04.01-09/12/97-01885

State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Solid Waste Management

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
William L. Meyer, Director

September 12, 1997

Commander, Atlantic Division
Naval Facilities Engineering Command
Code 1823
Attention: MCB Camp Lejeune, RPM
Ms. Katherine Landman
Norfolk, Virginia 23511-6287

Commanding General
Attention: AC/S, EMD/IRD
Marine Corps Base
PSC Box 20004
Camp Lejeune, NC 28542-0004

RE: Comments on the Draft Groundwater Modeling Report
Operable Unit No. 9 (Site 73)
Marine Corps Base Camp Lejeune, North Carolina

Dear Ms. Landman:

The Superfund Section has completed its review of the referenced document and submits the following comments. We agree with a using computer simulations to evaluate the groundwater contamination at Site 73; however, the approach taken in this report may not be appropriate. Natural attenuation of the plume followed by dilution in Courthouse Bay is an interesting proposal for remediating the groundwater contamination at Site 73. Unfortunately, if the water supply wells at Courthouse Bay are being contaminated by the Site 73 plume, this remedy will require a variance of the North Carolina groundwater standards. A difficult, but not impossible, process to justify.

In this report, the groundwater model presented for Site 73 creates a favorable result for the natural attenuation/dilution remedy. As with most models, using the range of data suggested by the geology and hydrogeology of the site, a number of other modeling results are possible. A different approach is to see if a model can be designed, using the suggested range of data, to produce the contamination found at the water supply well, and then use the worst-case model to suggest what additional field data is needed to show that the contamination is not coming from Site 73.

At present the following factors have not been adequately modeled or field-tested:

1. The conductance of the sediments beneath the floor of Courthouse Bay,

2. The impact of highly conductive limestone layers being pumped by the water supply wells,

3. The configuration of the Castle Hayne Confining unit beneath Courthouse Bay, and

4. The chemistry of the VOCs detected at BB-44. Are they compatible with the Site 73 plume?

Additional modeling of the above factors will tell if more field data is needed. Specific comments are attached. We appreciate the opportunity to review this document and look forward to continued progress at Camp Lejeune.

Sincerely,

David J. Lown, LG, PE
Geological Engineer
Superfund Section

Attachment

cc: Gena Townsend, US EPA Region IV
Michael P. Senus, MCB Camp Lejeune
Diane Rossi, DEHNR - Wilmington Regional Office

North Carolina Superfund Comments
Draft Groundwater Modeling Report
Operable Unit 9 (Site 73) MCB Camp Lejeune

1. Page ES-2. First Paragraph. It's stated here that "the flow model proved useful in predicting the ultimate fate of the groundwater contaminants... ." The usefulness of the model will be proven by continued monitoring of the plume.

2. Page ES-2. Third Paragraph. The text states that there is no surface water standard for cis-1,2 Dichloroethene. The Surface Water Section of the Division of Water Quality determines the surface water standards for regulated compounds. I suggest Dianne Reid at (919) 733 5083, extension 568, as a good contact in the Surface Water Section.

3. Page 1-1. Last Paragraph. We agree that projecting the contaminant plume backward in time is subject to errors. Since local heterogeneity, retardation, seasonal flow variations, nature of the release, and the configuration of the source are not considered, the source can be any where. At the most, the area defined by the pathlines, provides a rough approximation of the area to search for possible sources.

4. Figure 1. No scale.

5. Page 2-2. Third paragraph. Two limestone units are described as being the most productive layers of the Castle Hayne. Why weren't these included in the MODFLOW model for the site?

6. Page 2-2. Section 2.3. Paragraph 1. One inch/year is said to leak into the Castle Hayne Aquifer. Was this confirmed with the MODFLOW model?

7. Page 2-3. First paragraph. Please provide an analytical summary for the VOCs detected in the Courthouse Bay water supply wells.

8. Page 2-4. This discussion suggests that the hydraulic conductivities in the Camp Lejeune area may be lower than in other areas. Averaging the hydraulic conductivity over the entire thickness of the aquifer, may be underestimating the Castle Hayne's ability to move large amounts of water fairly quickly. It may be better to include highly conductive layers in the model.

9. Page 3-5. From the conductance value selected for the river cells that simulate Courthouse Bay, the hydraulic conductivity of the river cell is calculated to be $K = 1.9$ ft/d. In the Basewide Model, river cells simulating the New River have a calculated hydraulic conductivity of $K=0.01$ ft/d, **two orders of magnitude** lower than that used at Courthouse Bay. This is an important part of the model. Using the higher value at Courthouse Bay may be justified, but must be evaluated by sensitivity analysis.

10. Page 3-6. Section 3.4.2. The horizontal hydraulic conductivity for the confining unit is $7.3x10^{-4}$ ft/d. In the areas where the confining unit is missing, a horizontal hydraulic conductivity of 3 ft/d was used. How was this input into the model? An abrupt change in hydraulic conductivity within a layer, without a transition zone, may produce numerical dispersion. This should be checked.

11. Page 3-6. Section 3.4.2. Figure 3-5 shows that the Castle Hayne Confining Clay Unit is absent from Courthouse Bay. In Figure 3-5 from the Draft RI report, Cross-Section C-C' (which is closest to the Bay) shows that the Castle Hayne Confining Clay unit extends to a depth of 20 feet below sea level. Courthouse Bay is only about 5 feet deep. Unless the clay was removed by an erosional event, it could extend across Courthouse Bay. (The presence of the Castle Hayne Confining Unit beneath the New River is also indicated by Cross-Section D-D' from Cardinell et al. (1993)).

12. Page 3-6. Section 3.4.3. Why create two layers (layers 3 and 4), not separated by a confining layer, and give them exactly the same hydraulic characteristics? As stated on Page 2-2, "two or more conspicuous layers of indurated limestone occur at elevations of approximately -30 to -50, and -80 to -100 feet referenced to mean sea level (msl). These seem to be the most productive layers of the Castle Hayne aquifer as evidenced by the screened intervals of the Courthouse Bay Supple wells." Noting this, wouldn't it be more informative to take an approach similar to that in the Basewide model, and include at least one, maybe two, highly conductive limestone layers that are being pumped by the water supply wells?

13. Page 3-9. Section 3.6.1. First paragraph. In the Draft RI Report (Baker, 1996), the Surficial Aquifer includes the Castle Hayne Confining Clay Unit of this report. Please confirm that all the monitoring wells used to define the Surficial Unit are screened above the Confining Clay unit.

14. Page 3-9. Section 3.6.2. First Paragraph. Figure 3-12 is the interpreted potentiometric head contours in the Upper Castle Hayne as depicted in the Draft RI Report (Baker, 1996). The water levels from the "B-series" monitoring wells should be included in the evaluation of the Upper Castle Hayne Aquifer. In the Draft RI Report (Figures 3-4 and 3-5) these wells, which are screened below the Confining Clay Unit, were indicated as being part of the Surficial Aquifer.

15. Page 3-9. Section 3.6.3. It's stated here that Figures 3-17 and 3-18 show that Courthouse Bay is a groundwater discharge area for the lower Castle Hayne aquifer. The observed data, Figure 3-17, shows that flow is toward the New River, but not necessarily Courthouse Bay. It's also interesting to note that at the wells closest to Courthouse Bay (cluster 73-MW31, 73-DW06, cluster 73-MW09, 73-DW02, 73-GW02, and cluster 73-

MW15, 73-DW04, and 73-GW03), the water levels in the surficial aquifer are higher than the levels in the Castle Hayne, suggesting that the Castle Hayne may not be discharging to the Surficial Aquifer or Courthouse Bay.

16. Page 3-11. Section 3.7.5. Model Sensitivity to Changes in River Conductances. It is state here, "It is likely that a more significant change in the results would have been seen if the values river conductance were decrease by an order of magnitude." As noted previously, the hydraulic conductivity associated with the river conductance is 2 orders of magnitude higher than that used in the Basewide Model and the sensitivity of the model to this parameter needs to be evaluated at the appropriate scale.

17. Page 3-12. Section 3.8. MODPATH Pathline Analysis. Because the confining layer is removed and large values for the conductance are used for Courthouse Bay, it is no surprise that everything discharges to Courthouse Bay. An interesting test of this particular model would be to do a backward pathline simulation from water supply well BB-44. If these pathlines move to Courthouse Bay, then the model is probably flawed.

Reference

Cardinell, A.P., Berg, S.A., and Lloyd, O.B., Jr., 1993, Hydrogeologic framework of U.S. Marine Corps Base at Camp Lejeune, North Carolina: USGS Water-Resources Investigation Report 93-4049, 45p.