Oil & Natural Gas Technology

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Quarterly Report

January 2010 to March 2010

Water-related Issues Affecting Conventional Oil and Gas Recovery and Potential Oil-Shale Development in the Uinta Basin, Utah

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EXECUTIVE SUMMARY

The Utah Geological Survey's (UGS) Uinta Basin water project has reached its halfway point as of March 2010. Water chemistry data acquisition efforts have for the most part come to an end, with analyses received for approximately 1290 wells. These data will be invaluable as "ground truth" to aid in the mapping of aquifer salinity throughout the basin scheduled for the second half of the project. In addition, several oil and gas operators have donated digitized log data from over 600 wells. These files will save large amounts of in-house digitizing time and provide the data needed to calculate the base of the moderately saline aquifer.

The UGS determined that the Birds Nest aquifer can be best characterized by studying cores that cover all or part of the interval of interest. Of the 20 cores found, 10 have been studied to date, including one in the last quarter near the eastern edge of the Uinta Basin, north of the White River. Outcrop evaluation continued in March 2010 – excellent exposures can be found in the east near Evacuation Creek, but in the southern portion of the basin, the outcrop is highly weathered and is often a slope-former.

No water sampling was conducted over the winter months, but the project team is ready to begin spring water sampling, the third sampling set overall, in May.

PROGRESS, RESULTS, AND DISCUSSION

Task 1.0: Project Management Plan

During the month of January, the Principal Investigator (PI) wrote and submitted the project's fifth quarterly report for the period October through December 2009. This report was subsequently sent via email to all interested parties and posted on the UGS project Web site. The PI also updated the Project Summary in January 2010 and posted the revision to the Web site.

Task 2.0: Moderately Saline Aquifer Study

The Task 2 team continued to request donations of digital geophysical log files (LAS files) to expedite and aid in picking the base of the moderately saline aquifer. The Task 2 team leader, Paul Anderson, has made a list of 292 key wells spaced throughout the basin, and has focused on getting these specific LAS files. Through March 2010, the UGS has received about 70% of the LAS files on the key well list, and has overall obtained 637 LAS files from 25 different companies (many companies donated more LAS files than requested) (figure 1, table 1). Using the donated LAS files, Anderson has started picking the base of the moderately saline aquifer, comparing the results with water chemistry data where available. To date, the boundary has been picked for 66 wells.

The Task 2 team also continues to search for specific water chemistry data for wells in the Uinta Basin. Through March 2010, the team has collected approximately 2230 individual water analyses from about 1290 different wells. Again, most of these data have been generously donated by several oil and gas companies. During this quarter, the team has also made an effort to collect produced water chemistry data from oil and gas wells, as well as any available data from salt water disposal wells.

Table 1. *Number of donated LAS files by company.*

Company	# of LAS files
Questar	319
Newfield	85
Enduring	73
Anadarko	50
El Paso	20
Bill Barrett	15
Berry	15
EOG	15
Rosewood	6
Wind River	6
Devon	5
Gasco	5
FIML	4
Mustang Fuel	3
Whiting Petroleum	3
Forest	2
Flying J	2
Royale	2
Bayless	1
Pendragon	1
BT Operating	1
JW Operating	1
Elk Resources	1
McElvain	1
Summit Operating	1
Total	637

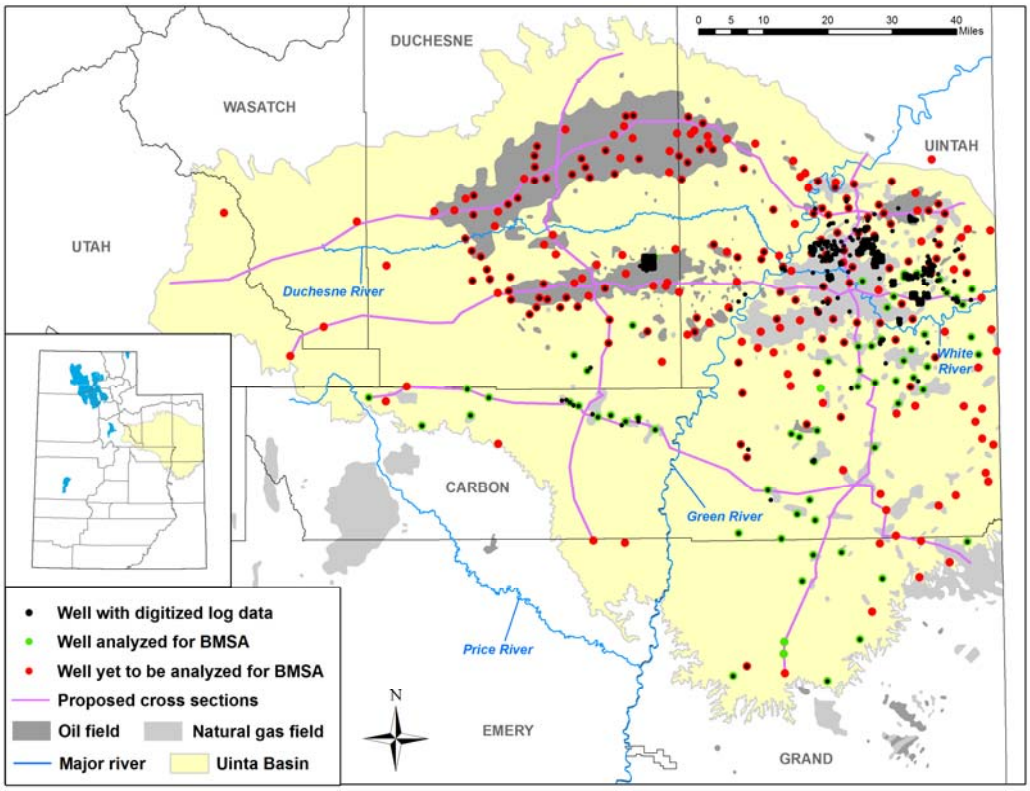

Figure 1. *Map of the Uinta Basin in Utah showing the location of wells with donated digitized geophysical logs and wells already and to-be evaluated for the base of the moderately saline aquifer (BMSA).*

Task 3.0: Geologic Examination of the Birds Nest Aquifer

One additional core, Corehole 2, was examined this quarter (figure 2). The Corehole 2 (T. 9 S., R. 25 E., sec. 32) well is on the eastern edge of the basin, north of the White River. The saline zone in this core is 131 feet thick (57-188 ft) – similar to the P-4 core not far to the south – with dissolution occurring primarily in a 77-foot interval between 103 and 180 feet. The Horsebench Sandstone is present at the top of the cored interval (30-39 ft).

The Task 3 team leader is currently gathering all information related to the 20 wells with core that captured the Birds Nest aquifer, including geophysical well logs (both TIFF images and digital files), old lithologic logs, Fischer assays, water analyses, photographs, and any old corehole reports. This information will soon be posted on the project Web site.

The Task 3 team also spent a few days in March examining the Birds Nest aquifer in outcrop near Evacuation Creek. As stated in previous reports, good outcrop examples seem to be restricted to the eastern edge of the basin where the erosion-resistant Horsebench Sandstone helps create a Birds Nest cliff exposure along several stream canyons (Figure 3). Farther to the south, the Horsebench thins and allows for extensive weathering of the Birds Nest zone, making outcrop identification nearly impossible (also, the saline mineral crystals greatly decrease in size to the south, making them difficult to find in the weathered slope). In the next quarter, the team plans to examine additional potential outcrop areas and complete one or two measured sections (one is planned near where the White River and Evacuation Creek converge).

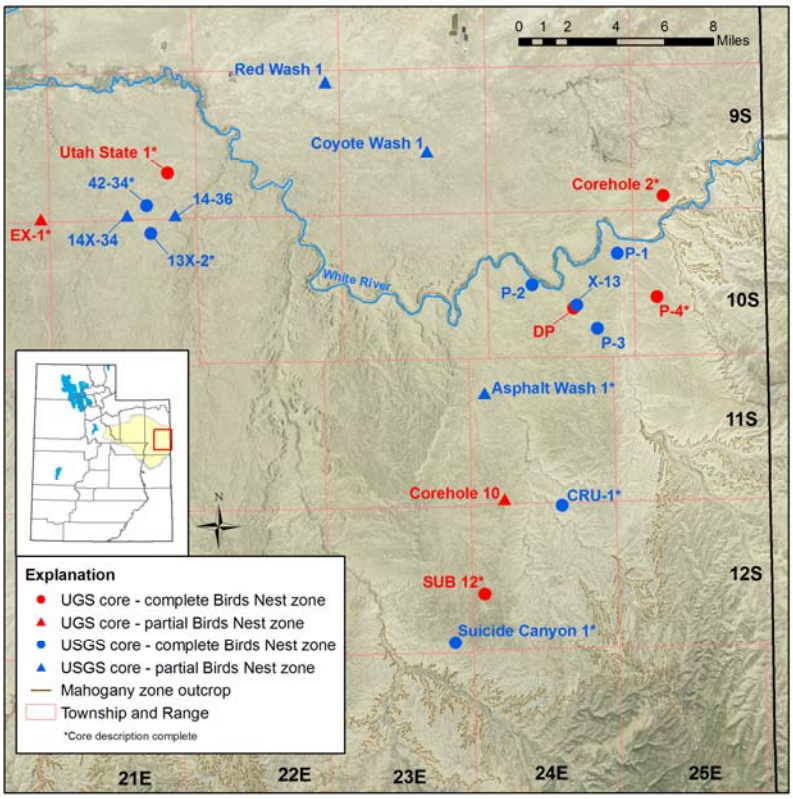

Figure 2. *Map showing the location of 20 wells with core that captured all or part of the Birds Nest aquifer. The cores are housed either at the UGS Core Research Center in Salt Lake City, UT, or at the USGS Core Research Center in Denver, CO.*

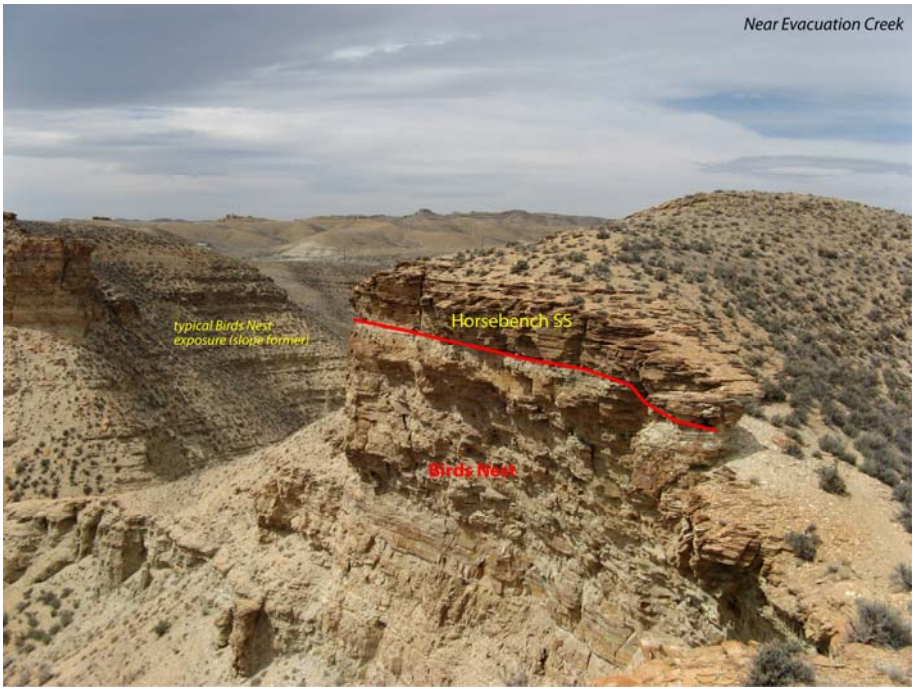

Figure 3. *Birds Nest exposures near Evacuation Creek, eastern Uinta Basin, Utah. The slope in the background is more typical of the outcrop expression of the saline zone in the southern part of the basin.*

Task 4.0: Baseline Water Quality and Quantity GIS Database

No water sampling was done in this quarter. Spring water samples are scheduled to be collected in May 2010.

Task 5.0: Integration of Analysis of Produced Water from Simulated In-situ Oil Shale Extraction Technologies

This task is scheduled for Budget Period 3.

Task 6.0: Technology Transfer

- The PI wrote a *Survey Notes* article summarizing the project's goals and listing preliminary accomplishments. *Survey Notes* is an informative, non-technical UGS magazine with short news articles on noteworthy and interesting geologic topics in Utah and is published three times a year. The next issue (with the project's article) will be published in May 2010.
- An abstract about the Birds Nest aquifer component of the project was submitted and accepted for the 2010 American Association of Petroleum Geologists Rocky Mountain Section (AAPG-RMS) meeting in Durango, CO. The research team will present a poster in the *Stratigraphy of Rocky Mountain Basins* session scheduled for June 15, 2010. The poster presentation will feature cores from the Birds Nest aquifer, one well displaying saline mineral dissolution and a second well showing no dissolution.
- The project Web site (http://geology.utah.gov/emp/UBwater_study) was updated with new quarterly reports, abstracts, and presentations prepared by project team members.

CONCLUSION

With the project at its halfway point, the study is on schedule to achieve the goal of better understanding aquifers in the Uinta Basin to help facilitate safe and efficient saline water disposal. The Task 2 team has collected hundreds of down-hole water chemistry analyses and hundreds of digitized log files to aid in picking the base of the moderately saline aquifer; the Task 3 team has described 10 cores containing the Birds Nest aquifer; and the Task 4 team is set to begin collecting the third consecutive set of samples from 17 sites in central Uintah County as part of a biannual sampling plan to develop baseline water quality in the area. Several more months of data collection and analysis are scheduled before the final interpretation and synthesis can begin in year three.

COST STATUS

The final water chemistry analyses for samples collected in fall 2009 were billed to the project in January 2010. The higher-than-budgeted expenses for January and February were the result of significant personnel time on the project, making up for previous under-budgeted months and for lower-than-budgeted billing in March 2010 (figure 4). As displayed in figure 5, the cumulative billing through the end of March 2010 is very close (92%) to budgeted costs.

Table 2. *Project costing profile for Budget Period 2 (second quarter).*

	Jan 2010		Feb 2010		Mar 2010	
	Plan	Actual	Plan	Actual	Plan	Actual
UGS-personnel	$7,343	$10,352	$6,280	$8,939	$8,389	$3,536
Travel Expenses[1]		$645		$303		
Water Chemistry[2]		$1,664				
Miscellaneous[3]		$1,231				$133
SUBTOTALS	$7,343	$13,891	$6,280	$9,242	$8,389	$3,669
UGS OVERHEAD (32.40%)	$2,379	$4,501	$2,035	$2,994	$2,718	$1,189
SUBCONTRACTS						
P. Anderson	$6,777	$5,222	$6,777	$7,340	$6,777	$7,900
GRAND TOTALS	$16,499	$23,614	$15,092	$19,577	$17,884	$12,758

[1]January – Early registration for 2010 AAPG Annual meeting; February – early booking of flight to 2010 AAPG Annual meeting
[2]Billing for water chemistry analysis performed in fall 2009
[3]January – PI Dwights database maintenance costs, 2010 AAPG Annual meeting exhibit booth charges; March – 2010 RMS AAPG exhibit booth charges

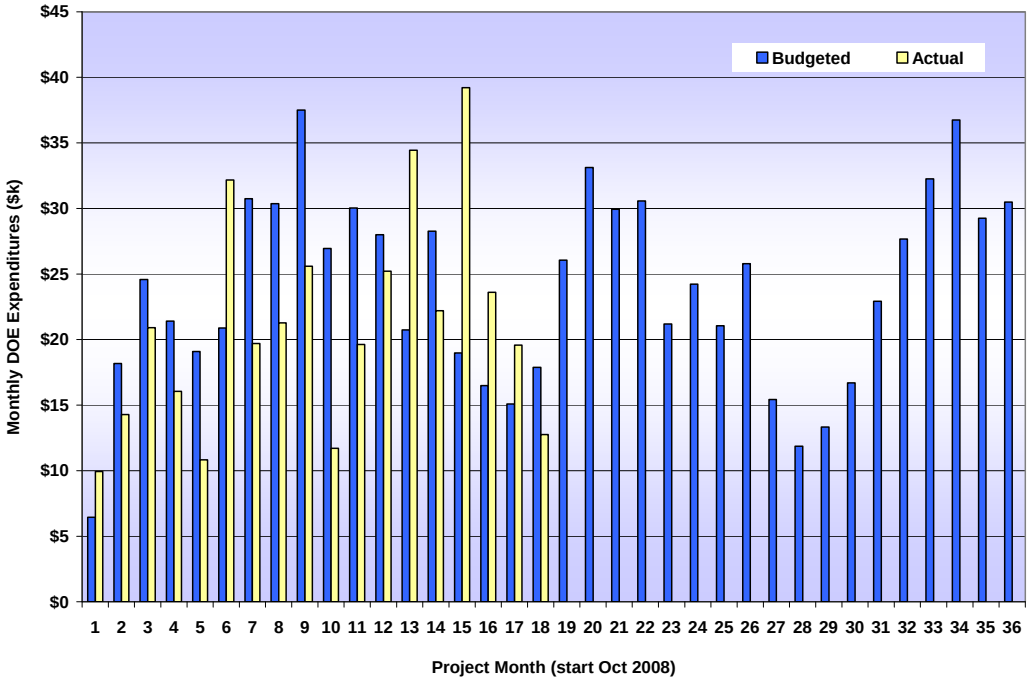

Figure 4. *Project costing profile.*

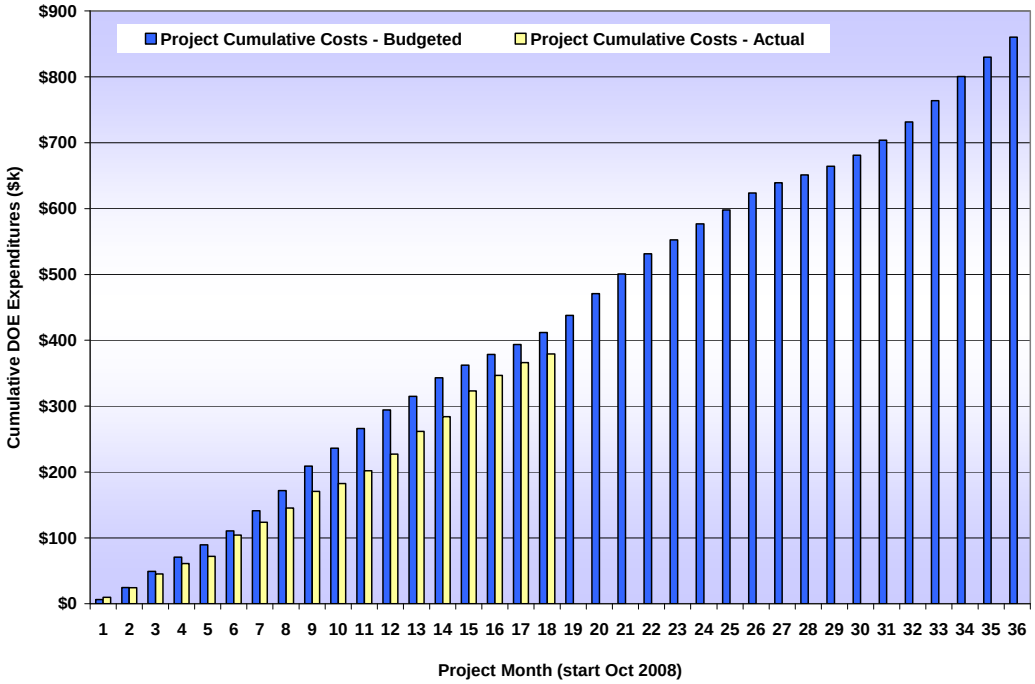

Figure 5. *Project cumulative costs.*

MILESTONE STATUS

Table 3. *Milestone log for Budget Period 2.*

	Title	Description	Related task or subtask	Completion Date	Update/comments
Milestone 2.1	Water chemistry data collection (part 2)	Collect the remaining required 1 well per township, adding additional data to areas of interest	Subtask 2.1	9/30/2010	Currently have chemistry data from 1289 wells; currently analyzing well logs in areas where no chemistry data exist (66 of 292 wells completed)
Milestone 2.2	Create Birds Nest aquifer well database	Create a database with all collected data	Subtask 3.4	9/30/2010	Evaluated Birds Nest in 10 of 20 cores; started Birds Nest well database, initially focusing on wells with core

ACCOMPLISHMENTS

- Revised Project Summary
- Wrote *Survey Notes* article summarizing project goals and results (*Survey Notes* is a UGS magazine published three times a year).
- Examined and described one additional Birds Nest core

PROBLEMS OR DELAYS

None at this time

PRODUCTS AND TECHNOLOGY TRANSFER ACTIVITIES

- Completed fifth quarterly report
  - October 2009 through December 2009 – available on the UGS project Web site
- Updated Project Summary
  - Available on the UGS project Web site
- Updated project Web site
  - Posted various new reports, abstracts, and presentations prepared by project team members
  - http://geology.utah.gov/emp/UBwater_study
- Uinta Basin Oil and Gas Collaborative Group meeting - Vernal, UT – convened January 7, 2010
  - This is a group of state and federal officials and Uinta Basin oil and gas operators that meets quarterly to discuss latest activities in the basin
  - Members of the research team attended the meeting and networked with industry members about the project
- Wrote *Survey Notes* article summarizing the project
  - *Survey Notes* is an informative, non-technical UGS magazine with short news articles on noteworthy and interesting geologic topics in Utah and is published three times a year.
  - The next issue (with the project's article) will be published in May 2010
- Abstract –AAPG-RMS Annual Meeting – Durango, CO – June 13-16, 2010
  - An abstract was submitted and accepted for the 2010 AAPG-RMS meeting
  - The presentation will detail the research done to date on the Birds Nest aquifer; examples of the Birds Nest aquifer from two cores will be available for viewing
  - The core-poster presentation will be part of the *Stratigraphy of Rocky Mountain Basins* session scheduled for June 15, 2010
  - The abstract is available on the UGS project Web site

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