State of Utah

Department of
Environmental Quality

Dianne R. Nielson, Ph.D.
Executive Director

DIVISION OF WATER QUALITY
Don A. Ostler, P.E.
Director

OLENE S. WALKER
Governor

GAYLE F. McKEACHNIE
Lieutenant Governor

MEMORANDUM

TO: Dianne R. Nielson
Utah Department of Environmental Quality
Executive Director

FROM: Candace C. Cady CCC
Utah DEQ, Division of Water Quality
Environmental Scientist

DATE: April 13, 2004

SUBJECT: Southwest Jordan Valley Ground Water Cleanup Project; Zone B / Lost Use Reverse Osmosis (RO) By-Product Disposal Alternative #3 - Deep Well Injection; Regulatory and Hydrogeological/Geochemical Feasibility

At your request, I have listed the regulatory requirements and the hydrogeological and geochemical parameters to be assessed in determining the feasibility of employing a deep injection well (completed at a depth of approximately 5,000 feet) to dispose of the Zone B / Lost Use Reverse Osmosis (RO) By-Product wastewater. Below I discuss separately considerations from a regulatory, hydrogeological / geochemical, and technical perspective.

Regulatory Considerations

Regulation of the deep injection well disposal alternative would fall under the Utah Underground Injection Control (UIC) Program (R317-7). UIC-regulated facilities are permitted-by-rule under the Utah Ground Water Quality Protection Program (R317-6-6.2(A)(8)). According to R317-6-6.2(B), no facility permitted-by-rule may cause the ground water quality of the receiving ground water to exceed the ground water quality standards (a subset of the drinking water standards and health advisories) of R317-6-2 of the applicable ground water class TDS limits of R317-6-3.

Under the Utah UIC Program Administrative Rules (R317-7), underground injections are prohibited that would allow movement of fluid containing any contaminant into underground sources of drinking water (USDWs) if the presence of that contaminant may cause a violation of any primary drinking water regulation (MCLs), may cause a violation of any ground water quality

regulations, or may adversely affect the health of persons. "Underground Source of Drinking Water" is defined as follows:

> **Underground Source of Drinking Water (USDW)** means an aquifer or a portion thereof which:
>
> A. Supplies any public water system, **or** which contains a sufficient quantity of ground water to supply a public water system; **and**
> 1. currently supplies drinking water for human consumption; **or**
> 2. contains fewer than 10,000 mg/l total dissolved solids (TDS); **and**
> B. is not an exempted aquifer. (See R317-7-4 of the Utah Administrative Rules for the UIC Program and 40 CFR 144.7 and 40 CFR 146.4).

The deep injection disposal well would require a UIC permit to operate either as a Class I or a deep Class V injection well. Along with a permit application, technical information would be required to be submitted that would demonstrate that the proposed injection would not endanger a USDW for the lifetime of the injection or thereafter.

Hydrogeological / Geochemical Considerations

In light of the regulatory requirements governing UIC facilities discussed above, the hydrogeological and geochemical considerations relevant to the deep injection well disposal option include:

- identifying USDWs,
- identifying and characterizing a suitable injection zone in terms of transmissivity, hydraulic conductivity, and the ability to receive the projected volume of injectate,
- identifying and characterizing suitable confining zone(s) in terms of transmissivity, hydraulic conductivity, and the ability to contain the projected volume of injectate,
- identifying any faults which may be activated to produce earthquakes due to the proposed injection or which may serve to transmit injectate out of the injection zone,
- characterizing the water quality of a proposed injection zone formation water,
- characterizing the contaminants and their concentrations in the RO By-Product waste stream,
- and assessing the compatibility between the injectate, the receiving formation fluid and materials.

Richard Bay and Bruce Callister of Jordan Valley Water Conservancy District and Pat Lambert and Bert Stolp of the U. S. Geological Survey, Salt Lake Office were contacted for information on the local hydrogeology and wastewater chemistry. According to Pat Lambert and Bert Stolp, there is very limited data currently available, other than that from the Utah Roses Geothermal Well described below, from which we can draw enough information to address all the considerations bulleted above. Bert expressed the opinion that it would be ill advised to move forward with implementing this disposal option unless assurances could be made that the injectate would not impact USDWs.

The only well in the vicinity of the Zone B / Lost Use Plant penetrating the proposed injection zone of 5,000 feet is the Utah Roses Geothermal Well located approximately 1.2 miles to the southeast of the Zone B / Lost Use Plant located at approximately 8300 South and 1000 West (see attached map). Information about this well was taken from the cited reference, portions of which are attached. This well was drilled in late 1979 to a total depth of 4,994 feet. The drilling summary indicates the well penetrated the valley-fill aquifer into a consolidated bedrock aquifer with evidence of fracture permeability at depths of approximately 4, 300 to 4, 500 feet. Water samples were collected and analyzed during a pump test commencing on April 3, 1980. Water quality data indicate Total Dissolved Solids (TDS) concentrations of 2811 mg/l (within the TDS range (500 – 3000 mg/l) for Class II ground water) and Selenium concentrations of 1 micrograms/l. However, a temperature log run on April 16, 1980 indicates the groundwater flow entered the borehole from behind the well liner, which extended from 2080 feet to 3885 feet, traveled down the annulus to the end of the liner, then back up the interior of the liner to the pump which was set at 712 feet. Based on this analysis, the ground water sampled did not originate from the consolidated bedrock adjacent to the end of the liner at 3885 feet or deeper but rather some shallower depth. This information indicates that somewhere within the deeper consolidated bedrock there exists a source for ground water that qualifies as a USDW.

Normally, before a deep injection well is constructed, a potential operator will contract with a consulting firm specializing in injection wells for the purpose of conducting a feasibility study involving an extensive literature search to assess, to the extent possible, the bulleted items above. Under certain circumstances where lateral homogeneity can be assumed, the operator may opt to proceed with the drilling of the well acquiring the necessary information during the drilling operation. Since the assumption of lateral homogeneity cannot be made, in this case, due to complexities in stratigraphy and structure, this option would not be advisable.

The information available from the Utah Roses Well is not sufficient to adequately assess the bulleted items above. However, this information raises questions regarding the presence of drinking water quality groundwater in the deep fractured rock aquifer, presence/absence of an adequate confining zone(s), and presence of faults in the deep bedrock underlying the proposed injection site. All of these issues would need to be thoroughly investigated, either through extensive research of the existing hydrogeological literature of the area or, if lacking that, an exploratory drilling program (a costly option), before this disposal alternative can be considered.

Technical Operational Considerations

In discussions with Richard Bay, he indicated that the RO By-Product demonstrates an extreme scaling potential, with precipitation of gypsum occurring within several hours despite efforts to stabilize the wastewater. This characteristic of the RO By-Product deserves serious consideration from an operational perspective. Scaling could not only adversely impact wellhead equipment and injection tubing, but also significantly reduce injectivity in the injection zone. Part of a detailed design of the injection system would include an evaluation of the geochemical compatibility between the injectate and the receiving formation waters for the purposes of developing an appropriate pre-conditioning system for the injectate to minimize the negative impacts of scaling, or any other physico-chemical reactions between the injectate and the receiving formation fluids or formation material. Additionally, cost estimates of the deep injection well alternative disposal option should include periodic well workovers to remove scale

and to increase injectivity. There are several companies that specialize in the design and servicing of deep injection well systems that could be contacted for assistance in addressing these design issues.

References

Floral Greenhouse Geothermal Heating Demonstration, October 1982, January 24, 1979 – September 30, 1982, Final Report Prepared by Energy Services, Inc.; Idaho Falls, ID; U.S. Department of Energy – Geothermal Energy, DOE/ET/27056-5.

P.O. Box 16690
Salt Lake City, Utah 84116-0690

UTAH-SALT LAKE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)