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November 24 2003

Mr. Rusty Wilder  
USDA Forest Service  
25041 North Highway 16  
Custer, SD 57730

**Re: Nemo Work Center Project, Nemo, South Dakota, USDA Forest Service  
Contract No. 53-84N8-1-009, Activity III,**

Dear Mr. Wilder:

Millennium Science and Engineering (MSE) has prepared this letter to address specific questions regarding the ethylene dibromide (EDB) groundwater plume on Forest Service land and the Nemo Guest Ranch property. Your inquiries are listed below, followed by our response.

**Are there additional approaches to investigate the nature of the EDB groundwater contamination and it's potential relationship with the petroleum plume at the Nemo Guest Ranch?**

Response - Yes, several options exist to investigate the local area including: sampling UST wells for the presence of EDB, defining local prevailing hydrogeologic and water quality conditions, and evaluating the threat of EDB to the ranch property and water supply wells. These potential activities are discussed below in more detail:

- 1) **Sample UST wells for EDB** - Perform EDB analysis on groundwater samples collected in conjunction with monitoring of the Underground Storage Tank (UST) release at the Guest Ranch. This sampling is critical to confirm our current understanding that the actionable EDB plume has contracted away from the Guest Ranch.
- 2) **Determine Groundwater Flow directions near the Guest Ranch**- Evaluate local gradients with respect to water elevation in Box Elder Creek, prevailing preferential flow paths associated with structural geology, and water levels in surrounding water supply and monitoring wells to determine prevailing groundwater flow directions. Tie all wells to a common datum with a detailed survey to determine critical local gradient relationships.
- 3) **Define the shape of the EDB MCL plume above actionable levels and declining EDB trends in water quality within the community.** Investigate EDB distribution with respect to plume geometry near the Guest Ranch property boundary. Document declining concentrations of EDB in wells near the Nemo community including old 4T.
- 4) **Evaluate likelihood of EDB impact to the Guest Ranch** - Evaluate impacts from pumping Guest Ranch Wells and connection with EDB plume; evaluate connectivity along transverse fault line. If necessary, perform additional aquifer testing activities to determine more specifically the hydrogeology and groundwater flow characteristics in the immediate vicinity of the Guest Ranch. We believe there is a fault that the N4T well has intersected at depth, as it has the ability to provide significant water. Aquifer testing in the area would help clarify the nature these types of geologic and hydrogeologic features.

Mr. Rusty Wilder  
November 24 2003  
Page 2 of 2

MSE

These activities can be done relatively quickly and can be performed with a narrow weather window this fall.

**Are there means to remediate or reduce EDB concentrations in groundwater at the Nemo Guest Ranch?**

Response: Yes, but the approach to remediation would be to reduce or prevent actionable EDB concentrations from migrating onto the Guest Ranch. Active remediation using extractive technologies on the ranch must be approached with caution.

**Pumping along major fault line** - We believe that the safest and most broadly effective approach to mitigate off-site EDB migration is to use pump and treat technology within the potential source area of the plume where the highest EDB groundwater concentrations are present, near and within the controlling fault line. This portion of the EDB plume on Forest Service land is also where the highest groundwater elevations occur, and therefore this area potentially feeds the plume in all directions. Multiple extraction wells and a treatment system would be required. With time, this will result in a further reduction of EDB at the periphery of the plume near the Guest Ranch property.

**Pumping within community** - Pump and treat remediation technologies in the community require that water be pumped out of the aquifer outside or near the periphery of the plume. This could potentially result in pulling higher concentrations of EDB from Forest Service land toward the Guest Ranch. We have seen that when pumping on contaminated domestic wells on the periphery of the plume was discontinued, a trend toward decreasing EDB concentrations has been observed in those areas. Reversal of the process could occur if pumping (in the vicinity) were resumed.

**Groundwater Injection at plume edge** - Injection at the property boundary could be performed to create a hydraulic barrier.

**In situ Groundwater Treatment - Air Sparging** (Forcing air bubbles into the aquifer) to volatilize EDB and provide oxygen to enhance biodegradation could work if zones of high porosity and/or conductivity could be tapped. This approach may require the use of Soil Vapor Extraction (SVE) to capture potential vapors generated as a result of the sparging. The effectiveness of this approach would be questionable in this area.

We appreciate the opportunity to assist with any issues you may have with this project. If you should have any questions or comments regarding this letter or any other aspect of the project, please don't hesitate to contact me at (801) 461-0868.

Sincerely,  
Millennium Science & Engineering

Mark S. Lilly, P. G.  
Project Manager

Cc: R. Kelsey, Technical Director, MSE