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MCAS EL TORO
SSIC NO. 5090.3.A

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132-5190

IN REPLY REFER TO:

5090
Ser 06CC.MS/0981
September 21, 2004

Mr. John Broderick
Remedial Project Manager
California Regional Water Quality Control Board
3737 Main Street, Suite 500
Riverside, CA 92501-3339

Mr. John Broderick:

Subj: DELIVERY OF RESPONSE TO COMMENTS ON THE DRAFT SITE ASSESSMENT REPORT, IRP SITE 16, FORMER MARINE CORPS AIR STATION (MCAS) EL TORO, CALIFORNIA

Submitted for your review is the response to comments for the Draft Site Assessment Report for IRP Site 16, Former MCAS El Toro, California. The response to comments address the modeling, proposed soil-vapor extraction (SVE) implementation, and data gaps from the site assessment. The responses were prepared by the SVE contractor and include additional details for the conceptual SVE well placement design. The response to comments also includes the proposed text changes and revised tables and figures for the Site Assessment Report. Once the response to comments are acceptable, the Final Site Assessment Report for Site 16 will be issued. Subsequently, an SVE Work Plan will be prepared to provide the specifics for system operation and well placement design. Operation of the SVE system is anticipated to begin in Spring 2005.

Please review the response to comments and attachments and provide any comments by Monday, October 25, 2004. Should you have questions or need additional information, please contact Mr. Marc P. Smits, the Site 16 Remedial Project Manager (619 532-0793).

Sincerely,

F. ANDREW PISZKIN
Base Realignment and Closure
Environmental Coordinator
By direction of the Commander

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Enclosure: (1) Response to Comments on the Draft Site Assessment Report, IRP Site 16, Former Marine Corps Air Station El Toro, California, September 2004.

Copy to:
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September 21, 2004

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Writer: Marc P. Smits, Marine Corps BRAC Team, x 2-0793.
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Comment No.	Section/Page Number	Comment	Response
Specific Comments from John Broderick, SLIC/DoD Section, California Regional Water Quality Control Board, Santa Ana Region, dated June 7, 2004			
1.	**Section 6.5 Target Levels, Pages 6-2 & 6-3:**	The proposed method for calculating target levels involves risk exposure factors. The risk based cleanup approach for Installation Restoration Site 16 has been evaluated under the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) and the Department of Defense installation Restoration Program. The majority of the petroleum contamination at Site 16 is not a CERCLA contaminant. At petroleum release sites, our approach is normally based on the protection of designated beneficial uses and groundwater quality. Releases are evaluated and cleanup goals are based on the threat to, or potential threat to, water quality. We do not accept as appropriate the approach that you have outlined to determine target cleanup levels. Therefore, we do not accept as appropriate the proposed target soil cleanup levels for Site 16. Additionally, we do not accept their use as screening levels or cleanup goals at this petroleum product release site. Please remove this discussion from the document, If you wish to discuss cleanup goals, replace this section with a discussion of soil cleanup goals for gasoline, diesel and other applicable fuel related compounds based on the protection of beneficial uses and the water quality of this groundwater basin. Cleanup goals are normally proposed in a corrective action plan.	Comment acknowledged. The model is presented as a means of an evaluation of the potential contribution from the identified residual TPH in the vadose zone soil to groundwater quality. Sections 6.5, 6.6, and 6.7 have been revised to remove discussion related to target levels. Revised pages are included as Attachment 1 of this response to comments document.
2.	**Section 6.7 Discussion of Model Results, Page 6-4;**	Again, we will not accept a human health exposure scenario for evaluating the significance of contamination at a petroleum fuel release site. It should be noted that your model predicts that there will be adverse impacts to groundwater quality as a result of this petroleum release. Based on our review of the parameters utilized In running the model, we believe that the modeling likely understates those predicted impacts to groundwater quality. This finding is sufficient to support the necessity for corrective action at this site.	Comment acknowledged. The Navy agrees that the model indicates the need for corrective action.

Comment No.	Section/Page Number	Comment	Response
Specific Comments from John Broderick, SLIC/DoD Section, California Regional Water Quality Control Board, Santa Ana Region, dated June 7, 2004			
3.	**Section 6.7 Discussion of Model Results, Evaluation of Results. Page 6-5, Second paragraph:**	Your report recommends limiting the application of soil vapor extraction (SVE) to a few "local hotspots" based on the modeling and application of proposed target levels. We do not concur with this recommendation of limiting the application of SVE to a few hotspots. Your report recognizes, within the limited areas targeted for SVE, that the predicted magnitude of the impact to water quality depends on the percentage of the total petroleum hydrocarbon mass removed. Therefore, we would not concur with a limited approach to application of SVE in a corrective action plan for this site. If the proposed remedy for this petroleum release is SVE, then it should be efficiently Implemented to reduce the maximum available mass of petroleum fuel and related compounds.	Comment acknowledged. The text on page 6-5 has been revised to state full-scale SVE system. The original intention was to implement full-scale remediation in the main pit, and hot-spot remediation in the hand held pit and any adjacent areas not connected to the main pit. In section 7, the report recommends 3 SVE extraction wells centered in the modeled VLEACH polygons predicted to contribute the most mass to groundwater. Section 7 also recommends pilot testing. The area of interest is small (~ 200 ft by 180 ft) and following pilot testing and determination of the radius of influence (ROI), the optimum use of SVE would be evaluated to determine if additional SVE wells are necessary to remediate the area. A copy of the revised page is included in Attachment 2.
4.	**Section 7.0 Discussion and Recommendations, Recommendations. Page 7-2, first and second paragraphs:**	We disagree that sufficient Information has been collected to narrow the implementation of a SVE system. This discussion centers on use of the proposed target levels and modeling results to support a recommendation on limiting the application of a remedy, As we have discussed in previous comments listed above, your proposed strategy is based on factors we do agree with. When designing a remedy and drafting the corrective action plan, information specific to the remedy is usually collected and justified. You indicate an awareness of this approach in the text of your third paragraph of this Recommendations section, Additionally, data gaps in the characterization should be clearly identified, recognizing the need for additional sampling, and allowing you to complete a baseline characterization appropriate for the selected remedy.	Comment acknowledged. The Navy agrees with the necessity of corrective action at IRP Site 16. The recommended next step is pilot testing of a SVE system at IRP Site 16. Additional monitoring points, necessary for radius of influence testing, would suffice to complete delineation. Implementation of this remedy would be a phased approach first testing the application radius of influence for each vertical interval. The number and spacing of the SVE wells would be derived from this test. Implementation of the SVE pilot test should be conducted to prevent residual TPH impacts to groundwater quality.

Comment No.	Section/Page Number	Comment	Response
General Comments from, Nicole Moutoux, Project Manager, U.S. Environmental Protection Agency, Region IX, dated May 13, 2004			
1.		The Discussion and Recommendations section recommends use of SVE to remove remaining TPH and TCE contamination but there is no discussion of next steps. Please provide a discussion of how these recommendations will be followed up on for both TPH and TCE contamination.	Comment acknowledged. Text has been revised to recommend that subsequent steps include: ▪ Borings and installation of a minimum of three multiple screened SVE test wells (EW) and at least four vadose zone nested monitoring points (MPs). These may be FLUTe technology or standard nested technology. ▪ Pilot testing of SVE wells and measurement of pressure field and vapor concentration using MP wells. ▪ Evaluate results and apply to full-scale system, which may or may not require additional SVE wells and MPs. A copy of the revised text for page 7-2 is included here in as Attachment 3.
2.		There is no figure for TPHd in soil at depths of 0-20 feet below ground surface (bgs), which would be the interval most useful for depicting the contamination at the hand-held fire-training pit as well as the down gradient northwestern edge of the main pit plume. Please provide a figure for shallow soil, especially since TPH at IRP16-CB-01 and IRP16-CB-02 is high.	Comment acknowledged. A new Figure showing the distribution TPHd and in the shallow soil (5 to 10 feet depth) has been prepared. A copy of the new map is included here in as Attachment 4
3.		Appendix B, Figure 1-2 is a reproduction of a 1980 aerial photograph that shows that the impacted area extends beyond the three pits in Units 1 and 2. This extended area to the southwest was included in the sampling for this investigation. However, it appears that there may be a "finger" of impacted ground that extends to the southeast off of the southwest extension that was not included in sampling. As this is a poor reproduction, this "finger" may be a result of the quality of the figure. Please include an explanation why sampling was not considered necessary in this area.	Comment acknowledged. The black and white Figure 1-2 in Appendix B is a poor reproduction of the 1980 aerial photograph. The extended area to the southwest was included for sampling based on the review of the historical data. The results from several soil-sampling locations (IRP 16-CB-16, IRP16-CB-17 and IRP16-CB-18) confirmed no TPH impact in this area.

Comment No.	Section/Page Number	Comment	Response
General Comments from, Nicole Moutoux, Project Manager, U.S. Environmental Protection Agency, Region IX, dated May 13, 2004			
4.		Unit 3 is the drainage ditch for Units 1 and 2, and yet the impacted ground described in comment #3 appears in the aerial photograph to be associated with drainage outside of Unit 3. Please clarify how the ground outside of the fire-fighting pits and drainage ditch was impacted by fire-fighting activities.	Please see above response to comment number 3.
5.		One of the primary objectives of this assessment was to completely delineate the vertical and lateral extent of TPH in the vadose zone (see first bullet on page 1-3). This does not appear to have been achieved in this report. Please discuss how this remaining data gap will be addressed.	Comment acknowledged. The objective of the assessment was to delineate the area to support further action, if necessary. The area of interest is 200X180 feet and the main impacted area is less than 100X100 feet. There are approximately 39 borings in the total area, with data collection locations in the central area approximately 20 feet apart. Evaluation of the data collected so far indicates that groundwater will potentially be impacted by TPH over time. The SAR indicates that residual soil TPH impacts are limited in depth, albeit appear to be in the process of moving down. VOC impacts, extending to groundwater, were delineated as part of CERCLA work. Sufficient information has been collected during the site assessment and previous investigations to progress to the next step of SVE pilot test. Additional refinement of the delineation of TPH contamination can be completed during implementation of the pilot test. Additional monitoring points, necessary for radius of influence testing, would suffice to complete delineation. Once information has been collected from the pilot testing and monitoring, a full-scale SVE system can be implemented.
Specific Comments from, Nicole Moutoux, Project Manager, U.S. Environmental Protection Agency, Region IX, dated May 13, 2004			
1.	**Section 5.1, Site Geology, Page 5-1;**	This section includes a written description of the general site stratigraphy rather than providing a visual representation of the stratigraphy, As there are lithologic data for the borings, it would be helpful to have that data mapped to assess the potential for vertical and horizontal migration of TPH and VOCs, Please provide a stratigraphic cross-section.	Comment acknowledged. The existing cross section with stratigraphic information has been revised to include more detailed information and included here in as Attachment 5.

Comment No.	Section/Page Number	Comment	Response
Specific Comments from, Nicole Moutoux, Project Manager, U.S. Environmental Protection Agency, Region IX, dated May 13, 2004			
2.	**Section 5.1) Site Geology, Page 5-1:**	There is a finer grained unit at 80 to 100 feet bgs that the text states impedes vertical migration of contaminants. The presence of a TPHd concentration of 4800 mg/kg and a TPHg concentration of 5,100 mg/kg at about 110' bgs at boring IRP16_CB11 contradicts the above statement; the higher values from samples taken at shallower depths within the same boring could represent the general trend from high concentrations at the surface release area to lower concentrations at depth due to dispersion. Other borings do not have elevated TPH concentrations below this fine grained unit, and thus it may be that the unit impedes downward migration but not consistently. A stratigraphic representation of the area would aid in determining the downward mobility of the contaminants. The permeability and continuity of this fine-grained layer (and others) will be important in determining the feasibility of remedial options. Please address this by providing a visual stratigraphic representation and discussing possible reasons for the difference in downward migration.	Comment acknowledged. This response to comment is related to response to specific comment number 1, in that the cross section has been drawn to clearly identify the fine-grained stratigraphic units. The fine-grained stratigraphic unit is probably the result of lower energy depositional system with a source of fine-grained particles. The unit would be somewhat heterogeneous over short distances, and it may occur locally at a little higher or lower elevation. This would explain why there was a relatively high TPH concentration at 110' at boring IRP16-CB11. On the other hand, It should also be noted that the next 3 samples at 120, 130, and 140 feet depth were non-detect, still indicating limited infiltration in the soils above 120 feet. The overall statement is still accurate that the TPHd impact is limited in depth and reflects retardation by the fine-grained zone.
3.	**Section 5.2, Petroleum Hydrocarbons, Page 5-2;**	Both TPHd and TPHg data are posted on Figures 8 through 12, but only TPHd is contoured. Please explain the lack of TPHg data and contours.	Comment acknowledged. TPHg detections are generally limited to boring IRP16-CB-11 and almost non detect in most of the borings. Therefore TPHg data were not contoured. However, the concentrations for TPH-g for each of the borings are shown in the cross sections in Attachment 5.
4.	**Section 5.3, Volatile Organic Compounds, Page 5-3**	There are two different residential PRGs listed for TCE in this section: 53 µg/kg in paragraph 1 and 52 µg/kg in paragraph 2. Please correct this error.	Comment acknowledged. The error has been corrected and revised page is included in Attachment 6.

Comment No.	Section/Page Number	Comment	Response
Specific Comments from, Nicole Moutoux, Project Manager, U.S. Environmental Protection Agency, Region IX, dated May 13, 2004			
5.	**Section 5.4) Discussion, Page 5-4:**	The text suggests that there is either an increase in TPH concentration with depth or the site assessment boring was located in a zone of higher concentration for this assessment, but that either way, the extent of TPH analytes is sufficiently defined to evaluate potential impacts to groundwater. If the differences in TPH concentration between past investigations and the current assessment are due to downward migration, the contamination problem could be much greater than simply a different screened interval. Please provide more explanation for why TPH contamination is sufficiently defined.	Comment acknowledged. TPH concentrations are laterally defined to the extent that they will be "seen" by a remediation system. Vertical delineation is a time relative definition, as vertical migration does not stop, although it appears to slow when infiltrating a fine-grained interval. SVE remediation if applied to the site, with sufficient ROI and vertical extent, will remediate these constituents regardless of variation in concentration. Based on the site conditions and the successful implementation of SVE technology for clean up of TPH contamination at other locations within former MCAS El Toro, SVE is recommended with the installation of soil vapor monitoring points to cleanup residual TPH contamination in the vadose zone soil.
6.	**Section 5.4, Discussion, Page 5-4**	It is stated that VOCs at low concentrations are more widely distributed than TPH, but that they are likely still entrained together, as the detection limit is much lower for VOCs. Rather than simply providing numbers of samples that apparently have similar TPH and VOC contamination problems it would be very helpful to have a visual representation of the delineation of the VOC contamination to compare to the extent of the TPH plumes. Please consider providing this figure for comparison.	Comment acknowledged. The existing cross section with stratigraphic information has been revised to include more detailed information such as VOC distributions. The changes to the cross sections are included in Attachment 5.

Comment No.	Section/Page Number	Comment	Response
Specific Comments from, Nicole Moutoux, Project Manager, U.S. Environmental Protection Agency, Region IX, dated May 13, 2004			
7.	**Section 7.0, Discussion and Recommendations, Page 7-2**	Again, the last paragraph discusses the need for three or four separate screened intervals in nested or clustered wells to remediate soil gas because of differences in permeability. It would be helpful to have a stratigraphic cross-section to refer to.	Comment acknowledged. A drawing showing conceptual construction or distribution of wells has been prepared and included in Attachment 7.
8.	**Figure 4 TPH in Soil**	There appear to be two wells on the downgradient edge of the main pit TPH plume that have high surface soil concentrations of TPH and have no wells further down gradient with which to confirm non-detect concentrations. At 5 feet bgs, IRP16-CB-01 has a TPHd concentration of 18,000 mg/kg, while IRP16-CB-02 has a TPHd concentration of 13,000 mg/kg and a TPHg concentration of 9900 mg/kg. Figure 5, Detected VOC Analytes in Soil, indicates that concentrations of TCE are also elevated, at concentrations of 1,400 µg/kg and 2,700 µg/kg at 5 and 10 feet bgs respectively, at IRP16-CB-02. It does not seem like the extent of either TPH or TCE contamination at the northwestern edge of Unit I are adequately characterized at this point. It is possible that these contaminants are present further northwest at concentrations of concern, both at the surface and subsurface. Please address this concern, including whether the proposed locations for SVE wells will include these two locations within the Radius of Influence.	Comment acknowledged. Borings IRP16-CB-09 and -17, which are essentially non-detect, define the western and north western boundary. IRP-CB-01 has a high concentration of TPHd at the 5 feet depth, but is non-detect at 10 feet depth. The two locations would be within the radius of influence, or sufficient additional SVE wells without short-circuiting would be added to ensure that residuals within those soil columns would be influenced.

Comment No.	Section/Page Number	Comment	Response
Specific Comments from, Nicole Moutoux, Project Manager, U.S. Environmental Protection Agency, Region IX, dated May 13, 2004			
9.	**Figure 5,**	Detected VOC Analytes in Soil, and Table 2, Summary of Analytical Results for Soil Samples Collected July 2003: There are some sample locations with very high non-detect values for VOCs, ex. IRP16-CB-11, IRP16-CB-13, and IRP16-CB-02, and there does not appear to be any explanation for this in the main text or appendices. Please provide an explanation for this high non-detects.	Comment acknowledged. VOC concentrations of detected analytes in the impacted soil samples were very high, already indicating sufficient impacts to ensure remediation. The analytes with high detection limits were an artifact of this detection and do not change the overall outcome. The laboratory reporting limits (RL) for these samples was higher (260 ug/l) than the actual method detection limit (MDL) of 100 ug/l. In the case of unimpacted soil samples, all detection limits were low, and confidently indicate the limit of impacts in that boring. The VOC analytical data has been provided to the CERCLA contractor for further evaluation.
10.	**Figure 7, Cross-Section B-B\ TPH in Soil:**	Boring 16AB213 ends at a total depth of 60' bgs and TPH concentrations of 7,040 mg/kg (TPHd) and 4,690 mg/kg (TPHg). Thus, the extent of vertical contamination at this boring log is incomplete. Please explain how the non-detect isocontour was drawn around this boring, and how this data gap will be addressed.	Comment acknowledged. The adjacent boring 16B205 (~ 24' distant) has an even greater concentration at 60' depth of 28,000 mg/kg; however, at 80' depth analysis did not detect the presence of TPH constituents. The contour was drawn reflecting the nearest control point.

Comment No.	Section/Page Number	Comment	Response
Specific Comments from, Nicole Moutoux, Project Manager, U.S. Environmental Protection Agency, Region IX, dated May 13, 2004			
11.	**Page 6-5**	Contains a couple of editorial errors. The first paragraph in the Evaluation of Results section uses the word "effecting" when it should be "affecting". The fourth bullet in this same section uses the word "acceptor" twice rather than "receptor".	Comment acknowledged. Text has been revised and corrected page 6-5 is included in Attachment 1.
12.	**Figure 3**	Sample Location Map: There is a symbol used frequently on this figure and others that is not defined in the legend. Please check to make sure that all symbols used in a figure are defined in the legend.	Comment acknowledged. Figure 3 was checked and all the symbols used in figure are defined in the legend.
13.	**Figure 3, Sample Location Map**	There are two boundaries drawn around the main pit, Please explain.	Comment acknowledged. The boundaries represent the inner and outer margins of the burn pit berm. The pits have been shown that way since the earliest reports, and this was continued only for continuity of the representation of the main pit.

Comment No.	Section/Page Number	Comment	Response
Specific Comments from, Tayseer Mahmoud, Senior Hazardous Substance Engineer, Department of Toxic Substance Control, dated May 14, 2004			
1.		DTSC concurs with the proposed SVE remedy for the site; however, the SVE should not be limited to the contaminant mass between 20 and 100 feet bgs. Please note that TCE has transited the entire vadose zone, reaching groundwater. The soils between 110 and 160 fest bgs almost certainly contain residual TCE and should also be subject to SVE remediation. This will help protect groundwater from further degradation, and will probably greatly enhance the monitored natural attenuation groundwater remedy proposed for the site. For additional comments on the document, please see the enclosed comments prepared by Mr. Dave Murchison, from our Geological Services Unit.	Comment acknowledged. The purpose of this report is to describe TPH impacts. Previous investigations, listed and referenced in the SAR delineate VOC impacts. Existing MPE wells may be incorporated into the design of the SVE remediation, if necessary. Also, depending on the vertical and lateral placement of these wells, additional SVE wells or screened intervals could be added. Data needed could be collected during pressure field-testing that includes not only lateral but also vertical extent of influence from extraction in any given interval.

Comment No.	Section/Page Number	Comment	Response
General Comments from, Dave Murchison, R.G., Engineering Geologist, Department of Toxic Substance Control, dated May 14, 2004			
1.		GSU has some concerns that the amount of data available to the Contractor was sufficient to run a valid VLEACH model. The data does not rule out TPH or VOC contamination in soil extending all the way to groundwater, since the number of deep borings is limited. VOC contamination has reached groundwater, and so the modeling is of limited value in planning remediation. In addition, the VLEACH model is based on a precipitation-driven infiltration model, which may not be well suited to the dry Mediterranean climate of-El Toro. Since the conclusions and recommendations of the Report indicate further action will be taken with respect to soil, GSU regards this comment as Informational, and does not request changes to the Report on this basis.	Comment acknowledged.
2.		GSU concurs that soil vapor extraction (SVE) is probably a suitable remedial alternative for this site.	Comment acknowledged.
3.		GSU does not concur that SVE should be limited to the contaminant mass between 20 and 100 feet bgs. GSU notes that TCE has transited the entire vadose zone, reaching groundwater. The soils between 110 and 160 feet bgs almost certainly contain residual TCE and should also be subject to SVE remediation. This will help protect groundwater from further degradation, and will probably greatly enhance the monitored natural attenuation groundwater remedy proposed in other submittals.	Comment acknowledged. The scope of this site assessment was focused on the residual petroleum hydrocarbons (i.e. TPH), with VOC data collected to be submitted to the CERCLA contractor. In earlier investigations, VOC constituents (e.g. TCE) were delineated and a pilot test using MPE system was implemented. The current conceptual SVE system could be extended in depth to overlap the existing MPE system, providing a bulk approach. A vapor treatment system would be designed to treat all constituents extracted in the vapor phase.

Comment No.	Section/Page Number	Comment	Response
Specific Comments from, Dave Murchison, R.G., Engineering Geologist, Department of Toxic Substance Control, dated May 14, 2004			
1.	**Figures 6 and 7, Cross-sections A-A' and B-B'.**	There is an apparent error in the depth scales on these figures. The deepest depth should probably be 140' rather than 40'.	Comment acknowledged. Revised Figures 6 and 7 are included in Attachment 5.

Attachment 1

Revised Sections 6.5, 6.6 and ~~6.7~~ Table 7

6.0 Vadose Zone Modeling

The VLEACH modeling results for the TPHg and TPHd surrogates indicate that residual petroleum hydrocarbon in the vadose zone at IRP Site 16 will impact groundwater quality. The modeled surrogates and surrogate concentrations are based on TPHg and TPHd analytes concentrations detected in the vadose zone during the site assessment and previous investigations. The model evaluated potential impacts to groundwater quality for a 100-year period at the site. The model indicates impacts to groundwater quality.

The modeling report and model output is enclosed in Appendix H. The following sections provide a description of the model set up and results.

6.1 VLEACH Model

VLEACH is a finite difference computational model from the EPA. It is widely used to calculate potential impacts to groundwater quality from residual contaminants in the vadose zone. The latest VLEACH Version 2.2a (released by the EPA Kerr Environmental Research Laboratory in June 1996) was used in this modeling work.

VLEACH describes mass transfers of an organic contaminant among three phases: vapor, liquid, and solid (sorbed) phases. The equilibrium distribution among the three phases is described in terms of the Henry's Law constant and soil distribution coefficient. VLEACH simulates vertical transport by advection in the liquid phase and by gaseous diffusion in the vapor phase.

For each simulation, a user defines one or several soil columns (or polygons) and selects input parameters, which describe soil properties, physical and chemical properties of the contaminant, and the initial contaminant concentration on the soil columns. After each simulation run, the output files from VLEACH provide information regarding the contaminant mass-loading to the groundwater, contaminant concentration distribution on the soil profile, and contaminant mass transfers among the three phases versus simulation time. By combining the contaminant mass-loading to the groundwater with aquifer thickness and groundwater flow velocity, the user can further calculate the contaminant concentration in the groundwater below the site.

6.2 Surrogates

VLEACH can only treat a single chemical in each model. TPHg and TPHd are both mixtures that contain several dozen chemicals each. It is not possible to design a model to simulate a mixture, instead, a few chemical surrogates are chosen to represent each mixture (i.e., TPHd and TPHg) and be evaluated by the model. The surrogate component modeling results are used to predict the impacts from residual TPHg and TPHd mixtures in the vadose zone upon groundwater quality.

TPHg and TPHd are represented in this model by ten separate surrogates (Utah Department of Environmental Quality, 2001). These 10 surrogates and their chemical and physical parameters used in VLEACH modeling are listed in Table 5. For each model run, 100 percent of the TPHd or TPHg concentrations are first assigned to each individual surrogate, the VLEACH model is run and the mass-loading rate is obtained from the model output. This mass-loading rate was then corrected for each individual surrogate fraction in the TPH. This approach was justified because of the linearity of the advection-dispersion transport equation with respect to concentration.

6.3 Model Polygons

Twelve model polygons, shown in Figure 13 were drawn with regard to areas of TPH impacts shown in Figures 6 through 10. Each polygon/cell encompasses an area with similar isoconcentration lines. Concentrations for cells within Polygons 1a, 1b, 1c, 1d, 1e, 4, 6, 7, and 8 used a sample boring located within the cell area as a reference, Table 5. Concentrations for cells within Polygons 2, 3, and 5 were estimated from the iso-concentration maps.

6.4 Input Parameters

VLEACH modeling requires soil parameters as input, for example, soil density, moisture content, organic carbon fraction, unsaturated soil column thickness, contaminant concentration distribution on soil column, and recharge rate. To calculate contaminant mass mixing in groundwater, several aquifer parameters are also needed, such as, aquifer thickness and mixing depth, and Darcy velocity. Soil parameters soil density, moisture, fractional organic content were measured from soil samples collected during site assessment activities. These laboratory results are presented in Appendix E. Other parameters were obtained from nearby sites at the former Station or were estimated. Those soil parameters are summarized in Table 7.

6.5 Model Setup

The contaminated soil volume at IRP Site 16 was divided into 12 polygons based on the distribution of TPH concentrations detected in the borings and interpreted in the isoconcentration maps. The polygons are shown in Figure 13. A representative soil boring was chosen for Polygons 1A, 1B, 1C, 1D, 1E, 4, 6, 7, and 8, see Table 6. The TPHd and TPHg concentrations detected in samples from that soil boring were used as the initial soil concentrations in that soil polygon in the VLEACH model. If the boring did not extend sufficiently deep, then composite soil columns were constructed for those intervals. For Polygons 2, 3, and 5, composite soil columns were made based on interpreted TPH concentration contours at 20, 40, 60, 80, 100, and 120 feet below ground surface, and used as the input data in the VLEACH models.

Each TPHd and TPHg surrogate was initially assigned a concentration value equal to 100 percent of soil TPHd or TPHg concentrations. Based on the three-phase partition model, the calculated liquid phase concentrations for some surrogates in the soil column were higher than their solubility in water. In these cases, we used increased solubilities in the models to satisfy that requirement of VLEACH. These increasing factors varied among the surrogates, and they ranged from 2 to 32,000.

Each model simulation was designed to provide a prediction of contribution to groundwater quality for a period 100-years. Natural degradation was not accounted for in the model. Natural degradation of residual concentrations in the vadose zone will occur over time and consequently will reduce the estimated impacted reported here.

The VLEACH model was run and the output provided the surrogate mass-loading rate to the groundwater in gallons per year. The mass-loading rates from all 12 polygons were added together to get the total mass-loading rate from the whole contaminated soil volumes in the site.

A volumetric fraction correction was then made for each surrogate according to its fraction in the TPHd or TPHg based on information presented in *Comparison of Petroleum Mixtures, Total Petroleum Hydrocarbons Criteria Working Group Series, Volume 2* (Potter, 1998). Combining the fraction-corrected total mass-loading rate and the aquifer parameters, we then calculated each surrogate's concentration in the groundwater with the Summers mixing model (EPA, 1989).

Model results are summarized in Table 7. A description of the model and model output are enclosed in Appendix H.

6.6 Discussion of Model Results

Among the 12 polygons used in the model, 4 Polygons - 1A, 1D, 1E and 2 contribute the predominant TPH mass loading to the groundwater. Using TPHg surrogate C5-C6 aliphatics hexane as an example, these four polygons contribute almost 96 percent of the total mass-loading.

Evaluation of Results

The VLEACH model constructed here is very conservative in that several factors assumed or used by the model lead to an overestimation of potential contribution from the residual petroleum hydrocarbons in the vadose zone. These factors affecting the estimation of the contribution from the vadose zone were described in the preceding sections and are summarized as follows:

- Natural degradation was not accounted for in the model. Natural degradation would certainly reduce the TPH concentrations in groundwater; however, no estimate was available for use in the model.
- Solubility numbers greater than actual solubility were used in the model, which will result in higher leachate concentration from the vadose zone than would occur.

- Initial surrogate constituent concentrations for each part of the modeled mixture were assumed to be equal to the total concentration of the mixture. This would also result in an overestimation of the contribution; however, a fractional correction was made that should correct for this problem.

Areas in model cells 1A, 1D, 1E, and 2 contribute approximately 96 percent of the mass impacting groundwater quality. To lower the potential for TPHd and TPHg to impact groundwater quality, we suggest that a full-scale SVE system be considered to reduce TPH mass centered in Polygons – 1A, 1D, 1E, 2, 7 & 8 areas. Based on the review of the pilot SVE system radius of influence data, addition SVE wells may be necessary to remediate residual mass of TPH at IRP Site 16.

Table 7
VLEACH Model Results, Predicted Petroleum Hydrocarbon Impacts on Groundwater Quality
IRP Site 16, Former MCAS, El Toro, California

Chemicals	CELL 1A	CELL 1B	CELL 1C	CELL 1D	CELL 1E	CELL 2	CELL 3	CELL 4	CELL 5	CELL 6	CELL 7	CELL 8	Total Mass Loading	Volume fraction in TPH	Concen. in GW
	Area (sq. ft) 250.0	Area (sq. ft) 406.9	Area (sq. ft) 816.2	Area (sq. ft) 680.5	Area (sq. ft) 667.7	Area (sq. ft) 1174.8	Area (sq. ft) 1094.7	Area (sq. ft) 482.4	Area (sq. ft) 118.9	Area (sq. ft) 232.5	Area (sq. ft) 338.9	Area (sq. ft) 380.3			
	M1A	M1B	M1C	M1D	M1E	M2	M3	M4	M5	M6	M7	M8	(g/year)		(mg/L)
TPH-g: C9-C10 aliphatics, nonane	435.0	0	1.06E-02	155.0	36.7	12.4	1.30	0	15.8	0	0	19.6	2.64E+05	0.02	2.4
TPH-g: C5-C6 aliphatics, hexane	**1547.2**	**0**	**3.84E-02**	**563.01**	**130.74**	**44.4**	**4.71**	**0**	**57.4**	**0**	**0**	**70.3**	**9.48E+05**	**0.063**	**27.3**
TPH-g: C7-C8 aliphatics, hexane	**983.5**	**0**	**2.39E-02**	**353.28**	**83.562**	**28.2**	**2.96**	**0**	**36.3**	**0**	**0**	**44.7**	**6.00E+05**	**0.02**	**5.5**
TPH-g: C9-C10 alkyl benzene, (Methylnaphthalene)	42.97	0	1.02E-03	15.623	3.2171	1.3	0.13	0	1.5	0	0	1.8	2.60E+04	0.12	1.4
TPH-d: C11-C12, C13-C16 aliphatics, nonane	**68.1**	**46.4**	**30.93**	**39.821**	**12.259**	**1.8**	**1.44**	**9.1**	**1.5**	**0**	**0.58**	**2.95**	**1.06E+05**	**0.4**	**19.4**
TPH-d: C11-C13, alkyl naphthalenes (methylnaphthalene)	2.81E-04	5.29E-08	1.70E-12	7.63E-10	1.53E-11	3.82E-11	7.64E-12	7.69E-12	1.46E-08	0	1.19E-18	1.89E-17	7.03E-02	1.0	3.2E-05
TPH-d: C17-C21, C22-C35 aliphatic eicosane	2.71E-07	9.40E-15	2.40E-21	2.58E-17	5.16E-19	1.29E-18	2.58E-19	2.58E-19	1.45E-14	0	3.68E-29	5.96E-28	6.78E-05	1.0	3.1E-08
TPH-d: C12-C22, PAHs pyrene	2.92E-04	1.45E-08	1.04E-13	1.31E-10	2.62E-12	6.54E-12	1.31E-12	1.31E-12	6.18E-09	0	1.71E-20	2.74E-19	7.30E-02	1.0	3.3E-05

Notes:

1. M - mass loading per square feet (g/year/ft2) in each CELL based on VLEACH modeling

2. A - cross sectional area (square feet) of each CELL

3. Total mass loading = summation of M x A from all CELLs (g/year)

4. Volume fraction - TPH fractional percentage in the carbon range represented by the surrogate

5. Concentration in GW - the specified surrogate concentration in groundwater

6. Target - Bench mark to compare with; two target levels with exposure time at 70 or 10 years, respectively; see section 5.6 for details

7. The rest three of TPH-d surrogates gave very low mass loading values(3.0E-27 or less), and they will not cause any detectable impact to groundwater

8. In calculation of the concentration in groundwater, the following parameters are used
transmissivity T = 0.035 sq. ft/minute = 18396 sq. ft/year; hydraulic gradient i = 0.007
width of soil columns in the direction perpendicular to groundwater flow: a = 600 ft.

Attachment 2
Revised Section 6.7 & Page 6-5

ATTACHMENT 2

REVISED SECTION 6.7 AND PAGE 6-5

THIS ATTACHMENT WAS NOT RECEIVED IN THE RESTORATION RECORD FILE.

FOR ADDITIONAL INFORMATION, CONTACT:

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Attachment 3
Revised Section 7.0 & Page 7-2

7.0 Discussion and Recommendations

The site assessment advanced and sampled 12 shallow borings and 6 deep borings at IRP Site 16. A total of 79 soil samples were analyzed for TPHd, TPHg, and VOCs to evaluate the presence of petroleum hydrocarbons and VOCs in the vadose zone soils. Evaluation of the site assessment data and previous investigation data collected at IRP Site 16 indicates that petroleum hydrocarbons released during fire-training facility operations are concentrated in the vadose zone around the main fire-training pit and the area to the west of the pit. Other less significant releases of petroleum hydrocarbons were detected around the hand-held fire-training pit. The TPH constituents were found to extend in relatively high concentrations from the surface to a depth of 110 feet. Less significant impacts were detected to approximately a depth of 130 feet. TPHd and TPHg were delineated laterally and vertically sufficient to evaluate the site.

Groundwater is at approximately a depth of 160-feet at the IRP Site 16.

VOC data collected during the investigation suggests that some VOC constituents, particularly TCE, appear to be entrained with the residual petroleum hydrocarbons in at least 50 percent of the occurrences. Other lines of evidence include that the mapped distribution of TPH and VOCs are concentric and mirror one another's distribution in the subsurface at IRP Site 16. These data have been submitted to the remedial design contractor and will be used in the development of the Remedial Design for IRP Site 16.

VLEACH modeling of the residual petroleum hydrocarbon concentration data from the Shaw Environmental, Inc. site assessment, and from previous investigations, indicates impacts to groundwater. Evaluation of the data and the model results indicates that the modeled cells 1A, 1D, 1E and 2 contribute approximately 96 percent of the mass impacting groundwater quality.

Recommendations

As a result of the occurrence of VOCs and TPH as apparently entrained mixtures, the presence of TCE may pose a problem because of its characteristic degradation occurring in anaerobic conditions. TPH degradation process is aerobic, and aerobic degradation of entrained mixtures may lead to mobilization of constituents like TCE and increased groundwater impacts. These constituents, both TPH gasoline fraction and VOCs are characteristically volatile, and consequently we believe that soil vapor extraction remedial techniques would provide an opportunity to remove these constituents, off-setting potential mobilization of the anaerobic degradation compounds.

The main pit, the area to the west of the main pit, and the hand-held fire-fighting pit should be considered for remediation using SVE technique. SVE has been used at several other sites at

MCAS El Toro to remove TPH contamination from the soil in an effective manner. Based on the high percentage of mass present, two SVE locations should be placed in the vicinity of the modeled Polygons 1A and 1D. The two locations should have nested or clustered wells that remediate between approximately 20 feet and 130 feet depth. A third location with only shallow wells should be considered at the border between the model cells 7 and 8 focused on remediating a zone from 20 to 60 feet depth.

Evaluation of these data suggests that SVE should be targeted to reduce the contaminant mass in the interval from approximately 5 to 10 and 20-feet below ground surface to approximately 130 feet below ground surface. It is estimated, at this time, that a mass reduction in the range of 50 percent to more than 90 percent would be necessary to reduce impacts to groundwater.

Testing would have to be conducted in order determine radius of influence and other design parameters, before construction should be implemented; however, data collected during testing of the MPE system may be useful to provide this information. Additionally, it may be feasible to use MPE system wells for remediation of the deepest zone.

It is estimated that to be effective and ensure sufficient radius of influence to reduce the mass there would probably have to be two or three locations of the nested or clustered wells. One location would be in the main pit proper (model cell 1A), a second would be on the near west side of the main pit (cell 1D or 1E), and a shallow third cluster would be in the center of the hand-held training pit (between cells 7 and 8).

Review of the stratigraphic distribution of fine-grained and coarser-grained lithic units suggests that three or four separate screened intervals will be necessary in nested wells, or clustered wells, because of the difference in permeability of the units. Conceptually in the vicinity of the main pit, we anticipate that remediation zones would be 5 to 10 feet depth, 20 to 50 feet depth, 50 to 80 feet depth, 80 to 100 feet depth, and 100 to 140 feet depth. Screened intervals for these zones would be 5 to 10, 25 to 45, 55 to 75, 80 to 100 feet depth, and 105 to 130 feet depth. An additional screened interval may be useful below 100 feet depth; however, it may be possible to use the existing MPE wells for this function. In the vicinity of the hand-held training pit, we anticipate only one remediation zone from 20 to 60 feet depth with a well from screened 30 to 50 feet depth.

In summary, the next step would be to install a minimum 3 multiple screened SVE extraction wells and at least four, nested vadose zone monitoring points at IRP Site 16. These may be FLUTE technology or standard nested technology. Then conduct pilot SVE test of wells and measure pressure field and vapor concentration using monitoring points. Finally, evaluate the pilot SVE test results and apply to full-scale system, which may or may not require additional SVE wells or monitoring points.

Attachment 4

New Figure, Maximum TPHd Concentration in Soil at 5 to 10 feet Depth

M60050_003266
MCAS EL TORO

SENSITIVE RECORD

PORTIONS OF THIS RECORD ARE CONSIDERED SENSITIVE AND ARE NOT AVAILABLE FOR PUBLIC VIEWING

ATTACHMENT 4 – MAXIMUM TPH-D CONCENTRATION IN SOIL AT 5 TO 10-FEET DEPTH
IRP SITE 16

FOR ADDITIONAL INFORMATION, CONTACT:

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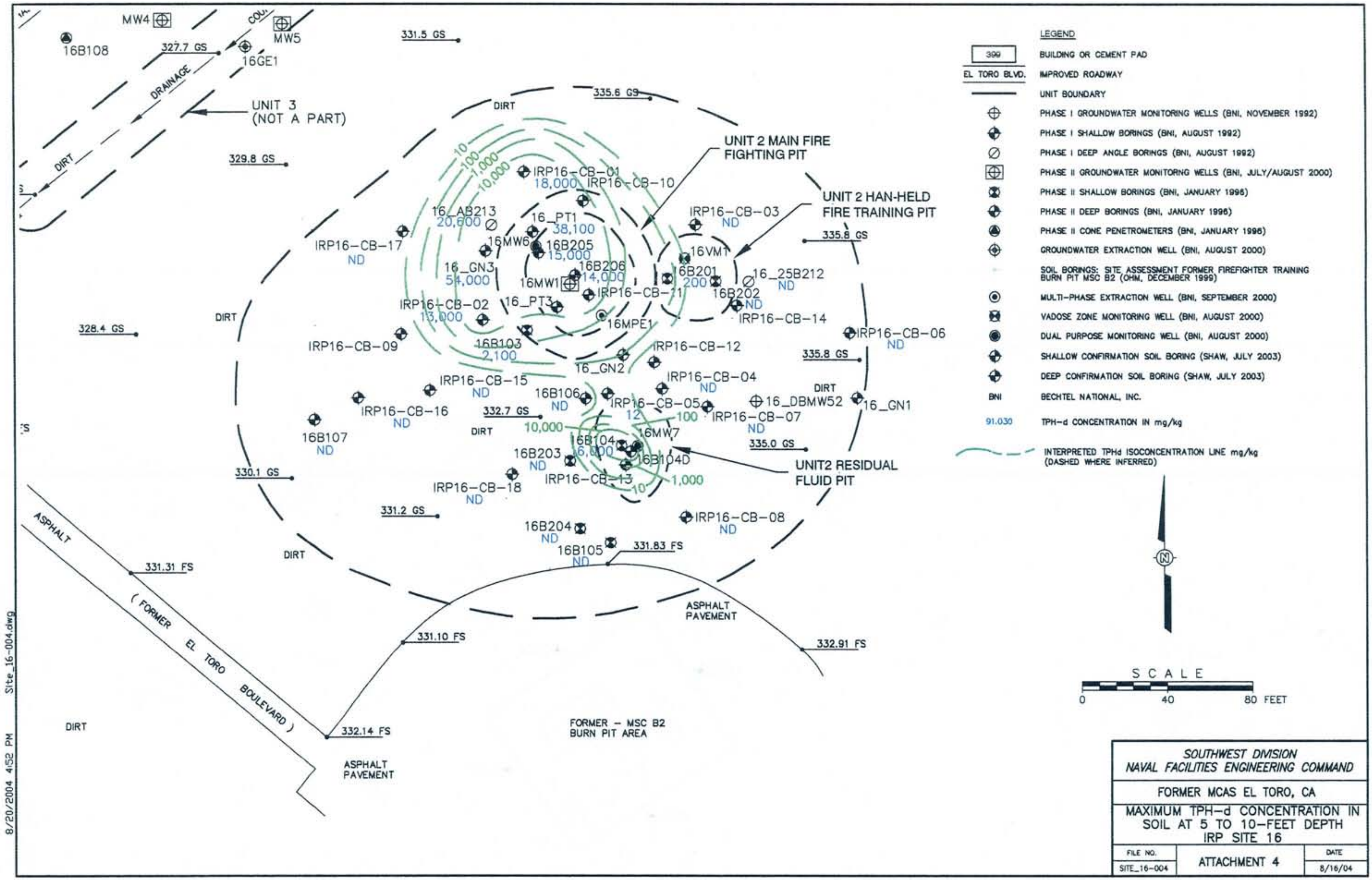
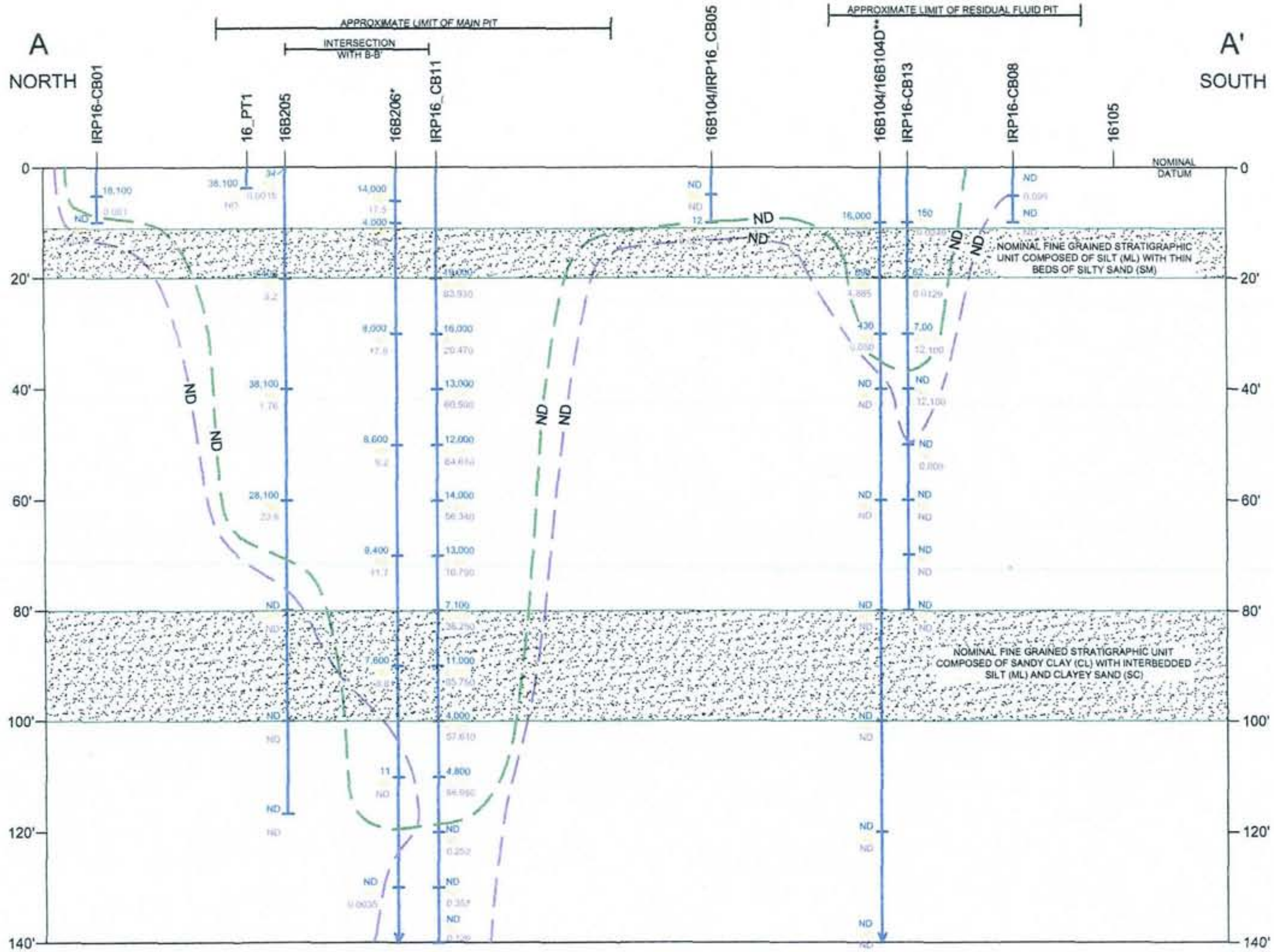

LEGEND
BUILDING OR CEMENT PAD
IMPROVED ROADWAY
UNIT BOUNDARY
PHASE I GROUNDWATER MONITORING WELLS (BNI, NOVEMBER 1992)
PHASE I SHALLOW BORINGS (BNI, AUGUST 1992)
PHASE I DEEP ANGLE BORINGS (BNI, AUGUST 1992)
PHASE II GROUNDWATER MONITORING WELLS (BNI, JULY/AUGUST 2000)
PHASE II SHALLOW BORINGS (BNI, JANUARY 1996)
PHASE II DEEP BORINGS (BNI, JANUARY 1996)
PHASE II CONE PENETROMETERS (BNI, JANUARY 1996)
GROUNDWATER EXTRACTION WELL (BNI, AUGUST 2000)
SOIL BORINGS: SITE ASSESSMENT FORMER FIREFIGHTER TRAINING BURN PIT MSC B2 (OHM, DECEMBER 1999)
MULTI-PHASE EXTRACTION WELL (BNI, SEPTEMBER 2000)
VADOSE ZONE MONITORING WELL (BNI, AUGUST 2000)
DUAL PURPOSE MONITORING WELL (BNI, AUGUST 2000)
SHALLOW CONFIRMATION SOIL BORING (SHAW, JULY 2003)
DEEP CONFIRMATION SOIL BORING (SHAW, JULY 2003)
BNI BECHTEL NATIONAL, INC.
91.030 TPH-d CONCENTRATION IN mg/kg
INTERPRETED TPHd ISOCONCENTRATION LINE mg/kg (DASHED WHERE INFERRED)
399
EL TORO BLVD.
UNIT 3 (NOT A PART)
UNIT 2 MAIN FIRE FIGHTING PIT
UNIT 2 HAN-HELD FIRE TRAINING PIT
UNIT2 RESIDUAL FLUID PIT
FORMER - MSC B2 BURN PIT AREA
(FORMER EL TORO BOULEVARD)
DRAINAGE
ASPHALT PAVEMENT
DIRT
MW4
MW5
16B108
16GE1
327.7 GS
331.5 GS
335.6 GS
329.8 GS
335.8 GS
328.4 GS
332.7 GS
335.0 GS
330.1 GS
331.2 GS
331.83 FS
331.31 FS
331.10 FS
332.91 FS
332.14 FS
IRP16-CB-01 18,000
IRP16-CB-10
16_AB213 20,600
16_PT1 38,100
16MW6
16B205 15,000
IRP16-CB-17 ND
16_GN3 54,000
16MW1
16B206 14,000
IRP16-CB-11
IRP16-CB-02 13,000
16_PT3
16MPE1
IRP16-CB-03 ND
16VMT
6B201 200
16_25B212 ND
16B202 ND
IRP16-CB-14
IRP16-CB-06 ND
IRP16-CB-09
16B103 2,100
16_GN2
IRP16-CB-12
IRP16-CB-04 ND
IRP16-CB-15 ND
16B106 ND
IRP16-CB-05 12
16_DBMW52
16_GN1
IRP16-CB-16 ND
IRP16-CB-07 ND
16B107 ND
16MW7
16B104 6,000
16B203 ND
16B104D
IRP16-CB-13
IRP16-CB-18 ND
IRP16-CB-08 ND
16B204 ND
16B105 ND
10
100
1,000
10,000
SCALE
0 40 80 FEET
Site_16-004.dwg
8/20/2004 4:52 PM
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
FORMER MCAS EL TORO, CA
MAXIMUM TPH-d CONCENTRATION IN SOIL AT 5 TO 10-FEET DEPTH IRP SITE 16
FILE NO. SITE_16-004
ATTACHMENT 4
DATE 8/16/04

Attachment 5

Revised Cross-Section Figure 6 and Figure 7



LEGEND:

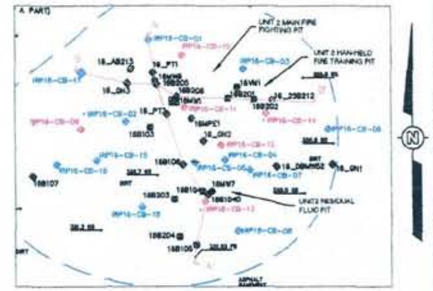
13,000 TPH-d IN mg/kg

17.5 VOCs IN mg/kg

ND EXTENT OF PETROLEUM HYDROCARBONS IN SOIL GREATER THAN 1 mg/kg

ND EXTENT OF VOCs IN SOIL GREATER THAN 0.001 mg/kg

FINE GRAINED STRATIGRAPHIC UNIT



SCALE

0 100 200 FEET

APPROXIMATE VERTICAL SCALE (FEET) 20

APPROXIMATE HORIZONTAL SCALE (FEET) 20

NOTE:

* BORING 16B206 EXTENDS TO 192-FEET DEPTH; HOWEVER ALL ANALYTICAL RESULTS FOR SAMPLES COLLECTED BELOW 110-FEET WERE ALL ND.

** BORING 16B104D EXTENDS TO 182-FEET DEPTH; HOWEVER ANALYTICAL RESULTS FOR SAMPLES BELOW 40-FEET DEPTH WERE ALL ND.

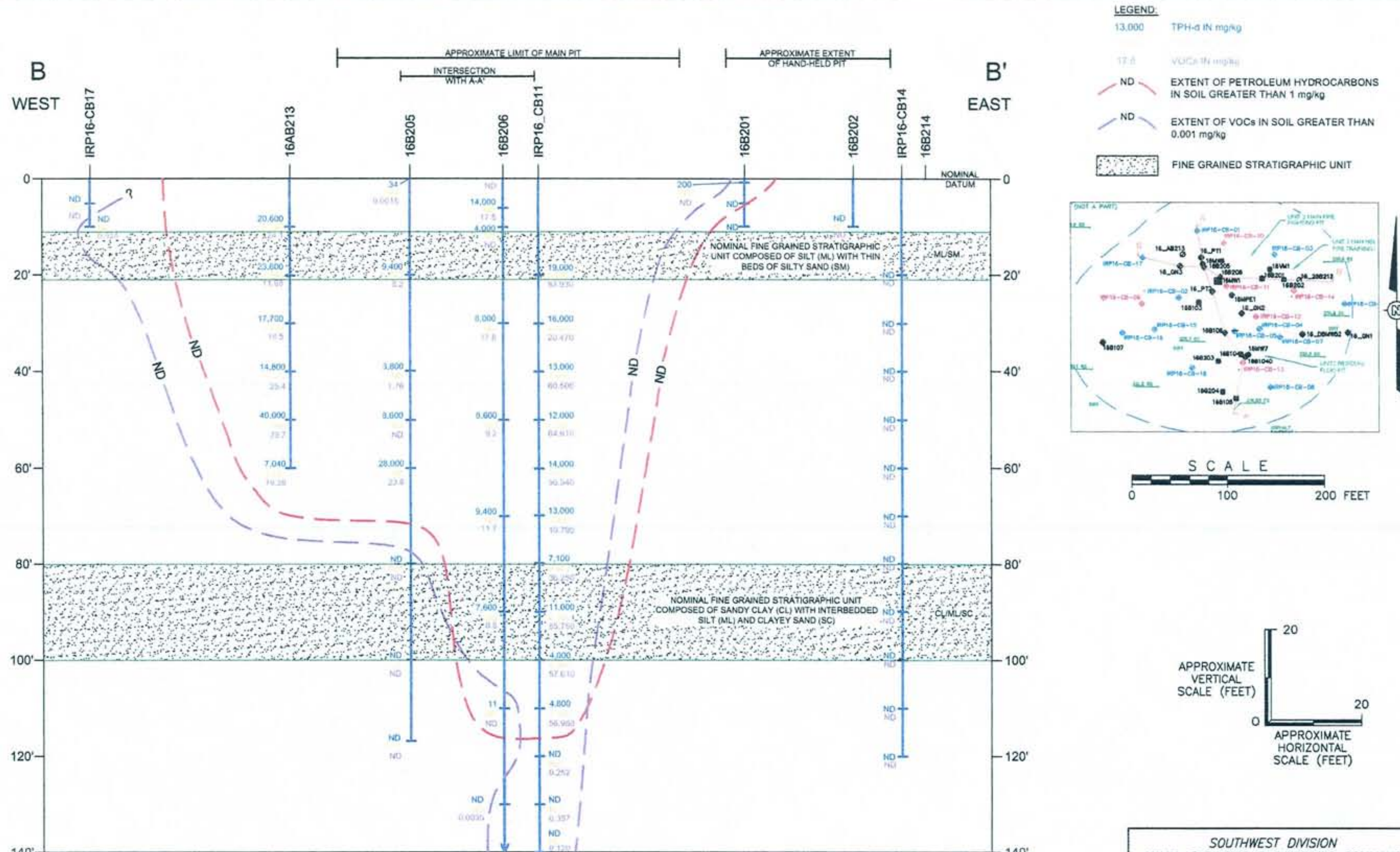
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

FORMER MCAS EL TORO, CA

CROSS-SECTION A-A'
TPH AND TOTAL VOCs IN SOIL

FILE NO.		DATE
SITE_16-002	FIGURE 6	8/16/04

8/20/2004 6:23 PM Site_16-002.dwg



NOTE:

* BORING 16B206 EXTENDS TO 192-FEET DEPTH; HOWEVER ALL ANALYTICAL RESULTS FOR SAMPLES COLLECTED BELOW 110-FEET WERE ALL ND.

SOUTHWEST DIVISION NAVAL FACILITIES ENGINEERING COMMAND	
FORMER MCAS EL TORO, CA	
CROSS-SECTION B-B' TPH AND TOTAL VOCs IN SOIL	
FILE NO. SITE_16-003	FIGURE 7	DATE 8/16/04

8/20/2004 5:06 PM Site_16-003.dwg

Attachment 6

Revised Section5.3, Page 5-3

5.3 Volatile Organic Compounds

Specific VOC analytes detected during this site assessment include the following:

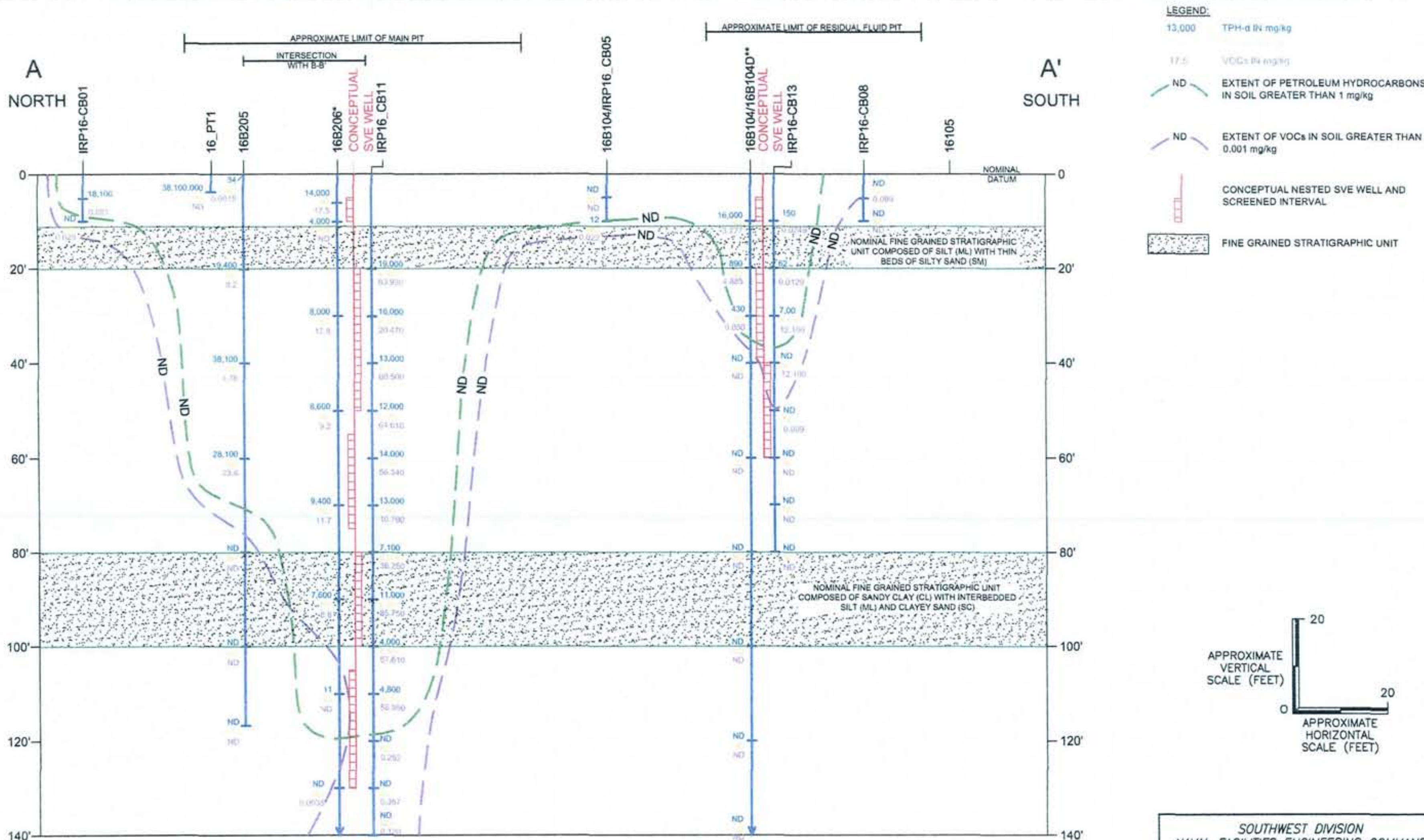
- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Acetone
- Benzene
- Ethylbenzene
- Isopropyl Benzene
- n-Butyl Benzene
- n-Propyl Benzene
- Naphthalene
- p-Isopropyl Toluene
- sec-Butyl Benzene
- tertiary-Butyl Alcohol
- Toluene
- Trichloroethylene
- Xylene (Total)

Only trichloroethylene exceeded the preliminary remediation goals (PRG) for residential soil (53 micrograms per kilogram [µg/kg]). A summary listing of the maximum concentration detected for each analyte and the concentration at the maximum depth detected is presented in Table 4. All analytical results are presented in Table 2.

Site assessment results indicate that TCE is present only in the vicinity of the main pit and area west of the main pit. TCE was detected in concentrations greater that the PRG for residential soil (53 µg/kg) in boring IRP16-CB-02 (1,400 µg/kg at 5 feet and 2,700 µg/kg at 10 feet) and boring IRP16-CB-11 (120 J µg/kg at 40 feet to 310 µg/kg at 110 feet depth). The maximum TCE concentration in boring IRP16-CB-02, 2,700 µg/kg, was detected at 10 feet depth, the limit of the boring. The maximum TCE concentration detected in boring IRP16-CB-11 was 820 µg/kg, at 90 feet depth. TCE concentrations above the PRG extended to a depth of 110 feet in boring IRP16-CB-11; however, TCE was detected at concentrations below the PRG for residential soil at 120 feet (6.2 µg/kg) and 130 feet (22 µg/kg). No TCE was detected at depths greater than 130 feet depth in this site assessment.

Source material for the VOCs is reported to be mixed waste oil, fuels, and solvent, and as such does not represent a specific waste stream of consistent composition. Because of the multiple analytes and range of concentrations in this mixture, it was decided to represent the VOC analytes detected in the soil samples as total VOCs in order to evaluate distribution in the subsurface. Total VOC concentrations were obtained by summing the all the VOC analyte

Attachment 7
New Figure, Conceptual SVE well and Screen Intervals Cross Section



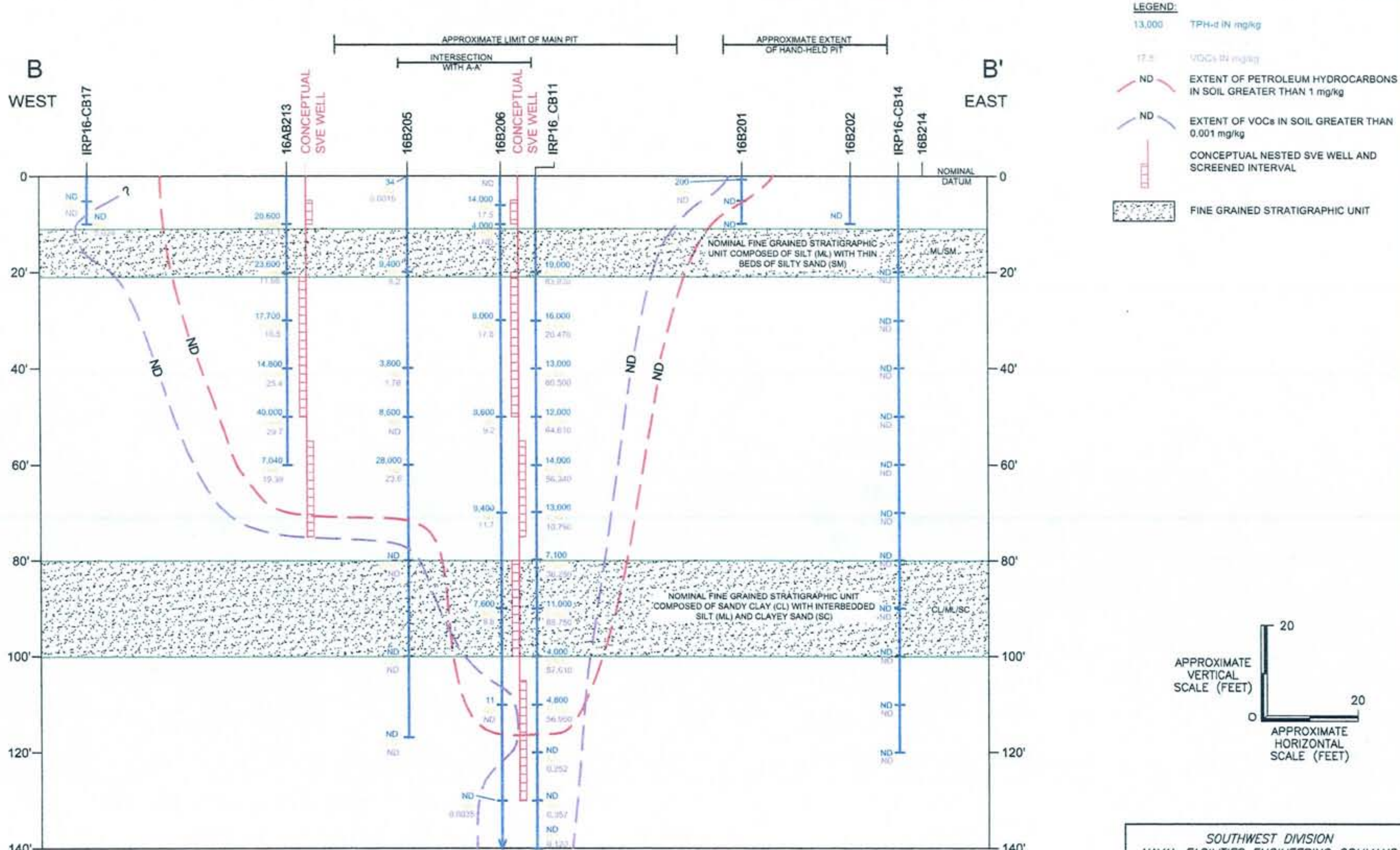
NOTE:

* BORING 16B206 EXTENDS TO 192-FEET DEPTH; HOWEVER ALL ANALYTICAL RESULTS FOR SAMPLES COLLECTED BELOW 110-FEET WERE ALL ND.

** BORING 16B104D EXTENDS TO 182-FEET DEPTH; HOWEVER ANALYTICAL RESULTS FOR SAMPLES BELOW 40-FEET DEPTH WERE ALL ND.

SOUTHWEST DIVISION NAVAL FACILITIES ENGINEERING COMMAND		
FORMER MCAS EL TORO, CA		
CROSS-SECTION A-A' CONCEPTUAL SVE WELL AND SCREEN INTERVALS		
FILE NO. SITE_16-013	ATTACHMENT	DATE 8/16/04

8/31/2004 3:34 PM Site_16-013.dwg



NOTE:

* BORING 16B206 EXTENDS TO 192-FEET DEPTH; HOWEVER ALL ANALYTICAL RESULTS FOR SAMPLES COLLECTED BELOW 110-FEET WERE ALL ND.

SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

FORMER MCAS EL TORO, CA

CROSS-SECTION B-B'
CONCEPTUAL SVE WELL AND SCREEN INTERVALS

FILE NO.		DATE
SITE_16-014	ATTACHMENT	8/16/04

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