



United States Environmental Protection Agency

One Congress Street, Suite 1100 (HBT)
Boston, MA 02114-2023

March 15, 2001

Mr. Ed Boyle
Northern Division - NAVFAC
10 Industrial Highway,
Code 1811/EB - Mail Stop 82
Lester, PA 19113-2090

Re: Draft Work Plan for the Characterization of CVOC Contamination at the former Nike PR-58 and adjacent Navy NCBC Davisville Site 03, dated September 3, 1999, former Naval Construction Battalion Center (NCBC), Davisville, Rhode Island

Dear Mr. Boyle:

Pursuant to §7.6 of the NCBC Federal Facility Agreement, please find enclosed the Environmental Protection Agency's (EPA) comments on the above referenced document. We generally agree with the reports recommendations, however, without discussions of the data usability/validity it is difficult to make any definitive statements of the nature and extent of contamination. In addition, there seems to be a need for further characterization in the NIKE silo area, in the north western part of the NIKE site and in the plume edges to the north and northeast off the Navy property.

We would like to discuss these comments with you, the Army Corps of Engineers, and the RIDEM, please contact me at (617) 918-1384 to confirm the meeting of March 22, 2001 at the Boston office of EPA New England.

Sincerely,

A handwritten signature in cursive script, appearing to read "Christine A.P. Williams".

Christine A.P. Williams
Remedial Project Manager
Federal Facilities Superfund Section

Enclosure

cc: Richard Gottlieb, RIDEM
Walter Davis, CSO
Peter Hugh, ACOE
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Bill Brandon, EPA
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Jim Shultz, EA Engineering, Science and Technology
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Howard Cohen, RIEDC
Anne Heffron, Applied Enviro-Tech, Inc.
Dinalyn Spears-Audette, Narragansett Tribe

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GENERAL COMMENTS

1. The Army/Navy's recommendation to re-sample the private-use ground-water supply wells north of Perimeter Road (sampled one time in 1997), and also to identify and sample potential private-use wells to the west of the former PR-58 Nike site is strongly supported. Furthermore, since ground-water contamination in bedrock fractures does not necessarily travel in predictable directions, the Army/Navy should conduct a thorough investigation of private-use ground-water supply wells in all potential bedrock ground-water flow directions from the former PR-58 Nike site area within a logical but conservative distance. As a result of the additional information obtained under this investigation, the additional sampling should be conducted as expeditiously as possible for the safety and protection of the local residents relying on ground-water. Efforts should be made to sample the "eighth" well that was not sampled in 1997.
2. As shown in Figure 4-6, significant levels of CVOC contamination were detected in the deep bedrock well MW03-14R2, the bottom of which is 93 ft bgs. Section 6.4 lists a general recommendation to further characterize the hydrogeology and contaminant nature and extent between the northernmost and westernmost wells and identified residential properties with private water supply wells, but no recommendations are provided to further assess the vertical extent of contamination on-site (e.g., in the vicinity of MW03-14R2). The Army/Navy should address this issue in the context of identifying, screening, and developing remedial alternatives for the site (in the absence of understanding the vertical extent of contamination).
3. The presence of daughter products (e.g, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride) at the site suggest that parent product degradation is occurring at the site. However, the natural attenuation screening results to date at the site do not encourage moving on to the the next step of the natural attenuation demonstration process (i.e., quantitative evaluation of the rate of contaminant degradation, estimation of the time-scale to reach clean up goals, fate and transport modeling, etc.) in support of a remedial alternative option. Please provide clarification on this issue (i.e., Army/Navy intent regarding natural attenuation at this time).
4. While the Army/Navy presents a significant amount of additional data related to the Former PR-58 Nike Site, adjacent Navy property, and off-site property, there is no comprehensive or consistent screening process for identifying Contaminants of Potential Concern (COPCs) or the vertical and lateral extent of contamination that exceeds COPCs. For clarification, the Army/Navy should explain in Section 1 how this *Characterization* report fits into the overall Remedial Investigation process and at what point COPCs will be identified to be used in the risk assessment, the FS and LTMP.

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5. In the Army/Navy's Responses to Comments to the *Draft Work Plan, Characterization of CVOC Contamination at the Former Nike PR-58 Site and Adjacent Navy NCBC Davisville Site 03*, dated April 2000, the Army (EA) responded to EPA Comment #15 (EPA's 18 October 1999 Comments) that the missile silo close-out report had been requested from USACE. If this report has been received, EPA's comment (re: installing piezometers into the sand backfill material in each of the silos) should be responded to appropriately. As noted by the Army in its response, it was agreed (during the 3 November 1999 BCT meeting) that the installation of a piezometer in each of the former missile silos could be included in a future phase of the investigation.
6. Section 4 (Nature and Extent) discusses VOC exceedances of the MCL and RIDEM groundwater standards for the competent bedrock groundwater zones (D, R, and R2), and one table is provided in Section 4.5.1.2 to show the exceedances of MCLs in R wells only (RIDEM standards are not listed in the table). A comprehensive screening table should be provided to show all wells that exceeded MCL and RIDEM (GA or GB as appropriate) criteria for all analyzed compounds and analytes. This information in figure format (include only wells that exceeded screening criteria) would also be helpful. Additionally, it should be made clear that the data represents only the most recent round of the groundwater sampling. Future report(s) should incorporate the historical data (including overburden wells and other sampled media) for a complete and comprehensive picture to aid in the identification, screening, and selection of remedial alternative(s).
7. A screening table should be provided that shows the comparison of TAL metal results in groundwater to MCLs and RIDEM groundwater standards (GA or GB as appropriate) to support the statement in the report that none of these analytes exceeded these standards.
8. Data Validation Reports (Appendix F) were not provided with the report, but were provided later. The subject report should contain a discussion of the data validation results and the usability of the data.
9. Appendices A3 and A4 contain Logs of Core Borings; however, Logs of Soil Borings are only provided for EA-114R (to 10.7 ft) and EA-116D. The remainder of the soil boring logs should be included. In addition, the core boring logs for MW01-15R and MW03-03R (Appendix A4) could not be located, and should be inserted.
10. A discussion of the management and disposal of the IDW generated under this investigation should be included in the report.
11. The ground-water data from deep and rock wells in Figures 4-1 to 4-4 should be presented in an additional format (i.e. isopleth plots - use contour lines to represent equal

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- concentrations) in order to clearly express the lateral and vertical extent of total CVOC contamination, individual contaminants (i.e. PCA and TCE), and daughter products (i.e. DCE and VC). Isopleth plots in plan and cross-sections should be used in the interpretation of the relative transport and degradation rates of contaminants in the subsurface environment.
12. The report does not provide a preliminary screening of remedial alternatives, contrary to the objectives listed in both this report (Section 1.2) and the *Final Work Plan, Characterization of CVOC Contamination at the Former PR-58 Nike Site and Adjacent Navy NCBC Davisville Site 03*, dated April 2000. The reason for not conducting this preliminary screening at this time should be provided in the report.
 13. Cross-sections of site geology have been included in the report. These cross-sections should identify as a separate stratum the depth of roller bitting prior to reaching the competent bedrock. In addition, plans showing the bedrock profile (contour) and observed RQD ranges should be included in the report. Also, flow pathlines based upon observed horizontal and vertical gradients in cross-sections should be presented in cross-sections. In addition, include observed permeabilities from slug tests for various geologic media in cross-sections.
 14. Ground water surface contours are presented for shallow wells (figure 3-6) and deep wells (figure 3-7) for July 2000. To the contrary, ground water surface contours are presented for rock wells in January of 2001 (figure 3 -8). It will be necessary in the future to collect additional synoptic water level rounds which include all wells (that is shallow, deep, and bedrock wells) so that flow contours for identical time periods may be compared directly, and vertical gradients may be assessed in a meaningful way. This exercise should be repeated at such times that high and low water table conditions are represented for all well types. Updated maps, once prepared, should post the head measurements for each well included in the contouring effort so that accuracy of the interpretive contours may be assessed directly.
 15. Discrepancies between the titles of tables, figures, and appendices in the Table of Contents, and the actual tables, figures, and appendices were noted. The Table of Contents should be reviewed for accuracy.
 16. The List of Acronyms was noted to be incomplete (e.g., MSL) for both text and tables. The list should be reviewed for completeness.
 17. The laboratory qualifiers (e.g., J, D) should be explained in the legends of the figures (e.g., Figures 4-6 and 4-8).

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18. Future ground water sampling should consider expanding the analyte list to include the following compounds: MTBE, 1, 4-Dioxane, and perchlorate. MTBE has been identified in samples collected from the former missile silos (ESE, 1995) and may be more widespread in the ground water. Perchlorate contamination of ground water has been shown at other sites to be a problem attributable to rocket fuels. At other waste solvent disposal sites, as noted in technical literature, 1,4-Dioxane has been shown to be a widespread contaminant of concern.
19. Additional source area delineation is needed in the areas directly beneath the former missile silos. See specific comments for additional discussion.
20. Additional monitoring well control is needed in the north western portion of the area (D/R/R2) as well as to the south and east of the former NIKE leaching field. See specific comments, below.
21. The leading edge of the plume has not yet been identified for either the eastern (e.g., beyond MW-Z3-02) or the northeastern (e.g., beyond EA-116R) plume segments. Additional monitoring well control is needed in both of these areas.
22. EPA previously commented that ground water and surface water head data is needed in the wetland areas (east of the northern residences and north of Sites 01, 02, and 03, north of EA-116R (north eastern plume segment)) and that the role of the wetlands as potential ground water/contaminant discharge areas needs to be examined. The Army/Navy recommends additional characterization of the hydrogeology and the nature and extent of the CVOC plume in the deep and competent bedrock zones between the northernmost monitoring wells and the northern residences, but does not mention the wetland area. Clarify whether the wetland area will be included in the additional characterization phase.

SPECIFIC COMMENTS

23. **Section 1.1, Investigation Area Description, Background, and Scope, Page 1-2, Paragraph 3.** Add the word "comments" to the end of the sentence.
24. **Section 1.3, Summary of Site History.** It is not clear that the potential contamination within the missile refueling area has been adequately evaluated. Please expand the text of this section to discuss the historical investigation(s) that ruled this area out as a potential source area. "Fuels" are discussed generically throughout this section in reference to the Nike site and Nike missiles. What specific fuel(s) were used? Also, what were the function of the acid-neutralization pits? Future groundwater sampling should consider addition of perchlorate to the analyte list due to the association of this compound with

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Cold War era missiles.

25. Section 1.3.1, Former PR-58 Nike Site, Page 1-5, Paragraph 1.

A. For clarification, please indicate whether the still-existing north-south swale (the potential receptor of the missile silo sump discharges) has been sampled for soils analysis.

B. EPA notes that the projected waste quantities would result in approximately 18,000 to 42,000 gallons of solvents over the course of the operating life of the facility (seven years). It is unclear how these volumes compare with the volume estimates mentioned for Peabody Clean mentioned in section 1.3.1.2 on the following page. The discussion in section 1.3.1.2 suggests that 50,000 gallons of oil/ water waste in addition to 10,000 gallons of waste solvents were on-site "at any one time". As written, it would appear that the Peabody Clean industries use of the site may have involved a considerably greater volume of waste. Please clarify.

26. Page 1 -- 5, footnote 1; Little discussion is directed to the 1,3-dichloro-5,5-dimethylhydantoin component of DANC. Indicate in the text if this compound is included in the project analyte lists, whether it is also a VOC, or does it exhibit other properties and/or additional concerns.

27. Page 1 -- 6, paragraph 2; The text indicates that monitoring well EA - 103 was installed to investigate potential CVOC. It is not clear, however, that this was the only concern here. Please review which analyses were completed here to address "chemical agents".

28. Page 1 -- 6, section 1.3.1.3; EPA notes that the MTBE detections on surface sheen samples are inconsistent with the Nike site use. MTBE was introduced to the United States in the late 1970s. As such, it appears likely that the silos may have been used as a receptacle for waste materials *after* the closure of the Nike site in 1962. In addition, the gasoline constituents detected in the samples are consistent with the MTBE detections. One might also conclude that the lead reported from the silo samples may also have a gasoline origin. On the other hand, barium was also commonly detected here. What is the likely origin of this metal? These data suggest, as EPA has commented on the past, that additional source area delineation is needed in the silo areas themselves. Nested wells are recommended for each former silo area. Since the silos were backfilled with clean sand, there should be no particular well installation problems.

29. Page 1 -- 6, section 1.3.1.3; The text refers to an ESS report dated 1995. However EPA's review of the reference section suggested this reference amounts to only a

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certificate of analysis. No report appears to have been prepared. If this is the case, how was the narrative information supplied in section 1.3.1.3 obtained? In any case, EPA would appreciate copies of any documentation for this sampling effort.

30. **Page 1 -- 7, last paragraph;** How many gallons were pumped and treated?
31. **Section 1.3.1.4, USACE Closure of UST at Building 344, Page 1-8, Paragraph 2.** The reference to Section 1.5.4.1 in the last paragraph is erroneous (this section does not exist). This discrepancy should be corrected. This paragraph, which describes backfilling of the missile silo's with clean sand, apparently belongs at the end of the previous section, section 1.3.1.3.
32. **Page 1 -- 9, section 1.3.2.2;** Was soil tested beneath the areas where the drums were located at a later date?
33. **Page 1 -- 12, third paragraph;** EPA notes that the suite of chlorinated solvents identified in the Area A-3 3-trench leach field are similar to the primary COCs in groundwater detected in the main part of the plume. In addition, the barium identified in groundwater is similar to ground water samples collected from the Nike Silos discussed in section 1.3.1.3.
34. **Page 1 -- 12; last paragraph;** EPA notes that the results of the area 3 leach field investigation should be viewed with some caution. Four shallow wells were sampled for methylene chloride only. This compound is not a primary contaminant of concern. As such, other chlorinated compounds may have been missed. Additional wells may need to be installed in this area and at the northwest corner of the site, particularly in deeper aquifers (D/R/R2).
35. **Page 1 -- 13, Second paragraph;** No samples were reported to have been collected from Area A-4. This does not appear to be acceptable. Particularly given the potential relationship to sporadic detections along the Western parameter of the site. Please clarify.
36. **Page 1 -- 13, third paragraph;** Again, barium was reported in area A-5, which may suggest a linkage between barium occurrences in the former Nike silos, the A-5 area, and the A-3 trench area.
37. **Page 1 -- 14 and 1 -- 15, silo water;** Additional information is needed concerning the water sampling effort conducted at the former silos. How was the bottom of the former missile silo determined? What depths were the samples collected at? This is important in view of the later ESS sampling program conducted in 1995, which paints a much

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different picture of contamination in the silos. A cogent explanation for the differences encountered during these two different sampling events is needed.

38. **Section 1.4.1.3, Engineering Evaluation of Contamination Study, Page 1-16.** The two references to Appendix A1 should be changed to A2 in the top section of the page.
39. **Section 1.4.1.4, Related Portions of the Navy's Phase III Remedial Investigation, Page 1-21, Last Paragraph/Bullet.** Figures 1-2A and 1-2B should be changed to Figures 1-2 and 1-2A (i.e. both show the location of the pipe structure area). There is no Figure 1-2B.
40. **Section 1.4.1.4, Related Portions of the Navy's Phase III Remedial Investigation, Page 1-23, Bullet 1.** This section should state that the addresses of the private drinking water supply wells are provided in Table 4-1, not Chapter 4.
41. **Section 2.2, Field Program, Page 2-2, Page 2-3, Sentence 1.** The first partial sentence on this page (continued from the last page) indicates that packer test logs for MW03-14R2, EA-114D/R, and EA-116D are provided in Appendix C. However, this reviewer's copy did not contain the test results for EA-114D or EA-116D. In addition, Sheet Number 5 of 5 for MW04-14R2 is listed as Hole No. EA-114R and contains the same information as the packer test log for EA-114R with the exception of the "Depths" information. The logs in Appendix C should be checked for both accuracy and completeness.
42. **Section 2.2, Field Program, Page 2-3, Paragraph 1.** This paragraph references the existence of monitoring well EA-114R2; however, this well was not installed. The reference should be corrected.
43. **Section 2.2, Field Program, Page 2-4, Sentence 2.** The *Final Work Plan, Characterization of CVOC Contamination at the Former PR-58 Nike Site and Adjacent Navy NCBC Davisville Site 03*, dated April 2000 (Chapter 3, Page 2, Paragraph 4), stated that 31 existing Navy wells would be sampled. This sentence states that 30 existing Navy wells were sampled. Please clarify, in this paragraph, which Navy well was not sampled, and why.
44. **Section 2.2, Field Program, Page 2-4, Paragraph 1.** This paragraph states that peristaltic pumps were used in certain wells due to the absence of a bladder pump. Since EPA Region 1 prefers the use of submersible-type pumps over peristaltic pumps (due to potential loss of VOCs), the text should explain why bladder pumps could not be used. Furthermore, the VOC data from these wells should be evaluated, in light of the

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surrounding data by bladder pump withdrawal, to determine whether sampling by peristaltic pump may have impacted the results.

45. **Page 3-5, para. 3;** Inclusion of a thickness map for the glacio-lacustrine deposits would improve the presentation, and should be considered.
46. **Page 3-5, para. 4** Inclusion of a thickness map for the till deposits would improve the presentation, and should be considered.
47. **Section 3.6.2, Site Geology, Page 3-6, Paragraph 2.** The second sentence states “These geophysical log data suggest that ground-water flow in bedrock beneath much of the former Nike Site may be along northeast trending fractures with only relatively few cross cutting fractures, resulting in a localized northeasterly flow compared to the apparent regional flow toward the east and southeast”; however, only a small area in the deep and rock zones show hydraulic gradients to justify the above comment. Contaminant transport near the potential source area in the deep zone may be due to a DNAPL induced density gradient. The paragraph should be revised accordingly.
48. **Page 3-7, para. 2;** Inclusion of a thickness map for the weathered bedrock deposits would improve the presentation, and should be considered. Do the greatest thicknesses of weathered bedrock correspond to the location of the NE-trending fracture zone ?
49. **Page 3-7, para. 4;** The “slope” of the rock layers should be fairly obvious from the core or geophysical (e.g., ATV logs) logs. This is not clear as written. Please clarify.
50. **Page 3-8, para. 2 and 3;** Does one unit appear to have a greater significance with respect to ground water flow ? Please clarify.
51. **Page 3-11; para. 1;** Although it is reasonable to define the ‘deep’ ground water zone as presented, the text does not make a particularly strong case as to why the ‘till’ is hydraulically similar to the underlying weathered bedrock. The discussion focuses mainly on the physical characteristics of the weathered bedrock, and little information regarding the character of the till is presented. As a point of clarification, the appearance of hydraulic connectivity does not necessarily imply that the two zones actually behave as one unit. A series of thin, discontinuous layers within either the till or the weathered bedrock may have the same effect as “continuous layers of low permeability material”.
52. **Page 3-12 to 3-13;** Please clarify that the vertical gradients were collected from water level information from D/R pairs *collected on the same day*. Discussions on page 3-11 (last para.) Indicates that bedrock wells measured on July of 2000 had not fully recovered

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from sampling, and these measurements must therefore be considered as suspect and should not be used for vertical gradient calculations. If this is the case, the calculations should be repeated once “synoptic” water level data are collected. As a point of clarification, “downward gradients” do not necessarily imply “unconfined conditions”, and “upward gradients” do not necessarily imply “confined conditions”. The text needs clarification in this respect.

53. **Section 4.2, Residential Water Supply Wells, Page 4-1, Paragraph 3.** The “Matoes” well contained trace concentrations of PCE and 1,1,1-TCA. Please indicate (on Figure 2-1) which well is the “Matoes” well and (in this section) whether the new information obtained under this phase of the investigation provides a stronger potential correlation between this trace contamination and the identified north-east trending fractures (i.e., is the “Matoes” private well the most northeastern private well shown on Figure 2-1?).
54. **Section 4.4, Soil, Page 4-2, Paragraph 1.** The results of the VOC and SVOC results are briefly discussed for soil; however, the soil samples (EA-114 and EA-116) were also analyzed for TAL metals. The TAL metals results should also be briefly discussed. Also, the units for 2-butanone detected in the shallow soil sample from EA-114R should be ug/kg, not ug/L.
55. **Section 4.5.1.1, Deep (D) Ground-Water Zone, Page 4-3, Paragraph 2.** The last sentence of this paragraph indicates that the plume extension to the northeast and offsite is less than 50 ug/L total CVOC. This statement could be interpreted to mean that the total CVOC concentration to the northeast is less than 50 ug/L (in addition to offsite). Since the on-site northeast portion of the plume is greater than 50 ug/L total CVOC (e.g., EA-104 and MWZ3-01), this sentence should be reworded to avoid confusion.
56. **Section 4.5.1.1, Deep (D) Ground-Water Zone, Page 4-3, Paragraph 3.** This paragraph discusses the appropriateness of certain existing wells to serve the purpose of monitoring the fringe of the plume. However, the discussion does not include MWZ3-02, the most northeastern well (closest to Allen Harbor) which contained 54.28 ug/L total CVOC in the September-October 2000 sampling round. This well, sampled once previously in 1996, was ND at that time (refer to Table 4-5). The appropriateness (or not) of this well as a monitoring point for the plume fringe should be discussed.
57. **Section 4.5.1.1, Deep (D) Ground-Water Zone, Page 4-4, Paragraph 1.** The discussion of data in Table 4-5 contains some discrepancies. The wells listed should be checked against Table 4-5 and corrected accordingly. Also, refer to the comment below on Table 4-5.

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58. **Section 4.5.1.2, Shallow Competent Bedrock (R) Ground-Water Zone, Page 4-5, Sentence 3.** This sentence indicates that the plume extension to the northeast and offsite is less than 500 ug/L total CVOC. This statement could be interpreted to mean that the total CVOC concentration to the northeast is less than 500 ug/L (in addition to offsite). Since the on-site northeast portion of the plume is greater than 500 ug/L total CVOC (e.g., EA-104R), this sentence should be reworded to avoid confusion.
59. **Section 4.5.1.2, Shallow Competent Bedrock (R) Ground-Water Zone, Page 4-6.** RIDEM ground-water standards should be added to this table.
60. **Section 4.5.3, Metals, Page 4-7.** This section discusses the comparison of TAL metal concentrations in groundwater to RIDEM GA groundwater standards which have been established for ten of the metals parameters. Comparisons should also be made to MCLs. Also, refer to related General Comment.
61. **Section 4.7, Potential VOC Source Areas, Page 4-8, Paragraph 2.** Errors were noted in the stated total CVOC concentrations in this paragraph, as well as the relative locations of wells. This information should be checked and the text should be corrected as needed.
62. **Section 4.7, Potential VOC Source Areas, Page 4-9, Last Paragraph.** Please briefly elaborate on the former Peabody Clean Drum Storage Area (also discussed in Section 1.3.1.2) and the 1983 soil removal action. Was the removal action, and the associated sampling/analyses, documented in a report? Were the main soil CVOC contaminants the same constituents detected in the groundwater today (not taking into consideration potential breakdown products)?
63. **Section 4.7, Potential VOC Source Areas, Page 4-9, Last Paragraph.** EPA generally concurs with the conclusions presented here. However, following this logic, there still remains questions concerning the potential for additional source mass in the areas directly beneath the former silos. In this context, additional source area delineation should be directed to the silos. Specifically, nested wells (D/R/R2) should be installed in each former silo. Information presented elsewhere in the report suggests that contaminants may have been introduced directly into these areas. (e.g., ESS, 1995). Such a release scenario would be consistent with other findings presented here, but might also suggest important implications which have not yet been considered. For instance, direct release into the silos may have allowed some DNAPL to enter the fractured bedrock without first having to penetrate the overburden. As such, the orientation and degree of interconnectivity of the fracture networks immediately beneath the silos would be expected to exert a strong influence on contaminant fate and transport. Low level detections near the western margin of the site (e.g., EA-105R and EA-107R) may be the

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- result of fractures or other currently unknown pathways (although migration on the top-of-bedrock surface is another plausible explanation). In addition, the potential presence of DNAPL at the site, although presently inferred, can not be ruled out without reasonable exploration efforts and source area delineation in these likely areas. Additional work is needed, which focuses on the subsurface directly beneath the former silos.
64. **Section 5.1.2, NAPL Transport, Page 5-5, Paragraph 1.** Several symbol definitions are missing from the DNAPL pool length equation and should be added to the list below the equation (i.e. interfacial tension, contact angle, density, and slope).
 65. **Page 5-5; para. 2;** Although a DNAPL “pool” has not been directly observed, it must be acknowledged that well control in both the “D” and “R” and “R2” units is poor directly northwestward from the EA-102 and MW03-14 clusters. A hypothetical release to the subsurface at silos 349 or 348 could have the potential to flow under gravity in the NW direction *without detection*, as no monitoring wells currently exist in this direction. Additional well control is needed in the NW corner of the site.
 66. **Section 5.1.2, NAPL Transport, Page 5-6, Paragraph 1.** Several symbol definitions are missing from the the DNAPL pool critical height equation and should be added to the list below the equation (i.e. interfacial tension, contact angle, and density).
 67. **Section 5.3.2.2, pH and Eh, Page 5-11, Paragraph 1.** In addition to presenting the average pH, the text should also present the range of pH values and explain anomalous values. Also, the reference in this paragraph to “three” sampling events is not understood since there have been four. Please correct or clarify.
 68. **Section 5.3.2.3, Temperature, Page 5-11, and Section 5.3.2.4, Dissolved Oxygen, Page 5-11.** The text in each of these paragraphs presents approximate ranges for temperature (6.0 °C to 17.0°C) and dissolved oxygen (0.4 mg/L to 9.4 mg/L) during the four sampling events from 1995 to 2000. The temperature range was qualified in the text by stating that “the lower and higher values are probably a result of the winter and summer (respectively) weather temperatures during the four sampling events”, although the data does not appear to support this statement. The stated (approximate) dissolved oxygen range was not qualified. These two sections should be more accurate in reporting the actual ranges and discuss the potential reasons for the anomalies. Table 2-7 reports dissolved concentration values up to 12.40 mg/L and temperatures up to 19.25°C.
 69. **Section 5.3.2.5, BOD/COD, Page 5-11, Paragraph 2.** BOD was detected in seven ground-water samples and COD was detected in 22 ground-water samples. If possible, BOD/COD ratios for ground-water samples where both were detected should be

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calculated and the significance discussed in this paragraph.

70. **Section 5.4.3.2, Daughter Products Evaluation, Page 5-17.** Data tables should be prepared for select individual contaminants, similar to Table 4-5 (total CVOC), to track the change in the concentration of daughter products by well number over time. These tables could then be used to evaluate natural attenuation over time. If some values are non-detect, then the detection limit should be provided in the table and identified as such (so that varying analytical detection limits are not misinterpreted).
71. **Section 5.4.3.2, Daughter Products Evaluation, Page 5-18, Paragraph 1.** The statement that there has been an increase in the aerial extent of vinyl chloride from that shown in the 1996 and 1998 results should be substantiated by presenting this data in table format. More importantly, the detection limits from the 1996 and 1998 data, versus the 2000 data, should be evaluated (and included in the table) to ensure that this is an accurate statement (i.e., that the detection limits are essentially the same by each well, each year). If the analytical detection limits were generally lower during the 2000 sampling round, this could explain what may appear to be an increase in the aerial extent of vinyl chloride concentrations. The analytical detection limit should be examined for each well that did not historically show the presence of vinyl chloride.
72. **Page 6-3;** Additional source area delineation work is needed, which focuses on the subsurface directly beneath the former silos. See previous comments.
73. **Page 6-5;** The residential wells could be physically tested, sounded or geophysically logged.
74. **Page 6-6 to 6-7;** Metals data should be considered as suspect given the widespread occurrence of elevated pH, likely attributable to grout contamination.
75. **Section 6.3.4, Metals in Ground Water, Page 6-7, Last Sentence.** Please clarify or correct the use of the word "dissolved" in the last sentence referring to metals. It is assumed that the samples were not filtered in accordance with the Final Work Plan. Additionally, Table 4-7 indicates total metals, not dissolved metals.
76. **Page 6-7, last bullet;** Future sampling should consider an expanded analyte list (e.g., MTBE, 1, 4-Dioxane, and perchlorate).
77. **Figure 1-3a, Storm Water Drainage System with Interpreted Ground-Water Table Contours (May-June 1995).** The two far left ground-water contours have both been

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labeled 25 feet MSL, or "25". As the contours are to represent equal ground-water elevation, it appears that the far left contour line should be labeled "26".

- 78. **Figure 1-3b, Storm Water Drainage System with Interpreted Groundwater Table Contours (July 2000).** Storm water drainage to Davol Pond should be shown with a different line type, similar to Figure 1-3a.
- 79. **Figure 2-2, Interpretive Contour Map of the Upper Surface of Competent Bedrock.** The third type of shading to the left of the legend should be identified.
- 80. **Figure 3-1, Location of Geologic Cross Sections.** The monitoring well numbers should be shown in a regular weight font to improve readability.
- 81. **Figure 3-3, Geological Cross Section B-B'.** The figure should be expanded to fill a 11"x17" page to improve readability.
- 82. **Figure 3-6, Ground-Water Surface Contours, Shallow Wells, July 2000.** Numbers representing the ground-water surface elevation should be placed at both the top and bottom of the contour line to improve readability. In addition, the "19" located between "21" and "20" should be removed.
- 83. **Table 1-3, Analytical Program for Ground-Water Samples (December 1996) and Table 1-4, Analytical Program for Ground-Water Samples (March 1998).** The notes section of each of these tables is incomplete, and should be completed (to include acronym definitions not provided in the Table of Contents).
- 84. **Table 2-7, Ground-Water Quality Field Parameters Measured Prior to Well Sampling (September - October 2000).** The following observations apply to the data in this table:

High pH: There are several wells that exhibit very high pH. All of the extreme pH values are associated with new, deep bedrock wells. Specifically, the following new wells exhibit very high pHs:

well	development sampling date	pH	subsequent sampling date	pH
MW03-14R2	7/17/00	11.95	9/28/00	12.30
EA-112R2	7/13/00	10.11	10/1/00	9.70

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EA-116R2	7/12/00	11.71	9/28/00	12.17
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This phenomenon is commonly observed in new wells that have been cemented; the high pH results from the chemical reactions in the curing cement. Completion of the reactions, purging during development and sampling, and natural flushing by moving groundwater should eventually bring the pH back down to the ambient bedrock-water pH. However, it appears that this had not happened yet after two and a half months (the time between development sampling and the subsequent sampling round). It is interesting to note that the extreme pH values are all in the deep bedrock, which may be because the deep bedrock is tighter, and “refreshing” by ambient groundwater is limited. This can be a significant issue, as the extreme pH can have a strong effect on the concentrations of a number of analytes, particularly the inorganics, many of which exhibit pH-sensitive solubilities.

A few other new wells show high pH, but not as extreme as the deeper bedrock wells. From Table 2-7, it is noted that EA-107R showed pH of 9.18 at development (7/10/00), and 8.38 on 9/27/00. Well MW01-15R showed a pH of 9.60 on 9/30/00. Well EA-113R showed pH of 7.86 at development (7/13/00) and 8.04 on 10/2/00. These elevated pHs are also likely a result of the lingering effect of cement curing.

The text of the report should note, and provide potential explanations for the pH values which are (or appear to be) outside the normal range of pH in site ground water. The impact on the analytical data should also be evaluated.

High conductance: There are a few wells that show very high electrical conductance. Table 2-7 shows 80 mS/cm for EA-104D, 91 mS/cm for EA-105D, 196 mS/cm for EA-106R, 90 mS/cm for EA-107D, 92 mS/cm for EA-108D, 206 mS/cm for EA-110R, 28.68 mS/cm for EA-111R, 211 mS/cm for EA-116R, and 150 mS/cm for MW01-15D. These readings are orders of magnitude higher than those for other wells, and suggest an inconsistency in setting or reading the meter, or in tabulating the data. It seems likely that these extremely high values are actually in units of microSiemen per centimeter; that is, in the units intended for the table (mS/cm), the values should be reduced by a factor of 1000, which would bring them in line with the other measurements shown. The field sheets and data tabulation should be reviewed to identify errors in scale.

Two of the deep bedrock wells also show high conductance (2.016 mS/cm at EA-116R2 and 2.367 mS/cm at MW03-14R2). (As a point of reference, conductance in what is interpreted to be a seawater wedge beneath fresh groundwater of the order of 7 mS/cm. Note that these high conductances are associated with two of the deep bedrock wells that also show evidence of presence of reaction products from the curing cement. This may

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result in elevated conductivity.

The text of the report should note, and provide potential explanations for the conductivity values which are (or appear to be) outside the normal or expected range in site ground water.

High DO / low ORP: A few wells show simultaneous high DO and low ORP (Eh): EA-116R shows DO of 10.75 mg/L and ORP of -434 mV; MW01-13D shows DO of 12.40 mg/L and ORP of -33 mV; MW03-14R shows DO of 10.10 mg/L and ORP of -140 mV. These observations do appear to be contradictory, although field readings showing high DO and low ORP are not uncommon. It is noted that reduced iron is high in all of these wells (2.54 mg/L, 1.75 mg/L, 2.25 mg/L), suggesting that the conditions are indeed reducing.

The apparent discrepancy can arise from a number of sources. First, accurate field measurements of DO are notoriously difficult to obtain, and these may be bad results. The field records should be reviewed for any indications of this (e.g., if all the anomalously high DO measurements were taken with the same instrument, successively on the same day, etc.). Also, it is noted that field ORP readings have their own uncertainties. In particular, the instantaneous measurements with a probe may not reflect true equilibrium with the system. If there are questions with the characterization of the redox conditions, an independent determination may be possible since the analytical lab results for TAL metals include the analyses for total iron in some wells (e.g., Table 4-7). The Fe(II) field measurements and the Fe(total) lab data can be used to calculate ORP, as reflected in the Fe(II) - Fe(III) couple.

Also as a final note, temperature should be expressed in the table as °C, not EC in the table or BC in the notes.

85. **Table 3-3, Summary of Bedrock Field Data, Page 4 of 4.** There are numerous (particularly new) wells missing from this table. The table should be reviewed and completed accordingly.
86. **Table 4-4, Volatile Organic Compounds Detected in the September - October 2000 Groundwater Samples.** The results should be bolded if they are above analytical detection limits to improve readability, similar to the previous tables.
87. **Table 4-5, Summary of 1995, 1996, 1998, and 2000 Total CVOC Detected in Ground Water.** Without a statistical evaluation, it is difficult to determine whether the concentrations can actually be considered increasing or decreasing over time (variations can be due to sampling methods, sampling equipment, seasonal impacts, etc.). It should

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be clearly noted that the comparisons in the table are subjective and not statistically-based. Any conclusions concerning the potential for natural attenuation cannot be made until the concentrations can be shown to be significantly different based on the appropriate statistical evaluation.

Wells with decreasing or stable CVOC concentrations are grouped as one category in this table. It would be more appropriate to separate these wells into two groups: stable (remaining approximately the same) and decreasing.

88. **Table 5-1, Inference of NAPL Presence.** EA-102 contained 110,000 ug/L 1,1,2,2 - tetrachloroethane (refer to Table 4-4, Page 1 of 15) and should be included, and noted in bold lettering, in this table.
89. **Table 5-1, Inference of NAPL Presence, and Table 5-2, Physical and Chemical Properties of VOC.** It is unclear why the solubilities for the same chemicals differ between these two tables. For example, the solubility for cis-1,2-DCE is listed as 800,000 ug/L on Table 5-1 and 3,500 mg/L (3,500,000 ug/L) on Table 5-2. If the solubilities on Table 5-1 have been corrected for groundwater temperature, this should be noted. Otherwise, these two tables should be checked for accuracy and consistency.
90. **Table 5-4, Summary of REDOX Indicator Parameter Results from Monitoring Well Sampling (September - October 2000).** The units for dissolved oxygen should be stated in the column heading.
91. **Table 5-8, Comparison of TCE to DCE Ratios from 1996 and 2000 Ground-Water Sample Data.** A single spot check of the TCE/DCE ratio for MW03-14D in 1996 (4.3) could not be substantiated based on the data provided in Appendix A2. TCE was detected at 150,000 ug/L. Total 1,2-DCE was not reported but only cis-1,2-DCE was detected at 13,000 ug/L. Therefore, the TCE/DCE ratio would be 11.54. It is unclear how the value of 4.3 was obtained. The correct ratio represents a decrease, as opposed to an increase, shown in the table. This correction should be made and all other calculations should be checked. Sections 5.4.3.2 and 6.3.3.4 should be re-written accordingly.

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