

MOFFETT FEDERAL AIRFIELD

RESPONSE TO NAVY COMMENTS ON  
SITE 5 GROUNDWATER TREATABILITY STUDY  
DRAFT TECHNICAL MEMORANDUM

The following presents PRC Environmental Management, Inc. (PRC) responses to U.S. Navy comments on the Site 5 Groundwater Treatability Study Draft Technical Memorandum, Moffett Federal Airfield, California. Mr. Donald Chuck prepared the comments for the U.S. Navy. Mr. Chuck presented one general comment and 27 specific comments. Each comment is presented below and is followed by PRC's response.

GENERAL COMMENT

Comment 1: The use of color in this report was excellent. It was especially useful in the graphs provided in the report and the fence diagrams. It is hoped that this is permanent trend in future reports.

*Response: Comment noted. PRC appreciates all comments, whether they indicate deficiencies or acknowledge appropriate actions and presentations.*

SPECIFIC COMMENTS

Comment 1: Sect. 1.1, Par. 2, 4th and 5th Sent., Page 1: Change *in situ* to in situ. It is not one word.

*Response: Comment noted. The text will be revised.*

Comment 2: Sect. 1.5, Par. 4, 3rd Sent., Page 10: Reference is made to a PRC report 1992b. No such report is listed in Section 8.0. Please correct.

*Response: Comment noted. The text will be revised*

Comment 3: Sect. 1.6.1, Par. 1, 3rd Sent., Page 11: The sentence states that the bulk storage tanks at Site 5 contained JP-5 from the time of construction to the present. This is incorrect. Tanks (Fac. 137) and 11 (Fac. 138) held aviation gasoline (AVGAS) until 1962. At that time the tanks were switched to JP-4 storage. All of the tanks stored JP-4 until 1973 when the base switched to JP-5. Please correct.

*Response: The text has been revised to incorporate the above-presented facts.*

Comment 4: Sect. 1.6.1, Par. 2, 2nd Sent., Page 11: The sampling points and concentrations mentioned in this sentence should be added to Figure 3.

*Response: The figure has been revised to incorporate the data summarized in the text.*

Comment 5: Sec. 1.6.2, Par. 1, 3rd Sent., Page 13: The phrase "nondetectable concentrations" appears to be an oxymoron. How can you have a concentration that is non-detectable? This portion of the sentence needs to be rephrased.

*Response: By "nondetectable concentrations," PRC meant concentrations below the analytical method detection limit that exist in groundwater outside the are of known (detected) contamination. This assumption is based on Fick's first law of diffusion, which states that diffusion is a function of concentration and the diffusion constant, and extends an infinite distance (theoretically) without physical bounds. However, PRC recognizes that the phrase may be misleading, and will change the wording to minimize reader confusion.*

Comment 6: Sect. 1.6.2, Par. 3, 2nd Sent., Page 13: It should be noted that the free product layer has been very thin, sometimes just a film on the surface of the water. Additionally, pumping at free product wells to capture fuel has generally been unsuccessful and the free product layer usually disappears.

*Response: The text has been revised to include this information.*

Comment 7: Sect. 1.6.2, Par 3, 3rd & 4th Sent., Page 13: These sentences should be rewritten to better describe the history of concentrations seen at FP5-1. As shown in Figure 5, there is

an early peak followed by a decrease. This decrease then reverses and concentration values increase again. Figure 5 does not show “an overall declining concentration curve.”

*Response:* *The text has been revised to more accurately describe concentration trends presented in the future.*

Comment 8: Figure 5: Label the graph as FP5-1.

*Response:* *The figure has been revised as requested.*

Comment 9: Sect. 2.1, Par. 2, Page 17: It should be noted that a manometer was used to establish elevations of the piezometers. The description of the process should remain as is.

*Response:* *The text has been revised to include the statement that a manometer was used to establish elevations.*

Comment 10: Sect. 2.4, Par. 2, Page 19: Delete this paragraph. It has no connection to the subject of this section nor is it really relevant to the purpose of this report.

*Response:* *The paragraph has been deleted.*

Comment 11: Figure 6: Addition of the different soil units to this figure would make it more useful (i.e. make it more like a cross section).

*Response:* *The figure will be revised to include the lithologies illustrated in Figure 12 (the fence diagram).*

Comment 12: Sect. 3.1, Par. 7, Page 28: The paragraph describes the graph represented in Figure 8. It notes that the decline in the bromide concentration follows an exponential decay. Is this to be expected? What does this mean to the test? Please amplify.

*Response:* *An exponential decay would be expected under steady state flow conditions. The fact that the observed decay so closely followed perfect exponential decay indicates that sample*

*removal from the source well (FP5-1) did not appear to interrupt steady state conditions to a measurable degree. The text has been revised to explain this point.*

Comment 13: Sect. 3.1, Par 8, Bullet 3, Pg. 28: Why was an assumed velocity of 0.45 ft/day used when you have a calculated value based on field data?

*Response: PRC assumed that the observed velocity of the tracer represented the velocity of groundwater. The value used in the text is the observed velocity of the bromide in groundwater.*

Comment 14: Sect. 3.2.2, Par. 2, 1st Sent, Pg 32: The sentence states that only JP-5 is the only known contaminant of concern at Site 5. It should be noted that AVGAS and JP-4 have also been stored at Site 5 (see Comment 3).

*Response: The text has been revised to state that JP-5 is the only fuel detected in subsurface soil and groundwater samples at the site and that is known to have been used at the site. Although previous analyses of samples from this location characterized soil or groundwater contaminants as kerosene and motor oil, PRC is not aware of any history of storage of these two petroleum products at this location.*

Comment 15: Sect. 3.2.3: According to this section some of the samples were measured for dissolved oxygen (DO) using a Horiba meter and/or Hatch measurement kit. How did the readings compare when using both to measure DO? Were there any major differences between the two that could have affected the results? Please add discussion about the results and the effects of using two different measuring systems.

*Response: PRC did not observe any significant differences in dissolved oxygen concentrations between measurements made with the Horiba meter and those made with the Hach field kits. The text has been revised to indicate the agreement between the two measurement systems.*

Comment 16: Sect. 3.2.4, Par. 5, Last Sent., Pg. 36: Add as s to piezometer so that the phrase reads "one or more piezometers."

*Response: The text has been so revised.*

Comment 17: Sect. 4.3, Par 3, Parentheses after 1st Sent., Pg. 46: Delete. It is not necessary to the report to note that Regenesis paid for the duplicates and triplicates. It is better to state that the duplicates and triplicates were done at the request of Regenesis.

*Response: The text has been revised to delete any mention of financial agreements between PRC and its subcontractors.*

Comment 18: Sect. 5.3, Par. 2, 2nd Sent., Pg 47: The sentence states that historical evidence indicates that only JP-5 was stored in the four bulk oil storage tanks. AVGAS and JP-4 were also stored there. (See Comment 3)

*Response: The text has been revised to more accurately describe historical storage practices at the site.*

Comment 19: Sect. 6.3.1, Par. 1, Last Sent., Pg. 51: What is meant by this statement? Gradient is not the same as velocity. The gradient expresses the rate of inclination or slope. It would have been better to have calculated a velocity for the DO and compare it to groundwater velocity for the same period. The velocity information also would have helped in determining what retardation, if any, there was with respect to the transport of the DO at the site. More work and analysis is needed.

*Response: The word "gradient" was inadvertently used instead of "flow direction." The text has been revised to make this change. Also, a range of values for velocity for dissolved oxygen between the source well (FP5-1) and the first row of monitoring points has been calculated and incorporated into the text. The data indicate dissolved oxygen velocity is retarded, and the retardation approximates a nonlinear function. This conclusion is based on the fact that elevated dissolved oxygen was detected in the first row of monitoring points, but not in the second-row monitoring point (WORC5-8). If retardation was linear, elevated oxygen levels should have been detected at monitoring point WORC5-8. Since elevated oxygen was detected only at one row of monitoring points away from the source, a nonlinear retardation function cannot be developed. (At least three data points are*

*required to estimate a second order or higher function by nonlinear regression.) This discussion has been added to the text.*

Comment 20: Sect. 6.3.1, Par. 2, Pg. 51: Some investigation and calculation should go into determining the amount of retardation at the site. Did the retardation seen at Site 5 fall within the range given in this paragraph? More work is required in this regard.

*Response: As described in the response to comment 19, the text has been revised to discuss retardation of dissolved oxygen transport in groundwater at the site. The range of values for retardation falls within the quoted range from the cited reference.*

Comment 21: Sect. 6.3.1, Par. 4, 5th Sent., Pg. 52: The citation for the Stumm and Morgan (1981) needs to be added to Section 8.0.

*Response: The citation has been added to the reference section.*

Comment 22: Sect. 6.3.1, Par. 4, Pg. 52: The dilution process from infiltration of surface water needs to be more clearly explained

*Response: According to the above-stated reference, dissolved oxygen in infiltrating surface water is consumed by indigenous micro-organisms that reside in the unsaturated zone. Consumption is especially high in the root zone. Data collected at petroleum sites at MFA suggest elevated microbial activity in the contaminated soils. These data would suggest that infiltrating surface water would provide a source of oxygen to the micro-organisms in petroleum-contaminated soil; consumption of this oxygen would lower the dissolved oxygen content of the infiltrating water. As this oxygen-free water enters the saturated zone, it would dilute the dissolved oxygen concentration of the groundwater. The text has been revised to more clearly explain this process.*

Comment 23: Sect. 6.3.2, Par. 1, Last Sent., Pg. 52: The pump and treat system at Site 14 did not aerate the water as part of the treatment as stated in this sentence. Water was pumped directly from the well to GAS [granular activated carbon] filters. No pretreatment was done at Site 14 to reduce calcium carbonate content of the water. The Bldg. 45 system at

Site 9 does use an air stripper which does require pretreatment to prevent the formation of scale. Please correct.

*Response: PRC referring to the recirculating in situ treatment system at Site 14 in the text. Severe calcium carbonate scaling has been observed in the syphoning chamber of that system, and has been detected in the educator tube of the air lift pump. The scaling is severe enough to require regular acid treatment to remove the deposits. At Site 9, pretreatment was required to suppress calcium carbonate scaling in the air stripper. The report has been revised to change this incorrect reference.*

Comment 24: Sect. 6.3.2, Par. 3, Last Sent., Pg. 52: It is noted by reference that most groundwaters are near saturation with respect to calcium carbonate. Was the groundwater at Site 5 analyzed for calcium carbonate to see if that is the case here? If not, why not? Please amplify.

*Response: The author of the referenced text meant that most groundwaters are near saturation with the ionic components of calcium carbonate: calcium cations and one of the three pH-dependent anionic carbon dioxide species (carbonate, bicarbonate, or carbonic acid). Groundwater samples from Site 5 groundwater wells have been analyzed for alkalinity as calcium carbonate, and three samples from oxygen release compound (ORC) monitoring points were analyzed for calcium ion concentration. The averaged value of six alkalinity analyses was 543 milligrams per liter (mg/L), and the averaged value for calcium ion concentration was 114 mg/L. A plot of these averaged values on nomographs in Hem's Study and Interpretation of the Chemistry of Natural Waters (U.S. Geological Survey Water Supply Paper 2254, third edition) indicates that bicarbonate is near saturation with respect to calcium carbonate. Under these conditions, subsequent displacement of dissolved carbon dioxide with dissolved oxygen would raise the pH, and carbonate ions would bond with calcium ions to form solid-phase calcium carbonate. The conclusion is supported by observations at Site 9 and Site 14 treatment systems*

Comment 25 Sect. 6.3.2, Par. 4, Pg. 53: Was the site sampled for calcium precipitation? Was any evidence of precipitation noted during the installation of the monitoring points? What does the formation of calcium carbonate precipitation mean for this study? Please add additional discussion.

*Response: Groundwater samples from Site 5 monitoring wells have been analyzed for carbonate species as calcium carbonate, and soils were analyzed for calcium. However, no soil samples were analyzed for mineral species, and no precipitation that happened to form during sample collection was analyzed for mineral identification. Furthermore, calcium carbonate as calcite was not observed during monitoring point installation. However, as the technical memorandum states, calcium carbonate precipitation occurs when dissolved oxygen concentrations are increased in groundwater at petroleum sites at Moffett Federal Airfield (MFA). This precipitation could reduce the effective permeability of the sand pack and sediments that surround the ORC source well, and reduce the rate at which the elevated dissolved oxygen advectively migrates and disperses from the source well. This discussion has been added to the text.*

Comment 26: Sect. 7.0, Pg. 57: The title of this section should be "Conclusions and Recommendations." Add some conclusions to this report. Was the testing successful? What did the data tell us about the site? What additional work is needed?

*Response: PRC believes the treatability study was successful. The test indicated that the technology would not be an economical alternative to reduce petroleum contamination in groundwater at Site 5. As stated in the text, the measured extractable-phase total petroleum hydrocarbon (TPD-e) concentrations changed during the study period, but no clear trends developed. Analytical chromatograms indicated the fuel has undergone substantial degradation in the subsurface, but addition of dissolved oxygen does not appear to have stimulated additional biodegradation.*

*The test also provided site-specific groundwater velocity data. These data can be used to estimate or model future transport of petroleum contamination at the site. If required as part of the corrective action plan. The data can also be used, in a qualitative sense, for contaminant transport evaluations at other MFA sites.*

Comment 27: Sect. 7.0, Pg. 58: Delete paragraphs 2 through 5. These paragraphs are not relevant to this report. The purpose of the report was to report on the results of a treatability study of using ORC to increase DO in groundwater to promote increased bioremediation of petroleum. It was not written to provide recommendations as to how to address the contamination found at Site 5 or whether or not the new petroleum guidance will be

applied to this site. That discussion is more appropriately handled in a feasibility study\correction action plan.

*Response: PRC incorporated this discussion into the recommendations section because the regulatory community historically has requested indications of intended actions in technical memoranda. PRC has added a new paragraph to the section. The new paragraph discusses additional work to be completed for the site, in light of the new petroleum guidance presented by the state regulatory agency. Some discussion regarding remedial alternatives will be retained in the technical memorandum since it provides guidance for corrective actions at the site. PRC initiated the groundwater treatability study as part of a corrective action. Therefore, it believes discussion regarding application of the state guidance to Site 5 should be part of the discussion regarding application of a technology to the site.*