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M60050.000925
MCAS EL TORO
SSIC # 5090.3

MEMORANDUM

TO: Andy Piszkin - Code 1812.AP **DATE:** 29 June 1993

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SUBJECT: **CTO# 145 MCAS El Toro RI/FS**
Data Quality Objectives - Position Paper on Petroleum Hydrocarbons
Document Control #CLE-C01-01F145-G2-0154

Screening levels are required for petroleum hydrocarbons for the Marine Corps Air Station (MCAS) El Toro Remedial Investigation/Feasibility Study (RI/FS) Data Quality Objectives (DQOs). Screening levels are used to determine whether a stratum/site will require further investigation for petroleum hydrocarbons during Phase II of the RI/FS.

Proposal

Total Fuel Hydrocarbons to Represent Petroleum Hydrocarbons

For the Phase I MCAS El Toro RI/FS, the presence of petroleum hydrocarbons were measured by total fuel hydrocarbons (TFH), and total recoverable petroleum hydrocarbons (TRPH) analyses. The TFH analytical method is based on a procedure developed by the Department of Health Services (DHS), and commonly referred to as "modified Environmental Protection Agency (EPA) Method 8015." The TRPH analytical method is EPA Method 418.1. TFH analyses differentiate between gasoline (composed predominantly of Carbon[C]-4 to C-12 hydrocarbons), and diesel (predominantly C-10 to C-23 hydrocarbons) fractions. The typical gasoline mixture also contains benzene, toluene, xylenes and ethylbenzene (BTXE), and polynuclear aromatic hydrocarbons (PAHs) such as naphthalene and benz(a)pyrene. The typical diesel mixture also contains PAHs found in gasoline mixtures. TRPH is a gross analytical parameter used primarily as a survey tool at petroleum contaminated sites. The analytical method is applicable for measuring levels of heavier hydrocarbons (greater carbon content) such as oil and grease, as well as the lighter fuel fractions in the soil. However, significant loss of the lighter (correspondingly more volatile) fuel fractions occurs during TRPH analysis. Therefore, results of TFH analyses are better indicators than TRPH analysis of fuel hydrocarbons that may have been released to the environment.

For the purpose of screening strata/sites for further investigation during Phase II, the Navy proposes to address petroleum hydrocarbons based on TFH-gasoline and TFH-diesel results only; TRPH values will not be used. TRPH results better indicate the presence of heavier hydrocarbons (e.g., unspecified organic matter, oil, and grease), not fuel hydrocarbons. TRPH analysis will be specified during Phase II if required as an operational/treatability parameter for the FS, and for other reasons unrelated to the screening of petroleum hydrocarbon levels.

Surface Soils

The risk-based concentrations (RBCs) calculated by the Navy for TFH-gasoline and TFH-diesel are based on actual gasoline & diesel fuel mixtures. The risks associated with gasoline and diesel mixtures are weighted heavily toward benzene, toluene, xylenes, and ethylbenzene (BTXE) and PAH concentrations because of the greater toxicity of these compounds compared to other compounds found in fuel mixtures such as straight chain alkanes and branched alkanes. Since BTXE and PAHs are already accounted for under volatile organic compounds (VOCs) (analyzed by EPA Method 8240) and semivolatile organic compounds (analyzed by EPA Method 8270), respectively, use of RBCs for TFH-gasoline and TFH-diesel screening essentially results in "double counting" of the risks posed by BTXE and PAHs.

The Navy proposes screening levels for surface soils be based on RBCs for BTXE and PAHs, and not RBCs for TFH-gasoline and TFH-diesel.

Subsurface Soils

The Navy proposes a two-phase approach to address petroleum hydrocarbons in subsurface soils.

1. For the purpose of screening contaminant concentrations from petroleum-contaminated sites for further investigation during Phase II, the California Leaking Underground Fuel Tank (CA LUFT) Field Manual (California Regional Water Quality Control Board [RWQCB], October 1989) guidance levels will be used for petroleum hydrocarbons. The primary reason for using available guidance is time constraints. Any attempt to collect soil cores or soil samples, conduct soil column or leaching tests, and perform the necessary laboratory analyses and data evaluation cannot be accomplished in a timely manner for incorporation into the DQO process.

2. During the DQO process, the Navy will review Phase I RI/FS data in greater detail, and assess the need to perform physical tests and/or modeling to determine cutpoints for petroleum hydrocarbons as part of Treatability Studies or during Phase II of the RI/FS.

Issues to Consider for Subsurface Soils

Ground Rules

The Navy understands the RWQCB's definition of "impact" to groundwater as any leaching of contaminants to groundwater. Demonstration of leaching potential can be through use of physical tests (i.e., leaching/extraction or soil column tests), vadose zone contaminant transport modeling, or a combination of testing and modeling. The RWQCB favors use of physical tests to calibrate modeling results. The agency will also consider calibration runs against example sites with known groundwater contamination due to fuel releases.

The Navy also understands that the RWQCB's primary concerns on petroleum hydrocarbons are BTXE and PAHs; the agency is not concerned with unspecified

organic matter, and oil and grease. The Navy will address the presence of BTXE and PAHs, regardless of the presence of petroleum hydrocarbons. As stated earlier, BTXE and PAHs are analyzed by EPA Method 8240 and 8270, respectively.

Current Guidance

The CA LUFT Field Manual provides guidance on maximum allowable concentrations of BTXE, TFH-gasoline, and TFH-diesel that can be left in subsurface soils without impacting groundwater. A scoring system that accounts for site features is used to determine whether the leaching potential is low, medium, or high. Site features to consider include:

- Depth to groundwater
- Presence of fractures
- Average annual precipitation
- Presence of man-made conduits
- Unique site features (e.g., recharge area, coarse soil, nearby wells, etc.).

The general risk appraisal described in the CA LUFT Field Manual used two models: SESOIL, an EPA-approved vadose zone model, and AT123D, a groundwater model.

The maximum allowable levels (in parts-per-million [ppm]) of BTXE, TFH-gasoline and TFH-diesel which can be left in subsurface soils, based on the range of total points assigned, are listed in Table 1.

Table 1
Maximum Allowable Concentrations of BTXE, TFH-Gasoline, and TFH-Diesel Which Can Be Left in Subsurface Soils Based on CA LUFT Guidance

Range of Total Points	Maximum Allowable BTXE[a] Levels (ppm)[d]	Maximum Allowable TFH-Gasoline[b] Levels (ppm)	Maximum Allowable TFH-Diesel[c] Levels (ppm)
49 or More	1, 50, 50, 50	1,000	10,000
41 - 48	0.3, 0.3, 1, 1	100	1,000
40 or Less	Not Applicable	10	100

[a]BTXE: benzene, toluene, xylenes, and ethylbenzene
[b]TFH-Gasoline: total fuel hydrocarbons, gasoline fraction
[c]TFH-Diesel: total fuel hydrocarbons, diesel fraction
[d]ppm: parts-per-million

Adapted from California Leaking Underground Fuel Tank Field Manual (California Regional Water Quality Control Board, October 1989).

Considerations on Physical Tests and Vadose Zone Modeling

1. Numerous technical committees, including those commissioned by the EPA, have rejected the use of soil column tests, especially when dealing with VOCs; instead, the committees have endorsed use of vadose zone transport modeling. Several reasons are cited for use of modeling rather than physical tests.

   - It is difficult to retrieve representative soil cores from the field and to set up the column tests in the laboratory. The alternative of packing soil columns is best for studying vadose zone transport processes (e.g., sorption, liquid advection, gas diffusion), not for model calibration.

   - Unless the site geology is relatively homogeneous, soil columns used for experimentation are usually too small to accurately represent the real system. Laboratory soil columns are generally one to 3 feet long and mesoscale experiments have been conducted on soil columns up to 15 feet long. At MCAS El Toro, the vadose zone ranges from approximately 90 to 220 feet.

   - The logistics of instrumenting soil column experiments is complicated. At a minimum, a rainfall simulator, suction lysimeters, tensiometers, soil gas samplers are needed; radioisotope tagging of compounds may be necessary.

   - Any attempts at simulating unsaturated flow conditions require a *long* time. Depending on the length of the soil column and moisture conditions desired, the average runs last on the order of months.

2. Extraction/leaching tests, such as the modified toxicity characteristic leaching procedure (TCLP), would yield conservative leaching values. The TCLP method specifies vigorous shaking within the extraction vessel, therefore, a large fraction of petroleum hydrocarbons is likely to partition to the extract fluid when compared to actual field conditions. Concentrations in the extract fluid can help generate sorption or distribution coefficients (K_ds) of petroleum hydrocarbons rather than provide calibration data. Such experimental data generated using site-specific soils would enhance the database of K_ds gathered from a literature search.

3. Independent of the type of physical tests used ultimately, the central unresolved issue lies in the interpretation of the test results. It is reasonable to argue for application of suitable attenuation factors (AFs) to soil column test leachate and soil leaching test extract fluid concentrations. AFs such as 10 or 100 times often have been used in the past. These AFs are not based on much experimental data, partially because of the difficulty of experimentation in the vadose zone. Instead, models are used to generate AFs.

4. The concept of representative elementary volume (REV) has received wide support as one means to overcome modeling the heterogeneity of the vadose zone. It is practically impossible to describe flow through the vadose zone on a microscopic scale. It is necessary, therefore, to adopt a larger volume (or REV)

of porous media over which flow is averaged. Calibration of VLEACH results on a depth-specific basis (cell-by-cell comparison of modeled results versus soil column test data) will be difficult. Vadose zone models can be used as a predictive tool. However, the validity of the modeled results will be attempted on the basis of observed impact on groundwater quality below known soil contamination rather than soil column test or leaching test results.

Phase I Data Review - A Reality Check

After applying the CA LUFT Field Manual guidance levels to subsurface soils, Phase I data indicated that only three locations may impact groundwater quality. The TFH-gasoline and TFH-diesel levels, and presence of BTXE and PAHs at these locations, are presented in Table 2.

Table 2
TFH and BTXE[a] Concentrations at Phase I RI Sites that Exceed LUFT Guidelines

Site/ Location	Depth (ft bgs)[e]	Total Fuel Hydrocarbons and BTXE Levels (mg/kg)[f]	Comments
Site 16 (Crash Crew Pit No. 2)	9 - 52	TFH-Gasoline[b]: 3,470-7,040 TFH-Diesel[c]: 11,900-40,000 Toluene: ND[g]-2.4 Xylenes: 2.2-13.0 Ethylbenzene: ND-2.3	Some PAHs[d]
Site 18 (Agua Chinon Wash)	17 - 52	TFH-Gasoline: 114-131,000 TFH-Diesel: 2,270-15,300	No BTXE; Wash will be lined by City of Irvine
Site 18/ Bee Canyon Wash	26	TFH-Gasoline: 719/1,260 TFH-Diesel: 750/1,560	No BTXE; some PAHs

[a]BTXE: benzene, toluene, xylenes, and ethylbenzene
[b]TFH-Gasoline: total fuel hydrocarbons, gasoline fraction
[c]TFH-Diesel: total fuel hydrocarbons, diesel fraction
[d]PAHs: polynuclear aromatic hydrocarbons
[e]ft bgs: feet below ground surface
[f]mg/kg: milligram per kilogram; approximately equal to parts-per-million (ppm)
[g]ND: Not detected

Significant petroleum hydrocarbon contamination exists at Site 18 beneath (Agua Chinon Wash). The City of Irvine will line Agua Chinon Wash with concrete this Fall. Although such action will minimize further leaching of petroleum hydrocarbons, it is reasonable to assume some form of remediation (e.g., soil vapor extraction, bioremediation), or removal of soils at the wash. Therefore, based on the petroleum

hydrocarbon levels at, and the imminent lining of, Agua Chinon Wash, neither vadose zone transport modeling nor physical testing is necessary.

CLE-C01-01F145-G2-0154
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