



Understanding the Aquifers in the Uinta Basin, Utah: A Key to Solving the Basin's Saline Water Disposal Problem

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Project Web site: http://geology.utah.gov/emp/UBwater_study



ABSTRACT

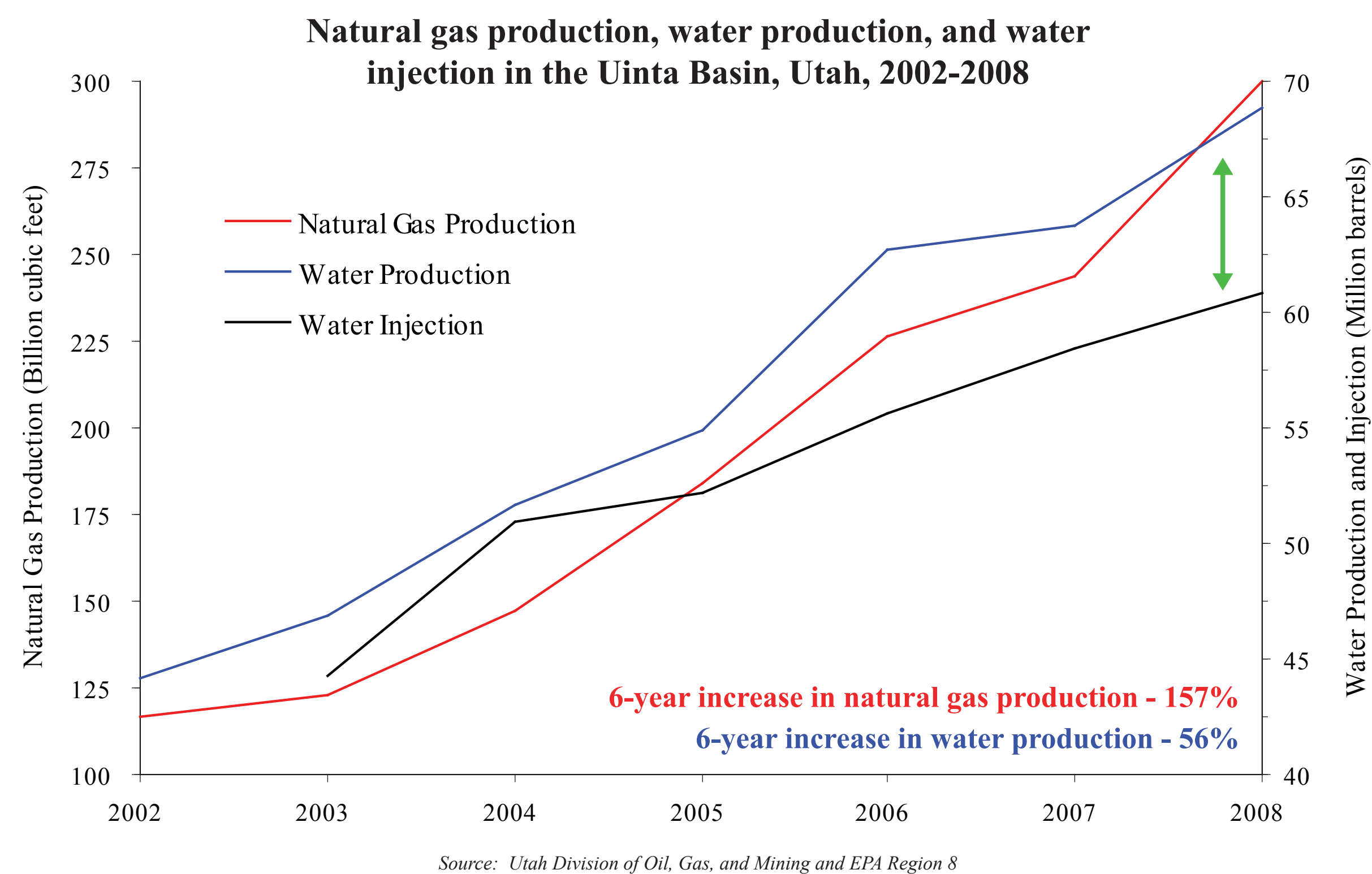
Our project aims to solve the major problem of saline water disposal faced by oil and gas operators in the Uinta Basin of Utah. As petroleum production increases - natural gas alone increased 60% in the last 10 years - so does saline water production, creating an increased need for economic and environmentally responsible disposal plans. Current water disposal wells are near capacity and permitting for new wells is being delayed because of a lack of technical data regarding potential disposal aquifers and questions concerning contamination of fresh water sources. Many Uinta Basin operators claim that crude oil and natural gas production cannot reach its full potential until a suitable, long-term saline water disposal solution is determined.

Part one of our effort involves re-mapping the base of the moderately saline aquifer within the Uinta Basin using more robust data and more sophisticated GIS techniques than previous work. Below this horizon, regulators agree that saline water can be injected without damage to the overlying fresh water aquifers. Thus far, we have compiled down-hole water chemistry data from about 1200 wells, mainly clustered around large oil and gas fields. For areas where water quality information is not available, we have developed refined techniques for determining the base of the moderately saline aquifer using geophysical logs.

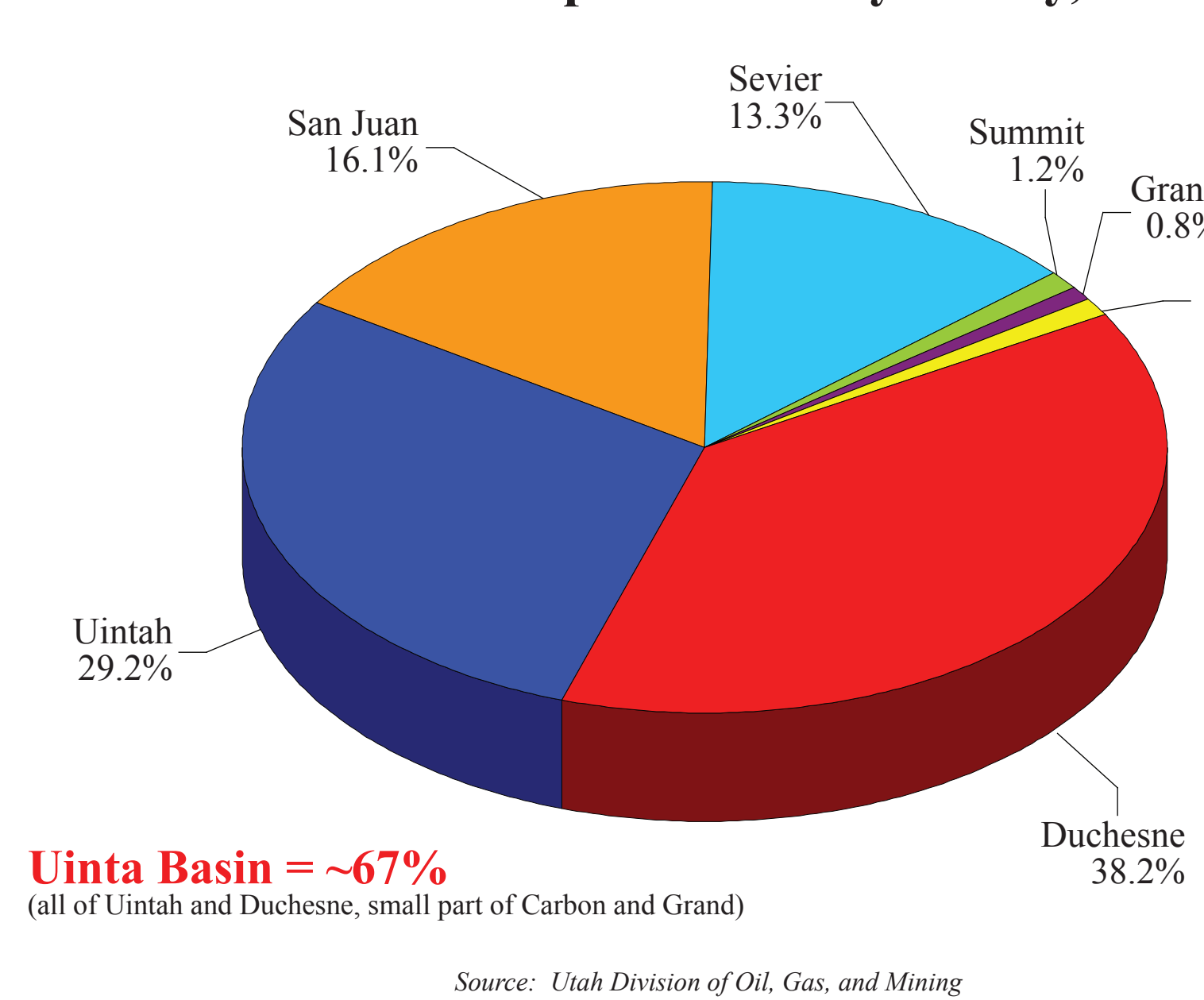
Part two of our project includes a detailed study of the Birds Nest aquifer, which is recognized as a possible large-volume saline water disposal zone. This aquifer, ranging in thickness from 100 to 300 feet, formed from the dissolution of saline minerals near the top of the Green River Formation and is mostly restricted to Uintah County. We have begun mapping this aquifer in the subsurface via core and geophysical logs and have examined this interval on out-crop. Preliminary research shows that northwest-trending gilsonite veins may influence groundwater flow patterns in the Birds Nest aquifer by creating "channels" of dissolution and impermeable barriers to flow. In addition, the Birds Nest aquifer is within the R-8 oil shale zone, creating concerns over how saline water disposal could affect future oil shale development.

PROJECT TASKS

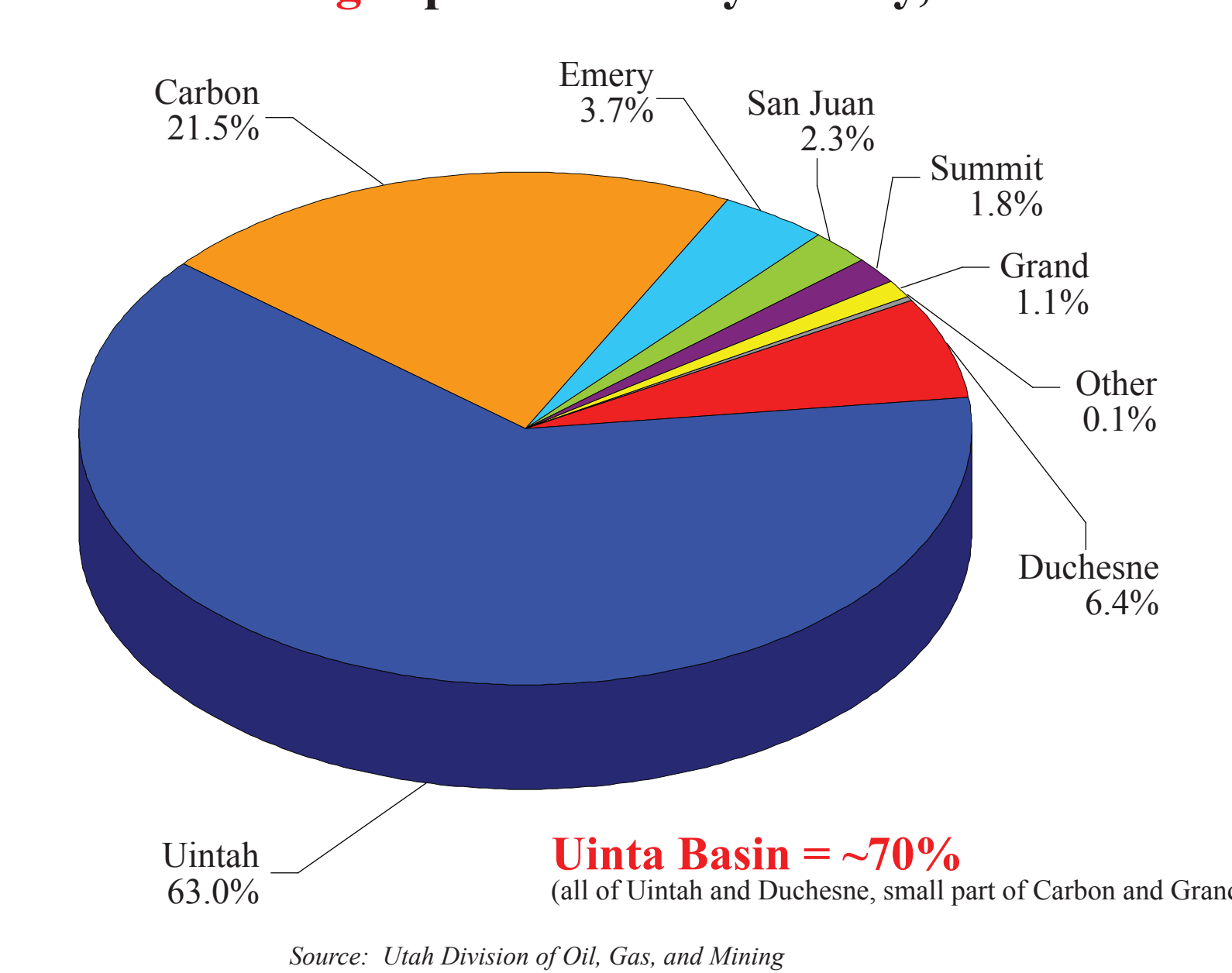
- Task 1** – Re-map the base of the moderately saline aquifer in the Uinta Basin, Utah (poster panel 1)
- Task 2** – Geologic examination of the Birds Nest aquifer, Uintah County, Utah (poster panels 2 and 3)
- Task 3** – Baseline water quality and quantity GIS data-base for lands with oil shale development potential (not discussed on this poster)



Utah crude oil production by county, 2009



Utah natural gas production by county, 2009



TASK 1: RE-MAPPING THE BASE OF THE MODERATELY SALINE AQUIFER (BMSA)

Problem: A lack of saline water disposal options is a significant limiting factor with regard to increases in oil and gas production in the Uinta Basin, Utah.

- Current disposal wells are at or near capacity
- Evaporation ponds can not handle the increase in saline water and pose several environmental challenges
- New disposal well permits are being delayed as these problems are addressed

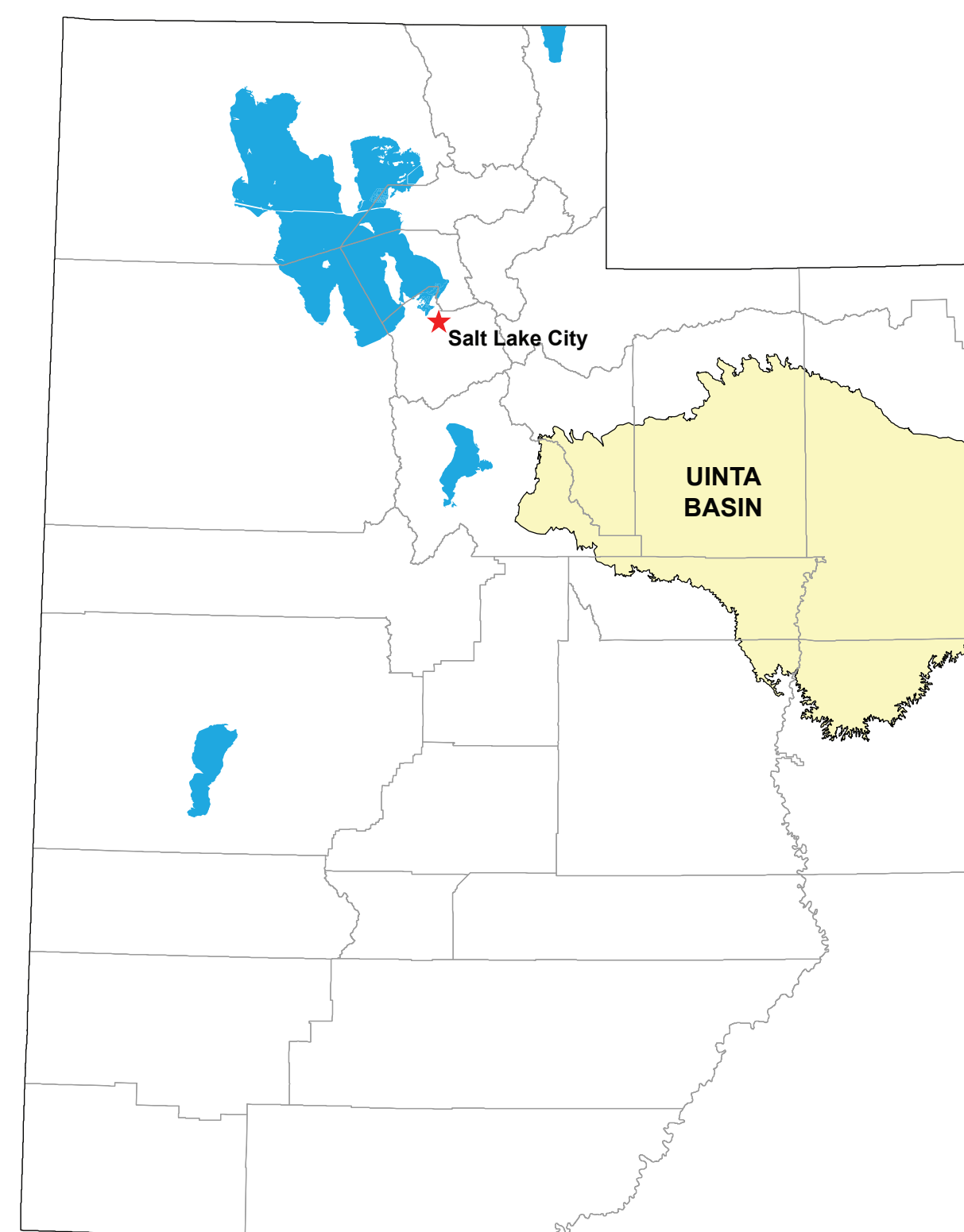
Currently, the agencies responsible for regulating the disposal of produced water use 20-year-old data amassed in a publication titled "Base of the Moderately Saline Ground Water in the Uinta Basin, Utah" to try and determine zones suitable for water disposal (Howells and others, 1987). This hard copy publication provides a paper map showing the depth of the transition between moderately saline and very saline water (10,000 mg/L), below this depth it is believed saline water can be injected without damage to overlying fresh-water aquifers. Several oil and gas operators working in the basin believe this dated study needs substantial revision. The original map was based solely on calculations of water quality from geophysical logs, a method with several limitations (e.g., tar sands were recognized as fresh water aquifers).

Solution:

- Determine new underground zones suitable for saline water disposal

Research/Deliverables:

- Re-map the base of the moderately saline aquifer in the Uinta Basin using:
 - Actual downhole water chemistry data
(as of March 2010, UGS has collected 2230 water chemistry analyses from 1289 wells)
 - Geophysical log analyses
(as of March 2010, UGS has picked the BMSA in 53 of 292 selected wells)
- Create geologic cross sections relating the saline water transition with regional geology and identify potential seals and disposal zones
- Create a comprehensive well database for data storage and manipulation

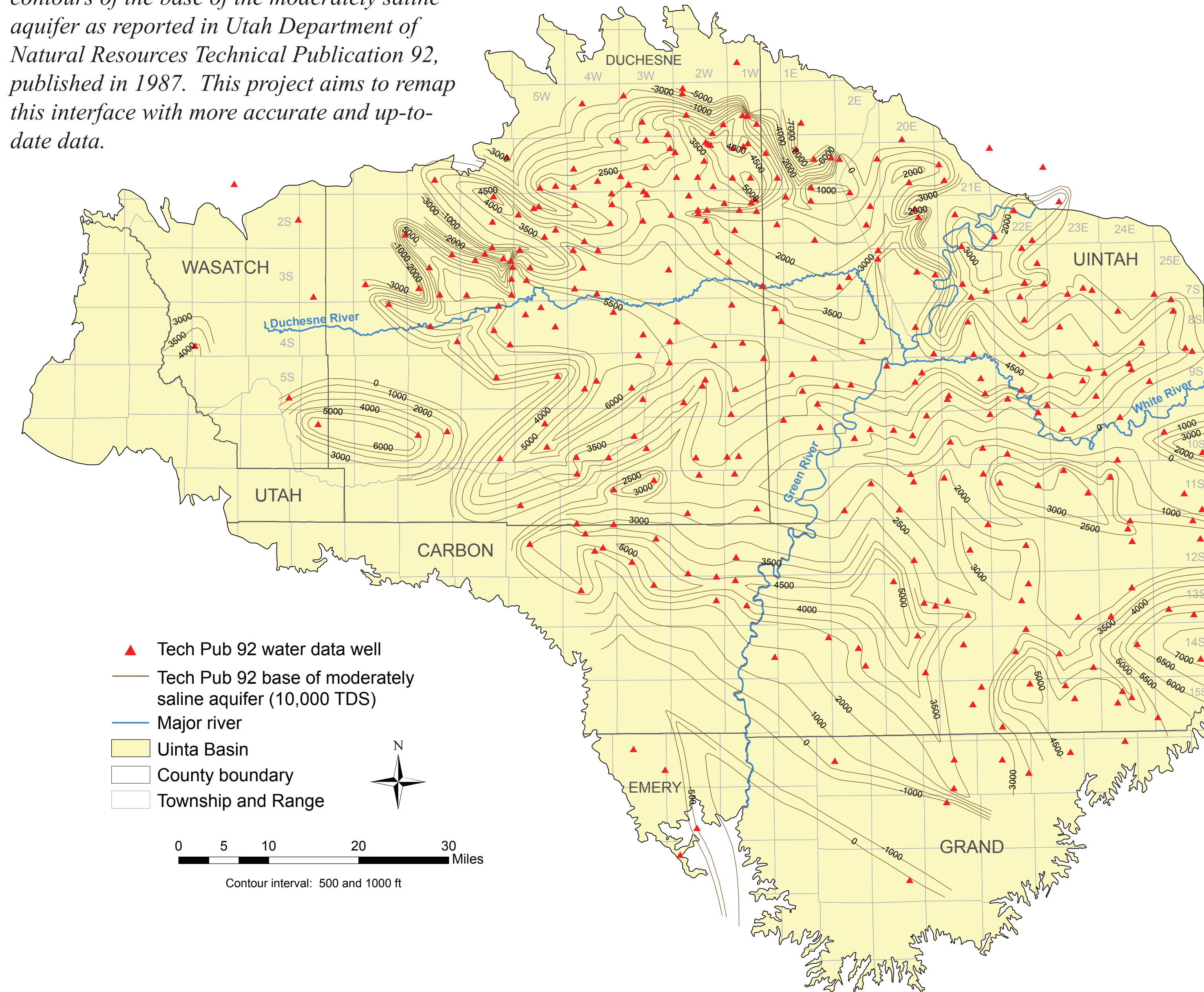


Donated digital log files

Company	# of LAS files donated	Company	# of LAS files donated
Questar	319	FIML	4
Newfield	85	Mustang Fuel	3
Enduring	73	Whiting Petroleum	3
Anadarko	50	Forest	2
El Paso	20	Flying J	2
Bill Barrett	15	Royale	2
Berry	15	Pendragon	1
EOG	15	BT Operating	1
Wind River	6	JW Operating	1
Rosewood	6	Elk Resources	1
Devon	5	McElvain	1
Gasco	5	Summit Operating	1

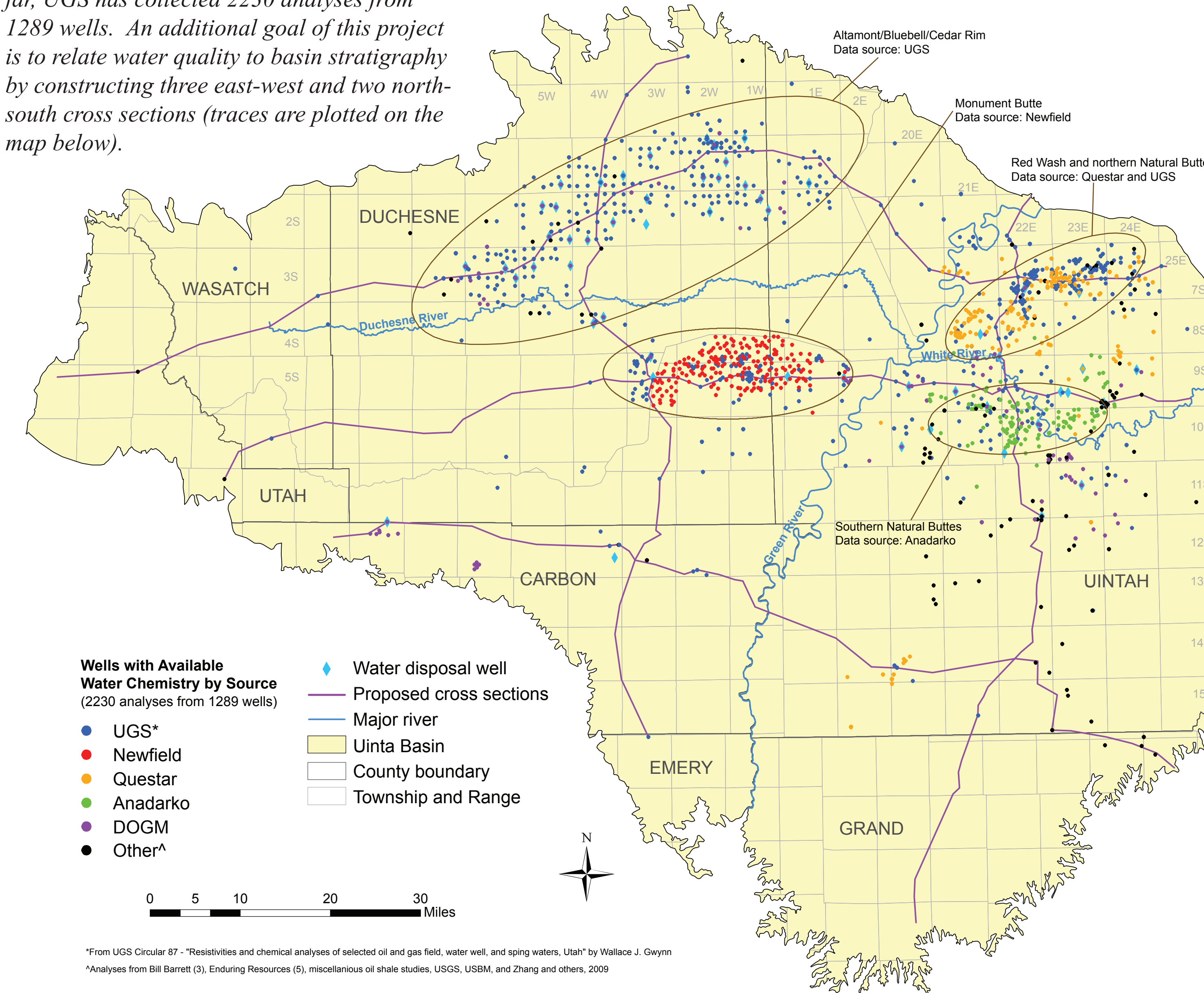
Tech Pub 92 Map

UGS has digitized the well locations and the contours of the base of the moderately saline aquifer as reported in Utah Department of Natural Resources Technical Publication 92, published in 1987. This project aims to remap this interface with more accurate and up-to-date data.



Water Chemistry Data

To better understand the salinity of aquifers in the Uinta Basin, UGS is trying to collect as much water chemistry data as possible. Thus far, UGS has collected 2230 analyses from 1289 wells. An additional goal of this project is to relate water quality to basin stratigraphy by constructing three east-west and two north-south cross sections (traces are plotted on the map below).



Geophysical Log Analyses

UGS is also using geophysical log data to determine the base of the moderately saline aquifer in 292 wells scattered throughout the basin. As of March 2010, the BMSA has been picked in 53 wells. Log analysis is greatly aided when a digital copy (LAS) of the log is available. Several companies have generously donated digital log files for this purpose (see table at right).

