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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

October 11, 1996

Joseph Joyce
BRAC Environmental Coordinator
Environment and Safety (Code 1AU)
MCAS El Toro
P.O. Box 95001
Santa Ana, CA 92709-5001

Dear Mr. Joyce:

EPA has reviewed the "Draft Phase II Feasibility Study-Operable Unit 2A Report." The attached comments (Enclosures A & B) are significant and we recommend that the BCT meet to discuss options for comment resolution. Additionally, I will forward minor comments from EPA legal counsel on October 15, 1996. If you have any questions regarding these comments, I can be reached at 415/744-2368.

Sincerely,

Bonnie Arthur
Remedial Project Manager
Federal Facilities Cleanup Office

cc: Tayseer Mahmoud, DTSC
Larry Vitale, RWQCB
Andy Piszkin, Southwest Div.

ENCLOSURE A

EPA COMMENTS ON THE DRAFT OPERABLE UNIT (OU) 2A
FEASIBILITY STUDY (FS)

MAJOR COMMENTS

1) As stated in EPA's 10/10/96 comments on the OU 1 IAFS, the proposed monitoring wells at the leading edge of the plume must be installed before EPA will sign a ROD for a Navy stand alone principal aquifer remediation alternative. Please discuss with the BCT the option of preparing a new alternative in the draft final FS which considers only onsite soil and/or groundwater remediation.

2) Aquifer and soil vapor extraction test results were not submitted in a timeframe to allow regulators to review these documents concurrent with the FS. As a result, additional new comments may be submitted during the Draft Final FS review.

3) EPA would like to discuss the positive and negative impacts of dewatering and SVE with the Navy and consultants.

4) Page 3-2, Figure 3-1; This figure misrepresents the text of this report. No action is not the same as passive aquifer remediation.

5) Page 3-19; The discussion of public perception of the acceptability of treated water should be included under the "Community Acceptance Section."

6) Page 4-67, Section 4.5.5; Please include a summary of the preferred alternatives for the principal aquifer as was completed for the shallow aquifer.

7) Page 6-2; The report does include narrative description of alternatives for the principal aquifer, however, the costs for the offsite monitoring is not included in cost estimates. Please clarify with the BCT.

8) Page 6-2; 35 ug/L is the highest Navy detected concentration in the principal aquifer. OCWD's sampling has detected higher concentrations and these levels should be included and referenced.

MINOR COMMENTS

1) Page 1-7; Please update the status of Site 25.

2) Page 4-18; Typographical error end of sentence starting with "The results of the 20 year groundwater simulation...,".

3) Page 4-19, "State and Community Acceptance"; Please add Cal/EPA which includes DTSC and the RWQCB.

4) Page 4-59; Please clarify how under Alternative 11, "970 pounds of TCE are removed from the groundwater after 20 years."

5) Page 4-67, Section 4.5.5; Typographical error, first sentence.

ENCLOSURE B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

October 10, 1996

MEMORANDUM

SUBJECT: Review Comments on Draft Phase II Feasibility Report Operable Unit 2A -- Site 24 MCAS El Toro

TO: Bonnie Arthur, RPM
Navy Section, FFCO

FROM: Herbert Levine, Hydrogeologist
Technical Support Section, FFCO

General Comments

In general I found this document to be unacceptable as an usable report to evaluate the effectiveness of the presented remedial alternatives. The interpretation of subsurface lithologies is simplistic and not appropriate for designing a remediation scheme. It is appropriate when constructing cross-sections to group lithologies based on grain size and estimated hydraulic properties. The inclusion of silty sand and clayey sand as coarse grained units in cross-section is misleading since these units clearly have different hydraulic properties than the other coarse grained units. There are more sophisticated techniques available for interpreting the subsurface than was presented here (see attachment).

The ground water flow model as presented is not a useful tool for accomplishing the model objectives, since critical supporting documentation and data were not included. The supposition that the pumping test data (and pilot test data) and interpretation may be presented in a draft final document is incorrect. These data are required to be included in the draft document. The draft final document is intended to resolve and include response to comments raised with the draft document (see FFA). The pumping test data is critical to evaluating both the model and well locations.

A sensitivity analysis was not presented with the ground water model. As stated in the ASTM Standard Guide for Application of a Ground-Water Flow Model to a Site-Specific Problem , "*The purpose of a sensitivity analysis is to quantify the uncertainty in the calibrated model caused by uncertainty in the estimates of aquifer parameters, stresses, and boundary conditions.*" Since a sensitivity analysis was not done (or presented) then the uncertainty of the flow and transport

model predictions can not be evaluated (see Specific Comments to Appendix D).

The proposal for placing extraction wells at the 5 ppb TCE contour is a very simplistic approach. The Navy should develop alternatives which include placing extraction and injection wells screened in the appropriate geologic materials and TCE hot spots. The reported drawdown from the IDP (if built) is significant and will have a dramatic impact on water levels within this OU. The Draft Final OU-1 Interim Action Addendum predicts water level declines over the first ten years of operation which dramatically impact on this project. The Navy must include this while selecting and comparing remedial alternatives.

I have repeatedly requested from the Navy data in an electronic format. The requested data included a site map, site 24 chemistry and water level data, and lithologic data. I was specifically interested in these data to attempt an alternative interpretation of geology and contaminant distribution. These data are supposed to be freely distributed and the reluctance to provide those data is very suspicious, especially since previously supplied pumping test data included viruses.

These deficiencies are critical components for a draft document. It is not appropriate, in my opinion, to address these in a draft final document. These issues must be resolved prior to issuing the draft final document. Therefore, I suggest that we either reject this document, or request that the next revision be submitted as a draft. The Navy may choose to separate the vadose zone and ground water and pursue a ROD for SVE while addressing these concerns for the ground water.

Specific Comments

1. Section 1.4.4.2 Stratigraphy, page 1-18. EPA disagrees with the statement that the coarse grained and fined grained units are continuous and extensive. This is an artifact of including silty sand and clayey sand in the coarse grained units (Figures 1-7 and 1-8) and an oversimplification of the geology. Both of these lithologies have an expected hydraulic conductivity several orders of magnitude less than sand. This is likely an explanation for the observation of contaminant distribution and an important distinction for extraction well placement. These Figures point out the data gaps present for understanding occurrence of contaminated ground water and the knowledge needed to place extraction wells. (See attachment)

2. Section 1.4.5.1 Shallow Groundwater Unit, page 1-23. EPA disagrees with the first paragraph interpretation of heterogeneities. See above comment. The reference to Phase II pilot tests points out the inadequacy of this document. EPA can not review data which are not presented nor comment on reported summary data (hydraulic conductivity of 1 to 5 ft/day). Which sands were measured for porosity? What value is there in averaging these data? The average linear velocity has little credence and little value as calculated. There is no supporting documentation for averaging hydraulic conductivity nor for averaging porosity. What is the significance of an average linear velocity of 146 ft/yr? What are the implications of plume movement based on this number? (73 years to reach 2 mi., 108 years to reach 3 mi.).

3. Figure 1-9, Conceptual Model of VOC Source Area. This Figure oversimplifies the distribution of VOC in the upper portion of the SGU. This Figure uses two dimensional data for contaminant distribution which is misleading. The data presented in Figures 1-7 and 1-8 shows that the contaminant concentrations vary dramatically. The three dimensional data distribution should be incorporated into the conceptual model.

4. Section 1.4.6.2 Saturated Zone, Horizontal Characterization, page 1-37. The interpretation of a homogeneous sandy unit is wrong and not appropriate for this report. The Navy should revise the cross-sections and then attempt an interpretation of contaminant distribution as a function of lithologies. As presented the Navy assumes similar behavior between sand and silty sands and clayey sands. EPA recommends using a third distinction for the cross-sections, an intermediate unit consisting of silty sands and clayey sands.

5. Section 1.4.6.2 Saturated Zone, Vertical Characterization, page 1-38. The discussion of silt and clay layers separating sandy units is a significant observation. How were the hydraulic conductivity values measured? For discussion purposes it is reasonable to assume that the hydraulic conductivity of clays and silts in the SGU are not significantly different from hydraulic conductivities of silts and clays in the SGU. This might provide an explanation of the stratification reported for TCE measured in HCPT83. If the Navy still contends that the upper 40 feet of the SGU is homogeneous sands and is laterally extensive please provide an explanation for the contaminant stratification found in the CPT/Hydropunch data.

6. Section 2.1.5.3 Cleanup to Background Level, page 2-8. RCRA is not necessarily an ARAR. This is dependent on how the groundwater treatment unit is defined. Why must background level or chemical concentrations be achieved? The reference to past U.S. EPA efforts to restore impacted aquifers to pristine levels should be expanded. One overriding conclusion presented in these site review reports (EPA, 1992a, 1992b) and subsequent ones (NRC, 1994) is that sites are not often characterized sufficiently to implement an effective remedy. This has important implications for El Toro. The general discussion (paragraph 2) on extraction and adsorption of contaminants should be expanded to discuss the impact of poorly placed extractions wells and the presence of DNAPLS. Though EPA does not mean to suggest that DNAPLs are present at El Toro, this has been an important factor in determining feasibility of pump and treat. The above mentioned reports do discuss as limiting factors for cleanup an appropriate site characterization and site heterogeneities. These should be addressed in the FS for site 24.

7. Section 2.3.2 Groundwater Volume and Associated Trichloroethene Mass, page 2-16. This estimate is based on an oversimplification of contaminant distribution and is likely wrong. As previously mentioned the distribution of TCE is highly stratified. Assuming that the upper 50 ft. of the SGU has a uniform contaminant distribution is wrong. The Navy should revise this section using measured concentration data.

8. Section 2.4.7 Screening of Technologies and Process Options, Figure 2-4 page 2-27. The data presented to the BCT indicated that air sparging did not work in the area where the pilot test was conducted. During BCT discussions the EPA has expressed reservations regarding this technique. Again, the EPA's position is that air sparging might be appropriate for shallow,

homogeneous zones. This is clearly not the case at El Toro. Please change this technology, as well as in-well air stripping, to not applicable. Also, please change dual phase from potential to applicable.

9. Section 2.4.7 Screening of Technologies and Process Options, Table 2-8, page 2-47. Comment # 8 applies here as well. Page 2-49, Please change ozone-enhanced air sparging to not applicable. Page 2-51, why is on station discharge limited to 6 months only? The irrigation does not necessarily need be for food crops as off-station.

10. Section 3.4 Alternative 2A, page 3-7. Please discuss why VOCs are to be polished to non-detect.

11. Section 3.5 Alternative 3, page 3-9. Please change process drawings to show treatment via IDP prior to VOC treatment.

12. Section 5.1 Effectiveness, page 3-9. If capture and treatment is provided by the IDP why is this alternative considered to have a low effectiveness?

13 Section 3.5.3 Results of Screening Alternative. Comment # 12 applies here as well.

14. Section 3.10.2 Implementability, page 3-23. Please provide information supporting the claim that the public will not accept treated groundwater as a potable water supply. EPA and DoD routinely provide treated groundwater as a potable supply.

15. Section 4.2 Groundwater Modeling, page 4-4. EPA agrees with the approach of developing the model based on an existing regional model. However, it was our expectation that the model would be developed at a different scale for site 24. The resolution of site parameters such as lithology and associated hydraulic conductivities is too coarse for this project. Figure A-3-5 from the OU-1 FS indicates that the upper 40 ft will be dewatered in 10 years at well 22_DBMW47 at the downgradient end of the plume. This dewatering follows an exponential curve with significant water level declines in the first 2 years. For this reason dual phase extraction should be considered as an alternative.

16. Section 4.4.2.1 Description, Shallow Groundwater Unit, page 4-20 and Figure 4-6. The problems associated with the groundwater model preclude the EPA from concurring with the extraction and injection scheme presented here. The Navy did not consider the implications of placing extraction and injection wells in the fine grained units. The modeling effort averaged the aquifer parameters so it is not possible to evaluate whether it is possible to maintain pumping rates in the fine grained units and whether the fine grained units can accept the recharge. This has dramatic implications for aquifer flushing and contaminant plume capture. Attachment A to these comments is a three dimensional geologic model with TCE concentrations. Slices through the geologic model indicate that high concentrations of TCE are contained in the fine grained units. It is possible to use such a model of geology and contaminant distribution to refine the groundwater model and more logically place the extraction and injection wells. EPA recommends the Navy to consider this approach since the presented model and alternatives are not acceptable.

17. Section 4.4.6.2 Evaluation, Long-Term Effectiveness and Permanence, page 4-58. While this alternative poses many positive actions; sve, containment of the shallow plume, extraction wells placed in the shallow plume hot spots, and natural attenuation of the principle aquifer, there are significant problems with the ground water conceptual and numeric model to actually document the scheme proposed here. While EPA agrees in principle with this approach, changes to the ground water conceptual and numeric model are needed to evaluate effectiveness. Specifically, the conceptual model and numeric model needs to address the concerns mentioned in comments 1,2,3,4,5,7,15,16, & Attachment A). All data produced by the numeric model are considered suspect until these concerns are addressed.

18. Section 4.5.3 Long-Term Effectiveness and Permanence, page 4-64. EPA agrees with the added benefit of removing mass from the vadose zone via SVE. EPA disagrees with the conclusion that the SGU dewaters after 17 years. As discussed in comment 15, the downgradient edge of the 500 ppb contour is significantly dewatered after 2 years, and after 10 years is dewatered by 40 ft.(see Figure A-3-5, OU-1 FS). This phenomenon must be included in the evaluations of alternatives. The Navy must revise the numeric model prior to EPA agreeing that the extraction/reinjection scheme as proposed for any alternative is valid.

19. Section 5.0 Pilot testing, page 5-1. It is inappropriate for the Navy to propose including these pilot tests in a Draft Final document. According to the FFA, and discussion with the Navy during BCT meetings, the Draft Final document should address the comments made during the initial presentation in the Draft document and not require extensive comments from the agencies.

20. Section 6.3 Recommendations, page 6-4. EPA agrees that the presentation of remedial alternatives is conceptual, however the failure to include a representative conceptual model and limitations of the subsequent numeric model leaves significant doubt that appropriate alternatives have been evaluated. While it is true that many design details can be addressed during the remedial design phase, the presentations of alternatives here, including alternative 11, does not include a realistic estimation of aquifer response to stresses (see comments for Appendix D). Therefore, EPA can not agree in concept to comparisons of cost and effectiveness.

21. Section 6.3.1 Soil Vapor Extraction, page 6-4. Agree.

22. Section 6.3.2 Horizontal Groundwater Extraction/Injection, page 6-4. Agree that a horizontal well could be beneficial and be simulated. EPA agrees with the suggestion that this technology be investigated, but not until the conceptual and numeric models are revised to incorporate EPA's comments.

23. Section 6.3.3 Air Sparging Using Ozone, page 6-5. EPA rejects the use of air sparging at EL Toro. The use of air sparging with ozone has not been demonstrated at any sites to be effective in destroying TCE in ground water. The example provided (Kerfoot, 1996) can not demonstrate whether the induced air is being captured and if TCE is being destroyed.

24. Section D1, Introduction, page D1-1. While a review of the model did not reveal any fatal flaws, sufficient information is missing to determine if the model actually meets the stated objectives. While the model might actually be modeling flow and response to stress, the Navy has

not demonstrated that the aquifers beneath EL Toro are being modeled.

25. Section D1, Introduction, page D1-1. A model sensitivity analysis was not presented. As stated in the ASTM Standard Guide for Application of a Ground-Water Flow Model to a Site Specific Problem, "*The purpose of a sensitivity analysis is to quantify the uncertainty in the calibrated model caused by uncertainty in the estimates of aquifer parameters, stresses, and boundary conditions.*" Since a sensitivity analysis was not done, then the uncertainty of the flow and transport model predictions can not be evaluated. EPA recommends conducting a sensitivity analysis when this model is revised.

26.**Section D1, Introduction, page D1-1.** According to the text, the objective of the OU-2A modeling effort was to "*provide a tool for the evaluation of remedial alternatives for the trichlorethene (TCE) contamination of the shallow groundwater unit underneath Site 24 and TCE sources in this area (p. D1-1)*" yet a significant amount of effort also went into developing a tool which simulates the deep Principal aquifer, and many of the remedial scenarios also include addressing contamination present in the deep Principal aquifer. Please clarify whether the objectives of this modeling effort also included addressing contamination present in the deep Principal aquifer, or whether the efforts to that end are considered out of the scope of the OU2-Site 24 modeling effort presented in the August, 1996 FS Report.

27. Section D2.2.2, Intermediate Zone, page D2-2. The text indicates that the intermediate zone average hydraulic conductivity measured from soil samples collected at Site 24 during the Phase II RI was 4.5×10^{-9} cm/sec and Figure D5-2 indicates that the value used in the OU2A model for the intermediate unit hydraulic conductivity at Site 24 was 2.0 ft/day (7.1×10^{-4} cm/sec). Please clarify which of these values represent horizontal and/or vertical hydraulic conductivity and specify the ratio of anisotropy used in the model. Also, explain how the horizontal and vertical hydraulic conductivity values used in the model compare with values obtained from site tests or with values expected from geologic descriptions of the soil where hydraulic data was not available.

28. Section D2.4, Hydraulic Conductivity, page D2-3. The hydraulic conductivity distribution in the Principal Aquifer used in the OU-1 and OU-2A models is shown on Figure D2-3. Please discuss the basis for this hydraulic conductivity distribution.

29.Section D2.4, Hydraulic Conductivity, page D2-3. Figure D2-5 shows that a hydraulic conductivity value of 10 ft/day was used to represent the Shallow Unit at Site 24 in the OU-2A model, and the text indicates that this value was based on the field measured hydraulic conductivity values shown on Figure D2-4. Neither the text nor the figure indicate how the value of 10 ft/day was derived from the field data. There are 15 OU-2A field obtained hydraulic conductivity values located within the gray zone representing 10 ft/day in the model on Figure D2-4, however, the geometric mean of these 15 values is 1 ft/day. Also, all of the field obtained values located in the northern half of the MCAS range from 0.01 to 1.1 ft/day, which is considerably lower than 10 ft/day. This apparent difference between observed hydraulic conductivity values and modeled values could impact the predicted capture zone widths and flow rates and should be incorporated into the model. Please clarify how the value of 10 ft/day was derived from the field data, and also explain why the model hydraulic conductivity was not varied

spatially across the MCAS based on the 28 field obtained values shown on Figure D2-4.

30. Section D4.3, Key Assumptions in the Transport Model, page D4-6.

The second listed assumption states that no biodegradation or chemical reactions are modeled. The reason given is that this creates a conservative result from the transport model. While it is true that the predicted contaminant distribution prior to remediation efforts would probably be larger, the effects of remedial pumping are likely exaggerated by these assumptions. The input file for MT3D shows that the factor describing both biological decay and adsorption reactions were set to zero in accordance with the statement in the text. The assumption of no decay is routine since there is insufficient data about the reactions resulting in the biodestruction of TCE to support a single input value. The assumption regarding adsorption is also reasonable given the uncertainties in accurately describing the governing reactions. However, these assumptions combine to create a situation where the resulting predictions are likely less reliable than if some attempt had been made to estimate one or the other of these components.

The third listed assumption indicates that a longitudinal dispersivity of 50 feet and a lateral dispersivity of zero feet were used in the transport model. The potential range of dispersivity and also the relative uncertainty in predicting the appropriate dispersivity is relatively high. However, it is generally considered to be affected by the scale of the problem. Anderson and Woessner (1992) state *"dispersivity seems to increase with the size of the contaminant plume; i.e., dispersivity seemingly increases as the plume moves downgradient."* Also, Fetter (1993) suggests that while the potential range is rather large, the longitudinal dispersivity can be estimated to be about 0.1 of the flow length. Fetter also states that the few field studies available indicate a ratio of longitudinal to transverse dispersivity ranging from 6 to 20. Please explain why a relatively low longitudinal dispersivity of 50 feet and a zero lateral dispersivity of 0 feet was used to represent large plumes ranging from 2,000 to 10,000 feet in length. The values used could potentially affect the predicted distribution of contaminants and also the recovery well design layout.

31.Section D5.2, Calibration Method, page D5-1. Figure D5-1 presents the recharge distribution used in the OU-2A model with values ranging from 0.1 to 1.6 ft/yr. The text on page D2-2 indicates that it is assumed that 10 percent of rainfall will infiltrate to the groundwater, which, based on the calculations on page D3-4, is equal to 1.18 in/yr (0.1 ft/yr). Please explain what data or literature sources were used in developing the recharge zones (0.1, 0.3, 0.4, 1.0, 1.4, and 1.6 ft/yr) input into the model. Explain what the variable recharge zone shown on Figure D5-1 represents. Also, explain why the amount of deep percolation from direct precipitation input into the MODFLOW was twice as high as the estimated amount shown on Table D5-1

32. Section D5.3, Calibration Results, page D5-3. The calibration results are briefly summarized on Table D5-2 and plotted on Figure D5-3. The lack of surface features shown on Figure D5-3 make it difficult to determine what area is represented by the figure. However, the contours indicate some areas where the model predicted groundwater elevation and flow direction differ significantly from the observed data. Most notably there is a 20 foot difference between 120 ft OU2A model contour and the adjacent 140 foot observed contour. The 120 ft OU2A model contour line also indicates a groundwater low area which is not seen in the observed data.

Also, the flow directions indicated by the 150 ft to 180 ft contours vary between the observed and predicted values in some areas. Discuss the distribution of the 101 calibration points relative to the location of the existing shallow and deep contaminant plumes and the existing and simulated recovery and production wells. Explain whether all of the calibration points were located in the shallow unit, or whether some of them were located in the deep unit.

There is no discussion of vertical gradients in the modeling text. Discuss whether the groundwater flow within the model domain is predominately horizontal, and if not, describe the vertical gradients that were observed in the field. Discuss whether the model duplicates any vertical gradients that are present. Since the shallow and deep units are both represented by more than one layer, indicate the layers within these units that were designated for comparison with values observed in the field.

33. Comments on Conclusions and Recommendations: Section D7

The following comments are provided with respect to the review of the groundwater flow and contaminant transport modeling effort review. They are organized in the same order as the bulleted items provided on page D7-1 of the subject report.

- Soil vapor extraction likely does reduce remediation times.
- Any conclusions regarding the effectiveness of a remedial alternative on drawdown, on water levels in deeper units or on vertical gradients may be biased because hydraulic conductivities and recharge values may be overestimated.
- Injection in the upper units (layers 1 and 2) should increase downward gradients in the lower layers. This observation may be indicative of effects of other uncertainties on the model results.
- Pumping in the zone most highly affected is likely the best approach.
- Alternative 11 is the most effective because of a large number of groundwater extraction wells combined with source input term reduction designed to reflect the use of SVE.
- The estimate of exactly 38 years to reach MCL concentrations for TCE is likely unreliable. At best attempts to model contaminant migration scenarios provide approximate time scales and are most useful when comparing alternatives. It is risky to rely on models for precise estimates of cleanup time.

Attachment A

EPA performed a geospatial analysis of the available geologic and contaminant data for Site 24, MCAS El Toro. This analysis was done using the EarthVision software developed by Dynamic

Graphics, Inc. The result of this analysis is provided as a three dimensional solid model of both the geologic conditions at the site and the contaminant distribution. Our objectives were: to determine if the observed distribution is controlled by the subsurface lithology, develop plan view figures showing the geology and contaminant distribution at fixed intervals through the upper 40 feet of the SGU, and to evaluate the proposed extraction/injection wells based on the geologic model and the distribution of contaminants.

Solid Model Construction

Since the purpose of this task is to provide some input on the likely effects of subsurface lithology on TCE distribution several simplifying assumptions were made to focus the model construction activities. First is the placing specific lithologies based on general grain size. Fine grained deposits were defined as being predominately clay or silt. Coarse grained deposits were defined as being predominately sand or gravel. The geologic data used for this evaluation were taken from the Draft Phase II Remedial Investigation Report Operable Unit 2A Site 24, Marine Corps Air Station, El Toro, CA dated June 1996. The data from approximately 100 borings, including Cone Penetrometer (CPT) points, were reviewed and the lithologies grouped according to the fine grained and coarse grained definitions provided above. These data were then used to construct a geologic solid model of the area of Site 24 by starting at an elevation of approximately 75 feet above mean sea level (MSL) and building upward through the lithologic materials to approximately 300 feet MSL. This results in a fairly detailed geologic model ranging in thickness from 90 to 110 feet. An oblique view of the geologic model showing the alternating layers of coarse grained and fine grained deposits is attached.

A three dimensional interpretation of TCE was constructed using data from monitoring wells and from HydroPunch sampling locations. These data were extracted from the Final Quarterly Groundwater Monitoring Report for MCAS, EL Toro, Ca dataed June 27, 1996. In the case of the monitoring wells the reported TCE concentration was assigned to the vertical location corresponding to the center of the well screen. These data were entered into the EarthVision data base and a three dimensional model of the TCE distribution was constructed. The TCE data analysis was done independent of the geologic model so that the interpretation of vertical distribution would be based only on the actual vertical location of the sample. Any observed correlation between the projected distribution of TCE and the geologic model would then be a result of the natural correlation between the data sets. An oblique view of the three dimensional TCE plume is provided and shows the estimated extent of the 5 ppb TCE surface.

Lithologic Control of Contaminant Distribution

Figures are presented which show horizontal slices depicting both geology and TCE distribution. These Figures are the result of slicing both of the three dimensional solid models at 5 foot intervals from the highest elevation of the water table to an elevation 40 feet below the lowest point of the water table. The Figures are provided in pairs. The first part of each pair shows the geology as fine grained and coarse grained deposits with no TCE information. The second part is a clear overlay showing the projected TCE concentrations down to 5 ppb along with geology only in areas outside the TCE plume. There are a total of 26 Figures attached as 13 pairs. These Figures illustrates the complexity of the distribution of the coarse and fine grained materials and

distribution of TCE. Figures from elevations ranging from 120 MSL to 140 MSL show the TCE distribution separating into two apparently distinct plumes. In addition, the high concentration under buildings 297 and 296 shifts from underneath building 296 toward 297 as depth increases. This separation and shifting is apparently coincident with the occurrence of a large area of fine grained materials which develops with increasing depth. This observation suggests that there may have been two distinct sources in this area and that at depth there remains a separation in these contaminant masses. The other important observation from these figures is that the TCE concentrations seem to be highest in the fine grained materials and have not spread into the more permeable coarse grained material at these depths. This observation suggest the possibility that phase separate contaminants are responsible for the concentrations observed in 24CPT83 (3100 ppb) even though the levels typically expected from a phase separate source would be higher. Figures from 140 MSL to 180 MSL suggest that the contaminants occurring in shallow locations are in coarse grained materials and are spread over a larger area and are more diffuse. This may be indicative of a combination of lower residual concentrations likely present in the more permeable layers and the larger volume of mobile groundwater available to dilute and move the TCE contamination from its original location. It appears from this analysis that the lithology at the site is affecting the distribution of TCE, but the contaminants are not necessarily concentrating in the coarse grained deposits. A more detailed analysis of lighologic data may provide some additional guidance on the relative contribution of lithology and original source location and distribution of TCE. An example would be including a transitional lithologic group between coarse grained and fine grained. An intermediate textural group would likely highlight the lack of very fine grained materials such as clay and determine if the few clays present are influencing contaminant distribution. The occurance of silty sands and clayey sands would be included in this intermediate textural group. This would also highlight the impact of these units included as coarse grained deposits, but having significantly different hydraulic properties.

Data Gaps

There is some bias included in this analysis by the distribution of the available data, the data collection method and the goals of the original data collection activities. The spatial anlysis provided through EarthVision helps provide some input on where additional data would be helpful in achieving the most complete and appropriate level of understanding. A data gap identified from this analysis is the area between buildings 296 and 297. This is an area where the existing data suggest a separation at depth between tow coarse grained sediment zones and the location of a high TCE concentration at approximately 122 ft. MSL. The nature and completeness of this lithologic separation could have a dramatic effect on the effectiveness of the planned remediation. The observed TCE concentration at 122 ft. MSL also suggests the need for additional TCE data in the area at similar depths using a more repeatable data collection technique. Additional data at severla locations at depths greater than 120 ft. MSL would be extremely helpful in confirming the locaiton of the highest contamination and in completing the site conceptual model with respect to TCE migration.

Extraction Well Layout

Review of the proposed extraction well layout for Alternative 11 does not suggest that the distribution of extraction wells is based on lithologic data interpretation. Given the variability in both the lithology of the subsurface and the distribution of TCE, a layout designed to maximize

the effectiveness of each well would be appropriate. In addition, the design of the associated injection wells does not seem to take into account geologic variablility. EPA recommends locating a focused number of extraction wells in areas known to be coarse grained and connected with the more highly contaminated zones. Similarly, the injection wells would be best located in areas most in need of further flushing action. This approach would likely result in fewer wells and a more focused remedial effort. This type of anlysis would also require the use of a ground water flow model that is capable of a focused analysis in the area of Site 24. This could be accomplished with the existing MODFLOW model, but would require some grid modifications to provide the level of detail best suited to extraction system design.

REFERENCES

American Society for Testing and Materials Designation (ASTM) Designation: D5447-93 *"Standard Guide for Application of a Ground -Water Flow Model to a Site-Specific Problem"* October, 1993.

Anderson, M. and Woessner, W. 1992. Applied Groundwater Modeling, Academic Press, Inc. Sand Diego, California.

Fetter, C. 1993. Contaminant Hydrogeology, Macmillan Publishing Company, New York, New York.

National Research Council, 1994, Alternatives for Ground Water Cleanup, National Academy Press, Washington, D.C.