Comprehensive Long-Term Environmental Action Navy (CLEAN) II
Contract No. N62742-94-D-0048
Contract Task Order No. 0072

Final Work Plan

Phase II Remedial Investigation

IRP Site 1, Explosive Ordnance Disposal Range
Marine Corps Air Station, El Toro, California

Prepared for:

Department of the Navy
Commander, Southwest Division
Naval Facilities Engineering Command
San Diego, California 92132-5190

Prepared by:

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November 2001

DEPARTMENT OF THE NAVY
SOUTHWEST DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
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5090
Ser 06CC.DG/1186
November 1, 2001

Ms. Nicole Moutoux
U.S. Environmental Protection Agency
Region IX, (SFD 8-2)
Hazardous Waste Management Division
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San Francisco, CA 94105-3901

Subject: FINAL WORK PLAN, PHASE II REMEDIAL INVESTIGATION AND (2) DRAFT FINAL WORK PLAN, ORDNANCE AND EXPLOSIVES RANGE EVALUATION, FOR IRP SITE 1, MARINE CORPS AIR STATION (MCAS) EL TORO

Dear Ms. Moutoux:

Enclosed are revised versions of the subject documents. These documents incorporate the responses to recent additional comments received from both EPA and DTSC. The OE Range Evaluation Work Plan will be finalized after the public comment period. Please contact either Mr. Don Whittaker at (619) 532-0791 or myself at (619) 532-0765 should you have any questions, or need additional information.

Sincerely,

DEAN GOULD
Base Realignment and Closure
Environmental Coordinator
By direction of the Commander

Enclosure: 1. Final Work Plan, Phase II Remedial Investigation and (2) Draft Final Work Plan, Ordnance and Explosives Range Evaluation, for IRP Site 1, MCAS, El Toro

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Final Work Plan
Phase II Remedial Investigation
Site 1-Explosive Ordnance Disposal Range
MCAS El Toro, California

Contract No. N62742-94-D-0048
Contract Task Order No. 0072

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PAGE NO. ii

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AMENDMENT NO.1
TO THE WORK PLAN
PHASE II REMEDIAL INVESTIGATON IRP SITE,
EXPLOSIVE ORDNANCE DISPOSAL RANGE

DATED 21 NOVEMBER 2002

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SAMPLING AND ANALYSIS PLAN
AMENDMENT NO.1 - PHASE II
REMEDIAL INVESTIGATON IRP SITE
EXPLOSIVE ORDNANCE DISPOSAL RANGE

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FINAL SAMPLING AND ANALYSIS PLAN
AMENDMENT NO.1 - PHASE II
REMEDIAL INVESTIGATON IRP SITE
EXPLOSIVE ORDNANCE DISPOSAL RANGE

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PHASE II REMEDIAL INVESTIGATION IRP SITE,
EXPLOSIVE ORDNANCE DISPOSAL RANGE

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PHASE II REMEDIAL INVESTIGATION IRP SITE,
EXPLOSIVE ORDNANCE DISPOSAL RANGE

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ACRONYMS AND ABBREVIATIONS

%R	percent recovery
°C	degrees Celsius
µg/dL	micrograms per deciliter
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µmho	micro ohms
2,3,7,8,-TCDD	2,3,7,8 -tetrachlorodibenzodioxin
Air SWAT	air quality solid waste assessment test
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society of Testing and Materials
BCT	BRAC Cleanup Team
BERA	baseline ecological risk assessment
bgs	below ground surface
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
Cal-EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CECOS	Civil Engineer Corps Officer's School (Naval School Environmental Training Division)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Ac
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
COC	chain of custody
COPCs	chemicals of potential concern
COPECs	chemicals of potential ecological concern
CRWQCB	California Regional Water Quality Control Board
CSM	conceptual site model
CSS	coastal sage scrub
CTO	contract task order
DAF	dilution attenuation factor
DHS	(California) Department of Health Services
DON	Department of the Navy
DOT	Department of Transportation
DQO	data quality objective
DTSC	Department of Toxic Substances Control
Earth Tech	Earth Tech, Inc.
EBS	environmental baseline survey
ECR	excess cancer risk
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
EM	electromagnetic
EOD	explosive ordnance disposal
EPA	Environmental Protection Agency
EPC	exposure point concentrations
ERAGS	Ecological Risk Assessment Guidance for Superfund
EWI	environmental work instructions
FFA	Federal Facilities Agreement
FOST	finding of suitability to transfer
FS	feasibility study

FS smoke	sulfur-trioxide chlorosulfonic acid
GC/MS	gas chromatography/mass spectrometry
GPR	ground penetrating radar
H_2SO_4	sulfuric acid
HCl	hydrochloric acid
HI	hazard index
HNO_3	nitric acid
HpCDD	heptachlorodibenzodioxin
HpCDF	heptachlorodibenzofuran
HRGCMS	high-resolution gas chromatography/mass spectrometry
HSP	health and safety plan
HxCDD	hexachlorodibenzodioxin
HxCDF	hexachlorodibenzofuran
ICP	inductively coupled plasma
ID	identification
IDW	investigation-derived waste
IRCDQM	Installation Restoration Chemical Data Quality Manual
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
JEG	Jacobs Engineering Group, Inc.
L	liter
LCS	laboratory control sample
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
ml	milliliter
mm	millimeter
MS	matrix spike
MSA	master services agreement
MSD	matrix spike duplicate
MSL	mean sea level
mV	millivolt
n.a.	not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDMA	N-nitrosodimethylamine
NEDTS	Naval Environmental Data Transfer System
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
ng/kg	nanograms per kilogram
ng/L	nanograms per liter
NPL	National Priorities List
NTP	National Toxicology Program
OCDD	octachlorodibenzodioxin
OCDF	octachlorodibenzofuran
OE	Ordnance Explosives
OSWER	Office of Solid Waste and Emergency Response
PACDIV	Pacific Division, Naval Facilities Engineering Command
PAL	provisional action level
PCBs	polychlorinated biphenyls
pCi/L	picoCuries per liter

PE	performance evaluation
PeCDD	pentachlorodibenzodioxin
PeCDF	pentachlorodibenzofuran
pg/kg	picograms per kilogram
pH	negative log of the hydrogen ion concentration
PPE	personal protective equipment
ppm	parts per million
PRE	preliminary risk evaluation
PRG	preliminary remediation goal
PVC	polyvinyl chloride
QA	quality assurance
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
R3M	range rule risk methodology
RA	risk assessment
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
RPD	relative percentage of difference
RPM	remedial project manager
SAP	sampling and analysis plan
SARA	Superfund Amendments and Reauthorization Act
SMDP	scientific management decision point
SOP	standard operating procedure
SOW	statement of work
SRA	screening risk assessment
SSL	soil screening level
SVOC	semivolatile organic compound
SWAT	solid waste assessment test
SWDIV	Southwest Division, Naval Facilities Engineering Command
TAL	target analyte list
TBC	to be considered
TCDD	tetrachlorodibenzodioxin
TCDF	tetrachlorodibenzofuran
TDS	total dissolved solids
TEF	toxicity equivalency factor
TEQ	toxicity equivalent quotient
TFH	total fuel hydrocarbons
TPH	total petroleum hydrocarbons
TPH(e)	total petroleum hydrocarbons (extractable)
TPH(v)	total petroleum hydrocarbons (volatile)
TRPH	total recoverable petroleum hydrocarbons
U.S.	United States
UCL	upper confidence limit
USACOE	United States Army Corps of Engineers
USC	United States Code
USFWS	United States Fish and Wildlife Service

USMC	United States Marine Corps
UXO	unexploded ordnance
VOC	volatile organic compound
WHO	World Health Organization

1. INTRODUCTION

This work plan details the objectives and procedures to conduct a phase II remedial investigation (RI) at Installation Restoration Program (IRP) Site 1, the Explosive Ordnance Disposal (EOD) Range, at the Marine Corps Air Station (MCAS), El Toro, California.

This project was authorized by the United States (U.S.) Navy, Pacific Division, Naval Facilities Engineering Command (PACDIV) under contract task order (CTO) no. 0072 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) II program, contract number N62742-94-D-0048.

1.1 PURPOSE AND SCOPE OF THE WORK PLAN

The purpose of this phase II RI work plan is to further identify and characterize the potential impact to human health and the environment as a result of past operations at Site 1, such as EOD training which also included the destruction of unserviceable ammunition.

The work plan complies with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) in Title 40 of the Code of Federal Regulations (CFR), Part 300, and the California Health and Safety Code, Section 6.8.

The scope of this phase II RI work plan is to collect data to characterize site conditions; document the nature of the waste; assess risk to human health and the environment; and conduct treatability testing as necessary to evaluate the potential performance and cost of treatment technologies that are being considered. This information will be used to evaluate appropriate response actions to support the decision-making process for further course of action in conjunction with the reuse options.

This work plan addresses, where applicable to the EOD Range, the State of California (California Code of Regulations [CCR] Title 22 and the Health and Safety Code) requirements for the closure and post-closure of a hazardous waste facility. The State of California maintains that the United States Marine Corps' (USMC) explosive ordnance activities at the EOD Range included unauthorized operation of an open burning/open detonation hazardous waste treatment unit. The USMC maintains that munitions were used at the EOD Range for their intended purpose, including the training of military personnel and explosives and emergency response specialists and that such training is neither waste treatment nor disposal. This document treats the State's facility closure plan and post-closure plan requirements to be relevant and appropriate for the sole purpose of facilitating a settlement of the EOD Range matter. This document does not constitute any modification to the USMC's position. Consistent with the with the intent of a proposed settlement intent, a table comparing the State of California closure requirements (for a conventional treatment and storage facility) and the CERCLA process is presented in Appendix A. In addition, a cross reference table based on the California's Department of Toxic Substances Control's (DTSC) Treatment and Storage Facility Closure Plan checklist, has also been included in Appendix A to provide a roadmap of where the specific closure requirements, if applicable, will be addressed in the CERCLA process.

This work plan presents the elements of the quality assurance project plan as recommended in the Environmental Protection Agency (EPA) document *Requirements for Quality Assurance Project Plans for Environmental Data Operations, QA/R-5* (EPA 1997a).

1.2 MCAS EL TORO-DESCRIPTION AND BACKGROUND

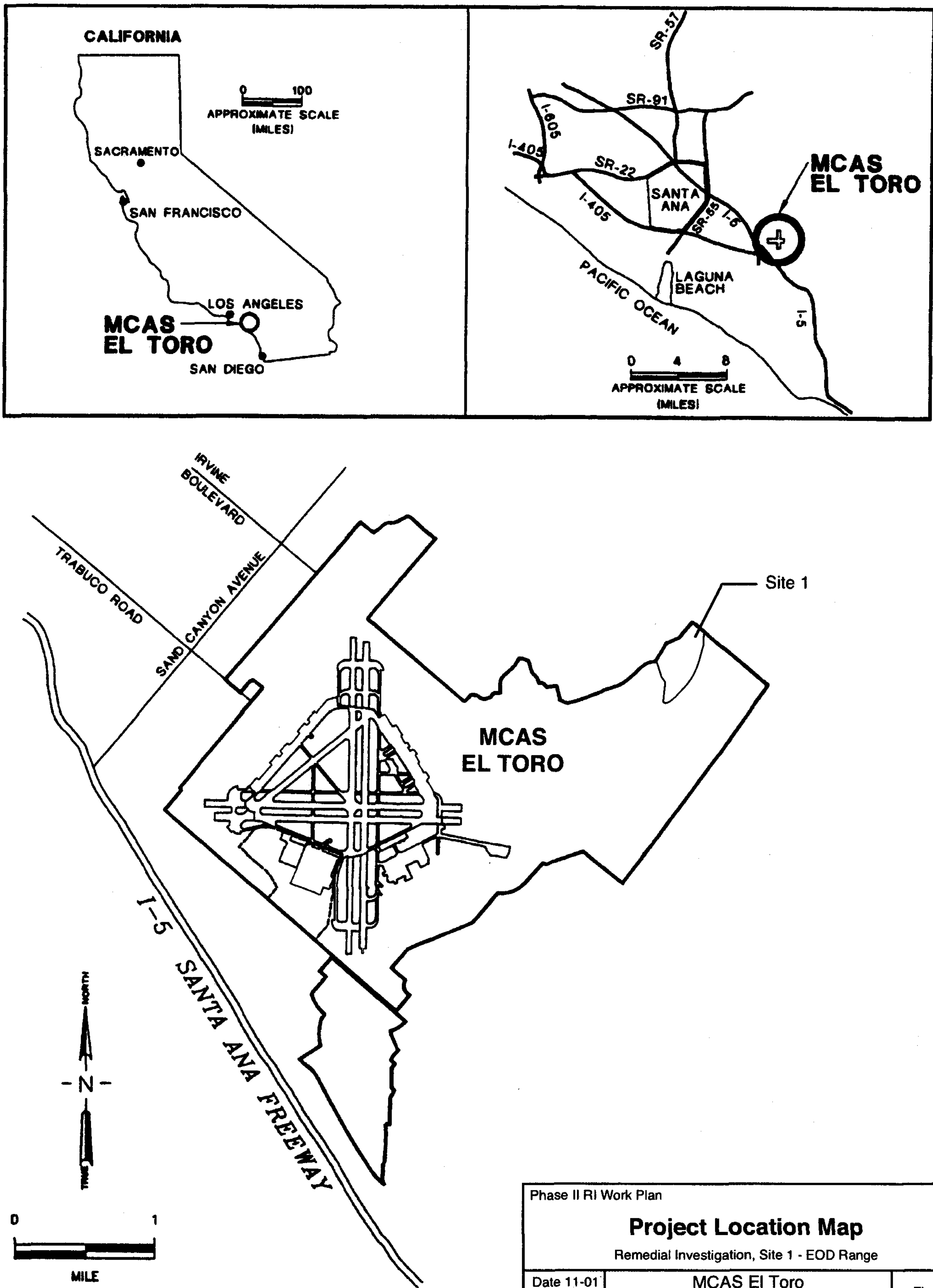
MCAS El Toro is located in a semi-urban, agricultural area of southern California, approximately 8 miles south of Santa Ana and 12 miles northeast of Laguna Beach (Figure 1-1). MCAS El Toro covers approximately 4,738 acres. Land use around the MCAS includes commercial, light industrial, and residential. MCAS El Toro closed on 2 July 1999, as part of the Base Realignment and Closure (BRAC) Act.

Initial work conducted by the Department of the Navy (DON) at MCAS El Toro included an initial assessment study during 1985 (NEESA 1986).

MCAS El Toro was added to the National Priorities List (NPL) of the Superfund Program on 15 February 1990, due to volatile organic compounds (VOCs) contamination at the MCAS boundary and in the agricultural wells west of MCAS. A Federal Facilities Agreement (FFA) was signed by the Marine Corps/DON in October 1990 with the EPA Region IX, California Department of Health Services (DHS) (part of which is currently DTSC), and the California Regional Water Quality Control Board, Santa Ana Region (CRWQCB).

In March 1993, MCAS El Toro was placed on the list of military facilities scheduled for closure under the BRAC Act. A BRAC Cleanup Team (BCT) including representatives from Southwest Division Naval Facilities Engineering Command (SWDIV), EPA, DTSC, and CRWQCB was formed to oversee implementation of the FFA.

Implementation of the FFA at MCAS El Toro included the following investigations and studies: Air Quality Solid Waste Assessment Test (Air SWAT), phase I RI, phase II RI, and a feasibility study (FS). Groundwater sampling is conducted station-wide on a routine basis by the Navy.



Phase II RI Work Plan		Final
Project Location Map Remedial Investigation, Site 1 - EOD Range		
Date 11-01	MCAS El Toro	Figure 1-1
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2. SITE BACKGROUND AND SETTING

2.1 LOCATION

IRP Site 1 is located in the northeast portion of MCAS El Toro in the foothills of the Santa Ana Mountains (see Figure 2-1). Site 1 is situated within a tributary canyon of Borrego Canyon Wash at elevations ranging from approximately 610 to 760 feet above mean sea level (MSL). Site 1 includes the Northern EOD Range (approximately 737,250 square feet) and the Southern EOD Range (approximately 721,600 square feet) (BNI 1995a).

A bermed retention pond is present in the northern portion of the site. Seasonal accumulations of rainwater were reported to have been observed in the retention pond. However, no ponding or accumulation contributing to surface water flow was observed (June 1999 to present) by Earth Tech. The site has been characterized by fairly rapid groundwater recharge in response to storm events (JEG 1993a).

2.2 LAND USE AND NATURAL RESOURCES

A great portion of the land immediately surrounding MCAS El Toro and including areas adjacent to Site 1 has been used for nursery and agricultural activities. Continued urbanization, however, has brought housing developments about one-half mile to the northeast of Site 1. The land located further north and northeast of the site near the foothills of the Santa Ana Mountains remains essentially undeveloped. Areas located to the south, southeast, and southwest have been developed for commercial, light industrial, and residential uses.

According to the Santa Ana Region Basin Plan (CRWQCB 1995), the groundwater beneath MCAS El Toro has potential beneficial uses for a municipal water supply, agricultural and are industrial supplies, and industrial process supply. Groundwater in the vicinity of MCAS El Toro is mostly used for irrigation of agricultural and greenbelt areas (i.e., parkways and parks). Potable water in the area is imported from various sources, and the remainder comes from local resources, including groundwater. The nearest municipal wells used as drinking water sources are located in the City of Tustin near the junction of Walnut Avenue and Red Hill Avenue and the City of Santa Ana near the junction of Grant Avenue and Walnut Avenue (BNI 1995a).

2.3 EOD ACTIVITIES

Training for EOD and detonation of munitions has been conducted at Site 1 since 1952 (BNI 1995a). Use of the EOD Range has been discontinued with the closure of MCAS El Toro on 2 July 1999.

The majority of recent military EOD training took place at the Northern EOD Range, and EOD training by the Orange County Sheriff Department and federal agencies took place at the Southern EOD Range (BNI 1995a). Several demolition pits, a range building, and a former observation bunker constructed from metal ammunition cans were reported to be present. Many of these metal cans were reported to be filled with the burned residue of disposed munitions such as cartridge-actuated devices and 20 millimeter (mm) ammunition (USACOE 1998).

Military ordnance that was used at the site includes hand grenades, land mines, cluster bombs, smoke bombs, and rocket warheads. Civilian and commercial explosives, such as dynamite, and plastic and gelatinous explosives have been used at the EOD Range. Munitions were detonated in trenches and pits, which were continually filled with soil and then reexcavated. In 1982, approximately 2,000 gallons of sulfur trioxide chlorosulfonic acid (FS smoke) were reportedly burned in trenches located in the northern portion of the site. An estimated 300,000 gallons of petroleum fuels were burned during disposal from 1952 through 1993 (JEG 1993a).

In addition, there are unconfirmed reports that low-level radioactive material was disposed at the site (NEESA 1986). Perchlorate was identified as a potential contaminant of concern at Site 1 due to its use in explosives and solid rocket propellants.

2.4 PREVIOUS WORK

Phase I RI. Previous investigations at Site 1 include a geophysical survey (JEG 1991) and a Phase I RI (JEG 1993a). Four surface soil samples were collected, and three groundwater monitoring wells (01_DGMW57, 01_DGMW58, and 18_BGMW24) were installed in and around Site 1 during the Phase I RI (Figure 2-1).

Phase II RI Work Plan. The *Phase II RI/FS Work Plan* (JEG 1993b) for the IRP sites, including the results of the data quality objectives (DQO) process was prepared by JEG for MCAS El Toro in 1993. No further investigation for Site 1 was required during the Phase II RI for MCAS El Toro, because the limited Phase I investigation results indicated no human health or ecological risk. However, since the Phase I sampling at Site 1 did not assess the areas used for active EOD training, further investigation following the discontinuation of EOD training was recommended.

An updated *Phase II RI Work Plan* and associated plans were prepared in 1995 (BNI 1995a). A three-tiered approach was proposed to investigate shallow and deeper subsurface soils and groundwater. Due to continued operation of the EOD Range, the soil investigation was deferred until cessation of EOD activities. However, three groundwater monitoring wells (01_MW101, 01_MW102, and 01_MW201) were installed at Site 1 during May 1996, as part of the Phase II RI (Figure 2-1).

Risk Assessment Work Plan. A *Final Risk Assessment Work Plan* (BNI 1995b) was prepared for MCAS El Toro. The plan presented the methods and procedures that were to be used to assess risks to human health and ecological receptors. Objectives, regulatory requirements, and procedures to be followed in the risk assessment process were also included.

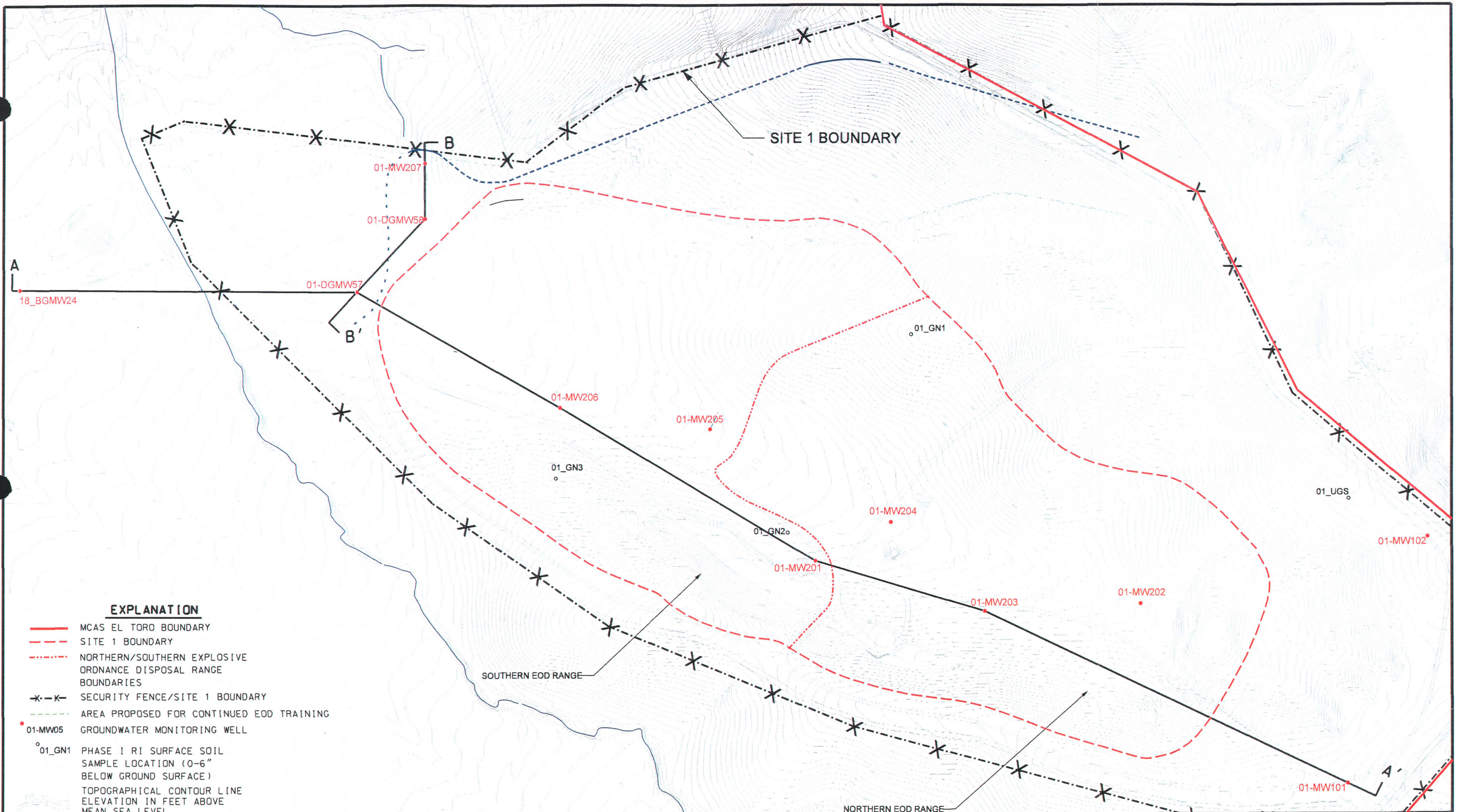
Evaluation of Perchlorate in Groundwater at MCAS El Toro. A station-wide evaluation (which included Site 1) for the presence of perchlorate in the groundwater was conducted during 1998. This investigation was performed as part of the routine groundwater monitoring that is being conducted station-wide by the Navy. In October 1998, existing groundwater wells at Site 1 were sampled and analyzed for perchlorate. The results of the investigation were presented in the *Draft Evaluation of Perchlorate in Groundwater* (BNI 1999b).

Perchlorate Verification at Site 1. A perchlorate verification study was conducted at Site 1 during 1999 (Earth Tech 2000). Six groundwater monitoring wells (01_MW202, 01_MW203, 01_MW204, 01_MW205, 01_MW206, and 01_MW207) were installed and sampled for perchlorate (Figure 2-1). During this investigation, a geophysical survey was also performed at Site 1 to locate buried debris. In addition, surface and shallow (up to 5 feet below ground surface [bgs]) soil samples were collected to assess selected geophysical anomaly areas (Figure 2-2) as part of a limited soil investigation to identify areas acceptable for transfer (Appendix B to this document).

2.5 ONGOING AND CONCURRENT WORK

2.5.1 Radionuclide Investigation

A station-wide radionuclide evaluation, including Site 1, is currently being conducted at MCAS El Toro (Earth Tech 2001a). This radionuclide evaluation will provide more definitive data on the origin of radioisotopes detected in groundwater at various sites on the station, including Site 1. Conclusions and recommendations of this evaluation pertaining to Site 1 will be incorporated into the RI, as appropriate.



Phase II RI Work Plan		Final
Site Plan Remedial Investigation, Site 1 – EOD Range		
Date 11-01	MCAS El Toro	Figure
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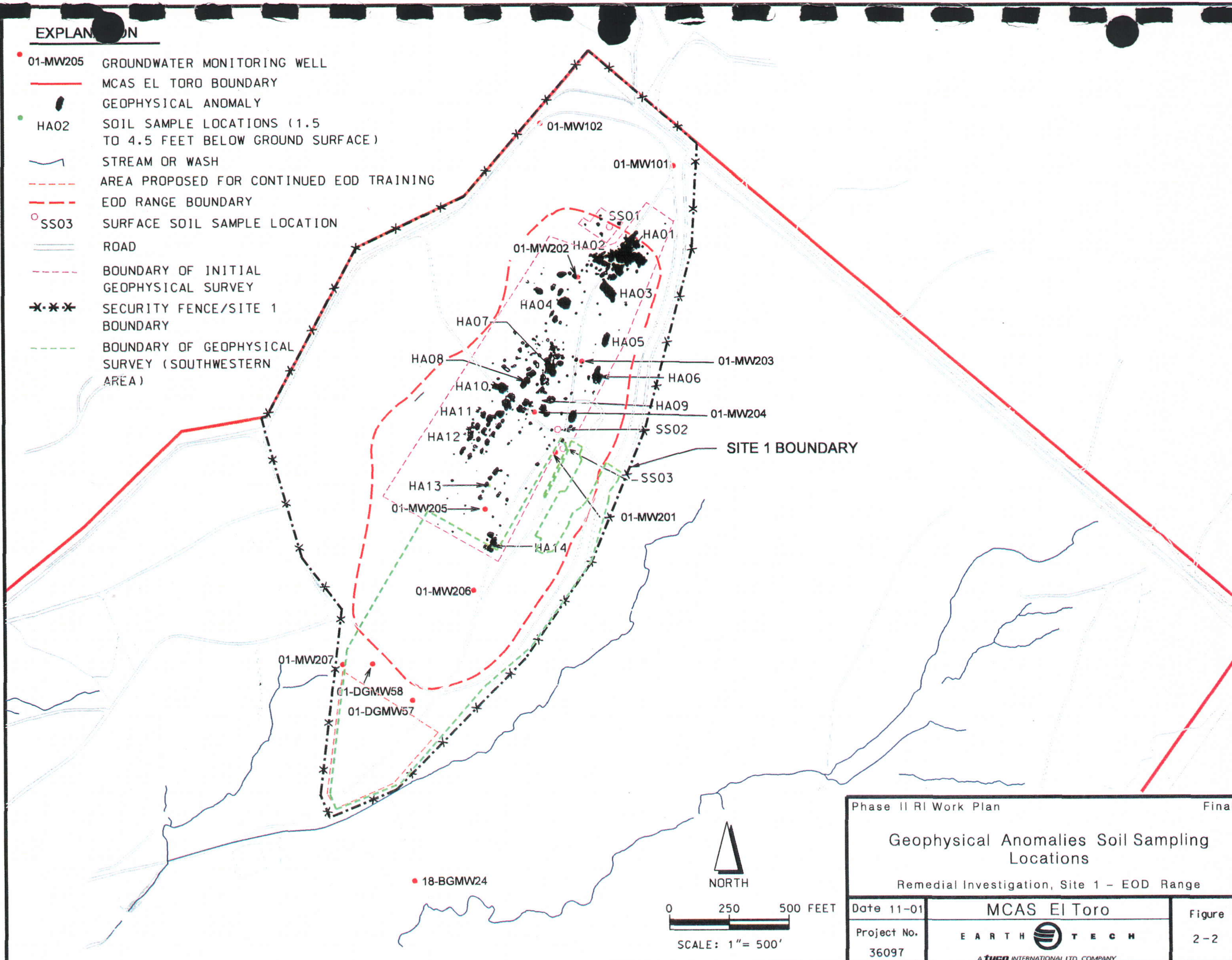

Phase II RI Work Plan — Final

Geophysical Anomalies Soil Sampling Locations

Remedial Investigation, Site 1 – EOD Range

Date 11-01 | MCAS El Toro | Figure 2-2

Project No. 36097

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2.5.2 Station-wide Radiological Survey

The entire station is currently being surveyed for radioactive materials, using mobile and hand-held survey equipment (Weston 2000). Conclusions and recommendations of this evaluation pertaining to Site 1 will be incorporated into the RI, as appropriate.

2.5.3 Proposed Federal Agency-To-Agency Transfer

The Navy is considering that Site 1 will continue to be used for EOD training activities by a federal agency. In that event, a federal agency-to-agency property transfer may occur prior to the completion of the CERCLA process for Site 1. The property transfer will be preceded by an environmental baseline survey (EBS), the results of which will be used to prepare a finding of suitability to transfer (FOST).

2.5.4 Ordnance Explosive Range Evaluation

Site 1 is currently being evaluated by the range rule risk methodology (R3M). As part of this evaluation, an *Ordnance Explosives (OE) Range Evaluation Work Plan* and an addendum to the phase II RI health and safety plan (HSP) are being developed. The OE will address the investigation and handling of OE items encountered including potential unexploded ordnance (UXO) that may be present at Site 1. Field activities for this phase II RI and the OE evaluation will be conducted concurrently; UXO encountered during fieldwork for the phase II RI will be handled in accordance with the OE work plan and the addendum to the HSP.

2.6 ENVIRONMENTAL SETTING

2.6.1 Geology

Subsurface lithology at Site 1 consists of unconsolidated sand, silt, and clay overlying sandstone and siltstone bedrock. The conceptual site geology is provided on Figure 2-3. The locations of sections A-A' and B-B' are shown on Figure 2-1. A fault is present in the southwestern portion of the site (Figure 2-1) between the locations of 01_DGMW57 and 01_DGMW58 (California Division of Mines and Geology 1974). The fault depth and angle are unknown. Apparent relative movement was upward northeast of the fault and downward southwest of the fault. The thickness of the unconsolidated sand, silt, and clay increases toward the southwest, most notably on the southwestern side of the fault. Depth to bedrock is approximately 5 feet at 01MW101 and 01MW102, 17 feet at 01MW201, 20 feet at 01_DGMW58, and 70 feet at 01_DGMW57. Site 1 is surrounded by ridges of sandstone bedrock except for the southern boundary where the drainage converges with a tributary of Borrego Canyon Wash (Earth Tech 2000).

2.6.2 Hydrogeology

The EOD Range is within a tributary canyon to Borrego Canyon Wash. The site lies within the Irvine Subbasin, which is located southeast and adjacent to the Main Orange County Groundwater Basin. The Irvine Subbasin has been divided into a forebay area and a pressure area. The forebay area lies along the margin of the Basin where relatively shallow and coarse-grained sediments overlie semiconsolidated rock. The forebay area encompasses most of the base (Brown and Caldwell 1986). Recharge to the regional system takes place in the forebay area, primarily along washes such as the Borrego Canyon Wash that exit the Santa Ana Mountains. The pressure area lies in the central portion of the basin where productive aquifers are present mainly in deeper zones (BNI 1995a).

Groundwater in the shallow aquifer beneath Site 1 generally flows toward the south-southwest, consistent with site topography. Based on groundwater elevations measured in December 1999 and listed in Table 2-1, depth to groundwater ranges from approximately 20 feet at 01_MW202 to 105 feet bgs at 01_MW102. As indicated by the groundwater elevation contours shown on Figure 2-4, the groundwater gradient is generally towards the south-southwest with a hydraulic gradient ranging from approximately 0.03 feet per foot at the Southern EOD Range to 0.07 feet per foot at the Northern EOD Range, for an average gradient of 0.05 feet per foot. At the northernmost boundary of Site 1, groundwater appears to have a gradient component towards the west.

The current monitoring well network as shown on Figure 2-4, was designed to allow coverage of groundwater conditions beneath Site 1. This design is consistent with the inferred groundwater gradient direction along the longitudinal axis of Site 1, and includes two upgradient wells (01_MW102 and 01_MW101), three downgradient wells (01_MW207, 01_DGMW57, and 01_DGMW58), and a total of six wells (01_MW201 through 01_MW206) along the main groundwater flow path. Additionally, monitoring well 18_BGMW24 was installed approximately 700 feet from the site boundary in association with RI activities for Site 18 (regional VOCs groundwater investigation for on and off the Station). This well is also used to evaluate contaminant migration, if any, downgradient from Site 1. Monitoring wells 01_MW102, 01_MW201, 01_MW202, 01_MW204, 01_MW205, 01_MW206, and 01_MW207 are screened across the potentiometric surface; 01_MW101, 01_MW203, 01_DGMW57, 01_DGMW58, and 18BGMW24 are screened below the potentiometric surface. Based on data gathered from these wells, groundwater flows through the bedrock and the fault does not appear to serve as a flow barrier. Groundwater elevations measured in February 2001 are listed in Table 2-1, and a groundwater contour map is provided on Figure 2-4 (Earth Tech 2000).

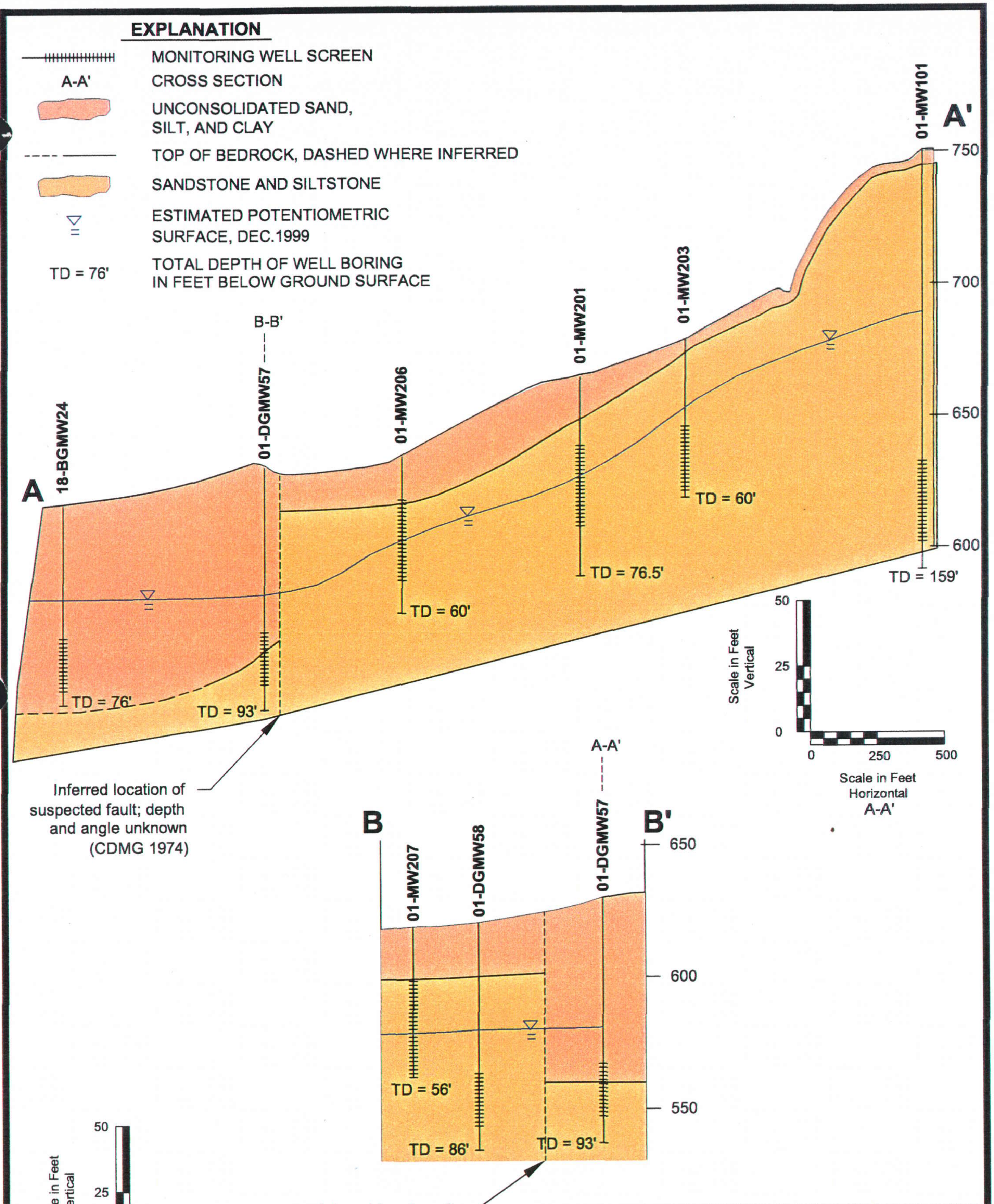
Table 2-1: Groundwater Elevations

Well	Depth to Water (feet below top of casing)	Elevation (02/01) (feet above mean sea level)
01_MW101	62.30	688.52
01_MW102	106.08	652.05
01_MW201	42.00	623.99
01_MW202	20.91	667.46
01_MW203	29.78	651.68
01_MW204	38.35	624.14
01_MW205	36.20	608.37
01_MW206	35.02	600.79
01_MW207	45.94	574.29
01DGMW57	54.65	576.52
01DGMW58	46.82	575.92
18BGMW24	40.48	577.65

Using an average hydraulic gradient of 0.050 feet per foot, a hydraulic conductivity value of 1.2 feet per day (JEG 1993b), and an assumed effective porosity value of 0.20, the calculated average groundwater linear velocity in the shallow aquifer at Site 1 is 0.30 foot per day.

2.6.3 Ecology

A habitat assessment was conducted at Site 1 on 20 December 2000. The preliminary results were used to characterize the habitat and identify potentially presence of impacted species, including any considered sensitive.



Phase II RI Work Plan — Final

Conceptual Site Geology

Remedial Investigation, Site 1 - EOD Range

Date: 11-01 | Project No. 36097 | MCAS El Toro | EARTH TECH, A tyco INTERNATIONAL LTD. COMPANY | Figure 2-3

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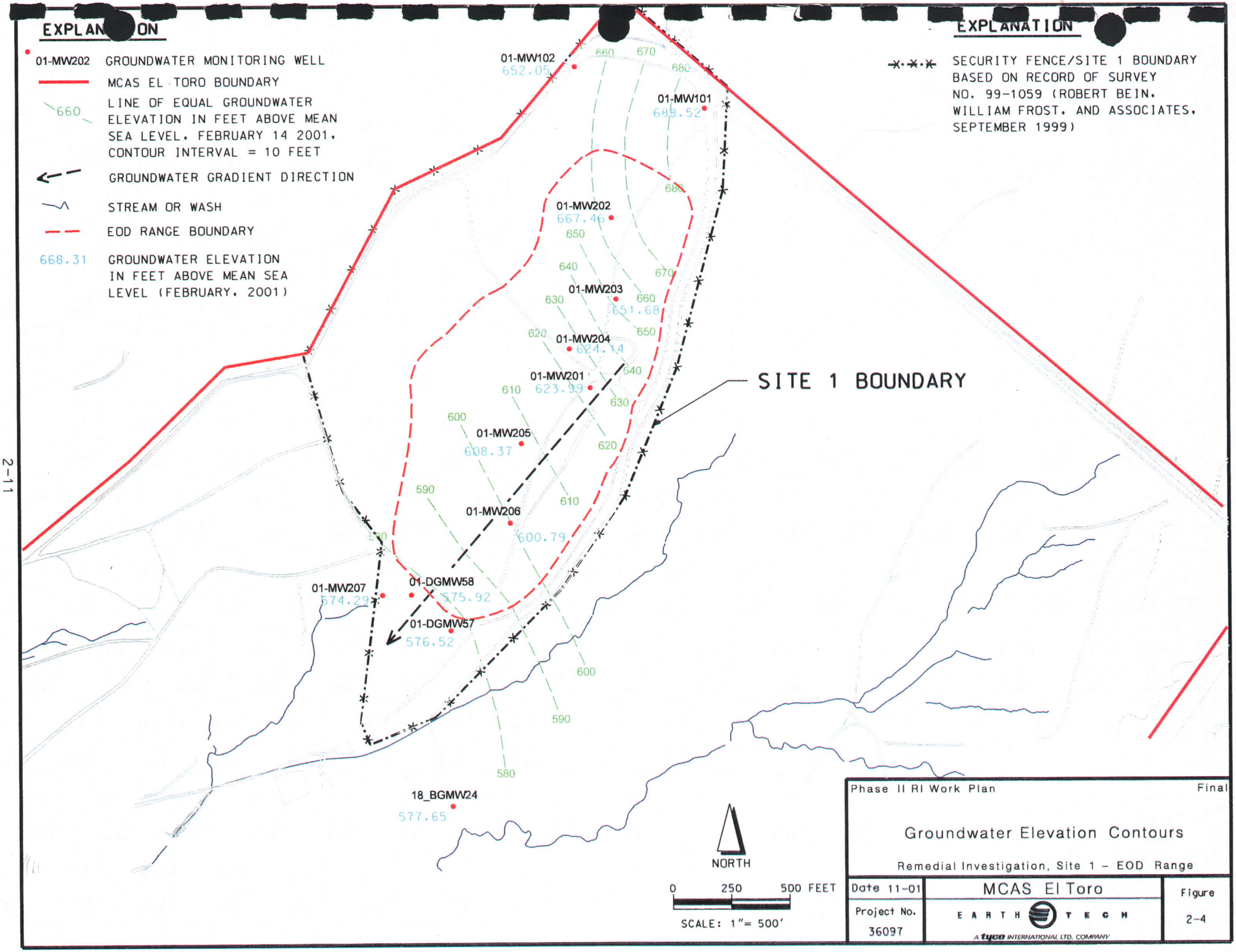

L:\REMEDIATION\NAVCLEAN\CTO-72\SITE1 RI\WORK PLAN\FINAL\FIGURE2-4.DGN

PAGE NO. 2-12

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2.6.3.1 FLORA

Sixty-eight plant species were observed, 27 of which (40 percent) are exotic or non-native species. It is expected that native and exotic species are underestimated by this survey because it was conducted during winter (December 2000). All of the species observed were typical for the southern California habitats present on site.

2.6.3.2 VEGETATION

The dominant vegetation types at Site 1 consist of non-native grassland coastal sage scrub (CSS), and toyon-sumac chaparral. There are also small areas of mulefat scrub, southern willow scrub, disturbed wetland, and ornamental plantings. The grassland is the most abundant vegetation type on site. It is composed of a variety of annual species including wild oat (*Avena* sp.), brome species (*Bromus* sp.), and mustard (*Brassica* sp.). There are also several native species scattered throughout this habitat type including annual burweed (*Ambrosia acanthicarpa*) and telegraph weed (*Heterotheca grandiflora*). The structure of the grassland appears to be related to how long since it was disturbed. In the areas where it has been recently disturbed by cultivation (e.g., along the fire breaks), the vegetation cover is sparse. In areas where there is no evidence of recent disturbance there is a dense thatch of annual grasses. Isolated shrubs, such as lemonadeberry (*Rhus integrifolia*) and deerweed (*Lotus scoparius*) also occur in the grassland. There are approximately 57 acres of non-native grassland on Site 1.

CSS occurs in patches on the slopes in the northern part of the property. It is typically dominated by California sagebrush (*Artemisia californica*), California encelia (*Encelia californica*), and California buckwheat (*Eriogonum fasciculatum*). Other common elements of this habitat type are prickly pear (*Opuntia littoralis*), black sage (*Salvia mellifera*), and goldenbush (*Isocoma menziesii*). The structure and composition of this habitat also appears to be a function of how long since it was disturbed. In some locations such as the west-facing slope above the main valley, the valley contains more succulents (e.g., prickly pear) than the other stands of sage scrub. The number and cover of annual species observed were limited, however, partly because of the dense canopy in some stands and partly due to the timing of the survey. There are approximately 9.74 acres of sage scrub on Site 1.

Toyon-sumac chaparral occurs primarily on the east-facing slopes above the main valley. On site, it is dominated by lemonadeberry. Subdominant elements of this vegetation type include toyon (*Heteromeles arbutifolia*) and laural sumac (*Malosma laurina*), and other CSS elements. It is a relatively tall (up to eight feet) and dense vegetation type and does not appear to have been disturbed or burned in recent times. There are approximately 2.63 acres of chaparral on Site 1.

Mulefat scrub is dominated by its namesake (*Baccharis salicifolia*) and occurs in two locations. One is in the vicinity of the bermed retention pond in the northern portion of the site. The other is along a flat graded section of a hillside, north of the main valley. This latter stand also supports an understory of exotic grasses. Mulefat scrub on Site 1 ranges up to 8 feet tall and covers an area of approximately 0.03 of an acre.

Southern willow scrub stands consist of a few individuals of black willow (*Salix gooddingii*) up to 25 feet tall. There is approximately 0.01 of an acre of southern willow scrub on Site 1.

Disturbed wetland occurs in the bottom of the bermed retention pond (perhaps a previous stockpond). It consists of a sparse cover of a variety of weedy and wetland species including mulefat, black willow, mustard, tocalote (*Centauria melitensis*), and soft chess (*Bromus hordeaceus*). There is approximately 0.29 of and acre of disturbed wetland on Site 1.

The berm, which is partly responsible for the creation of the above basin, is planted with fan palms (*Washingtonia robusta*) and pines (*Pinus* sp.). These are mature specimens with an understory of CSS and annual grassland species. There is approximately 0.18 of an acre of ornamental plantings on Site 1.

Developed areas are represented by small structures and total 0.05 of an acre on Site 1.

2.6.3.3 WILDLIFE

A total of 1 reptile, 1 amphibian, 36 avian, and six mammalian species were documented on the site. A complete listing of those species documented will be provided in the RI report. The limited number of reptiles and amphibians reflects a single midwinter survey.

2.6.3.4 SENSITIVE RESOURCES

Flora. No sensitive plant species were observed during this survey.

Vegetation. CSS is considered a sensitive vegetation type by several resource agencies because it supports a number of state and federally endangered, threatened, and rare vascular plants as well as several bird and reptile species that are federally listed or are candidate species for federal listing.

Wetland resources are also considered sensitive because of their scarcity in semi-arid southern California, their value to wildlife, and recent loss of this habitat from urbanization, agriculture, and flood control projects. The mulefat and southern willow scrubs and disturbed wetland are considered sensitive wetland habitats. Mulefat scrub is only considered sensitive where it occurs in a wetland landscape position (i.e., along drainages and not on level pads). There are very limited areas of these habitats on site, which limit their significance.

Potential Wetlands and Waters of the United States. The disturbed wetland and portions of the mulefat scrub and southern willow scrub may be subject to regulation under the Clean Water Act, as administered by the USACOE. Portions of the mulefat scrub and southern willow scrub may not be jurisdictional because they no longer occur in areas subject to wetland hydrology. All areas of these habitats would be delineated during the RI, following United States Army Corps of Engineers (USACOE) methods to determine their jurisdictional status.

Wildlife. Special status species include those listed by state and federal agencies (CDFG 1994; USFWS 1989, 1990, 1992, 1993) as endangered, threatened, rare, or of special concern. They also include species listed by Everett (1979).

Previous dry and wet sampling that was conducted during 1996 in the bermed retention pond revealed the presence of the Riverside fairy shrimp (*Streptocephalus woottoni*), which is a federally threatened species (KEA 1998). The presence of this species confers a high degree of sensitivity on this basin and its watershed.

During the generalized biological survey that was conducted during December 2000, the entire Site 1 was covered by foot using meandering transects. Each habitat type was examined for sign (i.e., tracks and scat) and regular five-minute stops were made to look and listen for birds and other wildlife. All observed species, either listed or considered sensitive, were noted.

Four coastal California gnatcatchers (*Polioptila californica californica*), which are a federally threatened species were documented on site. They consisted of one pair and two separate individuals of unknown gender.

Three individual cactus wren (*Campylorhynchus brunneicapillus*) were documented in a cactus patch within CSS in the northwestern quadrant of the site. This bird is a federally regionally sensitive species.

One non-vocalizing grasshopper sparrow (*Ammodramus savannarum*) was documented in non-native grassland in the north-central portion of the site.

Two southern California rufous-crowned sparrow (*Aimophila ruficeps canescens*) were documented in CSS in the north-central portion of the site (federally regionally sensitive).

Evidence (scat or feces) of San Diego black-tailed jackrabbit (*Lepus californicus bennettii*) was found in non-native grassland in the western portion of site between two patches of CSS.

2.7 SITE CHARACTERIZATION

2.7.1 Geophysical Assessment

The geophysical survey conducted at Site 1 in 1991 involved ground-penetrating radar (GPR) and electromagnetic (EM) techniques. The EM survey provided useful information on the location of historic operations (i.e., trenches, craters) and buried metallic objects (i.e., drums, vehicles) (BNI 1995a). The GPR survey did not provide responses to indicate the presence of buried wastes. A large portion of the EOD Range was not investigated during this survey (JEG 1991).

As part of the perchlorate investigation and a UXO clearance/avoidance exercise, a second geophysical survey was conducted during October and November 1999. This survey revealed numerous anomalies throughout the northern half of the range including a large anomaly at the northeast portion of the site. At this location, surface accumulation of large metallic debris was relocated using a bulldozer to survey the subsurface. Various anomalies detected throughout Site 1 appear linear in alignment, suggesting locations of former trenches (Figure 2-2) (Earth Tech 2000).

2.7.2 Surface Soil (0–1 feet bgs)

Phase I RI. Four surface soil samples (01_GN1 through 01_GN3, 01_UGS) were collected during the Phase I RI at depths up to 6 inches bgs at locations shown on Figure 2-1. Three samples were collected at random within the EOD Range, and one was collected upgradient of the site. All samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), total recoverable petroleum hydrocarbons (TRPH), total fuel hydrocarbons (TFH), target analyte list (TAL) metals, general chemistry, dioxins, and furans. It was reported in the *Phase II RI/FS Draft Work Plan* (JEG 1993b) that none of the analytes exceeded applicable human health or ecological criteria. The *Phase I RI* report (JEG 1993a) stated that low levels of fuel hydrocarbons were detected (TFH-gasoline and TFH-diesel), as well as low concentrations of VOCs (carbon tetrachloride and toluene); SVOCs, pesticides, PCBs, dioxins, and furans were not detected. All concentrations are below current applicable EPA Region IX residential preliminary remediation goals (PRGs) (EPA 2000). The summary of analytical results is provided below. The less-than symbol (<) before values indicates that the chemical was not evidenced at that detection limit.

1. VOCs: toluene (<10 to 6 micrograms per kilogram [µg/kg]) and carbon tetrachloride (<10 to 2 µg/kg).
2. General chemistry: ammonia-N (5.94 to 9.75 milligrams per kilogram [mg/kg]); nitrate-N (0.65 to 1.53 mg/kg); and, total Kjeldahl nitrogen (359 to 874 mg/kg).
3. Fuel and petroleum hydrocarbons: TFH-gasoline (<0.05 to 0.22 mg/kg); TFH-diesel (19.4 to 61.6 mg/kg); and TRPH (<20 to 147 mg/kg).
4. Metals: 16 of 23 TAL metals (aluminum, barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, potassium, selenium, sodium, vanadium, and zinc were detected at concentrations below the background sample).

Perchlorate Verification Study. Three surface samples (SS-01, SS-02, and SS-03; locations shown on Figure 2-2), were collected at topographic depressions to evaluate the presence of contaminants due to deposition via surface runoff. Perchlorate was detected in SS-02 at a concentration of 320 µg/kg. The samples were also analyzed for total petroleum hydrocarbons (TPH) as motor oil, diesel, and gasoline as a rough indicator of the possible presence of other contaminants (fuels being commonly used in EOD activities to detonate or burn the munitions). Detected concentrations of TPH as motor oil ranged from 15 to 59 mg/kg and detected concentrations of TPH as diesel ranged from 2 to 27 mg/kg. TPH as gasoline was not reported above laboratory detection limits. Appendix B contains the summary of analytical results for soil samples.

2.7.3 Shallow Soil (1–10 feet bgs)

Perchlorate Verification Study. Soil samples were collected at anomaly locations identified by the geophysical survey. Twenty-eight samples (HA-01 through HA-014, 1ft and 5ft) were collected using a hand auger at 14 locations (2 per location) from depths of approximately 1.5 feet to 4.5 feet bgs. The sample locations are shown on Figure 2-2. All samples were analyzed for perchlorate, TPH (motor oil, diesel, and gasoline ranges), and VOCs. Nine samples were analyzed for general chemistry (pH and nitrate as nitrogen), metals, SVOCs, and explosives. Four samples were analyzed for dioxins/furans. The detected concentrations did not exceed the applicable residential PRGs for any of the analytes.

Appendix B provides a summary of analytical results. A summary of the analytical results for analytes that were detected above the respective reporting limits is provided below.

1. Perchlorate: Detectable concentrations were found in 3 of the 28 samples (29 µg/kg in HA07 at a depth of 4 feet; 110 µg/kg in HA08 at a depth of 1.5 feet; and 210 µg/kg in HA08 at a depth of 3.5 feet).
2. SVOCs: Di-N-butyl phthalate (971 µg/kg in HA09 at a depth of 4 feet bgs).
3. General chemistry: nitrate-N (<220 to 2,700 mg/kg), maximum concentration at HA04 and HA09; and, pH (6.54 in HA14 at 4 feet bgs to 8.97 in HA06 at 4.5 feet bgs).
4. Dioxins and Furans: Toxicity equivalency quotient (TEQ) values of 0.57, 1.07, 2.3, and 0.65 nanograms per kilograms (ng/kg-parts per trillion, dry weight) were calculated for samples HA01, HA09, HA09 (duplicate), and HA14 respectively. The TEQ values were calculated from the toxicity equivalency factors (TEFs) (WHO 1997) for the individual compounds. In accordance with standard practice for risk assessment, a concentration equal to one-half the reported detection limit was used for compounds reported below detection limits to calculate the TEQs. All four samples were reported with TEQ values below the PRG for residential and industrial soil (3.9 and 27 mg/kg, respectively).
5. Metals: A summary of metals concentration in shallow soil is provided in Table 2-2.

Table 2-2: Shallow Soil Metals Concentration

	Concentration	
Metal	Range (mg/kg)	Location of Maximum (feet bgs)
Aluminum	3,580 to 7,290	HA08 at 3.5
Antimony	1.2	HA09 at 4
Arsenic	0.7 to 1.1	HA04 at 3.5
Barium	30.1 to 54.1	HA09 at 1.5

Table 2-2: Shallow Soil Metals Concentration

Metal	Concentration: Range (mg/kg)	Concentration: Location of Maximum (feet bgs)
Beryllium	0.36 to 0.9	HA01 at 4
Cadmium	0.26 to 5.2	HA04 at 3.5
Calcium	2,090 to 12,890	HA06 at 4.5
Chromium	1.8 to 5.2	HA09 at 4
Cobalt	0.67 to 1.4	HA08 at 3.5
Copper	1.9 to 234	HA09 at 4
Iron	2,190 to 4,730	HA06 at 4.5
Lead	0.68 to 133	HA09-duplicate at 1.5
Magnesium	993 to 1,350	HA08 at 3.5
Manganese	25.6 to 84	HA04 at 3.5
Nickel	0.84 to 96	HA04 at 3.5
Potassium	430 to 769	HA04 at 3.5
Selenium	1.4 to 1.8	HA06 at 4.5
Silver	***All results below reporting limits***	
Sodium	66.5 to 149	HA09 at 4
Thallium	***All results below reporting limits***	
Vanadium	4.1 to 6.7	HA04 at 3.5
Zinc	5.7 to 772	HA04 at 3.5
Mercury	0.53 to 10.6	HA09-duplicate at 1.5

Notes:
mg/kg = milligrams per kilogram; bgs = below ground surface; HA = hand-auger sample identification

Soil samples were also collected from the monitoring well boreholes. Six samples collected at depths of 5 feet and 10 feet bgs were analyzed for perchlorate: no detectable concentrations were present.

2.7.4 Subsurface Soil (deeper than 10 feet bgs)

Phase I RI. Soil samples were collected from the monitoring well boreholes 01_DGMW57 and 01_DGMW58. Two samples from depths of 40 and 30 feet bgs were analyzed for VOCs, SVOCs, TRPH, TFH, TAL metals, general chemistry, dioxins, and furans. All analytes except metals were reported with concentrations below detection limits, with the exception of 2-butanone (2 and 4 mg/kg). Because boreholes 01_DGMW57 and 01_DGMW58 were originally outside the boundaries of Site 1, there was no comparison of the results to applicable human health or ecological criteria in the *Phase II RI/FS Draft Work Plan* (JEG 1993b). However, the *Phase I RI* report (JEG 1993a) stated that no organic chemicals (except minor concentrations of VOCs) were detected in the subsurface samples collected from boreholes 01_DGMW57 and 01_DGMW58. A comparison to current applicable EPA Region IX residential PRGs (EPA 2000) indicates that none of the analytes exceeded residential PRGs, with the exception of arsenic.

Arsenic was detected above residential and industrial PRGs and background concentrations (95th quantile). This was verified with comparison to EPA Region IX's current PRGs (EPA 2000a). However, the maximum concentration of 3.4 mg/kg was well below the 95th quantile of 6.86 mg/kg. The borehole locations where subsurface soil samples were collected (01_DGMW57 and 01_DGMW58) were outside the Site 1 EOD Range boundary.

Perchlorate Verification Study. Selected monitoring well bore soil samples collected from depths of 15 feet to 35 feet bgs were analyzed for perchlorate. All samples were reported with concentrations below the reporting limit for perchlorate. Reporting limits varied between < 22 and < 28 μg/kg.

2.7.5 Groundwater

Phase I RI. Groundwater samples from monitoring wells 01_DGMW57 and 01_DGMW58 were analyzed for VOCs, SVOCs, TRPH, TFH, TAL metals, pesticides/polychlorinated biphenyls (PCBs), general chemistry, dioxins and furans, and gross alpha and beta. The summary of the analytical results is provided below. The less-than values < indicates that the chemical was not evidenced at that detection limit.

1. VOCs: chloromethane (<2 to 0.7 micrograms per liter [μg/L]), maximum concentration at 01_DGMW57 and 01_DGMW58.
2. SVOCs: bis (2-ethylhexyl) phthalate (<10 to 49 μg/L), maximum concentration at 01_DGMW57.
3. General chemistry: Nitrate/nitrite-N (1.66 to 7.66 milligrams per liter [mg/L]), maximum concentration at 01_DGMW58; and total dissolved solids (TDS) (429 to 808 mg/L), maximum concentration at 01_DGMW57.
4. Metals: Arsenic (<1.4 to 1.4 μg/L), maximum concentration at 01_DGMW58); nickel (12.6 to 110 μg/L), maximum concentration at 01_DGMW58; and manganese (2.4 to 74.7 μg/L), maximum concentration at 01_DGMW57.
5. Gross alpha and beta: gross alpha (5.8 to 7.5 picoCuries per liter [pCi/L]), maximum concentration at 01_DGMW57; gross beta (6.6 to 12.2 pCi/L), maximum concentration at 01_DGMW58.

Perchlorate Evaluation Study. Hydropunch groundwater samples that were collected at MCAS El Toro between January and March 1998 were reported with concentrations ranging from 4 to 23 μg/L (BNI 1998).

Groundwater sampling and analysis for perchlorate was conducted during October 1998 and May 1999 at Site 1 (BNI 1999c; Earth Tech 2000). Perchlorate concentrations of 280 and 380 μg/L were reported at well 01_MW201 for the two events, respectively. All other wells sampled were reported with concentrations below reporting limits or below the California provisional action level (PAL) of 18 μg/L (DHS 1999) and the EPA action level of 32 μg/L (EPA 1999a). The perchlorate concentrations in groundwater from these investigations are summarized in Table 2-3.

Table 2-3: Groundwater Perchlorate Concentrations

Well ID	October 1998 (μg/L)	May 1999 (μg/L)	July–August 1999 (μg/L)	November 1999 (μg/L)
01_MW101	<4	<4	<4	<4
01_MW102	NS	<4	<4	<4
01_MW201	280	380	350	324
01_MW202	NA	NA	NA	<8
01_MW203	NA	NA	NA	<10
01_MW204	NA	NA	NA	<6
01_MW205	NA	NA	NA	<4
01_MW206	NA	NA	NA	<4
01_MW207	NA	NA	NA	7
01_DGMW57	<4	<4	<4	<4

01_DGMW58	NS	17	5	7
18_BGMW24	NS	NS	NA	<4

Notes: NS = not sampled; NA = not applicable

Perchlorate Verification Study. The November 1999 sampling results are presented in Figure 2-3. Based on this study the following were concluded (Earth Tech 2000):

1. Perchlorate was detected in one groundwater sample in excess of the state and federal PALs of 18 µg/L and 32 µg/L, respectively.
2. Perchlorate in groundwater at concentrations exceeding the state and federal PALs is localized near 01_MW201.
3. The calculated average groundwater velocity at the downgradient boundary of Site 1 is 0.05 feet per day toward the south-southwest.

3. WORK PLAN APPROACH

3.1 INITIAL EVALUATION

A conceptual site model for Site 1 was developed based on the initial evaluation presented in the *Draft Phase I RI Technical Memorandum* and the *Phase II RI Work Plan* (JEG 1993a; BNI 1995a). Updated information on waste sources, pathways, and receptors at the site were used to develop a conceptual understanding of the site to evaluate potential risks to human health and the environment.

Figure 3-1 illustrates the conceptual site model (CSM), and Figure 3-2 identifies the potential exposure routes and pathways for human and ecological receptors.

3.1.1 Sources and Release Mechanisms

Potential contaminants have been released in the shallow soil as a result of EOD operations. The primary source includes munitions, explosives, and combustion and petroleum fuels. The primary release mechanism is related to the EOD training that involved detonation of munitions in trenches and pits, which were continually filled with soil and reexcavated. The topsoil was frequently disked for weed control, which resulted in disturbance of the near surface soil.

The secondary source is the soil that has been impacted due to the primary release. The previously identified secondary release mechanism involving the dust produced by explosion and any burning (BNI 1995a) is not applicable due to the cessation of EOD training and related activities at Site 1. Storm water runoff and resulting percolation is a potential secondary release mechanism. The tributary to Borrego Canyon Wash is the closest surface water feature to serve as a pathway. Observations by Earth Tech personnel following storm events indicate that runoff in this wash is minimal to nonexistent. Additionally, a hydrologic evaluation based on a 100-year storm, for the topographically depressed area (including the bermed retention pond) located at the northern boundary of the Northern EOD Range indicated that the total predicted storm volume is well below the capacity of the depression. The occurrence of ponding at this location will be evaluated following significant storm events.

3.1.2 Exposure Pathways

The potential pathways for human and ecological receptors are direct contact with soils, air, groundwater, and surface water/sediments runoff.

Airborne contaminants are primarily transported through volatilization and fugitive dust emissions from site surfaces. Both volatilization and fugitive dust release are considered insignificant human and ecological exposure pathways because VOCs and other analytes evaluated from shallow soil sampled at depths less that 5 feet bgs were reported at either non-detectable levels or levels less than EPA Region IX PRGs. It is inferred from this information that exposure via the inhalation route is insignificant and that the air pathway is incomplete. Analytical results from the Phase II RI will be used to confirm this inference.

Groundwater is considered beyond the reach of ecological receptors unless it discharges to the surface. Because it does not reach the surface on the site or in the immediate area, the groundwater pathway is considered incomplete for ecological receptors.

Surface water runoff is dependent on the amount of rainfall, the type of contaminant, topography, and soil properties such as infiltration rates. Based on relatively rapid recharges to groundwater following documented storm events (JEG 1993a), Site 1 has been characterized as having limited runoff. Therefore, surface water will be considered at this time as a potential pathway, which will be evaluated through surface runoff sampling following three storm events. These data will be used to evaluate surface water concentrations at the upstream end of Site 1 (retention pond) and at a downgradient location within the wash (tributary to Borrego Canyon Wash). Concentrations detected in surface water runoff samples from each storm event will be compared to groundwater quality criteria.

In summary, pathways warranting further consideration are

- Soil pathway for both human and ecological receptors
- Groundwater pathway for human receptors only
- Surface-water pathway for both human and ecological receptors

3.1.3 Land Use and Receptors

Land use at the site was industrial. Although residential use exists in proximity to MCAS El Toro, there is no residential land use near Site 1. Therefore, there are no residential receptors at or near Site 1 that would be exposed to site contamination. The site is currently fenced and locked, and unauthorized visitors are prohibited. Hence, authorized visitors and escorts are the only current human receptors on the site. Preliminary reuse scenarios proposed for Site 1 do not include residential use. Thus, potential future human receptors at the site only include industrial workers, construction workers, and agricultural workers. As needed, institutional controls will be implemented to ensure that these scenarios are valid. In summary, human receptors for consideration are

- Current workers and authorized visitors, and
- Future industrial, construction, and agricultural workers.

Wildlife and plants are potential ecological receptors. Ecological receptors will be updated based on the habitat assessment currently under way. The California gnatcatcher and the Riverside fairy shrimp are present at the site and will be considered as receptors.

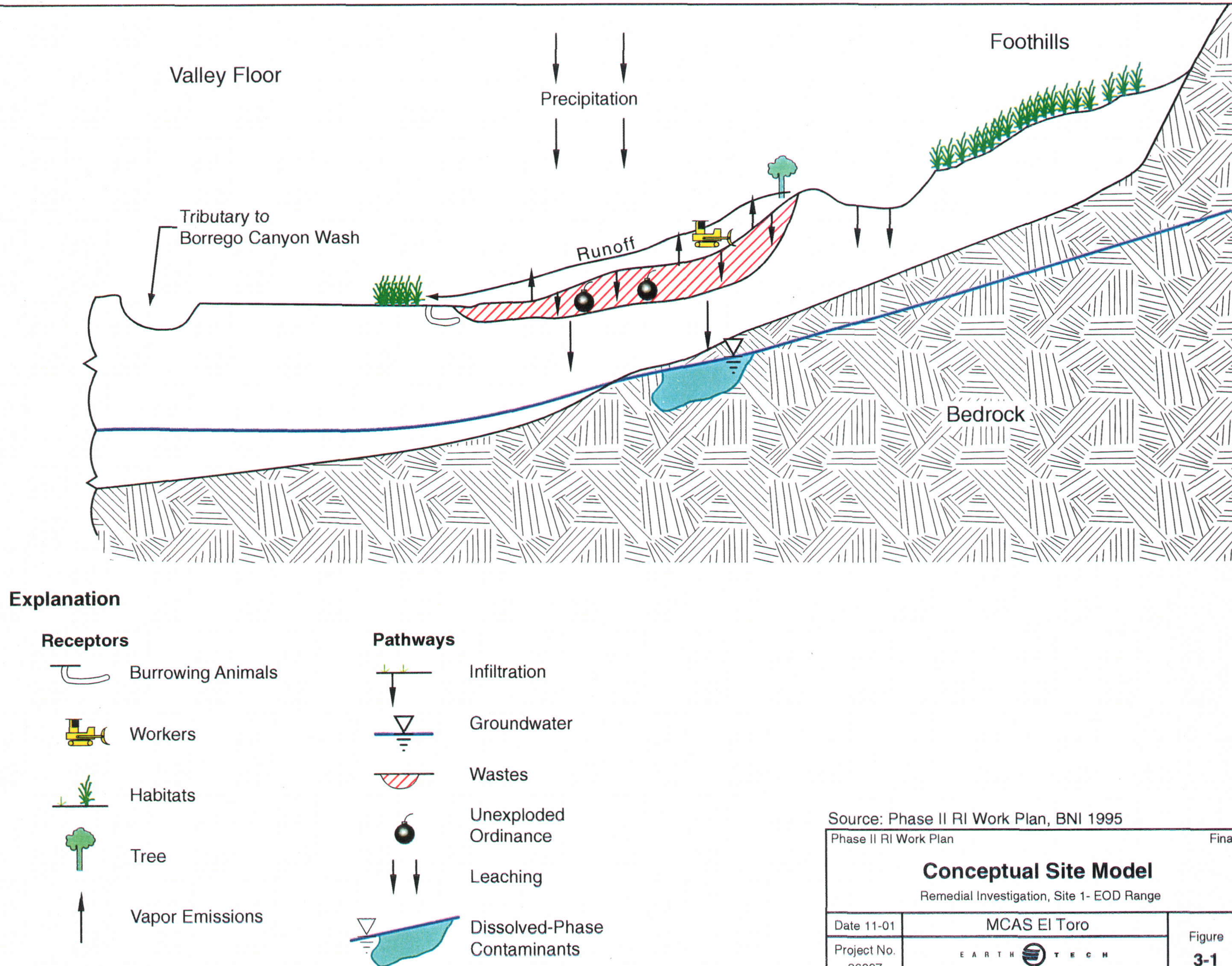
3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA

RI must comply with CERCLA, as amended by SARA and the NCP (40 CFR Part 300). CERCLA requires cleanup response actions to protect human health and the environment, to be cost-effective, and to comply with applicable or relevant and appropriate requirements (ARARs), and to-be-considered (TBC) criteria.

Definitions. ARARs and TBCs governing actions at CERCLA sites fall into three categories, depending on the chemical contaminants, site characteristics and location, and proposed cleanup action:

- *Chemical-specific* ARARs and TBCs establish numerical standards limiting the concentration of substances in the medium of concern or medium affected by a cleanup action.
- *Location-specific* ARARs and TBCs refer to restrictions placed on the concentration of substances or conduct of a cleanup action due to site location.
- *Action-specific* ARARs and TBCs deal with technology- or activity-based restrictions controlling the performance and design standards of a specific cleanup action.

ARARs. Requirements may be either *applicable* or *relevant and appropriate*. Applicable requirements are federal, state, and local standards that regulate the remediation (sampling, cleanup) at the site. Applicable requirements meet all legal prerequisites and are site-specific. ARARs are identified based on the following considerations:



Source: Phase II RI Work Plan, BNI 1995

Phase II RI Work Plan	**Conceptual Site Model** Remedial Investigation, Site 1- EOD Range	Final
Date 11-01	MCAS El Toro	Figure **3-1**
Project No. 36097	EARTH TECH A tyco INTERNATIONAL LTD. COMPANY	

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Contaminant Source	Transport Mechanism	Exposure Route	Potential Receptors[1]: Onsite Industrial Workers	Onsite Construction Workers	Offsite Agricultural Workers	Onsite Ecological Receptors	Rationale/Data Needs
Surface Soil	Direct Contact	Dermal Absorption	Potentially Complete	Potentially Complete	Incomplete	Insignificant	Direct contact with surface soil is potentially complete for future industrial workers and construction workers and ecological receptors (current and future).
		Incidental Ingestion	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	
		Bio-accumulation/ Consumption of Food	Incomplete	Incomplete	Incomplete	Potentially Complete	
	Air Transport	Inhalation of VOCs	Insignificant	Insignificant	Insignificant	Insignificant	Air pathway for VOCs is insignificant for all receptors, since VOCs are not present in soil. Inhalation of contaminated dust is potentially complete for all onsite human receptors.
		Inhalation of Particulates	Potentially Complete	Potentially Complete	Incomplete	Insignificant	
	Surface Water Runoff	Dermal Absorption	Potentially complete	Potentially complete	Potentially complete	Potentially complete	Surface water runoff and transport of dissolved contaminants is unlikely due to high infiltration rates and is considered insignificant because there are no surface water bodies which contribute to runoff within the site.
		Incidental Ingestion	Potentially complete	Potentially complete	Potentially complete	Potentially complete	
		Inhalation of VOCs	Potentially complete	Potentially complete	Potentially complete	Potentially complete	
		Bio-accumulation/ Consumption of Food	Potentially complete	Potentially complete	Potentially complete	Potentially complete	

Figure 3-2
Conceptual Site Model - Potential Exposure Scenarios
Final Work Plan-Phase II Remedial Investigation
Site 1-Explosive Ordinance Disposal (EOD) Range, MCAS El Toro

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Contaminant Source	Transport Mechanism	Exposure Route	Industrial Workers	Construction Workers	Agricultural Workers	Ecological Receptors	Rationale/Data Needs
			Potential Receptors[1]				
Subsurface Soil	Unsaturated/ Saturated Zone Transport to Leachate to Groundwater	Dermal Absorption	Potentially Complete	Potentially Complete	Potentially Complete	Incomplete	Exposure to groundwater is potentially complete for all workers if groundwater is pumped for agricultural use or becomes a *future source of* drinking water. Inhalation of VOCs is insignificant for all receptors, since VOCs are not present in soil.
		Incidental Ingestion	Potentially Complete	Potentially Complete	Potentially Complete	Incomplete	
		Inhalation of VOCs	Incomplete	Insignificant	Incomplete	Incomplete	
		Bio-accumulation/ Consumption of Food	Potentially Complete	Potentially Complete	Potentially Complete	Incomplete	
	Direct Contact	Dermal Absorption	Potentially Complete	Potentially Complete	Incomplete	Insignificant	Direct contact with subsurface soil is potentially complete for construction workers, recreational users, and industrial workers if future construction work brings subsurface soil to the surface. Exposure of ecological receptors is assumed to be insignificant in areas of industrial development due to disruption of habitat.
		Incidental Ingestion	Potentially Complete	Potentially Complete	Incomplete	Insignificant	

Note: [1] Ecological receptors and offsite agricultural well users are present for current and potential future use conditions; all other receptors are for potential future use conditions.

Figure 3-2 (continued)
Conceptual Site Model - Potential Exposure Scenarios
Final Work Plan-Phase II Remedial Investigation
Site 1- Explosive Ordinance Disposal (EOD) Range, MCAS El Toro

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- The regulatory authority and the statute or regulation;
- The types of tasks the statute or regulation requires, directs, or prohibits;
- The types of substances or tasks falling under the authority of the requirement;
- The period during which the statute or regulation is in effect.

When requirements do not apply directly to a site or task, they may still be relevant and appropriate if they pertain to problems resembling those at the site. Such requirements are identified by comparing the circumstances at the site with the requirements of a particular jurisdiction. It is possible for only a part of a requirement to be relevant and appropriate. Relevant and appropriate requirements are identified with some discretion based on the following considerations:

- Type of cleanup action,
- Contaminants present,
- Waste characteristics,
- Physical characteristics of the site.

TBCs. TBCs are advisory, not mandatory, and their application is subject to discretion. TBCs are used when no requirements apply to the particular situation or circumstance. They may also be used to set standards when ARARs do not adequately protect human health or the environment. TBCs may become compliance standards for a proposed cleanup remedy.

Table 3-1 identifies the chemical-, location-, and action-specific ARARs and TBCs for IRP Site 1-EOD Range and defines them by the type to be evaluated.

Table 3-1: Site ARARs and TBCs

ARAR or TBC[1]	Requirement or Description	Citation	Status
Chemical-Specific			
EPA Region IX PRGs	Chemical concentrations in soil, air, and water that can be used as screening levels or triggers for further investigation	EPA Region IX PRGs, 2000	TBC
Migration Guidelines	Chemical soil concentrations used to assess the potential for migration of contaminants from soil to groundwater	EPA Region IX Soil Screening Levels (SSLs), 2000	TBC
Cal-EPA Department of Toxic Substances Control	Definition of a non-RCRA hazardous waste	22 CCR 66261	ARAR
Cal-EPA Toxicological Database	Chemical-specific human health effects used to derive Cal-EPA toxicity criteria	Cal-EPA Region IX Toxicity Criteria	TBC
EPA Integrated Risk Information System (IRIS) Toxicity Criteria Database	Chemical-specific human health effects used to derive EPA toxicity criteria	EPA Toxicity Criteria	TBC
Safe Drinking Water Act: National Primary Drinking Water Regulations-MCLs	Maximum permissible level of a contaminant in water that is delivered to any user of a public water system	40 CFR 141.12, 141.16, 141 Subpart F	ARAR
RCRA– Groundwater Protection	Vadose zone and groundwater protection requirements under RCRA that include concentration standards	22 CCR 66264.94	ARAR
California Water Code (Porter Cologne Water Quality Control Act)	Standards to protect public water supplies from contamination and to require the provision of safe drinking water for public consumption	Division 7, Section 13240 and 13241	ARAR

Table 3-1: Site ARARs and TBCs

ARAR or TBC[1]	Requirement or Description	Citation	Status
Water Quality Control Plan-Santa Ana River Basin	Establishes beneficial use designations of groundwater, water quality objectives, and incorporates statewide water quality plans and policies	CRWQCB Santa Ana Region Resolution No. 94-1	ARAR
Location-Specific			
Endangered Species Act	Protects critical habitat upon which endangered species or threatened species depend	16 USC 1536(a) 50 CFR 402	ARAR
Migratory Bird Treaty Act	Prevents taking of migratory birds' nests or eggs without special permits	16 USC Section 703 et seq.	ARAR
Action-Specific			
RCRA– Waste generation	Generator of waste must determine if waste is hazardous. 90-day rule for onsite hazardous waste storage Requirements for transportation	42 USC Section 6901 et seq. 22 CCR 66262	ARAR

Note:
[1] Statutes and policies and their citations, if referenced, are provided to identify general categories of potential ARARs. The listings do not indicate that the Navy accepts entire statutes or policies as potential ARARs. Specific ARARs will be identified during the course of the RI, in consultation with the BCT, and presented with the substantive requirements of the identified citations.

ARAR = applicable or relevant and appropriate requirement
TBC = to be considered
EPA = Environmental Protection Agency
PRG = preliminary remediation goal
SSL = soil screening level
RCRA = Resource Conservation and Recovery Act
CCR = California Code of Regulations
IRIS = Integrated Risk Information System
MCL = maximum contaminant level
CRWQCB = California Regional Water Quality Control Board
CFR = Code of Federal Regulations
USC = United States Code
RI = remedial investigation
BCT = BRAC Cleanup Team

While radionuclides and UXO represent potential risks at this site, the investigation and inclusion of them as ARARs and TBCs will be carried out as part of the planned, concurrent investigations discussed in Section 2.5.

3.3 Data Quality Objectives

The project plan has been developed using the DQO process (EPA 2000b). Relevant elements of the DQOs that were formulated and presented in the earlier work plans for the phase II RI have been incorporated in this plan.

3.3.1 Problem Statements

1. Site 1 was used for EOD training and detonation of munitions for more than 40 years. The consequential impact to the subsurface has not been adequately evaluated.
2. Current soil data are not adequate to comprehensively identify the presence of chemicals of potential concern (COPCs) or evaluate human health and ecological risk posed by the site.
3. Potentially sensitive habitats may be present at Site 1. A habitat assessment to characterize the ecological receptors has not been completed.
4. Geophysical surveys conducted during the Phase I RI (JEG 1991) and the Perchlorate Verification Study (Earth Tech 2000) have identified several anomalies that require further investigation.
5. Perchlorate concentrations in excess of regulatory threshold levels were found in well (01_MW201); however, the source of perchlorate has not been identified. Additionally, the possible presence of N-nitrosodimethylamine (NDMA), which is associated with rocket fuel, needs to be investigated.

3.3.2 Project Decisions

Study Question. Does the site pose an unacceptable risk to human health or the environment? Is a remedial response consistent with CERCLA and the Navy's IRP/BRAC process required?

To resolve the principal study question, the following decision questions will be considered:

1. Are the analytical data from shallow (less than 10 feet bgs) soil samples adequate to characterize the risk, or are additional data required?
2. Has the lateral extent of the impacted shallow soil been defined or are additional data required?
3. Does the contamination extend beyond 10 feet bgs or is the vertical extent defined?
4. Do the existing groundwater monitoring wells adequately characterize impact to groundwater or is there a need for additional wells?
5. Is surface water due to runoff an exposure pathway?
6. Have potential human and ecological receptors been identified, and are they likely to be at risk for adverse health effects at this site?

3.3.3 Decision Inputs

Sampling performed at Site 1 in the course of this investigation will be used to resolve the decision statements. The critical data that will serve as input to the decisions are listed below.

1. Soil concentrations of analytes which are expected to be characteristic of releases during EOD operations will be used to determine COPCs. The chemical groups of analytes are metals, general chemistry, explosives, VOCs, SVOCs, dioxins, furans, and petroleum hydrocarbons. The type of materials that were used during training activities (discussed in Section 2.2) is presented here under a contaminant group with the corresponding analysis approach.

Contaminant Group	Analysis approach
Ordnance/munitions/explosives	Explosives, metals, perchlorate
Fuels	Fuel hydrocarbons, VOCs, SVOCs
Combustion byproducts	Dioxins, SVOCs
FS Smoke	pH

Target analytes within chemical groups are listed in the quality assurance project plan (QAPP).

The presence of radioactive materials will be assessed in accordance with a separate work plan (Weston 2000).

2. Previous soil and groundwater sample analytical data will be incorporated into the sampling and analysis program.
3. Results of the geophysical survey that was conducted as part of the perchlorate verification study.
4. The following threshold levels will be used to compare the concentrations of target analytes:
   - MCAS El Toro area background metals concentrations for soil. Background threshold for metals were developed and presented in the *Final Technical Memorandum, Background and Reference Levels, RIs* (BNI 1996). Concentrations of analytes that exceed the background threshold will be compared to the residential and industrial soil PRGs.

- EPA Region IX (California [Cal]-EPA modified) PRGs and soil screening levels (SSLs) for industrial and residential use scenarios for soil for all analytes except metals, which will be initially compared to established background thresholds.
- Federal and California maximum contaminant levels (MCLs) for drinking water, where available. In the absence of MCLs, EPA Region IX PRGs for tap water will be used.
- California DHS action levels for perchlorate (18 µg/L) and NDMA (2 nanograms per liter [ng/L]).
- Target compounds for dioxin and dioxin-like compounds will be the analytes in the World Health Organization (WHO) list of compounds. TEFs are shown in Table 3-2. The product of the analyte concentration and its associated TEF will be compared with the industrial and industrial soil PRG for the dioxin 2,3,7,8-tetrachlorodibenzodioxin (2,3,7,8-TCDD), as well as current EPA Office of Solid Waste and Emergency Response (OSWER) guidance for the evaluation of dioxin contamination in residential and industrial settings.

Table 3-2: Target Analyte List and TEFs

Analyte	WHO (1997) TEFs[1]
2,3,7,8-TCDD	1
1,2,3,7,8-PCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,7,8,9-HpCDD	0.01
OCDD	0.0001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PCDF	0.05
2,3,4,7,8-PCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.001

Note:
[1] World Health Organization (WHO) (1997) Toxicity Equivalency Factors (TEF)
CDD = chlorodibenzodioxin,
CDF = chlorodibenzofuran
In general, the prefixes that accompany these suffixes are as follows:T = tetra, Pe = penta, Hx = hexa, Hp = hepta, O = octa

5. The risk assessment approach developed and presented in the *Final Risk Assessment Work Plan* (BNI 1995b) was approved by the BCT. The following information will be incorporated into the assessment:
   - Results of habitat assessment,
   - Proposed future use of Site 1 in accordance with the *MCAS El Toro Community Reuse Plan* and associated exposure scenarios.

6. Regulatory review.

3.3.4 Study Boundaries

The EOD Range at Site 1 was considered as one stratum or study area during the Phase I RI. *The Final Phase II RI/FS Work Plan* (BNI 1995a) divided the EOD Range at Site 1 into two units or study areas. The combined areas of the two units have the same boundary as stratum 1 of the Phase I RI. This demarcation was made following MCAS El Toro employee interviews by the BCT team during May 1994 (BNI 1995a). Accordingly, the following two study areas will constitute the EOD Range:

- Northern EOD Range (approximately 737,250 square feet) where the majority of the recent military training exercises took place (Figure 2-1).
- Southern EOD Range (approximately 721,600 square feet) where ordnance training by the Orange County Sheriff's Department and federal agencies took place (Figure 2-1).

Considering the Northern and Southern EOD Ranges as discrete study areas will allow for separate characterization of the risk associated with each range. This approach will enable the Navy to make reuse decisions based on site use history and future use plans.

The scope of this study is intended to reflect measurable impacts from past uses of the site and will address the future planned uses of the site, based on the *current* understanding of those uses. The Phase II sampling will be conducted over a continuous six-month period; the project schedule is shown on Figure 5-2.

3.3.5 Decision Rules

The simplified decision rule flowchart for this investigation is presented on Figure 3-3. Decisions presented are discussed below, and the corresponding decision question(s) that will be resolved is listed in parenthesis:

1. ***If*** the evaluation of shallow soil (less than 10 feet bgs) analytical data indicate that the site soils have not been adequately characterized (with respect to threshold levels) to make the decisions with the specified statistical confidence, ***then*** additional soil sampling will be performed (decision question 1).

   Analytical data will be from soil samples collected during the Phase II RI and previous investigation studies, and will be evaluated against the decision criteria specified in the QAPP. Target analytes not detected in prior sampling events and with no reasonable expectation of being present will be removed from the target analyte lists.

2. ***If*** an analyte is detected, ***then*** it will be evaluated for the potential to have been the result of past uses of the site by EOD operations and be considered as a site-specific COPC (decision questions 1, 2, 3).

   Target analytes (natural or anthropogenic background) resulting from non-site-related activities will be flagged as non-site related and not carried into the risk screening phase. Target analytes, which are detected and can be associated with former site activities, will be considered site-specific COPCs.

3. ***If*** soil analytical data indicate that COPCs are present above criteria at a sampling location, ***then*** that location may be characterized as a "hot spot," a localized area of contamination. A hot spot will be determined based upon the characteristics of the contaminant's distribution.

   A) ***If*** a hot spot is identified, ***then*** localized investigation by trenching and sampling will be conducted in that area (decision question 2).

B) ***If*** the results of the localized investigation do not adequately define the extent of hot spot contamination, ***then*** additional sampling will be performed (decision question 2).

Further evaluation of whether a COPC is associated with a hot spot will be made based on the following:

- Do field observations confirm the presence of associated materials expected to be present if site activities contributed to the presence of the contaminant?
- Did geophysical surveys identify anomalies that would indicate the presence of buried debris, void spaces, or substantive alterations of the geology that could represent changes in soil material?
- Are other contaminants present that support the suggestion that a release occurred?

C) ***If*** a COPC is associated with a hot spot, ***then*** it will be evaluated to assess if spot removal, institutional controls, or other cleanup actions will be sufficient to remove the contaminant from the risk evaluation process (decision question 6).

4. ***If*** the results of the shallow surface and trenching samples indicate that COPCs may be present below 10 feet bgs, ***then*** soil boreholes will be advanced to determine the vertical extent of contamination (decision question 3).

5. ***If*** the results of soil boring samples suggest that contamination extends to groundwater, ***then*** groundwater samples may be required (decision question 4).

   - ***If*** existing monitoring wells are close (250–350 feet) to soil boring locations, ***then*** additional monitoring wells to obtain groundwater samples will not be required; ***or else*** new wells will be required. (In addition to proximity, the need for a new monitoring well will also be evaluated relative to the groundwater flow direction and gradient).

6. ***If*** the results of soil boring samples indicate that contamination does not extend to groundwater, ***then*** contaminant concentrations will be compared to EPA Region IX SSL (assuming a dilution attenuation factor [DAF] of 1) to evaluate potential migration to groundwater (decision question 6).

   Contaminants that are not detected or do not have SSLs will not be considered as having the potential to significantly impact the groundwater.

   A) ***If*** contaminant concentrations exceed respective SSLs, ***then*** further evaluation (such as fate and transport modeling and sampling/analysis from existing wells) will be recommended.

   B) ***If*** contaminant concentrations do not exceed respective SSLs, ***then*** confirmatory sampling/analysis from existing wells 01_MW201 (where perchlorate concentrations in excess of threshold levels were found), 01_MW204 and 01_MW203 (upgradient), and 01_MW205 (downgradient) will be conducted.

   A different conceptual model will be used to design the sampling and analysis approach for NDMA. The contaminant NDMA is readily desorbed from the soil; in groundwater it is highly mobile (NTP 2000). The mechanism for distribution of NDMA in the subsurface is release to the soil; however, it is believed that transport to groundwater could occur without leaving significant residue in the soil or from a hot spot too small to be reliably detected by sampling in the absence of supporting evidence as to its presence or location. Tier 1 and 2 soil samples will not be analyzed for NDMA. Groundwater sample(s) with maximum perchlorate concentration(s) will be analyzed for NDMA.

   - ***If*** detectable concentrations of NDMA are present in groundwater samples with the highest perchlorate values, ***then*** a soils investigation of NDMA will be initiated.

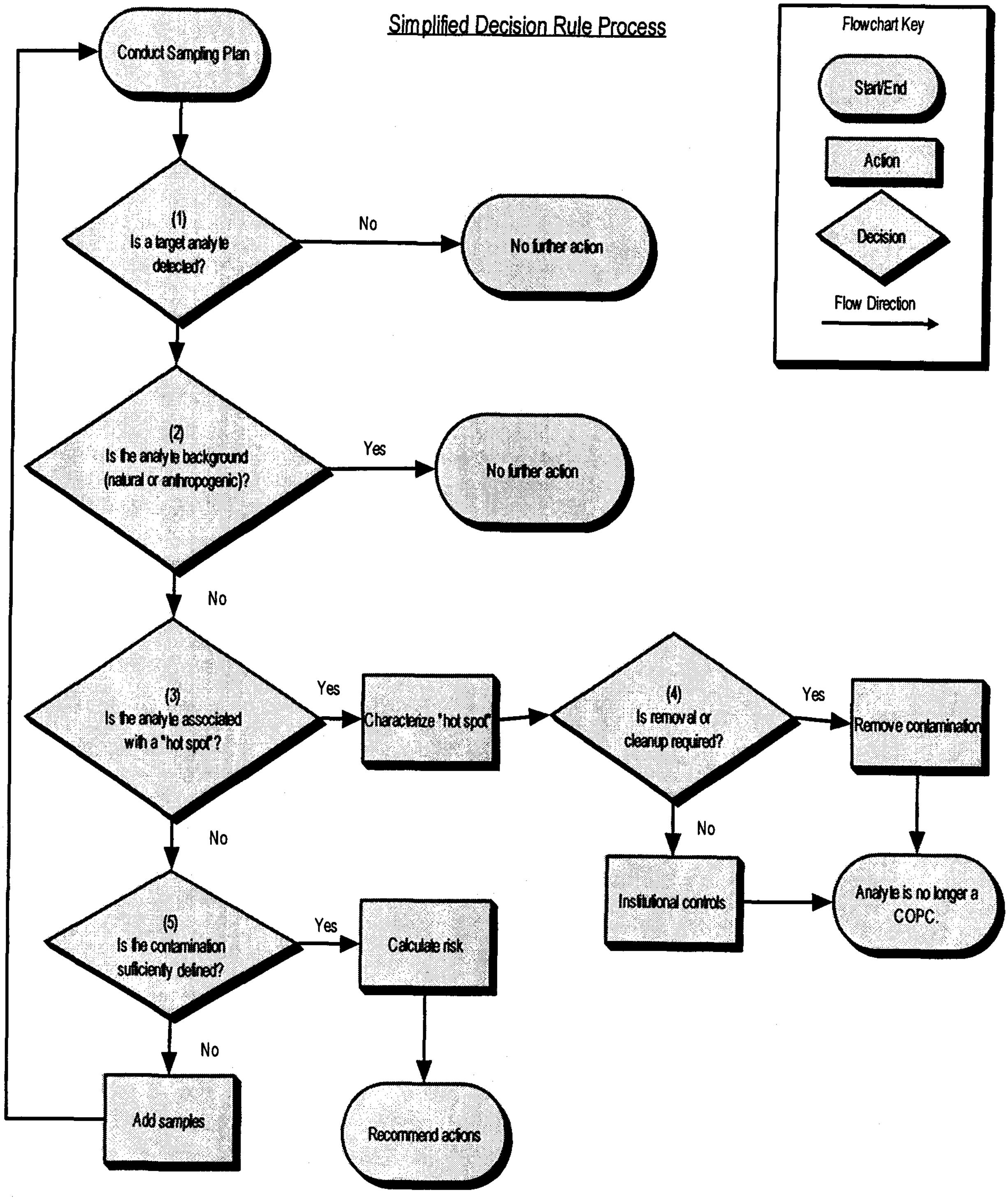

Figure 3-3: Simplified Decision Rule Process

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- Soils from areas exhibiting significant (detectable) evidence of contamination by explosives or perchlorate will be investigated for the presence of NDMA.

The presence of radionuclides in groundwater at Site 1 was investigated as part of a station-wide radionuclide evaluation (Earth Tech 2001a). The results of this evaluation concluded that the source of radionuclides is not anthropogenic. No further investigation of radionuclides beyond that in the *CERCLA Groundwater Monitoring Plan* (BNI 1999c) is proposed.

Groundwater monitoring to establish baseline conditions as part of this Phase II investigation will be used to assess the need for additional wells to define the extent of the impact.

7. ***If*** the extent of groundwater contamination is not defined (with respect to threshold levels) by either existing or new wells, ***then*** additional groundwater wells will be required (decision question 4).
8. ***If***, during three consecutive storm events, there is no measurable surface water runoff, ***then*** surface water will be eliminated as an exposure pathway (decision question 5).
9. ***If*** the screening preliminary risk evaluation (PRE), using EPA Region IX PRGs (residential and industrial), indicates risk $>10^{-6}$, ***then*** a site-specific PRE will be conducted (decision question 6).
10. ***If*** the site-specific PRE indicates risk which is

    A) Less than 10^{-6}, ***then*** no further action will be recommended (decision question 6).

    B) Between 10^{-6} and 10^{-4}, ***then*** the BCT will evaluate risk management decisions (decision question 5).

    C) Greater than 10^{-4}, ***then*** response actions will be evaluated (decision question 6).

11. ***If*** the results of the habitat assessment indicate that ecological receptors are present, ***then*** an ecological risk assessment will be conducted to evaluate impact due to site reuse scenarios and potential response actions (decision question 6).

3.3.6 Decision Error Limits

Null Hypothesis. One or more COPCs are found at the site in concentrations that pose an unacceptable risk to human health and the environment.

The acceptable probability of decision errors (the upper and lower boundaries of the gray region) for the Phase II RI/FS at MCAS El Toro was specified by the Navy and is as follows (BNI 1995a):

- $\alpha = 0.05$, is the allowable probability for rejecting the null hypothesis, when it is true (false-positive or Type I Error).
- $\beta = 0.20$ (power of 80 percent), is the allowable probability for accepting the null hypothesis, when it is not true (false-negative or Type II Error).

The *Phase II RI/FS Work Plan* (BNI 1995a) developed and presented the minimum sample quantities (n) needed to achieve the project objectives. The assessment was based on assumed variability calculated from the station-wide Phase I RI data. This approach serves as the basis for the sampling design and is incorporated by reference.

In this work plan, the initial number of samples has been developed based on two factors: (1) those meeting the minimum number of 36 samples (for each of the Northern and Southern EOD Ranges) estimated to be statistically valid as referenced above, and (2) the extent of anomalies that were evidenced during the geophysical survey, which was done as part of the perchlorate verification study. Accordingly, the initial number of soil samples proposed is 50 for the Northern EOD Range and 50 for the Southern EOD Range. The following potential qualitative decision errors are identified and presented in Table 3-3.

Table 3-3: Qualitative Analysis of Decision Errors and Tolerances, Site 1

Rule	Possible Errors	Associated Consequences	Gray Areas	Methods to Control Error
1	Concluding that one or more COPCs is present when there is none. Concluding that no COPCs are present when they are.	Unnecessary corrective action. Failure to take appropriate corrective action	Uncertainty associated with sample locations and the measurement of analyte concentrations.	Sampling design, standardized analytical processes, a quality management system.
2	Concluding that the analyte is background (natural or anthropogenic) when it is a contaminant. Concluding that the analyte is a contaminant when it is background.	Failure to take appropriate corrective action Unnecessary corrective action	Uncertainty associated with determination of background thresholds. Sampling within the representative populations.	Use of established methods for characterization of background.
3	Concluding the analyte is a hot spot when it is area-wide contamination. Characterizing the contaminant as area-wide when it is a hot spot.	Recommendations which don't address true conditions.	Uncertainty associated with definition of a hot spot. Samples which adequately characterize the population.	Sufficient assessment of identified potential contamination.
4	Concluding that removal is not required when it is. Concluding that removal is required when it is not.	Failure to take appropriate corrective action. Unnecessary corrective action.	Uncertainty associated with definition of a hot spot (the area requiring a corrective action).	Sufficient assessment of identified potential contamination.
5	Concluding that the site is sufficiently assessed when it has not been. Concluding the site is not sufficiently assessed when it has been.	Failure to collect sufficient samples to adequately characterize site. Unnecessary sampling and analysis.	Uncertainty associated with assumptions used to establish the sampling design.	Validation of design assumption with the results.

3.3.7 Sampling Design

The Phase II RI sampling design has been developed as a tiered approach based on both probability and judgmental sampling.

3.3.7.1 Tier 1

The principal objective of Tier 1 soil sampling is to collect adequate data to complete a screening level human health and ecological risk evaluation for each study area (Northern EOD Range and Southern EOD Range) at Site 1. Systematic sampling, using a central-aligned grid, will be used at Site 1 to allow uniform coverage of the site.

The number of sampling locations was calculated by dividing the initial number of samples (50 per study area) by the number of samples per location (at multiple depths). During the preliminary soil sampling that was conducted in the geophysical anomaly areas, two samples were obtained at each location, at depths ranging from 1 foot to 5 feet bgs. Based on this sampling method, two samples per location, at depths of approximately 1.5 feet and 5 feet bgs will be collected during the Phase II sampling. Accordingly, 25 sample locations per study area will be required. This will result in equal-sized blocks, each of which will be approximately 170 feet by 170 feet square. Sample locations will be at the centers of the blocks.

To optimize the sampling design, the locations of samples that were collected at the geophysical anomaly areas (during the perchlorate verification study) were overlain on the 25 blocks for each study area.

Blocks in which previous samples were located will not be sampled during the Phase II RI locations. This optimization results in a judgmental sampling design for those specific areas suspected of EOD activity.

Figure 3-4 illustrates the sampling design for Tier 1. Fourteen locations will be sampled at the Northern EOD Range and 24 locations at the Southern EOD Range. All samples collected during Tier 1 will be analyzed for metals, general chemistry, perchlorate, explosives, VOCs, SVOCs, and petroleum hydrocarbons. SVOC data will be used to select 10 percent of the samples for analysis of dioxins and furans. Radionuclides will be evaluated as part of a station-wide radiological survey.

Sampling of surface water runoff will be attempted from two locations within Site 1 during three storm events. The proposed sampling locations are designed to evaluate surface water concentrations at the upstream end of Site 1 (retention pond) and at a downgradient location within the wash (tributary to Borrego Canyon Wash), in the vicinity of well 01_MW207. As with groundwater, surface runoff samples will be analyzed for the full suite of COPCs and compared to groundwater quality criteria.

During the Tier 1 investigation, groundwater samples will be collected from all twelve monitoring wells shown on Figure 2-1 to establish baseline conditions. The samples will be analyzed for metals, general chemistry, perchlorate, explosives, VOCs, SVOCs, and petroleum hydrocarbons.

3.3.7.2 TIER 2

Tier 1 investigation results will be used to conduct localized investigations of hot spot areas (defined in the decision rules), as part of Tier 2 sampling.

Two perpendicular trenches, each approximately 25 feet long and 10 feet deep, will be excavated at each area requiring localized investigation. Four soil samples will be collected per trench (eight per pair), at depths ranging from 1 foot to 10 feet bgs. The number of trench locations will be determined based on the results of the Tier 1 sampling.

In addition, Tier 2 sampling will also be designed to evaluate previously identified geophysical anomaly areas. As part of the ordnance and explosive range evaluation (which will be conducted concurrent with this *Phase II RI*), Site 1 will be characterized for OE items. Intrusive investigation at geophysical anomaly areas by trenching and potholing will be conducted by UXO personnel to characterize explosive safety risk. During these trenching and potholing, soil samples will be collected by the UXO personnel at locations where OE items, if any, are present.

Soil samples will be analyzed for the COPCs that were identified during Tier 1 sampling.

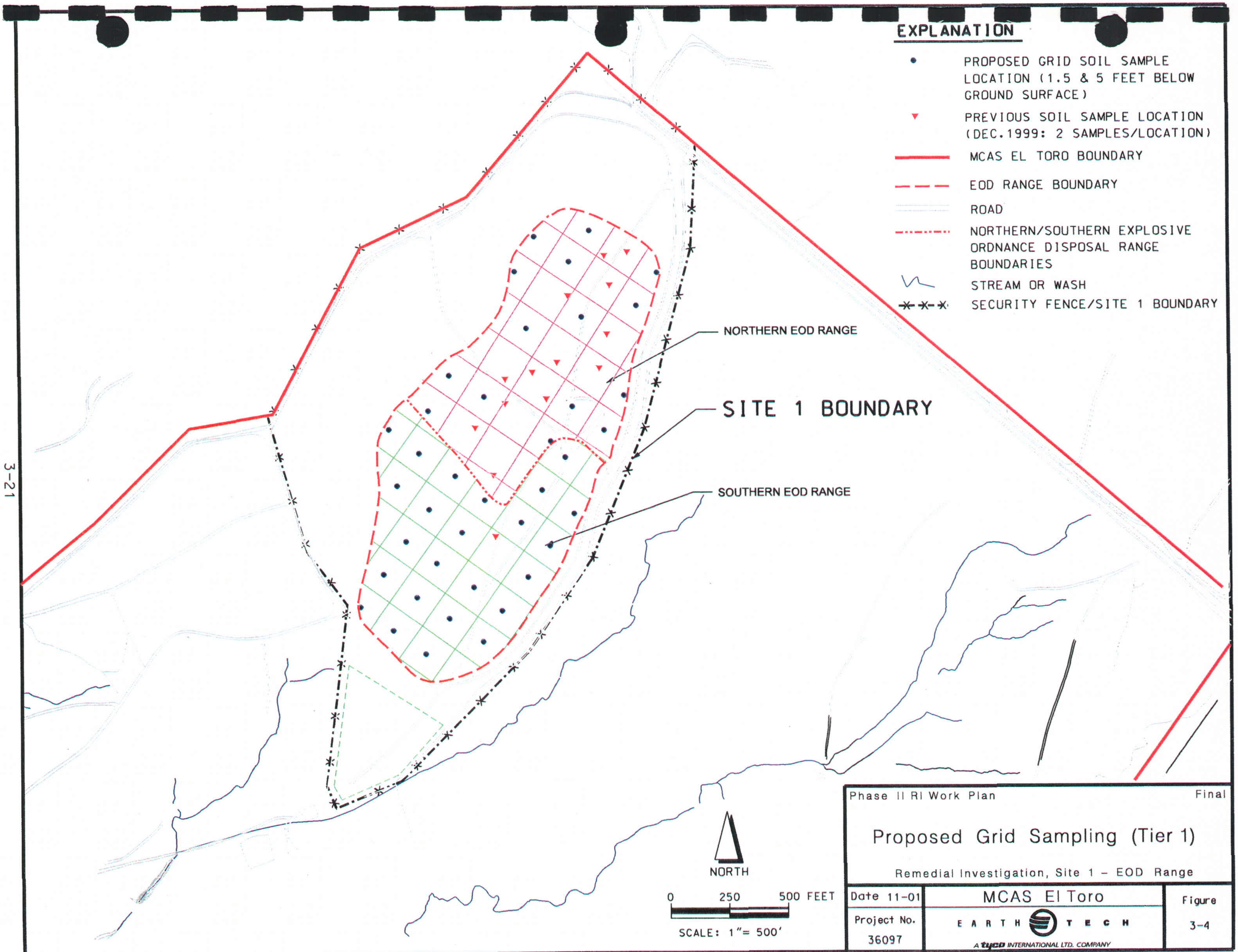
3.3.7.3 TIER 3

Tier 3 sampling will be conducted at Tier 2 locations that indicate contamination greater than 10 feet bgs. Soil boreholes will be advanced to a depth of approximately 50 feet bgs and sampled at 5-foot intervals, starting at 5 feet bgs to the maximum depth of the boring. Soil samples will be analyzed for COPCs identified during Tier 1 and Tier 2 sampling.

Groundwater wells will be installed, and groundwater samples will be collected at locations where the Tier 3 data indicate potential groundwater impact. A letter describing the rationale and placement of wells will be submitted to the BCT prior to the installation. However, as per the decision rule, additional wells will not be installed if existing groundwater wells are adequate to evaluate the impact to groundwater at a required location.

Groundwater samples will be analyzed for metals, general chemistry, perchlorate, explosives, VOCs, SVOCs, and petroleum hydrocarbons.

Groundwater samples with maximum perchlorate concentration(s) will be analyzed for NDMA. As per the decision rule, if detectable concentrations of NDMA are present in groundwater samples with the highest perchlorate values, then a soils investigation of NDMA will be initiated.



L:\REMEDIATION\NAVCLEAN\CTO-72\SITE1RI\WORKPLAN\FINAL\FIGURES\FIGURE3-4.DGN

4. FIELD SAMPLING PLAN

4.1 SAMPLING OBJECTIVES

Data gathering objectives for the RI include

- Habitat assessment to characterize ecological receptors present at Site 1;
- Surface (0 feet to 1.5 feet) and subsurface (greater than 1.5 feet) soil sampling and analysis for metals, general chemistry, perchlorate, explosives, VOCs, SVOCs, dioxins, furans, and petroleum hydrocarbons to establish COPCs and evaluate potential risk posed by the site to human and ecological receptors;
- Soil sampling and analysis for COPCs to define lateral extent of hot spots, if encountered;
- Soil sampling and analysis for COPCs to define vertical extent of contamination and evaluate the potential of impact to groundwater;
- Groundwater sampling and installation of monitoring wells to evaluate impact to groundwater.

4.2 FIELD METHODS AND PROCEDURES

Fieldwork for the Phase II RI will be performed in accordance with applicable CLEAN standard operating procedures (SOPs) (BNI 1999d). Earth Tech field personnel will have copies of all referenced SOPs during the fieldwork. Approved CLEAN SOPs were submitted to the BCT by the SWDIV; copies of the SOPs can be provided to reviewers of this document, if requested.

4.2.1 Intrusive Sampling

Project personnel will perform an evaluation of records prior to preliminary field marking of the sampling locations. The evaluation will include available site plans, utility layouts, construction of as-built drawings, and results of previous subsurface investigations. This survey will be conducted prior to soil sampling, drilling, excavation, or well installation. In addition, a geophysical survey will be conducted prior to any intrusive activities.

Preliminary results of the habitat assessment indicate that the California gnatcatcher is present at Site 1. Therefore, biological monitoring by a qualified biologist will be conducted during fieldwork.

A qualified UXO technician will oversee field activities that involve intrusive sampling. All activities will be conducted in accordance with the HSP, and an addendum to the HSP that details specific procedures for addressing UXO.

4.2.2 Tier 1 Data Collection

Soil samples will be collected at locations shown on Figure 3-4. The samples will be collected using direct-push techniques (or a hand auger) at depths of 1.5 feet and 5 feet bgs, at each location.

Soil samples will be collected at 14 locations at the Northern EOD Range and 24 locations at the Southern EOD Range. Two samples will be collected at each location, for a total of 76 samples.

Samples will be collected in accordance with CLEAN SOP 4, Soil Sampling (BNI 1999d). Samples for analysis of VOCs will be collected in accordance with EPA Method 5035. The Tier 1 sampling and analysis summary is presented in Table 4-1. SVOC data will be used to select 10 percent of the samples for analysis of dioxins and furans. Evidence of dioxin contamination will be further evaluated.

Table 4-1: Planned Soil Sampling and Analysis Summary - Tier 1

Analysis	Number of Samples				
	Field Samples	Field Duplicates	Field Blanks[a]	Equipment Rinsates[b]	Total
SVOCs	76	8	1	8	93
VOCs	76	8	1	8	93
TPH(e)	76	8	1	8	93
TPH(v)	76	8	1	8	93
Explosives	76	8	1	8	93
Dioxins/furans	8	1	1	1	11
Metals	76	8	1	8	93
Perchlorate	76	8	1	8	93

Notes:
[a] Assumes one field blank per water source for the final decontamination rinse water.
[b] Based on predicted number of field days/shipping events.
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds
TPH(e) = total petroleum hydrocarbons (extractable)
TPH(v) = total petroleum hydrocarbons (volatile)

Groundwater samples will be collected from all twelve monitoring wells shown on Figure 2-1 in accordance with Section 4.2.4.3. Surface water samples will be collected at locations described in Section 3.3.7.1, in general accordance with CLEAN Standard Operating Procedure (SOP) 12, Surface Water Sampling (BNI 1999d).

4.2.3 Tier 2 Data Collection

Trenches or potholes will be excavated at hot spot areas to refine the extent of impacted soil defined within each study area. It is anticipated that each trench will be approximately 25 feet long, 3 feet wide, and 10 feet deep. Trench alignments will be measured with a Brunton or other compass and a standard 100-foot tape, to a resolution of ±0.5 foot. All trenching will be accomplished in accordance with Section 5.4, Excavation Safety, of the Earth Tech *CLEAN Field Health and Safety Manual* (Earth Tech 1998). Trenches will be mapped to determine the limit of EOD waste, if encountered, and subsequently backfilled with the excavated soil. Trench descriptions, including cross sections, will be recorded in a field trench log. Field personnel will identify the types of soil collected following CLEAN SOP 3, Borehole Logging (BNI 1999d) and American Society of Testing and Materials (ASTM) D 2487/2488. Trenches will be backfilled upon completion of logging. No trench will be left unattended or open overnight.

Four samples per trench will be collected. Samples will be collected from undisturbed soil in the trench bottom and sidewalls. Soil samples will be collected from areas where there is visual evidence of contamination, such as stains. If no evidence impact is detected, samples will be collected at depths ranging from 2 feet to 10 feet bgs, one from each wall of the trench.

The excavated material will be backfilled within the same trenches. If OE or related items (including UXO) are encountered, they will be handled in accordance with the *OE Range Evaluation Work Plan* (Earth Tech 2001b).

4.2.4 Tier 3 Data Collection

Tier 3 soil borings will be advanced to depths up to 50 feet bgs at Tier 2 locations where contamination extends to 10 feet bgs. If contamination extends to 50 feet bgs at the Tier 3 soil borings, then groundwater wells will be installed if existing wells are not adequate to evaluate impact to groundwater.

Soil samples will be collected at 5-foot intervals during drilling of soil borings. During borehole drilling, lithology will be described, including all soil classification information as listed in CLEAN SOP 3, Borehole Logging (BNI 1999d). All equipment will be decontaminated before each use in accordance with CLEAN SOP 11, Decontamination of Equipment (BNI 1999d), and Section 4.2.6 of this document. Samples will be collected in accordance with CLEAN SOP 4, Soil Sampling (BNI 1999d).

4.2.4.1 Well Installation and Construction

Wells will be constructed in accordance with CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999d).

Each well will be constructed as follows:

1. The well bore will be drilled using 10-inch diameter hollow-stem augers.
2. The well casing will be installed. The well casing will consist of 4.0-inch inside diameter (4.3-inch outside diameter) sections of flush-threaded, blank schedule 40 polyvinyl chloride (PVC)-threaded blank casing connected to a 4-inch diameter, schedule 40 PVC, 0.020-inch slotted screen. The well screen will extend approximately 5 feet above and 10 feet below static water level.
3. The filter pack will be set from the total depth of the borehole to approximately 2 feet above the screened interval. The filter pack will be inserted to minimize chances of bridging. The proposed filter pack is 20–40-size quartz sand or equivalent nonreactive filter pack material. This well design was proposed based on typical specifications for the lithology that was encountered in the boreholes of existing Site 1 wells. A grain-size analysis (field method) will be conducted to confirm the proposed slot and filter pack material size.
4. The well will be surged to allow the filter pack to settle. Filter pack material will be added as required to allow the filter pack to extend to at least 2 feet above the screened interval of the well.
5. A bentonite well seal (a minimum of 3 feet thick) will be installed immediately above the filter pack. Bentonite will be added in chip or pellet form and will be hydrated with approximately 5 gallons of clean water. The remaining annular space between the borehole sidewall and outer casing will be grouted using a mixture of cement and 3–5 percent bentonite in accordance with CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999d).
6. The wellhead will be aboveground, completed with protective casing or monument installed around the top of the well casing within a cement surface seal. The monument will extend at least 18 inches above grade and 12 inches below grade, and will have at least 2 inches of clearance between the top of the well casing and the lid of the monument. A cement pad 2 feet long by 2 feet wide that gently slopes away from the well and is at least 3 inches deep will be constructed around the protective casing. The top of the well casing will have a slip cap or locking cap. The monument will be fitted with a case-hardened lock to prevent unauthorized entry.
7. The grout will be allowed to set for at least 24 hours. The well will be developed in accordance with CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999d).

Records for the wells that detail the timing, amount of materials, and methods of installation and construction will be prepared by the field manager while installation is in progress. These records will be kept in a hardbound field notebook that will be forwarded to the CTO manager. At the time of construction, an as-built drawing will be prepared detailing the location and amounts of all materials used in the construction of each monitoring well. Records will be filled out with indelible ink. Construction records will include the date, time, and quantities of materials used at each stage. A complete listing of the stages of construction is provided in CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999d).

Well location surveys will be conducted by a California-registered land surveyor to determine horizontal locations to the nearest 0.1 foot, vertical locations to the nearest 0.01 foot, and referenced to MSL. The vertical elevation will be surveyed at a notch cut in the top of the well casing, typically on the north side of the well. All water level measurements will also be made from this point. The top of the concrete slab surrounding the wellhead cover or the elevation of the ground adjacent to the monitoring well will be surveyed to the nearest 0.01 foot.

4.2.4.2 *Well Development*

Following construction and development, monitoring wells will be purged prior to groundwater sampling. Development of each well will be conducted in accordance with CLEAN SOP 5, Monitoring Well Installation and Development (BNI 1999d). Following installation, measurements of total well depth and static water level will be taken with a tape measure equipped with an electronic product/water interface detector to an accuracy of 0.01 foot. Measurements and calculated total well volume will be recorded in each well development log. Following 24 hours of grout curing, the same measurements will be taken and entered into each well development log. Field equipment (e.g., pH meter, conductivity meter, and water level recorders) will be calibrated prior to use each workday and promptly serviced, if required, in accordance with manufacturer's instructions.

Each well will be developed using a Teflon bladder pump or PVC bailer, depending on the volume of fluid to be removed. If possible, a minimum of four well-bore volumes will be extracted to remove fine-grained materials and to promote the movement of formation waters into the wells. Specific conductivity, temperature, and pH will be monitored during well development to demonstrate that these properties are stabilized. These data will also be entered into each well development log.

4.2.4.3 *Groundwater Sampling*

The physical and chemical properties listed in Table 4-2 will be assessed in accordance with CLEAN SOP 8, Groundwater Sampling (BNI 1999d). Water level measurements will be taken before purging the well or sampling.

Table 4-2: Well Development Monitoring Parameters

Type of Data	Measurement Unit	Resolution
Conductivity	μmho (micro mhos)	±5 percent full scale
Dissolved oxygen	parts per million (ppm)	±0.5 ppm
Oxidation-reduction potential	millivolt (mV)	±10mV
pH	standard units	±0.2
Static groundwater level	feet above mean sea level	±0.01 foot
Temperature	degrees Celsius (°C)	±1°C

The field crew will collect groundwater samples from each well in accordance with CLEAN SOP 8, Groundwater Sampling (BNI 1999d). The samples will be analyzed for the constituents listed in Table 5-3.

4.2.5 Investigation–Derived Waste

Investigation-derived waste (IDW) consists of all materials that may be contaminated with constituents of concern during fieldwork. It is anticipated that the field investigation will generate nonhazardous wastes (based on the prior investigations), including but not limited to the following:

- Soil,
- Well development and purged groundwater,
- Decontamination water,
- Disposable personal protective equipment (PPE), sampling equipment, and miscellaneous debris encountered during the investigation.

IDW will be properly classified, labeled, managed, and disposed in accordance with EPA Guidance and CLEAN SOP 22, IDW Management (BNI 1999d). If the IDW generated during sampling is determined to be regulated by the Resource Conservation and Recovery Act (RCRA), then RCRA storage, transportation, and disposal requirements may apply. In general, proper implementation of IDW procedures requires CTO managers, field managers, and their designees to perform the following tasks:

- Minimize IDW as it is generated.
- Segregate IDW by matrix and source location.
- Follow proper procedures for IDW drum handling and labeling.
- Prepare an IDW drum inventory.
- Update and report changes to the IDW drum inventory.

Soil, Decontamination Water, Well-Development Water, and Purged Groundwater. Soil cuttings from boreholes will be placed in 55-gallon drums. Non-disposable sampling equipment, the backhoe bucket, and PPE will be cleaned and decontaminated between each sample or activity location in accordance with the procedures described in Section 4.2.6 of this work plan. Decontamination water will be collected in troughs, buckets, or a decontamination pit constructed on site. Collected decontamination water will be transferred daily into Department of Transportation (DOT)-approved 55-gallon drums. Drums containing liquid IDW will be left with a headspace of 5 percent by volume to allow for expansion of the liquid. The drums will be labeled with the date and the boring number in accordance with CLEAN SOP 22, Investigation Derived Waste Management (BNI 1999d). Drums containing IDW will be inventoried daily, stored on pallets at a designated staging area, and covered with tarps. Upon completion of fieldwork, a final inventory of the drums will be conducted to ensure that they are labeled correctly and that all drums are present.

Disposable PPE and Sampling Equipment. If, based on the best professional judgment of the field manager, the PPE and disposable sampling equipment can be rendered nonhazardous after decontamination procedures, then this equipment will be collected in double plastic bags and disposed of off site as municipal waste. Equipment that is potentially contaminated will be stored in drums, labeled, inventoried, pending characterization for disposal. All waste materials generated in the support zone are considered non-IDW trash and will be properly disposed of as municipal waste.

IDW Disposal Plan. A disposal contractor will dispose of all IDW within 90 calendar days of completing the fieldwork, in accordance with the CERCLA offsite policy. Should hazardous waste disposal be required, an IDW disposal plan will be prepared for appropriate screening, sampling, chemical analysis, and disposal of the waste. Based on the results of the preliminary assessment of the site, it is not anticipated that hazardous waste will be generated; therefore, an IDW disposal plan has not been prepared.

4.2.6 Equipment Decontamination

All non-consumable equipment that comes into contact with potentially contaminated soil or groundwater will be decontaminated in accordance with CLEAN SOP 11, Decontamination of Equipment (BNI 1999d). Equipment will be decontaminated by steam cleaning or by a non-phosphate detergent scrub, followed by freshwater and distilled or deionized water rinses. Decontamination will take place on pallets or on plastic sheeting. Clean equipment will be stored on plastic sheeting in an uncontaminated area. Equipment stored for an extended period will also be covered by plastic sheeting.

All consumable equipment (e.g., gloves, disposable bailers) and liquid and solid wastes (e.g., purged groundwater, decontamination water, and soil cuttings) will be treated as potentially hazardous and handled in accordance with the procedures prescribed in Section 4.2.5.

The field team (including the drilling crew) will perform personnel decontamination prior to leaving the work site at the conclusion of each workday, following procedures described in the *CLEAN Field Health and Safety Manual* (Earth Tech 1998).

4.2.7 Sample Containers and Preservation

Table 4-3 and Table 4-4 list the chemical parameters to be tested and the types of containers and preservation methods to be used. These may be modified to accommodate selected laboratory preferences, but will meet the essential requirements of the method.

Table 4-3: Requirements for Soil Sample Preservation, Maximum Holding Time, and Containers

Analyte	Analytical Method(s)	Preservation	Maximum Holding Time	Number × Sample Container Type
Total Volatile Petroleum Hydrocarbons	SW5035/ SW8015B	Cool to 4°C or frozen	48 hours[a] (7 days, if frozen)	Three EnCore soil coring devices
Volatile Organic Compounds	SW5035/ SW8260B	Cool to 4°C or frozen	48 hours[a] (7 days, if frozen)	Three EnCore soil coring devices
Total Extractable Petroleum Hydrocarbons	SW3550B/ SW8015B	Cool to 4°C	14 days[b]/40 days[c]	One 16-oz glass jar or stainless steel liner with Teflon-lined lid/end caps
Perchlorate	Modified METHCLO4	Cool to 4°C	28 days[a]	
NDMA[d]	HRGCMS[d]	Cool to 4°C	14 days[b]/40 days[c]	
Semivolatile Organic Compounds	SW3550B/ SW8270C	Cool to 4°C	14 days[b]/40 days[c]	
Nitroaromatics/ nitroamines	SW8330	Cool to 4°C	14 days[b]/40 days[c]	
Dioxins/furans	SW3550B/ SW8290	Cool to 4°C	30 days[b] /45 days[c]	One 16-oz glass jar or stainless steel liner with Teflon-lined lid/end caps
Metals	SW3050B/ SW6010/7000	None	6 months[a]	One 16 oz-glass jar or stainless steel liner with Teflon-lined lid/end caps
pH	SW9045C	Cool to 4°C	Immediately	
Nitrate	Modified 300.0	Cool to 4°C	14 days[a]	

Notes:
°C = degrees Celsius
[a] From sample collection to analysis.
[b] From sample collection to extraction.
[c] From sample extraction to analysis.
[d] NDMA (N-nitrosodimethylamine) will be analyzed using high-resolution gas chromatography/mass spectrometry.

Table 4-4: Requirements for Groundwater Sample Preservation, Maximum Holding Time, and Containers

Analyte	Analytical Method(s)	Preservation	Maximum Holding Time	Number × Sample Container Type[d]
Total Volatile Petroleum Hydrocarbons	SW5030B/ SW8015B	HCl to pH<2 Cool to 4°C	14 days[a]	Three 40-ml VOC w/ Teflon-lined septa
Volatile Organic Compounds	SW5030B/ SW8260B	HCl to pH<2 Cool to 4°C	14 days[a]	Three 40-ml VOC w/ Teflon-lined septa
Total Extractable Petroleum Hydrocarbons	SW3520C/ SW8015B	Cool to4°C	7 days[b]/40 days[c]	Two 1-L amber glass
Perchlorate	METHCLO4	Cool to 4°C	28 days[a]	250-mL plastic
Semivolatile Organic Compounds	SW3520C/ SW8270C	Cool to 4°C	7 days[b]/40 days[c]	Two 1-L amber glass
NDMA[d]	HRGCMS[d]	Cool to 4°C	7 days[b]/40 days[c]	Two 1-L amber glass
Nitroaromatics/ nitroamines	SW8330	Cool to 4°C	7 days[b]/40 days[c]	Two 1-L amber glass
Dioxins/furans	SW3520C/ SW8290	Cool to 4°C	30 days[b]/45 days[c]	Two 1-L amber glass
Metals	SW3010A/ SW6010/7000	HNO_3 to pH<2	6 months[a]	1-L plastic
pH	SW9045C	Cool to 4°C	immediately	250-mL plastic
Nitrate	300.0	H_2SO_4 to pH <2 Cool to 4°C	14 days[a]	250-mL plastic

Notes:
HCl = hydrochloric acid
°C = degrees Celsius
L = Liter
HNO_3 = nitric acid
H_2SO_4 = sulfuric acid
mL = milliliter
[a] From sample collection to analysis.
[b] From sample collection to extraction.
[c] From sample extraction to analysis.
[d] Sample container volumes may be modified to meet laboratory-specific procedures.
[e] NDMA (N-nitrosodimethylamine) will be analyzed using high-resolution gas chromatography/mass spectrometry.

4.2.8 Sample Packaging and Shipment

Sample lids and caps will be covered with custody seals. All samples will be recorded on chain-of-custody (COC) forms in accordance with CLEAN SOP 10, Sample Custody, Transfer and Shipment (BNI 1999d). Samples will be shipped or delivered within 24 hours to allow the laboratory to meet holding times for analysis.

Two copies of the COC forms will be placed in an adhesive plastic pouch and taped on the inside of each sample cooler. The coolers will then be sealed with waterproof tape and labeled "Fragile," "This End Up" (or with directional arrows pointing up), and other appropriate notices. Coolers will also have custody seals placed on them to prevent tampering.

Upon receipt, the laboratory will sign and retain copies of the air bill. A list of analyses to be performed and a space to record sample condition upon receipt are located on the COC record. The laboratory representative will sign the COC form and record the temperature of the samples or cooler on the COC form and on the Sample Condition Upon Receipt form. All samples requiring preservative will be checked by measuring pH upon receipt (except for VOC samples). In case of breakage or discrepancies between the COC form, sample labels, or requested analyses, the sample custodian will notify the laboratory project manager. A nonconformance report will be completed, and the project chemist will be notified within 24 hours. At the time of notification, a corrective action will be chosen. The sample custodian will enter the information into the laboratory system, and a log-in confirmation sheet will be sent to the project chemist within 48 hours. The laboratory will send the project chemist a written declaration of the samples in each sample delivery group.

Hazardous Materials Shipment. Hazardous materials, as defined by the DOT, are not expected in the course of this project. Shipment of soil samples is not expected to exceed the minimal quantities for hazardous materials handling. The field team leader has been trained to recognize hazardous or dangerous goods and will notify the CTO manager of such issues prior to shipping.

4.2.9 Sample Documentation

Sample containers will be labeled as follows:

1. Labels will be written in indelible ink with the following information:
   - Project name or identifier,
   - EPA sample identification (ID) number,
   - Date and time of collection,
   - Initials of the person collecting the sample,
   - Method number or name of analysis to be performed,
   - Preservative (if applicable).
2. A label with adhesive backing will be affixed to each sample container.
3. The label will be covered with clear tape to further secure it to the container and to keep the ink from smearing.

EPA Sample ID Number. To facilitate data tracking and storage, all samples will be labeled with a five-character sample ID number, referred to as an EPA ID, in accordance with recordkeeping, sample labeling, and chain-of-custody procedures. The ID number for CTO 0072 is determined as follows:

LEzzz

Where,

L	The Long Beach Office
E	CTO72, Site 1-EOD Range, RI
zzz	Chronological number, starting with 001

For example, the EPA number "LE030" would represent the 30th sample collected for the MCAS El Toro, Site 1 RI project, a project managed by Earth Tech's Long Beach office. Quality control (QC) samples will be included in the chronological sequence. If a sample is lost during shipping, a replacement sample will be assigned a new EPA number. If different containers for the *same* sample are shipped to the laboratory on different days, a new EPA number must be assigned. All sample identification numbers will be recorded in field logs, records, and a database to ensure traceability of the sample to the designated location or site.

Samples will also be assigned an Earth Tech sample ID, which will be recorded in field logs and databases. A descriptive sample ID number will specify the location, sequence, matrix, and depth, as follows:

#-bbcc-dee-Dfff

Where,

#	IRP Site number
bb	Sample type and matrix (see Table 4-5)
cc	Location number (alphanumeric, e.g., MW201, HA11)
d	Sample or QC identifier (see Table 4-6)
ee	Chronological sample number from a particular sampling location (e.g., 01, 02, 03)
D	The letter "D," denoting depth
fff	Depth of sample in feet bgs. For field blanks and equipment rinsates, the depth field will contain the month and date of collection.

Table 4-5: Character Identifiers

Identifier	Sample Type	Matrix
SS	Soil Sample	Soil
GW	Groundwater Well	Water
QS	Field QC	Soil
QW	Field QC	Water

Table 4-6: QC Identifiers

Identifier	QC Sample Type	Description
S	Normal Sample	All non-field QC samples
D	Duplicate	Sample duplicate or co-located sample (adjacent liners or locations)
E	Equipment Rinsate	Water
F	Field Blank	Water
X	Blind Spike	Performance evaluation sample

4.2.10 Quality Control Samples

Field quality control samples will be submitted in accordance with the referenced standard operating procedures. The results of the analysis will be evaluated in accordance with the QAPP.

Field Duplicates. One field duplicate sample will be collected for every 10 samples during groundwater sampling. Soil duplicates will not be collected. Field duplicates will be assigned a unique EPA ID and Earth Tech ID number.

Field Blanks. A single field blank per water source will be collected to measure potential contamination resulting from the water used for the final rinse in the decontamination process.

Equipment Rinsates. Final rinse water from the decontamination process of reusable equipment will be poured through clean equipment, collected, and submitted for analysis of target analytes for that day.

Trip Blanks. Sample containers shipped to the site and returned to the laboratory will be accompanied by a trip blank. The trip blank will be prepared by the laboratory from certified organic-free water and shipped to the field. Each shipment of samples for VOC analysis will be accompanied by a trip blank, which will be labeled with a unique EPA ID number.

5. QUALITY ASSURANCE PROJECT PLAN

The quality assurance plan for the Phase II RI at the former EOD Range at MCAS El Toro has been prepared in accordance with the requirements and specifications of the following:

- U.S. Naval Facilities Engineering Command, Southwest Division, *Environmental Work Instructions* (EWI)

  EWI #1 "Chemical Data Validation" (SWDIV 1999)

  EWI #2 "Review, Approval, Revision, and Amendment of Field Sampling Plan and Quality Assurance Project Plan" (SWDIV 1999)

  EWI #3 "Laboratory Quality Assurance Program" (SWDIV 1999)

- *Navy Installation Restoration Chemical Data Quality Manual*, (NFESC) 1999)

5.1 PROJECT MANAGEMENT

The project will be managed in accordance with the contract requirements and specifications in CTO no. 0072 of CLEAN II program, contract number N62742-94-D-0048.

5.1.1 Task Organization

Tasks associated with the investigation are summarized in Table 5-1 and described in the following subsections.

Table 5-1: Task Summary

Data Review and Project Planning (SOW Task 1)	Field Activities (SOW Task 2)	Data Evaluation and Report Preparation (SOW Task 3)
Task 20 Project Planning Task 22 Work Plan Task 23 Sampling and Analysis Plan Task 24 Health and Safety Plan	Task 30 Field Activities Task 46 Laboratory Analysis and Oversight	Task 50 Data Validation Task 51 Data Evaluation Task 67 Report Preparation
Meetings (SOW Task 4)	**Purchasing Support (SOW Task 5)**	**Project Management (SOW Task 6)**
Task 11 Meetings Task 42 BCT/RAB Support	Task 12 Purchasing and Subcontract Administration	Task 10 Project Management

Notes:
BCT = BRAC Cleanup Team
SOW = statement of work
RAB = Restoration Advisory Board

5.1.1.1 DATA REVIEW AND PROJECT PLANNING

Existing data will be compiled and reviewed, and technical statements of work (SOWs) will be prepared. Planning documents, including a combined work plan and sampling and analysis plan (SAP), and an HSP have been prepared. Coordination and scheduling with subcontractors will be completed. Site access will be secured and pre-work meetings will be conducted.

5.1.1.2 FIELD ACTIVITIES

Soil and groundwater samples will be collected in accordance with the plan presented in the field sampling portion of this document.

5.1.1.3 DATA EVALUATION AND REPORT PREPARATION

Project staff will review all laboratory reports for contract and method compliance and data usability. Laboratory data packages will be subject to independent, third party validation when the data will be used to assess human or ecological risk or substantiate recommendations regarding the legal status or future liability of the property.

Data will be presented in a relational database, using the conventions and structure of the Naval Environmental Data Transfer System (NEDTS). Electronic data will be verified for consistency with hard copy laboratory data reports.

Data collected during field activities and pertinent previously reported data will be presented in an RI report. The report will provide the analytical results and the human health and ecological risk evaluation, with recommendations for a further course of action.

5.1.1.4 MEETINGS

Earth Tech personnel will participate in periodic BRAC Cleanup Team/Restoration Advisory Board (BCT/RAB) meetings and provide technical support when applicable, including briefing packages and fact sheets documenting project progress.

5.1.1.5 PURCHASING SUPPORT

Materials, supplies, and subcontractor services will be procured, and subcontracts will be administered.

5.1.1.6 PROJECT MANAGEMENT

The CTO manager will coordinate with the Navy remedial project manager (RPM) to ensure that the project objectives are accomplished in a timely and effective manner. Monthly progress reports summarizing project status will be prepared.

5.1.2 Project Organization

The project organization chart (Figure 5-1) identifies project team members.

Remedial Project Manager. Provides governmental oversight of technical issues for the project. Interfaces with the BCT, community representatives, and the contractor to meet project objectives.

Quality Assurance Officer (QAO). Provides governmental oversight of contractor's quality assurance (QA) program. Provides quality-related directives through the RPM. Has authority to suspend project execution if QA requirements are not adequately met.

BRAC Cleanup Team. Representatives from local, state, and federal regulatory agencies who provide input to the Navy.

Contract Task Order Manager. Responsible for day-to-day management of project budgets, staffing, deliverables, and schedule. Communicates with the RPM on technical issues.

CLEAN II Program Manager. Provides management oversight of execution of the task order in compliance with the program contract.

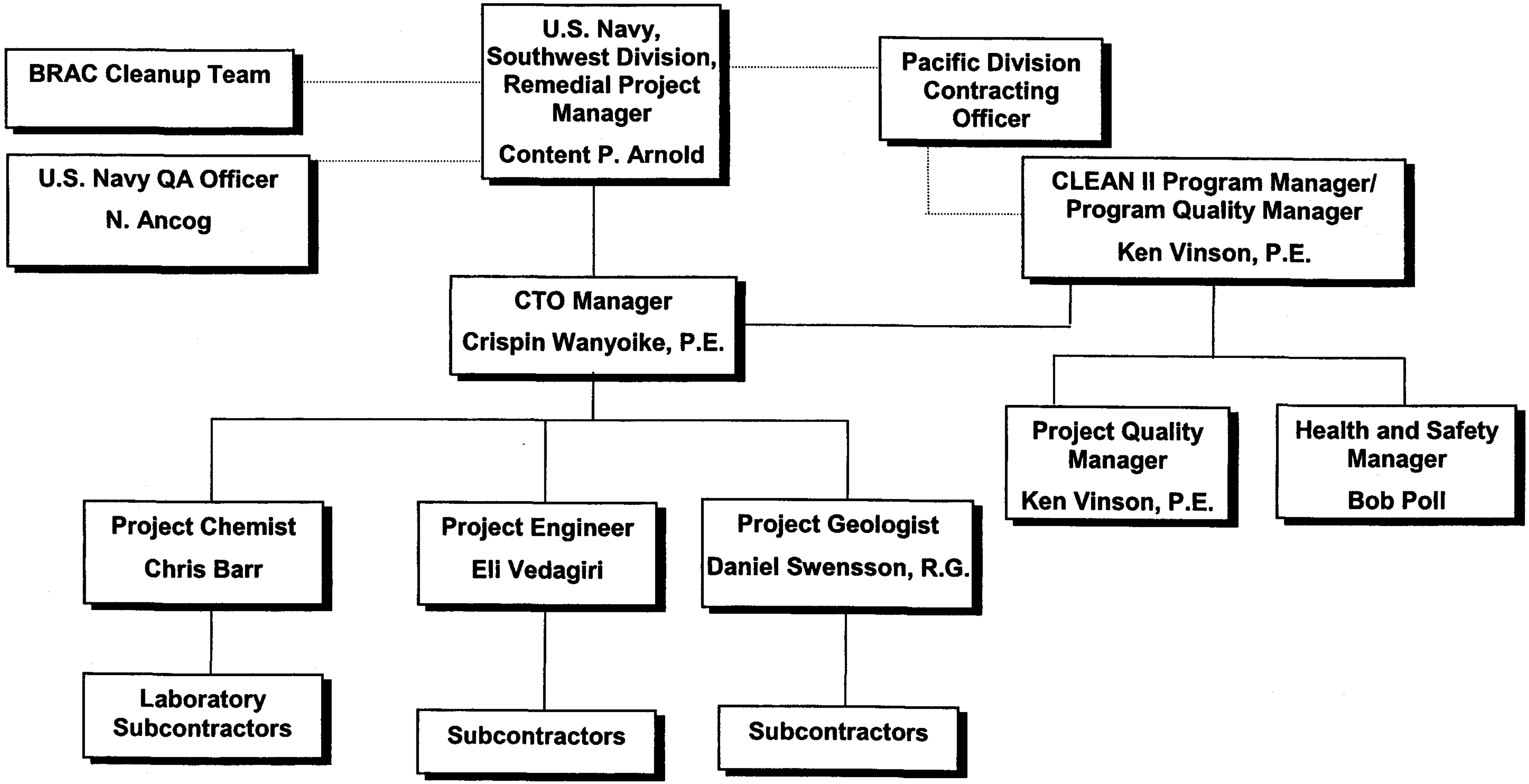


Figure 5-1 Project Organization Chart

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Pacific Division Contracting Officer. Represents the government in all contractual, cost, and scheduling issues. Interfaces with RPM on performance and execution of the task order.

Program Quality Manager. Responsible for executing the contractor's QA program. Responsible for ensuring that technical standards and specifications are met for each deliverable to the client. Coordinates the peer and technical review of project deliverables, and ensures standards and QA requirements are met.

Health and Safety Manager. Ensures that all field operations are conducted in accordance with safe operating practices and in compliance with federal and state requirements.

Project Chemist. Manages analytical laboratory services for the project. Prepares planning documents, technical specifications, and quality assurance plans for collection of data. Oversees technical performance of laboratory subcontractors.

Laboratory Subcontractor. Provides laboratory services in accordance with project specifications and subcontract statement of work.

Data Validation Subcontractor. Provides data validation services in accordance with project specifications and subcontract statement of work.

Project Geologist. Responsible for overseeing field operations that relate to groundwater and soil sampling, and evaluation of technical data. Oversees technical performance of subcontractors.

Project Engineer. Responsible for overseeing field activities and evaluating technical data in conjunction with the project geologist. Prepares planning documents for collection of data. Conducts data analysis and evaluation and prepares technical reports.

Special Training Requirements. Training requirements applicable to this project are as follows:

All field personnel will have current health and safety training in accordance with *CLEAN Health and Safety Manual* (Earth Tech 1998). This includes the initial 40-hour training and current 8-hour refresher training. The onsite health and safety manager will also have an additional 8 hours of supervisor training.

5.1.3 Schedule

The RI field activities will span approximately 4 months. The schedule shown on Figure 5-2 is for planning purposes only and will be revised as needed.

5.1.4 Data Quality Objectives

The EPA's seven-step DQO process (EPA 2000b) has been followed to develop the work plan as discussed in Section 3.3.

5.1.5 Documentation and Deliverables

Project records and documentation will be maintained in accordance with the procedures established for this program.

Field Documentation. Records will be kept in accordance with CLEAN SOP 17, Logbook Protocols (BNI 1999d). Monitoring well location, design, and construction will be recorded in the field notebook for the CTO and on a Well Completion Record form. The field manager will provide a copy of the form to the CTO manager for the project files. The CTO manager will review all well construction logs.

In accordance with CLEAN SOP 17, Logbook Protocols (BNI 1999d), a bound field notebook with consecutively numbered, water-repellent pages will be maintained. The logbook will be clearly identified with the name of the activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries. Data forms, with predetermined formats for logging field data, will be incorporated into the logbook. This logbook will serve as the primary record of field activities. Logbooks will allow a reviewer to reconstruct applicable events from entries made in chronological order and in sufficient detail. The logbook will be maintained in a clean area and used only when outer gloves have been removed. Entries on the data forms and in the logbook will meet the same requirements. Entries will be made in indelible ink. Information recorded in the logbook will include the following:

1. The logbook will reference data maintained in other logs.
2. Corrections to entry records will be made by drawing a single line through the incorrect entry, initialing, and dating the change. An explanation will be included if more than a simple mistake is made.
3. Entries will be signed or initialed by the individual making the entry at the end of each day.
4. Page numbers will be entered on each logbook page.
5. The preparer will photocopy completed pages weekly. The field manager will conduct a technical review of the logbook.

Laboratory Documentation. The laboratory will provide Level IV data packages for all results as required to perform validation in accordance with EPA guidance for data review (EPA 1994a and EPA 1994b). The packages will include a case summary, report forms, QC sample analysis results, acceptance criteria, calculations, chromatograms, and applicable bench logs and preparation notes. The laboratory will also provide data deliverables in a specified electronic format compatible with the project database, developed in compliance with NEDTS. All laboratory deliverables will be submitted within 30 calendar days of receipt of samples.

5.2 Measurement and Data Acquisition

All samples will be collected in accordance with Navy CLEAN II Program Procedures (BNI 1999d) except as modified to meet project-specific requirements and as presented in this QAPP.

5.2.1 Field Sampling Quality Assurance Measurements

Field sampling will include quality control samples that will characterize the potential contribution of sample collection and handling procedures to the results and provide an assessment of the quality of the data collected. The results of the quality assessment will be reflected in the conclusions and recommendations of the investigation.

5.2.1.1 Trip Blank

Trip blanks will be shipped with each package of samples submitted for analysis of volatile organic compounds. The trip blank will be assigned a unique EPA ID and submitted for analysis. The results of the measurements will be used to assess the potential contribution of the shipping process to analytes found in the samples. Trip blanks with detectable concentrations of target analytes may be used to qualify the findings and results of associated samples.

5.2.1.2 Temperature Blank

A temperature blank will be submitted with each package in which samples are cooled and measured upon receipt at the laboratory. The acceptance criteria (4°C + 2) will be used to qualify the results of associated samples in accordance with applicable guidance.

Figure 5-2
Project Schedule
Final Work Plan - Phase II Remedial Investigation
Site 1 - EOD Range, MCAS El Toro

72M2

ID	Task Name	Duration	(start)	(finish)
	Task 22 - Work Plan	**423 days**		
1	Preliminary Draft Work Plan/SAP	80 edays	3/8/00	5/27/00
2	Navy Review	53 edays	5/27/00	7/19/00
3	Draft Work Plan/SAP	56 edays	7/19/00	9/13/00
4	BCT Review	116 edays	9/13/00	1/7/01
5	Response to Comments	21 edays	1/7/01	1/28/01
6	Draft Final Work Plan/SAP	20 edays	1/28/01	2/17/01
7	BCT Review	30 edays	2/17/01	3/19/01
8	Final Work Plan/SAP	22 days	9/20/01	10/19/01
	Task 22.1 - OE Range Evaluation Work Plan	**231 days**		
9	Preliminary Draft UXO Evaluation Work	22 days	2/9/01	3/12/01
10	Navy Review	4 days	3/13/01	3/16/01
11	Draft UXO Evaluation	9 days	3/19/01	3/29/01
12	BCT Review	34 edays	3/29/01	5/2/01
13	Response to Comments	65 days	5/7/01	8/3/01
14	Draft Final Work Plan	30 days	9/10/01	10/19/01
15	Public Notice	30 edays	11/2/01	12/2/01
16	Final UXO Evaluation Work Plan	10 days	12/17/01	12/28/01
	Task 30 - Field Investigation	**62 days**		
17	Field Investigation at Site 1 - Tier I & II / OE Investigation	22 days	12/31/01	1/29/02
18	Field Investigation at Site 1 - Tier III	18 days	3/1/02	3/26/02
	Task 46 - Laboratory Analysis	**66 days**		
19	Laboratory Analysis	66 days	1/18/02	4/19/02
	Task 51 - Data Evaluation	**70 days**		
20	Data Evaluation	70 days	4/12/02	7/18/02
	Task 53 - Risk Assessment	**44 days**		
21	Human Health Risk Analyses (PRE)	44 days	7/5/02	9/4/02
22	Ecological Risk Assessment	44 days	7/5/02	9/4/02
	Task 67 - Report Preparation	**272 days**		
23	Prelim. Draft RI Report	90 days	7/24/02	11/26/02
24	Navy Review	30 days	11/27/02	1/7/03
25	Draft RI Report	32 days	1/8/03	2/20/03
26	Draft Final RI Report	45 days	3/12/03	5/13/03
27	BCT Review	60 days	2/21/03	5/15/03
28	BCT Review	30 days	5/14/03	6/24/03
29	Final RI Report	32 days	6/25/03	8/7/03

Timeline: 2000 (Oct, Jan, Apr, Jul), 2001 (Oct, Jan, Apr, Jul), 2002 (Oct, Jan, Apr, Jul), 2003 (Oct, Jan, Apr, Jul, Oct)

Project: Phase II RI EOD Range, Site 1
Print Date: Fri 10/5/01
Contract No: N62742-94-D004/CTO72

Legend: Task; Progress; Milestone; Summary; Project Summary

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5.2.1.3 FIELD DUPLICATES

Duplicate samples will be used to characterize the variability of the groundwater sampling process. Results will be compared to the laboratory variability criteria for laboratory duplicates to assess whether the effect is a function of laboratory sampling and analysis, a function of the sampling process, or a function of the inherent variability of the site. The qualitative assessment will be used to characterize the uncertainty of the conclusions of the investigation.

5.2.1.4 FIELD BLANKS

Field blank samples will be used to characterize any contribution from the water used for decontamination of equipment and may qualify the assessment of the results based on the equipment rinsates.

5.2.1.5 EQUIPMENT RINSATE BLANK

Equipment rinsates will be collected to assess the potential contribution of cross contamination between sample locations to the results reported. Target analytes detected in equipment rinsates will be compared to analytes detected in samples and the conclusions qualified as necessary.

5.2.2 Laboratory Analytical Methods and Requirements

Laboratory services will be contracted under the Pacific Division Navy CLEAN II subcontracting system, which has master services agreements (MSAs) with Naval Facilities Engineering Service Center (NFESC)-evaluated laboratories qualified to perform work for this project. The MSAs specify the work to be performed, which shall be done in accordance with the referenced method and the *Navy Installation Restoration Chemical Data Quality Manual (IRCDQM)* (NFESC 1999).

5.2.2.1 PERCHLORATE

No methods for analysis of perchlorate in soil have been published or proposed. Based on the relatively high solubility of the analyte, use of a deionized water extraction followed by analysis by ion chromatography will meet the project objective to estimate perchlorate concentrations in soil samples collected at the site. The performance of the method will be evaluated using matrix spikes, and the conclusions will be qualified appropriately. The cited method for analysis of the water extract will be EPA Method 314.1 or California DHS Method CLO4METH. A copy of the laboratory SOP is provided in Appendix C.

5.2.2.2 VOLATILE ORGANIC COMPOUNDS

VOCs will be analyzed in accordance with EPA Method 8260B, using sample collection and preparation in accordance with EPA 5035 for soil and 5030B for water. The analytes will be compounds on the contract laboratory program (CLP) target list.

5.2.2.3 VOLATILE PETROLEUM HYDROCARBONS

Volatile hydrocarbons will be evaluated for the approximate carbon range C6 through C12, using purge and trap followed by gas chromatography. Samples will be collected and analyzed in accordance with EPA Methods 5035 and 8015B for soil.

5.2.2.4 EXTRACTABLE PETROLEUM HYDROCARBONS

Extractable hydrocarbons will be evaluated for the approximate carbon range C10 through C36, using extraction and gas chromatography in accordance with EPA Method 8015B.

5.2.2.5 SEMIVOLATILE ORGANIC COMPOUNDS

Samples will be analyzed for SVOCs in accordance with EPA Method 8270C. The analytes will be compounds on the CLP target list. N-nitrosodimethylamine has been added to the target list; however, due to the nature of the analyte and its recent identification as a potential contaminant, the analysis in soil and groundwater may require method development and a separate analysis.

5.2.2.6 N-NITROSODIMETHYLAMINE BY HIGH-RESOLUTION GC/MS

N-nitrosodimethylamine in groundwater will be analyzed by high-resolution gas chromotography/mass spectrometry (GC/MS) using isotope dilution techniques.

5.2.2.7 DIOXINS AND FURANS

Samples will be analyzed for dioxins and furans in accordance with EPA Method 8290C. Target compounds will be analytes found in the WHO list of compounds (WHO 1997).

5.2.2.8 EXPLOSIVES (NITROAROMATICS/NITROAMINES)

Samples will be analyzed for explosive compounds by EPA Method 8330.

5.2.2.9 METALS

Samples will be analyzed for metals by trace inductively coupled plasma (ICP) EPA Method 6010, except where an alternative method will be needed to achieve the target reporting limits in the sample matrix. Samples will be analyzed for CLP target list metals by SW6010 or 7000 series methods. Soils will be prepared in accordance with 3050B, and waters in accordance with 3010A.

5.2.2.10 GENERAL CHEMISTRY

Samples will be analyzed for nitrates by deionized water extraction and EPA Method 352.1. Samples will also be analyzed for pH by EPA SW9045C for soil and SW9040 for water.

5.2.3 Quality Control Requirements

All laboratory measurements will be performed in accordance with the Navy's *IRCDQM* (NFESC 1999) and the Earth Tech MSA. The laboratory is required to have an approved QA program with current SOPs for each method performed.

The laboratory will perform the following quality control analyses in accordance with the cited methods:

- Method or reagent blanks,
- Matrix spikes,
- Duplicates or matrix spike duplicates,
- Surrogates,
- Blank spikes or laboratory control samples.

The values shown in Table 5-2 and Table 5-3 will be used to validate the data and assess the acceptability for the project goals. Laboratory-derived acceptance criteria will be used if the criteria are either narrower than those presented in Table 5-2 and Table 5-3, or if not, they will be developed in accordance with the published method to represent realistic operational criteria.

Table 5-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Total Volatile Petroleum Hydrocarbons (Extraction: SW5035; Analysis: SW8015B) (mg/kg)					
Volatile Petroleum Hydrocarbons	10	10	28	71–127	72–124
Total Extractable Petroleum Hydrocarbons (Extraction: SW3550B; Analysis: SW8015B) (mg/kg)					
Extractable Petroleum Hydrocarbons	10	10	50	50–149	51–134
Volatile Organic Compounds (Extraction: SW5035; Analysis: SW8260B) (µg/kg)					
1,1,1-Trichloroethane	630,000	5	30	65–135	65–135
1,1,2,2-Tetrachloroethane	380	5	30	64–135	64–135
1,1,2-Trichloroethane	840	5	30	65–135	65–135
1,1-Dichloroethane	590,00	5	30	62–135	62–135
1,1-Dichloroethene	54	5	29	69–127	71–125
1,2-Dichloroethane	350	5	30	58–137	58–137
cis-1,2-Dichloroethene	43,000	5	30	65–135	65–135
trans-1,2-Dichloroethene	63,000	5	30	65–135	65–135
1,2-Dichloropropane	350	5	30	60–135	60–135
2-Butanone	7,300,000	5	50	50–150	50–150
2-Hexanone	--	5	50	50–150	50–150
4-Methyl-2-pentanone	790,000	5	50	50–150	50–150
Acetone	1,600,000	100	50	35–165	35–165
Benzene	650	5	22	75–119	76–118
Bromodichloromethane	1,000	5	30	65–135	65–135
Bromoform	62,000	5	30	65–135	65–135
Bromomethane	3,900	5	30	62–135	62–135
Carbon disulfide	360,000	5	30	65–135	65–135
Carbon tetrachloride	240	5	30	52–135	52–135
Chlorobenzene	150,000	5	21	75–125	76–116
Chloroethane	3,000	5	30	55–135	55–135
Chloroform	240	5	30	64–135	64–135
Chloromethane	1,200	5	30	65–135	65–135
cis-1,3-Dichloropropene	700	5	30	64–135	64–135
Dibromochloromethane	1,100	5	30	63–135	63–135
Ethylbenzene	1,500,000	5	30	65–135	65–135
Methylene chloride	8,900	5	30	65–135	65–135
Styrene	4,600,000	5	30	65–135	65–135
Tetrachloroethene	5,700	5	29	66–125	69–121
Toluene	590,000	5	21	72–126	72–126
trans-1,3-Dichloropropene	700	5	30	56–135	56–135
Trichloroethene	2,800	5	30	61–135	61–135
Vinyl chloride	150	5	30	36–144	36–144

Table 5-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Xylenes (total)	1,400,000	5	30	65–135	65–135
Semivolatile Organic Compounds (Extraction: SW3550B; Analysis: SW8270C) (µg/kg)					
1,2,4-Trichlorobenzene	650,000	10	61	10–132	40–116
1,2-Dichlorobenzene	900,000	10	30	32–135	32–135
1,3-Dichlorobenzene	13,000	10	30	26–135	26–135
1,4-Dichlorobenzene	3,400	10	57	15–128	38–116
2,2'-oxybis(1-Chloropropane)	2900	10	30	36–135	36–135
2,4,5-Trichlorophenol	6,100,000	10	30	25–175	25–175
2,4,6-Trichlorophenol	44,000	10	30	29–138	29–138
2,4-Dichlorophenol	180,000	10	30	36–135	36–135
2,4-Dimethylphenol	1,200,000	10	30	35–149	35–149
2,4-Dinitrophenol	120,000	50	30	25–161	25–161
2,4-Dinitrotoluene	120,000	10	61	12–134	38–118
2,6-Dinitrotoluene	61,000	10	30	41–135	41–135
2-Chloronaphthalene	3,900,000	10	30	50–135	50–135
2-Chlorophenol	63,000	10	54	12–120	35–113
2-Methylnaphthalene	--	10	30	31–135	31–135
2-Methylphenol	3,100,000	10	30	25–135	25–135
2-Nitroaniline	3,500	50	30	40–135	40–135
2-Nitrophenol	--	10	30	34–135	34–135
3,3'-Dichlorobenzidine	1,100	10	30	25–175	25–175
3-Nitroaniline	--	50	30	41–135	41–135
4,6-Dinitro-2-methylphenol	--	50	30	25–144	25–144
4-Bromophenyl-phenylether	--	10	30	43–137	43–137
4-Chloro-3-methylphenol	--	10	58	10–126	37–113
4-Chloroaniline	240,000	20	30	35–146	35–146
4-Chlorophenyl-phenyl ether	--	10	30	41–142	41–142
4-Methylphenol	310,000	10	30	25–135	25–135
4-Nitroaniline	--	50	30	30–153	30–153
4-Nitrophenol	490,000	50	60	12–132	15–128
Acenaphthene	3,700,000	10	59	16–134	41–118
Acenaphthylene	--	10	30	37–135	37–135
Anthracene	22,000,000	10	30	35–175	35–175
Benzo(a)anthracene	620	10	30	41–143	41–143
Benzo(a)pyrene	62	10	30	31–135	31–135
Benzo(b)fluoranthene	620	10	30	27–135	27–135
Benzo(g,h,i)perylene	--	10	30	25–159	25–159
Benzo(k)fluoranthene	6200	10	30	31–135	31–135

Table 5-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
bis(2-Chloroethoxy)methane	–	10	30	39–135	39–135
bis(2-Ethylhexyl)phthalate	35,000	10	30	34–135	34–135
bis-(2-Chloroethyl)ether	210	10	30	25–139	25–139
Butylbenzylphthalate	12,000,000	10	30	25–135	25–135
Carbazole	24,000	10	30	25–159	25–159
Chrysene	62,000	10	30	45–143	45–143
Di-n-butylphthalate	6,100,000	10	30	40–135	40–135
Di-n-octylphthalate	1,200,000	10	30	42–135	42–135
Dibenz(a,h)anthracene	62	10	30	27–135	27–135
Dibenzofuran	290,000	10	30	25–175	25–175
Diethylphthalate	49,000,000	10	30	25–136	25–136
Dimethylphthalate	610,000,000	10	30	28–137	28–137
Fluoranthene	2,300,000	10	30	37–135	37–135
Fluorene	2,600,000	10	30	38–149	38–149
Hexachlorobenzene	200	10	30	36–143	36–143
Hexachlorobutadiene	6,200	10	30	25–135	25–135
Hexachlorocyclopentadiene	420,000	50	30	31–135	31–135
Hexachloroethane	35,000	10	30	25–163	25–163
Indeno(1,2,3-cd)-pyrene	620	10	30	25–170	25–170
Isophorone	510,000	10	30	25–175	25–175
N-Nitroso-di-n-propylamine	69	10	30	40–135	40–135
N-Nitroso-diphenylamine	99,000	10	30	36–143	36–143
Naphthalene	56,000	10	30	27–135	27–135
Nitrobenzene	20,000	10	62	10–134	32–122
Pentachlorophenol	3,000	50	62	10–134	15–128
Phenanthrene	–	10	30	44–135	44–135
Phenol	3,700,000	10	53	10–116	30–111
Pyrene	2,300,000	10	56	22–134	38–130
Metals (Preparation: SW 3050B; Analysis: Mercury SW 7471, all other metals SW 6010) (mg/kg)					
Aluminum	14,800	5	20	75–125	80–120
Antimony	3.06	3	20	75–125	80–120
Arsenic	6.86	0.3	20	75–125	80–120
Barium	173	1	20	75–125	80–120
Beryllium	0.669	0.2	20	75–125	80–120
Cadmium	2.35	0.2	20	75–125	80–120
Calcium	46,000	10	20	75–125	80–120
Chromium	26.9	0.5	20	75–125	80–120
Cobalt	6.98	0.5	20	75–125	80–120

Table 5-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Copper	10.5	0.5	20	75–125	80–120
Iron	18,400	3	20	75–125	80–120
Lead	15.1	0.3	20	75–125	80–120
Magnesium	8,370	0.5	20	75–125	80–120
Manganese	291	10	20	75–125	80–120
Mercury	0.22	0.2	20	75–125	80–120
Nickel	15.3	0.2	20	75–125	80–120
Potassium	4,890	20	20	75–125	80–120
Selenium	0.32	0.3	20	75–125	80–120
Silver	0.539	0.5	20	75–125	80–120
Sodium	405	100	20	75–125	80–120
Thallium	0.42	0.4	20	75–125	80–120
Vanadium	71.8	0.5	20	75–125	80–120
Zinc	77.9	1	20	75–125	80–120
Dioxins and Furans (Extraction: SW3550B. Analysis: SW8290C) (pg/kg)					
2,3,7,8-TCDD	3,900	400[c]	25	40–135	40–135
1,2,3,7,8-PCDD	*	400	25	40–135	40–135
1,2,3,4,7,8-HxCDD	*	1,000	25	40–135	40–135
1,2,3,6,7,8-HxCDD	*	1,000	25	40–135	40–135
1,2,3,7,8,9-HxCDD	*	1,000	25	40–135	40–135
1,2,3,4,6,7,8-HpCDD	*	1,000	25	40–135	40–135
OCDD	*	2,000	25	40–135	40–135
2,3,7,8-TCDF	*	400	25	40–135	40–135
1,2,3,7,8-PCDF	*	400	25	40–135	40–135
2,3,4,7,8-PCDF	*	1,000	25	40–135	40–135
1,2,3,4,7,8-HxCDF	*	1,000	25	40–135	40–135
1,2,3,6,7,8-HxCDF	*	1,000	25	40–135	40–135
1,2,3,7,8,9-HxCDF	*	1,000	25	40–135	40–135
2,3,4,6,7,8-HxCDF	*	1,000	25	40–135	40–135
1,2,3,4,6,7,8-HpCDF	*	1,000	25	40–135	40–135
1,2,3,4,7,8,9-HpCDF	*	1,000	25	40–135	40–135
OCDF	*	2,000	25	40–135	40–135
Nitroaromatics/nitroamines (Explosives) (Extraction and analysis: SW 8330) (μg/kg)					
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine(HMX)	44,000,000	200	23	64–109	59–111
Hexahydro-1,3,5-trinitro-1,3,5-triazine(RDX)	22,000	200	33	63–129	65–113
1,3,5-Trinitrobenzene (1,3,5-TNB)	26,000,000	200	24	76–125	73–110
1,3-Dinitrobenzene (1,3-DNB)	88,000	200	20	73–111	66–109

Table 5-2: Project Quality Control Criteria for Soil Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	8,800,000	200	29	60–117	48–116
Nitrobenzene (NB)	110,000	200	21	72–114	68–107
2,4,6-Trinitrotoluene (2,4,6-TNT)	82,000	200	26	69–120	70–111
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	--	200	27	63–118	55–114
2-Amino-4, 6-dinitrotoluene (2-Am-DNT)	--	200	29	65–122	62–115
2,4-Dinitrotoluene (2,4-DNT)	1,800,000	200	29	65–122	62–115
2,6-Dinitrotoluene (2,6-DNT)	880,000	200	27	63–118	55–114
2-Nitrotoluene (2-NT)	--	200	38	50–126	44–120
3-Nitrotoluene (3-NT)	1,000,000	200	23	68–114	62–118
4-Nitrotoluene (4-NT)	1,000,000	200	38	50–126	44–120
Miscellaneous analytes					
Perchlorate (mg/kg) (Method: Modified METHCLO4[d] or WW 314.1)	39	20	20	75–125	80–120
pH (units) (Method: SW9045C)	--	n.a.	n.a.	0.5 units	0.10 units
Nitrate (mg/kg) (Method: Modified WW300.0 or WW352.1)	--	200	20	75–125	80–120

Notes:

mg/kg	=	milligrams per kilogram	n.a.	=	not applicable
µg/kg	=	micrograms per kilogram	RPD	=	relative percentage of difference
pg/kg	=	picograms per kilogram	%R	=	percent recovery
LCS	=	laboratory control sample	SW	=	Test Method Solid Waste (EPA 1997b)
EPA	=	U.S. Environmental Protection Agency	*	=	calculated from TEF values as TEQ
--	=	none established	TEF	=	toxicity equivalency factor
MS	=	matrix spike	TEQ	=	toxicity equivalency quotient
MSD	=	matrix spike duplicate	WW	=	Water and Waste (EPA 1983)

CDD = chlorodibenzodioxin, CDF = chlorodibenzofuran

In general, the prefixes that accompany these suffixes are as follows:T = tetra, Pe = penta, Hx = hexa, Hp = hepta, O = octa

[a] For VOCs, SVOCs, explosives, dioxins, and perchlorate, the lower of California Modified PRGs and EPA Region IX PRGs residential (November 2000 Update) has been used; for metals, established background threshold levels (95[th] quantile) have been used (BNI 1996).

[b] Laboratory-specific performance criteria.

[c] Actual dioxin reporting limits are calculated based on sample-specific internal standard recovery data.

[d] California Department of Health Services published method.

Table 5-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Total Volatile Petroleum Hydrocarbons (Extraction: SW 5030B. Analysis: SW8015B) (mg/L)					
Volatile Petroleum Hydrocarbons	1	1	25	70–130	75-125
Total Extractable Petroleum Hydrocarbons (Extraction: SW 3520C. Analysis: SW8015B) (mg/L)					
Extractable Petroleum Hydrocarbons	1	1	50	50-150	60-140
Volatile Organic Compounds (Extraction: SW5030B. Analysis: SW8260B) (µg/L)					

Table 5-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
1,1,1-Trichloroethane	540	1	20	70–130	75-125
1,1,2,2-Tetrachloroethane	*1*	1	20	70–130	75–125
1,1,2-Trichloroethane	*5*	1	20	70–130	75–125
1,1-Dichloroethane	810	1	20	70–130	75–125
1,1-Dichloroethene	*6*	1	20	70–130	75–125
1,2-Dichloroethane	*0.5*	0.5	20	70–130	75–125
cis-1,2-Dichloroethene	61	1	20	70–130	75–125
trans-1,2-Dichloroethene	120	1	20	70–130	75–125
1,2-Dichloropropane	*5*	1	20	70–130	75–125
2-Butanone	1,900	100	40	50–150	60–140
2-Hexanone	–	50	40	50–150	60–140
4-Methyl-2-pentanone	160	50	40	50–150	60–140
Acetone	610	100	40	50–150	60–140
Benzene	*1*	1	20	70–130	75–125
Bromodichloromethane	0.18	0.1	20	70–130	75–125
Bromoform	8.5	1	20	70–130	75–125
Bromomethane	8.7	1	20	70–130	75–125
Carbon disulfide	1,000	1	20	70–130	75–125
Carbon tetrachloride	*0.5*	0.5	20	70–130	75–125
Chlorobenzene	110	1	20	70–130	75–125
Chloroethane	4.6	1	20	70–130	75–125
Chloroform	0.16	0.1	20	70–130	75–125
Chloromethane	1.5	1	20	70–130	75–125
cis-1,3-Dichloropropene	*0.5*	0.5	20	70–130	75–125
Dibromochloromethane	0.13	0.1	20	70–130	75–125
Ethylbenzene	1,300	1	20	70–130	75–125
Methylene chloride	4.3	3	20	70–130	75–125
Styrene	1,600	1	20	70–130	75–125
Tetrachloroethene	1.1	1	20	70–130	75–125
Toluene	720	1	20	70–130	75–125
trans-1,3-Dichloropropene	*0.5*	0.5	20	70–130	75–125
Trichloroethene	1.6	1	20	70–130	75–125
Vinyl Chloride	*0.5*	0.5	20	70–130	75–125
Xylenes (total)	1,400	1	20	70–130	75–125
Semivolatile Organic Compounds (Extraction: SW3520C. Analysis: SW8270C) (µg /L)					
1,2,4-Trichlorobenzene	190	10	30	44–142	44–142
1,2-Dichlorobenzene	370	10	30	42–155	42–155
1,3-Dichlorobenzene	5.5	10	30	36–125	36–125

Table 5-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
1,4-Dichlorobenzene	*5*	5	30	30–125	30–125
2,2'-oxybis(1-Chloropropane)	0.96*	10	30	35–135	35–135
2,4,5-Trichlorophenol	3,600	10	30	25–175	25–175
2,4,6-Trichlorophenol	6.1	5	30	39–128	39–128
2,4-Dichlorophenol	110	10	30	46–125	46–125
2,4-Dimethylphenol	730	10	30	45–139	45–139
2,4-Dinitrophenol	73	10	30	30–151	30–151
2,4-Dinitrotoluene	73	10	30	39–139	39–139
2,6-Dinitrotoluene	36	10	30	51–125	51–125
2-Chloronaphthalene	490	10	30	60–125	60–125
2-Chlorophenol	30	10	30	41–125	41–125
2-Methylnaphthalene	--	10	30	41–125	41–125
2-Methylphenol	1,800	10	30	25–125	25–125
2-Nitroaniline	2.1*	50	30	50–125	50–125
2-Nitrophenol	--	10	30	44–125	44–125
3,3'-Dichlorobenzidine	0.15*	10	30	29–175	29–175
3-Nitroaniline	--	50	30	51–125	51–125
4,6-Dinitro-2-methylphenol	--	50	30	26–134	26–134
4-Bromophenyl-phenylether	--	10	30	53–127	53–127
4-Chloro-3-methylphenol	--	10	30	44–125	44–125
4-Chloroaniline	150	10	30	45–136	45–136
4-Chlorophenyl-phenyl ether	--	10	30	51–132	51–132
4-Methylphenol	180	10	30	33–125	33–125
4-Nitroaniline	--	50	30	40–143	40–143
4-Nitrophenol	290	50	30	25–131	25–131
Acenaphthene	360	10	30	49–125	49–125
Acenaphthylene	--	10	30	47–125	47–125
Anthracene	1,800	10	30	45–165	45–165
Benzo(a)anthracene	0.09*	10	30	51–133	51–133
Benzo(a)pyrene	*0.2*	0.2	30	41–125	41–125
Benzo(b)fluoranthene	0.09*	10	30	37–125	37–125
Benzo(g,h,i)perylene	--	10	30	34–149	34–149
Benzo(k)fluoranthene	0.92*	10	30	37–125	37–125
bis(2-Chloroethoxy)methane	--	10	30	49–125	49–125
bis(2-Ethylhexyl)phthalate	4.8*	10	30	33–129	33–129
bis-(2-Chloroethyl)ether	0.01*	10	30	44–125	44–125
Butylbenzylphthalate	7,300	10	30	26–125	26–125
Carbazole	3.4*	50	30	29–135	29–135

Table 5-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Chrysene	9.2	5	30	55–133	55–133
Di-n-butylphthalate	3,600	10	30	34–126	34–126
Di-n-octylphthalate	730	10	30	38–127	38–127
Dibenz(a,h)-anthracene	0.01*	10	30	50–125	50–125
Dibenzofuran	24	10	30	52–125	52–125
Diethylphthalate	29,000	10	30	37–125	37–125
Dimethylphthalate	360,000	10	30	25–175	25–175
Fluoranthene	1,500	10	30	47–125	47–125
Fluorene	240	10	30	48–139	48–139
Hexachlorobenzene	*1*	1	30	46–133	46–133
Hexachlorobutadiene	0.86*	10	30	25–125	25–125
Hexachlorocyclopentadiene	260	50	30	41–125	41–125
Hexachloroethane	4.8*	5	30	25–153	25–153
Indeno(1,2,3-cd)-pyrene	0.09*	10	30	27–160	27–160
Isophorone	71	10	30	26–175	26–175
N-Nitroso-di-n-propylamine	0.0036*	10	30	37–125	37–125
N-Nitroso-diphenylamine	140	10	30	27–125	27–125
Naphthalene	6.2	5	30	50–125	50–125
Nitrobenzene	3.4*	5	30	46–133	46–133
Pentachlorophenol	0.56	1	30	28–136	28–136
Phenanthrene	--	10	30	54–125	54–125
Phenol	22,000	10	30	25–125	25–125
Pyrene	180	10	30	47–136	47–136
Metals (Preparation: SW 3010B; Analysis: Mercury SW7471, all other metals SW6010) (µg/L)					
Aluminum	36,000	5	20	75–125	80–120
Antimony	15	5	20	75–125	80–120
Arsenic	0.045	0.3	20	75–125	80–120
Barium	2,600	1	20	75–125	80–120
Beryllium	73	0.2	20	75–125	80–120
Cadmium	18	0.2	20	75–125	80–120
Calcium	--	10	20	75–125	80–120
Chromium	64	0.5	20	75–125	80–120
Cobalt	2,200	0.5	20	75–125	80–120
Copper	1,400	0.5	20	75–125	80–120
Iron	11,000	3	20	75–125	80–120
Lead	0.0036	0.3	20	75–125	80–120
Magnesium	--	0.5	20	75–125	80–120
Manganese	880	10	20	75–125	80–120

Table 5-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS
Mercury	11	0.2	20	75–125	80–120
Nickel	41,000	0.2	20	75–125	80–120
Potassium	--	20	20	75–125	80–120
Selenium	180	0.5	20	75–125	80–120
Silver	180	0.5	20	75–125	80–120
Sodium	--	100	20	75–125	80–120
Thallium	2.4	0.5	20	75–125	80–120
Vanadium	260	0.5	20	75–125	80–120
Zinc	11,000	1	20	75–125	80–120
Nitroaromatics/nitroamines (Explosives) (Extraction and analysis: SW8330) (µg/L)					
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine(HMX)	180	5	30	40–135	50–135
Hexahydro-1,3,5-trinitro-1,3,5-triazine(RDX)	0.61	5	30	40–135	50–135
1,3,5-Trinitrobenzene (1,3,5-TNB)	1,100	5	30	40–135	50–135
1,3-Dinitrobenzene (1,3-DNB)	3.6*	5	30	40–135	50–135
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	--	5	30	40–135	50–135
Nitrobenzene (NB)	3.4*	5	30	40–135	50–135
2,4,6-Trinitrotoluene (2,4,6-TNT)	2.2*	5	30	40–135	50–135
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	--	5	30	40–135	50–135
2-Amino-4, 6-dinitrotoluene (2-Am-DNT)	--	5	30	40–135	50–135
2,4-Dinitrotoluene (2,4-DNT)	73	5	30	40–135	50–135
2,6-Dinitrotoluene (2,6-DNT)	36	5	30	40–135	50–135
2-Nitrotoluene (2-NT)	61	5	30	40–135	50–135
3-Nitrotoluene (3-NT)	61	5	30	40–135	50–135
4-Nitrotoluene (4-NT)	61	5	30	40–135	50–135
Miscellaneous analytes					
Perchlorate (mg/kg) (Method: Modified METHCLO4[d] or WW 314.1)	18	5	20	75–125	80–120
pH (units) (Method: SW9045C)	6.5-8.0	n.a.	n.a.	0.5 units	0.10 units
Nitrate (mg/kg) (Method: Modified WW300.0 or WW352.1)	--	1	20	75–125	80–120

Notes:

mg/L = milligrams per liter
ng/L = nanograms per liter
µg/L = micrograms per liter
LCS = laboratory control sample
EPA = U.S. Environmental Protection Agency
-- = none established
MS = matrix spike
MSD = matrix spike duplicate
n.a. = not applicable
RPD = relative percentage of difference
% R = percent recovery
SW = Test Method Solid Waste (EPA 1997b)
WW = Water and Waste (EPA 1983)

CDD = chlorodibenzodioxin, CDF = chlorodibenzofuran
In general, the prefixes that accompany these suffixes are as follows:T = tetra, Pe = penta, Hx = hexa, Hp = hepta, O = octa

Table 5-3: Project Quality Control Criteria for Groundwater Samples

Analyte	Project Decision Threshold[a]	Reporting Limit Required	Precision (RPD)	Accuracy (%R)[b]	
				MS/MSD	LCS

* Laboratory reporting limits are greater than the project decision thresholds; see discussion in the subsection 'Reporting Limits' below for evaluation of these analytes.
Decision thresholds shown in italics are based on drinking water MCLs. PRGs for these compounds are too low to be detected with reasonable analytical confidence.
[a] For VOCs, SVOCs, explosives, dioxins, Perchlorate, and metals, the lower of California Modified PRGs and EPA Region IX PRGs for residential tap water (November 2000 Update) have been used; for analytes whose PRGs are lower than the laboratory reporting limits, primary MCLs have been used.
[b] Laboratory-specific performance criteria.
[c] Actual dioxin reporting limits are calculated based on sample-specific internal standard recovery data.
[d] California Department of Health Services published method.

Reporting Limits. The laboratory will have current and documented reporting limits consistent with the values presented in Table 5-2 and Table 5-3. Reporting limits that exceed the selected decision criteria will be evaluated on an individual basis. Analytes not detected in any sample at the site or that have no reasonable expectation to be the result of site activities will not be included in further evaluation. Analytes that are identified as site COPCs will be incorporated into the site evaluation and recommendations; the detection limit will be addressed as a factor in the uncertainty associated with the decision-making process.

Method Blanks. A method blank will be analyzed with every batch of 20 or fewer samples to measure laboratory contamination. The method blank will be an analyte-free matrix (water or soil) that will be carried through the entire preparation and analysis procedure. If any analytes are found above reporting limits, the results of samples in the batch will be examined. Those with results less than the reporting limit or greater than 10 times the value of the method blank will be accepted. Other samples will be reanalyzed in another batch. Consistent presence of contamination will require investigation and correction.

Laboratory Control Samples. A laboratory control sample (LCS) will be analyzed with every batch of 20 samples or less for accuracy. The LCS will consist of a method blank spiked with a known amount of analyte that will be carried through the entire preparation and analysis procedure. The LCS source will be different from that used to prepare calibration standards. Analytes used for the LCS will comply with the method requirements. Control charts may be used, and control limits will be calculated based upon historical data. When control limits are exceeded, the analysis will be stopped, and the problem corrected. Samples associated with the out-of-control LCS will be reanalyzed in another batch, unless documented evidence is presented to show that associated samples were not affected. Guidance limits for the LCS listed in Table 5-2 and Table 5-3 will be used unless more restrictive laboratory-specific limits are established or statistically based limits are developed.

Matrix Spikes. A matrix spike (MS) will be analyzed for at least one out of every 20 samples to measure matrix effects on accuracy. The MS will consist of additional aliquots of sample spiked with a known amount of analyte. Compounds to be spiked will be in accordance with the laboratory SOP or the published method. Guidance limits for the MS listed in Table 5-2 and Table 5-3 will be used unless more restrictive laboratory-specific limits are established. If the analyte concentration in the sample is greater than twice the amount of spike added, the spike will be considered invalid and the recovery will not be calculated. If a valid spike recovery exceeds acceptance limits but the LCS is in control, matrix interference is indicated.

Duplicates or Matrix Spike Duplicates. A duplicate or a matrix spike duplicate (MSD) will be analyzed for at least one out of every 20 samples to measure precision. For any batch of samples that does not contain a duplicate or MSD (i.e., when insufficient sample is available), two LCSs may be used.

However, every effort will be made to provide sufficient sample for laboratory QC. If the relative percentage of difference (RPD) does not meet the established acceptance limits, the problem will be investigated and corrected. Any affected samples will be reanalyzed in a separate batch. Acceptance limits for duplicates/MSDs listed in Table 5-2 and Table 5-3 will be used unless more restrictive laboratory-specific limits are established or statistically derived limits are developed.

Surrogates. Surrogate spikes will be added to all samples for organic analyses to measure sample-specific accuracy. Surrogate spike acceptance criteria are developed by the laboratory and will be provided with the data package.

5.2.4 Calibration and Preventive Maintenance

The laboratory is required to document calibration procedures in accordance with Appendix C, Section 5.9.4 of the *Navy IRCDQM* (NFESC 1999). Calibration procedures will be consistent with specified method requirements.

The laboratory will perform preventive maintenance on instruments used to analyze project samples and will keep records of all such maintenance in accordance with Section 5.8 of Appendix C of the *IRCDQM* (NFESC 1999) Preventive maintenance documentation is incorporated into laboratory certification requirements and is an element of the subcontractor laboratory quality assurance plan, which will be reviewed and approved prior to selection of a CLEAN II subcontractor laboratory.

5.2.5 Acceptance Requirements for Supplies and Consumables

Supplies and consumables that have the potential to impact data quality will include sample containers and preservatives. All sample containers and preservatives will be provided by the laboratory. The laboratory will track sample container and preservative sources and ensure that the containers are free from contamination. Field blanks will serve as an independent verification of consumable integrity.

Consumables used in sample collection include EnCore soil samplers and the tubing installed in each well. New materials in original packaging from the supplier will be used and selected on the basis of being appropriate for the application. Stainless-steel rings used for soil sample collection will be thoroughly scrubbed in a non-phosphate detergent solution and double-rinsed with distilled or deionized water prior to each use.

5.2.6 Data Management

The laboratory will verify, reduce, and report data as specified in their laboratory QA plan and in accordance with the laboratory SOW. Both hard copy and electronic data deliverables (EDD) will be required within 30 days of sample receipt. The format for both hard copies and EDDs is specified in the subcontract. Hard copy data will be delivered on CLP-like forms, along with a case narrative, table of contents, and raw data for Level IV QC deliverables.

Printed laboratory reports will be received and reviewed for completeness and compliance with the laboratory SOW. The project chemist will immediately review the case narrative and report to project management any issues that may effect the project conclusions or schedule. The project chemist will also ensure that appropriate copies are provided to technical staff, data validation personnel, and the CTO manager.

EDDs will be received on diskettes or through electronic mail in the format specified in the analytical laboratory technical specifications. EDDs will be loaded into a database management system and checked for completeness and errors. Part of this check involves verifying that all requested analyses for each sample are performed and reported. This may be accomplished by comparing the delivered results to those recorded electronically. If errors are encountered or data are not complete, the laboratory will be notified and data will be resubmitted. If only minor errors or omissions are encountered, data management personnel will manually correct the data, but the laboratory will be notified so that it can rectify the problems for future projects. Once in the database, the records will be made accessible to project personnel.

The electronic data versus hard copy data will be manually verified for the entire project. Final data tables will be compared to the database to verify the output.

Computer files will be backed up daily to avoid loss of information. Hard copy data will be stored in secure areas, while electronic data will be stored in password-protected files, with read-only access to users who do not have authorization to edit the data. The data will be stored for 10 years after the close of the PACDIV CLEAN II contract.

5.3 PROJECT QUALITY ASSURANCE OVERSIGHT

Samples will be submitted to an NFESC-evaluated laboratory for analysis by methods cited in Table 5-2 and Table 5-3. The laboratory will also be certified by the California State Environmental Laboratory Accreditation Program (ELAP). Laboratory data quality strategies and criteria were developed in accordance with the project DQOs and the following references:

- *Installation Restoration Chemical Data Quality Manual* (NFESC 1999),
- *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (SW846)* (EPA 1997b),
- *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis* (EPA 1994a),
- *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analysis* (EPA 1994b).

System and performance audits are a fundamental element of the QA process and are the tool used to demonstrate compliance with data quality requirements.

Overall responsibility for implementation and monitoring of the Earth Tech QA program resides with the CLEAN II project quality manager. The CLEAN II project quality manager and the CTO manager will be responsible for reviewing the technical contents of all submittals required under this project. The QA activities applicable to this CTO are described in Standard Operating Procedures (BNI 1999d). The Earth Tech peer review program will be followed during this project.

5.3.1 Field Audits

The project chemist is anticipated to visit the site weekly during field activities to assess field practices for compliance with procedures and requirements. Documentation of the review shall be included in the project files.

5.3.2 Laboratory System Audits

Laboratories solicited for this project are required to have successfully completed evaluation by the Naval Facilities Engineering Service Command. Further evaluation of laboratory performance will be through data package reviews and oversight by the project chemist.

5.3.3 Laboratory Performance Review

Continual laboratory performance review will be conducted for the project. This will consist of the following tasks:

- Internal laboratory oversight by laboratory QA manager,

- Frequent progress reports and discussions between the project chemist and the laboratory project manager,
- Project chemist oversight of deliverables and reports,
- Desktop evaluation of reports and data packages,
- Data validation, as discussed in Section 5.4.2.

5.3.4 Performance Evaluation Samples

Laboratory performance will be assessed using commercially available performance evaluation (PE) samples. Samples will be submitted as blind or double-blind samples within the first week of field activities. Results of the analysis will be compared to the statistically derived acceptance criteria provided by the PE sample vendor. The results of the assessment will be included in the discussion of data quality in the report.

5.3.5 Corrective Actions

Corrective action requests will be issued and tracked by the project chemist when deficiencies or instances of noncompliance are noted, whether in field audits or laboratory evaluations. These findings will be resolved in a timely manner, typically within 30 days, by the project manager and documented in the project file. Findings that affect the collection or interpretation of project data will be noted in the laboratory case narrative and, as necessary, the pilot test report.

5.3.6 Reports to Management

Documentation of audits, copies of audit checklists, and copies of corrective action reports will be included in project files to be reviewed during management evaluation of project progress. Significant corrective actions, which are identified as having a direct effect on data quality or project completion, will be addressed by the CTO manager in writing to the program manager.

5.4 DATA VALIDATION AND USABILITY

All data developed in the course of the project will be evaluated for usability and compliance with measurement quality objectives. Field data will be tabulated and presented in the context of the data gathering. Laboratory data will be validated as specified below in accordance with the project DQO's and Southwest Division's (SWDIV) environmental work instructions.

5.4.1 Desktop Data Review

Upon receipt, all field data will be reviewed by the field manager and project manager for internal consistency and completeness. Laboratory data will be reviewed by the project chemist and the project geologist for applicability to the assessment of the site.

5.4.2 Data Validation

The data validation strategies presented in the SWDIV EWI #1 specify investigations at NPL sites will be subject to a minimum of 20 percent Level IV validation, with the remainder of the data subject to Level III validation.

Due to the nature of the validation process, Level III and IV data validation will be performed on complete sample delivery groups, i.e. all samples in a package will be validated at Level III or IV as assigned. This may result in a higher percentage of Level IV validated data than planned, but the approach will save in management and tracking resources.

5.4.2.1 *LEVEL III VALIDATION*

A minimum of Level III validation, as described in SWDIV EWI #1, will be performed on all samples collected during the investigation. Systematic concerns identified in Level III may be cause for additional Level IV review. Such review will be conducted until a return to compliance is verified.

5.4.2.2 *LEVEL IV VALIDATION*

Level IV validation will be performed on at least 20 percent of the samples, typically the first data packages submitted by the laboratory. The Level IV validation is intended to identify if any significant, systematic errors are present in the laboratory procedures or processes. If the Level IV validation identifies systematic errors, the laboratory will be required to initiate corrective action and ensure that such errors are corrected.

5.4.3 Data Usability

The final report will summarize the data validation findings, indicating the processes and findings of the review process. Data reported in the project report will be flagged with appropriate qualifiers to indicate the usability.

Data may be assigned the following qualifiers:

J	estimated concentration
N	presumptive evidence of the identification of an analyte
R	rejected data (unusable)
U	not detected (e.g., not present because of blank contamination)

Combinations of qualifiers such as UJ and NJ are possible. Where the validation qualifiers affect the project decision recommendations, the report will discuss the issue and the necessary corrective action.

6. RISK EVALUATION

Phase II RI analytical data will be used in a PRE of human health and in an ecological PRE. When contamination is detected at the site, a PRE will be conducted to assist in the decision-making process. If the site has been fully characterized according to the CSM and contamination is not detected, a PRE will not be required. The human health and ecological PREs will be conducted according to current Navy methodology. The human health PRE will follow the draft *PACDIV Risk Assessment Protocols* (Earth Tech 1999)

6.1 HUMAN HEALTH PRE

A human health PRE will be performed to assess whether potential receptors are impacted by site contamination and whether contamination poses a significant risk to human health. The PRE will be conducted according to the *EPA Risk Assessment Guidance for Superfund (RAGS)* (EPA 1989 and 1991). The human health PRE will be conducted in two phases. First, a conservative screening PRE will be performed using EPA Region IX/Cal-EPA modified PRGs (EPA 2000) as the basis of comparison; and second, if necessary, a site-specific PRE will be performed. The PRE decision tree is shown on Figures 6-1, 6-2, and 6-3.

6.1.1 Screening PRE

Exposure point concentrations (EPCs) for media of concern will be determined consistent with guidelines established by EPA (1992) *Calculating the Concentration Term*. Both maximum and reasonable maximum exposure (RME) EPCs will be calculated. The maximum EPC is defined as the maximum detected concentration of an constituent of concern and will be used in an effort to place an upper boundary on the risk associated with potential exposure to a COPC. The RME EPC will be calculated as a statistically determined estimate of exposure and is defined by the EPA as "... the highest exposure that is reasonably expected to occur at a site" (EPA 1989). The RME risks will represent the benchmark for determining whether remedial actions are necessary for the protection of human health.

EPA Region IX soil PRGs will be used to determine the potential for exposure to the soil pathway. For this evaluation, the maximum and RME concentrations for all constituents in soil will be sequentially compared first to the Region IX residential PRGs and then to the industrial soil PRGs. This comparison will allow a stepwise evaluation of two generic land use scenarios (i.e., residential and industrial land use) for subsequent risk management use. Cumulative risk associated with the soil pathway for each land use scenario will be calculated and presented in the PRE.

For evaluation of the groundwater pathway, soil and groundwater data will be evaluated separately. Constituents in soil will be compared to EPA Region IX (Cal-EPA modified) SSLs to denote the potential for transfer to and exposure via groundwater. At this stage, risk associated with the soil constituents potentially impacting the groundwater pathway will not be determined, but will be noted for subsequent evaluation in the site-specific PRE. Correspondingly, groundwater data will be compared to the Region IX PRGs for tap water or the California MCLs to determine the potential risk to receptors via the groundwater pathway, assuming hypothetical potable use of this medium. The screening PRE involves the following steps:

- Development/Refinement of a CSM
- Identification of relevant data sets
- Estimation of EPCs
- Calculation of screening cumulative health risks
- Evaluation of the screening PRE results

Preliminary risk evaluations are only intended to address contaminants with complete or potentially complete exposure pathways under current and future land use conditions. The *RAGS* (EPA 1989) defines a complete or potentially complete exposure pathway as one that consists of the following four elements: (1) a source and mechanism of chemical release; (2) a retention or transport mechanism through an environmental medium; (3) a point of potential human contact with the contaminated medium (exposure point); and (4) an exposure route at the exposure point. The exposure pathway is considered incomplete if any of these elements is missing.

The human health PRE will be used to evaluate the following potentially complete exposure scenarios:

- Direct contact with contaminants in surface and subsurface soil and inhalation of contaminated dust and VOCs by future industrial workers at Site 1,
- Direct contact with contaminants in surface soil and inhalation of contaminated dust and VOCs by future construction workers,
- Direct contact with contaminants in groundwater (i.e., ingestion, dermal contact, and inhalation of VOCs) by future industrial workers and current/future agricultural workers.

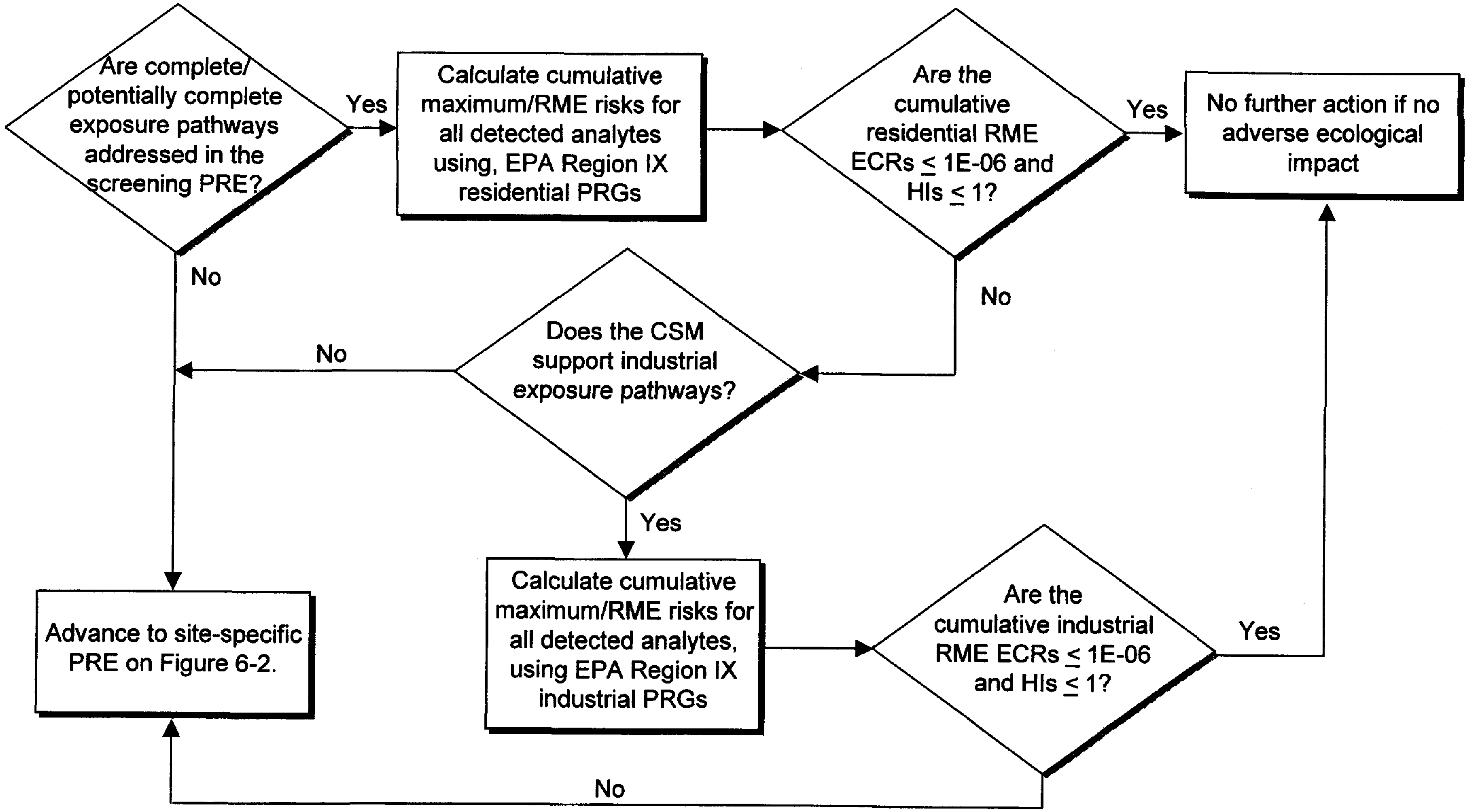
If the site has been adequately characterized and medium-specific and cumulative RME residential and industrial health risks are at or below an excess cancer risk (ECR) of 1E-06 and an hazard index (HI) of 1, and if there is no anticipated adverse ecological impact, then no further action will be recommended for industrial exposure. Because no PRGs or SSLs exist for scenarios considering current and future agricultural workers and future construction workers, a site-specific PRE will be performed for these classes of workers, using acceptable toxicity values and exposure factors as decision criteria. If maximum and RME EPCs for lead exceed the EPA Region IX residential or industrial PRG (as appropriate), then a site-specific PRE will be performed, and blood-lead models will be run to determine the potential health effects posed by lead.

6.1.2 Site-Specific PRE

As with the screening PRE, the RME risks will represent the benchmark for determining whether remedial actions are necessary for the protection of human health. If the screening PRE predicts potentially significant health risks, then a site-specific PRE will be performed to derive more realistic (i.e., site-specific) estimates of risk. The site-specific PRE will be designed to evaluate pathways, receptors, and exposure routes that are not accounted for in the Region IX PRGs or SSLs. Subsequent to performing the PRE, potential revisions of the conceptual site model may warrant inclusion of receptors (e.g., construction workers, trespassers, utility workers) or exposure routes (e.g., incidental contact with groundwater employed for other than potable use) that were not anticipated in the formulation of the PRE. For instance, if subsurface soil concentrations exceed SSLs or industrial soil PRGs, a site-specific PRE may be performed for the construction worker receptor group because SSLs and PRGs do not account for the exposure to construction workers. The site-specific PRE will differ mainly in that it will adjust only exposure frequencies and durations for these receptors to determine site-specific risk for RMEs. This approach will ensure that a reasonable consistent approach will be used for all receptors. If other exposure factors warrant modification, relevant regulatory agencies will be consulted in advance.

If site groundwater is found to potentially pose an unacceptable risk to receptors evaluated in the site-specific PRE, the investigation will be augmented with an additional phase of study followed by revision to the risk assessments.

For detected chemicals that are both site-related and associated with excess risk such that the individual chemical-specific risk makes a substantial contribution to the cumulative risk calculated in the PRE, the site-specific PRE will include organic and inorganic COPCs. Organic COPCs with maximum detected



Notes:

	CSM	conceptual site model
	ECR	excess cancer risk
	HI	hazard index
	PRE	preliminary risk evaluation
	PRG	preliminary remediation goal
	RME	reasonable maximum exposure

Figure 6-1
Human Health Screening Preliminary Risk Evaluation Decision Tree (for all chemicals except lead)
Final Work Plan-Phase II Remedial Investigation
Site 1-EOD Range, MCAS El Toro, California

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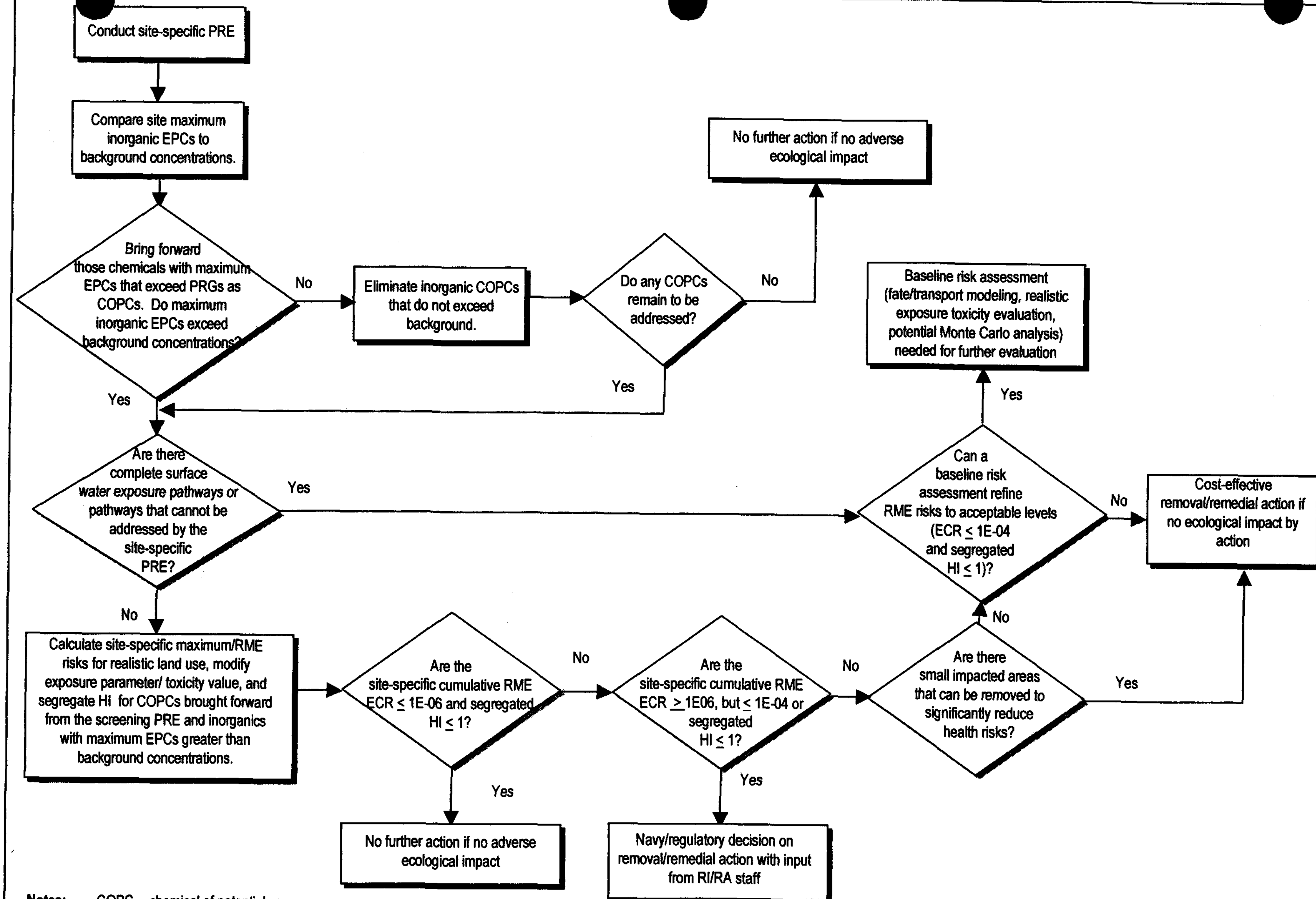

Notes:

COPC	chemical of potential concern	PRG	preliminary remediation goal
ECR	excess cancer risk	RA	risk assessment
EPC	exposure point concentration	RI	remedial investigation
HI	hazard index	RME	reasonable maximum exposure
PRE	preliminary risk evaluation		

Figure 6-2
Human Health Site-Specific Preliminary Risk Evaluation Decision Tree (for all chemicals except lead)
Final Work Plan-Phase II Remedial Investigation
Site 1-EOD Range, MCAS El Toro, California

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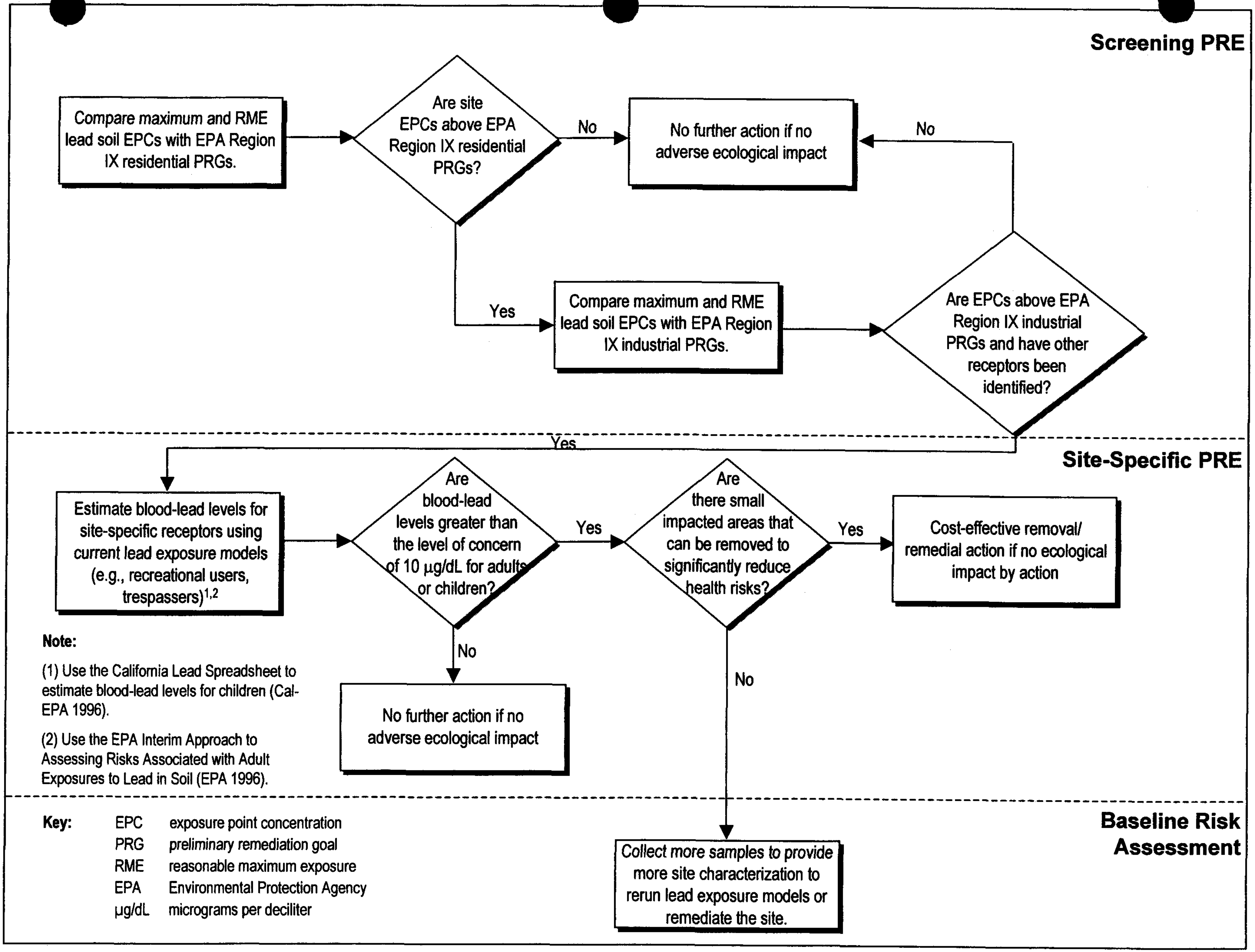

Figure 6-3
Human Health Preliminary Risk Evaluation Decision Tree for Lead
Final Work Plan-Phase II Remedial Investigation
Site 1-EOD Range, MCAS El Toro, California

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concentrations greater than medium-specific SSLs/PRGs will be retained in the site-specific PRE. Once organic COPCs have been identified, concentrations for inorganic constituents, i.e., metals, will be compared against background concentrations to determine whether inorganic materials are likely site-related. Metals with concentrations that do not exceed background levels will be flagged as potentially naturally occurring but included in the evaluation of risk as COPCs. If the data indicate that excess risk is associated with metals at levels that are naturally occurring, additional evaluation of the background conditions may be required. Such an evaluation is likely to consist of confirmation that background values are indeed representative of naturally occurring conditions but may involve additional sampling and analyses. Prior to conducting any additional sampling and analyses, appropriate regulatory agencies will be consulted regarding the intended objectives and proposed approaches.

If the site has been adequately characterized and the site-specific cumulative RME health risks are at or below an ECR of 1E-06 and an HI of 1, and there is no anticipated adverse ecological impact, then no further action will be recommended. If the site-specific cumulative RME ECR is between 1E-06 and 1E-04, then the most cost-effective action will be recommended. If the site-specific cumulative RME health risks slightly exceed an ECR of 1E-04 and an HI of 1 and there are no isolated, impacted areas where a small removal action could adequately reduce health risks, then a baseline risk assessment will be recommended. If the site-specific cumulative RME risk values are an order of magnitude or more above the levels deemed applicable for remediation and a baseline risk assessment cannot refine the risk estimates to acceptable levels, then a remedial/removal action (e.g., capping or excavation and removal of contaminated soil) will be recommended *if it* does not cause an unreasonable impact to the site ecology.

6.2 ECOLOGICAL PRE

The ecological PRE will be conducted in accordance with Federal (EPA 1997c) and Navy (DON 1999) guidance for conducting screening ecological risk assessments. Ecological receptors such as small mammals and birds may be exposed to soil contamination by ingestion of contaminated plants and soil. The PRE is a two-step process. First, a conservative screening PRE (screening risk assessment [SRA]) will be performed using conservative assumptions. Second, if necessary, a site-specific PRE (site-specific SRA) will be performed using refined, site-specific exposure assumptions. Because SSLs or screening PRGs do not exist for terrestrial or ecological receptors they may require development from existing information.

The SRA will be conducted in accordance with the following guidance:

- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, Interim Final *(ERAGS)* (EPA 1997c),
- *Navy Policy for Conducting Ecological Risk Assessments* (DON 1999),
- *Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites* (EPA 1999b),
- *Tri-Services Procedural Guidelines for Ecological Risk Assessments* (Wentsel et al. 1996).

Figure 6-4 illustrates the EPA's eight-step ecological risk assessment process for Superfund (EPA 1997c). Figure 6-5 presents the Navy's cost-effective three-tiered approach to ecological risk assessment, which combines a tiered approach with EPA's eight-step process.

The decision process for conducting a screening PRE (SRA) and a site-specific PRE (site-specific SRA), which is Tier 1 of the Navy's ecological risk assessment approach, is presented on Figure 6-6.

6.2.1 Screening PRE

A screening PRE (or SRA) is conducted in two steps:

Step 1, Screening-level Problem Formulation. The first step of the SRA is to determine what biological resources are present at the sites and to evaluate existing site information. It includes, but is not limited to, the following tasks:

- Performance of biological site reconnaissance;
- Description of ecological setting of the sites and surrounding area, listing of plants and animals, and identification of threatened and endangered species and habitats of special concern;
- Identification of chemicals of potential ecological concern (COPECs);
- Performance of exposure pathway analysis;
- Development of a biological CSM;
- Establishment of assessment and measurement endpoints;
- Development of soil screening concentrations for terrestrial ecological receptors.

The problem formulation component of the ecological PRE leads to one of two outcomes: 1) dismissal of a site from further investigation if there are no site-related contaminants or significantly exposed biota; or 2) conducting a screening assessment to identify actual or potential risks that require a response action.

Step 2, Screening-level Exposure Estimate and Risk Characterization. The second step of the SRA is to estimate the uptake/dose and calculate preliminary risks. This step involves (1) estimating potential exposure to site COPECs using information on exposure pathways and species natural history to model uptake or intake (dose) of contaminants in various site media by terrestrial species; and (2) comparing the potential exposure value to toxicological benchmark values potentially associated with adverse effects to representative species. If the exposure value exceeds the benchmark value, then the potential exists for adverse effects to the receptor of concern. Step 2 includes the following:

- Development of species-specific and chemical-specific exposure parameters,
- Comparison of exposure point concentrations to conservative species-specific soil screening values,
- Presentation of uncertainty analysis,
- Characterization of risk.

The SRA can lead to three possible outcomes:

1. The site passes the SRA based on conservative exposure assumptions. A determination is made that the site poses acceptable risk and shall be recommended for closure based on ecological concerns.
2. The site fails the SRA, and potential risks are not extreme. The site must have both complete exposure pathways and unacceptable risk. If the potential risks are not extreme, a refinement of the conservative exposure assumptions may reduce the estimated risk to acceptable levels. Move to a site-specific PRE (step 2a of the Navy three-tiered approach) and refine risk model assumptions.
3. The site fails the SRA and the potential risks are high. If it is obvious that refinement of the risk model assumptions will not reduce the estimated risk to an acceptable level, an accelerated site remediation is indicated.

6.2.2 Site-specific PRE

If a site does not pass the conservative screening PRE, then a site-specific PRE (also referred to as site-specific SRA) will be performed to determine more realistic levels of risk. The site-specific PRE focuses on only those COPECs that are not screened out in the initial screening process. It reevaluates and refines all assumptions to ensure that they are more realistic and applicable to the site, considering special characteristics and biological resources at the site. Refinements may include, but are not limited to

- Comparison of concentrations of inorganics to background concentrations,
- Refinement of exposure assumptions,
- Refinement of exposure point concentrations (use of 95 percent upper confidence limit [UCL] in place of maximum soil concentration),
- Final comparison of exposure point concentrations to screening concentrations,
- Calculation of screening level risk; interpretation of adverse effects in light of uncertainties.

If the initial refinements do not reduce the estimated risks to acceptable levels, a baseline ecological risk assessment (BERA) should be proposed. The results of the BERA will be used to further quantify risk and to calculate site-specific ecological risk-based cleanup goals.

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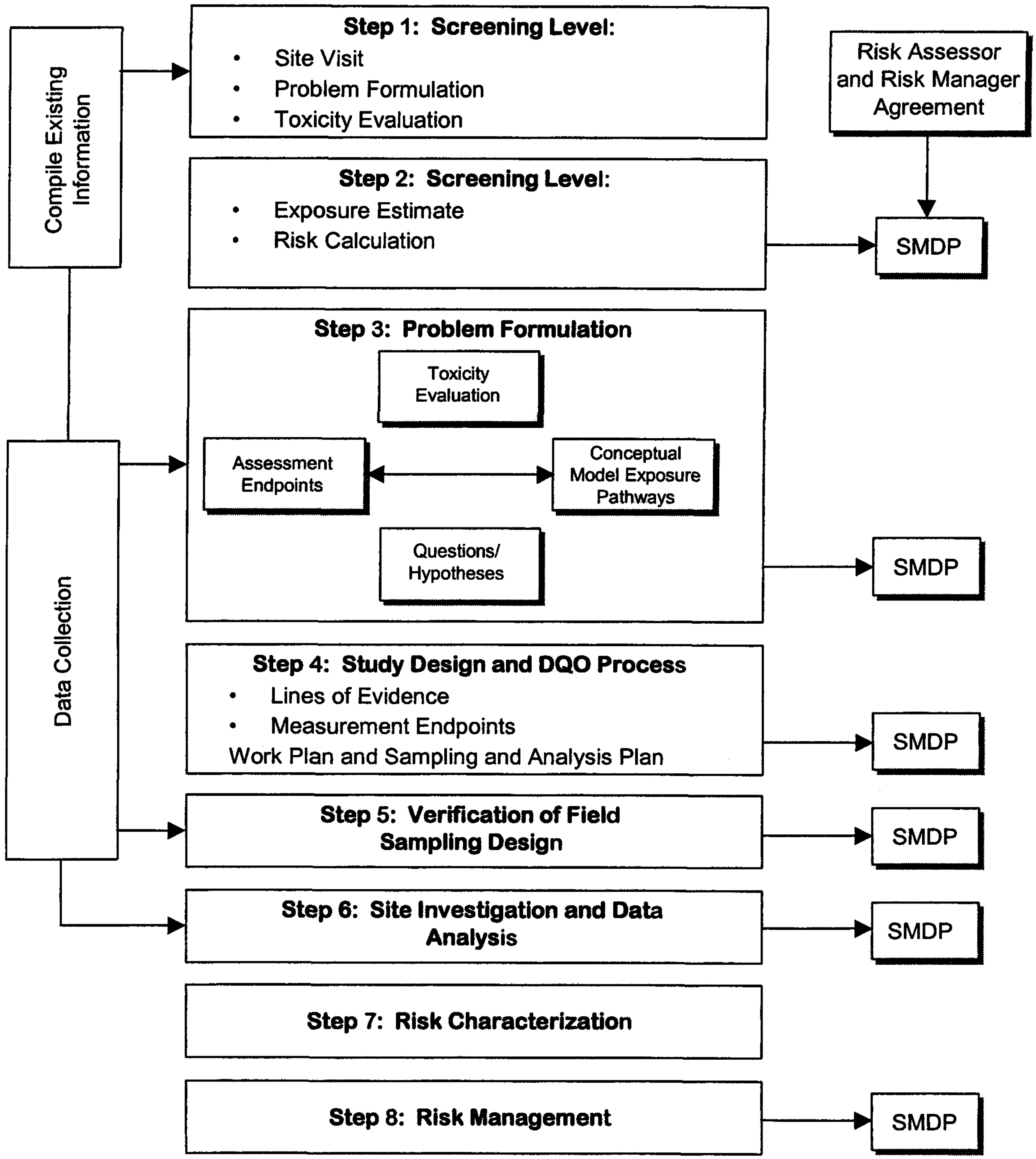

Note:
SMDP = scientific management decision point

Figure 6-4: Eight-Step Ecological Risk Assessment Process for Superfund

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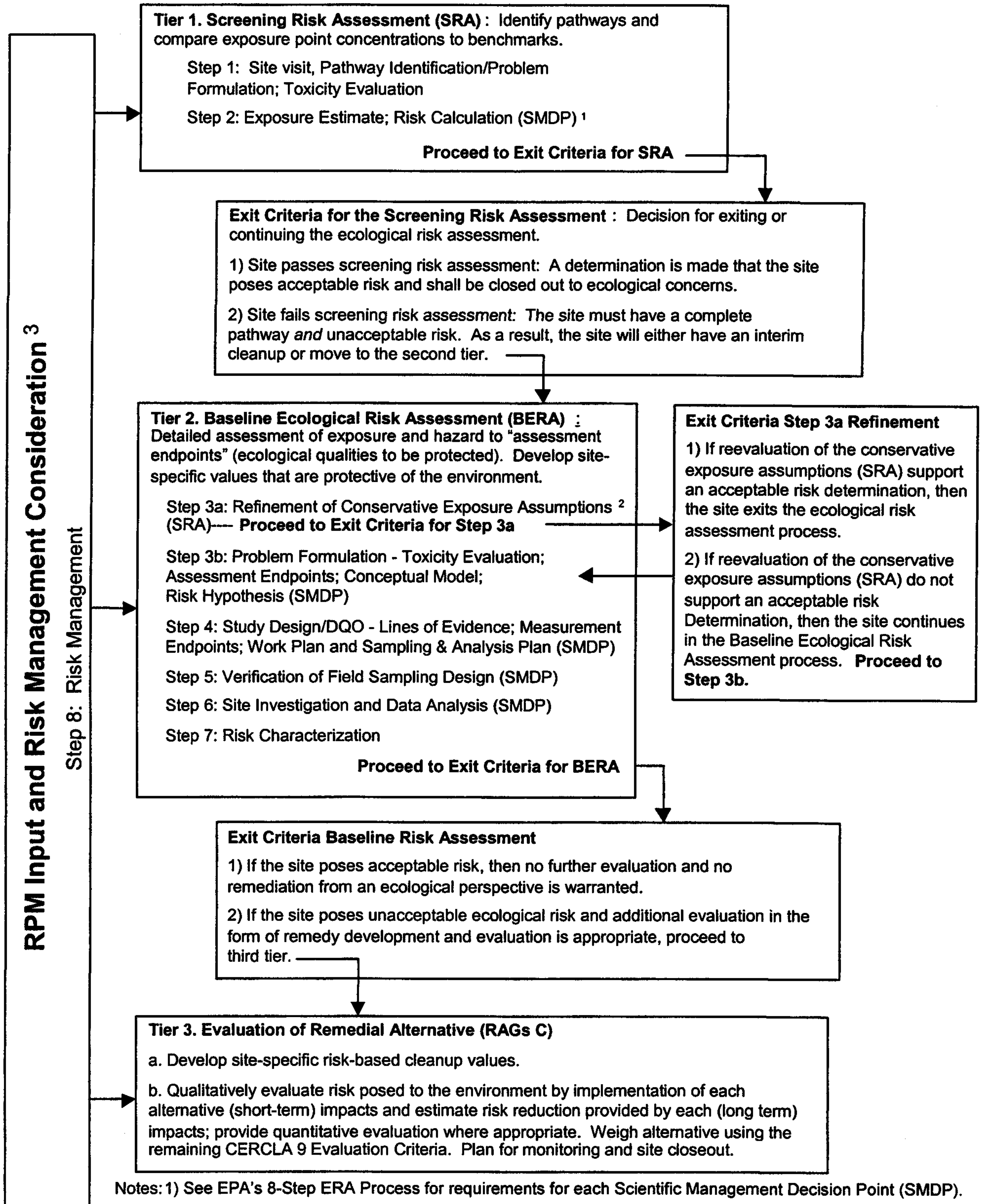

Notes: 1) See EPA's 8-Step ERA Process for requirements for each Scientific Management Decision Point (SMDP).
2) Refinement includes but is not limited to background, bioavailability, detection frequency.
3) Risk Management is incorporated throughout the tiered approach.

Figure 6-5: Three-tiered Navy Approach to Ecological Risk Assessment

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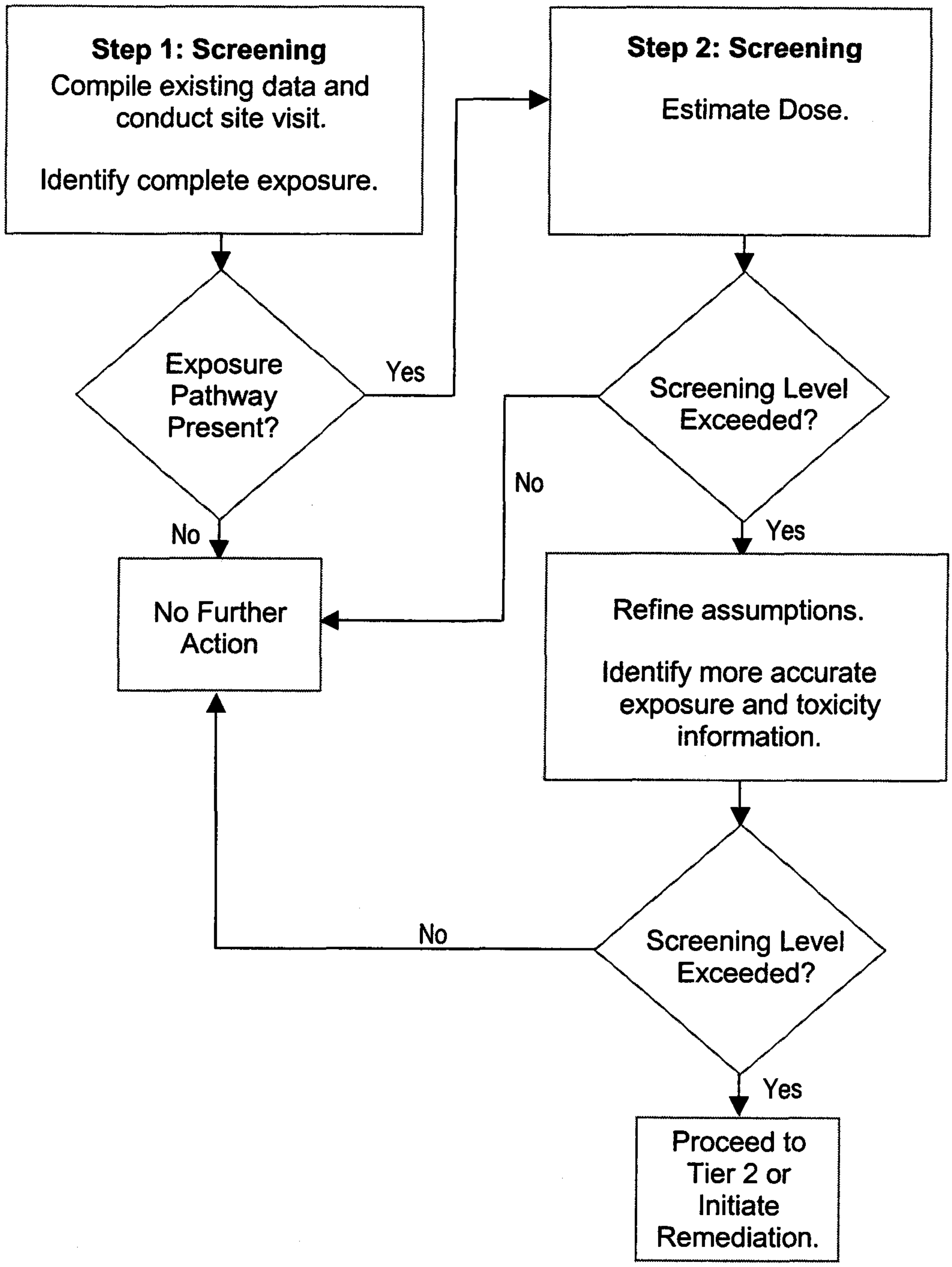

Figure 6-6: Tier 1 Ecological Risk Assessment (Preliminary Risk Evaluation)

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Appendix A
CERCLA Documentation Process and RCRA Facility Closure Comparison

Table A-1
CERCLA Documentation Process and RCRA Facility Closure Comparison

CERCLA	RCRA	REMARKS
Draft Remedial Investigation (RI) Work Plan Final RI Work Plan	Closure Plan (Interim Status Facility) • Facility Information • Waste Description • Soil Sampling • Groundwater Sampling • Analytical Methods • Soil Removal Procedures 45-day Public Notice Approval of Closure Plan	Application for Open Burn/Open Detonation Unit Permit was submitted in June 1988. The Closure Plan is a component of the Part B Application. Public Notice of Permit Actions and Public Comment period applies to a Draft Permit. Process for Closure Plan approval and associated requirements must be agreed upon between DTSC and Navy. RI Work Plan and RI Report will undergo BCT review.
RI Field Work Implementation	Implementation of Closure Plan	
Final RI Report		
Feasibility Study (FS) *Draft Final Proposed Plan (PP)*	*Post-Closure Plan* *Draft Permit* *45 day Public Notice*	*FS and PP documents will undergo BCT review. The Draft Final PP will also be made available for public review/comments.*
*Record of Decision (ROD)/*No Further Action (NFA) Decision Document	*Issuance of Post Closure Permit/*Closure Certification Report	*The ROD will undergo BCT review and public review/comments.*
Remedial Design (RD) *Remedial Action (RA)* *Operation and Maintenance (O&M)*	*Implementation of Post Closure Plan*	
Long Term Monitoring (LTM) Site Close-out	*Post-Closure Certification Report*	

Note:
Italicized tasks will be conducted only if required.
BCT = BRAC (Base Realignment and Closure) Cleanup Team
DTSC = Department of Toxic Substances Control

TABLE A-2
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
TREATMENT AND STORAGE FACILITY CLOSURE PLAN CHECKLIST

Facility Name: ____________________
EPA Identification No.: ____________________
Closure Plan Date: ____________________

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
A. FACILITY IDENTIFICATION [22 CCR 66270.14(b)(1)]	Part A Permit		
1. Facility name			
2. EPA ID number			
3. Facility address			
4. Mailing address			
5. Contact person			
6. Facility operator			
7. Owner			
a. Facility owner			
b. Landowner			
8. Preparer of closure plan			See Table A-1 for equivalent CERCLA document
9. Nature of business			
10. Environmental permits	N/A		
11. Certification	N/A		
B. FACILITY LOCATION [22 CCR 66270.14(b)(1)]			
1. Size	Page 2-1, Section 2.1		*Phase II RI Work Plan* (October 2001)
2. Topographic map	Page 2-3, Figure 2-1		*Phase II RI Work Plan* (October 2001)
3. Hydrogeologic conditions	Page 2-7, Section 2.6.2		*Phase II RI Work Plan* (October 2001)
4. Weather and climatic conditions	Page 2-7, Section 2.3.1		*Phase II RI/FS Work Plan* (July 1995)
C. FACILITY DESIGN [22 CCR 66270.14(b)(1)]			
1. Description of hazardous waste management units			
a. Size and dimensions	N/A		Hazardous Wastes were not handled (?)
b. Design capacity or throughput	N/A		

TABLE A-2
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
TREATMENT AND STORAGE FACILITY CLOSURE PLAN CHECKLIST

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
c. Ancillary equipment and structures	N/A		
d. Types of containment systems	N/A		
e. Types of detection and monitoring systems	N/A		
f. Planned expansions or modifications	N/A		
g. Drawings	N/A		
2. Tables showing the types and quantities of hazardous wastes:			
a. Hazardous waste management units	N/A		
b. Hazardous wastes ever handled or will be handled	N/A		
c. EPA hazardous waste number/CA waste code	N/A		
d. Quantities	N/A		
e. Physical state	N/A		
f. Principal chemical characteristics	N/A		
D. DESCRIPTION OF HAZARDOUS WASTE CONSTITUENTS [22 CCR 264.112(b)(3), 265.112(b)(3)]			
1. List of hazardous waste constituents	N/A		A wide range of munitions were used in training exercises. The constituents would be typical of ingredients used in military ordnance.
E. ESTIMATE AND MANAGEMENT OF MAXIMUM INVENTORY			
1. Maximum inventory of hazardous wastes [22 CCR 66264.112(b)(3) & (4), 66265.112(b)(3) & (4)]			
a. Permitted waste capacity	N/A		
b. Contaminated containment system	N/A		
c. Waste generated during closure	N/A		
d. Waste generation areas	N/A		
2. Management of maximum inventory			
a. Onsite management			
(1) Treatment in existing permitted treatment system	N/A		
(2) Proposal to treat waste in TTU/new treatment system	N/A		
b. Offsite management			
(1) Waste determination	N/A		If necessary, treatment of contamination resulting from site activities will be specified in the Proposed Plan/ROD. See Table A-1.
(2) Quantity of waste shipment	N/A		
(3) Offsite treatment/disposal method	N/A		
(4) Distance to offsite waste management facility	N/A		

TABLE A-2
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
TREATMENT AND STORAGE FACILITY CLOSURE PLAN CHECKLIST

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
(5) Waste acceptance at offsite waste management facility	N/A		
(6) Generator & transporter requirements	N/A		
3. Land disposal restriction:			
a. Applicability of LDR	N/A		
b. Compliance with LDR requirement	N/A		
4. Changes in maximum inventory:			
a. Maximum inventory increase	N/A		
b. Maximum inventory reduction	N/A		
F. EQUIPMENT AND STRUCTURES DECONTAMINATION PROCEDURES [22 CCR 66264.112(b)(4), 66264.178, 66264.197, 6265.112(b)(4), 66265.197]			
1. Identification of all areas requiring decontamination	N/A		
2. Decontamination procedures	N/A		
G. CONFIRMATION SAMPLING PLAN FOR CONTAINMENT STRUCTURES, BUILDINGS, AND EQUIPMENT [22 CCR 264.112(b)(5), 66265.112(b)(5)]			No containment structures were used during training exercises at the range.
1. Objectives	N/A		
2. Number & locations of samples	N/A		
3. Types of sampling	N/A		
4. Field sampling method/procedures	N/A		
5. QC samples	N/A		
6. Decontamination of sampling equipment	N/A		
7. Chain-of-custody procedures	N/A		
8. Labeling, packaging/preservation, and transportation	N/A		
9. Documentation	N/A		
10. Analytical methods	N/A		

H. SOIL SAMPLING PLAN

TABLE A-2
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
TREATMENT AND STORAGE FACILITY CLOSURE PLAN CHECKLIST

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
[22 CCR 66264.112(b)(4), 66265.112(b)(4)]			
1. Objectives	Page 4-1, Section 4.1		
2. Sampling locations and depths	Page 4-1, Sections 4.2.3, 4.2.4, 4.2.5		
3. Types of soil samples			
4. Sample collection methods			
5. QC samples	Page 4-9, Section 4.2.11		
6. Chain-of-custody	Page 4-7, Section 4.2.9		
7. Sample labeling, packaging & transportation			
8. Documentation	Page 4-8, Section 4.2.10		
I. ANALYTICAL TEST METHODS [22 CCR 66264.112(b)(4), 66265.112(b)(4)]			
1. List of hazardous constituent of concern	Page 5-11, Table 5-2		
2. EPA approved test methods			
3. Other analytical test methods			
J. GROUNDWATER SAMPLING AND MONITORING PLAN [22 CCR 66264.112(b)(5), 66265.112(b)(5)]			
1. If applicable, statement indicating that the owner or operator is not aware of any groundwater contamination at this time, and a groundwater sampling plan will be submitted upon request by the Department if groundwater contamination is suspected or confirmed.	Page 4-2, Section 4.2.4; Page 5-15, Table 5-3		
K. CLOSURE PERFORMANCE STANDARDS (CLEANUP LEVELS) [22 CCR 66264.111, 66264.112(b)(4), 66265.111, 66265.112(b)(4)]			To be developed following the completion of the remedial investigation. See Table A-1 for the applicable CERCLA document.
1. Soil			
a. Proposal to use background levels			
(1) Soil sampling plan			
i. Sampling area			
ii. Sampling location & depth			
iii. Number of samples			
iv. Sampling frequency			
v. Sampling methods			

TABLE A-2
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
TREATMENT AND STORAGE FACILITY CLOSURE PLAN CHECKLIST

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
vi. Sampling equipment			
vii. Analytical methods			
(2) Statement indicating that cleanup standards, based on background sampling, will be submitted to the Department within 120 days after permit issuance or closure plan approval.			
2. Equipment, containment structures, and buildings	N/A		
a. Table listing cleanup level of each decontaminated equipment, structure, or building (level should be the PQL of the analytical method).			
L. REMOVAL / CLEANUP PROCEDURES [22 CCR 66264.112(b)(4), 66265.112(b)(4), 66265.114]	Removal Action/ Removal Design Documents		See Table A-1 for equivalent CERCLA document.
1. Procedures for soil excavation			
a. Description of soil excavation equipment			
b. Step-by-step procedures to be followed			
(1) Surface area & depth of excavation			
(2) Equipment staging area			
c. Volume of soil to be excavated			
d. Provisions to minimize dust generation			
2. Offsite disposal of contaminated soil			
a. Quantity of contaminated soil shipment			
b. Offsite treatment/disposal methods			
c. Distance to offsite waste management facility			
d. Waste acceptance at offsite waste management facility			
e. Generator & transporter requirements			
3. Onsite cleanup of contaminated soil			
a. Proposal to treat waste in TTU/new treatment systems			
M. CLOSURE COST ESTIMATE [22 CCR 66264.142, 66265.142]	Feasibility Study/ Proposed Plan/ Record of Decision Documents		See Table A-1 for equivalent CERCLA document.
1. Itemized activities			
a. Cost of removal/transportation of maximum inventory			
b. Cost of treatment/transportation of maximum inventory			
c. Cost of disposal/transportation of maximum inventory			

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
d. Cost of decontamination activities e. Sampling f. Analysis g. Closure certification report preparation 2. 20 percent contingency factor 3. Update of cost estimate a. Statement indicating that closure cost will be updated annually due to inflation. Include a description of method used to calculate the adjusted estimate. b. Statement indicating that closure cost will be updated when changes in facility operation or maximum inventory cause a change in the cost estimate.			
N. FINANCIAL RESPONSIBILITY [22 CCR 66264.143, 66264.147, 66265.143, 66265.147] 1. Mechanism used for financial assurance of cost estimate a. Trust fund b. Surety bond (1) Guaranteeing payment into a trust fund (2) Guaranteeing performance of closure c. Letter of credit d. Insurance e. Financial test and corporate guarantee f. Alternative financial mechanism (non-RCRA units only) g. Multiple financial mechanism h. Financial mechanism(s) used for multiple facilities 2. Update of financial assurance for cost estimate a. Statement indicating that financial assurance mechanism for cost estimate will be updated annually due to inflation. b. Statement indicating that financial assurance mechanism for cost estimate will be updated whenever there is a change in facility operations or maximum inventory. 3. Mechanism used for liability coverage for sudden accidental occurrences a. Trust fund			Navy is lead agency and is financially responsible for the assessment and remediation of any impacts caused by activities associated with the EOD Range to the environment.

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
b. Surety bond			
c. Letter of credit			
d. Liability insurance			
e. Financial test/corporate guarantee			
f. Payment bond			
O. CLOSURE IMPLEMENTATION SCHEDULE [22 CCR 66264.112(b)(6) & (7), 66264.113, 66265.112(b)(6) & (7), 66265.113)]			See Table A-1 for equivalent CERCLA document.
1. Expected year of final closure			
2. Schedule			
a. Time required for each step in the process			
b. Time to close each unit			
c. Total time to close facility			
d. Due dates for all submittal			
3. Procedures to request extension to			
a. Start date of closure activities			
b. Completion date of final closure			
4. If appropriate, proposal and justification for using the closed area(s) prior to the approval of closure certification.			
P. CLOSURE CERTIFICATION REPORT REQUIREMENTS [22 CCR 66264.115, 66265.115]			See Table A-1 for equivalent CERCLA document.
1. Statement indicating that the following documents will be maintained at the facility until the approval of closure certification			
a. Approved closure plan			
b. Copies of the independent qualified professional engineer's field observation reports			
c. Laboratory results of samples analyzed			
d. Quality assurance/quality control demonstrations			
e. Manifests showing disposition of waste inventory			
f. Miscellaneous documentation (e.g., photographs)			
g. Closure certification report			

TABLE A-2
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
TREATMENT AND STORAGE FACILITY CLOSURE PLAN CHECKLIST

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
2. Statement indicating that a closure certification report will be submitted which contains at least the following information			
a. Certification by an independent registered professional			
b. Supervisory personnel description			
c. Summary of closure activities			
d. Field engineer observations reports			
e. Sampling data and analyses (i.e., sampling locations, soil boring logs, chain-of-custody, analytical results)			
f. Discussion of analytical results			
g. Manifests showing disposition of waste inventory			
h. Modifications to the approved closure plan (if applicable)			
i. Photographs of closure/sampling activities			
Q. HEALTH AND SAFETY PLAN [22 CCR 66264.112(b)(5), 66265.112(b)(5)]			Health and Safety Plan prepared for the Phase II RI activities
1. Hazard identification			
2. Hazard evaluation			
3. Personal protective equipment			
4. Environmental monitoring			
5. Site work zone			
6. Decontamination of worker			
7. Emergency procedures			
a. Names of personnel responsible for emergency action			
b. Location of nearest telephone			
c. Alternative means of emergency communication			
d. List of emergency services			
R. SITE SECURITY [22 CCR 66264.112(b)(5), 66265.112(b)(5)]			Site is currently secured with appropriate warning signs. Further CERCLA documentation as per Table A-1, will address security measures as required.
1. Description of the security measures to be used at the facility during partial and final closure			
2. Access control which includes the following:			

TABLE A-2
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
TREATMENT AND STORAGE FACILITY CLOSURE PLAN CHECKLIST

	Location (Page, Section, N/A)	Adequacy (Yes/No)	Comment
a. Signs with the legend "Danger Hazardous Waste Area - - Unauthorized Personnel Keep Out" posted at each entrance to the facility or waste management units and at other locations in sufficient numbers to be seen from any approach to these units			
b. A fence completely surrounding the facility or waste management units equipped with locked entrances			
3. Alternative access controls (i.e., 24-hour surveillance system)			

Note:
N/A = not applicable
Oct. 2001 *Phase II RI Work Plan* prepared by Earth Tech, Inc.
July 1995 *Phase II RI Work Plan* prepared by Bechtel National, Inc.

Appendix B
Site 1 Preliminary Soil Sampling Analytical Results

Memo

Date: May 16, 2000

To: Lynn M. Hornecker cc:

From: Crispin Wanyoike

Subject: Analytical Data Package: Preliminary Soil Sampling-IRP Site 1, Explosive Ordnance Disposal Range (EOD).

An investigation for chemicals of potential concern (COPCs) was conducted in December 1999 to assess the possibility of the release of COPCs to the subsurface resulting from activities at Site 1. This limited soil sampling program was also performed to evaluate the condition of IRP Site 1 and to identify areas acceptable for early transfer. Soil sampling was performed as described in the *Amendment to Final Work Plan* Verification of Perchlorate at IRP Site 1 (December 1999).

The sample results are presented in the following tables, Group I, II, III, and IV. All groups were analyzed for Nitrate and pH. The following were the analysis performed on each Group:

- **Group I:** Metals, Total Extractable Petroleum Hydrocarbons, Volatile Organic Compounds, Semi-Volatile Organic Compounds, and Explosives.
- **Group II:** Total Extractable Petroleum Hydrocarbons, and Volatile Organic Compounds .
- **Group III:** Total Extractable Petroleum Hydrocarbons.
- **Group IV:** Metals, Total Extractable Petroleum Hydrocarbons, Volatile Organic Compounds, Semi-Volatile Organic Compounds, Explosives, and Dioxins.

The analytical data were validated in accordance with the Quality Assurance Plan and SouthWest Division Environmental Work Instructions. All data were qualified as usable for the purposes intended with the exception of acetone, 2-butanone and 1,2-dichloroethane as noted in the data validation reports. This rejection was not considered to have impacted the ability to make the decisions required for the investigation and did not affect the overall usability of the data for the investigation. The attached analytical data package also contains the data validation report.

An evaluation of the data presented herein will be performed during the preparation of the *Remedial Investigation Work Plan* for IRP Site 1.

Should you have any questions, please call me at 562-951-2057.

Group I

Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

EPA ID:		LD111	LD117	LD123	LD125	LD128	LD131
LOCATION ID*:		01HA01	01HA04	01HA06	01HA07	01HA08	01HA09
DEPTH (ft):		4	3.5	4.5	1.5	3.5	4
TYPE:		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
DATE:		12/22/99	12/22/99	12/22/99	12/23/99	12/23/99	12/23/99
PARAMETER	Units						
GENERAL CHEMISTRY							
NITRATE AS N (300.0M)	mg/kg	220U	2700	220U	246	450	2700
pH (SW9040)	0-14	8.67	7.13	8.97	6.78	6.75	7.94
METALS (SW6010B)							
ALUMINUM	mg/kg	3580	6760	4500	6440	7290	5410
ANTIMONY	mg/kg	5.4U	5.3U	0.21UJ	5.3U	5.3U	1.2
ARSENIC	mg/kg	0.45UJ	1.1	0.34UJ	0.83	0.85	0.94
BARIUM	mg/kg	30.1	37.2	30.1	36.6	32.2	46.6
BERYLLIUM	mg/kg	0.36	0.2	0.26	0.19	0.23	0.21
CADMIUM	mg/kg	0.02UJ	5.2	0.054UJ	0.26	0.045UJ	2.5
CALCIUM	mg/kg	2900	2490	12800	2400	2430	2570
CHROMIUM	mg/kg	1.8	4.1	4	3.4	4.2	5.2
COBALT	mg/kg	0.67	1.5	0.93	1.3	1.4	0.97
COPPER	mg/kg	0.36UJ	7	3.1	30.4	1.9	234
IRON	mg/kg	2190	4460	4730	3590	3820	3150
LEAD	mg/kg	0.68	9.8	1.3	13.6	2	67
MAGNESIUM	mg/kg	1030	1290	1140	1200	1350	1050
MANGANESE	mg/kg	25.6	84	45.4	64.1	69	47.5
NICKEL	mg/kg	0.84	96	2.1	1.6	1.9	3.1
POTASSIUM	mg/kg	430	769	614	564	475	700
SELENIUM	mg/kg	0.79UJ	1.5	1.8	1.4	1.1UJ	0.74UJ
SILVER	mg/kg	0.54U	0.53U	0.55U	0.53U	0.53U	0.54U
SODIUM	mg/kg	35.8UJ	110U	90.4	11.9UJ	28.2UJ	149
THALLIUM	mg/kg	0.54U	0.48UJ	0.55U	0.53U	0.53U	0.54U
VANADIUM	mg/kg	4.1	6.7	5.6	5.9	5.5	5.6
ZINC	mg/kg	5.7	772	10.6	50.2	8.6	481
MERCURY	mg/kg	0.22U	0.074J	0.22U	0.083J	0.21UJ	2.8
TOTAL PETROLEUM HYDROCARBONS (SW8015)							
MOTOR OILS RANGE	mg/kg	11U	13	11U	24	3J	12
DIESEL FUEL RANGE	mg/kg	11U	11U	11U	4J	11U	7J
GASOLINE RANGE	mg/kg	0.1J	11U	11U	0.1J	11U	9.9U
VOLATILE ORGANIC COMPOUNDS (SW8260B)							
1,1,1-TRICHLOROETHANE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1UJ
1,1,2,2-TETRACHLOROETHANE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
1,1,2-TRICHLOROETHANE	µg/Kg	5.5U	5.1U	5.5UJ	5.5U	5.5U	6.1U
1,1-DICHLOROETHANE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
1,1-DICHLOROETHENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
1,2-DICHLOROETHANE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
1,2-DICHLOROPROPANE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
2-BUTANONE	µg/Kg	14U	13U	14UJ	14U	14U	16U
2-HEXANONE	µg/Kg	5.5U	5.1U	5.5UJ	5.5U	5.5U	6.1UJ
4-METHYL-2-PENTANONE	µg/Kg	5.5U	5.1U	5.5UJ	5.5U	5.5U	6.1UJ
ACETONE	µg/Kg	110U	100U	110R	110U	24J	120UJ
BENZENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
BROMODICHLOROMETHANE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
BROMOFORM	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
BROMOMETHANE	µg/Kg	5.5U	5.1U	5.5UJ	5.5U	5.5U	6.1UJ
CARBON DISULFIDE	µg/Kg	5.5U	5.1U	5.5UJ	5.5U	5.5U	6.1UJ
CARBON TETRACHLORIDE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
CHLOROBENZENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
CHLOROETHANE	µg/Kg	5.5U	5.1U	5.5UJ	5.5U	5.5U	6.1UJ
CHLOROFORM	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
CHLOROMETHANE	µg/Kg	5.5U	5.1U	5.5UJ	5.5U	5.5U	6.1UJ
CIS-1,2-DICHLOROETHENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
CIS-1,3-DICHLOROPROPENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
DIBROMOCHLOROMETHANE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
ETHYLBENZENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U

Group I

Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

	EPA ID:	LD111	LD117	LD123	LD125	LD128	LD131
	LOCATION ID*:	01HA01	01HA04	01HA06	01HA07	01HA08	01HA09
	DEPTH (ft):	4	3.5	4.5	1.5	3.5	4
	TYPE:	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
	DATE:	12/22/99	12/22/99	12/22/99	12/23/99	12/23/99	12/23/99
PARAMETER	Units						
METHYLENE CHLORIDE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
STYRENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
TETRACHLOROETHENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
TOLUENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
TRANS-1,2-DICHLOROETHENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
TRANS-1,3-DICHLOROPROPENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
TRICHLOROETHENE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1UJ
VINYL CHLORIDE	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
XYLENES TOTAL	µg/Kg	5.5U	5.1U	5.5U	5.5U	5.5U	6.1U
SEMI-VOLATILE ORGANIC COMPOUNDS (SW8270C)							
1,2,4-TRICHLOROBENZENE	µg/Kg	540U	530U	550U	530U	530U	540U
1,2-DICHLOROBENZENE	µg/Kg	540U	530U	550U	530U	530U	540U
1,3-DICHLOROBENZENE	µg/Kg	540U	530U	550U	530U	530U	540U
1,4-DICHLOROBENZENE	µg/Kg	540U	530U	550U	530U	530U	540U
2,4,5-TRICHLOROPHENOL	µg/Kg	540U	530U	550U	530U	530U	540U
2,4,6-TRICHLOROPHENOL	µg/Kg	540U	530U	550U	530U	530U	540U
2,4-DICHLOROPHENOL	µg/Kg	540U	530U	550U	530U	530U	540U
2,4-DIMETHYLPHENOL	µg/Kg	540U	530U	550U	530U	530U	540U
2,4-DINITROPHENOL	µg/Kg	2700U	2600U	2700U	2600U	2700U	2700U
2,4-DINITROTOLUENE	µg/Kg	540U	530U	550U	530U	530U	540U
2,6-DINITROTOLUENE	µg/Kg	540U	530U	550U	530U	530U	540U
2-CHLORONAPHTHALENE	µg/Kg	540U	530U	550U	530U	530U	540U
2-CHLOROPHENOL	µg/Kg	540U	530U	550U	530U	530U	540U
2-METHYLNAPHTHALENE	µg/Kg	540U	530U	550U	530U	530U	540U
2-METHYLPHENOL (O-CRESOL)	µg/Kg	540U	530U	550U	530U	530U	540U
2-NITROANILINE	µg/Kg	2700U	2600U	2700U	2600U	2700U	2700U
2-NITROPHENOL	µg/Kg	540U	530U	550U	530U	530U	540U
3 3'-DICHLOROBENZIDINE	µg/Kg	540U	530U	550U	530U	530U	540U
3-NITROANILINE	µg/Kg	2700U	2600U	2700U	2600U	2700U	2700U
3/4-METHYLPHENOL (M/P-CRESOL)	µg/Kg	540U	530U	550U	530U	530U	540U
4 6-DINITRO-2-METHYLPHENOL	µg/Kg	2700U	2600U	2700U	2600U	2700U	2700U
4-BROMOPHENYL PHENYL ETHER	µg/Kg	540U	530U	550U	530U	530U	540U
4-CHLORO-3-METHYLPHENOL	µg/Kg	540U	530U	550U	530U	530U	540U
4-CHLOROANILINE	µg/Kg	1100U	1100U	1100U	1100U	1100U	1100U
4-CHLOROPHENYL PHENYL ETHER	µg/Kg	540U	530U	550U	530U	530U	540U
4-NITROANILINE	µg/Kg	2700UJ	2600UJ	2700UJ	2600UJ	2700UJ	2700UJ
4-NITROPHENOL	µg/Kg	2700U	2600U	2700U	2600U	2700U	2700U
ACENAPHTHENE	µg/Kg	540U	530U	550U	530U	530U	540U
ACENAPHTHYLENE	µg/Kg	540U	530U	550U	530U	530U	540U
ANTHRACENE	µg/Kg	540U	530U	550U	530U	530U	540U
BENZO(A)ANTHRACENE	µg/Kg	540U	530U	550U	530U	530U	540U
BENZO(A)PYRENE	µg/Kg	540U	530U	550U	530U	530U	540U
BENZO(B)FLUORANTHENE	µg/Kg	540U	530U	550U	530U	530U	540U
BENZO(G H I)PERYLENE	µg/Kg	540U	530U	550U	530U	530U	540UJ
BENZO(K)FLUORANTHENE	µg/Kg	540U	530U	550U	530U	530U	540U
BENZYL BUTYL PHTHALATE	µg/Kg	540U	530U	550U	530U	530U	540U
BIS(2-CHLOROETHOXY) METHANE	µg/Kg	540U	530U	550U	530U	530U	540U
BIS(2-CHLOROETHYL) ETHER	µg/Kg	540U	530U	550U	530U	530U	540U
BIS(2-CHLOROISOPROPYL) ETHER	µg/Kg	540U	530U	550U	530U	530U	540U
BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	540U	530U	550U	530U	530U	540U
CARBAZOLE	µg/Kg	540U	530U	550U	530U	530U	540U
CHRYSENE	µg/Kg	540UJ	530UJ	550UJ	530UJ	530UJ	540UJ
DI-N-BUTYL PHTHALATE	µg/Kg	540U	530U	550U	530U	530U	971
DI-N-OCTYLPHTHALATE	µg/Kg	540U	530U	550U	530U	530U	540U
DIBENZ(A H)ANTHRACENE	µg/Kg	540U	530U	550U	530U	530U	540U
DIBENZOFURAN	µg/Kg	540U	530U	550U	530U	530U	540U
DIETHYL PHTHALATE	µg/Kg	540U	220J	550U	72J	530U	250J

Group I

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Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

	EPA ID:	LD111	LD117	LD123	LD125	LD128	LD131
	LOCATION ID*:	01HA01	01HA04	01HA06	01HA07	01HA08	01HA09
	DEPTH (ft):	4	3.5	4.5	1.5	3.5	4
	TYPE:	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
	DATE:	12/22/99	12/22/99	12/22/99	12/23/99	12/23/99	12/23/99
PARAMETER	Units						
DIMETHYL PHTHALATE	µg/Kg	540U	530U	550U	530U	530U	540U
FLUORANTHENE	µg/Kg	540U	530U	550U	530U	530U	540U
FLUORENE	µg/Kg	540U	530U	550U	530U	530U	540U
HEXACHLOROBENZENE	µg/Kg	540U	530U	550U	530U	530U	220J
HEXACHLOROBUTADIENE	µg/Kg	540U	530U	550U	530U	530U	540U
HEXACHLOROCYCLOPENTADIENE	µg/Kg	2700U	2600U	2700U	2600U	2700U	2700U
HEXACHLOROETHANE	µg/Kg	540U	530U	550U	530U	530U	540U
INDENO(1,2,3-C D)PYRENE	µg/Kg	540U	530U	550U	530U	530U	540UJ
ISOPHORONE	µg/Kg	540U	530U	550U	530U	530U	540U
N-NITROSODI-N-PROPYLAMINE	µg/Kg	540U	530U	550U	530U	530U	540U
N-NITROSODIPHENYLAMINE	µg/Kg	540U	530U	550U	530U	530U	540U
NAPHTHALENE	µg/Kg	540U	530U	550U	530U	530U	540U
NITROBENZENE	µg/Kg	540U	530U	550U	530U	530U	540U
PENTACHLOROPHENOL	µg/Kg	2700U	2600U	2700U	2600U	2700U	2700U
PHENANTHRENE	µg/Kg	540U	530U	550U	530U	530U	540U
PHENOL	µg/Kg	540U	530U	550U	530U	530U	540U
PYRENE	µg/Kg	540U	530U	550U	530U	530U	540U
EXPLOSIVES (SW8330)							
1,3,5-TRINITROBENZENE	µg/Kg	220U	210U	220U	210U	210U	220U
1,3-DINITROBENZENE	µg/Kg	220U	210U	220U	210U	210U	220U
2,4,6-TRINITROTOLUENE	µg/Kg	220U	210U	220U	210U	210U	220U
2,4-DINITROTOLUENE	µg/Kg	220U	210U	220U	210U	210U	220U
2,6-DINITROTOLUENE	µg/Kg	220U	210U	220U	210U	210U	220U
2-AMINO-4 6-DINITROTOLUENE	µg/Kg	220U	210U	220U	210U	210U	220U
2-NITROTOLUENE	µg/Kg	220U	210U	220U	210U	210U	220U
3-NITROTOLUENE	µg/Kg	220U	210U	220U	210U	210U	220U
4-AMINO-2 6-DINITROTOLUENE	µg/Kg	220U	210U	220U	210U	210U	220U
4-NITROTOLUENE	µg/Kg	220U	210U	220U	210U	210U	220U
HMX	µg/Kg	220U	210U	220U	210U	210U	220U
NITROBENZENE	µg/Kg	220U	210U	220U	210U	210U	220U
RDX	µg/Kg	220U	210U	220U	210U	210U	220U
TETRYL	µg/Kg	220U	210U	220U	210U	210U	220U

NOTES:

NA = Not Analyzed
R = Quality control indicates the data is not usable (value was rejected).
J = Estimated Value
U = Not detected; Number listed is detection limit
UJ = Not detected at stated value; detection limit is estimated.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram

***LOCATION = 01HA01/01SS01**

01 = Site 1
HA = Soil Sample
SS = Surface Soil Sample
01 = Location Number

Group II

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Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

	EPA ID:	LD112	LD113	LD114	LD115	LD116	LD120	LD121	LD122	LD126	LD127	LD132	LD133	LD134	LD135	LD136	LD137	LD138	LD139	LD142
	LOCATION ID*:	01HA02	01HA02	01HA03	01HA03	01HA04	01HA05	01HA05	01HA06	01HA07	01HA08	01HA10	01HA10	01HA11	01HA11	01HA12	01HA12	01HA13	01HA13	01HA14
	DEPTH (ft):	1.5	4	1.5	4	1.5	1.5	4.5	1.5	4	1.5	1.5	4.5	1.5	3	1.5	3.5	1.5	4	4
	TYPE:	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
	DATE:	12/22/99	12/22/99	12/22/99	12/22/99	12/22/99	12/22/99	12/22/99	12/22/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99
PARAMETER (LAB METHOD)	Units																			
GENERAL CHEMISTRY																				
NITRATE AS N (300.0M)	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH (SW9040)	0-14	7.04	7.28	6.97	8.61	7.02	8.64	8.76	8.12	6.94	6.77	6.95	7.01	6.88	7.2	7.15	7.32	6.72	8.88	6.54
TOTAL PETROLEUM HYDROCARBONS (SW8015)																				
MOTOR OILS RANGE	mg/kg	34	6J	7J	0.7J	9J	7J	5J	6J	2J	4J	17	11	7J	2J	7J	10J	5J	2J	19
DIESEL FUEL RANGE	mg/kg	6J	11U	11U	11U	11U	11U	11U	1J	11U	11U	11U	11U	11U	11U	13	11U	11U	1J	2J
GASOLINE RANGE	mg/kg	0.1J	11U	11U	11U	11U	11U	14U	10U	13U	12U	11U	11U	10U	10U	9.8U	10U	10U	10U	10U
VOLATILE ORGANIC COMPOUNDS (SW8260B)																				
1,1,1-TRICHLOROETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5UJ	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3UJ
1,1,2,2-TETRACHLOROETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
1,1,2-TRICHLOROETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6UJ	5.4UJ	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
1,1-DICHLOROETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
1,1-DICHLOROETHENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
1,2-DICHLOROETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4R	6.2R	5.7R	5.8R	5.5R	6R	6.1R	5.3U
1,2-DICHLOROPROPANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
2-BUTANONE	µg/kg	13U	15U	15U	16U	14U	15U	15UJ	14UJ	15U	16U	14U	8.8U	10U	9.2U	9.4U	8.9U	9.8U	9.9U	8.6U
2-HEXANONE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6UJ	5.4UJ	5.7U	6.2U	5.5UJ	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3UJ
4-METHYL-2-PENTANONE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6UJ	5.4UJ	5.7U	6.2U	5.5UJ	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3UJ
ACETONE	µg/kg	17J	15J	120U	120U	110U	110U	110R	110R	110U	120U	12J	110UJ	120UJ	110UJ	120UJ	110UJ	120UJ	120UJ	110UJ
BENZENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
BROMODICHLOROMETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
BROMOFORM	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
BROMOMETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6UJ	5.4UJ	5.7U	6.2U	5.5UJ	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3UJ
CARBON DISULFIDE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6UJ	5.4UJ	5.7U	6.2U	5.5UJ	5.4UJ	6.2UJ	5.7UJ	5.8UJ	5.5UJ	6UJ	6.1UJ	5.3UJ
CARBON TETRACHLORIDE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
CHLOROBENZENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
CHLOROETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6UJ	5.4UJ	5.7U	6.2U	5.5UJ	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3UJ
CHLOROFORM	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
CHLOROMETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6UJ	5.4UJ	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3UJ
CIS-1,2-DICHLOROETHENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
CIS-1,3-DICHLOROPROPENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
DIBROMOCHLOROMETHANE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
ETHYLBENZENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
METHYLENE CHLORIDE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
STYRENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
TETRACHLOROETHENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
TOLUENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U

Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

	EPA ID:	LD112	LD113	LD114	LD115	LD116	LD120	LD121	LD122	LD126	LD127	LD132	LD133	LD134	LD135	LD136	LD137	LD138	LD139	LD142
	LOCATION ID*:	01HA02	01HA02	01HA03	01HA03	01HA04	01HA05	01HA05	01HA06	01HA07	01HA08	01HA10	01HA10	01HA11	01HA11	01HA12	01HA12	01HA13	01HA13	01HA14
	DEPTH (ft):	1.5	4	1.5	4	1.5	1.5	4.5	1.5	4	1.5	1.5	4.5	1.5	3	1.5	3.5	1.5	4	4
	TYPE:	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
	DATE:	12/22/99	12/22/99	12/22/99	12/22/99	12/22/99	12/22/99	12/22/99	12/22/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99	12/23/99
PARAMETER (LAB METHOD)	Units																			
TRANS-1,2-DICHLOROETHENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
TRANS-1,3-DICHLOROPROPENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
TRICHLOROETHENE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5UJ	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3UJ
VINYL CHLORIDE	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U
XYLENES TOTAL	µg/kg	4.8U	5.7U	5.9U	6.1U	5.6U	5.6U	5.6U	5.4U	5.7U	6.2U	5.5U	5.4U	6.2U	5.7U	5.8U	5.5U	6U	6.1U	5.3U

NOTES:

NA = Not Analyzed

R = Quality control indicates the data is not usable (value was rejected).

J = Estimated Value

U = Not detected; Number listed is detection limit

UJ = Not detected at stated value; detection limit is estimated.

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

***LOCATION = 01HA01/01SS01**

01 = Site 1

HA = Soil Sample

SS = Surface Soil Sample

01 = Location Number

Group III

Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

	EPA ID:	LD143	LD144	LD145
	LOCATION ID*:	01SS01	01SS02	01SS03
	DEPTH (ft):	SURFACE	SURFACE	SURFACE
	TYPE:	NORMAL	NORMAL	NORMAL
	DATE:	12/23/99	12/23/99	12/23/99
PARAMETER (LAB METHOD)	**Units**			
GENERAL CHEMISTRY				
NITRATE AS N (300.0M)	mg/kg	NA	NA	NA
pH (SW9040)	0-14	5.89	6.46	6.32
TOTAL PETROLEUM HYDROCARBONS (SW8015)				
MOTOR OILS RANGE	mg/kg	59	15	37
DIESEL FUEL RANGE	mg/kg	12	2J	27
GASOLINE RANGE	mg/kg	10U	10U	10U

NOTES:
NA = Not Analyzed
R = Quality control indicates the data is not usable (value was rejected).
J = Estimated Value
U = Not detected; Number listed is detection limit
UJ = Not detected at stated value; detection limit is estimated.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
ng/kg = nanograms per kilogram

***LOCATION = 01HA01/01SS01**
01 = Site 1
HA = Soil Sample
SS = Surface Soil Sample
01 = Location Number

Group IV

Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

	EPA ID:	LD110	LD129	LD130	LD141
	LOCATION ID*:	01HA01	01HA09	01HA09	01HA14
	DEPTH (ft):	1.5	1.5	1-1.5	1.5
	TYPE:	NORMAL	NORMAL	DUPLICATE	NORMAL
	DATE:	12/22/99	12/23/99	12/23/99	12/23/99
PARAMETER	Units				
GENERAL CHEMISTRY					
NITRATE AS N (300.0M)	mg/kg	970	2600	2000	NA
pH (SW9040)	0-14	7.37	7.06	7.28	6.62
METALS (SW6010B)					
ALUMINUM	mg/kg	5770	5790	5480	NA
ANTIMONY	mg/kg	0.2UJ	0.57UJ	1.1UJ	NA
ARSENIC	mg/kg	0.71	0.7	0.94	NA
BARIUM	mg/kg	34.5	54.1	53.5	NA
BERYLLIUM	mg/kg	0.19	0.16	0.17	NA
CADMIUM	mg/kg	0.15UJ	0.85	1.4	NA
CALCIUM	mg/kg	2090	2690	2660	NA
CHROMIUM	mg/kg	4.1	3.5	4.6	NA
COBALT	mg/kg	1.3	1.1	1.1	NA
COPPER	mg/kg	3.9	56.7	107	NA
IRON	mg/kg	3260	3290	3120	NA
LEAD	mg/kg	9.5	44	133	NA
MAGNESIUM	mg/kg	1100	1140	993	NA
MANGANESE	mg/kg	42.7	61.4	67.2	NA
NICKEL	mg/kg	1.8	2.1	2.4	NA
POTASSIUM	mg/kg	433	715	638	NA
SELENIUM	mg/kg	1UJ	0.88UJ	0.69UJ	NA
SILVER	mg/kg	0.53U	0.53U	0.53U	NA
SODIUM	mg/kg	33.4UJ	36.9UJ	66.5	NA
THALLIUM	mg/kg	0.53U	0.53U	0.53U	NA
VANADIUM	mg/kg	5.9	5.5	5.4	NA
ZINC	mg/kg	21.9	123	177	NA
MERCURY	mg/kg	0.53	3.6	10.6	NA
TOTAL PETROLEUM HYDROCARBONS (SW8015)					
MOTOR OILS RANGE	mg/kg	28	13	9J	5J
DIESEL FUEL RANGE	mg/kg	5J	4J	6J	11U
GASOLINE RANGE	mg/kg	0.2J	9.9U	11U	11U
VOLATILE ORGANIC COMPOUNDS (SW8260B)					
1,1,1-TRICHLOROETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3UJ
1,1,2,2-TETRACHLOROETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3U
1,1,2-TRICHLOROETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3U
1,1-DICHLOROETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3U
1,1-DICHLOROETHENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
1,2-DICHLOROETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3U
1,2-DICHLOROPROPANE	µg/Kg	5.6U	5.6U	5.8U	5.3U
2-BUTANONE	µg/Kg	14U	14U	15U	8.6U
2-HEXANONE	µg/Kg	5.6U	5.6U	5.8U	5.3UJ
4-METHYL-2-PENTANONE	µg/Kg	5.6U	5.6U	5.8U	5.3UJ
ACETONE	µg/Kg	110U	110U	120U	110UJ
BENZENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
BROMODICHLOROMETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3U
BROMOFORM	µg/Kg	5.6U	5.6U	5.8U	5.3U
BROMOMETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3UJ
CARBON DISULFIDE	µg/Kg	5.6U	5.6U	5.8U	5.3UJ
CARBON TETRACHLORIDE	µg/Kg	5.6U	5.6U	5.8U	5.3U
CHLOROBENZENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
CHLOROETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3UJ
CHLOROFORM	µg/Kg	5.6U	5.6U	5.8U	5.3U
CHLOROMETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3UJ
CIS-1,2-DICHLOROETHENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
CIS-1,3-DICHLOROPROPENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
DIBROMOCHLOROMETHANE	µg/Kg	5.6U	5.6U	5.8U	5.3U
ETHYLBENZENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
METHYLENE CHLORIDE	µg/Kg	5.6U	5.6U	5.8U	5.3U
STYRENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
TETRACHLOROETHENE	µg/Kg	5.6U	5.6U	5.8U	5.3U

Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

	EPA ID:	LD110	LD129	LD130	LD141
	LOCATION ID*:	01HA01	01HA09	01HA09	01HA14
	DEPTH (ft):	1.5	1.5	1-1.5	1.5
	TYPE:	NORMAL	NORMAL	DUPLICATE	NORMAL
	DATE:	12/22/99	12/23/99	12/23/99	12/23/99
PARAMETER	Units				
TOLUENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
TRANS-1,2-DICHLOROETHENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
TRANS-1,3-DICHLOROPROPENE	µg/Kg	5.6U	5.6U	5.8U	5.3U
TRICHLOROETHENE	µg/Kg	5.6U	5.6U	5.8U	5.3UJ
VINYL CHLORIDE	µg/Kg	5.6U	5.6U	5.8U	5.3U
XYLENES TOTAL	µg/Kg	5.6U	5.6U	5.8U	5.3U
SEMI-VOLATILE ORGANIC COMPOUNDS (SW8270C)					
1,2,4-TRICHLOROBENZENE	µg/Kg	530U	530U	530U	NA
1,2-DICHLOROBENZENE	µg/Kg	530U	530U	530U	NA
1,3-DICHLOROBENZENE	µg/Kg	530U	530U	530U	NA
1,4-DICHLOROBENZENE	µg/Kg	530U	530U	530U	NA
2,4,5-TRICHLOROPHENOL	µg/Kg	530U	530U	530U	NA
2,4,6-TRICHLOROPHENOL	µg/Kg	530U	530U	530U	NA
2,4-DICHLOROPHENOL	µg/Kg	530U	530U	530U	NA
2,4-DIMETHYLPHENOL	µg/Kg	530U	530U	530U	NA
2,4-DINITROPHENOL	µg/Kg	2600U	2600U	2600U	NA
2,4-DINITROTOLUENE	µg/Kg	530U	530U	530U	NA
2,6-DINITROTOLUENE	µg/Kg	530U	530U	530U	NA
2-CHLORONAPHTHALENE	µg/Kg	530U	530U	530U	NA
2-CHLOROPHENOL	µg/Kg	530U	530U	530U	NA
2-METHYLNAPHTHALENE	µg/Kg	530U	530U	530U	NA
2-METHYLPHENOL (O-CRESOL)	µg/Kg	530U	530U	530U	NA
2-NITROANILINE	µg/Kg	2600U	2600U	2600U	NA
2-NITROPHENOL	µg/Kg	530U	530U	530U	NA
3 3'-DICHLOROBENZIDINE	µg/Kg	530U	530U	530U	NA
3-NITROANILINE	µg/Kg	2600U	2600U	2600U	NA
3/4-METHYLPHENOL (M/P-CRESOL)	µg/Kg	530U	530U	530U	NA
4 6-DINITRO-2-METHYLPHENOL	µg/Kg	2600U	2600U	2600U	NA
4-BROMOPHENYL PHENYL ETHER	µg/Kg	530U	530U	530U	NA
4-CHLORO-3-METHYLPHENOL	µg/Kg	530U	530U	530U	NA
4-CHLOROANILINE	µg/Kg	1100U	1100U	1100U	NA
4-CHLOROPHENYL PHENYL ETHER	µg/Kg	530U	530U	530U	NA
4-NITROANILINE	µg/Kg	2600UJ	2600UJ	2600UJ	NA
4-NITROPHENOL	µg/Kg	2600U	2600U	2600U	NA
ACENAPHTHENE	µg/Kg	530U	530U	530U	NA
ACENAPHTHYLENE	µg/Kg	530U	530U	530U	NA
ANTHRACENE	µg/Kg	530U	530U	530U	NA
BENZO(A)ANTHRACENE	µg/Kg	530U	530U	530U	NA
BENZO(A)PYRENE	µg/Kg	530U	530U	530U	NA
BENZO(B)FLUORANTHENE	µg/Kg	530U	530U	530U	NA
BENZO(G H I)PERYLENE	µg/Kg	530U	530U	530U	NA
BENZO(K)FLUORANTHENE	µg/Kg	530U	530U	530U	NA
BENZYL BUTYL PHTHALATE	µg/Kg	530U	530U	530U	NA
BIS(2-CHLOROETHOXY) METHANE	µg/Kg	530U	530U	530U	NA
BIS(2-CHLOROETHYL) ETHER	µg/Kg	530U	530U	530U	NA
BIS(2-CHLOROISOPROPYL) ETHER	µg/Kg	530U	530U	530U	NA
BIS(2-ETHYLHEXYL) PHTHALATE	µg/Kg	530U	530U	530U	NA
CARBAZOLE	µg/Kg	530U	530U	530U	NA
CHRYSENE	µg/Kg	530UJ	530UJ	530UJ	NA
DI-N-BUTYL PHTHALATE	µg/Kg	530U	71J	530U	NA
DI-N-OCTYLPHTHALATE	µg/Kg	530U	530U	530U	NA
DIBENZ(A H)ANTHRACENE	µg/Kg	530U	530U	530U	NA
DIBENZOFURAN	µg/Kg	530U	530U	530U	NA
DIETHYL PHTHALATE	µg/Kg	530U	530U	530U	NA
DIMETHYL PHTHALATE	µg/Kg	530U	530U	530U	NA
FLUORANTHENE	µg/Kg	530U	530U	530U	NA
FLUORENE	µg/Kg	530U	530U	530U	NA
HEXACHLOROBENZENE	µg/Kg	530U	530U	530U	NA
HEXACHLOROBUTADIENE	µg/Kg	530U	530U	530U	NA
HEXACHLOROCYCLOPENTADIENE	µg/Kg	2600U	2600U	2600U	NA

Group IV

(Page 3 of 3)

Preliminary Soil Sampling Analytical Results
IRP Site 1 - Explosive Ordnance Disposal (EOD) Range
Marine Corps Air Station (MCAS), El Toro, California

	EPA ID:	LD110	LD129	LD130	LD141
	LOCATION ID*:	01HA01	01HA09	01HA09	01HA14
	DEPTH (ft):	1.5	1.5	1-1.5	1.5
	TYPE:	NORMAL	NORMAL	DUPLICATE	NORMAL
	DATE:	12/22/99	12/23/99	12/23/99	12/23/99
PARAMETER	Units				
HEXACHLOROETHANE	µg/Kg	530U	530U	530U	NA
INDENO(1,2,3-C D)PYRENE	µg/Kg	530U	530U	530U	NA
ISOPHORONE	µg/Kg	530U	530U	530U	NA
N-NITROSODI-N-PROPYLAMINE	µg/Kg	530U	530U	530U	NA
N-NITROSODIPHENYLAMINE	µg/Kg	530U	530U	530U	NA
NAPHTHALENE	µg/Kg	530U	530U	530U	NA
NITROBENZENE	µg/Kg	530U	530U	530U	NA
PENTACHLOROPHENOL	µg/Kg	2600U	2600U	2600U	NA
PHENANTHRENE	µg/Kg	530U	530U	530U	NA
PHENOL	µg/Kg	530U	530U	530U	NA
PYRENE	µg/Kg	530U	530U	530U	NA
EXPLOSIVES (SW8330)					
1,3,5-TRINITROBENZENE	µg/Kg	210U	210U	210U	NA
1,3-DINITROBENZENE	µg/Kg	210U	210U	210U	NA
2,4,6-TRINITROTOLUENE	µg/Kg	210U	210U	210U	NA
2,4-DINITROTOLUENE	µg/Kg	210U	210U	210U	NA
2,6-DINITROTOLUENE	µg/Kg	210U	210U	210U	NA
2-AMINO-4 6-DINITROTOLUENE	µg/Kg	210U	210U	210U	NA
2-NITROTOLUENE	µg/Kg	210U	210U	210U	NA
3-NITROTOLUENE	µg/Kg	210U	210U	210U	NA
4-AMINO-2 6-DINITROTOLUENE	µg/Kg	210U	210U	210U	NA
4-NITROTOLUENE	µg/Kg	210U	210U	210U	NA
HMX	µg/Kg	210U	210U	210U	NA
NITROBENZENE	µg/Kg	210U	210U	210U	NA
RDX	µg/Kg	210U	210U	210U	NA
TETRYL	µg/Kg	210U	210U	210U	NA
DIOXINS (SW8290C)					
2,3,7,8-TCDD	ng/kg	0.1	0.25	0.25	0.2
1,2,3,7,8-PeCDD	ng/kg	0.15	0.25	0.3	0.2
1,2,3,4,7,8-HxCDD	ng/kg	0.15	0.25	0.35	0.25
1,2,3,6,7,8-HxCDD	ng/kg	0.41	0.25	0.3	0.25
1,2,3,7,8,9-HxCDD	ng/kg	0.15	0.25	2.4	0.25
1,2,3,4,6,7,8-HpCDD	ng/kg	8.5	14	34.5	0.4
1,2,3,4,6,7,8,9-OCDD	ng/kg	113	297	426	0.9
2,3,7,8-TCDF	ng/kg	0.1	0.2	1.5	0.15
1,2,3,7,8-PeCDF	ng/kg	0.1	0.2	0.2	0.15
2,3,4,7,8-PeCDF	ng/kg	0.1	0.2	0.25	0.15
1,2,3,4,7,8-HxCDF	ng/kg	0.36	0.76	3.1	0.15
1,2,3,6,7,8-HxCDF	ng/kg	0.1	0.15	1.4	0.15
2,3,4,6,7,8-HxCDF	ng/kg	0.1	0.15	1.3	0.15
1,2,3,7,8,9-HxCDF	ng/kg	0.1	0.2	0.25	0.2
1,2,3,4,6,7,8-HpCDF	ng/kg	2.1	6.2	16.2	0.25
1,2,3,4,7,8,9-HpCDF	ng/kg	0.4	0.35	0.45	0.35
1,2,3,4,6,7,8,9-OCDF	ng/kg	3.5	11.1	32.4	0.75

NOTES:

NA = Not Analyzed
R = Quality control indicates the data is not usable (value was rejected).
J = Estimated Value
U = Not detected; Number listed is detection limit
UJ = Not detected at stated value; detection limit is estimated.
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
ng/kg = nanograms per kilogram

***LOCATION = 01HA01/01SS01**
01 = Site 1
HA = Soil Sample
SS = Surface Soil Sample
01 = Location Number

Table of Perchlorate Results in Soil

Sample	Perchlorate
Surface Soil (0-1 ft bgs)	
SS01-SS01-D0.0	<20
SS02-SS01-D0.0	320
SS03-SS01-D0.0	<20
Shallow Soil (1-10 ft bgs)	
HA01-SS01-D1.5	<21
HA01-SS02-D4.0	<22
HA02-SS01-D1.5	<21
HA02-SS02-D4.0	<22
HA03-SS01-D1.5	<21
HA03-SS02-D4.0	<22
HA04-SS01-D1.5	<21
HA04-SS02-D3.5	<21
HA05-SS01-D1.5	<22
HA05-SS02-D4.5	<22
HA06-SS01-D1.5	<22
HA06-SS02-D4.5	<22
HA07-SS01-D1.5	<21
HA07-SS02-D4.0	29
HA08-SS01-D1.5	110
HA08-SS02-D3.5	210
HA09-SS01-D1.5	<21
HA09-SS02-D4.0	<22
HA10-SS01-D1.5	<21
HA10-SS02-D4.5	<21
HA11-SS01-D1.5	<21
HA11-SS02-D3.0	<22
HA12-SS01-D1.5	<21
HA12-SS02-D3.5	<22
HA13-SS01-D1.5	<21
HA13-SS02-D4.0	<21
HA14-SS01-D1.5	<21
HA14-SS02-D4.0	<22
Subsurface Soil (> 10 ft bgs)	
01MW202-SS01-D010	<23
01MW202-SS02-D020	<22
01MW203-SS01-D010	<22
01MW204-SS01-D010	<22
01MW204-SS06-D035	<24
01MW205-SS01-D010	<21
01MW205-SS05-D030	<28
01MW206-SS01-D005	<23
01MW206-SS03-D015	<25
01MW207-SS01-D005	<23
01MW207-SS03-D015	<23

Notes:
Perchlorate concentrations are in µg/kg.
µg/kg = micrograms per kilogram

Table A1-1a
Site 1 (Explosive Ordnance Disposal Range)
Summary of Detected Chemicals in Phase I RI - Shallow Soil (0 to 10 feet)
MCAS El Toro Phase II RI Work Plan

STATION ID		01_UG6		01_GN1		01_GN2		01_GN3	
AREA OF INVESTIGATION		Upgradient		Stratum 1		Stratum 1		Stratum 1	
SAMPLE NUMBER		61454007		61454004		61454000		61454006	
SAMPLE DEPTH(FT BGS)		(0)		(0)		(0)		(0)	
ANALYTE BY GROUP	UNITS		DVQ		DVQ		DVQ		DVQ
GENERAL CHEMISTRY									
AMMONIA-N	MG/KG	-		8.46	J	5.84	J	9.75	J
NITRATE AS N	MG/KG	-		1.53		0.649		0.712	
TOTAL KJELDAHL NITROGEN (TKN)	MG/KG	-		874		359		679	
MOISTURE	MG/KG	-		-		-		3.5	
METALS									
ALUMINUM	MG/KG	6560		7490		3370		6630	
BARIUM	MG/KG	27.7	b	36.3	b	30.3	b	41.4	b
CALCIUM	MG/KG	7290		6910		2330		4140	
COBALT	MG/KG	1.2	U	1.6	b	1.7	b	3.1	b
CHROMIUM	MG/KG	3.2		3.9		2.2		4	
COPPER	MG/KG	2.3	b	2.9	b	4.3	b	2.6	b
IRON	MG/KG	2960		4230		2230		4160	
MERCURY	MG/KG	0.03	U	0.03	U	0.06	b	0.03	U
POTASSIUM	MG/KG	697	b	778	b	506	b	882	b
MAGNESIUM	MG/KG	1270		1770		787	b	1790	
MANGANESE	MG/KG	49.6		86		48.9		82.1	
SODIUM	MG/KG	161	b	199	b	111	b	166	b
LEAD	MG/KG	2		5.6		7		6.9	
SELENIUM	MG/KG	0.83	b	0.11	b	0.1	U	0.1	U
VANADIUM	MG/KG	7.1	b	8.7	b	4.6	b	9.9	b
ZINC	MG/KG	11.1		17.2		16.4		15.8	
VOLATILE ORGANIC COMPOUNDS									
CARBON TETRACHLORIDE	UG/KG	-		2	J	10	U	10	U
TOLUENE	UG/KG	-		6	J	10	U	6	J
TOTAL FUEL HYDROCARBONS (DIESEL AND GASOLINE)									
TFH DIESEL	MG/KG	81.6		21.5		21.3		19.4	
TFH GASOLINE	MG/KG	0.219		0.079		0.05	U	0.069	
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (TRPH)									
TRPH	MG/KG	20	U	129		110		147	

Table A1-1b
Site 1 (Explosive Ordnance Disposal Range)
Summary of Detected Chemicals in Phase I RI - Subsurface Soil (Deeper than 10 feet)
MCAS El Toro Phase II RI Work Plan

STATION ID AREA OF INVESTIGATION SAMPLE NUMBER SAMPLE DEPTH(FT.BGS) ANALYTE BY GROUP	UNITS	01_DGMW57 Downgradient S1456006 (40)	DVQ	01_DGMW57 Downgradient S1456000 (70)	DVQ	01_DGMW58 Downgradient S1456007 (30)	DVQ	01_DGMW58 Downgradient S1456001 (60)	DVQ	01_DGMW58 Downgradient S1457103 (60)	DVQ
GENERAL CHEMISTRY											
TOTAL ORGANIC CARBON	MG/KGW	-		104		-		100	U	100	U
METALS											
ALUMINUM	MG/KG	5950		-		4160		-		-	
ARSENIC	MG/KG	2.7		-		3.4		-		-	
BARIUM	MG/KG	80.3		-		36.3	b	-		-	
CALCIUM	MG/KG	10300		-		8650		-		-	
CADMIUM	MG/KG	1.8		-		1.4		-		-	
COBALT	MG/KG	3.4	b	-		2.2	b	-		-	
CHROMIUM	MG/KG	10.8		-		8.2		-		-	
COPPER	MG/KG	6.6		-		3.5	b	-		-	
IRON	MG/KG	8840		-		6410		-		-	
POTASSIUM	MG/KG	2020		-		820	b	-		-	
MAGNESIUM	MG/KG	5040		-		1750		-		-	
MANGANESE	MG/KG	165		-		95.9		-		-	
SODIUM	MG/KG	235	b	-		226	b	-		-	
NICKEL	MG/KG	12.8		-		9.7		-		-	
LEAD	MG/KG	2.4		-		1.6		-		-	
VANADIUM	MG/KG	20.7		-		15.7		-		-	
ZINC	MG/KG	30.7		-		27.2		-		-	

Appendix C
Laboratory Standard Operating Procedure for Analysis of Perchlorate

Applied P & Ch Laboratory
13760 Magnolia Ave. Chino CA 91710
Tel: (909) 590-1828 Fax: (909) 590-1498

Standard Operation Procedure

G-38A Determination of Perchlorate by IC (EPA 314)

Method: EPA 314.0

File Name	[APCL.SOP.V8.GC]G38A_8p0.tex
Version No	8.0
Revision Date	08/2000

Prepared/Revised by:

Matt Yau

Approval:

Kevin Xie, Ph. D.
QA Director

Dominic Lau
Laboratory Director

§ 1.0 Scope and Application

1.1 This method covers the determination of the perchlorate anion using ion chromatography.

1.2 The matrices applicable to this method are drinking water, surface water, mixed domestic and industrial waste waters, groundwater, reagent waters. As in EPA 300.0 (SOP G-37), for soil samples, a water leaching method is used to extract the analyte to the water phase. The leachate is then analyzed for perchlorate.

§ 2.0 Summary of Method

2.1 A fixed volume of sample is introduced into an ion chromatograph system. Perchlorate is separated and measured, using a system comprised of an ion chromatographic pump, sample injection valve, guard column, separator column, suppressor device, and conductivity detector.

2.2 In order to detect perchlorate at the low ppb range without sample preconcentration, a high volume sample loop is used.

§ 3.0 Interferences

3.1 Interferences can be caused by substances with retention times that are similar to and overlap those of the anion of interest. Large amounts of an anion can interfere with the peak resolution of an adjacent anion. Sample dilution and /or spiking can be used to solve most interference problems.

3.2 The water dip or negative peak that elutes near and can interfere with the analysis. However, the perchlorate anion is retained for a sufficient length of time in the column and elutes free of interference from the water dip.

3.3 Method interferences may be caused by contaminants in the reagent water, reagents, glassware, and other sample processing apparatus that lead to discrete artifacts or elevated baseline in an ion chromatogram.

§ 4.0 Apparatus

4.1 Ion chromatograph (DX-100 or DX-500) - Analytical system complete with ion chromatograph and all required accessories , analytical columns, compressed gasses, detector, and computer based data acquisition system.

- Anion guard column: AG-11 (Dionex)
- Anion separator column : AS-11 (Dionex)
- Anion suppressor device : Anion micromembrane suppressor-II ASRS-ULTRA-4mm, P/N 53946
- Detector : CD20 Conductivity Detector

4.2 The Dionex AI-450 Data Chromatography Software (Version 3.33) is used to generate all the data on instrument DX-100. The Dionex PeakNet Data Chromatography

Software is used to generate all the data on instrument DX-500.

4.3 Dionex Automated sampler

4.4 Conductivity Meter: Accumet Model 30, Fisher Scientific. At a minimum, this meter should be capable of measuring matrix conductance over a range of 1-10000 $\mu S/cm$.

§ 5.0 Reagents and Standards

5.1 Reagent water: Distilled or deionized water, free of the anions of interest. Water should contain particles no larger than 0.20 microns.

5.2 Eluent solutions: 100 mM Sodium hydroxide, dissolve 4.0 g sodium hydroxide in 1 liter reagent water.

5.3 Perchlorate Stock Standard Solutions, 1000 mg/L; Dissolve 1.3931 g potassium perchlorate in 1 liter reagent water.

5.4 Intermediate standard solution: dilute the stock standard solution to prepare a 10 mg/L intermediate standard solution.
Note: Stability of standards: Stock standards are stable for up to 12 months when stored at 4 °C. The intermediate stock and dilute working standards should be prepared weekly.

5.5 Mixed Common Anion Stock Solution, 25000 mg/L:
Dissolve 1.0311g Sodium Chloride NaCl, 0.9245g Sodium Sulfate Na_2SO-4 and 1.1042g Sodium Carbonate Na_2CO_3 in reagent water to a final volume of 25.0 mL.

5.6 Conductivity Meter Calibration Solution, 0.01M KCL: See SOP G45 Specific Conductivity, Section 6.1.

§ 6.0 Sample Collection, Preservation and storage

6.1 Samples should be collected in scrupulously clean containers. Do not clean containers with strong acids or detergents because they leave traces of ions on the container walls; these ions may interfere with analysis. Samples do not need to be shipped iced or stored cold in a refrigerator but every effort should be taken to protect the samples from temperature extremes.

6.2 Sample preservation and holding times for the anions are as follows:

Analyte	Preservation	Holding time
Perchlorate	None required	28 days

§ 7.0 Procedure

¶ 7.1 Operation Conditions

a. Turn the system power on and set the control button on the system panel to Local.

Turn on the system nitrogen and confirm that the pressure is between 62 MPa (90 psi) and 76 MPa (110 psi).

b. Make sure that sufficient volume of eluent in the reservoir is available to sustain extended operation.

c. Ensure that the pump flow rate adjustment is correct, and turn on the pump. (Eluent flow rate 1.50 mL/min)

d. Set the detector range to the appropriate operating range (typically 1 μS).

e. Sample loop volume: 740 μL.

f. Anion suppressor setting to 4, using self-regenerating mode.

g. A stable base line indicates equilibrium conditions. Adjust detector offset to zero out eluent conductivity; with the fiber or membrane suppressor adjust the regeneration flow rate to maintain stability.

¶ 7.2 Calibration

a. For each analyte of interest, prepare calibration standards at a minimum of five concentration levels and a blank by adding accurately measured volumes of intermediate stock standard to a volumetric flask and diluting to volume with reagent water. The calibration concentrations are: 0, 4, 10, 25, 50, 75, and 100 μg/L. The correlation coefficient (r) must be greater or equal 0.995. The initial calibration verification (ICV) should be within the $\pm$10% control limit.

b. The calibration curve must be verified on each working day, or whenever the anion eluent is changed. and after every 10 samples. If the response or retention time for any analyte varies from the expected values by more than $\pm$10%, the test must be repeated, using fresh calibration standards. If the results are still more than $\pm$10%, a new calibration curve must be prepared for that analyte.

c. Non-linear response can result when the separator column capacity is exceeded(overloading). The response of the detector to the sample when diluted 1 to 1 and when not diluted should be compared. If the calculated responses are the same, samples of this total anionic concentration need not be diluted.

¶ 7.3 Sample Pretreatment

a. Do not filter groundwater and wastewater sample through 0.45 micron filters before injection as specified by in EPA 300.0. Filtration by 0.45 micron will result in loss of perchlorate. Use centrifuge to remove sediments.

b. The following extraction should be used for solid materials. Add an amount of reagent water equal to five times the weight of solid material. Normally, weigh 10 grams of sample and add 50 mL of reagent water. Using an orbital shaker, shake the slurry at 200 RPM for 30 minutes. Transfer the water into several centrifuge tubes and centrifuge at 10,000 RPM for 5 minutes. Collect about 3 - 5 mL of water from the tubes to the autosampler vial.

¶ 7.4 Determination of Matrix Conductivity Threshold (MCT)

- The MCT must be determined by preparing a series of sequentially increasing, common anion fortified, reagent water samples each contain a constant pechlorate concentration.

7.4.1 Prepare a Laboratory Fortified Blank (LFB) at perchlorate concentration of 25μg/L.

7.4.2 Prepare a series of sequentially increasing anionic solutions, each containing perchlorate at concentration of 25μg/L, which also containing the individual common anions of chloride, sulfate and carbonate, all included at uniform increasing concentrations of 200, 300, 400,500, 600,800 and 1000mg/L for each anion.

7.4.3 Measure and record the conductance of each of these prepared solutions on a calibrated conductivity meter. This meter must be calibrated as described in SOP G45 Specific Conductivity section 7.0 prior to measuring conductance.

7.4.4 Analyze each solution, recording the peak area to height(A/H) ratio and the quantified concentration of perchlorate.

7.4.5 Calculate the A/H ratio percent difference($PD_{A/H}$) between the average A/H ratio for the LFB (A/H_{LFB}) and the average A/H ratios for each mixed common anion solutions(A/H_{MA})using the following equation.

$$PD_{A/H} = 100 \text{ X } (A/H_{LFB} - A/H_{MA}) / A/H_{LFB}$$

7.4.6 As the conductivity of the matrices increase, the $PD_{A/H}$ will increase. The MCT is the matrix conductance where the $PD_{A/H}$ exceeds 20%. To derive the MCT, perform a linear regression on these data by plotting $PD_{A/H}$ versus the matrix conductance. The resulting regression data should yield an r^2 value of >0.95. Record the "constant"(intercept value) and the "X-coefficient"(slope)and calculate the MCT as follows,

$$MCT = (20\%) \text{ X } (\text{X-coefficient}) + (\text{constant})$$

¶ 7.5 Sample Analyses

7.5.1 Prior to conducting the analysis of a field sample matrix, the conductance of that matrix must be measured.

7.5.1.1 If the conductance is less than the MCT, the sample can be analyzed without dilution.

7.5.1.2 If the conductance is greater than the MCT, the matrix requires dilution prior to analysis.

7.5.1.2.1 To estimate the proportion required for the dilution by dividing the measured matrix conductance by the MCT. Round up to the next whole number and dilute the sample by a proportion equivalent to this value. For example, if the established MCT is 3290 μS/cm and a sample reflecting a conductance of 5000 μS/cm was measured, dilute the sample with reagent water by a factor of 2.

7.5.2 Performance of the Instrument Performance Check (IPC)

- IPC must be conducted with each analysis batch.

7.5.2.1 Prepare a mixed common anion solution which reflects a conductance near (within±10%) that specified as the MCT. This solution is prepared following the procedure in section 7.4.2. This solution contains perchlorate at a concentration of 25μg/L.

7.5.2.2 Confirm the conductance of the IPC and analyze it as the initial sample in the analysis batch. As the first tier criteria, the value for $PD_{A/H}$ must be less than 25% before proceeding with the analysis batch.

7.5.2.3 At the second tier criteria, the measured recovery for perchlorate in this IPC must fall between 80% and 120%.

7.5.3 Before any samples are analyzed, it should be demonstrated with a method blank(MB), that the system is free of contamination. Values of MB that exceed 1/2 the PQL indicate a laboratory or reagent contamination is present.

7.5.4 Prior to analyzing any samples, the INTIAL CALIBRATION CHECK STANDARD(ICCS) containing perchlorate at the PQL (4.0 μg/L) must be analyzed. Percent recovery for the ICCS must be in the range of 75-125% and if required, recalibrate as described in Section 7.2.

7.5.5 Following the ICCS, the LABORATORY CONTROL SPIKE (LCS) containing perchlorate 25μg/L must be analyzed, the recovery for LCS must be between 85-115%.

7.5.6 Load and inject a fixed amount of well mixed sample. Flush injection loop thoroughly, using each new sample. Use the same size loop for standards and samples.

7.5.7 The width of the retention time window used to make identifications of actual retention time variations of standards over the course of a day. Three times the standard deviation of a retention time can be used to calculate a suggested window size for each analyte. However, the experience of the analyst should weigh heavily in the interpretation of chromatograms.

7.5.8 If the response for the peak exceeds the working range of the system, dilute the sample with an appropriate amount of reagent water and reanalyze.

7.5.9 If the resulting chromatogram fails to produce a adequate resolution. or if identification of specific anions is questionable, fortify the sample with an appropriate amount of standard and reanalyzed.

7.5.10 CONTINUING CALIBRATION VERIFICATION/END CALIBRATION VERIFICATION (CCV/ECV) standards must be analyzed after every tenth field sample analysis and at the end of the analysis batch. The percent recovery for perchlorate in the CCV/ECV must be between 85-115%.

7.5.11 A Matrix Duplicate (MD) and a Matrix Spike (MS) should be analyzed in each analysis batch. The percent recovery for MS should be between 80-120%, and the RPD for the MD measurements of perchlorate shlould be less than ±15 %.

7.5.12 An analysis batch should include no more than 20 field samples and must also include all required QC samples, which do not contribute to the maximum field sample total of 20.

¶ 7.6 Data Analysis and Calculations

7.6.1 Calculate concentration of each anion, in mg/L, by referring to the appropriate calibration curve . Alternatively, when the response is shown to be linear, use the following equation:

$$C = H \times F \times D$$

Where:
C = mg anion/L.
H = peak height or area.
F = response factor = concentration of standard / height (or area) of standard.
D = dilution factor for those samples requiring dilution.
In fact, all data including sample concentrations can be generated directly by by the software.

7.6.2 Report results in ug/L for water samples.

7.6.3 Report results in ug/KG for soil samples.

7.6.4 If a sample was diluted with reagent water to a conductance below the MCT, the exact magnitude of this dilution will adversely increase the PQL by an equivalent proportion.

§ 8.0 Quality Control

¶ 8.1 QC limits

a. Before any samples are analyzed , it should be demonstrated with a method blank, that the system is reasonably free of contamination that would interfere with the determination of any analytes of interest.

b. Perform the daily or continuing calibration verification (CCV) by measuring the mid-point calibration before sample analysis of every 10 samples.

c. The recoveries of the analytes in MS and LCS should be within the control limits.

d. The control limit of lab control spike is 85%-115%.

e. The control limit of CCV is 85%-115%.

f. The control limit of matrix spike is 80%-120%.

§ 9.0 Corrective Action

- If the method blank (or instrument blank) indicates a result higher than MDL, the containers, reagents, and analytical system should be carefully examined and cleaned until the background disappears before samples can be analyzed.

- If CCV is out of the control limit, re-perform the CCV. If CCV is still out of the control limit, perform a new initial calibration.
- If recoveries of LCS are outside the acceptable range, carefully examine the analysis process and correct any problems that may have occurred and re-analyze the associated sample batch.
- If there is no enough samples for MD or MS, LCS/LCSD may be used for QC report.
- If recoveries of MS is outside the required range, check the recoveries of LCS, if LCS recoveries are reasonable, matrix interference is suspect; otherwise re-analyze the associated sample batch.

§ 10.0 Record Keeping and Storage

All raw data, such as chain of custody, sample preparation record, analysis logbook and the analytical data, etc, will be kept in file for a minimum of five years from the date the report is sent to the client.

§ 11.0 References

11.1 "Determination of Perchlorate by Ion Chromatography", Rev. No. 0, June 3, 1997, State of California, Department of Health Services, Sanitation & Radiation Laboratories Branch.

11.2 "Determination of Perchlorate in Drinking Water Using Ion Chromatography", EPA 314.0 Revision 1.0 Nov.,1999