Saline Water Disposal into the Birds Nest Aquifer in Uintah County, Utah: Implications for Potential Oil Shale Development





Michael D. Vanden Berg Utah Geological Survey

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UGS project website: geology.utah.gov/emp/UBwater\_study

#### **Research Project**

- Overall Goal: Assess aquifers in the Uinta Basin to determine where saline water (produced along with conventional petroleum development) can be disposed without harming freshwater resources
- Specific problem: The Birds Nest aquifer has been identified by Uintah County natural gas producers as a zone suitable for large-scale saline water disposal, **however** this aquifer is poorly understood and needs further study to determine potential impacts of proposed/active disposal
  - Relationship to fresh water resources







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- Utah Geological Survey

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#### Location: Mostly restricted to central Uintah County





## **Relation to oil shale deposits – What is the economic top?**



# **Option 1:**

Interburden – 70 to 100 ft

Mahogany Zone





#### Location 1: Ut St. 1 - 9S 21E sec. 26 Near basin center



Possible basinward extent of Horse Bench

#### Shortite fracture fill

Nahcolite beds and nodules

Location 2: P-4 - 10S 25E sec. 19 Eastern side of basin



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Lower Horse Bench

701

Birds Nest aquifer

Tai p

Sector States **Evacuation Creek** 





# Core is the key to understanding the Birds Nest aquifer



## Water quality in the Birds Nest aquifer



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# Water movement may be affected by gilsonite veins



# **Thoughts, Conclusions, and Future Work**

# • The effect of saline water disposal into the Birds Nest aquifer on oil shale development depends on the value of leaner deposits

- Mining and Surface Retort:
  - Little to no impact, the water is moving away from the outcrop
- In-situ Extraction:
  - Depends on where the top of the economic oil shale is chosen
    - Big 3 bed: Limited effect, ~70 feet of impermeable interburden
    - Bed 76: Lies directly within the Birds Nest aquifer, saline water will need to be dealt with, could affect a resource of ~2 billion bbls

Future Work: Determine how much of the oil shale resource will be affected by saline water disposal into the Birds Nest aquifer

#### • The key to regional characterization of the Birds Nest will be core descriptions

- These oil shale cores have only recently become available
- To date, UGS has looked at 5 cores

Future Work: Evaluate each core containing Birds Nest (22 total)

# **Related Questions and Future Work**

#### • How do gilsonite veins and associated fractures affect the Birds Nest aquifer

- Is water traveling up or down the gilsonite/rock interface?
- Not all joints are filled with gilsonite; is water traveling along these unfilled joints?
- If so, could water travel down to richer oil shale deposits below the Birds Nest zone, hindering future development?
- Are gilsonite veins a barrier to flow?

Future Work: Examine gilsonite/wall rock properties

### • How is the Horse Bench Sandstone related to the Birds Nest aquifer

- The Horse Bench is prominent in the east (core and outcrop) and to the southwest (outcrop), but is not present in core from the center of the basin (maybe it is, but is only 1 to 2 feet thick)

- Is the eastern "Horse Bench" the same as the western "Horse Bench" – they seem to be different units of sand coming from different places

Future Work: Continue outcrop and core evaluation of the Horse Bench Sandstone