SALINE WATER DISPOSAL IN THE UINTA BASIN, UTAH: THE SINGLE MOST PRESSING ISSUE WITH **REGARD TO INCREASING PETROLEUM PRODUCTION AND PROTECTING FRESHWATER AQUIFERS**

ABSTRACT

Saline water disposal is one of the single most pressing issues with regard to increasing petroleum and natural gas production in the Uinta Basin of Utah. Conventional oil and gas fields in the basin provide about 69% of Utah's total crude oil production and about 71% of Utah's total natural gas, the latter of which has increased 105% in the last 5 years (see graphs below). As and natural gas production cannot reach its full in the Uinta Basin.

potential until a suitable, long-term saline water disposal solution is determined.

The Utah Geological Survey has begun efforts to re-map the base of the moderately saline aquifer within the Uinta Basin using more robust data and more sophisticated GIS techniques than previor efforts. We believe saline water can be injected below this horizon without damage to the overlying petroleum production increases, so does saline freshwateraquifers. Waterchemistrydataarebeing water production, creating an increased need collected from basin operators and governmental for economic and environmentally responsible agencies. These ground-truth data will be disposal plans. Current water disposal wells are supplemented with water chemistry information near capacity and permitting for new wells is calculated from geophysical logs. In addition to being delayed because of a lack of technical data the new GIS-based map, we are constructing cross regarding potential disposal aquifers and questions sections showing the stratigraphic position of the concerning contamination of fresh water sources. moderately saline to very saline transition and its Many Uinta Basin operators claim that petroleum relationship to potential seals and disposal zones

A potentially suitable disposal zone for large volumes of saline water is the Birds Nest aquifer. This aquifer is located in the oil shale zone of the Green River Formation's Parachute Creek Member and is 250 to 300 ft above the kerogenrich Mahogany zone. A significant concern is that saline water disposal into the Birds Nest by conventional gas producers may hinder oil shale development by creating unforeseen economic and technical hurdles. With increased saline water disposal, the water quality in the Birds Nest could degrade and create additional water disposal problems for oil shale development companies. We are examining this aquifer in outcrop, core, and on geophysical logs to gain a better understanding of its areal extent, thickness, and zones of differing water chemistry.

OBJECTIVES

- Address saline water disposal problems that hinder oil and natural gas development in the Uinta Basin, Utah
- Assess how saline water disposal from conventional petroleum development might create technical and economic hurdles for a prospective oil shale industry
- Collect baseline surface and groundwater information for lands with oil shale development potential





Utah **CRUDE OIL** production by county, 200





Source: Utah Division of Oil, Gas, and Mining

PROJECT TASKS

- Task I Moderately saline aquifer study
- Task 2 Geologic examination of the Birds Nest aquifer
- Task 3 Baseline water quality and quantity GIS database (not discussed on this poster)

TASK 1: MODERATELY SALINE AQUIFER STUDY

Basin, Utah.

- Current disposal wells are at or near capacity
- Evaporation ponds cannot handle the increase
- 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 Moderately Saline Ground Water in the Uinta Basin, Utah" • Determine new underground zones suitable to try and determine zones suitable for water for saline water disposal

Problem: A lack of saline water disposal options disposal (Howells and others, 1987). This hard **Research**: is a significant limiting factor with regard to copy publication provides a paper map showing increases in oil and gas production in the Uinta 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 Methods: 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:

- Re-map the base of the moderately saline aquifer in the Uinta Basin
- Create geologic cross sections relating the saline water transition with regional geology and identify potential seals and disposal zones

- Collect as much actual water chemistry data as possible
- Develop new techniques for calculating water quality from geophysical logs
- Create a comprehensive well database for data storage and manipulation



We have 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. We aim to recreate these contours with more accurate and up-to-date data.

rstand the salinity of aquifers in the Uinta Basin, we are trying to collect as much water chemistry data as possible. Thus far, we have collected data from over south cross sections (traces are plotted on the map).



TASK 2: GEOLOGIC EXAMINATION OF THE BIRDS NEST AQUIFER

understood and needs further study to determine potential impacts of saline water disposal.

- What is its areal and stratigraphic extent?
- How is it related to Utah's oil shale deposits?
- What causes the differing zones of dissolution and salinity?

one of the only aquifers suitable for large volume saline water disposal is the Birds Nest aquifer shale development by creating unforeseen located in the Parachute Creek Member of the

literature search, it was determined that the Birds contains fresh to slightly saline water (Holmes Nest aquifer is poorly understood and further and Kimball, 1987). With increased saline water study is necessary before significant saline water disposal, the quality of the water in the Birds disposal continues. The Birds Nest aquifer is Nest could degrade and create additional water typically several hundred feet above the richest disposal problems for oil shale development oil shale interval called the Mahogany zone (see companies. cross section A-A'). A significant concern is that Eastern Uinta Basin gas producers claim that saline water disposal into the Birds Nest by conventional gas producers may hinder oil economic and technical hurdles. In many areas

Green River Formation. After an extensive containing rich oil shale deposits, the Birds Nest

Research:

- Comprehensive literature review and historic data collection
- Evaluate the Birds Nest in core, outcrop, and on geophysical logs

- Outcrop Thickness
- Lateral extent
- Water quality
- shale zones

Birds Nest aquifer in outcrop along Evacuation Creek, eastern Uinta Basin. The large cavities resulted from the dissolution of nahcolite nodules, creating the aquifer's porosity ana permeability.



Close-up of cavity, notice how the nodule growth warped and fractured the surrounding sediments.



Cliff-face along Evacuat the Birds Nest aquifer



Birds Nest aquifer outcrop along the White River, eastern Uinta Basin.



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PANEL I

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Cross section well

Cross section line

County boundary

Major river Uinta Basin

- Mahogany zone outcrop 20-40 ft

Township and Range 100-130 ft

0 5 10 20 30 Miles

5-20 ft

40-60 ft 60-80 ft

80-100 ft

Create a GIS database and maps showing:

Interburden between Birds Nest and rich oil

• Determine how gilsonite viens may influence water flow in the Birds Nest

One of the questions related to disposal of saline water into the Birds Nest aquifer is how such practices might affect potential oil shale development. This map shows the thickness of the 25 gallon per ton (GPT) oil-shale zone, which is considered to be the minimum economic grade. Our cross section is drawn through the thickest and richest of the oil shale in central Uintah County.