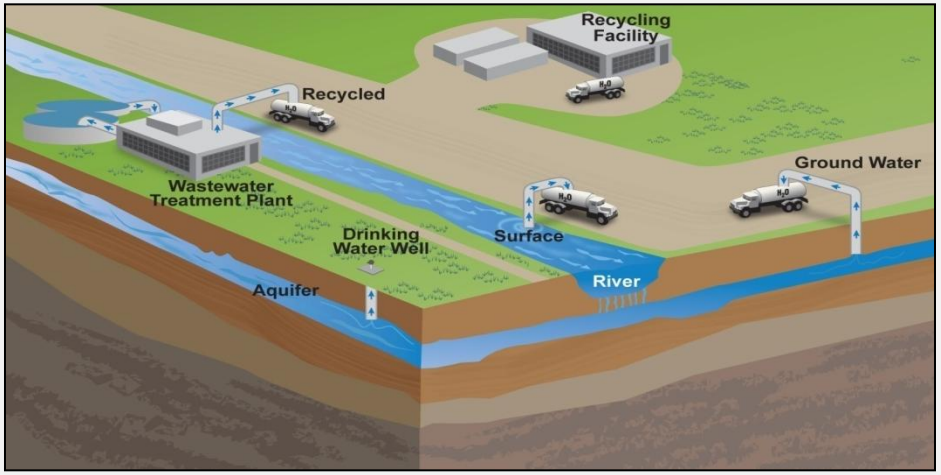
Evaluating Scenarios of Potential Impact of Water Acquisition

Technical Workshop Series:
Water Acquisition Modeling: Assessing Impacts Through Modeling and Other Means



Stephen R. Kraemer
EPA-Arlington, VA • June 4, 2013

Office of Research and Development
National Exposure Research Laboratory

EPA United States Environmental Protection Agency

EPA Hydraulic Fracturing Study – research questions

Chemical Mixing | Well Injection | Produced Water | Waste and Wastewater

Water Acquisition

What are the possible impacts of large water withdrawals from ground and surface waters 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

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Activity – Stressor/Pathway – Impact

SOURCE WATER
(non-recycled, non-saline)

Groundwater	Surface Water
• self supplied	• self supplied
• public	• municipal
• private	• private

Activity

Consumptive Use

Groundwater Storage	Reservoir Storage	Stream Flow
Lowering water table	Lowering stage	Increase pollutant concentrations

Stressor, Pathway

Drinking Water Quality

- well goes dry
- change geologic strata providing source water to the well
- increased treatment costs
- reservoir goes dry
- stream withdrawal restrictions
- decreased stream waste assimilative capacity

Impact

Water Availability Modeling

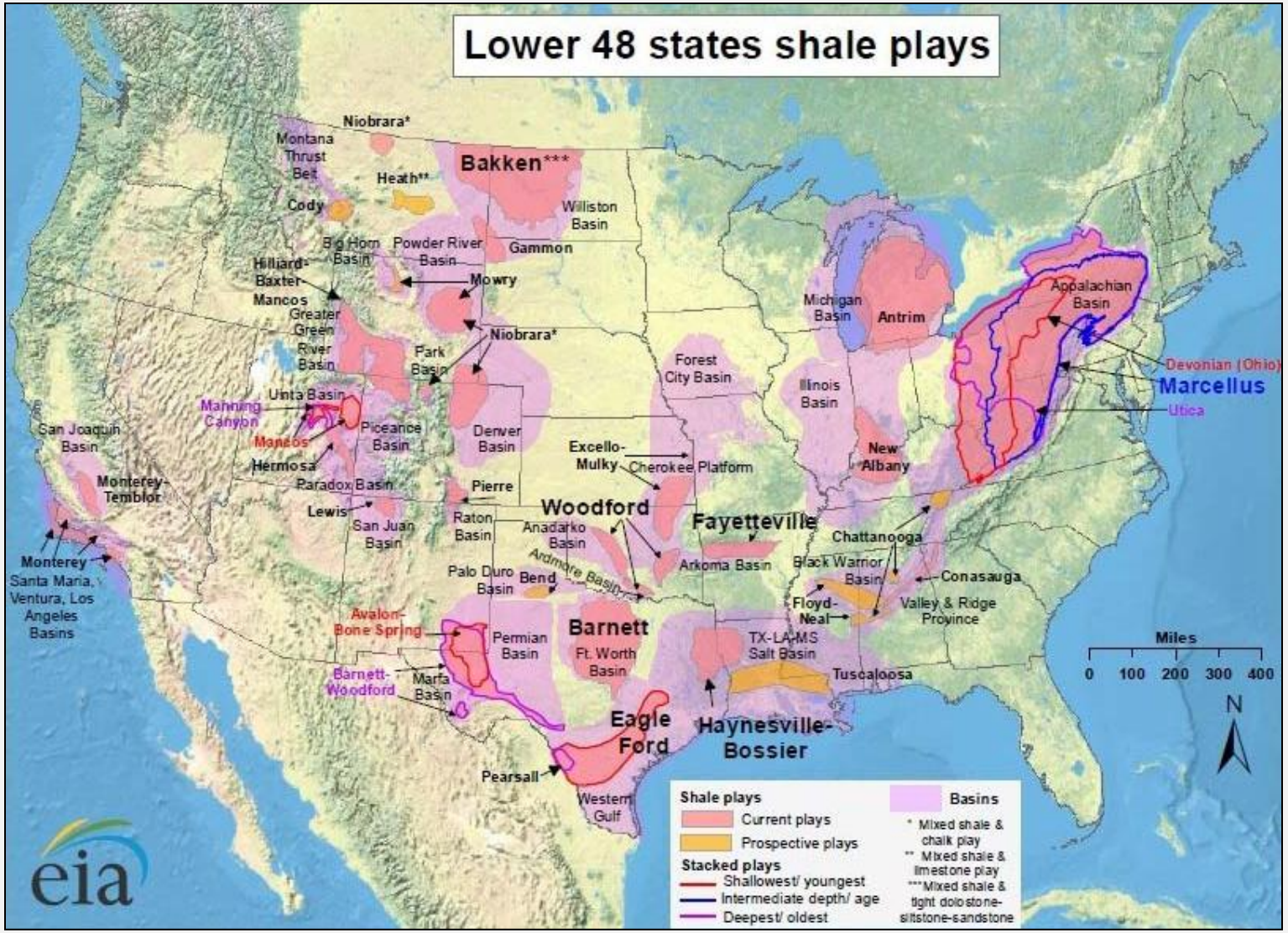
OBJECTIVE:

to evaluate possible impacts of large-volume consumptive water withdrawals supporting hydraulic fracturing in comparison to water availability in representative basins 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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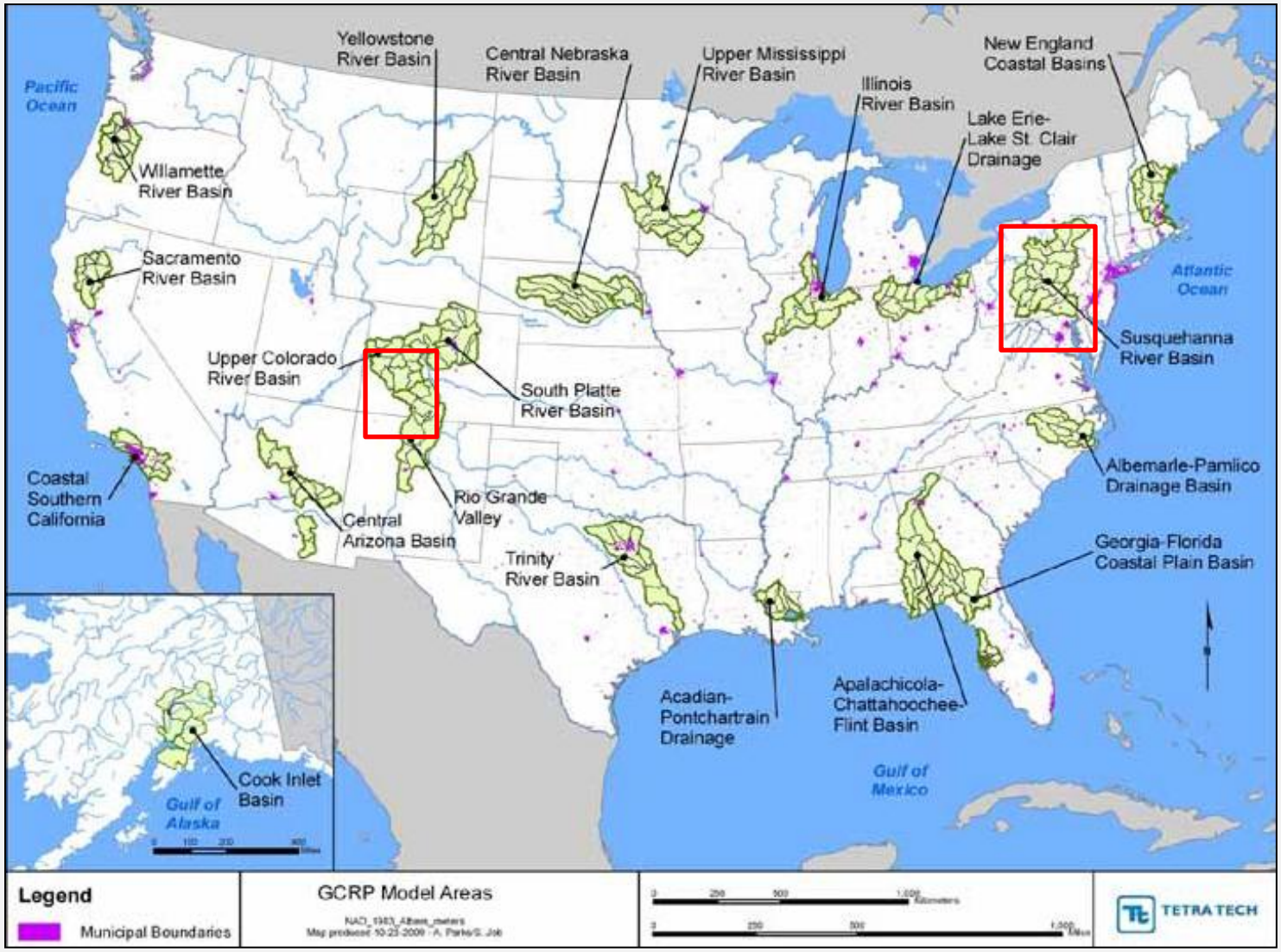
… Watershed Selection



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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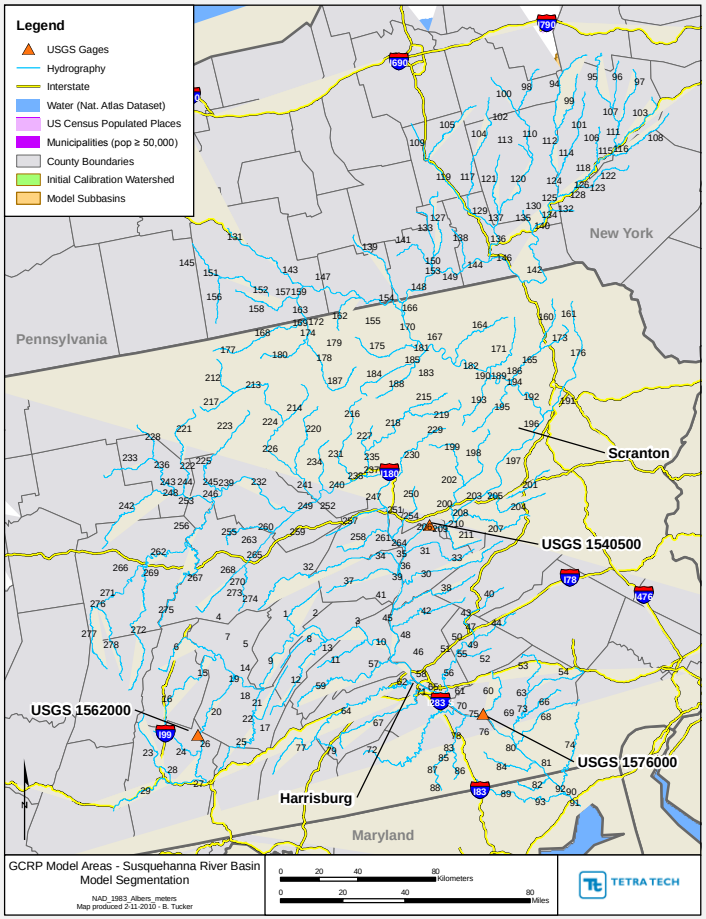
Watershed Models: spatial structure/segmentation

EPA HSPF

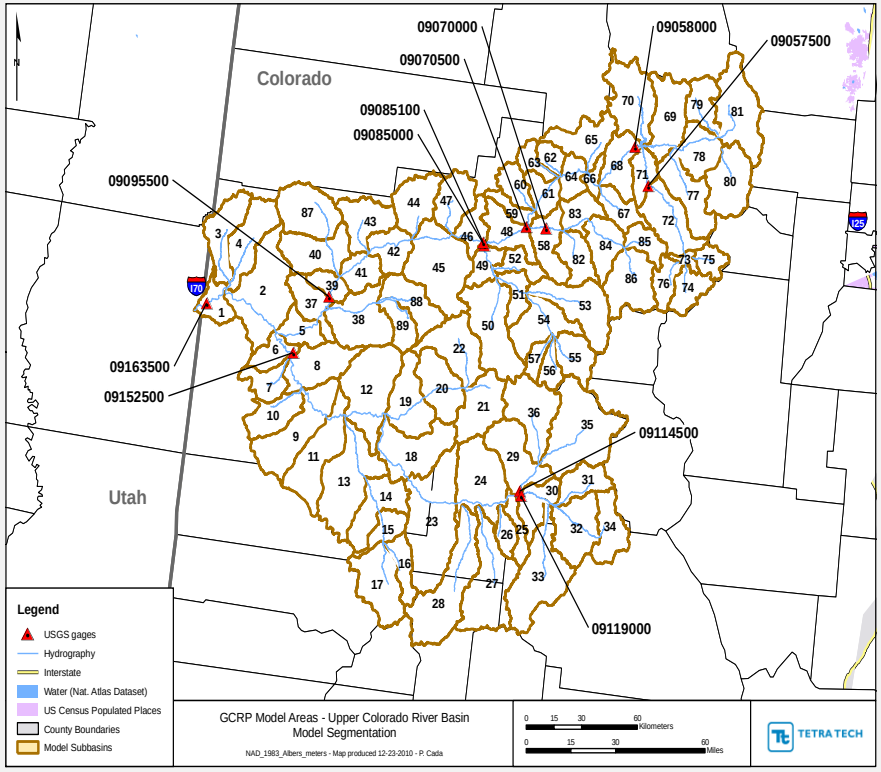
(hydrological simulation program fortran)



Susquehanna (27,0000 sq mi)

USDA SWAT

(soil water assessment tool)



Upper Colorado (17,800 sq. mi.)

Basin, Sub-basins

Hydrological Response Units

(unique combination of land use, soil, slope)

River segments

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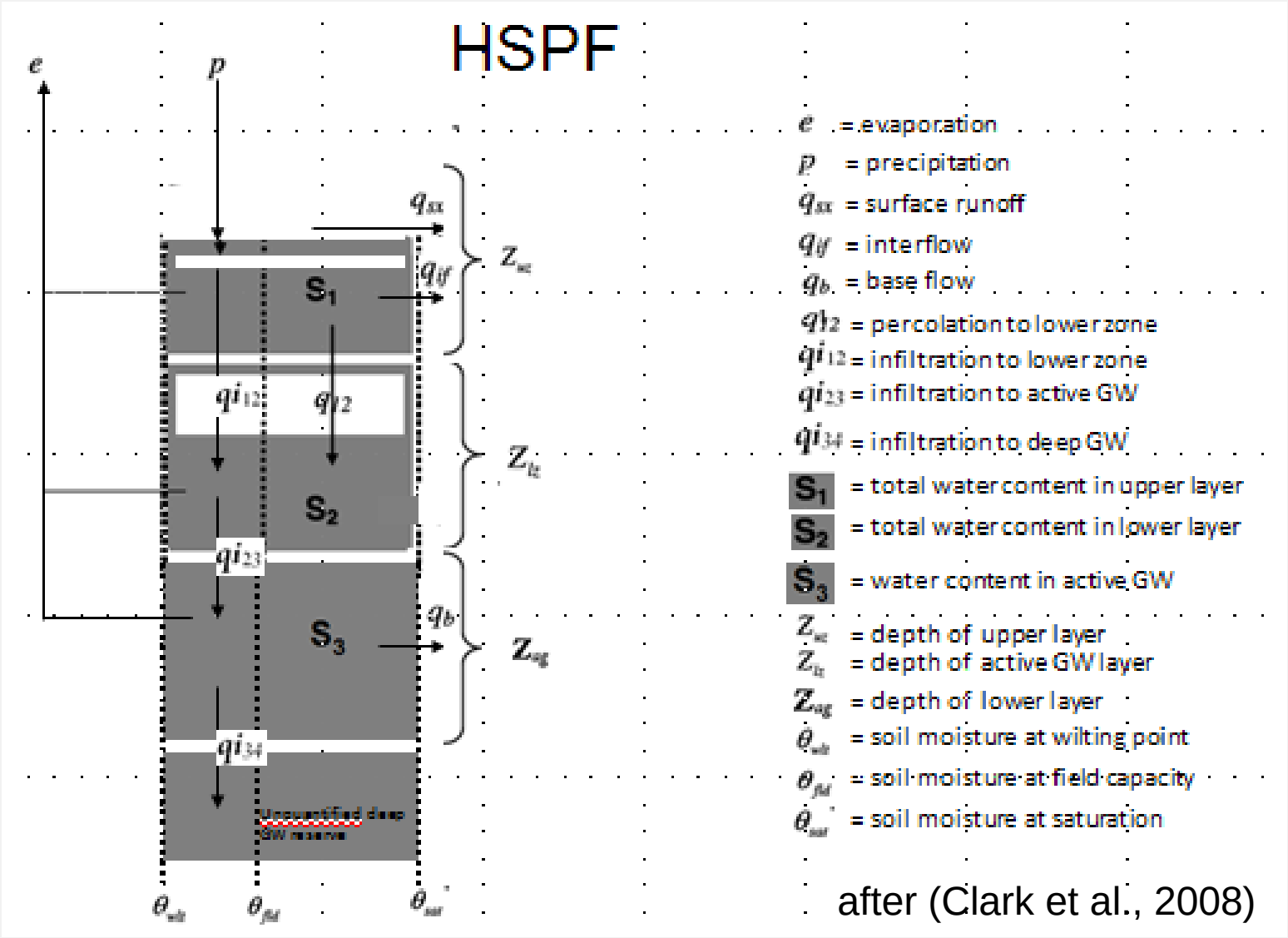
Model Structures – *fill and spill*



after (Clark et al., 2008)

Note: SWAT is similar in structure

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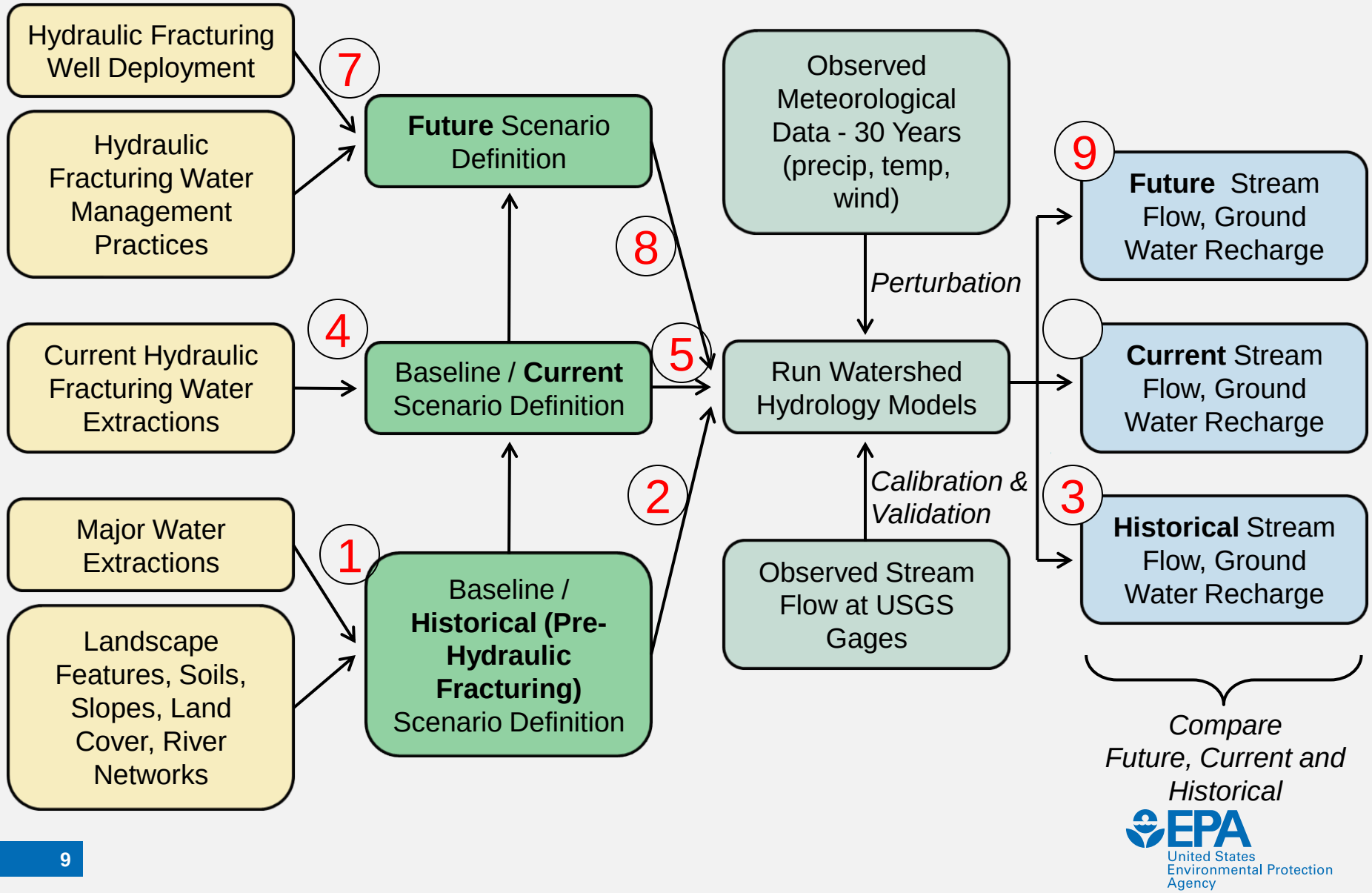
Future Scenarios: Model Assumptions

MODEL ASSUMPTIONS	FUTURE SCENARIOS		
	Business as Usual	**Energy Plus**	**Recycling Plus**
Projected number of wells (peak yr)	Average projected*	High-end projected*	Average projected*
Projected water use per well	Average observed	Average observed	Lower observed**

* Based on US Energy Information Administration and US Geological Survey projections

Critical Path for Modeling Approach



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Science Advisory Board Meeting (5/7/13) Selected Comments from Panelists

Several panelists suggested broadening the scale of the assessments and increasing granularity. Specifically:

- hierarchical spatial scales - zero order (ephemeral), 1st order (perennial), 2nd order, 3rd order streams, etc. and the associated catchments

- temporal scale - annual, seasonal, monthly, daily water balances

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
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?