, it was suggested that modeling should use the state's decision support system as a source of data

Next Steps

- Case Studies workshop July 30, 2013 in Research Triangle Park, NC
- EPA will reconvene Technical Roundtables in late Summer 2013
- Information on technical workshops can be found at: http://www.epa.gov/hfstudy/techwork13.html